REDACTED

Total Factor Productivity and Input Pricing Studies

RESPONSE TO REQUEST FOR PROPOSAL

PREPARED FOR

National Grid

PREPARED BY

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May 7th, 2020

THE Brattle GROUP

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I. Introduction

The Brattle Group (Brattle) is pleased to submit the enclosed response to the Boston Gas Company and Colonial Gas Company, d/b/a National Grid ("the Company" or jointly the "MA Gas Companies") Request for Proposal (RFP) for Productivity Factor/Performance Based Regulation Expert Witness. The firm engaged by the Company will be required to perform a Total Factor Productivity (TFP) study and Input Pricing study for the MA Gas Companies distribution rate case, and provide support in testimony to both the findings of the studies and the general advantages of a Performance-Based Regulation (PBR) plan in helping the company to meet its obligations to customers at a reasonable cost. In addition, the firm engaged will be required to develop and/or adopt and utilize a benchmarking study of gas utilities in the U.S. and the Northeast region to determine any appropriate adjustments to the resulting recommended through a consumer dividend.

Our team is well suited to perform the work required and to meet the objectives of the study. As we demonstrate in this proposal, Brattle and its team have extensive experience and expertise in economic policy analysis and the theory and design of PBR/IR plans, in the quantification of TFP using modern theories of productivity output and input analysis and under different data availability constraints, and economic and econometric benchmarking analysis on total cost and partial cost dimensions and their application in economic regulation and incentive rate-making plans.

We have worked in Canada, the U.S., Australia, and in other countries on dozens of regulatory proceedings involving the theory and design of PBR/IR plans. These projects include review of incentive frameworks, review of price and revenue determination, proposals for performance incentive mechanisms, determination of applicable offsets and X factors, and review of price and service regulation. We are currently working on several PBR/IR plans and I-X plans in the U.S. and Canada and recently worked on behalf of major U.S. and Canadian utilities to review and enhance their alternative regulatory frameworks and incentive models that would support a changing investment demands and sustainable energy efficiency business.

Our work on PBR/IR plan frequently requires us to undertake benchmarking analysis on total costs, partial costs and firm and industry-wide productivity growth. The work includes developing consistent and comparable cost information across different utilities, selecting appropriate sample of utilities for benchmarking comparisons and developing and applying economically appropriate benchmarking techniques. We are currently involved in a project involving economic benchmarking analysis for a major Canadian public utility and we have worked on numerous similar projects across North America and globally in electricity as well as in other infrastructure industries.

Brattle has extensive experience and familiarity with the Massachusetts gas sector and with PBR plans in the Commonwealth.

With respect to econometric benchmarking analysis, we have assembled a team of consultants who have considerable experience and practice in formulating, testing, and critically assessing econometric models, as econometric analysis is a fundamental tool we use in many of our consulting engagements, such as econometric assessment of the impact of TOU rates. In addition, members of our team have published econometric analysis and research in peer-reviewed, academic journals such as the *Journal of Regulatory Economics*, *Review of Industrial Organization*, *Review of Network Economics*, *The Energy Journal* and *The Electricity Journal*.

We organize our response to our RFP as follows: First, we provide an outline of our proposed project team and summary of their qualifications. (Their full resumes are attached.) Next, in Section III, we detail our proposed scope of work for supporting National Grid in this engagement. Then, in Section IV, we provide examples of our experience in TFP and PBR engagements. Finally, in Section V, we present our proposed budget and timeline for this engagement, covering everything from the initial development of the rate case strategy to ad-hoc post-filing support.

II. Proposed Project Team

We propose a highly qualified and experienced team to perform the subject work. Below, we highlight the key members of our proposed team, who will be supported by Brattle Research Analysts as need. Three members of our core team—Mr. Zarakas, Dr. Ros, and Mr. Shetty—are based in Brattle's Boston headquarters, while Dr. Donohoo-Vallett is based in Brattle's Washington, DC office. We have attached resumes for our core team to this proposal.

William Zarakas is an expert on economic and regulatory matters in the energy and telecom and media, and energy industries. Mr. Zarakas leads much of Brattle's work related to regulatory frameworks and utility business models, notably including the application of PBR to the electricity and natural gas industries. He led Brattle's recent work on surveying and benchmarking PBR applications and practices throughout the U.S. and in key jurisdictions elsewhere in the world. Mr. Zarakas has also authored expert reports and provided testimony in recent rate cases which involved performance based dimensions. Mr. Zarakas also works extensively on benefit-cost analyses, particularly with respect to investments in grid modernization, reliability, resilience, and smartening the grid. He has authored a wide range of reports and articles on PBR, "utility of the future" visions and implementation, the utility platform and multi-sided markets, and competition in the retail electricity sector.

Mr. Zarakas has also conducted cost benchmarking and total factor productivity analyses in the electricity and telecommunications industries, including a comprehensive TFP analysis as part of

the FCC's Business Data Service price cap proceeding. He has provided expert reports and testimonies in a range of regulatory proceedings concerning the economic analysis of mergers among telecom carriers and media companies; competition in telecom markets; forbearance from price regulation; infrastructure access, sharing and pricing arrangements; the economics and financial feasibility of deploying broadband networks; analysis and valuation of wireless spectrum bands and holdings; and the distribution of royalties and retransmission fees in the cable and satellite TV industries.

Mr. Zarakas will be the project director and will lead the Brattle team's PBR study and will provide expert testimony on PBR. He will also work on the TFP and benchmarking analyses, which will be led by Dr. Ros.

Dr. Agustin J. Ros has 25 years of consulting and agency experience in regulatory and public utilities economics in network industries, particularly energy and telecommunications. He specializes in TFP and performance-based ratemaking, cost of service, demand studies, competition analysis and disputes, damages, and econometric modelling. He has provided dozens of expert reports before Public Utility Commissions and Federal agencies in the United States, Canada and more than a dozen countries and before the International Chamber of Commerce Arbitration Panel. Dr. Ros is an Adjunct Professor at the International Business School at Brandeis University where he teaches a course on regulatory and antitrust economics. He previously taught a similar course at Northeastern University.

Dr. Ros has worked on dozens of TFP studies involving electricity, gas and telecommunications. He worked on the early TFP studies before the Federal Communications Commission and before state PUCs involving the incumbent local telephone companies. His work continued internationally, working on TFP studies in Canada. Dr. Ros was the expert nominated by the Alberta Public Utilities Commission to conduct a TFP study for the electricity and natural gas distributors in Alberta and he was responsible for developing the methodology and the model that was used and accepted by the Commission in that proceeding. In that proceeding, he filed an expert report on benchmarking productivity growth that the Commission used as the basis for the Commission's first X factor determination for electricity and gas distribution companies. The study utilized a panel data of 72 US electricity and combination electricity/natural gas companies during the period 1972-2009. He appeared as a witness in oral hearings that lasted three days. The Commission accepted the study in total. He has also led TFP projects throughout Latin America. He is currently working on a TFP project for a large Canadian utility.

Dr. Ros has extensive experience estimating econometric models in consulting projects as well as in his research in peer-reviewed academic and industry journals. He has econometrically estimated electricity demand models and examined the impact of competition in retail and wholesale electricity markets in the U.S. that the *Energy Journal* recently published. He has published additional econometric research in *Journal of Regulatory Economics*, *Review of Industrial Organization*, *Review of Network Economics*, *Telecommunications Policy*, and *Info*. Moreover, he has co-authored econometric research with one of the world's leading

econometricians, Professor Jerry A. Hausman that appeared in the *Journal of Regulatory Economics* and has peer-reviewed dozens of econometric articles submitted to academic journals.

Dr. Ros will lead the work on task 2: Initial TFP and IP Studies, task 3: PBR Plan/Study Support Direct Testimony and task 5: Benchmarking Study.

Dr. Pearl Donohoo-Vallett provides transmission and distribution companies strategic support on the increasing overlap of retail and wholesale regulatory and policy issues including the value of distribution resources, non-wires alternatives, and performance-based and alternative regulatory mechanisms. Dr. Donohoo-Vallett brings her breadth of experience across alternative ratemaking mechanisms, performance incentive mechanisms, transmission planning, system operation, renewable portfolio standards, and distributed energy resources to help clients identify, understand and address emerging utility challenges. She also works with transmission developers to identify value propositions and estimate the economic footprint of projects. In this project, Dr. Donohoo-Vallett will focus on PBR-related tasks, supervising Brattle Research Analysts as necessary to conduct the necessary modeling and analysis.

Mr. Sai Shetty is an Electricity Modeling Specialist at The Brattle Group with experience in the regulation and economics of the energy sector. With a background in econometrics, his work focuses on the application of econometric principles to understand outcomes in electricity markets. Mr. Shetty has worked with electric utilities on innovative pricing strategies to estimate customer load impacts attributed to pricing pilots and in performance-based regulation to help quantify productivity growth in the electric transmission industry.

III. Proposed Scope of Work

We developed the work plan for this project by following the deliverables and activities outlined by National Grid in its scope of work and services.

- Rate case strategy, planning and overview of critical elements are included under Task 1;
- The conduct of TFP, IP benchmarking studies and associated support and preparation of Direct Testimony are included in Tasks 2, 3 and 5;
- Analysis of PBR, complementary components, analysis of PBR practices and benefits and preparation of policy-related Direct Testimony are covered in Tasks 4 and 6; and,
- Rate case support including preparation of Rebuttal Testimonies, preparation of and/or response to interrogatories and data requests, testimony at hearings and/or depositions and input into attorney briefs and settlement negotiations and other areas of support as needed are included under Tasks 7, 8, 9, 10 and 11.

Task 1: Develop Rate Case Strategy

This task is the logical starting point for initiating an integrated and strategic rate case project. In Task 1, we will clarify National Grid's goals and the potential outcomes and implications associated with pursuit of a PBR-based rate case. We will identify and discuss with the National Grid team the key regulatory areas of focus and develop a high-level model of regulatory decisions concerning element values and/or treatments impact outcomes. Working with the National Grid team, we will also assign probabilities based on past regulatory practices, trends and other insights to PBR framework values and/or regulatory treatments. This will provide the foundation and context for National Grid to make a "go/no go" decision concerning rate case direction. We expect to develop the rate case strategy by the end of June 2020, however we expect that we will revise the strategy throughout the pre-filing phase to reflect any new information or insights gleaned in subsequent tasks.

Task 2: Initial TFP and IP Studies

Background

TFP is a standard measure of the relationship between a firm's use of inputs such as labor, capital and materials and the output of final goods and services produced from the inputs. TFP models generally measure productivity as the ratio of an *index* of a firm or an industry's output to an *index* of its inputs over a certain period of time. Productivity growth is the amount by which this ratio changes over time and can be positive (negative) due to outputs growing more rapidly (slower) than inputs. Input price studies are a component within a TFP study, as the input prices are used as weights when aggregating the different inputs into a single index. That is, once a TFP study is conducted, a separate input price study is not required, and as such, the TFP study described in this task will be foundational to our subsequent analysis and testimony on behalf of National Grid.

TFP and IP are key elements of a PBR plan when the PBR plan contains a formula that constrains a company's prices or revenues on a periodic, typically annual, basis. The goal of the price/revenue formula in a PBR plan is to establish a cap such that the change in prices or revenues resulting from the cap emulate the change in prices one would observe in competitive markets. A formula that achieves this objective is to constrain the growth rate of a firm's prices/revenues to be no greater than the difference between the growth rate of the industry's input costs and the growth rate of the industry's TFP. This is generally known as the "I-X" approach and is the approach generally consistent with what the MADPU most recently adopted in Final Order DPU 17-05 when ruling on Eversource's revenue cap formula to adjust electricity distribution rates annually.[1] Based upon underlying economic theory, the MADPU properly defined the X factor in the I-X formula as:

[1] See The Commonwealth of Massachusetts Department of Public Utilities, D.P.U. 17-05, November 30, 2017.

> "[T]he difference between the differential in expected productivity growth between the electric-distribution industry and the overall economy and the differential in expected input price growth between the overall economy and the electric distribution industry. In combination with the inflation factor, the X factor is designed to represent the expected unit cost performance of an average performing company in the industry."[2]

In other words, the X factor that we will estimate from our TFP and IP studies is:

Equation 1: Calculation of X Factor

$$(1) \qquad X = (dTFP - dTFP^N) + (dIP^N - dIP)$$

where: dTFP and $dTFP^N$ is the TFP growth rate of the industry (in this case the gas distribution industry) and the U.S. economy, respectively, and dIP and dIP^N is the input price growth rate of the industry and the economy, respectively. Equation 1 shows that the X factor consists not only of the industry TFP and industry IP (two measures that come directly from the TFP study) but also economy-wide measures of TFP and IP (two measures that are available through the Bureau of Labor Statistics). From Equation 1, it can be seen that there is no *a priori* reason to believe that the X factor has to be positive or negative. It can be either depending on the relationship between industry- and economy-wide TFP and IP. For a firm or an industry, a negative X factor does not, in and of itself, imply the firm is inefficient or failing to minimize its costs, a point recognized by the MADPU when discussing the X factor for electricity distribution:

> "Whether an is positive or negative is determined solely by the relationship between outputs and inputs in a given industry, and there is no reason to dismiss the possibility that the electric distribution industry may be in a period exhibiting changes that result in decreasing output given a similar or increasing level of inputs. For these reasons, the Department cannot find that the proposed X factor is unreasonable merely because it is negative or lower than any productivity offset approved to date. Rather, in the sections below, the Department reviews the Companies' TFP study to determine whether it was conducted in a reasonable manner using appropriate assumptions."[3]

Approach

Brattle will develop a single model encompassing TFP, IP, and the X factor model that will be transparent, objective, and based upon public data that is easy to use for internal financial and strategic PBR considerations and tradeoffs as well as for evaluation and inspection by interveners and the MADPU. Our model is an Excel-based model with all the underlying data, inputs, intermediate and final calculations, and outputs logically structured and easily understood. The

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2 *Id.* p. 381.

3 *Id.* p. 382.

TFP model will follow the general structure and flow of the TFP model that Dr. Ros developed for the Alberta Public Utilities Commission. This model met the fundamental requirements of the Alberta Commission that the model and study be transparent, objective, and use publicly available data.

With respect to the underlying data, a TFP and IP study for National Grid requires that we obtain a dataset of a large sample of natural gas distribution companies with data on the outputs/sales of the gas distributor—gas usage (Mcf) and customers—as well as the inputs—capital, labor, and materials. Specifically, the data that Brattle will obtain to perform the X factor Our study will include the following items:

- Output:
  - Annual revenue by customer type, annual number of customers by type, and annual volume (Mcf)
- Inputs:
  - Capital: Net and gross value of distribution plant, gross capital additions, price index of capital gas utility construction costs, depreciation rate, cost of capital
  - Labor: Wages and salaries and employment cost index
  - Material, rents, and services
- Other:
  - Economy-wide TFP and IP from the Bureau of Labor Statistics

The data source for the study will be a combination of data from FERC Form 2 and state-level PUC data[4]. Much of the data required for the study are data that gas distribution companies file at the FERC and are recorded in FERC Form 2. Some of the gas data needed for a TFP study, however, are not required to be filed at the FERC and instead are filed at the gas distributors' respective PUC. SNL is a firm that collects all the gas distribution data either at the FERC or the PUC level and makes it available as part of a subscription package. All the SNL data are publicly available either at the FERC or the PUC, but the use of SNL helps standardize the data collection process and reduces the time and effort to compile the TFP database.

In compiling the dataset for use in the study, our objective is to produce a dataset of a sample of gas distribution companies that is as large (number of gas distributors) and long (number of years) as possible, with the constraint being the availability of the data. Since annual TFP growth can be very variable and volatile, a large sample over a long period of time acts to smooth out the estimate and reveal long-run productivity growth.[5] We look to use only those companies in SNL

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[4] Specifically, we will use SNL Financial MI Office Add-in Data/Screening Wizard.

[5] There is always the possibility, however, that due to significant changes in the economic, technical or regulatory environment productivity results from a long series may not be a good forward-looking predictor of expected productivity growth during the price cap period. The use of a shorter period, however, does come with the cost of having the productivity estimate be less precise due to the significant annual variations and volatility in productivity growth.

where all the data required are available. A TFP study requires that there be no missing years and that any specific missing data—one for example, capital, labor or materials—be as small as possible and require minimal extrapolation. The table below presents a preliminary list of the gas distribution companies that are *candidates* to include in the TFP study based upon an initial review of the available data. These companies have data available in SNL and will be the beginning point for our TFP analysis and company-selection process.

Table 1: Sample of Gas Distribution Companies for Productivity Research

Atlanta Gas Light Company	Spire Missouri Inc.
Atmos Energy Corporation	St. Joe Natural Gas Co, Inc.
Berkshire Gas Company	St. Lawrence Gas Company, Inc.
Black Hills Energy Arkansas, Inc.	The East Ohio Gas Company
Bluefield Gas Company	Virginia Natural Gas, Inc.
Boston Gas Company	Washington Gas Light Company
Brooklyn Union Gas Company	Wisconsin Gas LLC
Cascade Natural Gas Corporation	Yankee Gas Services Company
Colonial Gas Company	Baltimore Gas and Electric Company
Columbia Gas of Kentucky, Incorporated	Central Hudson Gas & Electric Corporation
Columbia Gas of Maryland, Incorporated	Cheyenne Light, Fuel and Power Company
Columbia Gas of Pennsylvania, Inc.	Consolidated Edison Company of New York, Inc.
Connecticut Natural Gas Corporation	Consumers Energy Company
Corning Natural Gas Corporation	Duke Energy Ohio, Inc.
Delta Natural Gas Company, Inc.	Louisville Gas and Electric Company
DTE Gas Company	Madison Gas and Electric Company
Indiana Gas Company, Inc.	New York State Electric & Gas Corporation
Mountaineer Gas Company	Niagara Mohawk Power Corporation
National Fuel Gas Distribution Corporation	Northern Indiana Public Service Company
New Jersey Natural Gas Company	Northern States Power Company - WI
Northern Illinois Gas Company	Orange and Rockland Utilities, Inc.
Ohio Gas Company	Pacific Gas and Electric Company
Ohio Valley Gas Corporation	Public Service Electric and Gas Company
Oklahoma Natural Gas Company	Puget Sound Energy, Inc.
Peoples Gas Light and Coke Company	San Diego Gas & Electric Company
Peoples Gas System	Southern Indiana Gas and Electric Company
Public Service Company of North Carolina, Incorporated	Superior Water, Light and Power Company
Questar Gas Company	Wisconsin Power and Light Company
South Jersey Gas Company	Wisconsin Public Service Corporation
Southern California Gas Company	

Task 3: PBR Plan/Study Support Direct Testimony

Brattle will prepare direct testimony on the TFP and IP studies, as well as the benchmark study if required, that includes a description of the underlying theoretical underpinning and derivation of TFP and IP studies, the X factor, stretch factor as well as descriptions of the data sets used, the TFP model created with description of the calculations performed and the econometric models estimated. The direct testimony will include exhibits with tables and figures detailing all the major intermediate and final results supporting the major conclusions of the study.

Regarding the MADPU directive in DPU 17-05, it involves the output selection in a TFP study. Specifically, the DPU stated:

> "[g]oing forward, any distribution company conducting a TFP study should consider and present data regarding alternative or non-traditional output measures that are designed to capture all of the products and services it provides." (pp. 388-389).

In general, the unit of output selected in a TFP study should be related to either the cost changes the company expects to observe as a result of changes in output (cost elasticity) or the changes in revenues associated with the change in output (revenue elasticity). A gas company provides more than one service (output), as it provides connections to the network (number of customers), average usage throughout the year and usage at system peak. The DPU's concern in the electricity TFP study referenced was that the TFP study used only one output measure, number of customers and by so doing it may have left out output measures that also significantly affect changes in costs or changes in revenue, and thus significantly affects TFP.

Task 4: Additional PBR Proposal Components

Background

Performance-based regulatory plans are frequently paired with trackers, riders, tariffs, reconciliations, and other mechanisms to allow recovery of revenues beyond base rates or allow for recovery of expenses associated with exogenous factors, such as changes in law. Under an I-X approach to regulation, the inclusion of costs through an alternative recovery mechanism depends on whether those costs are not part of "business-as-usual" expenses or otherwise deviate from traditional recovery. For example, pilot programs by definition explore new approaches that deviate from business-as-usual. Similarly, targeted investment programs, which require expenditures above and beyond historical levels or that are recovered on non-traditional schedules (e.g., delayed recovery to allow for economic recovery from the COVID-19 pandemic), may reasonably be recovered through trackers and riders.

Due to the public safety risks associated with old, or otherwise leak-prone, natural gas pipes, trackers to allow acceleration of investment have been approved in multiple jurisdictions, notably in Pennsylvania, where the Distribution System Improvement Charge has been in place for several years. The need for replacement programs is especially acute in the older east coast cities including Boston, New York City, and Philadelphia, where portions of the natural gas systems are more than 100 years old. Depending on program design, accelerated investment programs to replace these pipes may reasonably be considered outside of an I-X base rate revenue requirement.

Efficiency carry-over mechanisms incentivize utilities to find greater cost efficiencies by allowing the utility to retain those savings for a predetermined number of years and mitigates incentives to allow costs to rise near the end of a PBR plan term. When a utility files a new rate case, revenues are "reset" through a review of the requested revenue requirement. Through this

reset, the savings from cost efficiencies are taken into account and included in a lower revenue requirement. Because of this reset, the utility is incentivized to increase costs in the last year of the plan term, to allow the utility to recapture those savings in the next plan term (assuming historical costs are used to determine going forward revenues). Similarly, the utility is not incentivized to find the greatest amount of cost efficiencies because it is only able to retain those savings for a limited time. Efficiency carry-over mechanisms can be designed to address both of these incentive issues.

Developing an efficiency mechanism required developing a benchmark against which savings will be compared. This benchmark can be based on peers (as discussed in Task 5) or relative to the allowed revenues under the PBR plan. While not commonly applied in the United States, efficiency carry-over mechanisms are used in Canada and other international jurisdictions.

Approach

Brattle will develop a financial model, with input and support from the National Grid, to analyze the potential impacts and trade-offs associated with carry-over mechanism design and interactions with other PBR elements. For example, if infrastructure programs, such as accelerated pipe replacement, are included in the historical rate base from which an I-X revenue stream is calculated, then the Company may benefit from capturing cost efficiencies related to those projects. However, if the expenditures are closer to the beginning of the plan term, it may be more efficient to maintain the investment program in a tracking mechanism to mitigate regulatory lag. Brattle will use this same financial model to evaluate potential design options for a carryover mechanism.

Our budget estimate, shown in Section V of this proposal and detailed in the accompanying Project Cost spreadsheet, assumes that we will need to build a basic financial model to estimate potential impacts and trade-offs. Our budget estimate can be modified downward if National Grid has such a model and it is available for Brattle to use as part of this work effort.

Task 5: Benchmarking Study

Background and Approach

A benchmarking study can have different meanings and interpretations to different practitioners, regulators and policymakers. In this case, we would use a benchmarking study to quantitatively assess how "good" a performer the MA Gas Companies are *vis-à-vis* their peers, with their peers to be determined from the sample of gas distribution companies that are contained with the TFP study. The results of the TFP study for the sample of gas distribution companies will directly result in a ranking of unit costs and TFP. These two factors, unit costs and TFP, are highly correlated as, by definition, changes in TFP track changes in unit costs. As this benchmarking study will form a crucial part of our overall analysis and testimony, we provide a detailed description of our approach.

With respect to econometric analysis, Brattle will estimate cost functions using the TFP study as well as additional business and economic condition variables. A cost function relates the total costs of each gas distribution company to a number of independent variables, such as the output variables, customer density, topological conditions, geographic area, weather, and other factors. The econometric model will use a panel of data on the gas distribution companies over the time period in the TFP database. The general specification of the econometric model is the following:

Equation 2: General Specification of the Econometric Model

$$(2) \quad TC_{it} = f(Q_{it,}\, Z_{it}) + v_i + \mathcal{E}_{it}$$

Where: TC_{it} is the total cost of gas distribution company i at time t, Q_{it} is the output of gas distribution company i at time t, Z_{it} is a vector of business conditions variables of gas distribution company i at time t, v_i is the gas distribution company unit-specific fixed effect that is unobservable and does not vary over time, and the $\mathcal{E}_{it}$ is the overall error term of the model. We will estimate the model in Equation 2 using different specifications and estimators in order to ascertain the model that has the best statistical fit and consistent with economic theory. We will estimate linear, double-log and translog models using fixed effects, random effects and dynamic panel estimators.

The overall objective of estimating the model in Equation 2 is to estimate the coefficient parameters of the model using regression analysis. We then use the estimated regression model to predict what the total costs of each gas distribution company would be if the company was an "average" performer. A comparison of the gas distribution company's actual total costs to the predicted total costs then becomes the basis of the benchmark analysis and conclusion.[6]

Considerations

This scope of work connects the benchmarking analysis to the determination of the consumer dividend or stretch factor. The stretch factor or consumer dividend is a concrete benefit given to consumers because of the move from rate of return regulation to a price/revenue cap form of regulation. The change to price/revenue cap regulation results in increased incentives to the regulated firm to reduce costs, increase efficiency and become more productive than was previously the case. The stretch factor thus recognizes that some of the initial benefits of a price/revenue cap should accrue to consumers, and thus becomes a tangible benefit of a PBR plan. It is important to note that the stretch factor itself does not result in more or less productivity, it is simply a sharing mechanism of the expected productivity improvement that the PBR plan itself is anticipated to generate.

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[6] This is an approach that is standard in the academic literature, see for example Jerry A. Hausman and Agustin J. Ros, "An econometric assessment of telecommunications prices and consumer surplus in Mexico using panel data," *Journal of Regulatory Economic* (2013), 43:284-304.

While the benchmarking analysis described above can be used in assisting in the determination of the stretch factor or consumer dividend used in an I-X PBR plan, we urge caution in mechanistically linking the results of the benchmarking study to the stretch factor. Economic theory is silent on what the *magnitude* of the stretch factor in a PBR plan should be and so formulaically linking the benchmarking results to the stretch factor, without a thorough comprehensive analysis of the PBR plan's goal, objectives, elements and tradeoffs, is mistaken. A high (low) stretch factor is incompatible with a PBR plan that provides generally weak (strong) incentives for efficiency improvements. Thus, the benchmarking results is one of several factors examined when determining the stretch factor.

Another important consideration in the selection of the stretch factor is whether the PBR plan will consist of a price cap, a revenue cap or a revenue per customer cap. In the latter two cases, if the number of customers is not accounted for in the revenue formula, the historic customer growth rate becomes an implicit stretch factor in the formula, and so inclusion of a large stretch factor on top of the implicit customer growth stretch factor may result in the lion's share of the PBR benefits flowing to customers and being inconsistent with the underlying purpose of PBR.

Task 6: PBR Policy Testimony

This task area is primarily included in order to provide context for National Grid's PBR proposal to the Massachusetts DPU. We will use foundational and ongoing Brattle research concerning the status, trends and recent developments in PBR in the U.S. and in other key jurisdictions, notably Canada and the U.K. As noted in our qualifications We will also compile the primary rationales behind PBR from regulatory decisions and orders and academic literature concerning the economic reasoning behind PBR (e.g., de-linking prices from costs; enhancing incentives to control costs) and the scope of realized and potential benefits to customers. In addition, we will work with National Grid to compile and fully understand regulatory developments and precedents in Massachusetts, in cases involving National Grid as well as other electric and gas utilities in the Commonwealth. This will include review and compilation of issues concerning PBR and regulatory frameworks as well as energy policy and other relevant policy considerations. The work completed in Task 6 will be incorporated into testimony as appropriate.

Task 7: Rebuttal Testimony

Using the results of our work in the previous six tasks as a basis, we will, if necessary, prepare rebuttal testimony to support our study results in response to challenges raised by the MADPU and interveners. We will support our rebuttal testimony with robust exhibits and work papers that are consistent with the methodology applied elsewhere in this study.

Task 8: Respond to MADPU and Intervener Requests

We will assist National Grid in preparing responses to interrogatories and data requests from MADPU and intervener staff. We will provide detailed supporting documentation and data on our studies and their conclusions, particularly with regards to productivity factors, X factors, and other specific components of our analysis and calculations.

Task 9: Expert Witness Testimony

We will work with National Grid select the appropriate witnesses. We expect (but are not limited to) specifying Dr. Ros and Mr. Zarakas as Brattle's expert witnesses in this case. Specifically, Mr. Zarakas will serve as Brattle's testifying expert on PBR-related issues before the MADPU, while Dr. Ros will testify on TFP-related issues. Both Dr. Ros and Mr. Zarakas are experienced expert witnesses, having testified before a wide range of regulators. They are both based in Brattle's Boston office.

Task 10: Draft Initial and Reply Briefs

Brattle will work with National Grid to draft our initial report, which will fully detail our methodology and findings. Throughout this process we will use our internal peer review and auditing process to ensure that our work product will accurately and effectively support National Grid's case before the MADPU. We anticipate that this will be an iterative process, involving input from National Grid on drafts of both our initial and reply briefs.

Task 11: Ad-Hoc Support

Brattle's team will be available to provide ad-hoc support beyond the anticipated duration of the rate case's reply and rebuttal phase, including support during settlement negotiations, should these occur.

IV. Representative Experience

A. TFP/Productivity Analysis

TFP Modeling for Enbridge Gas Distribution. Brattle experts provided expert testimony regarding econometric cost modeling to determine Total Factor Productivity (TFP) for Enbridge Gas Distribution. This analysis included examination of the specifications of the model, statistical methods, robustness, and stability of results. Specifically, Brattle's analysis focused on the significant problems associated with the previously proposed econometric cost model, including the instability of its results with regard to alternative specifications and failure to correct statistical maladies, such as autocorrelation and multicolinearity. We also provided testimony to address PEG's approach and measurement of the applicable to the forthcoming incentive regulation (IR) regime for Ontario's gas utilities as well as recommendations on the appropriate relevant to the forthcoming IR regime for Ontario's gas utilities.

First Generation PBR in Alberta for Gas and Electricity Distributors. In a proceeding before the Alberta Public Utility Commission, Dr. Ros filed an expert report on benchmarking and

productivity growth that the Commission used as the basis for its first X factor determination for electricity and gas distribution companies. The study utilized a panel data of 72 US electricity and combination electricity/natural gas companies during the period 1972-2009. Dr. Ros appeared as a witness in oral hearings that lasted three days. The Commission accepted the study in total.

Second Generation PBR in Alberta, Canada. ATCO Electric and ATCO Gas have been regulated under an I-X framework since 2010. Brattle was retained at that time to estimate the TFP that should be applied to the companies under this framework. Brattle worked with four of the Alberta utilities in analyzing the effectiveness of the first-generation PBR plans and developing recommendations for transitioning to second generation PBR. As part of this comprehensive work effort, Brattle presented the results of our analyses and recommendations at three sessions/seminars sponsored by the Alberta Utilities Commission as part of the kick-off of the regulatory proceeding. Brattle subsequently supported the utilities in developing their regulatory proposals, and also provided expert testimony in the generic proceeding to design Alberta's distribution PBR. More recently, ENMAX retained Brattle to provide a recommendation when, at the conclusion of the 2007-12 FBR plan, ENMAX joined the other Alberta distribution utilities on a generic PBR plan. Brattle developed an X factor recommendation by reviewing and updating the TFP study originally filed in the first generic proceeding. Finally, in 2016 Brattle testified in the second-generation generic PBR proceedings (on behalf of ATCO Gas, ATCO Electric, ENMAX, Fortis Alberta and AltaGas). Brattle's evidence covered the X factor (based on a further update of the TFP study from the first generic proceeding), how going-in rates should be rebased, and the design of the capital or K-factor.

Investigation the use of TFP analysis by network regulators in setting price controls. A Brattle team wrote a factual review of TFP analyses used by energy regulators in the UK, the Netherlands, and New Zealand. The Brattle report made observations on the use of TFP in these jurisdictions that would be relevant to a regulator considering whether to make use of a TFP approach. Subsequently, the client asked us to write a further report comparing the incentive properties of TFP-based and building-block-based price controls.

TFP Analysis for the AEMC. Following on from two earlier projects on Total Factor Productivity analysis, the AEMC hired Brattle to write a paper describing the range of ideas that have been raised in recent thinking about the future of the building-blocks framework for energy network regulation, both in Australia and elsewhere. The AEMC also asked Brattle to review a proposed model for quantifying different price control options.

Sprint FCC Price Cap Analysis. Sprint Communications engaged Brattle to update the Federal Communications Commission's (FCC's) price caps for Business Data Services (BDS), formerly referred to as Special Access in WC Docket Nos. 16-143, 15-247, 05-25 and RM-10593. Brattle conducted a comprehensive review of telecommunications input price and calculated the TFP for BDS services and the resulting price cap index (PCI). The Brattle Group also conducted a comprehensive analysis concerning the competitiveness of the BDS market, in order to opine on market segments, which should be deregulated and not subject to the FCC's price cap regime.

The BDS proceeding was a particularly high profile case because it involved exceptionally large and complex data sets and unclear levels of competition across discrete geographic segments.

TFP Measurement for Teléfonos De México. A Brattle expert directed a project measuring TFP for Teléfonos de México (Telmex) in a proceeding in 2015 before the Mexican telecommunications regulator. The telecommunications sector in Mexico is currently characterized by many services being unregulated and not included as part of the price cap regime. A challenge was how to handle these unregulated services, similar to how to handle unregulated natural gas services. As part of this Study, we implemented the methodology proposed by David Sappington and Jeffrey Bernstein in a 1999 article in The Journal of Regulatory Economics entitled: "Setting the in Price-Cap Regulation Plans." This approach requires that an adjustment be made to the X factor formula when not all the regulated firm's services are subject to price-cap regulation and when, as is usually the case, it is not possible to measure product-specific costs and productivity.

On Behalf of Telefónica de Perú 2000 and 2004. Dr. Ros was the main economic expert in a proceeding before OSIPTEL, the Peruvian regulator in charge of the telecommunications sector in which he measured TFP for Telefónica de Perú from 1996-2003. The work included estimating TFP for Telefonica de Peru and developing the appropriate X factor. The work undertaken is summarized in an article co-authored by Dr. Ros, Jeffrey Bernstein, Jose Maria Rodriguez and Juan Hernandez entitled "X factor Updating and Total Factor Productivity Growth: The Case of Peruvian Telecommunications, 1996-2003." The article was published in 2006 in The Journal of Regulatory Economics.

B. Benchmarking

Benchmarking of Operating Costs for a Major Canadian Utility. The Brattle team identified a list of utilities to be used for benchmarking using a variety of criteria including urban/rural status, vertical integration status, and generation mix among others. Once the benchmarking list was agreed upon, The Brattle Team compiled operating cost data through publicly available data sources (such as FERC Form 1 forms) and ensured that the US data and benchmarked utility data was comparable through a series of account adjustments. Next, The Brattle Team defined benchmarking metrics and applied these metrics to subcategories of operating costs to determine the relative performance of the benchmarked utility in these areas. The results of the benchmarking analysis will be used in utility's revenue requirements application.

Cost and Performance Benchmarking. The Brattle Group has conducted cost and performance benchmarking as part of analyses and planning for electric utilities on numerous occasions. Our work in this area primarily involves defining a benchmarking tiers of utility peer panels based on geographic, demographic and/or system characteristics and developing comparative statistics using public (i.e., replicable and transparent) cost and performance data. These analyses have involved functional level and root-cause comparative statistical analyses. We have then added econometric level analyses to more fully understand causes and correlations. Our benchmarking analyses for these projects have been used in identification of organizational strengths and

weaknesses, improvement and stretch targets and in setting budgets. These projects were led by Mr. Zarakas.

Cost Benchmarking and Analysis of Strategic Organizational Options for the Long Island Power Authority (LIPA). LIPA is a municipal corporation in New York that outsources a majority of its distribution operations to an investor-owned utility (IOU) subsidiary. LIPA's Board of Trustees retained a Brattle team, led by Mr. Zarakas, to assess whether LIPA should insource these services, continue outsourcing (albeit under possibly different arrangements) or privatize its operations (i.e., transition from a municipal corporation to an IOU). A key area of analysis involved determining LIPA's cost and performance relative to peers under its current organizational arrangement as well as likely cost and performance under alternate organizational arrangements. Brattle conducted extensive cost and performance benchmarking, including econometric analyses and root-cause analysis. Summaries of our static benchmarking analysis are included in the public report. (LIPA's Board reviewed econometric and root cause analyses, however these are not included in public documents.)

In connection with a regulatory proceeding relating to the use of benchmarking in the UK. The Brattle team reviewed a published critique of the UK energy regulator's methodology that it had applied to electricity distribution companies.

C. PBR Plans & Policies

PBR Benchmarking and Strategic Regulatory Planning for Detroit Edison. DTE Energy engaged The Brattle Group to benchmark PBR frameworks that are in place in the U.S. and elsewhere in the world for purposes of 1) supporting the DTE team in developing its internal regulatory strategy and plans (for its electric and gas utilities) and 2) educating and providing perspective to the Michigan PSC Staff. Brattle participated in and presented our perspectives on the scope and intents of PBR in PBR Collaborative meetings sponsored by MPSC Staff. We also authored a report entitled *Performance-Based Regulation Plans: Goals, Incentives and Alignment*.

Studies and Testimonies Before State Regulatory Commission on PBR, Alternative Forms of Regulations (AFORs) and Performance Incentive Mechanisms (PIMs). The Brattle Group recently provided support to utilities concerning regulatory frameworks, the scope and practices associated with AFORs and the appropriateness of fit for the proposed regulatory plans:

- On behalf of Pepco, In the Matter of the Application of Potomac Electric Power Company for the Authority to Implement a Multiyear Rate Plan for Electric Distribution Service in the District of Columbia, Formal Case No. 1156;
- On behalf of the Joint Utilities in Maryland, Exploring the Use of Alternative Rate Plans or Methodologies to Establish New Base Rates for an Electric Company of Gas Company Before the Public Service Commission of Maryland, PC 51; and,
- On Behalf of Public Service Company of Oklahoma Before the Corporation Commission of the State of Oklahoma In the Application of the Public Service Company of Oklahoma For an Adjustment To Its Rates and Charges and the Electric Service Rules, Regulations

and Conditions of Service For Electric Service in the State of Oklahoma, Cause No. PUD 201800085.

Analysis and Testimony Concerning Guidelines for PIMs. On behalf of National Grid, Brattle developed a response to proposed *Principles for Performance Incentive Mechanisms* proposed for consideration by the Rhode Island Public Utilities Commission. Brattle examined the proposal, which centered primarily on cost savings incentives and rationales, and provided an opinion concerning whether or not these principles are well suited to the full scope of PIMs that may be going forward, and possible implications of their application in practice.

Riders and Trackers. The Brattle Group conducted extensive review of riders and trackers that are applied in the U.S. and in key jurisdictions worldwide (notably in the U.K., Canada and Australia). We reviewed and analyzed the scope of tracker, structures including frequency of review, cost areas, capex vs. opex designations and reconciliation mechanisms. We also examined the relationship between riders and trackers and PBR mechanism, by reviewing carve-outs and other approaches.

Innovative Regulatory Frameworks under New York's REV. New York's Reforming the Energy Vision (REV) initiatives encompassed a wide range of consultations and analyses. The Brattle Group was engaged by the New York Public Service Commission to develop a comprehensive financial model of a representative (downstate) New York utility capable of demonstrating the impacts of REV initiatives upon utility financial performance. Our modeling effort included developing plausible IRFs, including generically specifying price cap, new incentive mechanisms, and potential platform frameworks, services and futures. Related to this effort, The Brattle Group also worked with the New York PSC Staff and, subsequently, with the State's six investor-owned electric utilities, including National Grid, in analyzing the feasibility and impacts associated with proposed earnings sharing mechanisms (EAMs), primarily the EAMs associated with load factor and system efficiency.

Design of Earnings Sharing Mechanisms in New York. Brattle worked with the New York Public Service Commission and New York's six investor-owned electric utilities in analyzing and designing preliminary "earnings sharing mechanisms" (EAMs). EAMs fit into the category of evolving incentives mechanisms that are aimed at promoting regulatory and policy goals associated with the utility of the future. Our most recent work in this area concerned the design of a PBR addressing system efficiency.

Expert Reports and Testimony on Incentive Regulation, Performance Based Regulation and Performance Incentive Mechanisms for the Hawaiian Electric Companies. Brattle was extensively involved the proceedings concerning the broad topic of PBR. Brattle conducted extensive analysis and authored multiple expert reports and testimony on PBR structure, multi-year rate plans (MRPs), revenue adjustment mechanisms, decoupling and PIMs. Brattle also participated on behalf of HECO in stakeholder workshops on MRPs and PIMs. Brattle worked with HECO in specifying a range of emerging PIMs covering areas (such as GHG reductions, capex bias and DER integration), as well as for traditional areas such as reliability and customer service.

Review of North American and European PBR Mechanisms. On behalf of a Canadian Utility, Brattle conducted a comparative analysis of PBR frameworks. We presented a jurisdictional scan of the PBR implementations across North America and Europe, and assessed pros and cons of each approach. We also advised them on currently proposed Distributed Utility Models and assessed how these comported to Alternative Regulatory Models, with focus on the likelihood that the subject utilities could effectively coexist with the DERs and continue to maintain healthy balance sheets.

Review of Price and Revenue Determination for the AEMC. The Australian Energy Market Commission (AEMC) asked Brattle to review the processes used by regulators in the Australian National Energy Market for reviewing cost forecasts supplied by utilities as part of their price/revenue determination applications, and to compare those processes to arrangements in other jurisdictions. The Brattle team that interviewed regulators in Australia (including the Australian Energy Regulator and regulators in New South Wales and Western Australia), New Zealand, the UK, and Ontario.

Survey of US PBR Practices for the National Association of Water Industries. Brattle developed a report for the National Association of Water Industries called Alternative Regulation and Ratemaking Approaches for Water Companies Supporting the Capital Investment Needs of the 21st Century. The report provided a survey of policies that state regulators across the US have developed to meet investment challenges by improving traditional cost of service ratemaking in the electric, natural gas distribution and water industries.

Review of Price and Service Quality Regulation for the AEMC. The Australian Energy Market Commission asked Brattle to review how energy regulators in various jurisdictions collect and publish information from the utilities they regulate in performing their price and service quality regulation functions. Brattle examined approaches in New Zealand, the UK, Ontario, Italy and at the Federal Energy Regulatory Commission in the US.

Alternative proposal to prevailing PBR framework for a Canadian Utility: The Brattle Group assisted a Canadian utility as the utility developed an alternative proposal to their current PBR framework. Brattle examined and benchmarked several examples of performance based regulation schemes in place for other utilities, and advised on an enhanced PBR mechanism.

Review of alternative regulatory frameworks and incentive models: For a Canadian electric utility, the Brattle Group reviewed and summarized alternative regulatory frameworks and incentive models that would support a sustainable energy efficiency business. We investigated the pros and cons of these models, identified the implications of each model for the utility, and made a recommendation based on our findings. The utility will discuss the recommended approach with the regulator and seek an approval.

Electricity Rate Regulation Initiative and Subsequent Proceedings before the Alberta Utility Commission. As part of the Alberta Utilities Commission's initiative to develop PBR plans for the distribution utilities in Alberta, Brattle made multiple presentations at the van Horne institute workshop that launched the AUC initiative on an introduction to PBR, key PBR plan

components, and lessons from international experience. The ATCO Utilities later retained Brattle to advise on the development of a PBR plan. Brattle sponsored written evidence in the generic PBR proceeding before the AUC, covering the overall form of the PBR plan, the appropriateness of filed TFP studies, the need for a capital or K-factor, and a proposed mechanism for quantifying the required K-factor, the need for a stretch factor, and the benefits of pass-through mechanisms. Brattle also reviewed and responded to evidence filed by other experts in the proceeding.

V. Proposed Budget and Timeline

A. Budget

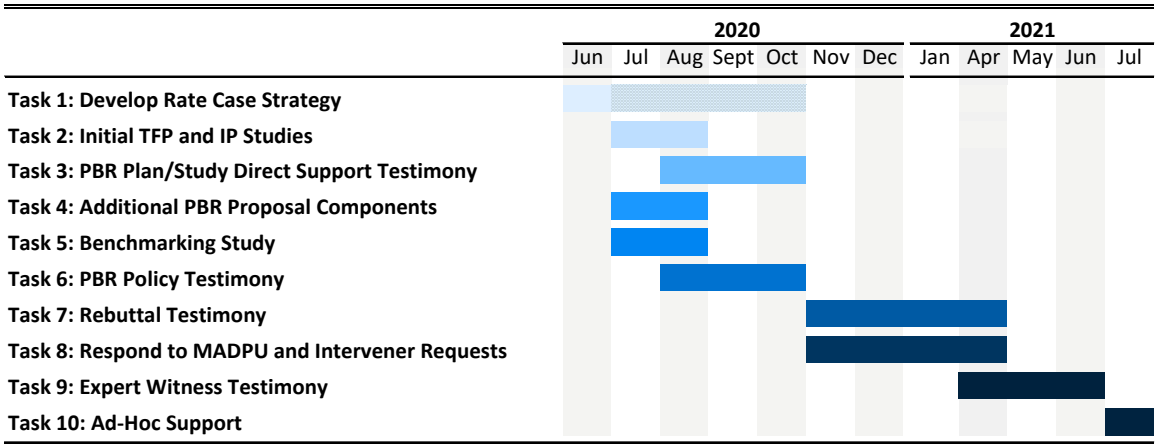
[redacted]

B. Timeline

In Figure 1, we present our proposed timeline for our engagement with National Grid, based on our understanding of the schedule described in the RFP and our experience in prior cases. This

timeline assumes a project start date of June 1, 2020. We understand that ongoing uncertainties resulting from the COVID-19 pandemic and efforts to combat it may result in delays or changes.

Figure 1: Proposed Timeline



Team Resumes

WILLIAM P. ZARAKAS
Principal

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William Zarakas is an expert on economic and regulatory matters in the telecom, media, and energy industries.

Mr. Zarakas holds a leadership role in Brattle's Telecommunications, Internet, and Media practice. He has provided expert reports and testimonies in a range of regulatory proceedings concerning the economic analysis of mergers among telecom carriers and media companies; competition in telecom markets; forbearance from price regulation; infrastructure access, sharing and pricing arrangements; the economics and financial feasibility of deploying broadband networks; analysis and valuation of wireless spectrum bands and holdings; and the distribution of royalties and retransmission fees in the cable and satellite TV industries.

Mr. Zarakas also leads much of Brattle's work related to evolving utility regulatory and business models, including the application of performance-based regulation (PBR) and regulatory reform and incentives designed to improve efficiencies and advance policy goals, such as decarbonization and customer engagement. He works extensively on benefit-cost analyses, particularly with respect to investments in grid modernization, reliability, resilience, and smartening the grid. He has authored a wide range of reports and articles on PBR, "utility of the future" visions and implementation, the utility platform and multi-sided markets, and competition in the retail electricity sector.

Additionally, Mr. Zarakas has led special investigations on behalf of corporate boards of directors, as well as audits of management practices and operational and financial performance on behalf of regulatory commissions. He has provided expert testimony and reports before the Federal Communications Commission, the Federal Energy Regulatory Commission, the Securities and Exchange Commission, the Copyright Royalty Judges (Library of Congress), the US Congress, state regulatory agencies, arbitration panels, and foreign governments and courts of law.

Competition and Antitrust. Recent work includes:

- Conducted merger simulation analysis, submitted testimony and provided ongoing support on the potential effects of the merger of mobile wireless carriers Sprint and T-Mobile, under review before the US Federal Communications Commission, the Department of Justice, and various state Attorneys General on behalf of DISH Network.
- Conducted merger analysis, submitted testimony and provided ongoing support on the potential effects of the merger of Sinclair Broadcast Group and Tribune Media, under review before the US Federal Communications Commission on behalf of DISH Network.
- Conducted merger analysis, submitted testimony and provided ongoing support on the potential effects of the mergers of Comcast-Time Warner Cable; AT&T-Time Warner; and, Disney-Fox.
- Conducted competitive analysis, submitted testimony, and provided expert support in a regulatory proceeding before the Federal Communications Commission on competition issues in dedicated internet bandwidth services, including possession of market power and assessment of market power abuse on behalf of Sprint Corporation.
- Analyzed effectiveness of retail competition in U.S. electricity markets.

- Analyzed market structure and degree of competition in U.S. retail telecom markets and authored expert reports with regard to Petitions for FCC to forbear from price regulating resale services and UNEs on behalf of Granite Telecom and Incompas.
- Analyzed acquisition price premium in merger of cross-state gas and electric utilities on behalf of TECO Energy, Inc., New Mexico Gas Company, Inc in a matter before the New Mexico Public Regulatory Commission.
- Analyzed prospective merger savings and divestiture losses for electric and gas utilities in merger applications before the U.S. Securities and Exchange Commission (SEC).

Spectrum Valuation and Due Diligence. Work includes:

- Led numerous analyses of the values of wireless spectrum in the U.S., Canada, the Middle East and North Africa (MENA), and other geographic markets. Scope of analyses included: PCS, AWS, 2.3-2.5 GHz, SMR, PLMR, IVDS, MSS and Big Leo spectrum bands, among others, for purposes of planning, transactional analysis, regulatory proceedings, domestic and international arbitration, and commercial litigation.
- Conducted analyses and authored expert reports concerning utility use of private networks vs. leased spectrum, and valuations of 900 MHz spectrum.
- Led due diligence of acquisition of spectrum holdings and telecom assets for major telecom carrier.
- Led due diligence of northwestern U.S. electric and gas utility on behalf of buyer; analysis included comprehensive sales, revenue, and operating and capital cost modeling and scenarios.

Telecom Regulatory and Compliance. Work includes:

- Analyzed and provided testimony in matters concerning acces and foreclosure of network elements and services.
- Developed cost and revenue models to estimate costs, feasibility and customer rates associated with deploying wireless broadband to Alaska and rural areas in the continental U.S. on behalf of GCI Communications for FCC proceedings regarding the Connect America Fund and Mobility Fund.
- Analysis and expert reports on matters concerning pole attachment rates before the FCC on behalf of electric utilities.
- Led comprehensive modeling concerning costs and rates for unbundled network elements (UNEs), undertaken in fulfillment of requirements associated with the Telecommunications Act of 1996, using the Total Element Long Run Incremental Cost (TELRIC) methodology

Utility Regulatory and Business Models. Analyzed, advised and/or testified on matters concerning regulatory frameworks, performance-based regulation (PBR) and utility business models, notably with respect to emerging competitive alternatives and network integration. Recent work includes:

- Analyzed implementation of New York's Reforming the Energy Vision by modeling the economics of the utility platform model, access pricing and financial impacts of retail competition on utility.
- Analyzed, advised and/or testified on matters concerning performance incentive mechanism (PIMs); e.g., analyses of: New York's "earnings adjustment mechanisms" on behalf of New York's six investor owned utilities) and performance measures and incentive structures on behalf of the Hawaiian Electric Companies.

- Surveyed and analyzed PBR frameworks and applications, including multi-year rate plans (MRPs), PIMs and other alternative regulatory mechanisms, including the U.K.'s "RIIO" model.
- Surveyed and analyzed regulatory approaches to setting electric distribution reliability standards around the world on behalf of the Australian Energy Market Commission (AEMC).
- Modeled multi-variate "utility of future" scenarios using system dynamic approach on behalf of utilities and industry groups.
- Advised Board of Directors of a major generation and transmission (G&T) cooperative and its member electric distribution cooperatives on matters concerning: asset valuations, risk management strategy, merger and acquisition options, and outlook for retail electric markets.

Infrastructure and Investment Analysis. Analyzed and testified on matters concerning infrastructure economics and financial feasibility. Work includes:

- Led benefit-cost and economic "break-even" analysis of utility system reliability and resilience investment using a value of lost load (VOLL) methodology on behalf of Public Service Electric & Gas Company (PSE&G).
- Conducted financial feasibility analysis concerning deployment of a broadband communications network for an Asian electric utility.
- Analyzed economics and financial feasibility of providing (wholesale) transport and (retail) broadband services for multiple U.S. electric utilities.

Management Analysis and Audits. Recent work includes:

- Led strategic organizational options analysis for the Board of Trustees of the Long Island Power Authority (LIPA).
- Led special investigations; e.g., economic analysis of "swap" transaction for the Special Committee of the Board of Directors of Global Crossing.
- Led management and/or regulatory audits of utilities and telecommunications carriers on behalf of state regulatory commissions Alabama, Kentucky, Maryland, New York and Pennsylvania.

Other Regulatory Analyses. Recent work includes:

- Led benchmarking studies of utility costs and regulatory practices.
- Analyzed markets for and costs of providing utility pole attachments.
- Calculated total factor productivity (TFP) and X factors in price regulation proceedings involving utilities before state regulatory commissions and incumbent telecommunications carriers before the FCC.
- Analyzed costs and value of retransmitted television programming in cable and satellite video markets on behalf of Music Claimants in proceedings involving distribution of royalty funds.
- Examined impact of regulatory fees and constraints on economic output in 22 countries in the Middle East and Africa for international mobile carrier.

Expert Testimony

WILLIAM P. ZARAKAS

Declaration of William Zarakas Verizon Maryland LLC, Complainant v. The Potomac Edison Company, Defendant, in a Pole Attachment Complaint Before the Federal Communications Commission, Proceeding No. 19-355, Bureau ID No. EB-19-MD-009 (February 1, 2020)

Declaration of William Zarakas Verizon Pennsylvania LLC and Verizon North LLC, Complainants v. Metropolitan Edison Company, Pennsylvania Electric Company, and Penn Power Company, Defendant, in a Pole Attachment Complaint Before the Federal Communications Commission, Proceeding No. 19-354, Bureau ID No. EB-19-MD-008 (February 1, 2020)

Declaration of William P. Zarakas BellSouth Telecommunications, LLC d/b/a AT&T Florida, Complainant, v. Florida Power & Light Company, Respondent, in a Pole Attachment Complaint Before the Federal Communications Commission, Proceeding No. 19-187, Bureau ID No. EB-19-MD-006 (September 12, 2019).

Direct Testimony of William Zarakas In the Matter of the Application of Potomac Electric Power Company for the Authority to Implement a Multiyear Rate Plan for Electric Distribution Service in the District of Columbia, Formal Case No. 1156 (May 30, 2019); Second Supplemental Direct Testimony (January 21, 2020).

Declarations of Coleman Bazelon, Jeremy Verlinda, and William Zarakas Before the Federal Communications Commission In the Matter of Applications of T-Mobile US, Inc. and Sprint Corporation for Consent to Transfer Control of Licenses and Authorizations, WT Docket No. 18-197

- May 1, 2019, Response to Israel, Katz, and Keating April 12, 2019 Declaration
- March 28, 2019, Response to Compass Lexecon February 20, 2019 Declaration and Mark McDiarmid March 6, 2019 Declaration
- March 25, 2019, Response to Applicants' February 7 Filings on Diversion Ratios
- March 18, 2019, Reply to Cornerstone's "Response to Dish's February 19 and 25 Submissions"
- February 19, 2019, Reply to Cornerstone "Response to Dish and CWA Comments"
- February 4, 2019, Network Model's Sensitivity to Millimeter Wave Adjustments
- January 28, 2019, Response to Applicant Filings on Diversion Ratios
- December 4, 2018, Further Reply Declaration of Coleman Bazelon, Jeremy Verlinda, and William Zarakas

Declaration (August 27, 2018) and Reply Declaration (October 31, 2018) of Joseph Harrington, Coleman Bazelon, Jeremy Verlinda, and William Zarakas Before the Federal Communications Commission In the

Matter of Applications of T-Mobile US, Inc. and Sprint Corporation for Consent to Transfer Control of Licenses and Authorizations, WT Docket No. 18-197

"The Role of Competitive Bidding Based Prices in Determining the Rural Rate," William Zarakas and Augustin J. Ros, In the Matter of Promoting Telehealth and Telemedicine in Rural America, Before the Federal Communications Commission, WC Docket No. 17-130 (May 24, 2019).

Response to PC 51 Request for Comments, Prepared for Joint Utilities of Maryland, Prepared by William Zarakas, Sanem Sergici, Pearl Donohoo-Vallett, and Nicole Irwin in Exploring the Use of Alternative Rate Plans or Methodologies to Establish New Base Rates for an Electric Company of Gas Company Before the Public Service Commission of Maryland, PC 51 (March 29, 2019).

Declaration of William Zarakas and Dr. Eliana Garces Before the Federal Communications Commission In the Matter of Tribune Media Company (Transferor) and Nexstar Media Group, Inc. (Transferee) Consolidated Application for Consent to Transfer Control, MB Docket No. 19-30 (March 18, 2019).

Expert Report of William P. Zarakas On Behalf of BC Hydro, BC Hydro Fiscal 2020—Fiscal 2021 Revenue Requirements Application to the British Columbia Utilities Commission (February 8, 2019).

Direct and Rebuttal Testimony of William P. Zarakas On Behalf of Public Service Company of Oklahoma Before the Corporation Commission of the State of Oklahoma In the Appication of the Public Service Company of Oklahoma For an Adjustment To Its Rates and Charges and the Electric Service Rules, Regulations and Conditions of Service For Electric Service in the State of Oklahoma, Cause No. PUD 201800085 (September 21, 2018, February 5, 2019).

Declaration of William P. Zarakas Before the Federal Communications Commission In the Matter of Petition of USTelecom for Forbearance Pursuant to 47 U.S.C. § 160(c) to Accelerate Investment in Broadband and Next-Generation Networks WC Docket No. 18-141, Opposition of Granite to USTelecom's Forebearnace Petition (August 6, 2018).

Declaration of William P. Zarakas Before the Federal Communications Commission In the Matter of Petition of USTelecom for Forbearance Pursuant to 47 U.S.C. § 160(c) to Accelerate Investment in Broadband and Next-Generation Networks WC Docket No. 18-141, Opposition of Incompas, FISPA, Midwest Association of Competitive Communications, and the Northwest Telecommunciations Association (August 6, 2018)

Expert report on behalf of GCI Communications "Rate of Return Analysis of GCI's TERRA Network," by William P. Zarakas, Agustin J. Ros, and Nicholas E. Powers. Prepared for GCI Communication Corp., March 30, 2018, in connection with the FCC's investigation of the Rural Health Care Telecommunications Program.

Expert report on behalf of GCI Communications before the Federal Communications Commission, In the Matter of Connect America Fund and Universal Service Reform, WC Docket No. 10-90 and WT Docket

No. 10-208A: analysis of the FCC's Rural Health Care Program Funding and Recipients, by William Zarakas, Augustin Ros, David Kwok, and M. Elaine Cunha, September 2017.

Declaration (August 7, 2017) and Reply Declaration (August 29, 2017) of William P. Zarakas and Jeremy A. Verlinda Before the Federal Communications Commission In the Matter of Tribune Media Company (Transferor) and Sinclair Broadcast Group, Inc. (Transferee), Consolidated Applications for Consent to Transfer Control, MB Docket No. 17-179.

Before the State of New York Public Service Commission In the Matter of Earnings Adjustment Mechanism and Scorecard Reforms Supporting the Commission's Reforming the Energy Vision, Case 16-M-0429, On Behalf of the New York Joint Utilities (Central Hudson Gas and Electric Corporation, Consolidated Edison Company of New York, Inc., New York State Electric & Gas Corporation, Niagara Mohawk Power Corporation d/b/a National Grid, Orange and Rockland Utilities, Inc., and Rochester Gas and Electric Corporation), Report: "Assessment of Load Factor as a System Efficiency Earnings Adjustment Mechanism," William Zarakas, Sanem Sergici, et. al. (February 10, 2017).

Declaration of William P. Zarakas Before the Federal Communications Commission In the Matter of Business Data Services in an Internet Protocol Environment, Investigation of Certain Price Cap Local Exchange Carrier Business Data Services Tariff Pricing Plans, Special Access for Price Cap Local Exchange Carriers, AT&T Corporation Petition for Rulemaking to Reform Regulation of Incumbent Local Exchange Carrier Rates for Interstate Special Access Services, WC Docket No. 16-143, WC Docket No. 15-247, WC Docket No. 05-25, RM-10593. Declaration of William P. Zarakas and Susan M. Gately (January 27, 2016); Supplemental Declaration of William P. Zarakas (March 24, 2016); Declaration of William P. Zarakas and Jeremy Verlinda (June 28, 2016, Attachment D to Comments of Sprint Corporation); Declaration of David E. M. Sappington and William P. Zarakas (June 28, 2016, Attachment E to Comments of Sprint Corporation); Further Supplemental Declaration of William P. Zarakas (August 9, 2016, Attachment A of Reply Comments of Sprint Corporation).

Declaration of William P. Zarakas Before the Federal Communications Commission In the Matter of Verizon Virginia. LLC and Verizon South, Inc., Complainants, v. Virginia Electric and Power Company d/b/a Dominion Virginia Power, Docket No. 15-90, File No. EB-15-MD-006 (November 18, 2015).

Declaration of William P. Zarakas and Matthew Aharonian in the United States Court for the District of Columbia Circuit United States Telecom Association, Petitioner, v. Federal Communications Commission and the United States of America, Respondents, Case No. 15-1063 (and consolidated cases) (May 22, 2015).

Declarations Before the Federal Communications Commission In the Matter of Application of Comcast Corporation, General Electric Company and NBC Universal, Inc. for Comcast to Assign or Transfer Control of Licenses, Federal Communications Commission, MB Docket No. 10-56. Analysis of the FCC's Vertical Foreclosure and Nash Bargaining Models Applied To The Proposed Comcast-Time Warner Cable Transaction (December 21, 2014) and Supplemental Declaration: Analysis of the FCC's Vertical Foreclosure and Nash Bargaining Models Applied To The Proposed Comcast-Time Warner Cable Transaction (March 5, 2015).

Before the Public Utilities Commission of the State of Hawaii, In The Matter of Public Utilities Commission Instituting an Investigation to Reexamine the Existing Decoupling Mechanisms for Hawaiian Electric Company, Inc., Hawaii Electric Light Company, Inc., and Maui Electric Company, Limited, Docket No. 2013-1041, On Behalf of the Hawaiian Electric Companies. Report: "Targeted Performance Incentives: Recommendations to the Hawaiian Electric Companies," Prepared For The Hawaiian Electric Companies, William P. Zarakas and Philip Q Hanser (September 15, 2014).

Before the New Mexico Public Regulatory Commission, In The Matter Of The Application of TECO Energy, Inc., New Mexico Gas Company, Inc. and Continental Energy Systems, LLC, For Approval of TECO Energy Inc.'s Acquisition of New Mexico Gas Intermediate, Inc. and For All Other Approvals and Authorizations Required To Consummate and Implement The Acquisition, Utility Case No. 13-00231-UT, On Behalf of TECO Energy, Inc., New Mexico Gas Company, Inc. and Continental Energy Systems, LLC, Joint Applicants (March 2014).

"Analysis of Benefits: PSE&G's Energy Strong Program," by Peter Fox-Penner and William P. Zarakas Before the New Jersey Board of Public Utilities In the Matter of the Petition of Public Service Electric and Gas Company for Approval of the Energy Strong Program, Docket No. EO13020155 and GO13020156 (October 7, 2013).

"Review and Analysis of Service Quality Plan Structure In The Massachusetts Department of Public Utilities Investigation Regarding Service Quality Guidelines For Electric Distribution Companies and Local Gas Distribution Companies." Philip Q Hanser, David E. M. Sappington and William P. Zarakas, Massachusetts D.P.U. 12-120 (March 2013).

"Alaska Mobile Broadband Cost Model, Before The Federal Communications Commission In The Matter Of Connect America Fund and Universal Service Reform – Mobility Fund. WC Docket No. 10-90 and WT Docket No. 10-208A." William P. Zarakas and Giulia McHenry (February 2013; updated May 2016, with David Kwok).

Expert Report of William P. Zarakas In The United States District Court For The Northern District of Florida MCI Communications Services, Inc., Plaintiff v. Murphree Bridge Corporation, Defendant, Case No. 5:09-cv-337 (February 19, 2010).

Testimony of William P. Zarakas Before The Copyright Royalty Judges, Library of Congress, Washington D.C. In The Matter of Distribution of the 2004 and 2005 Cable Royalty Funds, Docket No. 2007-3 CRB CD 2004-20 (June 1, 2009).

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Dr. Agustin J. Ros is a Principal of the Brattle Group and has 25 years of consulting and agency experience in regulatory and public utilities economics in network industries, particularly energy and telecommunications. He specializes in TFP and performance-based ratemaking, cost of service, demand studies, competition analysis and disputes, damages, and econometric modelling. He has provided dozens of expert reports before Public Utility Commissions and Federal agencies in the United States, Canada and more than a dozen countries and before the International Chamber of Commerce Arbitration Panel. Dr. Ros is an Adjunct Professor at the International Business School at Brandeis University where he teaches a course on regulatory and antitrust economics. He previously taught a similar course at Northeastern University.

Dr. Ros has worked on dozens of TFP studies involving electricity, gas and telecommunications. He worked on the early TFP studies before the Federal Communications Commission and before state PUCs involving the incumbent local telephone companies. His work continued internationally, working on TFP studies in Canada. Dr. Ros was the expert nominated by the Alberta Public Utilities Commission to conduct a TFP study for the electricity and natural gas distributors in Alberta and he was responsible for developing the methodology and the model that was used and accepted by the Commission in that proceeding. He has also led TFP projects throughout Latin America. He is currently working on a TFP project for a large Canadian utility.

Dr. Ros has extensive experience estimating econometric models in consulting projects as well as in his research in peer-reviewed academic and industry journals. He has econometrically estimated electricity demand models and examined the impact of competition in retail and wholesale electricity markets in the U.S. that the *Energy Journal* recently published. He has published additional econometric research in *Journal of Regulatory Economics*, *Review of Industrial Organization*, *Review of Network Economics*, *Telecommunications Policy*, and *Info*. Moreover, he has co-authored econometric research with one of the world's leading econometricians, Professor Jerry A. Hausman that appeared in the *Journal of Regulatory Economics* and has peer-reviewed dozens of econometric articles submitted to academic journals.

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EDUCATION

Ph.D. Economics, University of Illinois-Urbana Champaign	1994
M.S. Economics, University of Illinois-Urbana Champaign	1991
B.A. Economics, Rutgers University-Newark	1989

TEACHING POSITIONS

Brandeis University, International Business School, *Adjunct Professor*	2016-present
University of Anahuac, Mexico City, *Guest Lecturer*	2010
Northeastern University, *Adjunct Instructor*	2000

EXPERT REPORTS, TESTIMONIES AND AFFIDAVITS

Expert report before the Canadian Radio and Telecommunications Commission, on behalf of Bragg Communications Inc. (c.o.b. Eastlink), Cogeco Communications Inc., Rogers Communications Canada Inc., Shaw Cablesystems G.P., and Videotron Ltd., Assessment of an Expert Report by the Brattle Group Regarding Telecom Order CRTC 2019-288, with Renée M. Duplantis, Dimitri Dimitropoulos and Ian Cass, March 13, 2020.

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Expert report on behalf of Infraestructura Marina del Golfo, before the Mexican Energy Regulatory Commission: expert opinion on issues related to the appropriate allowed rate of return for the IMG pipeline, with Paul Carpenter and Bente Villadsen, May 23, 2018.

Expert report on behalf of GCI Communications before the Federal Communications Commission: rate of return, cost of service and cross-subsidy analysis of GCI's Satellite-Based Services, with William Zarakas and Nicolas E. Powers, May 2018.

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Expert report on behalf of Leyde and LACTHOSA before the Honduran Competition Commission: expert report on the competitive effects of a joint venture between Leyde and LACTHOSA in the Honduran dairy sector, April 2013.

Expert report on behalf of Lowe's Mexico before the Mexican Competition Commission: economic analysis on market definition, market power and monopolistic practices in the market for home improvement products sold through superstores, October 2012.

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Expert report before the Federal Communications Commission on behalf of US West, An Economic and Policy Analysis of Efficient Inter-Carrier Compensation Mechanisms for ISP-Bound Traffic, 12 November 1999.

Expert report before the Pennsylvania Public Utility Commission on behalf of Bell Atlantic Pennsylvania, Promised Fulfilled: Bell Atlantic-Pennsylvania's Infrastructure Development (with William Taylor, Charles Zarkadas, and Jaime D'Almeida), 15 January 1999.

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Expert report before the Spanish Regulatory Commission on behalf of Telefónica, final report "Assessment of the methodology used by Telefónica in the calculation of the prices included in the interconnection reference offer and comparison with BT's interconnection prices" (with Nigel Attenborough, David Robinson, Yogesh Sharma, and José María Rodríguez Ovejero), October 1998.

Expert report before the Italian Regulatory Commission on behalf of Telecom Italia, final report "Volume Discounts: A Report for Telecom Italia" (with Nigel Attenborough, Andrea Coscelli, and Andrea Lofaro), October 1998.

Expert report before the Federal Communications Commission on behalf of Bell Atlantic, Docket Nos. 96-262, 94-1, 91-213, 96-263, "An Analysis of the Effects of Exchange Access Reform on Demand Stimulation" (with Charles Zarkadas), 27 April 1997.

RECENT CONSULTING ENGAGEMENTS

Consulting work on behalf of a large Mid-western electricity provider in the U.S.: Analysis of the costs to serve residential and commercial distributed generation customers and standby customers, 2019.

Consulting work on behalf of a municipal electricity provider in the U.S.: Rate Design Principles and Rate Review for electricity and water services, 2019.

Consulting report on behalf of large South American oil and gas company: Evaluation of proposal in relation to the regulation of wholesale petroleum prices, (Evaluación de las propuestas en relación con la regulación de los precios de reconocimiento), with Pedro Marin, November 13, 2019,

Consulting work on behalf of a major electricity distribution company in the U.S.: cost study and competitive pricing principles of advanced metering services, 2018-2019.

Consulting work on behalf of a Canadian electricity provider: benchmarking analysis of generation utilities in transmission and regulatory practices with respective to generation procurement practices, distributed energy resources and customer-specific pricing practices, 2018.

Consulting work on behalf of a U.S. generation and transmission electricity cooperative: embedded and marginal cost of service studies to support rate reform initiative, 2018.

Consulting work on behalf of a major electricity distribution provider in the U.S.: develop a locational distribution marginal cost-based cost of service study to support the value of distributed energy resource proceedings, 2017 - 2018.

Consulting report on behalf of major foreign electricity and gas distribution company: Rules and regulations applicable to the competitive U.S. retail electricity providers in the U.S. and Canada: A regulatory assessment, November 2017.

Consulting report on behalf of major foreign electricity and gas distribution company: Rules and regulations applicable to the competitive U.S. retail natural gas providers in the U.S. and Canada: A regulatory assessment, November 2017.

Consulting work on behalf of the Cities of Garland, Mesquite, Plano, and Richardson appealing the decision by North Texas Municipal Water District affecting wholesale water rates, Texas PUC Docket No. 46662 and SOAH Docket No. 473-17-4964.WS: economic analysis of whether wholesale water rate charged by the District adversely affects the public interest and rate design issues., 2017 – 2018.

Consulting work on behalf of a major electricity distribution company in the U.S.: cost study and competitive pricing principles of advanced metering services, 2015 - 2016.

Consulting report for the Mexican National Center for the Control of Natural Gas: Electricity demand forecast for the National Mexican Electricity System for the period 2017-2030. December 2016. With Veronica Irastorza and Elvira Creel.

Consulting report for the Mexican Secretariat of Communications and Transport: "Econometric demand study of fixed and mobile broadband and telephony services and Pay-TV services using discrete choice analysis." January 2016. With Kenneth Train and Douglas Umaña.

Consulting report for the Mexican Secretariat of Energy, CFE horizontal generation split analysis: recommended number of CFE gencos. September 2015. With Hamish Fraser and Willis Geffert.

Consulting report for the Mexican Secretariat of Energy, CFE horizontal generation split analysis: Recommended optimal portfolio mix for the CFE gencos. September 2015. With Hamish Fraser and Willis Geffert.

Consulting report for the Mexican Secretariat of Energy, CFE horizontal generation split analysis: Identification of relevant markets within the Mexican wholesale electricity markets. August 2015. With Hamish Fraser and Willis Geffert.

Consulting report for the Mexican Secretariat of Energy: Vesting contract criteria and methodology report. July 2015. With Hamish Fraser, Gene Meehan and Kurt Strunk.

RECENT PRESENTATIONS

Presentation before the National Association of Regulatory Utility Commissioners (NARUC): Cost of Service Allocation in a New Era, February 9, 2020.

Presentation before Rutgers University's Center for Research in Regulated Industries, Advanced Workshop: "Empirical Assessment of the Demand for Residential Solar Distributed Generation and the Impact of Electricity Rate Design Reform, January 17, 2020.

Presentation before the Harvard Electricity Policy Group: Rate Design and Low Income Consumers June 12, 2019.

Presentation before Rutgers University Center for Research in Regulated Industries Eastern Conference: "Does Electricity Competition Work for Residential Customers?" May 30, 2019.

Presentation before Rutgers University's Center for Research in Regulated Industries, Advanced Workshop: "Residential Electricity Competition at a Crossroads," February 15, 2019.

Presentation before the EEI Electric Rates Advanced Course, "Introduction to Embedded Cost of Service," with Phil Q Hanser, July 2018.

Presentation before the EEI Electric Rates Advanced Course, "Introduction to Marginal Cost of Service," with Phil Q Hanser, July 2018.

Presentation before the Public Collaborative for the Puerto Rico Electricity System, "Introduction to Utility Regulation," with Karl McDermott, July 19, 2018.

Presentations before the Public Collaborative for the Puerto Rico Electricity System, "Introduction to Electricity System Planning," with Karl McDermott, July 19, 2018.

Presentation before the Public Collaborative for the Puerto Rico Electricity System, "Ownership Structure, Contracting Process and Wholesale Markets," with Karl McDermott, July 19, 2018.

Presentation before Rutgers University Center for Research in Regulated Industries Eastern Conference: "Marginal cost of service: electricity distribution locational marginal costs, with Phillip Q Hanser and T. Bruce Tsuchida, June 8, 2018.

Presentation before the World Forum on Energy Regulation, Cancun Mexico: "Rate design helping facilitate change in electricity markets," March 2018.

Presentation before Rutgers University's Center for Research in Regulated Industries, Advanced Workshop: "Utility of the future and cost of service: challenges and opportunities," January 2018.

Presentation before Rutgers University's Center for Research in Regulated Industries, 36th Annual Eastern Conference: "The evolving electricity distribution network – technological, competitive and regulatory implications." May 2017.

Presentation before Rutgers University's Center for Research in Regulated Industries, Advanced Workshop: "Costing and pricing of electricity smart grid service offerings and competitive implications." January 2017.

Presentation before Rutgers University's Center for Research in Regulated Industries, 35th Annual Eastern Conference: "Determinants of total factor productivity in the U.S. electricity sector and the effects of performance-based regulation." May 2016.

Presentation before Rutgers University's Center for Research in Regulated Industries, Advanced Workshop: "merger theory and practice in the U.S. electricity sector." January 2016.

PUBLICATIONS

"Economic framework for compensating distributed energy resources: Theory and practice." (with Romkaew Broehm and Philip Hanser), *The Electricity Journal* 31(8): 14-22 (2018).

"The future of the electric grid and its regulation: Some considerations," *The Electricity Journal* 31(2): 18-25 (2018).

"An Econometric Assessment of Electricity Demand in the United States using Utility-Specific Panel Data and the Impact of Retail Competition on Prices." *The Energy Journal* 38(4): 73-99 (2017).

"An Econometric Assessment of Telecommunications Prices and Consumer Surplus in Mexico using Panel Data." (with Jerry A. Hausman), *Journal of Regulatory Economics*, vol. 43:284-304 (2013).

"Corrección de la Evaluación Errónea de la OCDE Acerca de la Competencia en el Sector de las telecomunicaciones en México." (con Jerry Hausman), *El Trimestre Economico* (2013).

"The Impact of Asymmetric Mobile Regulation in Colombia." (with Douglas Umana), *Info*, vol. 15 No. 3:54-65 (2013).

"Correcting the OECD's Erroneous Assessment of Telecommunications Competition in Mexico." (with Jerry A. Hausman), *CPI Antitrust Chronicle* June 2012.

"North American Performance-Base Regulation for the 21st Century." (with Jeff D. Makholm and Stephen Collins), *Electricity Journal* vol. 25, Issue 4, May 2012.

"The Determinants of Pricing in the Mexican Domestic Airline Sector: The Impact of Competition and Airport Congestion." *Review of Industrial Organization* vol. 38:1 (2011), pp 43-60.

"Anticipating Merger Guidelines from Mexico's Commission on Competition." (with Elizabeth M. Bailey), *International Antitrust Bulletin* vol. 4, (2010).

"X-factor Updating and Total Factor Productivity Growth: The Case of Peruvian Telecommunications, 1996-2003." (with Jeffrey I. Bernstein, Juan Hernandez and Jose Maria Rodriguez), *Journal of Regulatory Economics*, vol. 30:3 (2006), pp 316-342.

"Crecimiento de la demanda por servicios de comunicación móviles. Mitos y realidades (International Mobile Demand Growth: Myths and Reality)" (with Aniruddha Banerjee), *AHCIET Móvil* (September 2005).

"Concepto de costes básicos para la modelización entelecomunicaciones (Basic Economic Cost Concepts for Telecommunications Cost Modeling), Perspectivas en Telecomunicaciones (Perspectives in Telecommunications) (July 2005).

"Drivers of Demand Growth for Mobile Telecommunications Services: Evidence from International Panel Data." (with Aniruddha Banerjee), in Global Economy and Digital Society, Elsevier (2004).

"Patterns in Global Fixed and Mobile Telecommunications Development: A Cluster Analysis." (with Aniruddha Banerjee), *Telecommunications Policy*, vol. 28 (2004), pp. 107-132.

"The Impact of the Regulatory Process and Price Cap Regulation in Latin American Telecommunications Markets." *Review of Network Economics*, vol. 2 (2003), pp. 270-286.

"Does Employee Ownership Motivate Workers? Worker Effort, Shirking and Horizontal Monitoring in ESOP." The Determinants of the Incidence and the Effects of Participatory Organizations, Advances in the Economic Analysis of Participatory and Labor Management, edited by Takao Kato and Jeffrey Pliskin, Elsevier Science, vol. 7 (2003).

"The Internet: Market Characteristics and Regulatory Conundrums." (with Aniruddha Banerjee), Forecasting the Internet: Understanding the Explosive Growth of Data Communications, edited by David G. Loomis and Lester D. Taylor, Kluwer Academic Publishers (2002), pp. 187-216.

Profits for All? The Costs and Benefits of Employee Ownership, Nova Science Publishers, (2001).

"Are Residential Local Exchange Prices Too Low? Drivers to Competition in the Local Exchange Market and the Impact of Inefficient Prices." (with Karl McDermott), in Expanding Competition in Regulated Industries, edited by Michael Crew, Kluwer Academic Publishers (2000), pp. 149-168.

"Telecommunications Privatization and Tariff Rebalancing: Evidence from Latin America." (with Aniruddha Banerjee), *Telecommunications Policy*, vol. 24 (2000), 233-252.

"Utility Regulation in Latin America." (with Leonardo Giacchino, Cesar Herrera, Siôn Jones, Phillip Maggs, and Kristina Sepetys), Privatisation International, edited by Mark Baker, vol. 2 (2000).

"Essential Facilities, Economic Efficiency, and a Mandate to Share: A Policy Primer." (with Karl McDermott, Kenneth Gordon, and William Taylor), Edison Electric Institute (January 2000).

"Does Ownership or Competition Matter? The Effects of Telecommunications Reform on Network Expansion and Efficiency." *Journal of Regulatory Economics*, vol.15 (1999), pp. 65-92.

"Telecommunication Restructuring in Brazil: Issues and Options (A Report Based on the Proceedings of the U.S./Brazil Aspen Global Forum)." International Center for Public Administration and Policy Institute for Policy Research and Implementation, Graduate School of Public Affairs, University of Colorado at Denver (December 1997).

"When, Where and How? Implementing Effective Telecommunications Competition & Regulatory Policy." *Journal of Project Finance* (Winter 1997).

"Telecommunications in Brazil: Restructuring and Privatization" (et. al.), A Report Based on the Proceedings of the Brazil/U.S. Aspen Global Forum, International Center for Public Administration and Policy Institute for Policy Research and Implementation, Graduate School of Public Affairs, University of Colorado at Denver, August (1997).

"Another Look at What's Driving Utility Stock Prices." (with John L. Damagalski and Philip R. O'Connor), *Public Utilities Fortnightly* (January 1997).

"Regulatory Change and the Dismantling of the Bottleneck." Tenth NARUC Biennial Regulatory Information Proceedings (October 1996).

"Stranded Costs: Is the Market Paying Attention? A Look at Market-to-Book Ratios." (with John L. Damagalski and Philip R. O'Connor), *Public Utilities Fortnightly* (May 1996).

"The Gas Storage Market: What Does it Tell Us?" (with Ruth Kretschmer), *Public Utilities Fortnightly* (April 1996).

"Incentive Ratemaking in Illinois: The Transition to Competitive Markets" (with Terry S. Harvill), *Public Utilities Fortnightly* (July 1995).

PEARL DONOHOO-VALLETT
Senior Associate

Washington, DC +1.202.955.5050 Pearl.Donohoo-Vallett@brattle.com

Dr. Pearl Donohoo-Vallett provides utilities and independent transmission companies strategic support on the increasing overlap of retail and wholesale regulatory and policy issues including the value of distribution resources, non-wires alternatives, and performance-based and alternative regulatory mechanisms. Her recent work for utilities, merchant transmission developers, and regulators focuses on:

- Performance based and alternative ratemaking,
- Distributed energy resources,
- Marginal cost of service,
- Clean energy policy, and
- Transmission planning.

Dr. Donohoo-Vallett brings her breadth of experience across alternative ratemaking mechanisms, performance incentive mechanisms, distributed energy resources, system operation, renewable portfolio standards, and transmission planning to help clients identify, understand and address emerging utility challenges. She also works with transmission developers to identify value propositions and estimate the economic footprint of projects. Dr. Donohoo-Vallett is active within the firm's pro bono practice currently working on criminal justice related issues.

EDUCATION

Dr. Donohoo-Vallett earned her Ph.D. from MIT in the field of Technology, Management and Policy; her doctoral dissertation explored transmission planning under uncertainty. She earned her S.M. from the Technology and Policy Program at MIT and a B.S. in Mechanical Engineering from the Franklin W. Olin College of Engineering.

AREAS OF EXPERTISE

- Performance Based Ratemaking
- Marginal Cost of Service
- Clean Energy Policy
- Transmission Planning and Evaluation

REPRESENTATIVE EXPERIENCE

Performance Based/Alternative Regulation

- For a Caribbean utility, provided review of retail rider structures including frequency of review, differentiation between asset types, cost containment mechanisms, and performance incentives.

- For a U.S. utility, provided analysis on potential areas for shared savings mechanisms and performance incentive mechanisms and review of utility proposed responses. Analysis included review of best practices, discussion of alignment with commission goals, and benchmarking of O&M performance.
- For a U.S. utility, provided stakeholder and utility education on alternative regulation, including underlying economic concepts and current regulatory process. Presented an overview of alternative regulation to stakeholders and supported the utility in its ongoing stakeholder proceedings. Developed detailed case studies of multi-year rate plans for executives to demonstrate the variety of approaches to regulatory plans. Worked with the utility to identify potential performance incentives that would align with local policies and prioritize measures based on the utility's risk in implantation.
- For a U.S. utility, developed ten detailed state case studies on alternative regulation respond to commission questions in a docket on alternative regulation. Augmented case studies with an informal survey of select utility commissions in a report filed with the commission.
- For a U.S. utility, prepared a report demonstrating the wide-spread nature of alternative regulatory mechanisms including state-counts of different regulatory approaches.
- For a U.S. utility, supported filing of a new regulatory plan including formula-based rates and performance incentive mechanisms. Assisted the utility understanding industry standard and emergent performance incentive mechanisms and aided the utility in shaping its performance incentive mechanism portfolio. Supported preparation of direct testimony and discovery responses.
- For a Canadian utility, advised and supported new performance based metrics that were grounded in a survey of Canadian and U.S. reliability, customer service, and storm performance based regulations. Supported preparation of direct testimony and discovery responses.

Natural Gas Distribution

- For a large east-coast utility, reviewed benefit cost framework and model data to evaluate non-pipe options. The review included treatment of geographic differences in marginal costs due to pipeline access, and the Brattle team rebuilt the model from the ground-up to allow for intuitive use.
- For a U.S. based municipal natural gas distribution company, developed financial benchmarking to illustrate the company's performance relative to peers and industry trends during for a rate case. Developed integrated financial model to conduct scenario analysis on future health of the company including impact of increased borrowing. Supported direct testimony.

- For a proposed natural gas distribution company and electric utility merger, analyzed market power issues related to fuel-switching in home heating through census data and bottom-up technology models.

Cost of Service and Rate Design

- For a Canadian utility, developed a transmission rate design proposal to reflect evolution of the system, including the growth in distributed energy resources on bypass, changing generation types and needs, and differentiation in geographic load growth.
- For a state commission, reviewed and critiqued a utility sponsored distribution marginal cost of study analysis based premised on an engineering approach. Supported the use of a marginal cost approach that reflects the timing of investments and straightforward analysis of time-of-day marginal costing for T&D assets.
- For a state commission, reviewed proposed rate designs for two utilities against Bonbright's rate design principles.
- For a Canadian commission, reviewed and critiqued the marginal cost of study for generation and transmission using an engineering approach for going-forward costs. Critique included analysis of export potential and appropriate energy costs.

Value of Distributed Energy Resources and Non-Wires Alternatives

- For a U.S. utility, reviewed the utility's benefit cost assessment model used to evaluate distributed energy resources for alignment with commission orders and staff guidance. The assessment identified areas for refinement, including increasing the temporal and geographic granularity of the model. As part of the review, the Brattle team provided insights into potential misalignments between the valuation of transmission and distribution investment deferral within the model, customer value, and system value. The Brattle team rebuilt the model from the ground-up to allow for intuitive use and ensure that assumptions are clearly articulated and well-documented.
- For an independent transmission company, provided assessment intervener testimony regarding potential for non-wires alternatives to mimic benefits of proposed transmission line. Assessment included review of regulatory and practical barriers to implementation of proposed alternative based on jurisdictional requirements and existing regulatory models.
- For a U.S. utility with heterogeneous service territory, developed a granular distribution marginal cost of service model and study to provide improved pricing signals and reflect varied investment needs across the system. Worked collaboratively with the utility's engineering teams to classify investments, quantify capacity needs, and align forecasts.

- For a large U.S. utility with a dense urban service territory, developed a granular distribution marginal cost of service model to provide improved pricing signals for the location of distribute energy resources. The study differentiated areas of the system geographically, to reflect differing costs, and network topology, to reflect the ability of distributed energy resources to offset multiple investments.
- For a U.S. utility, developed modeling to assess the value of commercial and industrial demand options across wholesale energy, ancillary service, and transmission and distribution value streams.

Clean Energy

- For a battery manufacturer, analyzed the ability of market stakeholders to anticipate changes to PJM's regulation market and explained the impact of those changes on battery performance.
- For the Massachusetts Attorney General's Office, reviewed the 83C offshore wind procurement process and developed analyses to support critiques of the solicitation process. Described potential benefits of including offshore wind transmission networks in future solicitations and potential distortion of project ranking due to scoring methodology used.
- For the Massachusetts Attorney General's Office, reviewed the 83D hydro and renewables procurement process. Reviewed and critiqued ability of power purchase agreements to procure incremental hydro generation for Massachusetts. Analyzed and described scoring improvements to remove potential distortions in future solicitations.
- For a trade group, reviewed clean energy policy differences by generator and vintage and developed an analysis of Tier 1 and Tier 2 renewable energy credit prices.
- For an investment group, provided strategic information related to potential future renewable energy and regional transmission needs through a review of policy drivers and procurement processes.
- For a consortium of Canadian entities, examined the potential for imported Canadian generation to qualify and participate in U.S. carbon mitigation programs. Analyzed Clean Power Plan legislation and provided insight into how participation may vary between different greenhouse gas policy implementation options. Developed framework for how Canadian generators could participate in state programs based on existing renewable portfolio tracking systems and eligibility requirements.
- For a large U.S. city, developed a comprehensive regional electricity generation capacity expansion model to evaluate options for greenhouse gas emission reductions to achieve economy-wide deep decarbonization under multiple scenarios developed in concert with stakeholders.

- Prior to joining The Brattle Group, compared current operating reserve definitions across timescales (frequency to replacement) and levels to modeled approaches in wind integrated studies in the U.S. and internationally.
- Prior to joining The Brattle Group, evaluated trade-offs between carbon dioxide emissions, water usage and cost for generation capacity planning in ERCOT.

Transmission

- For a large U.S. utility, analyzed the economic footprint of a new transmission project across four regions.
- For a large U.S. utility, analyzed the economic footprint of a generation tie line and wind farm using custom spending models to reflect geographic location of suppliers and work force.
- For a large U.S. utility, analyzed the economic footprint of its transmission investment portfolio across multiple states. As part of the engagement, benchmarked spending patterns to existing models and created custom spending models to reflect investment type, voltage level of equipment, and geographic location of suppliers and work force.
- For the WIRES organization, provided comments to the FERC on the resiliency benefits and challenges related to the transmission network.
- For a transmission development company, reviewed renewable energy credit markets and renewable portfolio standard eligibility requirements to develop an estimate of the potential value streams for users of an HVDC line.
- For a transmission development company, provided feedback and mock scoring of the company's bid for a FERC Order 1000 competitive transmission solicitation.
- For a Canadian transmission operator, reviewed Open Access Transmission Tariff requirements and NERC eTag practices to identify commonly applied practices.
- For a merchant transmission developer, analyzed the potential value of an HVDC line connecting the MISO and PJM markets.
- For a merchant transmission developer, synthesized transmission, natural gas and renewable generation studies to identify high-value transmission corridors.
- Prior to joining The Brattle Group, worked with a team to co-plan transmission and generation in WECC. Dr. Donohoo-Vallett developed a reduced-model of the WECC transmission network incorporating new transmission investments and existing reliability flow-constraints.

ACADEMIC HONORS AND FELLOWSHIPS

- Martin Family Society of Fellows for Sustainability (2012)

- National Science Foundation Graduate Research Fellowship (2009-2013)
- BP MIT Energy Fellowship (2009)

PUBLICATIONS

- "Review of Existing and Proposed Network Additions Policies for Newfoundland and Labrador Hydro," A. Ros, P. Hanser, and P. Donohoo-Vallett, prepared for the Newfoundland and Labrador Board of Commissioners of Public Utilities. November 19, 2019.
- "Exploring the Use of Alternative Regulatory Mechanisms to Establish New Base Rates: Response to PC51 Request for Comments," W. Zarakas, S. Sergici, P. Donohoo-Vallett, and N. Irwin, prepared for Joint Utilities of Maryland and filed in support of comments in PC51 for the Maryland Public Utilities Commission. March 29, 2019.
- "U.S. Alternative Regulatory Mechanisms: Scope, Status and Future," W. Zarakas, S. Sergici, and P. Donohoo-Vallett, prepared for Baltimore Gas & Electric, Delmarva Power & Light, and Pepco. February, 2019.
- "Recognizing the Role of Transmission in Electric System Resilience," M. Chupka and P. Donohoo-Vallett, prepared for WIRES and submitted to ERC Docket No. AD18-7-000. May 9, 2018.
- "Pricing Carbon into NYISO's Wholesale Energy Market to Support New York's Decarbonization Goals," S. Newell, R. Lueken, J. Weiss, K. Spees, and P. Donohoo-Vallett. August 2017.
- "Capricious Cables: Understanding Key Concepts in Transmission Expansion Planning and Its Models," by P. Donohoo and M. Milligan. NREL Research Report; TP-5D00-61680. Golden, Colorado, 2014.
  "Water-CO2 Tradeoffs in Electricity Generation Planning," by M. Webster, P. Donohoo and M. Palmintier. Nature Climate Change. Issue 3. October 2013. doi: 10.1038/nclimate2032
- "Algorithmic Investment Screening for Wide-Area Transmission Network Expansion Planning," by P. Donohoo, M. Webster and I. Perez-Arriaga. IEEE Power and Energy Society General Meeting; Vancouver, Canada. July 2013.
- "Stochastic Methods for Planning and Operating Power Systems with Large Amounts of Wind and Solar Power," by M. Milligan, P. Donohoo and M. O'Malley. 10th International Workshop on Large-Scale Integration of Wind Power into Power Systems; Porto, Portugal. November 2012.

- "Using Market-Based Dispatching with Environmental Price Signals to Reduce Emissions and Water Use at Power Plants in the Texas Grid," by N. Alhajeri, P. Donohoo, A. Stillwell, C. King, M. Webster, M. Webber and D. Allen. Environmental Research Letters, Vol. 6, 2011.
- "Operating Reserves and Wind Power Integration: An International Comparison," by M. Milligan, P. Donohoo, D. Lew, E. Ela, et al. 9th International Workshop on Large-Scale Integration of Wind Power into Power Systems; Quebec, Canada. October 2010.
- "An Examination of the Regional Supply and Demand Balance for Renewable Electricity in the United States through 2015," by L. Bird, D. Hurlbut, P. Donohoo, K. Cory and C. Kreycik. NREL Technical Report. March 2009.

PRESENTATIONS

- "Panel 2: Implementation Experience of Other States" with W. Zarakas. Presented to the District of Columbia Public Service Commission Technical Conference FC 1156. October 18, 2019.
- "Washington D.C. Performance-Based Regulation Workshop" with W. Zarakas and S Sergici. September 19, 2018.
- "Debtor's Prisons in Faulkner County: Review of Issues & Analysis of Historical Data" with C. Bazelon, H. Green, N. Powers, M. Vinnakota, and M. Yoder A. (Brattle); Crawford, K. Johnson, A. Lynn, L. Reynolds, K. Robisch, and S. Rosenthal (Veneable LLP); and M. Huggins and M. Kelley (Lawyers' Committee for Civil Rights Under Law), presented to Arkansas Journal of Social Change and Public Service Symposium: "Life Beyond Bars." April 2018.
- "Lessons from Large Scale Transmission Planning using Stochastic Programming: Evaluation for WECC" with B. Hobbs, J. Ho, S. Kasina, Q. Xu and J. Ouyang, presented at the EPRI Risk Based Planning Workshop. Little Rock, Arkansas. November 19, 2015.
- "Transmission Planning for Renewables" presented at the Utility Variable-Generation Integration Group Spring Technical Workshop. Anchorage, Alaska. May, 2014.
- "Strategic Robust Transmission Planning" with M. Webster, and I. Perez-Arriaga, presented at the Western Electric Coordinating Council. Salt Lake City, Utah. May, 2012.
- "Robust Transmission Planning: Overview of Issues" with M. Webster. And I. Perez-Arriaga, presented to ABB Corporate Research Center. Raleigh, North Carolina. February, 2012.

- "Integrating Dynamics and Generator Location Uncertainty for Robust Electric Transmission Planning" presented at the INFORMS Annual Meeting. Charlotte, North Carolina, USA. November, 2011. Presented to Red Eléctrica. Madrid, Spain. July, 2011.

SAI P. SHETTY
Electricity Modeling Specialist

Boston, MA | +617.234.5787 | Sai.Shetty@brattle.com

Mr. Sai Shetty is an Electricity Modeling Specialist at The Brattle Group with experience in the regulation and economics of the energy sector. With a background in econometrics, his work focuses on the application of econometric principles to understand outcomes in electricity markets. Mr. Shetty has worked with electric utilities on innovative pricing strategies to estimate customer load impacts attributed to pricing pilots and in performance based regulation to help quantify productivity growth in the electric transmission industry.

Mr. Shetty previously worked as a decision analyst at a US based healthcare consulting firm from 2015 – 2017, focusing on pricing analytics for specialty drugs. Mr. Shetty holds a M.S. degree in Economics from the University of Wisconsin – Madison and a B.Tech degree in Chemical Engineering from the National Institute of Technology Karnataka, India.

AREAS OF EXPERTISE

- *Econometric Estimation and Forecasting*
- *Financial Modeling*
- *Pilot Design and Impact Evaluation*
- *Rate Design*
- *Performance Based Regulation*

SELECTED EXPERIENCE

- **Impact Evaluation of Time-of-Use (TOU) Pilot.** Assisted three utilities in Maryland in quantifying the residential load impacts over the first summer of a three-year TOU pricing pilot. Conducted econometrics analysis to study residential customers' load patterns and isolate the effect of the pilot in the presence of exogenous factors that affect load consumption. Estimated demand elasticities quantifying customer's load shifting behavior in response to price signals.
- **Alternative Rate Design for Net Energy Metering (NEM) Customers.** Formulated rate design structures as part of a Maryland utility's efforts to understand the cross-subsidy between solar and non-solar customers. Analyzed alternatives to the standard volumetric pricing strategies in a bid to reduce the cross-subsidy and make residential electric rates more reflective of cost drivers.
- **US Electric Vehicle (EV) Demand Estimation.** For a large utility in Maryland, assisted with the building of a vast dataset consisting of US EV sales related data. Used econometric estimation techniques to model EV adoption in the US as a part of the company's efforts to understand the levers that drive EV sales. Leveraged the model to forecast EV sales in Maryland to gauge EV performance against the State's Zero Emission Vehicle (ZEV) mandate.
- **Revenue Cap Mechanism for Electric Transmission.** As part of a regulatory rate case proceeding, assisted a large Canadian utility to study total factor productivity (TFP) trends for transmission companies. Built a model that calculates TFP growth for a sample of US utilities involved in transmission services, which provide a benchmark to compare the utility's productivity.

REDACTED

REDACTED

PROPOSAL FOR:

MASSACHUSETTS RATE CASE 2020 PERFORMANCE BASED REGULATION & BENCHMARKING

PREPARED FOR:

NATIONAL GRID

CONFIDENTIAL

DUE: MAY 7, 2020 AT 4:00 P.M. VIA ARIBA

CONCENTRIC ENERGY ADVISORS

CEADVISORS.COM

REDACTED

CONFIDENTIAL

May 7, 2020

National Grid
40 Sylvan Road
Waltham, MA 02461

Attn: Christopher Swezey
National Grid
Christopher.Swezey@nationalgrid.com

RE: MASSACHUSETTS RATE CASE 2020 PERFORMANCE BASED REGULATION & BENCHMARKING

Dear Mr. Swezey,

Concentric Energy Advisors, Inc. ("Concentric") appreciates the opportunity to respond to National Grid's ("the Company") Request for Proposals ("RFP") for a consultant to perform a Total Factor Productivity study and Input Pricing study for National Grid's Boston Gas/Colonial Gas (jointly the "MA Gas Companies") distribution rate case. This consulting support will also include expert testimony on both the findings of the studies and the advantages of the proposed Performance Based Regulation plan ("PBR") in helping the Company meet its obligations to customers at a reasonable cost. Concentric is well suited to support National Grid on this important assignment. Our team possesses extensive knowledge of the Massachusetts regulatory environment as well as Performance Based Regulation and the development of supporting productivity and benchmarking studies. We are also keenly aware of the pressures on gas distribution utilities created by increasingly stringent greenhouse gas policies, and the need to reflect these impacts and other industry trends in a PBR plan. Concentric understands the relationships between industry drivers, TFP studies, and practical ratemaking. We are experienced at defending our studies through expert testimony and we will provide the Company with ongoing support throughout the proceeding. Concentric has engaged a subcontractor with whom we have prior experience for specific expertise in conducting Total Factor Productivity and Input Price studies in order to provide a comprehensive proposal to fully meet the Company's needs.

This proposal contains information regarding Concentric's qualifications and relevant experience, and our proposed methodology to the tasks identified in the RFP. In addition to this introduction, this proposal contains resumes for the project team as Attachment A. We have uploaded our Price Sheet separately through Ariba.

We believe that our response fully meets the requirements as stated in the RFP. If National Grid determines that Concentric's response is deficient in any way, Concentric respectfully requests to be promptly notified and be given the opportunity to correct any such deficiency. Please forward any questions regarding this solicitation response to me. My contact information is below.

REDACTED

On behalf of Concentric, thank you for providing us the opportunity to respond to this RFP, and we look forward to hearing from you.

Sincerely,

James Coyne
Senior Vice President
293 Boston Post Road West, Suite 500
Marlborough MA 01752

TABLE OF CONTENTS

TABLE OF ATTACHMENTS

SECTION 1:

EXECUTIVE SUMMARY

Concentric welcomes the opportunity to provide our expertise and services to National Grid to develop and support its performance-based regulation plan. Concentric understands that this work will be conducted for both the Boston Gas and Colonial Gas subsidiaries, to be included with the Company's next base distribution rate filing in the fall of 2020.

Concentric's proposal relies on industry experts in the field of performance-based regulation. Specifically, Mr. James Coyne of Concentric will lead a team of experts including our Total factor Productivity ("TFP") and benchmarking specialist Mr. Steve Fenrick, supported by Concentric's econometric and gas industry expert Ms. Melissa Bartos. Additionally, Mr. Gregg Therrien and Ms. Meredith Stone, two of Concentric's in-house PBR specialists, will provide project management, gas LDC operational expertise, and expert research consultancy to ensure a high quality and responsive study.

Consistent with the RFP's "Scope of Services", Concentric's team will produce support for a Performance-Based Regulation Plan that includes a TFP study, an Input Pricing Study and an industry benchmarking study. Collectively, these studies will formulate a PBR plan that will be thoroughly analyzed and explained in detailed direct testimony before the Massachusetts Department of Public Utilities ("MADPU").

With our firm's capabilities, Concentric is ideally positioned to assist National Grid with this important engagement. Our relevant expertise includes:

- **Development of innovative performance-based ratemaking approaches**. Concentric has worked extensively in the development and evaluation of innovative rate proposals and restructuring-related rate initiatives in both the U.S. and Canada. This work has included the development of full PBR programs, the estimation of productivity models and benchmarking studies in support of these programs, and development of alternative programs and mechanisms such as multi-year cost of service programs and capital cost tracking mechanisms.
- **Detailed knowledge of National Grid and its subsidiaries.** Concentric provided consulting assistance and testified in the recent National Grid gas distribution rate case, D.P.U.17-170. In this case, we prepared rate case testimony and extensive supporting exhibits in support of both Boston Gas and Colonial Gas's revenue requirements and marginal cost studies. This engagement also included ongoing support throughout the case, including responding to discovery requests and providing expert testimony at hearings. As a result, we are familiar with the Company and its business challenges and opportunities.
- **Detailed knowledge of the Massachusetts regulatory environment**. Our team has in-depth experience working with Massachusetts utilities and before the MADPU on significant rate and regulatory matters, including revenue requirements, rate design, allocated cost of

service studies, marginal cost of service studies, grid modernization, cost of capital, decoupling, capital trackers, and demand forecasting. Our consulting staff has extensive regulatory and ratemaking experience including three former Massachusetts utility employees, three former MADPU staff members, and a former MADPU Chair. We have testified at the MADPU on over 80 occasions, and on a number of topics and issues–we are accepted as knowledgeable, trustworthy experts in Department proceedings.

- **Deep expertise on the natural gas distribution business.** Concentric's experts posess a fundamental understanding of the gas distribution business. Our experts, including those on this project team, are involved in rate and regulatory cases on behalf of our clients across the U.S. and Canada. We are are also on the cutting edge of developing reponses to envirnonmental policy initiatives and broader mandates that are shifting the business and regulatory environment for gas LDCs. We believe it is important to reflect these changing fundamentals in the development of a successful PBR program for both shareholders and customers.

SECTION 2:

ORGANIZATION BACKGROUND

Concentric Energy Advisors was founded in 2002 by a small group of executive-level consultants who were committed to establishing a mid-sized energy consulting firm with capabilities and a reputation unsurpassed by any firm in North America. Since its inception, Concentric has grown more than eight-fold and has significantly expanded its service offerings, while remaining focused on achieving the highest standards of consulting excellence in the energy field.

We provide our clients access to one of the nation's largest pool of expert witnesses in the field of utility regulation, with more than 20 individuals who have appeared as experts in regulatory proceedings across North America, backed up by a team of consultants that are experienced in all aspects of developing the financial, economic, and technical data filed as part of regulatory proceedings.

Currently, Concentric has approximately 60 employees who work out of the corporate headquarters in Marlborough, Massachusetts, or in offices in Washington, DC, Chicago, Illinois, and Calgary, Alberta, Canada. Our team specializes in management consulting and financial advisory services with a focus on the North American energy industry. Our energy industry experts have held positions with utility companies, regulatory agencies, integrated energy companies, regional transmission organizations, retail marketing companies, and utility management consulting firms. Many members of our team have been working together for more than 30 years.

Through our subsidiaries, CE Capital Advisors, Concentric Advisors ULC, and Concentric Energy Publications, we provide capital market advisory support, consulting services in Canada, and publish *The Foster Report*.

CE Capital Advisors: A securities firm that provides services relating to corporate mergers and acquisitions, the valuation of securities, and capital market advisory support. CE Capital assists clients with transactions involving the acquisition or disposition of large assets and with the purchase and sale of business units and companies. CE Capital often provides services as an extension of Concentric's management consulting services, including rendering fairness opinions for transactions and corporate valuations for financings, litigation, and strategic assignments.

Concentric Advisors, ULC: Based in Calgary, Alberta and provides utility consulting services in Canada, with a specialty in depreciation and valuation services.

Concentric Energy Publications: The Foster Report addresses significant regulatory and business events that impact all segments of the North American natural gas and oil industries, with a particular focus on tracking Federal Energy Regulatory Commission activities.

The Concentric family of companies is dedicated to creating value for clients through hard work, market knowledge, and excellent work product. This dedication is evident in the fact that more than 80% of Concentric's assignments come from existing clients.

SERVICE AREAS

Concentric offers a broad range of services that enable our clients to address diverse needs comprehensively without the difficulty of retaining and coordinating multiple resources.

Our **Regulation Team** includes former regulators and utility executives who have served as decision-makers and expert witnesses on a broad range of policy and rate matters in state, provincial, and federal regulatory proceedings across North America.

The **Markets and Resource Planning Team** conducts analytical work in the energy industry that spans all aspects of the natural gas and electric markets, including both wholesale and retail levels.

Our **Financial Advisory Team** is comprised of senior financial, economic, and industry professionals who advise clients on all aspects of the structure, negotiation, and implementation of asset-based and corporate transactions.

The **Litigation Team** provides clients with expert-based litigation and arbitration support services on matters pertaining to the North American energy industry.

SECTION 3:

TEAM OF QUALIFIED EXPERTS

Concentric staffs its projects with both a Responsible Officer and a Project Manager. This two-fold approach to project leadership ensures that our clients always have access to a senior engagement manager and the quality of work is in full alignment with expectations. While the Responsible Officer provides oversight and manages strategic focus, the Project Manager is in charge of the day-to-day activities including interacting with the client, managing and reviewing work products, and generating the final results.

Concentric has identified a team of experts who have extensive experience with PBR, TFP and benchmarking studies, and ratemaking for gas LDCs. James Coyne will serve as the Responsible Officer and Gregg Therrien will serve as Project Manager. For this engagement, Concentric is partnering with Clearspring Energy Advisors, whose Principal, Steve Fenrick, will be responsible for conducting the TFP study and will be an integrated part of the team throughout the engagement. Concentric has successfully partnered with Steve on two previous PBR engagements. Ms. Bartos will lend her econometrics and gas industry expertise and collaborate with Mr. Fenrick and his team. Further, Mr. Therrien and Ms. Meredith Stone will provide subject matter expertise on PBR plan development and benchmarking in support of this comprehensive proposal.

These individuals were selected for their specific knowledge of PBR plans and related regulatory context across multiple jurisdictions. Specifically, Mr. Coyne has served as an expert witness for Hydro Quebec on the development of PBR plans for HQD and HQT, including the appropriate X, I, capital, and related plan parameters. He served in a similar role on behalf of Enbridge in development of a comprehensive multi-year PBR plan. He also recently led a unit-cost benchmarking study of North American electric and gas utilities that was filed with the client's PBR plan for purposes of setting the stretch factor. He also led a series of workshops on behalf of Vermont Gas and the Vermont Public Service Board to research and identify potential incentive regulation programs, their specific program features, and assisted the company and Board with reaching agreement on a recommended PBR formulation for Vermont Gas, including the appropriate X factor. He supported this proposal with expert testimony and supporting documentation. He has provided extensive evidence in Ontario on PBR for Enbridge (including TFP), and also on behalf of Hydro One and the OPA.

Additional members of the proposed team have a broad understanding of alternative regulation models and will be used selectively for their insights and contribution to specific questions and issues as they arise. Mr. Therrien has filed joint testimony in D.P.U. 18-40 in support of Berkshire's Alternative Rate Plan and Revenue Decoupling mechanism. Ms. Stone has extensive experience in PBR plans in the U.S. and Canada, supporting Mr. Coyne and Mr. Therrien with expert research and analysis of PBR plans. Mr. Coyne will oversee all content of the engagement and lend his considerable experience and expertise to the panel.

Mr. Fenrick will also be a testifying witness in the proceeding, with specific responsibility for rigorous support of the TFP, Input Price and econometric benchmarking studies. Mr. Fenrick has also testified

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on multiple occasions in support of TFP and benchmarking, including expert testimony and research supporting PBR plans for Toronto Hydro, Hydro One Distribution and Transmission, and Hydro Ottawa. Mr. Fenrick was the expert witness on behalf of The Coalition of Large Distributors during Ontario's latest PBR proceeding that set the X, I, and stretch factor parameters for Ontario's 4th Generation Incentive Regulation plan. He had previously worked on behalf of the Ontario Energy Board in Ontario's 3rd Generation Incentive Regulation plan. Mr. Fenrick has assisted in numerous other TFP and benchmarking research studies throughout North America.

Short biographical descriptions for the core team are below, and their complete resumes are included as Attachment A.

James M. Coyne, Senior Vice President, is an energy industry expert who provides financial, regulatory and strategic support services to clients in the power and gas utilities industries. Drawing upon his industry and regulatory expertise, he regularly advises utilities, public agencies and investors on business strategies, investment evaluations, cross-border trade, rate and regulatory policy, capital cost determinations and energy markets. He is a frequent speaker and author of numerous articles on the energy industry and regularly provides expert testimony before federal, state and provincial jurisdictions in the U.S. and Canada. He testifies on matters pertaining to the cost of capital, capital structure, business risk, alternative ratemaking mechanisms and regulatory policy. Prior to Concentric, Mr. Coyne worked in senior consulting positions focused on North American utilities industries, in corporate planning for an integrated energy company, and in regulatory and policy positions in Maine and Massachusetts. Mr. Coyne holds a B.S. in Business from Georgetown University with honors and an M.S. in Resource Economics from the University of New Hampshire.

Melissa F. Bartos, Vice President, is a financial and economic consultant with more than twenty years of experience in the energy industry. In the last several years, she has focused on natural gas markets issues, including conducting comprehensive market assessments for various clients considering infrastructure investments and developing detailed demand forecasts for a number of gas distribution companies. Ms. Bartos has also designed, built, and enhanced numerous financial and statistical models to support clients in asset-based transactions, energy contract negotiations, reliability studies, asset and business valuations, rate and regulatory matters, cost-of-service analysis, and risk management. Her modeling experience includes building Monte-Carlo simulation models, designing an allocated cost-of-service model, statistical modeling using SPSS, and programming using Visual Basic for Applications (VBA). Ms.

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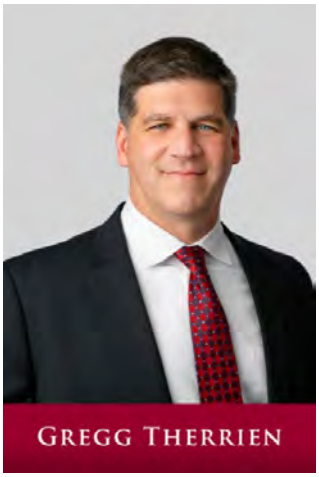
Bartos has also provided expert testimony regarding natural gas demand forecasting and supply planning issues, and incentive ratemaking. Ms. Bartos previously consulted with Reed Consulting Group and Navigant Consulting, Inc.; she has an M.S. in Mathematics (Statistics) from the University of Massachusetts at Lowell, a B.A. from the College of the Holy Cross in Worcester, MA, and is a member of the American Statistical Association.



Gregg Therrien, Assistant Vice President, is a former utility executive who has held Director level positions at Connecticut Natural Gas Corporation and affiliated companies for more than 15 years. Most recently, he served as the Director, Gas Construction at Connecticut Natural Gas and The Southern Connecticut Gas Company and Director, Regulatory & Tariffs at UIL Holdings, Inc. Mr. Therrien's experience includes regulatory strategies, natural gas growth, infrastructure replacement programs and technical rate case issues such as utility cost of service, rate design, tariff writing and administration, as well as pricing, gas cost accounting, gross margin and load forecasting for regulated utilities.

Mr. Therrien has an M.B.A. from the University of Connecticut and a B.S. in Finance from Bryant University, and is also a certified Project Management Professional (PMP).

Meredith Stone, Project Manager has experience providing analytical and research support on various wholesale market, regulatory and arbitration projects that often involve expert witness testimony. Ms. Stone has extensive experience in the North American power markets, with a focus in wholesale market design, analysis, and operations. Ms. Stone has provided analysis on the net Cost of New Entry in the ISO-NE wholesale capacity markets, as well as the recalculation of Offer Review Trigger Prices. Ms. Stone also has experience in multiple elements of the regulatory ratemaking process, including incentive regulation, targeted infrastructure replacement plans, cash working capital/lead-lag studies, revenue requirement modeling, earnings sharing and marginal cost studies. She holds a Master of Public Policy from Brown University and a B.A. in Political Science from Middlebury College.

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Steve Fenrick, Principal, Clearspring Energy Advisors, is an economist who has worked in the utility industry for the last 19 years. At Clearspring, Mr. Fenrick is responsible for providing consulting services and expert witness testimony to utilities and regulators in the areas of reliability and cost benchmarking, productivity studies and other empirical aspects of performance-based ratemaking and incentive regulation. His experience includes direct activities in the areas of demand-side management programs, peak time rebate programs, load forecasting, and market research. He has provided expert witness testimony in a number of utility applications pertaining to performance-based ratemaking, written journal articles, and regularly presents at conferences. Previously he was the Director of Economics at Power System Engineering, Inc. and a Senior Economist at Pacific Economics Group, LLC.

SECTION 4:

PROJECT EXPERIENCE

Concentric's regulatory experts are closely attuned to the latest rate-setting practices, policies, and trends, including the establishment of performance-based rate plans, capital tracking mechanisms, and related alternative regulation mechanisms.

Concentric has worked extensively in the successful development of innovative rate proposals that balance the interests of regulators, shareholders, and customers. Our expertise includes the development of utility productivity studies, benchmarking analysis, and incentive ratemaking proposals including multi-year rate plans, productivity-based rate adjustment mechanisms, capital and expense cost adjustment mechanisms and considerations of rate caps, earnings sharing and targeted incentives. Our consultants have made substantial contributions to innovative rate mechanisms that accomplish a number of social policy or utility objectives, including economic efficiency, cost control, reduced regulatory burden, and more timely cost recovery.

We have studied the evidence and regulatory decisions across a broad range of PBR plans in order to assess best practices both in terms of evidence and the resulting decisions. We have built a substantial record of evidence and decisions from the U.S., Canada, Australia, the United Kingdom, Europe, and New Zealand, which provides our team with an understanding of the strengths and weaknesses of the approaches advocated and the results achieved. We have also carefully considered the recent evidence and decisions for Eversource's and National Grid's electric operations in Massachusetts.

The following pages contain Concentric's project experience in the areas of performance-based ratemaking and utility benchmarking:

PBR EXPERIENCE

Berkshire Gas Company ("BGC")	Concentric assisted BGC with developing an Alternative Rate Mechanism ("ARM") that was proposed in BGC's 2018 rate case. Concentric provided extensive research on various PBR plan components including X and I factors, exogenous factors, and capital and cost trackers. Concentric filed testimony on BGC's proposed ARM before the MADPU. (2017). Mr. Therrien served as an expert witness on Alternative Rate Plan policy and constructs, and revenue decoupling, and Ms. Stone provided research and analytical support.

Hydro-Québec TransÉnergie ("HQT") and Hydro-Québec Distribution ("HQD")	Concentric acted as the regulatory and policy advisor to HQT and HQD in support of the development of their PBR frameworks. This assistance was provided in response to the Régie de l'energie's ("Régie") regulatory proceeding to establish PBR mechanisms for HQT and HQD. Concentric provided comprehensive support to both companies, including the development of the overall plan proposals, applicability to each company's business profile, development of X, I, Y and Z factors, earnings-sharing, off-ramp, and earnings carry-forward mechanisms. Concentric provided technical support and economic analysis, North American and international research, and expert testimony in support of the proposed plans. (2015 – 2019). Mr. Coyne served as Concentric's lead expert and Ms. Stone provided technical support.
Ontario Power Authority ("OPA")	Concentric assisted the OPA with developing an appropriate set of metrics for each division of the OPA for the purposes of measuring efficiency productivity and reporting this information in the OPA's revenue requirement submissions to the Ontario Energy Board. Concentric reviewed the efficiency metrics utilized by similar organizations in the U.S. and Canada, and determined their applicability to the OPA, and drafted recommendations submitted to the Ontario Energy Board ("OEB") in the 2014 revenue requirement submission. Expert analysis was provided with respect to the efficiency metrics report and filed before the OEB. (2014) Mr. Coyne served as Concentric's lead expert.
Hydro One	Concentric provided consulting services pertaining to Hydro One's 2015 - 2019 Custom Distribution Rate Application to the Ontario Energy Board. Concentric recommended appropriate metrics to be utilized in the Next Generation PBR Plan. (2014) Mr. Coyne served as Concentric's lead expert.

Toronto Hydro

Concentric provided consulting support for the development of Toronto Hydro's Next Generation Incentive Rate plan and related expert testimony before the Ontario Energy Board. Concentric researched incentive rate models in the United Kingdom and Australia and related the implications of these approaches to the proposed 5-year plan. (2014) Mr. Coyne served as Concentric's lead expert.

Nova Scotia Power

Concentric prepared and presented an overview of electric market design and PBR approaches and highlights of the North American experience to the Nova Scotia Power Inc. Board of Directors. (2014) Mr. Coyne served as Concentric's lead expert.

Enbridge Gas Distribution ("EGD")

Concentric provided EGD with extensive analysis and expert evidence relating to its Next Generation IR Plan proposal. Concentric's role included assessing relevant regulatory precedents in select North American jurisdictions pertaining to IR plans and researching productivity factors and methods established in other jurisdictions for estimating utility productivity. The research found that a variety of IR frameworks have been implemented over the past two decades in the U.S. and Canada. Four basic approaches have been utilized: multiyear "fixed" rate plans (or "rate freeze"); I-X plans; building block ratemaking; and targeted rate adjustment mechanisms.

Concentric's analysis included the development of a North American total factor productivity study and a North American benchmarking study in support of the plan's parameters. Concentric provided extensive support to the client team throughout the process, which included defending the study through written discovery and oral technical conferences and hearings. The client's proposed IR plan was accepted by its regulator in July 2014. (2011-2014) Mr. Coyne served as Concentric's lead expert and Ms. Bartos provided technical support and industry expertise.

Ontario Energy Board	As a subcontractor to Power Advisory, a Concentric senior officer was a co-author of a report to Board staff entitled, "Incentive Regulatory Options for Ontario Power Generation's Prescribed Generation Assets." This report reviewed the evolution of economic regulation of OPG's prescribed generation assets, discussed the potential application of incentive regulation, and identified several options for consideration by the Board, OPG, and stakeholders. The engagement concluded with a presentation to stakeholders. (2012)
Western Massachusetts Electric Company ("WMECO")	Concentric supported WMECO in its decoupling proposal. Concentric's work included: (1) research on the financial implications of decoupling; (2) identification of decoupling mechanism details to address company and regulatory requirements and objectives; (3) identification of rate adjustment mechanisms that would work together with the Company's proposed decoupling mechanism; and (4) preparing prefiled testimony and testifying at hearings in support of the Company's decoupling and rate adjustment proposals. The proposed rate adjustment mechanisms included an inflation adjustment mechanism, which was based on Concentric's statistical analyses, and a capital spending mechanism to recover the costs associated with capital plant investment that was targeted to improving service reliability. (2010)

BENCHMARKING EXPERIENCE

Concentric's experts have also developed benchmarking analyses of gas and electric utilities in a wide variety of regulatory and operational applications. In doing so, Concentric employs its research, analytical, and quantitative skills, and industry expertise to create insightful studies for reliance by regulators, management teams, and stakeholders.

Fortis	Concentric performed an industry benchmarking study gathering a combination of public and confidential company data in support of the company's proposed PBR program for its gas and electric utilities in B.C. The benchmarking study was designed to compare the financial and operational performance of the client's electric and gas operations to proxy groups of Canadian and U.S. electric and gas utilities. Concentric gathered and analyzed confidential data with agreement from participating companies in order to assess operational and financial performance, including service quality metrics. The report was ultimately submitted to the client's regulator for purposes of establishing plan parameters for the company's Next Generation PBR plans. (2018) Mr. Coyne served as senior subject matter expert for the study.
Florida Power & Light Co. ("FPL")	On multiple occasions, Concentric served as a consulting expert and provided expert testimony with respect to performance benchmarking on behalf of FPL. Concentric's analysis included identifying relevant operational and financial metrics, developing a proxy group of comparable utilities, preparing metrics analysis, and other analysis requested by the client team and FPL counsel. This engagement also included preparing and reviewing written direct testimony before the Florida Public Service Commission. (2008, 2011, 2015)
Vectren	Mr. Fenrick led an econometric benchmarking study for Vectren in an internal investigation into their gas utility's emergency response times. This study used a number of explanatory variables and models that examined the performance in regard to emergency response times for each operational area within the utility. (2014)

Pacific Gas & Electric ("PGE")	Mr. Fenrick led an econometric and unit cost benchmarking study for PGE in an internal investigation into their transmission and distribution costs and performance. This study used a number of explanatory variables and models that examined O&M and capital cost performance in each operational area. (2013)
Arizona Public Service Co. ("APS")	APS retained Concentric to conduct an independent review of the benchmarking study prepared by Liberty Consulting Group ("Liberty") and commissioned by the Arizona Corporation Commission. Our review included both an examination of the approaches and methods used by Liberty in measuring APS's performance, as well as an assessment of the recommendations made by Liberty for improvements in certain areas. In addition, Concentric prepared an independent benchmarking study of APS by establishing several comparable groups of companies, gathering and assessing operating data and costs, and measuring APS' performance against its peers across a variety of operational and financial metrics. These productive efficiency metrics were augmented by an analysis of exogenous factors to recognize that the cost advantages or disadvantages that many utilities face are the product of circumstances beyond their control. (2011)
Green Mountain Power Corp. ("GMP")	Concentric reviewed GMP's benchmarking study prepared as part of a directive by the Department of Public Service. GMP receives an ROE incentive-base on its position against similar utilities in the comparable group. Concentric supported GMP's benchmarking study by reviewing the comparable group of companies and verifying FERC Form 1 data for certain transmission, distribution, and customer service expenses. Concentric also provided expert testimony. (2009)
Questar Gas Co.	Concentric provided testimonies focused on return on equity testimony and policy testimony related to the appropriate return on equity and equity premiums for performance as well as on performance benchmarking of the gas utility. (2007)

Ameren Illinois Company ("AIC")	Concentric conducted benchmarking of AIC's Administrative and General expenses, the results of which were submitted in testimony before the Illinois Commerce Commission in the Company's Formula Rate proceeding. (2016)
El Paso Electric	Concentric prepared benchmarking assessments of El Paso Electric Company's ("EPE") costs of constructing the Montana Power Station Units 3 and 4, both of which are General Electric LMS100 simple cycle gas turbine units. The assessment compared EPE's projects to other LMS100 construction projects in the U.S., including previous EPE LMS100 installations. (2016)
El Paso Electric	Concentric benchmarked the capital costs associated with four new generation facilities and provided expert testimony regarding the results of the benchmarking analysis. (2015)
Puget Sound Energy ("PSE")	Concentric performed a review of how PSE compares to similarly-situated utilities in underlying costs related to new customer additions ("New Business Investment"). An assessment of PSE's New Business Investment costs compared to those of peer utilities enabled PSE to rank its performance relative to peers. Further, a review of PSE and the peer utilities identified certain trends and/or inter-relationships between management policies and practices, as well as other exogenous factors, and the resulting impact on New Business Investment. (2012).

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The following table contains relevant expert testimony listings of Messrs. Coyne and Fenrick:

EXPERT TESTIMONY

Witness	Applicant / Case ID	Subject
James Coyne	Enbridge Gas Distribution EB-2011-0354	Industry Benchmarking Study and Cost of Capital
	Enbridge Gas Distribution EB-2012-0459	Incentive Regulation Plan and Industry Productivity Study
	Gaz Métro R-3809-2012	ROE/Business Risk/ Capital Structure
	HQD/HQT R-3897-2014	PBR
	Vermont Gas Systems VPSB Docket No. 7109	Models of Incentive Regulation
Steve Fenrick	Hydro One Transmission Sault St. Marie EB-2018-0218	TFP, IP, and Benchmarking Research and PBR parameter recommendations
	Hydro One Transmission EB-2019-0082	TFP, IP, and Benchmarking Research and PBR parameter recommendations
	Hydro Ottawa EB-2019-0261	TFP, IP, and Benchmarking Research and PBR parameter recommendations
	Toronto Hydro Electric System Limited EB-2018-0165	Econometric benchmarking for stretch factor recommendation
	Hydro One Distribution EB-2017-0049	TFP and Benchmarking Research and PBR parameter recommendations
	Hydro Ottawa EB-2015-0004	Econometric benchmarking for stretch factor recommendation
	Toronto Hydro Electric System Limited EB-2014-0116	Econometric benchmarking for stretch factor recommendation
	Coalition of Large Distributors EB-2010-0379	PBR plan recommendations, TFP and benchmarking research
	Ameren Illinois No. 09-0306 No. 09-0307 No. 09-0308	Econometric Benchmarking

SECTION 5:

SPECIFIC EXPERIENCE WITH NATIONAL GRID (MA)

- Concentric prepared two marginal cost studies, as well as accompanying testimony and supporting schedules for the National Grid Gas MA rate proceeding filed in 2017 for Boston Gas Company and Colonial Gas Company. Concentric also provided ongoing support throughout the rate case including responses to discovery requests and testifying at hearing. (2016-2018)
- Concentric provided expert testimony and other rate case advisory services, including responses to discovery questions, and testifying at hearing in support of Boston Gas Company and Colonial Gas Company revenue requirements in the Company's 2017 rate case. (2017-2018)
- Concentric performed an audit on behalf of the MA AG and the MADPU of National Grid's annual filing under its capital investment cost recovery mechanism. The audit scope included a review of the Company's policies and procedures in place related to the recording of and internal controls related to capital expenditures; the appropriateness of the company's reliance on information systems for the purposes of storing, tracking, and reporting information; the reasonableness of the Company's data extraction process; and, based on a sample of tested transactions, whether the Company's filing was supported by underlying documentation. (2014-2015)
- Concentric reviewed Boston, Colonial, and Essex Gas Companies' revenue requirements schedules and testimony for the National Grid 2010 gas rate case. (2010)
- Concentric prepared allocated and marginal cost studies and rate design for National Grid Massachusetts gas companies. Concentric's work included providing expert testimony, and related rate case support, in a rate case filed in 2010. (2010)
- Concentric provided rebuttal testimony on behalf of National Grid in a filing to obtain approval from the Department of Public Utilities for the Company's proposed base-rate increase and revenue decoupling ratemaking plan. (2009)
- Concentric provided rebuttal testimony in a filing to obtain pre-approval from the Department of Public Utilities of a range of cost estimates for a proposal to construct, own and operate approximately five megawatts of solar generation on five separate properties owned by National Grid or its affiliated companies in Massachusetts. (2009)

SECTION 6:

SPECIFIC EXPERIENCE WITH THE MADPU

Concentric consultants also have extensive experience and strong relationships with the MADPU. We have provided expert testimony before the MADPU on over 80 occasions, and we are accepted as knowledgeable, trustworthy experts in Department proceedings. A sample of recent Concentric projects for Massachusetts utilities (other than National Grid) is provided below:

Berkshire Gas Company

- For Berkshire's 2018 rate case, Concentric prepared and submitted pre-filed testimony regarding revenue requirements, allocated cost of service study, marginal cost of service study, rate design, decoupling, and an alternative rate mechanism. (D.P.U. 18-40)
- Concentric prepared and testified in support of Berkshire's 2018, 2016, 2014, 2012 and 2010 Forecast and Supply Plans.

Fitchburg Gas & Electric ("FG&E")

- For FG&E's Grid Modernization Plan, Concentric prepared estimates of economic benefits associated with investments in Advanced Metering Infrastructure. Concentric also prepared rate related analyses and calculations for FG&E's Short-Term Investment Plan.
- Concentric prepared and testified in support of FG&E's proposed electric and gas decoupling mechanisms and capital spending tracker mechanisms in the company's 2010 rate cases.
- Concentric prepared FG&E's 2008 Forecast and Supply Plan, which was filed with the MADPU in September 2008, and provided consulting and advisory assistance related to the preparation of FG&E's 2010 Forecast and Supply Plan that was filed November 2010.

Massachusetts Consortium of Gas and Electric Utilities

- Concentric filed comments on behalf of a group of Massachusetts electric and gas utilities and participated in three panel discussions in a generic investigation into decoupling opened by the Department in June 2007.

New England Gas

- Concentric developed allocated cost studies, marginal cost of service studies, weather normalized billing determinants, proposed rates, and prepared supporting testimony for (1) a general rate case that was settled in 2007 (D.P.U. 07-46); (2) a rate case that was filed with the MADPU in July 2008 (D.P.U. 08-35); and (3) a rate case that was filed with the MADPU in September 2010 (D.P.U. 10-114).
- Concentric testified before the MADPU in support of the 2012, 2010, and 2008 Forecast and Supply Plans that Concentric prepared for New England Gas.

SECTION 7:

METHODOLOGY

Concentric understands that the Company is seeking a consultant to complete the following tasks. For each numbered task below, we have identified which member of the team will be responsible for the task, as well as a discussion of how we will fulfill the requirement.

1. ***Discuss overall rate case strategy with the Company*** *to understand any potential PBR implications of different rate case elements.*

   Responsible Team Member(s): Jim Coyne, Steve Fenrick, Gregg Therrien

   Approach: Kick-off meeting (likely via videoconference) to discuss over-arching goals of the case, main themes, and how the PBR plan will be reflected in National Grid's policy testimony. Adjust the PBR and TFP study work plans depending on case-specific conditions.

2. ***Prepare initial TFP and IP studies in accord with MADPU precedent*** *and practice as well as any alternative approaches in order to inform the Company's strategy in advance of drafting the direct testimony in support of its specific proposed "X" or productivity factor within an I-X PBR rate plan proposal. The results of such initial studies will inform further development of an I-X PBR proposal, and any responses should recognize the potential for a "no-go" decision gate, and termination of the remainder of the deliverables in this SOW.*

   Responsible Team Member(s): Steve Fenrick, Melissa Bartos

   Approach: The TFP and IP study research should be based on an external measure of the gas industry productivity and IP trends. The utility that it is being applied to should have no (or negligible) impact on the measured industry productivity trend used as the basis for the productivity offset. This is because performance-based ratemaking principles seek to decouple the link between a utility's costs to the allowed revenue (or rate) escalation. The measured productivity is sometimes referred to as total factor productivity (TFP), multi-factor productivity (MFP), or if applied only to the O&M expense portion of the revenue requirement as partial factor productivity (PFP).

   While the TFP and IP measurement should be external to the actual performance MA Gas Companies, there are several ways to conduct this external measurement. In this study we will explore and provide preliminary results to the Company for multiple methods. These include aggregation at the U.S. and the Northeast regional level, aggregation can be done by using either a summation or mean approach for whichever region is chosen. Another approach we will investigate is to use econometrics to produce a "TFP trend expectation" based on the conditions the MA Gas Companies are faced with. For example, system age, size, and expected system growth can all influence what a proper TFP expectation would be that is customized to the specific circumstances of the MA Gas Companies.

As with any model, the assumptions and calculations inputted are critical. Our team will investigate several plausible assumptions and calculation methods to determine their feasibility and appropriateness. Assumptions such as the depreciation rate for gas plant assets, cost shares between gas plant/common plant/O&M expenses, weighting methods for outputs (including non-traditional ones) and the time period used, will all be investigated in the preliminary research.

Traditional outputs for gas utilities include the number of customers served and the amount of throughput to end-use customers. Other non-traditional outputs will be investigated and considered. Our team will also investigate how best to weight these non-traditional outputs into the TFP output index. Our team has conducted and testified on similar research that combined non-traditional outputs into a TFP study in the electric distribution industry for Hydro One Networks which serves approximately 1.2 million customers in Ontario.

These preliminary results will be presented to the Company and put into the context of the I-X PBR rate proposal. Advantages and disadvantages of the results and approaches used will be detailed for each approach. The decision can then be determined if any of the presented approaches should be finalized and placed into the PBR plan.

The productivity approach used for this study will be the indexing approach. This approach is comparable to the approach the U.S. Bureau of Labor Statistics (BLS) measures economy-wide and industry-specific measures of MFP. The approach is widely used within academic studies and in PBR contexts. The BLS defines productivity in the following manner:[1]

> *"Multifactor productivity (MFP), also known as total factor productivity (TFP), is a measure of economic performance that compares the amount of goods and services produced (output) to the amount of combined inputs used to produce those goods and services."*

In the context of gas utilities, productivity is the quantity of output produced by the utility (including non-traditional outputs) divided by the input quantity resources used by the utility to provide valued outputs to customers and society. The output quantity index measures the level of output provided by the utility. The input quantity index measures the level of resources used by the utility. The research will then examine how this productivity ratio changes over time to determine the productivity index trend.

The input quantity index consists of economic resources, such as O&M labor, O&M materials, and capital stock. A Tornqvist chain index will be constructed to combine the disaggregated inputs into one comprehensive input quantity index. The weights used will be based on the cost shares of each index component in each year. The BLS also uses a Tornqvist chain index when calculating the input quantity index in their MFP studies.

The estimation of the capital stock is an important component in productivity studies. A capital service flow perspective of capital will be used that is somewhat analogous to how the

[1] https://www.bls.gov/mfp/#technotes

rate base is incorporated into the utility's revenue requirement. An industry assumption on the rate of return and depreciation rate will be used and applied to the entire sample to determine the capital costs. A geometric decay assumption on depreciation and the perpetual inventory method of estimating the capital stock will be employed.

The productivity trend is the difference between the annual growth rate in the output quantity index and the input quantity index.

$$TFP\ trend = Output\ Quantity\ trend - Input\ Quantity\ trend$$

Industry input price (IP) differentials also play an important part in the escalation formula. Determining a fair IP differential based on examining the specific industry factors that influence a gas utility's input prices and comparing that to the macroeconomic index used in the formula is an important process. Consistent methods should be employed for both the productivity measurement and the IP differential. If not, the study will not be defensible based on violating the underlying mathematical basis of the formula. We will examine the spectrum of possible input price indexes and determine the most appropriate indexes to use in determining the IP differential (and to be used as calculations in the productivity trend research). Data sources such as Handy-Whitman indexes, producer price indexes, BLS employment cost indexes, and other appropriate price indexes will be examined.

3. ***PBR Plan/ Study Support Direct Testimony*** - *Prepare the Company's TFP study and all related and supporting workpapers in compliance with MADPU precedent. Prepare direct testimony on all elements of the studies, their methodologies, sources of data, and comparison to other recent studies on the record in MA, including two drafts and rounds of review with the Company. Testimony will provide expert opinion on the overall development of the productivity factor, and its interaction with the intent of the PBR framework proposed. This pre-filed direct testimony will address typical analyses and issues with such productivity factors. The consultant's work should address the MADPU's directive in its order in D.P.U. 17-05 that "[g]oing forward, any distribution company conducting a TFP study should consider and present data regarding alternative or non-traditional output measures that are designed to capture all of the products and services it provides." (pp. 388-389)*

   Responsible Team Member(s): Steve Fenrick

   Approach: Based on the decisions made in Deliverable #2, our team will draft testimony and provide supporting workpapers in compliance with MADPU precedent. The testimony will cover all elements of the TFP and IP studies, our methodology, data sources, and comparisons to other recent studies on the record in MA. Two rounds of review with the Company on the testimony are planned. The testimony will provide our expert opinion on the most appropriate productivity and IP differentials to be inserted into the PBR framework. An overview of the implications of the opinion on the framework will be discussed. Furthermore, we will address the MADPU directive on the consideration of alternative or

non-traditional output measures. The testimony in this matter will be influenced by the decisions made in Deliverable #2.

Traditional outputs for gas utilities include the number of customers served and the amount of throughput to end-use customers. In accordance with the MADPU's *Eversource* decision, other non-traditional outputs (e.g., reduced greenhouse gas emissions) will be investigated and considered. Our team will also investigate how best to weigh these non-traditional outputs into the TFP output index. Our team has conducted and testified on similar research that combined non-traditional outputs into a TFP study in the electric distribution industry for Hydro One Networks which serves approximately 1.2 million customers in Ontario.

These preliminary results will be presented to the Company and placed in the context of the I-X PBR rate proposal. Advantages and disadvantages of the results and approaches used will be detailed for each approach. The decision can then be determined if any of the presented approaches should be finalized and placed into the PBR plan.

4. ***Additional PBR Proposal Components*** *– The Company is exploring certain additional aspects of an I-X PBR plan, including the continuance of the Gas System Enhancement Plan, or GSEP, which allows for timely recovery of investment related to leak prone infrastructure. The Company may also propose other pass through items such as pilot programs to decarbonize the gas network, such as a local renewable natural gas (RNG) procurement program and conducting studies and developing demonstration projects that assess the integration of hydrogen. In addition, the Company wishes to consider some form of efficiency carry-over mechanism as part of its PBR plan. The consultant shall provide guidance and support to the Company for developing such capital recovery and efficiency carry-over mechanisms and provide testimony to propose such mechanism to the MADPU, along with all work papers and methodologies and full explanation of its interaction with the other aspects of the PBR plan being proposed.*

   Responsible Team Member(s): Melissa Bartos, Gregg Therrien

   Approach: Analyze the Company's GSEP capital expenditure plan, annual trends in GSEP deployment (e.g., cost per mile of main, etc.), and any additional incremental capital projects. In addition, review the Company's proposed pass through items, such as RNG pilot programs and hydrogen demonstration projects and determine appropriate treatment in the PBR proposal. Determine if a "K-Factor" adjustment is warranted and, if so, propose a calculation compatible with the Company's proposal and MADPU precedent.

5. ***Benchmarking Study*** *– Prepare a benchmarking study of the Company compared to peers in order to provide supporting evidence for the company's PBR proposal and recommend any potential adjustments as a Consumer Dividend or "stretch factor" to the recommended X factor from the TFP and IP study conclusions. Such benchmarking study should be proposed as both a unit cost and TFP ranking assessment, and as an econometric study.*

   Responsible Team Member(s): Melissa Bartos, Meredith Stone, and Steve Fenrick

Approach: The stretch factor also is a prevalent feature of the escalation formula. Oftentimes, this is calibrated by estimating the relative cost efficiency of the company to the industry through a cost benchmarking study. The logic being that if the utility already has strong cost efficiency, then it should not be expected to exceed the measured industry productivity trend by a large amount or should even be expected to be below the industry productivity trend (i.e., negative stretch factor). On the other hand, if the utility has poor cost efficiency relative to the industry, then the utility should be expected to exceed the measured industry productivity trend.

We propose to use a cost benchmarking study of the gas utility industry to ascertain the relative cost efficiency of the MA Gas Companies. Similar to the TFP and IP study approach, we propose to conduct both the econometric benchmarking approach and peer group/unit cost benchmarking on a preliminary basis. Both approaches are popular in North American utility regulation. Our team has utilized both approaches in the regulatory arena and each has its own advantages. We will discuss the results with the Company and the specific advantages and disadvantages of each approach to determine the most appropriate method to move forward to testimony with. Further, multiple approaches and results to each approach will be investigated and reported to the Company.

The peer group approach to benchmarking is more understandable and straightforward than the econometric approach. However, it does have the downside of requiring a somewhat arbitrary and possibly imprecise decision on the most appropriate peer group. The econometric benchmarking method has the advantages of including and adjusting for more variables that may influence cost levels. Regarding the MA Gas Companies the approach can help control the analysis for higher wage and input price levels, frost depth and other weather conditions, age of pipes, etc.

For these reasons, we propose to produce both peer group and econometric benchmarking results for the Company to examine.

The general approach of the peer group benchmarking analysis is as follows:

a. Determine and test for an appropriate peer group candidate list based on the similarities of the MA Gas Companies to other gas utilities based on key cost drivers such as number of customers served, throughput sales, regional input price levels, utility type, etc.

b. Assemble the historical costs of the peer group, along with the specific data for the cost drivers.

c. Divide the costs of each utility to the determined cost drivers (or combined output index of the cost drivers).

d. Compare MA Gas Companies unit cost ratios to the peer group. A comparison to the mean values and quartile rankings can be produced.

The general approach of the econometric benchmarking analysis is as follows:

a. Assemble the historical costs of all utilities in the dataset, along with the variables that affect cost, such as number of customers served, throughput sales, length and size of pipes, input price levels, weather conditions, customer density, etc.

b. Using the historical data estimate an econometric model that expresses the relationship between the variables and cost.

c. Produce a "benchmark" value for MA Gas Companies in each year of the sample. The benchmark values are determined from the model, using the specific variable values for a given year. In MA Gas Companies' case, the benchmark represents the total cost amount expected for an average-performing utility with the same variable values faced by the MA Gas Companies.

d. We then compare the total costs that are expected (predicted) by the model to the MA Gas Companies' actual historical costs, which allows us to: (1) evaluate the historical cost performance, and (2) recommend a stretch factor.

6. ***PBR Policy Testimony*** *– In addition to the scope elements above, prepare testimony in support of the merits of the Company's PBR proposal in light of such factors as: core economic rationales for PBR and general benefits to customers from PBR; specific financial incentive properties of the Company's PBR proposal and the anticipated benefits for customers; consistency of the Company's PBR proposal with MADPU precedent, Commonwealth energy policy goals; broad utility industry trends and developments in PBR, including evolution of PBR in Canada and elsewhere. Explain why the Company's proposal better aligns the interests of customers, regulators/policymakers, and shareholders.*

   Responsible Team Member(s): Jim Coyne

   Approach: Concentric will leverage the team's past PBR experience, testimony, and personal insights gained through involvement in numerous cases in the U.S. and Canada. We understand that the MADPU will evaluate the Company's proposal according to the following criteria for determination of a "well-designed incentive proposal"[2]

   a. Comply with Department regulations, unless accompanied by a request for a specific waiver

   b. Be designed to serve as a vehicle to a more competitive environment and to improve the provision of monopoly services

   c. Not result in reductions of safety, service reliability, or existing standards of customer service

   d. Not focus excessively on cost recovery issues

   e. Focus on comprehensive results;

[2] D.P.U. 17-05, at 373 (the *Eversource* Order)

f. Be designed to achieve specific, measurable results; and

g. Provide a more efficient regulatory approach, thus reducing regulatory and administrative costs.

PBR has a long-standing history in Massachusetts. In the late 1990's the then Massachusetts Department of Telecommunications and Energy (DTE) encouraged PBR as a means of incenting operational efficiencies through the various mergers occurring post-electric restructuring in the state. The premise of PBR is that utility revenues are no longer tied to the cost of providing utility service, but rather to more independent measures. Historically, the most common form of PBR has been variations on the price cap and indexing where annual revenue requirements are a function of inflation (I) less a productivity factor (X), usually referred to "I-X." More recently, other variations of this have arisen through multi-year rate plans where utilities are given annual benchmarks derived through formulae or otherwise. There are also numerous ways to overlay incentive mechanisms on standard or alternative traditional ratemaking models.

Advantages of PBR is that it is typically tied to a rate plan with a prescribed period of time for the utility to "stay out" before seeking further rate relief. The structure of annual rate changes using I-X provides potential rate relief to the utility during the stay out period, thus enabling further capital investments while also providing an opportunity for the utility to maintain or increase its earnings through operational efficiencies realized during the rate plan. The stay out also helps avoid costly rate proceedings. Most PBR rate plans include SQMs, thus ensuring service quality to customers does not diminish during the term of the rate plan.

Disadvantages of PBR is that they tend to get complicated. The I-X formula often includes other components, such as a "Z factor," designed to protect both the utility and ratepayers from exogenous events. A periodic, robust compliance filing can help alleviate regulator concerns over the perceived lack of transparency that PBR may have compared to traditional cost of service ratemaking.

The objective of the policy testimony will be to effectively respond to these criteria in terms of the specific elements of the proposed rate plan and the Company's circumstances. This testimony will also address broader industry trends affecting productivity and decisions in other jurisdictions that reflect the evolution of PBR plans for North American utilities. This evolution has also been required to respond to legislative initiatives designed to address climate change and promote a clean energy economy through energy efficiency, demand response, distributed energy resources, and the procurement of renewable energy. While the focus of these initiatives has often been more on electric utilities, gas companies are increasingly under pressure to deliver a cleaner environmental solution for their customers.

Concentric will carefully review the precedents for approval established by the D.P.U. in the Eversource[3] and National Grid[4] orders and present the Company's proposed plan in light of

[3] D.P.U. 17-05 (*Eversource* Order)
[4] D.P.U. 18-150 (*National Grid* Order)

these standards, while also reflecting the unique circumstances of the Company's gas business and the results of the TFP and benchmarking studies which will incorporate more recent industry data.

7. ***Prepare rebuttal testimony supporting the productivity factors and overall study results and PBR pla****n (and any other issues stemming from the scope of work above), and all related and supporting exhibits and work papers.*

   Responsible Team Member(s): Jim Coyne, Steve Fenrick

   Approach: Concentric is familiar with the intervenors and witnesses likely to respond to the Company's proposal, and the concerns expressed in other proceedings before the MADPU. The development of effective rebuttal testimony requires a careful assessment of claims and analysis submitted by opposing witnesses, and a tactful response highlighting the key areas of divergence while defending the Company's proposal and pointing out any weaknesses or errors in proposed alternatives. Supporting analysis is also effective in rebuttal to illustrate the practical effects of counter proposals.

8. ***Prepare responses to interrogatories and data requests*** *from the staff of the MADPU and interveners on the studies, productivity factor, precedent of I-X in MA, and any new or innovative elements being proposed.*

   Responsible Team Member(s): Gregg Therrien, Meredith Stone (and other team members as necessary)

   Approach: Provide accurate and persuasive responses to data requests.

9. ***Testify as an expert witness*** *on the testimony, exhibits, and work papers and related issues in evidentiary hearings before the MADPU.*

   Responsible Team Member(s): Jim Coyne, Steve Fenrick

   Approach: Both Messrs. Coyne and Fenrick are highly experienced expert witnesses.

10. ***Assist the Company in drafting sections of its initial and reply briefs*** *on the productivity factor studies and other elements of the PBR plan.*

    Responsible Team Member(s): Jim Coyne, Steve Fenrick, Gregg Therrien

    Approach: Assist legal counsel with technical assessments and ratemaking arguments.

11. ***Provide ad-hoc support*** *for possible settlement negotiations.*

    Responsible Team Member(s): Jim Coyne, Steve Fenrick, Gregg Therrien

    Approach: Assist with technical calculations, assessments, etc. as needed.

REDACTED

SECTION 8:

BUDGET & SCHEDULE

[redacted]

[redacted]

Concentric is prepared to start work on this project in June 2020, and to complete all exhibits and testimony related to the PBR plan and supporting studies by October 9 to meet the planned filing date of November 13, 2020.

[redacted]

REDACTED

CONFIDENTIAL

SECTION 9:

CONFLICT OF INTEREST

Concentric has no conflicts of interest to disclose related to this engagement.

ATTACHMENT A:

RESUMES OF PROPOSED PROJECT TEAM

On the following pages, please find resumes for the individuals listed below:

- James M. Coyne
- Melissa Bartos
- Gregg Therrien
- Meredith Stone
- Steve Fenrick

JAMES M. COYNE
Senior Vice President

Mr. Coyne provides financial, regulatory, strategic, and litigation support services to clients in the natural gas, power, and utilities industries. Drawing upon his industry and regulatory expertise, he regularly advises utilities, public agencies and investors on business strategies, investment evaluations, and matters pertaining to rate and regulatory policy. Prior to Concentric, Mr. Coyne worked in senior consulting positions focused on North American utilities industries, in corporate planning for an integrated energy company, and in regulatory and policy positions in Maine and Massachusetts. He has authored numerous articles on the energy industry and provided testimony and expert reports before the Federal Energy Regulatory Commission and numerous jurisdictions in the U.S. and Canada. Mr. Coyne holds a B.S. in Business from Georgetown University with honors and an M.S. in Resource Economics from the University of New Hampshire.

AREAS OF EXPERTISE

Energy Regulation

- Rate policy
- Cost of capital
- Incentive regulation
- Fuels and power markets

Management and Business Strategy

- Fuels and power market assessments
- Investment feasibility
- Corporate and business unit planning
- Benchmarking and productivity analysis

Financial and Economic Advisory

- Valuation analysis
- Due diligence
- Buy and sell-side advisory

Litigation Support and Expert Testimony

- Rate and regulatory policy
- Fuels and power markets
- Contract litigation
- Valuation and damages

REDACTED

PROFESSIONAL HISTORY

Concentric Energy Advisors, Inc. (2006 – Present)
Senior Vice President
Vice President

FTI Consulting (Lexecon) (2002 – 2006)
Senior Managing Director – Energy Practice

Arthur Andersen LLP (2000 – 2002)
Managing Director, Andersen Corporate Finance – Energy and Utilities

Navigant Consulting, Inc. (1996 – 2000)
Managing Director, Financial Services Practice
Senior Vice President, Strategy Practice

TotalFinaElf (1990 – 1996)
Manager, Corporate Planning and Development
Manager, Investor Relations
Manager of Strategic Planning and Vice President, Natural Gas Division

Arthur D. Little, Inc. (1989 – 1990)
Senior Consultant – International Energy Practice

DRI/McGraw-Hill (1984 – 1989)
Director, North American Natural Gas Consulting
Senior Economist, U.S. Electricity Service

Massachusetts Energy Facilities Siting Council (1982 – 1984)
Senior Economist – Gas and Electric Utilities

Maine Office of Energy Resources (1981 – 1982)
State Energy Economist

EDUCATION

University of New Hampshire
M.S., Resource Economics, *with honors*, 1981

Georgetown University
B.S., Business Administration and Economics, *cum laude*, 1975

DESIGNATIONS AND AFFILIATIONS

Community Rowing Inc., Board of Directors, 2015 - 2019

Georgetown University, Alumni Admissions Interviewer, 1988 – current

NASD General Securities Representative and Managing Principal (Series 7, 63 and 24 Certifications), 2001

American Petroleum Institute, CEO's Liaison to Management and Policy Committees, 1994-1996

National Petroleum Council, Regulatory and Policy Task Forces, 1992

President, International Association for Energy Economics, Dallas Chapter, 1995

Gas Research Institute, Economics Advisory Committee, 1990-1993

NARUC, Advanced Regulatory Studies Program, Michigan State University, 1984

PUBLICATIONS AND RESEARCH

"Regulator Rationale for Ratepayer-Funded Electricity and Natural Gas Innovation", James M. Coyne, Robert C. Yardley, Jr. and Jessalyn G. Pryciak, Energy Regulation Quarterly, Volume 6, Issue 3, 2018.

"Stimulating Innovation on Behalf of Canada's Electricity and Natural Gas Consumers" (with Robert Yardley), prepared for the Canadian Gas Association and Canadian Electricity Association, May 2015.

"Autopilot Error: Why Similar U.S. and Canadian Risk Profiles Yield Varied Rate-making Results" (with John Trogonoski), Public Utilities Fortnightly, May 2010

"A Comparative Analysis of Return on Equity of Natural Gas Utilities" (with Dan Dane and Julie Lieberman), prepared for the Ontario Energy Board, June 2007

"Do Utilities Mergers Deliver?" (with Prescott Hartshorne), Public Utilities Fortnightly, June 2006

"Winners and Losers: Utility Strategy and Shareholder Return" (with Prescott Hartshorne), Public Utilities Fortnightly, October 2004

"Winners and Losers in Restructuring: Assessing Electric and Gas Company Financial Performance" (with Prescott Hartshorne), white paper distributed to clients and press, August 2003

"The New Generation Business," commissioned by the Electric Power Research Institute (EPRI) and distributed to EPRI members to contribute to a series on the changes in the Power Industry, December 2001

Potential for Natural Gas in the United States, Volume V, Regulatory and Policy Issues (co-author), National Petroleum Council, December 1992

"Natural Gas Outlook," articles on U.S. natural gas markets, published quarterly in the Data Resources Energy Review and Natural Gas Review, 1984-1989

SELECTED SPEAKING ENGAGEMENTS

"Energy Sector in Transition", Ontario Energy Association, Toronto, ON, September 24, 2018.

"Understanding Regulated Utilities in Today's Capital Markets", NARUC Annual Meeting, La Quinta, CA, November 14, 2016.

"Rate of Return: Where the Regulatory Rubber Meets the Road," CAMPUT Annual Conference, Montreal, Quebec, May 17, 2016.

"Innovations in Utility Business Models and Regulation", The Canadian Association of Members of Public Utility Tribunals (CAMPUT) 2015 Energy Regulation Course, Queens University, Kingston, Ontario, June 2015

"M&A and Valuations," Panelist at Infocast Utility Scale Solar Summit, September 2010

"The Use of Expert Evidence," The Canadian Association of Members of Public Utility Tribunals (CAMPUT) 2010 Energy Regulation Course, Queens University, Kingston, Ontario, June 2010

"A Comparative Analysis of Return on Equity for Utilities in Canada and the U.S.", The Canadian Association of Members of Public Utility Tribunals (CAMPUT) Annual Conference, Banff, Alberta, April 22, 2008

"Nuclear Power on the Verge of a New Era," moderator for a client event co-hosted by Sutherland Asbill & Brennan and Lexecon, Washington D.C., October 2005

"The Investment Implications of the Repeal of PUCHA," Skadden Arps Client Conference, New York, NY, October 2005

"Anatomy of the Deal," First Annual Energy Transactions Conference, Newport, RI, May 2005

"The Outlook for Wind Power," Skadden Arps Annual Energy and Project Finance Seminar, Naples, FL, March 2005

"Direction of U.S. M&A Activity for Utilities," Energy and Mineral Law Foundation Conference, Sanibel Island, FL, February 2002

"Outlook for U.S. Merger & Acquisition Activity," Utility Mergers & Acquisitions Conference, San Antonio, TX, October 2001

"Investor Perspectives on Emerging Energy Companies," Panel Moderator at Energy Venture Conference, Boston, MA, June 2001

"Electric Generation Asset Transactions: A Practical Guide," workshop conducted at the 1999 Thai Electricity and Gas Investment Briefing, Bangkok, Thailand, July 1999

"New Strategic Options for the Power Sector," Electric Utility Business Environment Conference, Denver, CO, May 1999

"Electric and Gas Industries: Moving Forward Together," New England Gas Association Annual Meeting, November 1998

"Opportunities and Challenges in the Electric Marketplace," Electric Power Research Institute, July 1998

SPONSOR	DATE	CASE/APPLICANT	DOCKET	SUBJECT
Alberta Beverage Container Management Board				
Alberta Beverage Container Management Board	2016 2019	Expert for the Board	N/A	Return Margin on Bottle Depots
Alberta Utilities Commission				
ATCO Utilities Group	2008 2009	ATCO Gas; ATCO Pipelines Ltd.; ATCO Electric Ltd.	Application No. 1578571 / Proceeding ID. 85	2009 Generic Cost of Capital Proceeding (Gas & Electric)
Enmax Power Corporation	2017	Enmax	22570	Cost of Common Equity
Enmax Power Corporation	2020	Enmax	24110	2021 Generic Cost of Capital
American Arbitration Association				
TransCanada Corporation	2004	TransCanada Corporation	AAA Case No. 50T 1810018804	Valuation of Natural Gas Pipeline
British Columbia Utilities Commission				
FortisBC	2012	FortisBC Utilities	G-20-12	Cost of Capital Adjustment Mechanisms
FortisBC	2015 2016	FortisBC Utilities	Project 3698852	Cost of Capital (Gas and Electric Distribution)
California Utilities Commission				
San Diego Gas & Electric Company	2019	San Diego Gas & Electric Company	A-19-04-014	Cost of Capital (Gas Distribution)
Connecticut Department of Public Utility Control				
Aquarion Water Company of CT/ Macquarie Securities	2007	Aquarion Water Company of CT	DPUC Docket No. 07-05-19	Return on Equity (Water)
Federal Energy Regulatory Commission				
Atlantic Power Corporation	2007	Atlantic Path 15, LLC	ER08-374-000	Return on Equity (Electric)
Atlantic Power Corporation	2010	Atlantic Path 15, LLC	Docket No. ER11-2909-000	Return on Equity (Electric)
Atlantic Power Corporation	2011	Atlantic Path 15, LLC	Docket Nos. ER11-2909 and EL11-29	Rate of Return (Electric Transmission)
Startrans IO, LLC	2012	Startrans IO, LLC	ER-13-272-000	Cost of Capital (Electric Transmission)
Startrans IO, LLC	2015	Startran IO, LLC	ER-16-194-000 and EL16-25-000	Cost of Capital (Electric Transmission)
Northern States Power Company	2019	Northern States Power Company	ER20-26-000	Cost of Capital (Electric Transmission)

SPONSOR	DATE	CASE/APPLICANT	DOCKET	SUBJECT
Hawaii Public Utility Commission				
The Gas Company	2017	The Gas Company	Docket No. 2017-0105	Cost of Capital (Gas Distribution)
Maine Public Utilities Commission				
Bangor Hydro Electric Company	1998	Bangor Hydro Electric Company	MPUC Docket No. 98-820	Transaction-Related Financial Advisory Services, Valuation
Central Maine Power Company	2007	Central Maine Power Company	MPUC Docket No. 2007-215	Sales Forecast
Enmax Corporation	2019	Enmax Corporation	2019-00097	Regulatory Approval of Emera Maine Acquisition
Maryland State Board of Contract Appeals				
Green Planet Power Solutions	2018	Green Planet Power Solutions and Maryland Bio Eneregy LLC v. Maryland Department of General Services	MSBCA 3061	Contract Litigation, Power Purchase Agreement, Damages Analysis
Massachusetts Superior Court				
Burncoat Pond Watershed District	2010	Central Water District v. Burncoat Pond Watershed District	WDCV 2001-0105	Valuation/Eminent Domain
Minnesota Public Utilities Commission				
Northern States Power Company	2015 2016	Northern States Power Company	E-002-GR-15-826	Cost of Capital (Electric)
Northern States Power Company	2017	Northern States Power Company	E002/M-17-797 G002/M-17-787 E002/M-17-818	Cost of Capital (Electric and Gas Rate Riders for Transmission, Renewable Generation and Gas Distribution)
Newfoundland and Labrador Board of Commissioners of Public Utilities				
Newfoundland Power	2016	Newfoundland Power	2016 GRA	Cost of Capital (Electric)
Newfoundland Power	2018	Newfoundland Power	2018 GRA	Cost of Capital (Electric)

SPONSOR	DATE	CASE/APPLICANT	DOCKET	SUBJECT
New Jersey Board of Public Utilities				
Conectiv	2000-2001	Atlantic City Electric Company	NJBPU Docket No. EM00020106	Transaction-Related Financial Advisory Services
Nova Scotia Utility and Review Board				
Nova Scotia Power Inc.	2012	Nova Scotia Power Inc.	2013 GRA	Return on Equity/Business Risk (Electric)
Ontario Energy Board				
Enbridge Gas Distribution and Hydro One Networks and the Coalition of Large Distributors	2009	Enbridge Gas Distribution and Hydro One Networks and the Coalition of Large Distributors	EB-2009-0084	Ontario Energy Board's 2009 Consultative Process on Cost of Capital Review (Gas & Electric)
Enbridge Gas Distribution	2012	Enbridge Gas Distribution	EB-2011-0354	Industry Benchmarking Study and Cost of Capital (Gas Distribution)
Enbridge Gas Distribution	2014	Enbridge Gas Distribution	EB-2012-0459	Incentive Regulation Plan and Industry Productivity Study
Ontario Power Generation	2016	Ontario Power Generation	EB-2016-0152	Cost of Capital (Electric Generation)
Prince Edward Island Regulatory and Appeals Commission				
Maritime Electric Company	2015	Maritime Electric Company	UE20942	Return on Capital (Electric)
Régie de l'énergie du Québec				
Gaz Métro	2012	Gaz Métro	R-3809-2012	Return on Equity/Business Risk/ Capital Structure (Gas Distribution)
Hydro-Québec Distribution and Hydro- Québec TransÉnergie	2013	Hydro-Québec Distribution and Hydro- Québec TransÉnergie	R-3842-2013	Return on Equity/Business Risk (Electric)
Hydro-Québec Distribution	2014	Hydro-Québec Distribution	R-3905-2014	Remuneration of Deferral Accounts
Hydro-Québec Distribution and Hydro- Québec TransÉnergie	2015-2017	Hydro-Québec Distribution and Hydro- Québec TransÉnergie	R-3897-2014	Performance-Based Ratemaking
South Dakota Public Service Commission				
Northern States Power Company-MN	2012	Northern States Power Company-MN	EL 11-019	Return on Equity

SPONSOR	DATE	CASE/APPLICANT	DOCKET	SUBJECT
Texas Public Utility Commission				
Texas New Mexico Power Company	2004	Texas New Mexico Power Company	PUC Docket No. 29206	Auction Process and Stranded Cost Recovery
U.S. Department of Commerce				
Government of Québec	2017	Duty Investigation of Uncoated Groundwood Paper from Canada	PUC Docket No. 29206	Contracting for Renewable Resources, Market Analysis, Damages Analysis
Vermont Public Service Board				
Vermont Gas Systems, Inc.	2006	Vermont Gas Systems, Inc.	VPSB Docket No. 7109	Models of Incentive Regulation
Vermont Gas Systems, Inc.	2012	Vermont Gas Systems, Inc.	Docket No. 7803A	Cost of Capital (Gas Distribution)
Green Mountain Power Corporation	2013	Green Mountain Power Corporation	Docket No. 8191	Return on Equity (Electric)
Vermont Gas Systems, Inc.	2016	Vermont Gas Systems, Inc.	Docket No. 8698/8710	Return on Equity (Gas Distribution)
Green Mountain Power Corporation	2017	Green Mountain Power Corporation	Docket No. Tariff-8677	Return on Equity (Electric)
Green Mountain Power Corporation	2018	Green Mountain Power Corporation	18-0974	Return on Equity (Electric)
Wisconsin Public Service Commission				
Wisconsin Power and Light Company	2007	Wisconsin Power and Light Company	PSCW Docket No. 6680-CE-170	Return on Equity (Electric)
Wisconsin Power and Light Company	2007	Wisconsin Power and Light Company	PSCW Docket No. 6680-CE-171	Return on Equity (Electric)
Northern States Power Company	2011	Northern States Power Company	PSCW Docket No. 4220-UR-117	Return on Equity (Electric)
Northern States Power Company	2013	Northern States Power Company	PSCW Docket No. 4220-UR-119	Return on Equity (Gas & Electric)
Northern States Power Company	2015	Northern States Power Company	PSCW Docket No. 4220-UR-121	Return on Equity (Gas & Electric)
Northern States Power Company	2017 2019	Northern States Power Company	PSCW Docket No. 4220-UR-123, 4220-UR-124	Return on Equity (Gas & Electric)
Yukon Utilities Board				
ATCO Electric Yukon	2016	ATCO Electric Yukon	2016-2017 GRA	Return on Equity (Electric)

MELISSA F. BARTOS
Vice President

Ms. Bartos is a financial and economic consultant with more than twenty years of experience in the energy industry. In the last several years, she has focused on natural gas markets issues, including conducting comprehensive market assessments for various clients considering infrastructure investments and developing detailed demand forecasts for a number of gas distribution companies. Ms. Bartos has also designed, built, and enhanced numerous financial and statistical models to support clients in asset-based transactions, energy contract negotiations, reliability studies, asset and business valuations, rate and regulatory matters, cost-of-service analysis, and risk management. Her modeling experience includes building Monte-Carlo simulation models, designing an allocated cost-of-service model, statistical modeling using SPSS, and programming using Visual Basic for Applications (VBA). Ms. Bartos has also provided expert testimony on multiple occasions regarding natural gas demand forecasting and supply planning issues, natural gas markets and marginal cost studies.

REPRESENTATIVE PROJECT EXPERIENCE

Natural Gas Market Assessments

- Reviewed and evaluated long-term natural gas supply and demand, existing natural gas pricing dynamics, and future implications associated with new natural gas infrastructure in New England, New York, and New Jersey.
- Provided an analysis of the existing Gulf Coast natural gas market, the client's natural gas pipeline competitors, changing flows, and how those factors may affect transportation values to the client going forward.
- Prepared a comprehensive study examining the costs associated with improving natural gas pipeline access from western Canada and the eastern U.S. to Atlantic Canada.
- Produced a report on the benefits associated with incremental natural gas supplies delivered to New York City.
- Prepared an independent natural gas supply and pipeline transportation route assessment associated with natural gas for the client's proposed LNG export terminal.

Natural Gas Expansion

- Conducted a study that examined potential commercial and industrial conversions from oil-based fuels to natural gas in various east coast U.S. markets.
- Produced a report that identified growth potential in off-system stationary and mobile markets in the mid-west that could be served by compressed natural gas or liquefied natural gas.
- Performed an external audit and filed expert testimony associated with two natural gas utilities' hurdle rate/contribution in aid of construction calculations for new off main customers.

- Produced a report that identified and reviewed innovative cost model approaches that utilities and regulators are using across the U.S. that allow expansion of gas distributions systems to new communities.
- Assisted in developing a strategy to identify residential natural gas growth opportunities within the client's franchise area.
- Presented at two Northeast Gas Association conferences regarding "Regulatory Policy and Residential Main Extensions".

Demand Forecasting

- Filed expert testimony regarding the development of demand forecast models and the evaluation of natural gas resource plans for multiple northeast gas utilities.
- Provided litigation support regarding demand forecasting techniques with respect to certain natural gas pipeline and storage decisions for a mid-west gas utility.
- Reviewed demand forecasting practices and procedures and recommended certain changes to improve the methodology and accuracy of the forecast for a multi-state utility.
- For a mid-west gas utility, developed a natural gas demand forecast that was utilized for supply and capacity decisions.

Ratemaking and Utility Regulation

- Participated in the rate case of a large North American gas distribution company, which determined the client's five-year incentive regulation plan, including performing benchmarking and productivity analyses that were filed with the regulator.
- Developed a marginal cost study, including data collection, analysis and testimony development, in support of rate case filings for a number of New England utilities.
- Provided comprehensive analysis, drafted testimony and provided litigation support regarding the appropriate return on equity for a New England water utility, and for proposed wind and coal electric generation facility additions for a mid-west combination utility.
- Performed a detailed analysis of the components included in the client's lost and unaccounted for gas calculation.
- Conducted multiple natural gas portfolio asset optimization analyses to evaluate performance of the client's asset manager for regulatory purposes.
- On behalf of multiple New England gas companies, participated in the 2009 Avoided Energy Supply Cost Study Group (for New England), which worked with third-party consultants to develop the marginal energy supply costs that will be avoided due to reductions in the use of electricity, natural gas, and other fuels resulting from energy efficiency programs.
- Conducted a study to determine the cost of significantly reducing peak day natural gas demand for a northeast gas utility through energy efficiency, conservation and demand management measures. Project involved researching natural gas energy efficiency plans in multiple U.S. states and Canadian provinces, reviewing energy efficiency potential studies, and exploring geothermal, peak pricing and direct load control options.

PROFESSIONAL HISTORY

Concentric Energy Advisors, Inc. (2002 – Present)
Vice President
Assistant Vice President
Project Manager
Senior Consultant

Navigant Consulting, Inc. (1996 – 2002)
Senior Consultant

EDUCATION

University of Massachusetts at Lowell
M.S., Mathematics (Statistics), 2003

College of the Holy Cross
B.S., Mathematics and Psychology, *magna cum laude*, 1998

PROFESSIONAL ASSOCIATIONS

Member of the American Statistical Association

Member of the Northeast Energy and Commerce Association

Member of the Northeast Gas Association

SPONSOR	DATE	CASE/APPLICANT	DOCKET NO.	SUBJECT
Connecticut Public Utilities Regulatory Authority				
Connecticut Natural Gas Corporation & Southern Connecticut Gas Company	2014	Connecticut Natural Gas Corporation & Southern Connecticut Gas Company	Docket No. 13-06-02	CIAC Hurdle Rate Calculation
Federal Energy Regulatory Commission				
PennEast Pipeline Company, LLC	2015	PennEast Pipeline Company, LLC	Docket No. CP15-558	Market Conditions/Need
PennEast Pipeline Company, LLC	2016	PennEast Pipeline Company, LLC	Docket No. CP15-558	Market Conditions/Need
Millennium Pipeline Company, LLC	2017	Millennium Pipeline Company, LLC	Docket No. CP16-486	Market Conditions/Need
Laclede Gas Company	2017	Spire STL Pipeline, LLC	Docket No. CP17-40	Market Conditions/Need
Maine Public Utilities Commission				
Northern Utilities, Inc.	2011	Northern Utilities	Docket No. 2011-526	Integrated Resource Plan; Demand Forecast
Massachusetts Department of Public Utilities				
New England Gas Company	2008	New England Gas Company	D.P.U. 08-11	Integrated Resource Plan; Demand Forecast; Supply Planning
New England Gas Company	2010	New England Gas Company	D.P.U. 10-61	Integrated Resource Plan; Demand Forecast; Supply Planning
Berkshire Gas Company	2010	Berkshire Gas Company	D.P.U. 10-100	Integrated Resource Plan; Demand Forecast
New England Gas Company	2012	New England Gas Company	D.P.U. 12-41	Integrated Resource Plan; Demand Forecast; Supply Planning
Berkshire Gas Company	2012	Berkshire Gas Company	D.P.U. 12-62	Integrated Resource Plan; Demand Forecast
NSTAR Gas Company	2014	NSTAR Gas Company	D.P.U. 14-63	Integrated Resource Plan; Demand Forecast
Berkshire Gas Company	2014	Berkshire Gas Company	D.P.U. 14-98	Integrated Resource Plan; Demand Forecast

SPONSOR	DATE	CASE/APPLICANT	DOCKET NO.	SUBJECT
Liberty Utilities (New England Gas Company)	2015	Liberty Utilities (New England Gas Company)	D.P.U. 15-75	Marginal Cost of Service Study
Berkshire Gas Company	2016	Berkshire Gas Company	D.P.U. 16-103	Integrated Resource Plan; Demand Forecast
Eversource Energy	2017	Eversource Energy (NSTAR Electric and WMECO)	D.P.U. 17-05	Marginal Cost of Service Study
National Grid (Boston Gas Company and Colonial Gas Company)	2017	National Grid (Boston Gas Company and Colonial Gas Company)	D.P.U. 17-170	Marginal Cost of Service Study
Bay State Gas Company d/b/a/ Columbia Gas of Massachusetts	2018	Bay State Gas Company d/b/a/ Columbia Gas of Massachusetts	D.P.U. 18-45	Marginal Cost of Service Study
Berkshire Gas Company	2018	Berkshire Gas Company	D.P.U. 18-40	Marginal Cost of Service Study
Berkshire Gas Company	2018	Berkshire Gas Company	D.P.U. 18-107	Integrated Resource Plan; Demand Forecast
NSTAR Gas Company	2019	NSTAR Gas Company	D.P.U. 19-120	Marginal Cost of Service Study
Bay State Gas Company d/b/a Columbia Gas of Massachusetts	2019	Bay State Gas Company d/b/a Columbia Gas of Massachusetts	D.P.U. 19-135	Integrated Resource Plan; Demand Forecast
New Hampshire Public Utilities Commission				
Northern Utilities, Inc.	2011	Northern Utilities	DG 2011-290	Integrated Resource Plan; Demand Forecast
Liberty Utilities (EnergyNorth Natural Gas)	2017	Liberty Utilities (EnergyNorth Natural Gas)	DG 17-048	Marginal Cost of Service Study
Liberty Utilities (Granite State Electric)	2019	Liberty Utilities (Granite State Electric)	De 19-064	Marginal Cost of Service Study
New Jersey Board of Public Utilities				
South Jersey Gas Company	2015	South Jersey Gas Company	GR15010090	Energy Efficiency Cost Benefit Analysis
Ontario Energy Board				
Enbridge Gas Distribution	2012	Enbridge Gas Distribution	EB-2011-0354	Industry Benchmarking Study
Enbridge Gas Distribution	2013	Enbridge Gas Distribution	EB-2012-0459	Incentive Rate Making
Régie de l'énergie du Québec				

SPONSOR	DATE	CASE/APPLICANT	DOCKET NO.	SUBJECT
TransCanada Pipelines Ltd.	2014	TransCanada Pipelines Ltd.	R-3900-2014	Natural Gas Market Assessment
Washington Utilities and Transportation Commission				
Puget Sound Energy, Inc.	2015	Puget Sound Energy, Inc.	UG-151663	Distributed LNG Market Assessment

GREGG H. THERRIEN
Assistant Vice President

Gregg Therrien is a former utility Director who has held leadership positions at Connecticut Natural Gas Corporation and affiliated companies for more than 19 years. Most recently, he served as the Director, Gas Construction at Connecticut Natural Gas and The Southern Connecticut Gas Company and Director, Regulatory & Tariffs at UIL Holdings, Inc. Mr. Therrien's experience includes natural gas distribution system operations and construction practices, regulatory strategies, natural gas growth, infrastructure replacement programs, integrated resource planning and technical rate case issues such as utility cost of service, rate design, tariff writing and administration, as well as pricing, gas cost accounting, gross margin, and load forecasting for regulated utilities. Mr. Therrien has an M.B.A. from the University of Connecticut and a B.S. in Finance from Bryant University, and is also a certified Project Management Professional (PMP).

REPRESENTATIVE PROJECT EXPERIENCE

Representative responsibilities performed for Connecticut gas utilities include:

Business Strategy and Operations

- Led a newly created gas construction organization, leveraging project management practices to plan and execute a $100M annual capital budget
- Responsible for RFP development and bid selection of five-year contracts of local, regional and national gas construction and restoration contractors representing approximately 70 work crews
- Developed and implemented a tablet-based QA/QC inspection program
- Developed annual sales and revenue operating budgets
- Developed rate of return new customer acquisition model
- Led several process improvements teams
- Successfully negotiated contracts with large cogeneration users avoiding system bypass and obtaining regulatory approval
- Helped develop and refine the Company's Emergency Plan, Business Continuity Plan, and Gas Construction Standards Manual
- Participated in table-top planning exercises to simulate system disruption and restoration

Regulatory Affairs

- Led the preparation, filing, discovery and implementation of several rate cases
- Designed rates and prepared testimony, and served as the primary rate design witness
- Prepared, testified, and implemented revenue requirement rate mechanisms for new customer growth and pipeline replacement programs
- Prepared gas Integrated Resource Plans
- Prepared assessment of forecast methodology and forecast accuracy of gas demands

- Prepared validation of sales forecast and analysis of declining use per customer
- Proposed, testified, and implemented Connecticut's first gas decoupling mechanism
- Key contributor in settlement negotiations for rate cases and other litigated regulatory matters, including the LDC gas expansion plan
- Prepared testimony and exhibits for bi-annual Purchased Gas Adjustment proceedings
- Prepared testimony and new program tariffs in support of gas unbundling

Consultancy

- Regulatory risk assessments
- Gas infrastructure replacement program technical and financial analysis and testimony
- Market analysis for international clients
- M&A due diligence (regulatory)
- Electric distribution alternative rate plan analysis
- Economic Development tariff development
- Decoupling testimony assistance for a Western Gas LDC
- Decoupling and Rate Design expert witness testimony for a New England Gas LDC
- Revenue Requirements witness for an electric distribution company
- Regulatory rate strategies for a vertically-integrated electric utility
- Testified on behalf of a New England gas LDC on the subjects of decoupling, capital trackers and rate design
- Developed an Alternative Rate Plan for a New England gas LDC
- Developed a Business Continuity Plan for a New England investor-owned water utility
- Rate comparison study for the Government of Alberta, Canada
- Developed a cost of service-based pricing model for a 10MW fuel cell developer
- Power procurement consultancy for a New England investor-owned water utility

PROFESSIONAL HISTORY

Concentric Energy Advisors, Inc. (2016 – Present)
Assistant Vice President

AVANGRID and affiliated companies (2016)
Connecticut Natural Gas and The Southern Connecticut Gas Company (2014 – 2016)
Director, Gas Construction

UIL Holdings, Inc. (2010 – 2014)
Director, Regulatory & Tariffs

Iberdrola S.A. / Energy East Corporation / Connecticut Natural Gas and The Southern Connecticut Gas Company (2001 – 2010)
Director, Regulatory & Pricing / Director, Pricing & Analysis

Connecticut Natural Gas Corporation (1997 – 2001)
Manager, Pricing

United Technologies, Inc. – Pratt & Whitney
Turbo Power & Marine Systems (1996 – 1997)
Manager, Financial Planning & Analysis

Pratt & Whitney Aircraft
Business Unit Cell Leader, Overhaul & Repair / Manufacturing – turbine airfoils (1994 – 1996)
Financial Analyst, Commercial Engine Business (1987 – 1994)

EDUCATION

University of Connecticut
M.B.A., Concentration in Finance, 1993

Bryant University (College)
B.S., Finance, 1987

PROFESSIONAL AFFILIATIONS

American Gas Association
State Affairs Committee, 2001 – Present

Northeast Gas Association

Project Management Institute

CERTIFICATIONS

Certified Project Management Professional (PMP)

LEADERSHIP

Connecticut Economic Resource Center (CERC)
Member, Board of Directors 2008 – 2011
Treasurer, 2011 – 2016

Connecticut Power and Energy Society (CPES)
Executive Secretary and Director, 2018 – Present
Member, Board of Directors 2017 – 2018

AGA Executive Leadership Development Program – 2012

SPONSOR	DATE	DOCKET	SUBJECT
Connecticut Public Utilities Regulatory Authority			
NuPower, LLC	2019	Docket No. 18-08-14	Cost of Service analysis for a regulated fuel cell project
Yankee Gas Services (Eversource Energy)	2018	Docket No. 18-05-10	Distribution Rate Case Rate design, decoupling, and capital trackers
Connecticut Natural Gas Corporation & Southern Connecticut Gas Company	2016	Docket No. 16-04-10	State of Connecticut LDC Gas Expansion Plan: System Expansion Reconciliation Capital Expenditures, System Improvement/Reinforcement Projects
Connecticut Natural Gas Corporation & Southern Connecticut Gas Company	2014	Docket No. 13-06-02RE01	State of Connecticut LDC Gas Expansion Plan Settlement Agreement
Connecticut Natural Gas Corporation & Southern Connecticut Gas Company	2013	Docket No. 13-06-02	State of Connecticut LDC Gas Expansion Plan Rates, Hurdle Rate analysis, Demand forecast, Rate Mechanism
Connecticut Natural Gas Corporation	2013	Docket No. 13-06-08	Distribution Rate Case Revenue Requirements, Cost of Service, Rate Design, Demand Forecast, and Forecasted Revenues; Decoupling, DIMP and System Expansion Reconciliation Rate Mechanisms, Tariffs
The Southern Connecticut Gas Company	2013	Docket No. 99-10-25RE01	Firm Transportation Service Agreement and Gas Exchange Agreement - Review of Revenue Requirement Allocation
Connecticut Natural Gas Corporation & Southern Connecticut Gas Company	2011	Docket No. 08-12-06RE02, 08-12-07RE02	Settlement Agreement RE: Resolve Stayed Decisions and Orders from Appealed CNG and SCG Rate Cases, and resolve SCG overearnings
The Southern Connecticut Gas Company	2011	Docket No. 10-12-17	Just and Reasonable Rates – Potential Overearnings Investigation
Illinois Commerce Commission			
The Peoples Gas Light & Coke Company	2017	Docket No. 16-0376	Gas Distribution Aging Infrastructure Peer Utility Benchmark Study, Affordability
Maine Public Utilities Commission			
Emera, Maine	2017	Docket No. 2017-00198	Electric Distribution Revenue Requirements
New Hampshire Public Utilities Commission			
Liberty Utilities – New Hampshire d/b/a/ EnergyNorth Natural Gas	2017	DG 17-048	Revenue Decoupling Rate Design

MEREDITH C. STONE
Project Manager

Ms. Stone has experience providing analytical and research support on various regulatory and arbitration projects that often involve expert witness testimony. Ms. Stone has experience in multiple elements of the ratemaking process, including: Alternative regulation, targeted infrastructure replacement plans, cash working capital/lead-lag studies, revenue requirement modeling, earnings sharing and marginal cost studies. She holds a Master of Public Policy from Brown University and a B.A. in Political Science from Middlebury College.

PROFESSIONAL HISTORY

Concentric Energy Advisors, Inc. (July 2015 – Present)
Project Manager
Senior Consultant
Assistant Consultant

Policy Navigation Group (2014)
Intern

City of Everett, Massachusetts (2013)
Consultant

EDUCATION

Brown University
Master of Public Policy

Middlebury College
B.A., Political Science, cum laude

REPRESENTATIVE PROJECT EXPERIENCE

Regulatory Affairs

On behalf of electric, gas, and water utilities in North America, Ms. Stone has provided services relating to rate design. Specifically, she has:

- Researched the performance-based rate designs of electric and natural gas utilities in the US and Canada
- Developed revenue requirement models under performance-based regulation
- Developed lead-lag studies for calculation of cash working capital requirements
- Developed models linking service quality indicators to earnings sharing mechanisms
- Analyzed capital and operating expenditures for distribution utilities

- Contributed to the development of a performance-based rate design for a Canadian electric utility to be filed with Québec Régie de l'Energie
- Developed econometric regression models for a marginal cost of service study
- Developed econometric regression models for an LDC forecast & supply plan
- Prepared a new fee schedule for a municipal water utility based on capital and operating cost projections in order to balance municipality's water and sewer enterprise fund budget

Other Experience

Ms. Stone also has experience in the North American power and natural gas markets, with a focus in wholesale market analysis and wholesale market operations. Ms. Stone has provided analysis on the net Cost of New Entry in the ISO-NE wholesale capacity markets, as well as experience analyzing Offer Review Trigger Prices in New England and reviewing new entrant supply offer bids and retirement and delist bids.

AVAILABLE UPON REQUEST

Extensive client and project listings, and specific references.

SPONSOR	DATE	DOCKET	SUBJECT
Connecticut Public Utilities Regulatory Authority			
NuPower, LLC	March 2019 May 2019	Docket No. 18-08-14	PPA Approval – Cost of Service Pricing Methodology Supplemental ROE Testimony

Clearspring Energy Advisors LLC

1050 Regent St., Suite L3, Madison, WI 53715 608.442.8668 www.clearspringenergy.com

STEVEN A. FENRICK, Principal

SUMMARY OF EXPERIENCE AND EXPERTISE

- I have directed project teams and engaged in research in the fields of performance based regulation, performance benchmarking, DSM, load research and forecasting, and survey design and implementation
- I have been a expert witness in a number of cases involving performance-based ratemaking and incentive regulation and peak time rebates.

PROFESSIONAL EXPERIENCE

Clearspring Energy Advisors, LLC (2019 to Present)
Principal Consultant

Responsible for providing consulting services and expert witness testimony to utilities and regulators in the areas of reliability and cost benchmarking, productivity studies and other empirical aspects of performance-based ratemaking and incentive regulation. Direct activities in the areas of demand-side management programs, peak time rebate programs, load forecasting, and market research.

Power System Engineering, Inc.– Madison, WI (2009 to 2018)
Director of Economics

Responsible for providing consulting services to utilities and regulators in the areas of reliability and cost benchmarking, incentive regulation, value-based reliability planning, demand-side management including demand response and energy efficiency, ran peak time rebate programs, load research, load forecasting, end-use surveys, and market research.

Pacific Economics Group – Madison, WI (2001 - 2009)
Senior Economist

Co-authored research reports submitted as testimony in numerous proceedings in several states and in international jurisdictions. Research topics included statistical benchmarking, alternative regulation, and revenue decoupling. Managed and supervised PEG support staff in research and marketing efforts.

EDUCATION

University of Wisconsin - Madison, WI
Bachelor of Science, Economics (Mathematical Emphasis)

University of Wisconsin - Madison, WI
Master of Science, Agriculture and Applied Economics

Publications & Papers

- "Peak-Time Rebate Programs: A Success Story", *TechSurveillance*, July 2014 (with David Williams and Chris Ivanov).

- "Demand Impact of a Critical Peak Pricing Program: Opt-In and Opt-Out Options, Green Attitudes and other Customer Characteristics:, *The Energy Journal*, January 2014. (With Lullit Getachew, Chris Ivanov, and Jeff Smith).
- "Evaluating the Cost of Reliability Improvement Programs", *The Electricity Journal*, November 2013. (With Lullit Getachew)
- "Expected Useful Life of Energy Efficiency Improvements", Cooperative Research Network, 2013 (with David Williams).
- "Cost and Reliability Comparisons of Underground and Overhead Power Lines", *Utilities Policy*, March 2012. (With Lullit Getachew).
- "Formulating Appropriate Electric Reliability Targets and Performance Evaluations, *Electricity Journal*, March 2012. (With Lullit Getachew)
- "Enabling Technologies and Energy Savings: The Case of EnergyWise Smart Meter Pilot of Connexus Energy", Utilities Policy, November 2012. (With Chris Ivanov, Lullit Getachew, and Bethany Vittetoe)
- "The Value of Improving Load Factors through Demand-Side Management Programs", Cooperative Research Network, 2012 (with David Williams and Chris Ivanov).
- "Estimation of the Effects of Price and Billing Frequency on Household Water Demand Using a Panel of Wisconsin Municipalities", *Applied Economics Letters*, 2012, 19:14, 1373-1380.
- "Altreg Rate Designs Address Declining Average Gas Use", *Natural Gas & Electricity*. April 2008. (With Mark Lowry, Lullit Getachew, and David Hovde).
- "Regulation of Gas Distributors with Declining Use per Customer", *Dialogue*. August 2006. (With Mark Lowry and Lullit Getachew).
- "Balancing Reliability with Investment Costs: Assessing the Costs and Benefits of Reliability-Driven Power Transmission Projects." April 2011. *RE Magazine*.
- "Ex-Post Cost, Productivity, and Reliability Performance Assessment Techniques for Power Distribution Utilities". Master's Thesis.
- "Demand Response: How Much Value is Really There?" *PSE whitepaper.*
- "How is My Utility Performing" *PSE whitepaper*.
- "Improving the Performance of Power Distributors by Statistical Performance Benchmarking" *PSE whitepaper*.
- "Peak Time Rebate Programs: Reducing Costs While Engaging Customers" *PSE whitepaper*.
- "Performance Based Regulation for Electric and Gas Distributors" *PSE whitepaper*.
- "Revenue Decoupling: Designing a Fair Revenue Adjustment Mechanism" *PSE whitepaper.*

Expert Witness Experience

- Docket EB-2019-0261, Hydro Ottawa, Custom Incentive Regulation Application.
- Docket EB-2019-0082, Hydro One Networks Transmission, TFP and Econometric Benchmarking research.
- Docket EB-2018-0165, Toronto Hydro Electric System Limited, Econometric Benchmarking research.
- Docket EB-2018-0218, Hydro One Transmission Sault St. Marie, TFP and Econometric Benchmarking research.
- Docket EB-2017-0049, Hydro One Distribution, TFP and Benchmarking research.
- Docket EB-2015-0004, Hydro Ottawa, Custom Incentive Regulation Application.
- Docket 15-SPEE-357-TAR, Application for Southern Pioneer Electric Cooperative, Inc., Demand Response Peak Time Rebate Pilot Program.
- Docket EB-2014-0116, Toronto Hydro, Custom Incentive Regulation Application.
- Docket EB-2010-0379, The Coalition of Large Distributors in Ontario regarding "Defining & Measuring Performance".
- Docket No. 6690-CE-198, Wisconsin Public Service Corporation, "Application for Certificate of Authority for System Modernization and Reliability Project".
- Expert Witness presentation to Connecticut Governors "Two Storm Panel", 2012.
- Docket No. EB-2012-0064, Toronto Hydro's Incremental Capital Module (ICM) request for added capital funding.
- Docket No. 09-0306, Central Illinois Light rate case filing.
- Docket No. 09-0307, Central Illinois Public Service Company rate case filing.
- Docket No. 09-0308, Illinois Power rate case filing.

Recent Conference Presentations

- Institute of Public Utilities Advanced Rate Conference at Michigan State University, "Performance Benchmarking". October 2019.
- Institute of Public Utilities Advanced Rate Conference at Michigan State University, "Performance Benchmarking". October 2018.
- Panel Moderator at WPUI conference on cost allocation and innovative rate designs at Madison WI. June 2018.
- Institute of Public Utilities Advanced Rate Conference at Michigan State University, "Performance Benchmarking". October 2017.
- Wisconsin Manager's Meeting, "Reliability Target Setting Using Econometric Benchmarking". November 2016.
- Institute of Public Utilities Advanced Rate Conference at Michigan State University, "Performance Benchmarking". October 2016.
- Wisconsin Electric Cooperative Association (WECA) Conference, "An Introduction to Peak Time Rebates". September 2016.
- Institute of Public Utilities Advanced Rate Conference at Michigan State University, "Performance Benchmarking". October 2015.
- EUCI conference chair, 2015. "Evaluating the Performance of Gas and Electric Distribution Utilities."

- Institute of Public Utilities Advanced Rate Conference at Michigan State University, "Performance Benchmarking". October 2014.
- Cooperative Exchange Conference, Williamsburg VA. "Smart Thermostat versus AC Direct Load Control Impacts". August 2014.
- EUCI conference chair in Chicago. "The Economics of Demand Response". February 2014.
- Institute of Public Utilities Advanced Rate Conference at Michigan State University, "Performance Benchmarking". October 2013.
- EUCI conference chair in Chicago. "Evaluating the Performance of Gas and Electric Distribution Utilities." August 2013.
- Presentation to the Ontario Energy Board, "Research and Recommendations on 4th Generation Incentive Regulation".
- Presentation to the Canadian Electricity Association's best practice working group. 2013
- Conference chair for EUCI conference in March 2013 titled, "Performance Benchmarking for Electric and Gas Distribution Utilities."
- Presentation to the board of directors of Great Lakes Energy on benchmarking results, December 2012.
- Presentation on making optimal infrastructure investments and the impact on rates, Electricity Distribution Association, Toronto, Ontario. November 2012.
- Conference chair for EUCI conference in August 2012 titled, "Performance Benchmarking for Electric and Gas Distribution Utilities."
- 2012 presentation in Springfield, IL to the Midwest Energy Association titled, "Reliability Target Setting and Performance Evaluation".
- 2012 presentation in Springfield, IL to the Midwest Energy Association titled, "Making the Business Case for Reliability-Driven Investments".
- Conference chair for EUCI conference in 2012 titled, "Balancing, Measuring, and Improving the Cost and Reliability Performance of Electric Distribution Utilities". St. Louis.
- Conference chair for EUCI conference in 2012 titled, "Demand Response: The Economic and Technology Considerations from Pilot to Deployment". St. Louis.
- 2012 Presentation in the Missouri PSC Smart Grid conference entitled, "Maximizing the Value of DSM Deployments". Jefferson City.
- 2011 conference chair on a nationwide benchmarking conference for rural electrical cooperatives. Madison.
- 2011 presentation on optimizing demand response program at the CRN Summit. Cleveland.
- Conference chair for EUCI conference in 2011 titled, "Balancing, Measuring, and Improving the Cost and Reliability Performance of Electric Distribution Utilities". Denver.
- 2010 presentation on cost benchmarking techniques for REMC. Wisconsin Dells.

REDACTED

CHRISTENSEN ASSOCIATES ENERGY CONSULTING

DEVELOPMENT AND SUPPORT FOR PERFORMANCE-BASED DISTRIBUTION RATEMAKING PLAN FOR THE MASSACHUSETTS GAS COMPANIES

A Proposal to
National Grid

by

Christensen Associates Energy Consulting, LLC
800 University Bay Drive, Suite 400
Madison, WI 53705-2299
Voice 608.231.2266 Fax 608.231.2108

and

Kaufmann Consulting
12520 Central Park Drive
Austin, TX 78732

May 7, 2020

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DEVELOPMENT AND SUPPORT FOR PERFORMANCE-BASED DISTRIBUTION RATEMAKING PLAN FOR THE MASSACHUSETTS GAS COMPANIES

1. INTRODUCTION

Christensen Associates Energy Consulting, LLC (CA Energy Consulting) and Kaufmann Consulting (the "Project Team") are pleased to present our response to National Grid's RFP for the development and support for a performance-based distribution ratemaking plan for National Grid's Boston Gas/Colonial Gas (jointly the "MA Gas Companies"). Our proposed workplan will provide empirical analysis and testimony supporting the MA Gas Companies' PBR plan, including: 1) the development of a gas distribution industry TFP and input price study; 2) a cost benchmarking study comparing the MA Gas Companies' cost performance to broader industry cost metrics; and 3) the development of a PBR plan that is appropriate for the Companies' current business conditions and promotes the Department's regulatory objectives.

CA Energy Consulting is a wholly owned subsidiary of Laurits R. Christensen Associates, Inc. that has been providing service to clients since 1976. Performance-based regulation (PBR) in the U.S. has been a component of telecommunications regulation since the late 1980s. The Massachusetts Department of Public Utilities ("the Department") has been a leading proponent of PBR for the electric power and natural gas industries and has approved numerous PBR plans for gas and electricity distributors in the Commonwealth over the last twenty-five years.

CA Energy Consulting staff has been involved since the inception in the development, design, analysis, and implementation of all aspects of incentive regulation and PBR programs across network industries. Our knowledge and experience include the design of effective regulatory plans and state-of-the-art empirical research. CA Energy Consulting staff was instrumental in establishing much of the foundation for performance-based regulation as it exists today.

An important area in the design of a PBR plan is the measurement of productivity. Determining the firm and industry rates of productivity growth are key tasks in the setting of a price cap mechanism. CA Energy Consulting staff members are internationally known and cited for their productivity studies; we developed several of the approaches that are accepted in many industries today. Our team members have published a number of scholarly papers on productivity measurement and have applied our knowledge to PBR plans in many industries, including railroad, telephone, postal, electricity, and natural gas.

In addition to CA Energy Consulting, the project team includes Dr. Larry Kaufmann of Kaufmann Consulting. Dr. Kaufmann has designed and provided empirical support for the PBR proposals of numerous North American energy utilities and has testified on PBR, benchmarking and related utility regulation and public policy issues a total of fifty times. In addition, Dr. Kaufmann has testified overseas and managed a diverse array of empirical projects for clients in Canada, Japan, the UK, Germany, Australia, New Zealand, Mexico, Jamaica, and Curacao, as well as participating in PBR or benchmarking projects in Israel, Argentina, Bolivia, and Brazil.

The Project Team has considerable experience in making complex theoretical ideas understandable to non-specialists. We have prepared numerous reports and presentations for senior management on the benefits and risks of PBR programs. Our staff members have extensive experience testifying on incentive mechanisms, including indexed cap regulation. We provide testimony in support of our own analyses, as well as on broad public policy issues

This proposal is organized as follows. Section 2 discusses the qualifications of the Project Team. Section 3 discusses the scope of work, the approach we propose to take to address the issues listed in the RFP, and the Project Team's deliverables for each task. Section 4 provides the project schedule. Section 5 describes our staffing for the project and provides bios of Project Team principals. Section 6 describes our proposed project budget and Section 7 presents the Project Team's project persons for this project. Our proposed hourly rates and project budget are provided separately as an attachment to this proposal. Appendix A contains the resumes of the team members.

2. QUALIFICATIONS OF CA ENERGY AND KAUFMANN CONSULTING

The Project Team has unparalleled experience in developing the theoretical foundations of incentive regulation and its implementation across network industries, including electricity, telecommunications, natural gas, railroads, and oil pipelines. Our experience dates back to one of the first price cap plans in the U.S., implemented for AT&T in the late 1980s, and electric industry plans in the 1990s. Drs. Mark Meitzen and Philip Schoech of CA Energy Consulting recently coauthored two articles in *The Electricity Journal* about PBR in the electric utility industry.[1] Following the publication of the first article, the Massachusetts Department of Public Utilities rendered a decision in the Eversource proceeding in which the project team participated and, in fact, adopted a negative *X* factor largely along the lines of what Dr. Meitzen proposed.[2] This marked the first time that a regulatory commission in North America adopted an explicit negative *X* factor for electricity distribution. A year later, Dr. Meitzen provided testimony on behalf of National Grid in its PBR proceeding in Massachusetts, and again, the Department adopted an *X* factor that was based on Dr. Meitzen's proposal with no adjustments.[3]

Dr. Kaufmann also has extensive experience designing and supporting PBR plans for gas and electric utilities. Over the last twenty-seven years, he has participated in over 200 PBR-related projects in fourteen countries. Working in such a diverse array of jurisdictions has deepened Dr. Kaufmann's knowledge of PBR options and applications and provided insight into how to design PBR proposals that address a utility's specific needs and conditions.

[1] Mark E. Meitzen, Philip E. Schoech, and Dennis L. Weisman, "The Alphabet of PBR in Electric Power: Why X Does Not Tell the Whole Story," *The Electricity Journal,* 30 (2017) 30-37; Mark E. Meitzen, Philip E. Schoech, and Dennis L. Weisman, "Debunking the Mythology of PBR in Electric Power," *The Electricity Journal,* 31 (April 2018) 39-46.

[2] Final Order, D.P.U. 17-05, Massachusetts Department of Public Utilities, November 30, 2017.

[3] Final Order, D.P.U. 18-150, Massachusetts Department of Public Utilities, September 30, 2019.

In addition, Dr. Kaufmann has unmatched experience in PBR proceedings before the Department. Between 2000 and 2010, he testified 12 times before the Department on PBR and benchmarking issues. This includes testimony in support of successful PBR proposals for Boston Gas (in D.T.E. 03-40) and Bay State Gas (D.T.E. 05-27). He also testified in the first decoupling application presented to the Department (D.P.U. 09-30), in the generic decoupling proceeding on the relationship between decoupling and PBR (D.P.U. 07-50), and on service quality PBR (D.T.E. 99-84). In both D.T.E. 99-84 and D.P.U. 07-50, Dr. Kaufmann testified on behalf of a consortium of the state's gas and power distributors. Most recently, in 2018-19 Dr. Kaufmann provided PBR policy and benchmarking testimony on behalf of National Grid/Massachusetts Electric (D.P.U. 18-150). Dr. Kaufmann will bring the breadth and depth of his experience (in and outside the Commonwealth) to bear on advice provided to the MA Gas Companies.

The project team is on the forefront of both the theory and practice of PBR. What is more, the project team offers a unique perspective on PBR in that it has traversed the trials and tribulations associated with the adoption of incentive regulation in the telecommunications and energy utility industries throughout the world. Collectively, the project team has over one-hundred years of experience with PBR and related issues. Thus, we have abundant and successful experience with the PBR developments in the state of Massachusetts and elsewhere.

2.1. Sample of PBR Projects

Christensen Associates

PBR for a Massachusetts Utility. CA Energy Consulting developed total factor productivity (TFP) and input price studies and provided testimony for National Grid in its PBR proceeding in Massachusetts. This project resulted in the acceptance of a PBR plan for National Grid in D.P.U. 18-150.

Development of a Ratemaking Plan for Eversource Energy Massachusetts Electric Companies. CA Energy Consulting provided expert assistance in the development of a comprehensive incentive or performance-based alternative ratemaking plan in anticipation of rate case filings and provided testimony and support in the rate case. This project resulted in the acceptance of a PBR plan for Eversource in D.P.U. 17-05.

Incentive Regulation for Electric Distribution for EPCOR Distribution and Transmission. CA Energy Consulting provided testimony and support on incentive regulation issues in a price cap proceeding in Alberta.

AltaGas Utilities. We assisted AltaGas Utilities in developing a performance-based regulation plan, conducted productivity research that supported the X-factor in the plan, provided testimony on that plan, and offered general regulatory support. The Commission sponsored a productivity study that other parties reviewed. That study was based on U.S. electric utilities using FERC Form 1 data. While there was general agreement on the TFP methodology, there was no consensus on the length of history to be used in setting the productivity factor. The Commission adopted a much longer time

frame than what had been used elsewhere, which ended up over-predicting for subsequent periods.

Maine Public Utilities Commission. We provided expert testimony and litigation support to the Maine commission as part of its Performance-Based Regulation proceeding. We conducted a productivity analysis that served as the commission's analysis of the appropriate productivity factor for a price cap index, and prepared reports on our findings. We reviewed productivity testimony from various parties to the proceeding. We participated in technical conferences on productivity matters and assisted the hearing examiner in his questioning of parties testifying on productivity.

Union Gas Limited. We assisted Union Gas Limited, a gas distribution company in Ontario, with the development of a five-year price cap regulatory framework. In developing this proposal, the company consulted with us regarding many of the components that are included in the proposal. We provided background on the precedents for the approaches taken in several key areas including the overall price indexing formula, the choice of an inflation factor, the determination of the X-factor offset, pricing flexibility, service quality indexes, and the criteria for second generation performance-based regulation programs. The Union Gas proposal was based on a general inflation factor that represented output prices in the economy. We provided direct empirical support in the derivation of the X-factor. An integral part of our analysis was the measurement of TFP for the transmission, distribution, and storage services provided. We then advised our client on the application of these results in the determination of the X-factor offset.

Performance-Based Regulation (PBR) of Electricity and Natural Gas. CA Energy Consulting staff assisted a large east coast utility company with evaluating the prospects of developing a successful PBR program for its electricity and natural gas distribution services. This project included the preparation of a scoping document establishing the issues that must be addressed and the analyses that must be conducted in order to evaluate these prospects.

Telecommunications Price Caps for AT&T. Christensen Associates assisted our client with an analysis of price cap productivity factor development options in a proceeding before the Federal Communications Commission.

Federal Price Cap Proceedings for Local Exchange Telecommunications Carriers. From 1993 through 1997, Christensen Associates participated in the Federal Communications Commission's price cap proceedings for local exchange telecommunications carriers. Christensen Associates performed TFP studies that were used in determining the price cap X-factor and produced written testimony on the appropriate design of price cap plans.

State Price Cap Proceedings for Local Exchange Telecommunications Carriers. Christensen Associates has participated in numerous telecommunications industry price

cap proceedings before state regulatory bodies. In these various proceedings, we performed TFP studies, provided testimony on price cap design issues, and evaluated the results of price cap plans.

Advising a South American Regulatory Commission on Price Cap Regulation. Christensen Associates provided a report to a newly created South American regulatory commission. Our report described and evaluated alternative forms of price cap regulation for the country's newly privatized telecommunications industry. This report also provided advice on how the regulatory commission could establish a price cap mechanism. We also assisted in resolving issues regarding X-factor adjustments in the country's recently-adopted price cap plan. Christensen Associates also participated in a high-level forum that was charged with deciding these issues.

Analysis of the U.S. Postal Service Price Cap for the Postal Service Office of Inspector General. In 2013, Christensen Associates was retained by the Postal Service Office of Inspector General (OIG) to evaluate the Postal Service price cap for market dominant services and to propose methods for improving the price cap in an environment of falling mail volumes. That analysis was contained an OIG white paper. In 2015, we assisted the OIG in responding to questions raised about the price cap by the U.S. Senate Committee on Homeland Security and Governmental Affairs. As part of that response we updated the 2013 analysis, and we provided examples of the legislative and regulatory authority to implement and design incentive regulation plans in various U.S. industries.

U.S. Postal Regulatory Commission Proceeding on Statutory Review of the System for Regulating Rates and Classes for Market-Dominant Products. As part of this proceeding in 2017, we submitted a report on behalf of the U.S. Postal Service that analyzed the current price cap system and presented options for future postal regulation. That report conducted an analysis of problems with the current price cap system, reviewed regulatory systems used in other U.S. industries, and reviewed regulatory systems in use for postal systems in Europe, Canada, and Australia. That report then used this information to provide viable options for future Postal Service price regulation.

United States Postal Service. Beginning in 1982, Christensen Associates has developed and been responsible for the official measurement of Postal Service TFP. TFP is used to measure and monitor Postal Service performance and is published in the Postal Service Annual Report and in reports to the United States Congress. Our methods and computational procedures were adopted by the Postal Service as an official measure of its performance and have been reviewed and endorsed by both the Postal Regulatory Commission and the Office of the Inspector General. We continue to conduct the TFP measurement using Postal Service data systems. We also assist the Postal Service in monitoring performance by providing monthly and quarterly TFP measures.

Texas Public Utilities Commission. CA Energy Consulting produced a review of alternative ratemaking mechanisms throughout the U.S., the report for which accompanies this proposal.

Tennessee Valley Authority. CA Energy Consulting conducted a comprehensive review and benchmarking analysis of the competitiveness of the Tennessee Valley Authority (TVA) in providing power supply (i.e., generation and transmission delivery) to its Local Power Company (LPC) wholesale customers. It compared TVA's performance to that of a group of peer utilities operating in the southeastern U.S., where performance was measured through comparisons of TVA and peer utilities' wholesale rates, generation costs, and transmission costs based on financial cost benchmark metrics, with consideration of the additional non-power products and services (like recreational facilities) that TVA is required to offer by statute. In addition, the study examined the relationship of TVA's wholesale rate to the retail rates of the LPCs, reviewed factors that contribute to wholesale rate stability and volatility, and examined various factors that may influence wholesale rates in the southeast in the future.

Southern California Edison. We provided consulting services and reviewed TFP studies prepared by a large electric distribution utility, which were filed as part of the utility's general rate cases. The California Public Utilities Commission, which regularly reviews historical TFP and the TFP implicit in the test year data, accepted the methods we proposed.

Ontario Energy Board. The Ontario Energy Board retained us to develop a methodology and process to assess and benchmark the costs of Ontario's numerous electricity distributors. The benchmarking study was used to assist the Board in gauging and comparing the costs of the local distribution companies (LDCs). We participated in the Board's stakeholder process, provided formal testimony before the Board, and drafted Phase I and Phase II reports regarding methodology and results. The recommended approach included econometric cost analysis using flexible form models and statistical clustering of Ontario's LDC's into comparable peer groups.

Stentor Companies. We assisted Canadian telecommunications carriers in designing TFP studies that were conducted for the initiation of price cap regulation in Canada. In addition, we provided both written and oral testimony on the determination of the X-factor in the Canadian Radio and Telecommunications Commission (CRTC) proceedings. Our TFP study was accepted by the CRTC.

Kaufmann Consulting

Boston Gas/MA Gas Companies. Dr. Kaufmann has contributed to every PBR-related proposal put forward by the MA Gas Companies' over the last twenty-five years.

- In D.P.U. 96-50, he was part of the team that developed the gas industry TFP and input price study that was ultimately approved as the basis for the productivity factor (net of the stretch factor) for Boston Gas's first PBR plan

- In D.T.E. 03-40, Boston Gas asked Dr. Kaufmann to be the witness in support of its updated PBR proposal. His work included an updated TFP and input price study as well as an econometric benchmarking study that showed Boston Gas was a superior cost performer in the industry. D.T.E. 03-40 was a highly contested proceeding, since it was the first review of an approved energy PBR plan in the Commonwealth, and the Department relied entirely on Dr. Kaufmann's analysis as the basis for the approved productivity factor and also referenced his benchmarking study when selecting a stretch factor.

- In D.P.U. 10-55, the MA Gas Companies proposed an O&M cost indexing incentive-based mechanism, and Dr. Kaufmann undertook an O&M partial factor productivity and input price study to support the proposed O&M cost adjustment mechanism. The Department did not accept the MA Gas Companies' proposed PBR mechanism for policy reasons that were unrelated to Dr. Kaufmann's work.

Bay State Gas. Dr. Kaufmann testified in support of Bay State Gas's proposed PBR plan in D.P.U. 05-27. The Department approved Bay State's proposed PBR plan and Dr. Kaufmann's recommended productivity factor, although it did not accept the Company's proposed capital cost tracker mechanism.

Consortium of Massachusetts Gas and Electric Companies. On two occasions, Dr. Kaufmann has testified on behalf of a consortium of gas and electric utilities in the Commonwealth.

- In D.T.E. 99-84, he testified in support of a statistically-based methodology for establishing "deadbands" within which energy utilities would not be penalized for measured service quality performance that fell below established benchmarks. The Department ultimately adopted a statistically-based approach for setting such deadbands.

- In 2007, the Department initiated D.P.U. 07-50 primarily to mandate revenue decoupling for all MA energy distribution utilities. Dr. Kaufmann was hired by a consortium of Massachusetts gas and electricity distributors to provide testimony in D.P.U. 07-50 on the relationship between revenue decoupling and PBR. In addition to surveying all U.S. decoupling mechanisms in effect at that

time, Dr. Kaufmann's testimony emphasized that decoupling and PBR rate adjustment formulas are complementary rather than substitute mechanisms since each is focused on separate regulatory objectives.

This position differed from the Department's "strawman" decoupling proposal at the outset of D.P.U. 07-50. The strawman view argued that PBR would not be necessary after decoupling was implemented because the latter would reconcile actual to allowed revenues per customer. Dr. Kaufmann pointed out, among other things, that "just and reasonable" distribution revenues can grow more rapidly than growth in customer numbers for a variety of reasons, including capital investment needs and input price inflation. In its final D.P.U. 07-50 Order, the Department reversed its strawman position and allowed utilities to file capital cost recovery and inflation adjustment mechanisms in conjunction with decoupling proposals. The Department's explanation of the potential value of such mechanisms in a decoupling environment cited several passages of Dr. Kaufmann's testimony verbatim.

Massachusetts Electric/National Grid. In D.P.U. 18-150, Dr. Kaufmann served as a policy witness in support of the Company's proposed PBR plan and also undertook cost benchmarking analysis to support the stretch factor/consumer dividend component of the X factor. The Department approved Dr. Kaufmann's recommended stretch factor value.

Ontario Energy Board. From 2007 through 2015, Dr. Kaufmann was the main advisor to the staff and Board members of the Ontario Energy Board (he voluntarily relinquished this role in 2016 because of other commitments). During this time, he played a central role in the establishment of both "Third Generation" and "Fourth Generation" performance-based regulation for all electricity distributors in the province. The "fourth generation" PBR application included an innovative approach to establishing consumer dividends that linked updated consumer dividends to benchmarking studies that were updated annually. Dr. Kaufmann referenced this approach in rebuttal testimony for Massachusetts Electric, and the Department approved a similar application of benchmarking in D.P.U. 18-50.

In addition to his roles in Third And Fourth Generation incentive ratemaking, Dr. Kaufmann was involved in over a dozen additional projects on behalf of the OEB, including the review of "Custom" incentive regulation proposals, the development of service quality standards, assessing methods for estimating energy savings from DSM programs, and reviewing the outcomes of previous PBR plans.

2.2. Sample of Testimony Related to PBR and Incentive Ratemaking

Christensen Associates

- Direct Testimony of Mark E. Meitzen, Ph.D., Massachusetts D.P.U. 18-150, November 15, 2018.
- Rebuttal Testimony of Mark E. Meitzen, Ph.D., Massachusetts D.P.U. 18-150, April 22, 2019.
- Direct Testimony of Mark E. Meitzen, Ph.D., Massachusetts D.P.U. 17-05, January 17, 2017.
- Rebuttal Testimony of Mark E. Meitzen, Ph.D., Dennis L. Weisman, Ph.D., and Carl G. Degen, Massachusetts D.P.U. 17-05, May 19, 2017.
- Mark E. Meitzen, Ph.D., *Determination of the Second-Generation X Factor for the AUC Price Cap Plan for Alberta Electric Distribution Companies*, Alberta Utilities Commission Proceeding ID 20414, March 2016.
- Rebuttal Evidence of Mark E. Meitzen, Ph.D., Alberta Utilities Commission Proceeding ID 20414, May 2016.
- Mark E. Meitzen, Ph.D., and Philip E. Schoech, Ph.D., *Assessment of the FCC's Proposed Options for the Special Access Price Cap X-Factor*, Federal Communications Commission, WC Docket No. 16-143, *et. al.*, June 28, 2016.
- R.J. Camfield and P.E. Schoech, *Review and Evaluation of AltaGas Utilities Inc. Incentive Regulation Plan*, and *Analysis Update, Including Responses to Evidence Filed by Interveners*, before the Alberta Utilities Commission, Docket 566, July 2011 and April 2012.
- L.R. Christensen, M.E. Meitzen, P.E. Schoech, and S.M. Schroeder, *Productivity Performance of the Wisconsin Local Exchange Carrier Industry* and *Comments of Christensen Associates on Consultant Productivity Studies*, before the Wisconsin Public Service Commission, Docket 1-AC-193, January 2003.
- P.E. Schoech and R.C. Hemphill, *An Evaluation of the Union Gas Limited Performance Based Regulation Proposal*, before the Ontario Energy Board, Docket RP-1999-0017, December 1999.
- M. Meitzen, P.E. Schoech, C. Smyser, and S.M. Schroeder*, Determination of the X Factor for the Regulation of Telefonica del Peru*, report to OSIPTEL (the Peruvian Regulator), August 2001.
- M.E. Meitzen, L.R. Christensen, P.E. Schoech, L.D. Kirsch, C.A. Herrera, and S.M. Schroeder, *Price Cap Design and X Factor Estimation for Peruvian Telecommunications* Regulation, Final Report to OSIPTEL, May 1999.

- M.E. Meitzen, P.E. Schoech, and S.M. Schroeder, *The Ameritech Illinois Total Factor Productivity Study*, before the Illinois Commerce Commission, Docket 98-0252, June 2000.
- L.R. Christensen, P.E. Schoech, and M.E. Meitzen, *The TFPRP Provides the Best Basis for Determining the Rate of LEC TFP Growth*, Federal Communications Commission, CC Docket 94-1, February 1997.
- L.R. Christensen, P.E. Schoech, and M.E. Meitzen, *Updated Results for the Simplified TFPRP Model and Response to Productivity Questions in FCC's Access Reform Proceeding*, Federal Communications Commission, CC Docket 94-1, January 1997.
- L.R. Christensen, P.E. Schoech, and M.E. Meitzen, *A Survey of X-Factor Experience in the United States,* filed with Canadian Radio and Telecommunications Commission on behalf of Stentor Member Companies, June 1996.
- L.R. Christensen, P.E. Schoech, and M.E. Meitzen, *An Evaluation of the Bell Canada, BC TEL, MTS NetCom Inc., and Maritime Tel & Tel Limited Total Factor Productivity Studies*, filed with Canadian Radio and Telecommunications Commission on behalf of Stentor Member Companies, June 1996.
- L.R. Christensen, P.E. Schoech, and M.E. Meitzen, *Total Factor Productivity Methods for Local Exchange Carrier Price Cap Plans*, Federal Communications Commission, CC Docket 94-1, December 1995.
- L.R. Christensen, P.E. Schoech, and M.E. Meitzen, *Productivity of the Local Operating Telephone Companies Subject to Price Cap Regulation*, Federal Communications Commission, CC Docket 94-1, May 1994.

<u>Kaufmann Consulting</u>

- Before the Massachusetts Department of Public Utilities, evidence on behalf of National Grid, 2019. Subject: testimony on performance-based regulation and performance benchmarking.
- Before the Puerto Rico Energy Commission, evidence on behalf of the Puerto Rico Electric Power Authority, 2016. Subject: rebuttal testimony on cost and wage benchmarking.
- Before the Edmonton City Council, evidence on behalf of EPCOR Water and Sewer Inc., 2016. Subject: updated inflation factors in a performance-based regulation plan.
- Before the Wisconsin Public Service Commission, evidence on behalf of Associated Builders and Contractors of Wisconsin, 2015. Subject: assessing the merits of an expanded bidding process for the expansion of the Alliant Riverside Energy Center facility.

- Before the Ontario Energy Board, evidence on behalf of OEB Staff, 2015. Subject: review of Custom Incentive Regulation proposal and benchmarking evidence of Toronto Hydro.
- Before the Wisconsin Public Service Commission; evidence on behalf of Kwik Trip, 2014. Subject: testimony on the impact of gas extension tariffs on the development of the CNG marketplace in Wisconsin.
- Before the Ontario Energy Board; evidence on behalf of OEB Staff, 2014: Subject: review of Customized Incentive Regulation proposal for Enbridge Gas Distribution.
- Before the Ontario Energy Board; evidence on behalf of OEB Staff, 2013. Subject: total factor productivity estimation, cost benchmarking, and establishing incentive regulation plans for Ontario electricity distributors.
- Before the Wisconsin Public Service Commission; evidence on behalf of Wisconsin Public Service, 2013. Subject: testimony on the value of reliability improvements from undergrounding power lines.
- Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of National Grid, 2010. Subject: testimony in support of a net inflation adjustment mechanism applied to operating and maintenance expenditures.
- Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of Bay State Gas, 2009. Subject: direct testimony on performance-based regulation.
- Before the Appeal Panel Constituted Pursuant to Section 55 of the *Essential Services Commission Act* 2001, Victoria Australia; evidence on behalf of the Essential Services Commission, 2008. Subject: estimating partial factor productivity growth for O&M expenditures for natural gas distributors.
- Before the Ontario Energy Board, 2008. Subject: appropriate values for total factor productivity-based productivity factor; benchmarking-based productivity "stretch factors;" and appropriate thresholds for capital investment modules; in an incentive regulation plan for electricity distributors in the Province.
- Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of Bay State Gas, 2007. Subject: panel testimony on revenue decoupling and performance-based regulation.
- Before the Michigan Public Service Commission; evidence on behalf of Detroit Edison, 2007. Subject: service quality regulation and benchmarking.
- Before the Appeal Panel, South Australia, Australia; evidence on behalf of the Essential Services Commission of South Australia, 2006. Subject: the operating expenditures and outsourcing management fee of Envestra Ltd.
- Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of Bay State Gas, 2006. Subject: rebuttal testimony on exogenous recovery of revenues lost due to declining natural gas usage.

- Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of Bay State Gas, 2005. Subject: performance-based regulation and benchmarking.
- Before the New Zealand Commerce Commission, evidence on behalf of Vector and NGC, 2004. Benchmarking evidence for New Zealand gas distributors.
- Before the New Zealand Commerce Commission, evidence on behalf of Powerco, 2003. Evaluation of total factor productivity and benchmarking evidence in studies undertaken for the Commission.
- Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of Boston Gas, 2003. Subject: performance-based regulation, total factor productivity measurement, and benchmarking
- Before the Supreme Court of Victoria, Australia; evidence on behalf of TXU Australia, 2000. Subject: Whether the regulator's price determination complied with legal mandates to use price-based incentive regulation.
- Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of Massachusetts gas and electric distribution companies, 2000. Subject: Service quality benchmarking.

2.3. Sample of Publications Related to PBR and Incentive Ratemaking

Christensen Associates

- Mark E. Meitzen, Philip E. Schoech, and Dennis L. Weisman, "The Alphabet of PBR in Electric Power: Why X Does Not Tell the Whole Story," *The Electricity Journal,* 30 (2017) 30-37.
- Mark E. Meitzen, Philip E. Schoech, and Dennis L. Weisman, "Debunking the Mythology of PBR in Electric Power," *The Electricity Journal,* 31 (2018) 39-46.
- R.C. Hemphill, M.E. Meitzen, and P.E. Schoech, "Incentive Regulation in Network Industries: Experience and Prospects in the U.S. Telecommunications, Electricity, and Natural Gas Industries," *Review of Network Economics*, 2(4): 316-337, December 2003.
- L.R. Christensen, P.E. Schoech, and M.E. Meitzen, "Telecommunications Productivity," in Gary Madden, ed., *Traditional Telecommunications Networks: The International Handbook of Telecommunications Economics*, Edward Elgar, 2003, Vol. I, pp. 100-119.
- L.R. Christensen, M.E. Meitzen, and P.E. Schoech, "Where Do We Go From Here,?" *Public Utilities Fortnightly*, June 15, 1993.
- M. Meitzen, S. Massa, and S.G. Parsons, "Pricing Network Elements Under the Telecommunications Act of 1996: Back to the Future," *Comm/ENT*, Summer 2001.

Kaufmann Consulting

- *The Price Cap Designers Handbook* (with M.N. Lowry), Edison Electric Institute, 1995.
- "Forecasting Productivity Trends of Natural Gas Distributors" (with Mark Newton Lowry), *AGA Forecasting Review*, March 1996.
- *Performance-Based Regulation for Electric Utilities: The State of the Art and Directions for Further Research* (with Mark Newton Lowry), Palo Alto: Electric Power Research Institute, 1996.
- *Price Cap Regulation for Power Distribution* (with Mark Newton Lowry), Washington: Edison Electric Institute, 1998.
- "Performance Based Regulation of Energy Utilities" (with Mark Newton Lowry), *Energy Law Journal*, 2002.
- "Incentive Power and the Design of Regulatory Regimes," *Network*, December 2005.
- "Alternative Regulation for Electric Utilities" (with Mark Newton Lowry), *Electricity Journal*, June 2006.
- "Performance Indicators and Price Monitoring: Assessing Market Power," *Network*, March 2007.
- "Incentive Regulation in North American Energy Markets" *Energy Law and Policy*, Carswell Publishing, Toronto, Canada, 2009.
- "Regulatory Reform in Ontario: Successes, Shortcomings and Unfinished Business" *Public Utilities Fortnightly*, November 2009.
- "The Past and Future of the X Factor in Performance-Based Regulation," *The Electricity Journal*, April 2019.

2.4. References

The Project Team provides the following references:

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3. SCOPE OF WORK AND DELIVERABLES

The Scope of Work issued by National Grid describes the objectives of this project as follows:

> The firm engaged by National Grid ("the Company") will be required to perform a Total Factor Productivity study and Input Pricing study for National Grid's Boston Gas/Colonial Gas (jointly the "MA Gas Companies") distribution rate case, and provide support in testimony to both the findings of the studies and the general advantages of a Performance Based Regulation plan in helping the company to meet its obligations to customers at a reasonable cost. In addition, the firm engaged will be required to develop and/or adopt and utilize a benchmarking study of gas utilities in the U.S. and the Northeast region to determine any appropriate adjustments to the resulting X factor recommended through a consumer dividend.

The tasks described below are designed to meet these objectives, following the requirements specified in the Scope of Work.[4]

Task 1 – Kickoff Meeting

Upon awarding of a contract, we propose that the Project Team have a conference call with appropriate National Grid staff to discuss overall rate case strategy, and to ensure a common understanding of the scope of work and a smoothly-functioning process for achieving the stated deliverables. An important aspect of this meeting will be a discussion of the precise scope of work and the resulting testimony. For example, we anticipate that National Grid will ask for either a revenue per customer or revenue cap form of PBR, and in our kickoff meeting, the project team will discuss in detail with the National Grid team what studies and testimony we will provide to support this request. We will also communicate what data, if any, that we will need from National Grid, as well as any other data-related tasks. A convenient starting point for the determination of project scope will be how the proposed testimony for the MA

[4] We note that the order in the Scope of Work has producing rebuttal testimony (number 7 on the Scope of Work list) before responding to interrogatories and data requests (number 8 on the Scope of Work list). We keep that order below for Tasks 7 and 8, although the order will be largely reversed in the actual performance of the tasks.

Gas Companies is similar to or different than the direct testimony of Dr. Meitzen and Dr. Kaufmann for National Grid in D.P.U. 18-150.

To further facilitate the kickoff discussion, the project team will submit data requests to National Grid to obtain internal data to perform analyses related to the scope of work. We will provide National Grid with an initial data request at this meeting.

Deliverables:

- Project kick-off conference call.
- Memorandum summarizing meeting and takeaways, including scope of testimony.
- Memoranda requesting data from the Company.

Task 2 – Produce TFP and Input Price Studies

The foundation of a revenue per customer or revenue cap is the *I – X* formula. Consistent with Massachusetts precedent, the *I* factor in the *I – X* PBR formula will be the economy-wide measure of output inflation, GDP-PI. In this specification, the *X* factor is based on the difference between industry and economy-wide total factor productivity (TFP) growth plus the difference between economy-wide and industry input price (IP) growth. Therefore, studies of both industry TFP and input price growth will be needed in specifying the PBR formula's *X* factor. We will produce TFP and input price studies in accord with D.P.U. precedents and practices. This includes the methodology Dr. Meitzen successfully employed on behalf of Eversource in D.P.U. 17-05 and National Grid in D.P.U. 18-150.

While TFP and input price growth for the United States macroeconomy are available directly from U.S. government sources, industry-specific data must be collected and organized to calculate industry-specific TFP and input price growth. We will obtain the most up-to-date FERC Form 2 and EIA 176 data to perform our analysis, with supplemental data from SNL Financial and, when necessary, state commissions.

In addition to producing studies in accord with proven and accepted methodology that have been successful in previous proceedings before the Department, we will explore alternative approaches to inform National Grid's strategy regarding its PBR filing.

Deliverables:

- Produce TFP and IP studies and relevant alternative approaches to inform National Grid's go/no-go decision.
- Assuming National Grid's decision is to go ahead with the PBR filing, completed TFP and IP studies to be included in pre-filed direct testimony.
- Assuming National Grid's decision is to go ahead with the PBR filing, workpapers to be filed in support of testimony.

Task 3 – TFP and Input Price Direct Testimony

As in D.P.U. 17-05 and D.P.U. 18-150, Dr. Meitzen will provide direct testimony covering all elements of the TFP and IP studies and the studies' interaction with the intent of the PBR framework proposed. This will include a detailed description of the methodology used and data sources, and a comparison to other recent studies on the record in Massachusetts. Litigation-quality workpapers that clearly explain the methods used and are capable of being audited will also be produced. As he did in D.P.U. 18-150, Dr. Meitzen will address the Department's directive in its D.P.U. 17-05 order that "[g]oing forward, any distribution company conducting a TFP study should consider and present data regarding alternative or non-traditional output measures that are designed to capture all of the products and services it provides."

Deliverables:

- Two drafts of direct pre-filed testimony of Dr. Meitzen.
- Final direct pre-filed testimony of Dr. Meitzen, including workpapers.

Task 4 – PBR Design and Additional PBR Components

Beyond the I-X rate adjustment formula, the design of the PBR proposal is likely to be of considerable importance to the MA Gas Companies. A well-designed PBR plan balances strong performance incentives with provisions to mitigate risk and recover the costs of programs necessary to satisfy public policy mandates and regulatory objectives. The PBR plan can be designed in numerous ways to balance these objectives and enable the utility to earn adequate returns.

Dr. Kaufmann will explore these options with Company personnel, make recommendations on the overall design of the PBR plan, and testify in support of an appropriately structured plan. Among the options to be considered in this task are the continuance of the Gas System Enhancement Plan, or GSEP, which allows for timely recovery of investment related to leak-prone infrastructure; adding other "Y factor" or pass through items such as pilot programs to decarbonize the gas network (e.g., local renewable natural gas (RNG)) procurement programs, studies and demonstration projects for integrating hydrogen); adjustments of the earnings sharing mechanism and Z factor provisions; and the possible adoption of an efficiency carry-over mechanism within the PBR plan. Dr. Kaufmann will analyze these and other options and provide guidance and support to the Company for developing capital recovery, risk mitigation and efficiency carry-over mechanisms. He will also testify in support of appropriate, well-designed mechanisms and provide all relevant work papers and analyses to support the recommended mechanisms and explain their interaction with other aspects of the PBR proposal.

Deliverables:

- Analysis of PBR design options and additional PBR components that address capital cost recovery, risk mitigation, efficiency carry-over and other issues of strategic importance to the overall rate filing.
- Recommended PBR plan design and additional PBR plan components

- Direct pre-filed testimony of Dr. Kaufmann supporting the PBR plan and discussing how it addresses key business concerns and promotes important regulatory objectives.

Task 5 – Benchmarking Study

Dr. Kaufmann will provide a cost benchmarking study that compares Company cost metrics to similar measures for peers and broader industry aggregates (nationwide and regional). This benchmarking evidence will, in turn, be used to support a recommended value for the consumer dividend or "stretch factor" component of the recommended X factor. The benchmarking analysis can either utilize a unit cost approach (similar to the analysis that Dr. Kaufmann performed for Massachusetts Electric in D.P.U. 18-150) or a more sophisticated econometric benchmarking methodology. There are costs and benefits of undertaking an econometric rather than a unit cost benchmarking approach, and the project team believes these costs and benefits should be explored with the Company before a final approach is determined.

Deliverables:

- Completed benchmarking study to be included in pre-filed direct testimony.
- Workpapers to be filed in support of testimony.

Task 6 – PBR Policy and Benchmarking Direct Testimony

Dr. Kaufmann will prepare testimony in support of the merits of the Company's PBR proposal in light of such factors as: core economic principles and the underlying public policy rationale for PBR; the general benefits to customers from PBR; specific financial incentive properties of the Company's PBR proposal and the anticipated benefits for customers; consistency of the Company's PBR proposal with Department precedent and the Commonwealth's energy policy goals; and broad utility industry trends and developments in PBR, including the evolution of PBR in Canada and elsewhere. Among other things, this testimony will explain why the Company's proposal better aligns the interests of customers, regulators/policymakers, and shareholders than traditional cost of service regulation. Dr. Kaufmann undertook a systematic analysis of these issues and the policy merits of PBR in his testimony for Massachusetts Electric in D.P.U. 18-150, and he can draw on and potentially enhance this framework in the current project for the MA Gas Companies.

Deliverables:

- First and second drafts of direct pre-filed policy and benchmarking testimony of Dr. Kaufmann.
- Final direct pre-filed testimony of Dr. Kaufmann, including workpapers.

Task 7 – Produce Rebuttal Testimony

The Project Team will produce effective and persuasive rebuttal testimony. Based on their experience in other proceedings, including D.P.U. 17-05 and D.P.U. 18-150, the Project Team has a good understanding of the arguments that will be made by intervenors and are

continually working on developing and refining responses to anticipated intervenor positions. Therefore, when it is time to produce rebuttal testimony in the Company's proceeding, the Project Team will have already anticipated much of the intervenors' testimony, which will allow the project team to efficiently produce effective rebuttal testimony.

Deliverables:

- Draft rebuttal testimony.
- Final rebuttal testimony, including all related and supporting exhibit and workpapers.

Task 8 – Respond to Interrogatories and Data Requests

The Project Team will efficiently produce responses to interrogatories and data requests in a timely manner. We also stand ready to assist the Company in producing interrogatories and data requests for intervenors.

The Project Team will assist the Company in interrogating the testimony by other parties to the proceeding. As appropriate, the Project Team will review the Company's information requests, or will draft original information requests.

Deliverables:

- Written responses to information requests as needed.
- Draft or revise information requests for other parties as needed.

Task 9 – Participate in D.P.U. Hearings

In addition to being recognized experts, Dr. Meitzen and Dr. Kaufmann are experienced witnesses who have testified successfully in numerous evidentiary hearings. The hearings in D.P.U. 17-05 and D.P.U. 18-150 attest to their ability to perform persuasively in a professional manner in regulatory hearings.

Deliverable:

- Attendance and testimony at evidentiary hearings.

Task 10 – Assist Company in Producing Briefs and Reply Briefs

The Project Team is experienced in both regulatory and civil litigation settings in assisting counsel to develop and draft briefs.

Deliverable:

- Edits to and recommendations for the legal briefs.

Task 11 – Provide Support for Possible Settlement Negotiations

The Project Team stands ready to assist the Company in possible settlement negotiations.

Deliverable:

- Support for possible settlement negotiations as needed.

4. PROJECT SCHEDULE

The preliminary schedule provided in the scope of work is provided in Figure 1 and the project team's hours by task are provided in Figure 2. As noted below, Tasks 1 through 6 represent work performed through the filing of direct pre-filed testimony and this work is predictable. The work for Tasks 7 through 11 is much less predictable in nature and the hours for these tasks represent our best, good-faith estimates for these tasks at this time. This schedule is illustrative and depends on the actual date of filing and the Massachusetts DPU's procedural schedule. The project team is prepared to meet all deadlines on a timely basis and has an established track record of doing so.

Figure 1
Project Timeline
Based on Preliminary Timeline in Presented in Scope of Work

Task	Description	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	Month 13
1	Kickoff Meeting													
2	Produce TFP and IP Studies													
3	TFP and IP Direct Testimony													
4	PBR Design and Additional Components													
5	Benchmarking Study													
6	PBR Policy and Benchmarking Testimony													
7	Rebuttal Testimony													
8	Interrogatories and Data Requests													
9	Hearings													
10	Briefs and Reply Briegs													
11	Ad Hoc Support													

[redacted]

[redacted]

5. PROJECT MANAGEMENT AND PROJECT TEAM STAFFING

The Project Team will collaborate closely with National Grid staff to ensure the project proceeds smoothly and that any problems or issues are addressed in a timely manner. Communication between the Project Team and National Grid may take the form of regular project memoranda or Project Team calls.

The Project Team will be led by Dr. Mark Meitzen. Other project principals include Dr. Lawrence Kaufmann, Mr. Nick Crowley, and Dr. Philip Schoech. In addition to leading the team, Dr. Meitzen will be primarily responsible for the TFP and input price studies and testimony on these topics. Dr. Kaufmann will be primarily responsible for PBR policy, additional PBR components and the benchmarking study and testimony on these topics.

Below are biographical sketches of project principals.

Mark E. Meitzen. PhD (University of Wisconsin–Madison). Dr. Meitzen has expertise in the economic analysis of network industries on a range of issues that includes cost and productivity analysis, and the design of incentive regulation plans. He has applied his expertise across a number of industries including electric utilities, telecommunications, postal services, and railroads. Recently, he testified on behalf of National Grid and Eversource Energy in Massachusetts and his work was instrumental in getting the first PBR plan approved in North America with a negative X factor. This work, along with his experiences in PBR proceedings in Alberta, led to two recent publication regarding the current state of PBR in the electric utility industry in *The Electricity Journal.* Dr. Meitzen has consulted for both regulated companies and regulatory agencies. He has directed analyses and testified in jurisdictions in the U.S. and elsewhere on these issues, including the Federal Communications Commission, various state regulatory agencies, the Alberta (Canada) Utilities Commission, OSIPTEL (Peru), and the U.S. Surface Transportation Board. Prior to joining Christensen Associates, Dr. Meitzen was a corporate economist for Southwestern Bell Telephone Company (now part of AT&T).

Lawrence Kaufmann, PhD (University of Wisconsin–Madison) Dr. Kaufmann is President of Kaufmann Consulting and will manage and be the expert witness in support of the PBR design, public policy, and cost benchmarking elements of the project. Dr. Kaufmann has designed and provided empirical support for the PBR proposals of numerous North American energy utilities. He has testified on PBR, benchmarking and related utility regulation and public policy issues a total of fifty times. In addition, Dr. Kaufmann has testified overseas and managed a diverse array of empirical projects for clients in Canada, Japan, the UK, Germany, Australia, New Zealand, Mexico, Jamaica, and Curacao, as well as participating in PBR or benchmarking projects in Israel, Argentina, Bolivia, and Brazil. He has twenty-seven years of experience as an energy and economics consultant. Dr. Kaufmann also has unmatched experience in PBR proceedings before the Department. Between 2000 and 2010, he testified twelve times before the D.P.U. on PBR and benchmarking issues. This includes testimony in support of successful PBR proposals for Boston Gas (in D.T.E. 03-40) and Bay State Gas (D.T.E. 05-27). He also

testified in the first decoupling application presented to the Department (D.P.U. 09-30), in the generic decoupling proceeding on the relationship between decoupling and PBR (D.P.U. 07-50), and on service quality PBR (D.T.E. 99-84). In both D.T.E. 99-84 and D.P.U. 07-50, Dr. Kaufmann testified on behalf of a consortium of the state's gas and power distributors. Most recently, in 2018-19 Dr. Kaufmann provided PBR policy and benchmarking testimony on behalf of National Grid/Massachusetts Electric (D.P.U. 18-150).

Nick Crowley, MS (University of Wisconsin–Madison) is an Economist at CA Energy Consulting. He has calculated total factor productivity measures for the electricity sector and developed indexes for use in performance-based ratemaking. Mr. Crowley has participated in the development of cost benchmarks for power systems and participated in marginal cost estimation and the development of marginal cost models. He assists electric utilities in measuring cost of capital and preparing COS studies for rate cases. He has also assisted in the measurement of price response by customers participating in leading demand response programs. Mr. Crowley's reports have been filed before regulatory authorities. Prior to joining CA Energy Consulting, Mr. Crowley worked at the Federal Energy Regulatory Commission, where he assisted with energy industry benchmarking, the incentive regulation of oil pipelines, and the review and evaluation of natural gas pipeline rate cases. Mr. Crowley is proficient in Stata and Excel, in addition to other software packages used in quantitative analysis.

Philip E. Schoech, PhD (University of Wisconsin–Madison). Dr. Schoech is a Senior Consultant at Christensen Associates, where he has been employed for forty-one years. He has expertise in productivity measurement and price cap design and has applied his expertise across several industries including electric utilities, telecommunications, postal services and railroads. Dr. Schoech was involved in developing some of the earliest price cap plans for various U.S. telecommunications companies, and his testimony in 2017 was widely cited by the Federal Communications Commission in their recent decision on price caps for telecom special services. Previously, he testified on price cap issues for electric and gas utilities in Ontario and Alberta, and he helped develop the rate cap formula for the railroad industry. Currently, he oversees the measurement of productivity for the United States Postal Service.

6. HOURLY RATES AND PROPOSED BUDGET

Hourly rates are provided in the pricing document submitted with this proposal. Our hourly rates are fully loaded, incorporating all overhead and administrative fees. We have included separate subtotals for Tasks 1 through 6 and Tasks 7 through 11.

Tasks 1 through 6 represent work performed through the filing of direct pre-filed testimony. This work is very predictable. Thus, we are offering a not-to-exceed budget for Tasks 1 through 6.

The work required for Tasks 7 through 11 is much less predictable in nature and our budget for these items represents our best, good-faith estimate for these tasks at this time. Because of the

uncertainty inherent in tasks 7 through 11, these tasks will be billed on a time-and-materials basis. The relevant hourly rates found in the bid form will be used to bill for these tasks.

CA Energy Consulting and Kaufmann Consulting will submit separate invoices on a monthly basis to National Grid. Travel will be separately identified and supported with receipts for airfare, ground transportation, lodging, and other costs. Other Direct Costs, if any, will also be identified and supported with receipts. Travel and Other Direct Costs will be charged to National Grid at our cost, without markup.

7. CONTACT PERSONS

The individual who is authorized to conduct negotiations on behalf of CA Energy Consulting is Tammy Droessler, CEO, TCDroessler@LRCA.com, 608.216.7139.

For technical issues, contact Dr. Mark Meitzen, memeitzen@LRCA.com, 608.216.7108.

APPENDIX A
RESUMES OF PROJECT PRINCIPALS

We attach resumes for the following project principals:

- Dr. Mark E. Meitzen
- Dr. Lawrence Kaufmann
- Mr. Nick Crowley
- Dr. Philip E. Schoech

Mark E. Meitzen

RESUME

June 2019

Address:

Laurits R. Christensen Associates, Inc.
800 University Bay Drive, Suite 400
Madison, Wisconsin 53705-2299
Telephone: 608.231.2266
Fax: 608.231.2108
Email: memeitzen@LRCA.com

Academic Background:

PhD, University of Wisconsin–Madison, 1982, Economics
MS, University of Wisconsin–Madison, 1979, Economics
BS, University of Wisconsin–Oshkosh, 1976, Economics

Positions Held:

Senior Consultant, present
Vice President, Laurits R. Christensen Associates, Inc., 1998–2016
Director-Telecommunications, Laurits R. Christensen Associates, Inc., 1993–1998
Senior Economist, Laurits R. Christensen Associates, Inc., 1990–1993
Regulatory Economist, Southwestern Bell Telephone Company, 1988–1990
Regional Economist, Southwestern Bell Telephone Company, 1986–1988
Adjunct Faculty, Saint Louis University, St. Louis, Mo., 1987–1990
Visiting Assistant Professor of Economics, University of Wisconsin-Milwaukee, 1984–1985
Assistant Professor of Economics, Eastern Michigan University, 1981–1984

Professional Experience:

I have expertise in the economic analysis of network industries including telecommunications, electricity, postal and railroad. This experience includes cost and productivity analysis, and the design of incentive regulation plans. I have directed analyses and testified in a number of jurisdictions in the U.S. and elsewhere on these issues, including the Federal Communications Commission, the Alberta (Canada) Utilities Commission, OSIPTEL (Peru), and the U.S. Surface Transportation Board. I also have experience as an expert witness on economic damages in civil litigation cases on a range of issues, including antitrust, intellectual property, breach of contract, and employment issues.

Publications:

"Debunking the Mythology of PBR in Electric Power," *The Electricity Journal*, 31 (2018), (with P. E. Schoech and D. L. Weisman).

"The Alphabet of PBR in Electric Power: Why X Does Not Tell the Whole Story," *The Electricity Journal*, 30 (2017), (with P. E. Schoech and D. L. Weisman).

"Minnesota Freight Rail Economic Development," prepared for the Minnesota Department of Transportation and the Minnesota Department of Employment and Economic Development, November 2013.

"Preserving and Protecting Freight Infrastructure and Routes," *TR News* No. 284, Jan-Feb 2013.

"NCFRP Report 16: Preserving and Protecting Freight Infrastructure and Routes," Transportation Research Board of the National Academies, 2012.

"Preserving and Protecting Freight Infrastructure and Routes," *Proceedings of the ASME/ASCE/IEEE 2012 Joint Rail Conference*, April 2012 (with L. Loftus-Otway, R. Grow, N. Hutson, and A. Bruening).

"Railroad Performance Under the Staggers Act," *Regulation,* Vol. 33, No 4 – Winter 2010–2011 (with B. K. Eakin, A. T. Bozzo, and P. E. Schoech).

"Incentive Regulation in Network Industries: Experience and Prospects in the U.S. Telecommunications, Electricity and Natural Gas Industries," *Review of Network Economics*, Vol. 2, Issue 4 - December 2003, pp. 316–337, (with R. C. Hemphill and P. E. Schoech).

"Total Factor Productivity in the Telecommunications Industry," in *International Handbook on Telecommunications Economics*, G. Madden and S. Savage, eds., 2003, (with L. R. Christensen and P. E. Schoech).

"Pricing Network Elements Under the Telecommunications Act of 1996: Back to the Future," *Comm/ENT*, Summer 2001, (with S. Massa and S. G. Parsons).

"Controlling for Cross Subsidization in Electric Utility Regulation," Edison Electric Institute, September 1998, (with L. Kaufmann and M. Lowry).

"Where Do We Go from Here?" *Public Utilities Fortnightly*, June 15, 1993, (with L. R. Christensen and P. E. Schoech).

"Recent State Legislation for Telecommunications: Brave New World or Bad Public Utility Law?" *George Mason University Law Review*, Vol. 14, No. 1, Fall 1991, (with A. C. Larson). Reprinted in *Public Utility Law Anthology*, Vol. 15, Part 2, July-December 1992, Allison P. Zabriske, ed., (Gaithersburg MD: International Library Book Publishers, Inc.) 1992, pp. 433–491.

"The Uses and Abuses of Stand-Alone Costs," *Utilities Policy*, April 1992, (with A. C. Larson). Shorter, nontechnical version appeared as "The Use of Stand-Alone Cost in Public Utility Regulation," *National Estimator*, spring 1992.

"The Shared Cost Problem and Cash Cow Economics: Who Gets Milked?" *Public Utilities Fortnightly*, April 1, 1991.

"Diversification of Telephone Company Service Offerings and Cash Cow Economics: Who Gets Milked?" *Utilities Policy*, October 1990.

Cost and Pricing Principles for Telecommunications: An Anthology, Washington: United States Telephone Association, September 1990, (co-edited with A. C. Larson).

"The LEC's Transition to Full Competition: The Response of Regulation," *The Computer Lawyer*, July 1990, (with T. J. Schroepfer).

"Differential Compensation and Worker Turnover," *Journal of Economics*, 1989, (with L. Brannman).

"Differences in Male and Female Job Quitting Behavior," *Journal of Labor Economics*, 1986.

"The Impact of Unionism on Exit and Voice Decisions in the Labor Market," *Journal of Economics*, 1984, (with S. Hayworth).

"Empirical Analysis of the Rate of Worker Separation," in *Subsidizing On-the-Job Training*, Columbus, OH: National Center for Research in Vocational Education, 1982.

Presentations at Workshops and Professional Meetings:

"Adoption of Broad-Based PBR Indexing Plans in Electric Distribution," Wisconsin Public Utilities Institute, July 2017 (with Dennis Weisman).

"Preserving and Protecting Freight Infrastructure and Routes, Findings from NCFRP 24," Transportation Research Board Annual Meetings, January 2012.

"Preserving and Protecting Freight Infrastructure and Routes, Findings from NCFRP 24," Federal Highway Administration, Talking Freight Seminar, August 2011.

"Preserving and Protecting Freight Infrastructure and Routes," NCFRP24 Workshop, January 2011.

"Preserving and Protecting Freight Infrastructure and Routes," Minnesota Freight Advisory Committee, October 2010.

"An Update to the Study of Competition in the U.S. Freight Railroad Industry," Midwest Association of Rail Shippers, July 2010.

Overview of the Christensen Associates' Railroad Industry Studies," National Coal Transportation Association, September 2009.

"Overview of the Christensen Associates' Railroad Industry Studies," Midwest Association of Rail Shippers, July 2009.

"A Study of Competition in the Railroad Industry and Analysis of Proposals to Enhance Competition, A Progress Report," National Coal Transportation Association, April 2008.

"A Study of Competition in the Railroad Industry and Analysis of Proposals to Enhance Competition, A Progress Report," Midwest Association of Rail Shippers, January 2008.

"Economics of Price Erosion Using Available Data," Law Seminars International Patent Damages Workshop, Chicago, IL, April 2004.

"Economics of Price Erosion and Lost Convoyed Sales Using Available Data," Law Seminars International Patent Damages Workshop, Chicago, IL, April 2003 (with J. Cordray).

"Local Exchange Competition," Wisconsin Public Utility Institute, Madison, WI, April 2003.

"Patent Damages: Analyzing the Market But-For Infringement," presented to the Milwaukee Bar Association's Intellectual Property Section, May 2000, (with C. Degen).

"Implementation of Price Cap Regulation–The FCC Experience," Wisconsin Public Utility Institute, Madison, WI, September 1999.

"Costs of Universal Service," Wisconsin Public Utility Institute, Madison, WI, March 1997.

"Unbundled Network Elements and Economic Cost Standards," Wisconsin Institute of Certified Public Accountants, Madison, WI, October 1997.

"The Uses and Abuses of Stand-Alone Costs," Second Prize winner in the Research Awards Competition of the Eleventh Annual Southeastern Public Utilities Conference, Atlanta, GA, September 23, 1991.

"Diversification of Telephone Company Service Offerings and Cash Cow Economics: Who Gets Milked?" First Prize winner in the Research Awards Competition of the Tenth Annual Southeastern Public Utilities Conference, Atlanta, GA, August 1990. Also presented at the Third Annual Western Conference of the Rutgers University Advanced Workshop in Regulation and Public Utility Economics, San Diego, CA, July 1990.

"Financial Market Implications of Competition and Regulation in the Telecommunications Industry," Eighth Annual Conference of the Rutgers University Advanced Workshop in Regulation and Public Utility Economics, Newport, RI, May 1989.

"Foreign Trade in Telecommunications Equipment," Second prize winner in the papers competition held in conjunction with the Eleventh Annual Midwestern Telecommunications Conference, Minneapolis, MN, October 1988.

"Perspectives on Local Exchange Competition," Presented at the Seventh Bi-Annual Conference of the International Telecommunications Society, Cambridge, MA, June 1988.

"The Effects of Market Signals on the Construction of Incentive Contracts in a Principal-Agent Model: The Case of the Academic Labor Market," 1984 Atlantic Economics Society Conference, Montreal, Canada, (with B. Woodland).

"The Role of Voice Mechanisms in Workers' Participation in and Satisfaction with Unions," 1984 Midwest Economics Association Convention, Chicago, IL.

"Hedonic Wage Models and Worker Turnover," 1984 Midwest Economics Association Convention, Chicago, IL.

"The Impact of Unionism on Exit and Voice Decisions in the Labor Market," 1984 Missouri Valley Economics Association Convention, Kansas City, MO, (with S. Hayworth).

"Differences in Male and Female Job Quitting Behavior," 1983 Midwest Economics Association Convention, St. Louis, MO.

Non-Confidential Consulting Reports and Research Papers:

"Rebuttal Testimony of Mark E. Meitzen, Ph.D.," Massachusetts Department of Public Utilities Docket No. D.P.U. 18-150, April 22, 2019.

"Pre-Filed Direct Testimony of Mark E. Meitzen, Ph.D.," Massachusetts Department of Public Utilities Docket No. D.P.U. 18-150, November 15, 2018.

"Rebuttal Testimony of Mark E. Meitzen, Ph.D., Dennis L. Weisman, Ph.D., and Carl G Degen," Massachusetts Department of Public Utilities Docket No. D.P.U. 17-05, May 19, 2017.

"Direct Testimony of Mark E. Meitzen, Ph.D.," Massachusetts Department of Public Utilities Docket No. D.P.U. 17-05, January 17, 2017

"Supplemental Declaration of Mark E. Meitzen, Ph.D. and Philip E. Schoech, Ph.D.," Federal Communications Commission, WC Docket No. 16-143, *et. al.*, September 22, 2016.

"Reply Comments of Mark E. Meitzen, Ph.D. and Philip E. Schoech, Ph.D.," Federal Communications Commission, WC Docket No. 16-143, *et. al.*, August 9, 2016.

"Assessment of the FCC's Proposed Options for the Special Access Price Cap X-Factor (with P.E. Schoech), Federal Communications Commission, WC Docket No. 16-143, *et. al.*, June 28, 2016.

"Determination of the Second-Generation X Factor for the AUC Price Cap Plan for Alberta Electric Distribution Companies," Alberta Utilities Commission Proceeding ID 20414, March 2016.

"Revisiting the CPI-Based Price Cap Formula for the U.S. Postal Service," 2012 Eastern Conference of the Center for Research in Regulated Industries, May 2012 (with P. Schoech and M. Kubayanda).

"An Update to the Study of Competition in the U.S. Freight Railroad Industry," prepared for the U.S. Surface Transportation Board, January 2010 (Christensen Associates).

"Supplemental Report to the U.S. Surface Transportation Board on Capacity and Infrastructure Investment," prepared for the U.S. Surface Transportation Board, March 2009 (Christensen Associates).

"A Study of Competition in the U.S. Freight Railroad Industry and Analysis of Proposals that Might Enhance Competition," prepared for the U.S. Surface Transportation Board, November 2008 (Christensen Associates).

"Comments of the Minnesota Department of Commerce," *in the Matter of Commission Investigation of Cost for Appropriate Level of Universal Service Support*, Minnesota Docket No. P999/CI-00-829 (Minnesota Department of Commerce).

"Productivity Performance of the Wisconsin Local Exchange Carrier Industry," and "Comments of Christensen Associates on Consultant Productivity Studies," January 2003, Wisconsin PSC Docket 1-AC-193, (with L. R. Christensen, P. E. Schoech, and S. M. Schroeder).

"Determination of the X Factor for the Regulation of Telefonica del Peru," August 2001, (with P. E. Schoech, C. Smyser, and S. M. Schroeder).

"The Ameritech Illinois Total Factor Productivity Study," June 2000, Illinois Commerce Commission Docket 98-0252, (with P. E. Schoech and S. M. Schroeder).

"Market Power Study of the Potomac River, Benning Road, and Buzzard Point Power Plants," Final Report to Potomac Electric Power Company, April 2000, (with F. L. Alvarado, L. D. Kirsch, S. D. Braithwait, B. K. Eakin, S. L. Greene, R. Rajaraman, and J. D. Reaser).

"Price Cap Design and X Factor Estimation for Peruvian Telecommunications Regulation," Final Report to OSIPTEL, May 1999, (with L. R. Christensen, P. E. Schoech, L. D. Kirsch, C. A. Herrera, and S. M. Schroeder).

"Analysis of Benchmark Cost Proxy Model 3.0, Hatfield Model, Version 5.0 and Hybrid Cost Proxy Model," Federal Communications Commission, CC Docket 96-45, January 1998, (with A. T. Bozzo, T. Rutkowski, and T. Grau).

"Analysis of Benchmark Cost Proxy Model and Hatfield Release 3.1," Federal Communications Commission, CC Docket 96-45, April 1997, (with L. R. Christensen, P. E. Schoech, A. T. Bozzo, and T. Rutkowski).

"The TFPRP Provides the Best Basis for Determining the Rate of LEC TFP Growth," Federal Communications Commission, CC Docket 94-1, February 1997, (with L. R. Christensen and P. E. Schoech).

"Appropriate Standards for Cost Models and Methodologies," Federal Communications Commission, CC Docket 96-45, Final Report to United States Telephone Association, February 1997.

"Updated Results for the Simplified TFPRP Model and Response to Productivity Questions in FCC's Access Reform Proceeding," Federal Communications Commission, CC Docket 94-1, January 1997, (with L. R. Christensen and P. E. Schoech).

"Economic Evaluation of Proxy Cost Models for Determining Universal Service Support," Federal Communications Commission, CC Docket 96-45, January 1997.

"A Survey of X-Factor Experience in the United States," filed with Canadian Radio and Telecommunications Commission on behalf of Stentor Member Companies, June 1996, (with L. R. Christensen and P. E. Schoech).

"An Evaluation of the Bell Canada, BC TEL, MTS NetCom Inc., and Maritime Tel & Tel Limited Total Factor Productivity Studies," filed with Canadian Radio and Telecommunications Commission on behalf of Stentor Member Companies, June 1996, (with L. R. Christensen and P. E. Schoech).

"Total Factor Productivity Methods for Local Exchange Carrier Price Cap Plans: Reply Comments," Federal Communications Commission, CC Docket 94-1, March 1996, (with L. R. Christensen and P. E. Schoech).

"Total Factor Productivity Methods for Local Exchange Carrier Price Cap Plans," Federal Communications Commission, CC Docket 94-1, December 1995, (with L. R. Christensen and P. E. Schoech).

"Productivity of the Local Operating Telephone Companies Subject to Price Cap Regulation 1993 Update," Federal Communications Commission, CC Docket 94-1, January 1995, (with L. R. Christensen and P. E. Schoech).

"Productivity Growth in the Cable Television Industry," filed with Federal Communications Commission on behalf of the National Cable Television Association, June 1994, (with L. R. Christensen and P. E. Schoech).

"Productivity of the Local Operating Telephone Companies Subject to Price Cap Regulation," Federal Communications Commission, CC Docket 94-1, May 1994, (with L. R. Christensen and P. E. Schoech).

"Sources and Methods for the Ohio Bell Total Factor Productivity Study," Public Utilities Commission of Ohio, Case No. 93-487-TP-ALT, 1993, (with L. R. Christensen and P. E. Schoech).

"Sources and Methods for the Illinois Bell Total Factor Productivity Study," Illinois Commerce Commission, Case No. 92-0448, December 1992, (with L. R. Christensen and P. E. Schoech).

Expert Testimony – Regulatory Proceedings

Massachusetts Department of Public Utilities, *Massachusetts Electric Company and Nantucket Electric Company each d/b/a National Grid, Investigation as to the Propriety of Proposed Tariff Changes,* D.P.U. 18-150, May 2019.

Massachusetts Department of Public Utilities, *Petition of NSTAR Electric Company and Western Massachusetts Electric Company each d/b/a Eversource Energy for Approval of an Increase in Base Distribution Rates of Electric Service,* D.P.U, 17-05, June 2017.

Alberta Utilities Commission, *Next Generation Performance-Based Regulation Generic Proceeding*, AUC Proceeding ID 20414, July 2016.

Federal Communications Commission, *Special Access for Price Cap Local Exchange Carriers*, WC Docket No. 16-143, WC Docket No. 15-247, WC Docket 05-25, June 2016, August 2016.

Before the U.S. Surface Transportation Board, "Joint Verified Statement of B. Kelly Eakin, Mark E. Meitzen, and Philip E. Schoech," STB Ex Parte No. 722, Railroad Revenue Adequacy, September 2014.

Before the U.S. Surface Transportation Board, "Joint Verified Statement of B. Kelly Eakin and Mark E. Meitzen," STB Docket No. NOR 42121, Total Petrochemicals & Refining USA, INC. v. CSX Transportation, Inc., June 2013.

Before the U.S. Surface Transportation Board, "Joint Verified Reply Statement of B. Kelly Eakin and Mark E. Meitzen," STB Ex Parte No. 711, Petition for Rulemaking to Adopt Revised Competitive Switching Rules, May 2013.

Before the U.S. Surface Transportation Board, "Joint Verified Statement of B. Kelly Eakin and Mark E. Meitzen," STB Ex Parte No. 711, Petition for Rulemaking to Adopt Revised Competitive Switching Rules, March 2013.

Before the U.S. Surface Transportation Board, "Joint Statement of B. Kelly Eakin and Mark E. Meitzen," STB Docket No. NOR 42125, E.I. DuPont De Nemours and Company v. Norfolk Southern Railway Company, November 2012

Before the U.S. Surface Transportation Board, "Joint Verified Statement of B. Kelly Eakin and Mark E. Meitzen," STB Docket No. NOR 42123, M&G Polymers USA, LLC v. CSX Transportation, Inc., November 2012.

Before the U.S. Surface Transportation Board, "Joint Verified Statement of B. Kelly Eakin and Mark E. Meitzen," STB Ex Parte No. 705, Competition in the Railroad Industry, May 2011.

Before the U.S. Surface Transportation Board, "A Study of Competition in the U.S. Freight Railroad Industry and Analysis of Proposals that Might Enhance Competition, Final Report," November 2008.

Client: Coal Shippers Coalition (2006)
Proceeding: Surface Transportation Board Ex Parte No. 657 (Sub-No. 1)

Client: AEP Texas North (2004)
Proceeding: Surface Transportation Board Docket No. 41191

Client: OSIPTEL (2003)
Proceeding: TdP Price Cap Implementation (Peru)

Client: OSIPTEL (2002)
Proceeding: TdP Price Cap Implementation (Peru)

Client: OSIPTEL (2001)
Proceeding: TdP Price Cap Implementation (Peru)
Client: Ameritech Illinois (2001)
Proceeding: ICC Docket No. 98-0252

Client: Texas Municipal Power Agency (2001)
Proceeding: Surface Transportation Board Docket No. 42056

Client: Reliant Energy HL&P (2000)
Proceeding: Texas SOAH Docket No. 473-00-1020, Texas PUC Docket No. 22355

Client: Frontier Communications (1999)
Proceeding: MPSC Case No. U-12049

Client: TDS Telecom (1998)
Proceeding: MPSC Case No. U-11815

Client: Mid-Plains Telephone (1997)
Proceeding: PSCW Dockets 3650-MA-100 and 5845-MA-100

Client: Washington Independent Telephone Association (1997)
Proceeding: WUTC Docket UT-960369

Client: Michigan Exchange Carriers Association (1997)
Proceeding: MPSC Case No. U-11448

Client: Wisconsin State Telephone Association (1996)
Proceeding: PSCW Docket 05-TI-137

Client: Ameritech Illinois (1995)
Proceeding: ICC Docket 95-0458

Client: Southwestern Bell Corporation Media Ventures (1994)
Proceeding: Maryland PSC Docket 8659

Client: Ameritech Illinois (1993)
Proceeding: ICC Docket 92-0211

Client: Urban Telephone Company (Wisconsin) (1992)
Proceeding: PSCW Docket 6050-TI-100

Lawrence Kaufmann

Resume

April 2020

Address: 12520 Central Park Drive
Austin, Texas 78732
(608) 443-9813 (cell)

Education:

Ph.D.:	Economics, University of Wisconsin-Madison, 1993
BA & MA:	Economics, University of Missouri-Columbia, 1984
High School:	St. Louis University High, St. Louis, MO, 1980

Relevant Work Experience, Primary Positions:

December 2008 – present: President, Kaufmann Consulting
Senior Advisor, Pacific Economics Group and Navigant Consulting
Fellow, Canadian Energy Research Institute (since April 2015)

Advise companies and public agencies, particularly energy utilities and regulators, on various regulatory and industry restructuring issues. Duties include consultation on performance-based regulation (PBR), developing service quality incentive plans, analyzing appropriate code of conduct policies for competitive markets, and providing supporting empirical research. Duties involve preparing public testimony and written reports, overseeing empirical research, client contact and briefings, and public presentations.

January 2001 – December 2008: Partner, Pacific Economics Group, Madison, WI
November 1998 – December 2000: Vice President, Pacific Economics Group, Madison, WI

Advise energy utilities and regulators on various industry restructuring issues. Duties include consultation on performance-based regulation (PBR), developing service quality incentive plans, analyzing appropriate code of conduct policies for competitive markets, and providing supporting empirical research. Duties involve preparing public testimony and written reports, overseeing empirical research, client contact and briefings, and public presentations.

August 1993 – October 1998: Senior Economist, Christensen Associates, Madison, WI

Assisted in the development and evaluation of PBR plans for energy utilities and other regulated enterprises. Duties included theoretical and empirical research (including the estimation of total factor productivity trends), written reports, client contact and briefings, public presentations, and monitoring regulatory trends in the United States and overseas.

January 1993 - July 1993: Research Assistant to Dr. Robert Baldwin, Department of Economics, University of Wisconsin-Madison

Project investigated whether dumping penalties imposed by the United States have led to a diversion of imports from the nations on which the duties were assessed to other exporters.

January 1991 - May 1993: Dissertation research on the impact of foreign investment on Mexican firms.

Dissertation examined whether there has been any spillover of advanced multinational technologies to competing Mexican firms. Research included development of a theoretical model of spillovers through Mexican recruitment of multinational personnel, interviews and data collection in Mexico, and empirical tests of theoretical conclusions. Dissertation research was funded through a fellowship from the Mellon Foundation.

June 1989 - December 1990: Research Associate, Credit Union National Association, Madison, WI

Initiated and assisted on several long-term research projects, including the assessment of capital positions at Corporate credit unions, comparing the asset portfolios of credit unions and banks, and analysis concerning the development of credit union industries in Poland and Costa Rica.

January 1988 - August 1988: Investment Banking Officer and Associate Economist, Centerre Bank, St. Louis, MO

April 1985 - December 1987: Assistant Economist, Centerre Bank, St. Louis, MO

As Assistant Economist, the primary duty was to prepare country risk reports on nations to which the bank was lending. As Associate Economist and Investment Banking Officer, duties expanded to include writing a twice-weekly column on interest rate trends and preparing special reports on regional, national and international economic trends for senior management.

August 1983 - December 1984 and four semesters during the period September 1988 - May 1993:

Teaching assistant for classes in introductory microeconomics, introductory macroeconomics, international economics and the history of economic thought.

Professional Memberships: American Economic Association
National Association of Business Economists

Foreign Language Proficiency: Spanish

Major Consulting Projects:

1. Advice on PBR strategy and application. Fortis BC, 2018-2020.
2. Policy testimony and cost benchmarking study in support of performance-based regulation plan. National Grid, 2018.
3. Confidential advice on regulatory strategy. Client wishes to remain anonymous at this time, 2018.
4. Advice on regulatory environment and investment strategy. Client wishes to remain confidential at this time, 2017-2018.
5. Escalators for operating and construction expenses. Epcor Water West, 2017-18.

6. Rebuttal testimony on cost and wage benchmarking. Puerto Rice Electric Power Authority, 2016-2017.
7. Review and respond to comments on Epcor Water testimony. Epcor Water, 2016.
8. Review of regulatory framework to encourage efficient investment and accommodate uncertainty. Client wishes to remain confidential at this time, 2016.
9. Assessment of Ontario Power Generation ratemaking proposal. Ontario Energy Board, 2016.
10. Testimony on cost and wage benchmarking. Puerto Rico Electric Power Authority, 2016.
11. Testimony recommending updated inflation escalators in performance-based regulation plan. Epcor Water, 2015-2016.
12. Testimony recommending productivity factor for updated performance-based regulation plan. Epcor Water, 2015-2016.
13. Finalize reliability standards for electricity distributors in Ontario. Ontario Energy Board, 2015-2016.
14. Testimony on benefits of expanding bidding process for expansion of Alliant Riverside Energy Center facility. Associated Builders and Contractors of Wisconsin, 2015.
15. Cost benchmarking study. Puerto Rico Electric Power Authority, 2015.
16. Multi-client "Utility of the Future" and PBR study. Clients wish to remain confidential at this time, 2015.
17. Advise on benchmarking methods for electricity distribution. ANEEL, Brazilian Electricity Regulatory Agency, 2014.
18. The impact of gas extension tariffs on the development of the CNG market in Wisconsin. Reinhart Boerner Van Deuren on behalf of Kwik Trip, 2014.
19. TFP study and review of price controls in New Zealand. New Zealand Electricity Network Association, 2014.
20. Advise on benchmarking and regulatory issues in Toronto Hydro Custom IR application. Ontario Energy Board, 2014-15.
21. Advise on interrogatory responses. Consumer Energy Coalition of British Columbia, 2014.
22. Survey and analysis of implementation issues associated with customer-specific reliability metrics. Ontario Energy Board, 2013-15.
23. Empirical analysis and recommendation of appropriate reliability benchmarks. Ontario Energy Board, 2013-15.
24. Cost of service review (transmission and distribution operations) and cost benchmarking for Israel Electric Corporation. Public Utility Authority of Israel, 2013-15.
25. Value of reliability improvements from undergrounding power lines. Wisconsin Public Service, 2013.
26. Advise on and assess gas distribution incentive regulation plans. Ontario Energy Board, 2013-14.
27. Advise on price control application. UK Power Networks, 2013.

28. Advise on electricity distribution incentive regulation plans and other aspects of renewed regulatory framework for electricity. Ontario Energy Board, 2012-13.

29. Response to Productivity Commission Report on Energy Network Regulatory Frameworks. Energy Safe Victoria, 2012.

30. Statement on appropriate opt-out policies for smart meters to Wisconsin Public Service Commission. SMART Water, 2012.

31. Submission to Australia's Productivity Commission on the role of benchmarking in utility regulation. Energy Safe Victoria, 2012.

32. Assist Staff on review of cost of service applications for Enbridge Gas Distribution and Union Gas. Ontario Energy Board, 2012.

33. Assist with responses on data requests in testimony on alternative regulation plan. Potomac Electric Power, 2011-12.

34. Assess incentive regulation plans for Union Gas and Enbridge Gas Distribution in Ontario. Ontario Energy Board, 2011.

35. Advise on demand-side management and decoupling plans, and utility involvement in conservation and renewable energy businesses. ATCO Gas, 2011.

36. Advise on defining and measuring utility performance and the use of performance measures and standards in electric utility regulation. Ontario Energy Board, 2011-12.

37. Advise on rate mitigation strategies. Ontario Energy Board, 2011.

38. Advise on PBR strategy in Alberta. EDTI, 2011-12.

39. Estimate total factor productivity trend for gas distributors in New Zealand. Powerco, on behalf of industry, 2011.

40. Evaluation of reliability standards and alternative regulatory approaches for maintaining the reliability of electricity supplies. Ontario Energy Board, 2010-12

41. Prepare submission on rule change application and respond to consultant reports on TFP spreadsheet simulations and the impact of the regulatory framework on energy safety. Energy Safe Victoria, 2010.

42. Research on operating productivity and input price changes and testimony in support of an incentive-based formula to recover changes in gas distribution operating expenses. National Grid, 2010.

43. Prepare submission on rule change application and respond to consultant reports on TFP methodology. Essential Services Commission, 2010.

44. Advise on submission on rule change application. Victoria Department of Primary Industries, 2010.

45. Productivity research Victoria gas distribution industry, Essential Services Commission, 2010.

46. Productivity research Victorian power distribution industry, Essential Services Commission, 2010.

47. Advise on revenue decoupling and alternative regulatory strategies in context of upcoming gas distribution rate case. Northwest Natural Gas, 2009-2010.

48. Advise on revenue decoupling. Ontario Energy Board, 2009-2010.

49. Develop a "top down," econometrically-based measure of reductions in gas consumption resulting from utility DSM programs, and evaluate the merits of this approach compared to the existing "bottom up" methodology. Ontario Energy Board, 2009-2010.

50. Respond to proposals to amend National Energy Regulatory Framework to allow alternative approaches to incentive regulation. Essential Services Commission, 2009-2010.

51. Evaluate consultant reports and prepare submission on the update of price control formulas. New Zealand Energy Network Association, 2009.

52. Evaluate consultant reports in review on alternate regulatory arrangements. Essential Services Commission 2009.

53. Estimate TFP trend for New Zealand electricity distributors. New Zealand Energy Network Association 2009.

54. Evaluate consultant reports in review on alternate regulatory arrangements. Essential Services Commission 2009.

55. Submission on the application of total factor productivity in utility network regulation. Essential Services Commission, 2008-09.

56. Estimate total factor productivity trends, benchmark gas distribution cost performance, and testify in support of research. Bay State Gas, 2008-09.

57. Advise on appropriate regulatory treatment of early termination fees in retail energy markets. Essential Services Commission, 2008.

58. Advise on appropriate regulation of gas connection charges. Essential Services Commission, 2008.

59. Advise on appropriate cost of capital. Jamaica Public Service, 2008.

60. Estimate total factor productivity trends and benchmark bundled power cost performance for use in a productivity based regulation plan. Jamaica Public Service, 2008.

61. Estimate gas distribution total factor productivity trends. Essential Services Commission, 2008.

62. Update estimate total factor productivity trends electricity distributors. Essential Services Commission, 2008.

63. Respond to productivity and benchmarking studies. New Zealand Electricity Networks Association, 2008.

64. Response to comments on appropriate productivity and input price measures to be used to update gas distributors' operating expenses. Essential Services Commission, 2007-08.

65. Advise on update of performance based regulatory plan for power distributors, including recommendations for total-factor productivity based X factors. Ontario Energy Board, 2007-08.

66. Estimate lost wage and health damages. Wolfgram and Associates, 2007.

67. Response to critique of X factor recommendations. Ontario Energy Board, 2007.

68. Review of benchmarking methods and proposed benchmarking for the pricing of unbundled copper local loop. Telecom NZ, 2007.

69. Report on the relationship between revenue decoupling and performance-based regulatory mechanisms. Massachusetts energy distribution companies, 2007.

70. Research on revenue decoupling experience in California. National Grid, 2007.

71. Report on regulatory reforms needed to facilitate demand response, advanced metering infrastructure and energy efficiency objectives. Essential Services Commission, 2007.

72. Estimate lost wage and health damages. Wolfrgram and Associates, 2007.

73. Evaluation of gas distribution construction cost trends. Essential Services Commission, 2007.

74. Appropriate productivity trends and labor inflation rates to be used to adjust operating expenses in incentive-based ratemaking. Essential Services Commission, 2007.

75. Testify in support of rate adjustment under a performance based regulation plan. Bay State Gas, 2007.

76. Report on service quality regulation and benchmarking, submitted as expert witness testimony. Detroit Edison, 2007.

77. Develop and testify in support of alternative regulation plan for gas distribution services. Client confidential at this time, 2007.

78. Evolution of energy asset management companies and outsourcing relationships. Davidson Kempner Advisers, 2007.

79. O&M partial factor productivity trends for gas distribution services. Essential Services Commission, 2006-07.

80. Principles for designing gas supply PBR plans and assessing the impact of retail gas costs. DLA Piper Rudnick, 2006-07.

81. Framework for analyzing appropriate early termination fees in competitive retail electricity markets. Essential Services Commission, 2006-07.

82. Testify in support of exogenous factor recovery of revenues lost due to declining natural gas usage. Bay State Gas, 2006.

83. Service quality benchmarking. Canadian Electricity Association, 2006.

84. Analyze natural resource and recreational damage calculations for environmental damage to trout stream. Michael, Best and Friedrich, 2006.

85. Evaluate outsourcing contract and report benchmarking Envestra's gas distribution operations and maintenance expenses. ESCOSA, 2006.

86. Report on the use of partial factor productivity trends in the updated gas access arrangement. Essential Services Commission, 2006.

87. Advise on approved X factors and total factor productivity trends in approved alternative regulation plans for electric utilities. Central Maine Power, 2006.

88. Estimate total factor productivity and input price trends power distribution industries in all Australian States and territories, Essential Services Commission, 2006.

89. Develop and testify in support of an alternative regulation plan for gas distribution services. Client wishes to remain confidential at this time, 2006.

90. Develop and testify in support of an alternative regulation plan for gas distribution services. Client wishes to remain confidential at this time, 2006.

91. Testimony on treatment of outsourcing contract costs and labor-nonlabor cost allocations. Essential Services Commission, 2005-06.

92. Incorporate lessons from incentive regulation and benchmarking overseas into newly-established regulatory framework for nation's electric utilities. Bundesnetzagentur (BNA), Bonn Germany, 2005-2006.

93. Submission to Ministerial Council on Energy related to Regulatory Rulemaking. Essential Services Commission, 2005.

94. Evaluation of early termination fee policies for energy retailers. Essential Services Commission, 2005.

95. Advise on alternative regulation strategies for gas distribution services. Client wishes to remain confidential at this time, 2005-2006.

96. Report on comprehensive framework for using performance indicators to evaluate market power abuses, efficiency gains, and the distribution of benefits to stakeholders. Essential Services Commission, 2005.

97. Evaluation of regulatory options and estimation of total factor productivity for Port of Melbourne Corporation. Essential Services Commission, 2005.

98. Evaluation of regulatory options for taxi services in Melbourne, Australia. Essential Services Commission, 2005.

99. White Paper advising government agency on regulatory reform of State's electric power industry. Department of Natural Resources Newfoundland and Labrador, 2005.

100. Review report on CAPM and differences in beta between rural and urban power distributors. Essential Services Commission, 2005.

101. Develop "incentive power" model and apply towards evaluation of regulatory options in Victoria, Australia. Essential Services Commission, 2004-2005.

102. Review report on labor price forecasts for Victoria, Australia. Essential Services Commission, 2004-2005.

103. Develop and testify in support of performance-based regulation plan. Bay State Gas, 2004-2005.

104. Review of gas regulatory framework in Ontario, Canada. Ontario Energy Board, 2004-2005.

105. Benchmarking gas distribution operations. Powerco, Vector, NGC (New Zealand), 2004.

106. Report on methodologies for updating CPI-X price controls and assemble US gas transmission pipeline data, to be used in update of price controls for gas transmission services. Comision Reguladora de Energia (Mexico), 2004-2005.

107. Benchmark comprehensive power and water utility operations. Aqualectra (Curacao, Netherlands Antilles), 2004-2005.

108. Benchmarking power distribution operations. Energex and Ergon Energy, 2004.

109. Regulatory treatment of hub and storage facilities. NICOR Gas, 2004.

110. Review and comment on proposed service quality regulation. Essential Services Commission, 2004.

111. Review and contribute to report on ring fencing policies. Essential Services Commission, Victoria Australia, 2004.

112. Estimate lost earnings in litigation case. Wolfgram and Gherardini, 2004.

113. Respond to Productivity Commission report on Gas Access Arrangements. Essential Services Commission, Victoria Australia, 2004.

114. Analysis of PBR plans for rates and service quality worldwide. Jamaica Public Service, 2004.

115. Undertake benchmarking and total factor productivity studies in support of an X factor in a performance-based regulatory plan. Jamaica Public Service, 2003-2004.

116. Evaluate incentive regulation options. Questar Gas, 2003-2004.

117. Project evaluating implementation of total factor productivity in energy utility regulation. Essential Services Commission, Victoria Australia, 2003-2005.

118. Evaluate incentive regulation reports commissioned by Australian Competition and Consumer Commission. Essential Services Commission, Victoria Australia, 2003.

119. Evaluate proposed regulatory thresholds regime. Powerco New Zealand, 2003.

120. Evaluate benchmarking methods and regulatory reform proposals. Jamaica Public Service, 2003.

121. Evaluate proposals for service quality regulation in province of Ontario. Hydro One, 2003.

122. Evaluate benchmarking methods and regulatory reform proposals. Overseas New Zealand client wishes to remain confidential at this time, 2003.

123. US-Japan power transmission benchmarking. Central Research Institute of Electric Power Industry (Japan), 2003.

124. Benchmarking power distribution operations and maintenance (O&M) costs benchmarking and O&M productivity growth. Superintendente de Electricidad (Bolivia), 2003.

125. Benchmarking gas distribution operations and maintenance expenses. ACTEW (Australia), 2003.

126. Estimate lost earnings in wrongful death case. Wolfgram and Gherardini, 2003.

127. Advise on updating incentive plan for demand-side management. Hawaiian Electric, 2003.

128. Estimate and testify in support of damages in patent infringement case, Trombetta, LLC vs. Dana Corporation and AEC. Ryan, Kromholz and Mannion, 2003.

129. Analyze service quality proposals for a natural gas distributor, recommend modifications and testify in support of recommendations. New England Gas, 2002-2003.

130. Develop a service quality incentive plan for power distributors in Queensland, Australia; the plan is to be developed through a consultative process between the companies, major customer groups, and the regulator. Queensland Competition Authority, 2002-2003.

131. Consultation on developments regarding Wisconsin Electric's "Power the Future" initiative. Fidelity Investments, 2002.

132. Confidential report on US experience with benchmarking and alternative regulation. Central Research Institute of Electric Power Industry (Japan), 2002-2003.

133. Confidential report on capital cost measurement. Central Research Institute of Electric Power Industry (Japan), 2002-2003.

134. Report on merits and feasibility of benchmarking New Zealand power distributors. United Networks, 2002.

135. Impact of gas marketing expenditures on residential gas consumption. Envestra, 2002.

136. Advise on index-based performance-based regulation plan for a power distribution utility. Client wishes to remain confidential at this time, 2002.

137. Estimate productivity trend gas distribution industry and testify in support of trend. Boston Gas, 2002-2003.

138. Gas distribution benchmarking study. TXU Australia, Envestra and Multinet, 2002.

139. Benchmarking power transmission cost. Transend, 2002.

140. Advise on the development of an incentive regulation proposal for a North American power transmission utility. Hydro One Networks, 2001-2002.

141. Application of productivity and econometric benchmarking in an update of an incentive regulation plan. Ameren UE, 2001-2002.

142. Litigation regarding violations of Unfair Trade Practices Act for Tamoxifen, Taxol, and Buspar prescription drugs. Miner, Barnhill, and Galland, P.C., 2001-2002.

143. Recommend reforms of Western Australia power market, including reforms of wholesale markets, retail markets, structure of the incumbent utility, and regulatory arrangements; work was summarized in a report to the Electricity Reform Task Force. Western Power, 2001.

144. Faculty member of Regulatory Training Seminar in Bolivia. Seminar organized by the Public Utility Research Center and sponsored by SIRESE, 2001.

145. White Paper on implementing total factor productivity measures in regulation for the Utility Distributor's Forum. CitiPower, 2001.

146. Electronic forum on service quality incentives and research topics. Edison Electric Institute, 2001.

147. Economies of scale and scope in power services. Western Power, 2001.

148. Report evaluating the merits of alternative benchmarking methods and their application to energy distributors. Electricity Supply Association of Australia, 2001.

149. Response to report on benchmarking and incentive regulation. Client confidential at this time, 2000-2001.

150. Report on consistency of Price Determination with legislative mandates. TXU Australia, 2000-2001.

151. Develop methodology for service quality benchmarking and construction of appropriate deadbands. Massachusetts Gas and Electric Distribution Companies, 2000.

152. Advise on Performance-Based Regulation strategy, including development of a service quality incentive. BCGas, 2000.

153. Power distribution benchmarking. Queensland Competition Authority, 2000.

154. Develop and testify in support of service quality incentive. Western Resources, 2000.

155. Response to regulatory proposals for "ring fencing" operations. CitiPower, 2000.

156. Benchmarking evaluation of power distribution costs. Client name withheld, 2000.

157. Updated White Paper on Metering and Billing Competition in California. Edison Electric Institute, 2000.

158. Economies of scale and scope in power delivery and metering services. Massachusetts Utility Distribution Companies, 2000.

159. Evaluation of merger benefits. Client wishes to remain anonymous at this time, 2000.

160. Response to study on benchmarking capital spending. CitiPower, 2000.

161. Response to incentive regulation proposals of Pareto Economics in Victorian distribution price review. CitiPower, 2000.

162. Estimate scale economies in power generation, scope economies between power transmission and power generation, and implications for public policy in Western Australia. Western Power, 2000.

163. White Paper on "best practice" regulation and evaluation of price and non-price regulation of energy and water utilities in Australia, the US, and the UK. Electricity Association of New South Wales, 2000.

164. Power transmission benchmarking. Client confidential at this time, 2000.

165. Development of performance-based regulation plan for power distribution services. Texas Utilities, 2000.

166. Response to UMS benchmarking study on O&M costs. Victorian power distributors, 2000.

167. Response to Consultation Paper on Detailed Proposal for Form of the Price Control. CitiPower, 1999-2000.

168. White Paper on cost structure of power distribution. Australian power distributors (coalition contact: the Electricity Supply Association of Australia), 1999-2000.

169. White Paper on benchmarking principles and applications. Victorian power distributors, 1999-2000.

170. Service quality testimony. Hawaiian Electric, Maui Electric, and Hawaii Electric Light, 1999.

171. Faculty member of Regulatory Training Seminar in Argentina. Seminar organized by the Public Utility Research Center and sponsored by Enargas, 1999.

172. Service quality benchmarking study. Southern California Edison, 1999.

173. US-Australia performance benchmarking study. Victorian Distribution Businesses, Victoria, Australia, 1999.

174. Cost benchmarking for power delivery and customer services. Southern California Edison, 1999.

175. Development of Service Quality Incentive and Testimony in Support of Plan. Oklahoma Gas and Electric, 1999.

176. Evaluation of Intervenor Assessments of Customer Benefits in Proposed Merger. Western Resources, 1999.

177. Response to Regulator Proposals for Regulatory Methodology, Efficiency Measurement and Benefit-Sharing, and Form of Distribution Price Controls. CitiPower, Australia, 1999.

178. Response to Incentive Regulation Proposal of Australian Competition and Consumer Commission. CitiPower, Australia, 1998.

179. Report on Metering and Billing Competition in California. Edison Electric Institute, 1998-99.

180. Evaluation of Economies of Vertical Integration for Electric Utilities in Illinois. Edison Electric Institute, 1998.

181. Assessment of Cost Performance of Power Distributors in the United States and Australian state of Victoria. Victorian Power Distributors, 1998.

182. Formal Response to Regulatory Proposals for Price Cap Regulation/Development of Regulatory Options. Victorian Power Distributors, 1998.

183. Development of Service Quality Incentive and Testimony in Support of Plan. Louisville Gas and Electric/Kentucky Utilities, 1998.

184. Regulatory Support for Overall PBR Strategy. Louisville Gas and Electric/Kentucky Utilities, 1998.

185. Testimony on Impact of Brand Name Restrictions in Maine's Retail Energy Markets. Edison Electric Institute, 1998.

186. Development of Service Quality Incentive. Hawaiian Electric, 1998.

187. Regulatory Support for Comprehensive PBR Strategy and Feasibility of Retail Competition in Power Supply Services. Hawaiian Electric, 1997-98.

188. White Paper on Controlling Cross-Subsidization in Electric Utility Regulation. Edison Electric Institute, 1997-98.

189. White Paper on Cost Structure of Integrated Electric Utilities and Implications for Retail Competition. Edison Electric Institute, 1997-98.

190. Regulatory Support for a Price Cap Plan for Combination Utility. San Diego Gas and Electric, 1997-98.

191. White Paper on Price Cap Methodologies for Power Distributors in Victoria, Australia. Victorian Power Distributors, 1997.

192. Development of a Price Cap Plan for a Local Gas Distribution Utility. Atlanta Gas Light, 1997.

193. White Paper on Price Cap Regulation for Power Distribution. Edison Electric Institute, 1997.

194. Comprehensive Report on Performance-Based Regulatory Options for a Local Gas Distribution Utility. Atlanta Gas Light, 1997.

195. White Paper on Use of Electric Utility Brand Names in Competitive Markets. Edison Electric Institute, 1997.

196. Options for Price Cap Regulation for Power Distribution in Colombia. Comision Reguladora de Energía y Gas en Colombia, 1997.

197. Options for Performance-Based Regulation for Power Transmission and Stranded Cost Recovery for an Electric Utility. Client wishes to remain confidential at this time, 1997.

198. Regulatory Support for an Index-Based Incentive Plan of a Local Gas Distribution Utility. BCGas, 1997.

199. Recommendations for a service quality incentive plan. Hawaiian Electric, 1997.

200. Survey of Service Quality Incentive Plans and Assessment of Options. BCGas, 1996.

201. Regulatory Support for a Price Cap Plan. Southern California Gas, 1996.

202. Determination of service territories for newly-privatized gas distributors in Mexico. Comisión Reguladora de Energía, 1996.

203. Assessment of Regulatory Options for a Public Enterprise. United States Postal Service, 1996-97.

204. Regulatory support for a Price Cap Plan of a Local Gas Distribution Utility. Brooklyn Union Gas, 1996.

205. Development of a Price Cap Plan for the Gas Operations of a Combination Utility. Client wishes to remain confidential at this time, 1996.

206. Assessment of Options for Service Quality Incentives. Client wishes to remain confidential at this time, 1996.

207. Development of a Price Cap Plan for an Electric Utility. Client wishes to remain confidential at this time, 1996.

208. Assessment of Lessons from Natural Gas Restructuring for Electric Utilities. Client wishes to remain confidential at this time, 1996.

209. Advised on the Establishment of a Regulatory Framework for the Mexican Natural Gas Industry. Comision Reguladora de Energia, 1996.

210. White Paper on Unbundling Electric Utility Services. Edison Electric Institute, 1996.

211. Regulatory support for a Price Cap Plan of a Local Gas Distribution Utility. Boston Gas, 1995.

212. Development of a Price Cap Plan for a Local Gas Distribution Utility. Client wishes to remain confidential at this time, 1995.

213. Assessment of Incentive Regulation Options in the Context of a Proposed Restructuring of the Electric Utility Industry. Client outside of the United States wishes to remain confidential at this time, 1995.

214. Organization of a Conference on Price Cap Regulation. Edison Electric Institute, 1995.

215. Development of Regulatory Strategies Regarding the Transition to Retail Competition in the Electric Power Industry. Niagara Mohawk Power, 1995.

216. Assessment of Incentive Regulation Options in the Context of a Proposed Restructuring of the Electric Utility Industry. Alberta Power Limited, 1995.

217. Development of a Price Cap Plan for the Gas Operations of a Combination Utility. Public Service Electric and Gas, 1995.

218. Development of a Price Cap Plan for the Electric Operations of a Combination Utility. Public Service Electric and Gas, 1995.

219. White Paper on Incentive Regulation Theory and Its Application to Electric Utilities. Electric Power Research Institute, 1994-95.

220. Productivity Trends of U.S. Gas Distributors. Southern California Gas, 1994-95.

221. White Paper on Price Cap Regulation. Edison Electric Institute, 1994.

222. Regulatory Support for a Price Cap Plan. Central Maine Power, 1994.

223. Advanced Benchmarking Methods for U.S. Electric Utilities. Southern Electrical System, 1994.

224. Development of and Regulatory Support for a Price Cap Plan. Niagara Mohawk Power, 1994.

225. Competitive Price Scenarios for Power Markets in the Northeastern U.S. Niagara Mohawk Power, 1993-94.

226. Survey of Price Cap Plans in the U.S. and Abroad. Niagara Mohawk Power, 1993.

Expert Witness Testimony:

1. Before the Massachusetts Department of Public Utilities, evidence on behalf of National Grid, 2019. Subject: rebuttal testimony on performance-based regulation and performance benchmarking.

2. Before the Massachusetts Department of Public Utilities, evidence on behalf of National Grid, 2018. Subject: performance-based regulation and performance benchmarking.

3. Before the Puerto Rico Energy Commission, evidence on behalf of the Puerto Rico Electric Power Authority, 2016. Subject: rebuttal testimony on cost and wage benchmarking.

4. Before the Puerto Rico Energy Commission, evidence on behalf of the Puerto Rico Electric Power Authority, 2016. Subject: cost and wage benchmarking.

5. Before the Edmonton City Council, evidence on behalf of Epcor Water and Sewer Inc., 2016. Subject: updated inflation factors in a performance-based regulation plan.

6. Before the Edmonton City Council, evidence on behalf of Epcor Water and Sewer Inc., 2016. Subject: updated inflation factors in a performance-based regulation plan.

7. Before the Wisconsin Public Service Commission, evidence on behalf of Associated Builders and Contractors of Wisconsin, 2015. Subject: assessing the merits of an expanded bidding process for the expansion of the Alliant Riverside Energy Center facility.

8. Before the Ontario Energy Board, evidence on behalf of OEB Staff, 2015. Subject: review of Custom Incentive Regulation proposal and benchmarking evidence of Toronto Hydro.

9. Before the Wisconsin Public Service Commission; evidence on behalf of Kwik Trip, 2014. Subject: surrebuttal testimony on the impact of gas extension tariffs on the development of the CNG marketplace in Wisconsin.

10. Before the Wisconsin Public Service Commission; evidence on behalf of Kwik Trip, 2014. Subject: the impact of gas extension tariffs on the development of the CNG marketplace in Wisconsin.

11. Before the Ontario Energy Board; evidence on behalf of OEB Staff, 2014: Subject: review of Customized Incentive Regulation proposal for Enbridge Gas Distribution.

12. Before the Ontario Energy Board; evidence on behalf of OEB Staff, 2013. Subject: total factor productivity estimation, cost benchmarking, and establishing incentive regulation plans for Ontario electricity distributors.

13. Before the Wisconsin Public Service Commission; evidence on behalf of Wisconsin Public Service, 2013. Subject: sur-surrebuttal testimony on the value of reliability improvements from undergrounding power lines.

14. Before the Wisconsin Public Service Commission; evidence on behalf of Wisconsin Public Service, 2013. Subject: rebuttal testimony on the value of reliability improvements from undergrounding power lines.

15. Before the Wisconsin Public Service Commission; evidence on behalf of SMART Water, 2012. Statement on appropriate opt-out policies for smart meters.

16. Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of National Grid, 2010. Subject: rebuttal testimony in support of a net inflation adjustment mechanism applied to operating and maintenance expenditures.

17. Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of National Grid, 2010. Subject: empirical support for a net inflation adjustment mechanism applied to operating and maintenance expenditures.

18. Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of Bay State Gas, 2009. Subject: direct testimony on performance based regulation.

19. Before the Appeal Panel Constituted Pursuant to Section 55 of the *Essential Services Commission Act* 2001, Victoria Australia; evidence on behalf of the Essential Services Commission, 2008. Subject: estimating partial factor productivity growth for O&M expenditures for natural gas distributors.

20. Before the Ontario Energy Board, 2008. Subject: appropriate values for total factor productivity-based productivity factor; benchmarking-based productivity "stretch factors;" and appropriate thresholds for capital investment modules; in an incentive regulation plan for electricity distributors in the Province.

21. Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of Bay State Gas, 2007. Subject: direct testimony on performance based regulation.

22. Before the Circuit Court of the City of St. Louis, Missouri, Division 9, in Michele Thrash v. Freightliner *et al*, 2007. Subject: deposition testimony on estimated damages for lost income and medical treatment.

23. Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of Bay State Gas, 2007. Subject: panel testimony on revenue decoupling and performance based regulation.

24. Before the New Zealand Commerce Commission, evidence on behalf of Telecom New Zealand, 2007. Subject: principles for price benchmarking and the merits of alternative methods of benchmarking unbundled copper local loop prices.

25. Before the Circuit Court of the City of St. Louis, Missouri, Division 13, in Anastacia McNutt v. Globe Transport, Inc *et al*, 2007. Subject: deposition testimony on estimated damages for lost income and past and future medical treatment.

26. Before the Michigan Public Service Commission; evidence on behalf of Detroit Edison, 2007. Subject: service quality regulation and benchmarking.

27. Before the Appeal Panel, South Australia, Australia; evidence on behalf of the Essential Services Commission of South Australia, 2006. Subject: the operating expenditures and outsourcing management fee of Envestra Ltd.

28. Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of Bay State Gas, 2006. Subject: rebuttal testimony on exogenous recovery of revenues lost due to declining natural gas usage.

29. Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of Bay State Gas, 2006. Subject: direct testimony on exogenous recovery of revenues lost due to declining natural gas usage.

30. Before the Appeal Panel Constituted Pursuant to Section 55 of the *Essential Services Commission Act* 2001, Victoria Australia; evidence on behalf of the Essential Services Commission, 2006. Subject: regulatory treatment of an outsourcing contract to a related corporate party in a power distribution price determination.

31. Before the Appeal Panel Constituted Pursuant to Section 55 of the *Essential Services Commission Act* 2001, Victoria Australia; evidence on behalf of the Essential Services Commission, 2005. Subject: labor and non-labor shares in operating expenditures.

32. Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of Bay State Gas, 2005. Subject: rebuttal testimony on performance based regulation and benchmarking.

33. Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of Bay State Gas, 2005. Subject: performance based regulation and benchmarking.

34. Before the New Zealand Commerce Commission, evidence on behalf of Vector and NGC, 2004. Benchmarking evidence for New Zealand gas distributors.

35. Before the New Zealand Commerce Commission, evidence on behalf of Powerco, 2003. Evaluation of total factor productivity and benchmarking evidence in studies undertaken for the Commission.

36. Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of Boston Gas, 2003. Subject: rebuttal testimony on performance based regulation, total factor productivity measurement and benchmarking

37. Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of Boston Gas, 2003. Subject: performance based regulation, total factor productivity measurement and benchmarking

38. Before the US District Court for the Western District of Wisconsin, Trombetta, LLC vs. Dana Corporation and AEC, 2003. Subject: estimate damages in solenoid patent infringement case.

39. Before the Rhode Island Public Utilities Commission: evidence on behalf of New England Gas, 2003. Subject: direct testimony on alternative service quality regulation proposals.

40. Before the Kansas Corporation Commission; evidence on behalf of Western Resources, 2001. Subject: reply to surrebuttal testimony in support of service quality incentive plan.

41. Before the Kansas Corporation Commission; evidence on behalf of Western Resources, 2000. Subject: rebuttal testimony in support of service quality incentive plan.

42. Before the Supreme Court of Victoria, Australia; evidence on behalf of TXU Australia, 2000. Subject: Whether the regulator's price determination complied with legal mandates to use price-based incentive regulation.

43. Before the Kansas Corporation Commission; evidence on behalf of Western Resources, 2000. Subject: Support of a service quality incentive plan, including valuation of quality and other intangible aspects of customer welfare.

44. Before the Massachusetts Department of Telecommunications and Energy; evidence on behalf of Massachusetts gas and electric distribution companies, 2000. Subject: Service quality benchmarking.

45. Before the Hawaii Public Service Commission; evidence on behalf of Hawaiian Electric, 1999. Subject: Support of a service quality incentive plan, including valuation of quality and other intangible aspects of customer welfare.

46. Before the Oklahoma Corporation Commission; evidence on behalf of Oklahoma Gas and Electric, 1999. Subject: Support of a service quality incentive plan, including valuation of quality and other intangible aspects of customer welfare.

47. Before the Kentucky Public Service Commission; evidence on behalf of Louisville Gas and Electric and Kentucky Utilities, 1998. Subject: Rebuttal testimony in support of service quality incentive plan and benefits of companies' regulatory proposal to low-income customers.

48. Before the Kentucky Public Service Commission; evidence on behalf of Louisville Gas and Electric and Kentucky Utilities, 1998. Subject: Support of a service quality incentive plan, including valuation of quality and other intangible aspects of customer welfare.

49. Before the Maine Public Utilities Commission, evidence on behalf of the Edison Electric Institute, 1998. Subject: Merits of allowing utility companies to use their brand names in competitive retail energy markets.

50. Before the California Public Utilities Commission, evidence on behalf of the Edison Electric Institute, 1997. Subject: Merits of allowing utility companies to use their brand names in competitive retail energy markets.

Publications:

1. *The Price Cap Designers Handbook* (with M. N. Lowry), Edison Electric Institute, 1995.

2. "The Treatment of Z Factors in Price Cap Plans" (with Mark Newton Lowry), *Applied Economics Letters*, 2: 1995.

3. "Forecasting Productivity Trends of Natural Gas Distributors" (with Mark Newton Lowry), *AGA Forecasting Review*, March 1996.

4. *Performance-Based Regulation for Electric Utilities: The State of the Art and Directions for Further Research* (with Mark Newton Lowry), Palo Alto: Electric Power Research Institute, 1996.

5. *Developing Unbundled Electric Power Service Offerings: Case Studies of Methods and Issues* (with Laurence Kirsch), Washington: Edison Electric Institute, 1996.

6. "A Theoretical Model of Spillovers Through Labor Recruitment", *International Economic Journal*, Autumn 1997.

7. *Branding Electric Utility Products: Analysis and Experience in Related Industries* (with Mark Newton Lowry and David Hovde), Washington: Edison Electric Institute, 1997.

8. "The Branding Benefit", *Electric Perspectives*, November 1997.

9. *Price Cap Regulation for Power Distribution* (with Mark Newton Lowry), Washington: Edison Electric Institute, 1998.

10. *Controlling for Cross-Subsidization in Electric Utility Regulation* (with Mark Meitzen and Mark Netwon Lowry), Washington: Edison Electric Institute, 1998.

11. "Price Caps for Distribution Service: Do They Make Sense?", *Edison Times*, December 1998 (with Eric Ackerman and Mark Newton Lowry).

12. *Economies of Scale and Scope in Power Distribution* (with Mark Newton Lowry), Washington: Edison Electric Institute, 1999.

13. *Competition for Metering, Billing and Information Services: The Experience in California So Far*, Edison Electric Institute, 1999.

14. *Third Party Metering, Billing and Information Services: Further Evidence from California*, Edison Electric Institute, 2000.

15. "Performance Based Regulation of Energy Utilities" (with Mark Newton Lowry), *Energy Law Journal*, 2002

16. "Performance Based Regulation and Business Strategy" (with Mark Newton Lowry), *Natural Gas*, 2003.

17. "Performance Based Regulation and Energy Utility Business Strategy" (with Mark Newton Lowry), *Natural Gas and Electric Power Industries Analysis 2003*, Financial Communications, Houston, 2003

18. "Price Control Regulation in North America: Role of Indexing and Benchmarking," (with M.N. Lowry and L. Getachew), *Proceedings of Market Design Conference*, Stockholm, Sweden, 2003.

19. "Performance Based Regulation Developments for Natural Gas Utilities" (with Mark Newton Lowry), *Natural Gas and Electricity*, 2004.

20. "Incentive Power and the Design of Regulatory Regimes," *Network*, December 2005.

21. "Alternative Regulation for Electric Utilities" (with Mark Newton Lowry), *Electricity Journal*, June 2006.

22. "Performance Indicators and Price Monitoring: Assessing Market Power," *Network*, March 2007.

23. "Incentive Regulation in North American Energy Markets" *Energy Law and Policy*, Carswell Publishing, Toronto, Canada, 2009.

24. "Regulatory Reform in Ontario: Successes, Shortcomings and Unfinished Business" *Public Utilities Fortnightly*, November 2009

25. "An Update to Keystone XL Development," *CERI Crude Oil Report*, September 2015

26. "Mexico Natural Gas Reform," *Geopolitics of Energy*, January-February 2016

27. "Clean Energy Policy in the U.S." *Geopolitics of Energy*, July 20616.

28. "The Energy Policy Outlook Under President Trump," *Geopolitics of Energy*, November-December 2016.

29. "Electricity Security, Renewables, and the South Australia Power Outages," *Geopolitics of Energy*, April-May 2017.

30. "Prospects for Nuclear Power in the U.S.," *Geopolitics of Energy,* August 2017.

31. "The Past and Future of the X Factor in Performance-Based Regulation," *Geopolitics of Energy*, February 2019

32. "The Past and Future of the X Factor in Performance-Based Regulation," *The Electricity Journal*, April 2019

Presentations at Seminars and Professional Meetings:

1. Department of Energy/NARUC, Orlando, FL, 1995.
2. Illinois Commerce Commission and the Center for Regulatory Studies, St. Charles, IL, 1995.
3. Regulatory Studies Program, NARUC/Michigan State University, East Lansing, MI, 1995.
4. Marketing Conference, Edison Electric Institute, Chicago, IL, 1997.
5. Advanced Rate School, Edison Electric Institute, Indianapolis, IN, 1997.
6. Code of Conduct Conference, Denver, CO, 1997.
7. Code of Conduct Conference, Denver, CO, 1998.
8. Forum on Price Cap Regulation for Power Distribution. Melbourne, Australia, 1998.
9. Conference on Competition and Regulatory Reform in Hawaii. Honolulu, HI, 1998
10. Alternative Approaches Towards Price Cap Regulation. Melbourne, Australia, 1998.
11. Economics Meetings, Edison Electric Institute. Charlotte, NC, 1998.
12. Metering, Billing and Information Services Policy Convention, EEI, Chicago, IL, 1999.
13. Electricity Deregulation Conference. Vail, CO, 1999.
14. PURC Regulatory Training Seminar for Natural Gas Policy, Buenos Aires, Argentina, 1999.
15. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2000.
16. Seminar on Theory and Practice of Economic Regulation, Sydney, Australia, 2000.
17. Power Delivery Reliability Conference. Denver, CO, 2000.
18. Performance-Based Regulation Conference. Chicago, IL, 2000.
19. Regulatory Studies Program, NARUC/Michigan State University, East Lansing, MI, 2000.
20. Performance-Based Ratemaking Conference, Denver, CO 2000.
21. Energy Forum, Institute of Public Affairs, Melbourne, Australia, 2000.
22. Chamber of Commerce and Industry, Perth, Australia, 2001.
23. Energy Regulation Conference, Melbourne, Australia, 2001.
24. Advanced Rate School, Edison Electric Institute, Indianapolis, IN, 2001.
25. PURC Regulatory Training Seminar, La Paz, Bolivia, 2001.
26. Performance-Based Regulation Conference, Denver, CO, 2001.
27. Cost Structure of Energy Networks, Sydney, Australia, 2002.
28. Advanced Rate School, Edison Electric Institute, Indianapolis, IN, 2002.
29. Performance-Based Ratemaking Conference, Denver, CO 2002.
30. How to Regulate Electricity Lines Companies?, New Zealand Institute for the Study of Competition and Regulation, Wellington, New Zealand, 2003
31. Public Utility Regulation Seminar: Tariff Design and Incentives, Acapulco, Mexico, 2003
32. Rates and Regulation Meeting: Southeastern Electric Exchange, Williamsburg, VA, 2003.
33. Workshop on Service Quality Regulation in Ontario, Toronto, ON 2003.

34. Joint Canadian Electricity Association Distribution Council and Customer Council Meeting, Halifax, Nova Scotia, 2004.
35. Asia-Pacific Productivity Conference, Brisbane, Australia, 2004. [invitation, paper submitted]
36. Workshop on Productivity Measurement, Melbourne Australia, 2005.
37. Utility Regulators Forum, Canberra Australia, 2005.
38. CAMPUT Energy Regulation Course, Kingston Canada, 2006.
39. Performance Based Regulation Seminar, Toronto Canada, 2006.
40. Performance Benchmarking for Energy Utilities, Arlington, Virginia, 2006.
41. Performance Benchmarking for Energy Utilities, Seattle, Washington, 2007.
42. Alternative Regulation Seminar, Boston, Massachusetts, 2007.
43. CAMPUT Energy Regulation Course, Kingston Canada, 2007.
44. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2008.
45. Performance Benchmarking for Energy Utilities, Denver, Colorado, 2008.
46. Alternative Regulation Seminar, Toronto, Canada, 2008.
47. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2008.
48. CAMPUT Energy Regulation Course, Kingston Canada, 2008.
49. Performance Benchmarking for Energy Utilities, Chicago, IL, 2008.
50. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2009.
51. Alternative Regulation Seminar, Boston, MA, 2009.
52. CAMPUT Energy Regulation Course, Kingston Canada, 2009.
53. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2010.
54. Alternative Regulation Seminar, Boston, MA, 2010.
55. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2010.
56. CAMPUT Energy Regulation Course, Kingston Canada, 2010.
57. Alternative Regulation Seminar, Toronto Canada 2010.
58. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2011.
59. Alternative Regulation Seminar, Philadelphia PA, 2011.
60. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2012.
61. Alternative Regulation Seminar, Chicago, IL, 2012.
62. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2013.
63. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2013.
64. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2014.
65. Alternative Regulation Seminar, Chicago, 2014.
66. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2014.
67. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2015.
68. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2015.
69. CERI Oil and Gas Conference, Calgary, Canada. 2015.
70. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2016.
71. Latin American Natural Gas Conference, Naturgas, Cartegena, Colombia, 2016.
72. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2016.
73. CERI Electricity Conference, Calgary, Canada, 2016.
74. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2017.
75. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2018.
76. Florida Infrastructure Conference, Gainesville, FL, 2018.
77. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2018.
78. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2019
79. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2019.
80. World Bank International Training Program on Utility Regulation, Gainesville, FL, 2020.

Nick Crowley

RESUME

February 2020

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Academic Background:

Master of Science – University of Wisconsin-Madison, 2014, Economics
Bachelor of Arts – University of Wisconsin-Madison, 2012, Economics

Positions Held:

Economist, Laurits R. Christensen Associates, Inc., 2019-present
Staff Economist, Laurits R. Christensen Associates, Inc., 2016-2018
Economist, Federal Energy Regulatory Commission, 2015-2016

Professional Experience:

I provide data management and research support on projects related to the energy industry. My work at Christensen Associates Energy Consulting includes marginal cost modeling studies and cost-of-service analysis, in addition to assisting in the measurement of price response by customers participating in demand response programs. I have also calculated total factor productivity measures for clients and developed rate indexes for use in performance-based ratemaking. I manage large datasets and undertake quantitative analysis on a variety of software platforms including Excel and Stata. Previously, I worked at the Federal Energy Regulatory Commission, where I assisted with the review and evaluation of natural gas pipeline rate cases and energy industry benchmarking.

Publications:

"2018 Load Impact Evaluation of San Diego Gas and Electric's Voluntary Residential Critical Peak Pricing (CPP) and Time-of-Use (TOU) Rates." (with Michael Ty Clark)

"2017 Load Impact Evaluation of California Statewide Base Interruptible Programs (BIP) for Non-Residential Customers: Ex-post and Ex-ante Report." (with Michael Ty Clark and Dan Hansen)

"2017 Load Impact Evaluation of San Diego Gas and Electric's Voluntary Residential Critical Peak Pricing (CPP) and Time-of-Use (TOU) Rates." (with Michael Ty Clark and Dan Hansen)

"2016 Load Impact Evaluation of Pacific Gas and Electric Company's Residential Time-Based Pricing Programs: Ex-post and Ex-ante Report for Customers with Net Energy Metering." (with Michael Ty Clark and Dan Hansen)

"2016 Load Impact Evaluation of Pacific Gas and Electric Company's Mandatory Time-of-Use Rates for Small, Medium, and Agricultural Non-residential Customers: Ex-post and Ex-ante Report." (with Michael Ty Clark and Dan Hansen)

"Common Metrics Report: Performance Metrics for Regional Transmission Organizations, Independent System Operators, and Individual Utilities for the 2010-2014 Reporting Period." Federal Energy Regulatory Commission Staff Report, 2016.

Conference Presentations:

"Ratemaking Under Performance-Based Regulation." EUCI Workshop. Atlanta Georgia. March 9, 2020. (Forthcoming)

"Load Impact Evaluation: *Base Interruptible Program*." DRMEC Spring Workshop, California Public Utilities Commission. April 26, 2019.

"FERC Regulatory Policy and Relevant Environmental Issues, Focusing on the United States Natural Gas Grid" at the University of Wisconsin for the 2015 Energy Hub Conference.

Computer/Programming Skills: Proficient in Excel and STATA for data analysis; some experience with R, SAS, and Python

Philip E. Schoech

RESUME

May 2020

Address:

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Madison, Wisconsin 53705-2299
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Academic Background:

PhD, University of Wisconsin–Madison, 1980, Economics
MA, University of Wisconsin–Madison, 1976, Economics
BA, Northwestern University, 1973, Mathematics

Positions Held:

Senior Consultant, Christensen Associates, 2015-present
Vice President, Christensen Associates, 1991–2015
Senior Economist, Christensen Associates, 1979–1990
Project Associate, University of Wisconsin–Madison, 1984–1985
Economist, U.S. Bureau of the Census, 1984
Research Associate, University of Wisconsin–Madison, 1983–1984
Research Associate, Christensen Associates, 1976–1979

Professional Experience:

I specialize in the areas of productivity measurement, econometric and statistical analysis, and the construction of economic statistics. Over the past 44 years,I have consulted for a variety of clients on productivity and performance measurement; incentive regulation design; pricing, costing, and budget analysis; revenue forecasting; and statistical sample design.

Major Projects

Project Manager, measurement of United States Postal Service total factor productivity—monthly, quarterly, and annually.

Consultant to private companies, trade associations, and regulatory commissions on telecommunications productivity.

Consultant to private companies and regulatory commissions on electric and gas utility industry productivity.

Consultant to the U.S. Surface Transportation Board on competition, capacity, and investment issues in the railroad industry.

Consultant to the National Research Council Transportation Research Board on transportation infrastructure and national productivity.

Consultant to the California Energy Commission on the development of a transportation energy demand model for the state of California.

Consultant to private companies, trade associations, and regulatory commissions on incentive regulation in the telecommunications and cable television industries.

Consultant to private companies, trade associations, and regulatory commissions on universal service in the telecommunications industry.

Consultant to private companies and regulatory commissions on electric and gas utility incentive regulation.

Consultant to the United States Postal Service on regulatory reform.

Project Manager, development of revenue forecasting model for the Wisconsin Department of Transportation.

Consultant to the United States Postal Service on statistical design for surveys of operating practices.

Consultant to the United States Postal Service on statistical models for measuring mail volumes in small areas.

Consultant to the U.S. Bureau of the Census on measurement of output in service industries.

Consultant to the U.S. Bureau of Labor Statistics and U.S. Department of Commerce on productivity measurement in European economies.

Consultant to the USDA Forest Products Laboratory on demand for residential and nonresidential structures.

Consultant to two Fortune 500 companies on pricing analysis.

Consultant to two regulatory commissions on economic impacts of residential time of day pricing.

Litigation support in four Postal Service and one railroad industry labor arbitration cases.

Litigation support in *Polaroid v. Kodak, DOJ v. AT&T,* and *MCI v. AT&T*.

Selected Professional Papers:

Mark E. Meitzen, Philip E. Schoech, and Dennis L. Weisman, "Debunking the Mythology of PBR in Electric Power," *The Electricity Journal,* 31 (April 2018) 39-46."Vehicle Registration Compliance in Wisconsin,"

Mark E. Meitzen, Philip E. Schoech, and Dennis L. Weisman, "The Alphabet of PBR in Electric Power: Why X Does Not Tell the Whole Story," *The Electricity Journal,* 30 (2017) 30-37

Final Report to the Wisconsin Department of Transportation, August 2014 (with Terry L. Schoenherr).

"Revisiting the CPI-based Price Cap Formula for the U.S. Postal Service," paper presented to the 2012 Eastern Conference of the Center for Research in Regulated Industries, May 2012 (with Mark Meitzen and Michael Kubayanda).

"Railroad Performance Under the Staggers Act," *Regulation*, Vol. 33, No. 4, pp. 32–38, Winter 2010, (with B. Kelly Eakin, A. Thomas Bozzo, and Mark E, Meitzen)

"Incentive Regulation in Network Industries: Experience and Prospects in the U.S. Telecommunications, Electricity and Natural Gas Industries," *Review of Network Economics*, Vol. 2, Issue 4 December 2003, pp. 316–337, (with Ross C. Hemphill and Mark E. Meitzen).

"Telecommunications Productivity," in *Traditional Telecommunications Networks; The International Handbook of Telecommunications Economics, Vol. 1*, G. Madden, ed., 2003, Edward Elgar, (with Laurits R. Christensen and Mark E. Meitzen).

"Measuring the Costs of Universal Service for the Postal Industry," paper presented at the American Economic Association meetings, January 2000, (with Dianne C. Christensen, Laurits R. Christensen, and Mark E. Meitzen).

"Where Do We Go From Here?" *Public Utilities Fortnightly,* June 15, 1993, (with Laurits R. Christensen and Mark E. Meitzen).

"Capital in the United States Postal Service," in *Technology and Capital Formation,* D. W. Jorgenson and R. Landau, eds., 1989, The MIT Press, (with Dianne C. Christensen, Laurits R. Christensen, and Carl G. Degen).

"United States Postal Service Quarterly Real Output, Input, and Total Factor Productivity, 1982 First Quarter Through 1986 First Quarter," Final Report to the Office of Economics, United States Postal Service, February 1986, (with Dianne C. Christensen, Laurits R. Christensen, and Carl G. Degen).

"United States Postal Service Real Output, Input, and Total Factor Productivity, 1963–1984," Final Report to the Office of Economics, United States Postal Service, October 1985, (with Dianne C. Christensen, Laurits R. Christensen, and Carl G. Degen).

"The Methodology of Output and Input Measurement in the Service Industries," report prepared for the U.S. Bureau of the Census, April 1985, (with Laurits R. Christensen).

"Cost-Benefit Analysis: A Comparison of Different Approaches in a Case Study of Residential Time-of-Use Electricity Pricing," *Journal of Econometrics*, Vol. 26, 1984, pp. 17–34, (with Douglas W. Caves, Laurits R. Christensen, and Wallace Hendricks).

"Costs and Benefits of Residential TOU Pricing in Illinois," in *Trends in Electric Utility Research*, C. W. Bullard and P. J. Womeldorff, eds., 1984, Pergamon Press, (with Douglas W. Caves, Laurits R. Christensen, and Wallace E. Hendricks).

"Econometric Estimation of Scale Economies in Telecommunications," in *Economic Analysis of Telecommunications*, L. Courville, A. deFontenay, and R. Dobell, eds., 1983, North-Holland Press, (with Laurits R. Christensen and Dianne Cummings).

"Cost-Benefit Analysis of Residential Time-of-Use Rates: A Case Study for Four Illinois Utilities," *Electric Ratemaking*, December 1982, (with Douglas W. Caves, Laurits R. Christensen, and Wallace E. Hendricks).

"Cost-Benefit Analysis of Time-of-Use Rates for Illinois Utilities," Final Report to the Illinois Commerce Commission, November 1982, (with Douglas W. Caves, Laurits R. Christensen, and Wallace E. Hendricks).

"Residential Customer Response to Time-of-Day Pricing Alternatives for the Wisconsin Public Service Corporation," Final Report to the Wisconsin Public Service Commission, July 1982, (with Douglas W. Caves and Laurits R. Christensen).

"Total Factor Productivity in the Bell System, 1947–1979," Report Prepared for American Telephone and Telegraph Company, September 1981, (with Laurits R. Christensen and Dianne C. Christensen).

Testimony and Studies Filed in Regulatory and Arbitration Proceedings

"Assessment of the FCC's Proposed Options for the Special Access Price Cap X-Factor," Federal Communications Commission Dockets WC 16-143; WC 05-25; RM-10593, June 2016 (with M.E. Meitzen)

"Review and Evaluation of AltaGas Utilities Inc. Incentive Regulation Plan," and "Analysis Update, Including Responses to Evidence Filed by Inteveners," Alberta Utilities Commission Docket 566, July 2011 and April 2012, (with R.J. Camfield).

Report on Productivity and Compensation, submitted to Presidential Emergency Board 243, National Mediation Board Case Nos. A-13569; A-13570; A-13572; A-13574; A-13575; A-13592, October 10, 2011 (with B. Kelly Eakin).

Verified Statement and Rebuttal Verified Statement, STB Ex Parte No. 657 (Sub-No. 1) *Major Issues in Rail Rate Cases*, May and June 2006, (with Douglas W. Caves, B. Kelly Eakin, and Mark E. Meitzen).

"Phase II Report: Comparators and Cohorts Study for 2006 EDR," Ontario Energy Board Docket RP-2004-0188, October 2005, (with Robert Camfield, J. David Glyer, and Michael Welsh).

"Productivity Performance of the Wisconsin Local Exchange Carrier Industry" and "Comments of Christensen Associates on Consultant Productivity Studies," Wisconsin PSC Docket 1-AC-193, January 2003, (with Laurits R. Christensen, Mark E. Meitzen, and Steven M. Schroeder).

"Non-Routine Adjustments for Taxes under a Floating GDPPI Price Cap Index" and "Using the GDPPI Consistently to Set the Inflation Factor," Ontario Energy Board Docket RP-2001-0029, November 2001 and April 2002, (with Ross C. Hemphill).

"Determination of the X Factor for the Regulation of Telefonica del Peru," Revised Final Report to OSIPTEL, August 2001, (with Mark E. Meitzen, Connie Smyser, and Steven M. Schroeder).

"The Ameritech Illinois Total Factor Productivity Study," Illinois Commerce Commission Docket 98-0252, June 2000, (with Mark E. Meitzen and Steven M. Schroeder).

"An Evaluation of the Union Gas Limited Performance Based Regulation Proposal," Ontario Energy Board Docket RP-1999-0017, December 1999, (with Ross C. Hemphill).

"Price Cap Design and X Factor Estimation for Peruvian Telecommunications Regulation," report prepared for OSIPTEL, May 1999, (with Laurits R. Christensen, Mark E. Meitzen, Laurence D. Kirsch, Cesar A. Herrera, and Steven M. Schroeder).

"Analysis of Benchmark Cost Proxy Model and Hatfield Release 3.1," Federal Communications Commission Docket 96-45, April 1997, (with Laurits R. Christensen, Mark E. Meitzen, A. Thomas Bozzo, and Thomas J. Rutkowski).

"Updated Results for the Simplified TFPRP Model and Response to Productivity Questions in FCC's Access Reform Proceeding" and "The TFPRP Provides the Best Basis for Determining the Rate of LEC TFP Growth," Federal Communications Commission Docket 94-1, January and February 1997, (with Laurits R. Christensen and Mark E. Meitzen).

"An Evaluation of the Bell Canada, BC TEL, MTS NetCom Inc., and Maritime Tel & Tel Limited Total Factor Productivity Studies" and "A Survey of X-Factor Experience in the United States," Canadian Radio-television and Telecommunications Commission Docket 96-8, June 1996, (with Laurits R. Christensen and Mark E. Meitzen).

"Total Factor Productivity Methods for Local Exchange Carrier Price Cap Plans" and "Total Factor Productivity Methods for Local Exchange Carrier Price Cap Plans: Reply Comments," Federal Communications Commission Docket CC 94-1, December 1995 and March 1996, (with Laurits R. Christensen and Mark E. Meitzen).

"Productivity of the Local Operating Telephone Companies Subject to Price Cap Regulation 1993 Update," Federal Communications Commission Docket CC 94-1, January 1995, (with Laurits R. Christensen and Mark E. Meitzen).

"Productivity Growth in the Cable Television Industry," Federal Communications Commission Dockets CS 94-28 and MM 93-215, June 1994, (with Laurits R. Christensen and Mark E. Meitzen).

"Productivity of the Local Operating Telephone Companies Subject to Price Cap Regulation," Federal Communications Commission Docket CC 94-1, May 1994, (with Laurits R. Christensen and Mark E. Meitzen).

"Sources and Methods for the Indiana Bell Total Factor Productivity Study," Indiana Utility Regulatory Commission Cause No. 39705, 1993 (with Laurits R. Christensen).

"Sources and Methods for the Ohio Bell Total Factor Productivity Study," Public Utilities Commission of Ohio, Case No. 93-487-TP-ALT, 1993, (with Laurits R. Christensen and Mark E. Meitzen).

"Sources and Methods for the Illinois Bell Total Factor Productivity Study," Illinois Commerce Commission Docket 92-0448, December 1992, (with Laurits R. Christensen and Mark E. Meitzen).

REDACTED

NERA
ECONOMIC CONSULTING

Proposal to Provide Expert Assistance on Performance-Based Ratemaking Methods

Prepared for Boston Gas Company and Colonial Gas Company, d/b/a National Grid

May 2020

CONFIDENTIALITY

We understand that the maintenance of confidentiality with respect to our clients' plans and data is critical to their interests. NERA Economic Consulting rigorously applies internal confidentiality practices to protect the confidentiality of all client information.

Similarly, our approaches and insights are proprietary and so we look to our clients to protect our interests in our proposals, presentations, methodologies and analytical techniques. Under no circumstances should this material be shared with any third party without the prior written consent of NERA Economic Consulting.

Contents

NERA
Economic Consulting

I. Introduction

On behalf of National Economic Research Associates (NERA), I am pleased to respond to the invitation from Boston Gas Company and Colonial Gas Company, d/b/a National Grid ("National Grid" or "the Company") to submit a Proposal to provide expert assistance in the area of performance-based distribution ratemaking methods in connection with a base distribution rate filing in 2020.

NERA would be delighted to collaborate with National Grid on the development of a performance-based ratemaking mechanism, consistent with Massachusetts precedent. Our proposed team has a depth of professional knowledge with respect to traditional and next-generation incentive ratemaking programs. We have extensive hands-on experience in the design and implementation of all components of incentive-based ratemaking plans, having worked on the development of dozens of incentive-based ratemaking plans in North America and throughout the world.

Specifically, our areas of expertise include the development of: (i) well-defined and clearly-articulated goals for the performance-based rate plan; (ii) definition of an appropriate scope and duration; (iii) specification of parameters for all formulas involved; (iv) the need to account for ongoing investments; and (v) the treatment of service quality.

Our proposal that follows includes the following sections: (2) Sector context; (3) Proposed project team and experience; (4) Project methodology and approach; (5) NERA's corporate capabilities; (6) References for similar services provided by NERA; (7) Proposed work plan; and (8) Summary of proposed fees and expenses. We also include Appendices 1, 2, and 3, which contain CVs for the proposed project team and recent lectures and publications by project team members addressing 21st century incentive ratemaking.

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II. Sector Context

Incentive-based rates can provide a mechanism by which regulators encourage efficiency and provide incentives to utilities to meet goals that are not necessarily adequately met through existing market incentives. Although incentive ratemaking gained some popularity in the U.S. power sector during the 1990s, its use during the first decade following restructuring and retail market liberalization was fairly limited, with Maine and Massachusetts (DTE's decision in 05-85) being among the examples.

Today, many utilities have found themselves with a need to file annual rate cases due to a confluence of factors, including:

- flat or declining load growth attributable to energy efficiency and other developments; and
- a need to invest to replace aging infrastructure and accommodate existing and new customers.

These trends have led to earnings attrition and, in some instances, have reduced the likelihood that equity investors will have reasonable opportunities to earn their authorized return. They have weighed on regulators and their staff, who find the greater frequency of rate cases difficult to manage and are under increasing pressure to create incentives for the utilities they regulate to lower costs and mitigate future rate increases.

In such a context, pressure has mounted to develop innovative regulatory solutions (incentive or performance-based ratemaking plans) that are fair to investors and customers yet also reduce the administrative burden of the regulatory process. Utilities are considering a wide range of proposals with implicit and explicit incentive-based rates. Some believe that an incentive rate plan will be the best solution for ending the cycle of annual rate cases.

The push for innovative solutions has not come from utilities alone. Several regulators (including those in New York and the UK) have sought to design new regulatory frameworks that allow utilities' business models to focus more on customer orientation. Massachusetts is among the states in the United States that has used PBR for both gas and electric distribution utilities.

NERA has tracked the development of performance-based ratemaking from its early applications in telecommunications to its use by Stephen Littlechild for electric distributors in England and Wales following privatization of the area boards and to its most recent renaissance in North America. We are enthused by the opportunity to work with National Grid in defining an incentive-based plan that fits its particular objectives and challenges. We recognize that

III. Proposed Team and Experience

The proposed NERA team includes Kurt Strunk (Project Director), Willis Geffert, and Richard Druce. These senior NERA economists will be supported by Mr. Walter Hopkins. They will be able to draw upon the knowledge and experience of other NERA staff on an as-needed basis. Mr. Eugene Meehan will provide peer review.

We highlight relevant qualifications and assignments for each staff member below:

A. Kurt G. Strunk

Mr. Strunk is a Director with NERA in New York and would serve as the Project Director. For over 20 years, he has served as an advisor to gas distribution utilities, pipelines, and other stakeholders on a wide variety of regulatory issues in the US, Canada, Latin America, Europe, and Australia. As he also works for electric utilities, he has a keen understanding of the operating, legal, and regulatory differences across utility types.

He has performed the following projects on PBR:

- **Marginal Cost Working Group.** Mr. Strunk leads NERA's Marginal Cost Working Group, a utility-only group that examines emerging issues in gas and electric ratemaking**.** This group routinely studies the application of PBR in various parts of North America and analyzes key success factors for those jurisdictions that appear to be successful in applying PBR despite the challenges of increasing network costs.
- **ATCO Energy (Gas and Electric) PBR and Capital Tracker**. Mr. Strunk provided peer review of NERA's work product, including pre-filed testimony, for NERA's engagement with ATCO in Alberta relating to the implementation of its capital tracker in connection with the AUC's implementation of a PBR regime there. This
- **Eskom PBR (2012-2015)**. Mr. Strunk advised ESKOM in South Africa on the development of a regulatory strategy to modify the prevailing PBR regime, which was failing to meet many of its stated objectives. He worked with ESKOM on strengthening the pass-through provisions for items that fall outside of the 5-year price review. In addition, when insufficient regulated prices under the PBR regime led ESKOM to be downgraded to speculative grade credit, he worked with the utility to evaluate the financial consequences of continuing under the PBR or seeking a reopener before the end of the 5-year term. Mr. Strunk analyzed many alternative PBR structures in connection with a potential reopener proposal**.**
- **Hawaiian Electric Company (HECO) Incentive Mechanisms (2006-2007, 2013-2014 and 2016)**. Mr. Strunk has advised the HECO operating utilities on methods for modifying existing incentive mechanisms embedded in their current rates. The Hawaii Commission has directed the utilities to strengthen incentives to reduce costs and to accelerate the integration of renewables into its portfolio. Specifically, Mr. Strunk evaluated potential regulatory mechanisms that could achieve the goals articulated by the Commission. This included the

evaluation of proposals from intervenors to change existing pass-through clauses and to implement other regulatory changes including decoupling and the potential adaption of elements of Ofgem's RIIO model (the latest power sector PBR program being implemented in the UK).

- **PPL (2010)**. Mr. Strunk served on the NERA team advising PPL on PBR mechanisms, including the definition of an appropriate Infrastructure Cost Recovery Mechanism. This assignment included a benchmarking of PBR practices in other jurisdictions.
- **Ireland (2008)**. Mr. Strunk directed NERA's engagement with the Commission for Energy Regulation. He was retained to evaluate the submission of ESB PES to establish new tariffs
- **Southern California Edison PBR (1995)**. Mr. Strunk advised on the definition and implementation of z-factors in the company's PBR mechanism.
- **Various assignments (1998-present)**. Where Mr. Strunk has served as cost of capital expert, he has evaluated the relative risk characteristics of the regulatory frameworks for companies in his proxy group as compared to the applicant. This involved detailed analysis of various incentive provisions, decoupling, and other regulatory innovations.

Mr. Strunk has carried out over a hundred consulting engagements on behalf of gas and electric utilities in the United States and has served as an advisor in over 50 rate cases. He has extensive work for both gas transmission and gas distribution companies, and has analyzed the rates and costs of Alliance Pipeline, NGTL Alberta, TransCanada, PEMEX, and Southern Star pipelines. His gas and electric distribution utility clients include Hawaiian Electric Company, Chugach Alaska Corporation, Southern California Edison, Pacific Gas & Electric, Nevada Power Company, Sierra Pacific Power Company, PacifiCorp, TransElec, Ameren, Commonwealth Edison, Illinois Power Agency, Dayton Power & Light, ConEdison, Niagara Mohawk, New York State Electric & Gas, New York Power Authority, Public Service Electric & Gas, Jersey Central Power & Light, Atlantic City Electric, Rockland Electric, FirstEnergy, Pennsylvania Power and Light Company, Energy East, Allegheny Power, Baltimore Gas & Electric, Potomac Edison, PEPCO, Southern Company, and Dominion. His CV contains more detail on these engagements.

B. Richard Druce

Mr. Druce is a Director with NERA, working across a range of geographies. He has worked extensively on the "RIIO-ED1" price control process, during which he advised three electricity distributors and the UK industry association of energy network companies (the ENA). His advice on the RIIO process covered a range of topics including, *inter alia*, cost benchmarking, incentive design, regulatory finance, forecasting real input price inflation, cost-benefit analysis, the regulatory treatment of smart grid technologies, and the calibration of distributors' output obligations. He also supported one distributor in relation to appeals against Ofgem's final RIIO-ED1 decision.

C. Willis Geffert

Mr. Geffert is an Associate Director with NERA, specializing in sophisticated economic analysis and modeling to assist global energy clients in meeting the strategic, financial, and legal challenges of operating in restructured and regulated markets. Mr. Geffert's analyses and models have aided regulators in implementing power market reforms, helped firms assess major investment decisions, and supported clients by providing expert testimony (or supporting NERA testimony) before the US Federal Energy Regulatory Commission, the MADPU, the International Centre for Settlement of Investment Disputes, the Singapore International Arbitration Centre, and numerous other courts and regulators.

Mr. Geffert's litigation support experience also includes drafting expert testimony and reviewing and assessing the arguments of opposing experts. Mr. Geffert's regulatory experience includes the evaluation of retail electricity rates; definition of key elements of the revenue requirement; market power assessments; transmission and distribution network pricing; setting the demand curve for generation capacity auctions; and wholesale power contract analysis.

Mr. Geffert has worked on economic and contract issues related to retail gas pricing and gas extraction. He has assessed retail gas markets for potential investors. He has twice assessed the growth in natural gas consumption from the power sector for the gas operator in Mexico. He regularly reviews the prudence of wholesale gas purchases by electric utilities.

D. Eugene Meehan

Mr. Meehan is a Special Consultant affiliated with NERA. He has over forty years of experience consulting with electric and gas utilities and has testified as an expert witness before numerous state and federal regulatory agencies, as well as having appeared in federal court and arbitration proceedings.

At NERA, Mr. Meehan's practice concentrates on serving energy industry clients, with a focus on helping clients manage the transition from regulatory to more competitive environments. He has performed consulting assignments for over fifty large electric, gas, and combination utilities in the areas of retail access, regulatory strategy, strategic planning, financial and economic analysis, merger and acquisition advisory services, power contract analysis, market power and market definition, stranded cost analysis, power pooling, power markets and risk management, ISO and PX development, and costing and pricing. In addition, he has advised numerous utilities on various forms of incentive ratemaking.

Mr. Meehan led NERA's advisory work on several major restructuring and unbundling assignments. These assignments were multi-year projects that involved integration of regulatory and business strategy, as well as development of regulatory filings associated with the recovery of stranded cost and rate unbundling.

He has recently assisted the Public Service Company of New Hampshire with prudence analysis and cost recovery support in state regulatory proceedings.

IV. NERA's Approach to the Assignment

Typically, NERA's analysis of PBR programs will recognize that the steps a utility (or its regulator) can take to improve the incentives inherent in a given regulatory framework vary widely in scope. They could include, for example:

- Supplementing the existing rate-of-return model with targeted incentives (rewards and penalties) for factors under the control of the utility;
- Changing the required frequency of mandated rate cases (or implementing multi-year rate plans) to increase regulatory lag;
- Adopting earnings sharing mechanisms or refining existing ones;
- Implementing revenue requirements that depend on benchmarked costs rather than actual cost;
- Addressing the perceived CAPEX bias[1] by fixing the share of revenue requirement that comes from fixed assets (a tool used in the UK under RIIO);
- Fast-Tracking and/or Menu Regulation (additional tools used in the UK under RIIO); and
- Implementing output-based incentives.

We understand that Massachusetts precedent focuses on a subset of these options. We anticipate that we will work with National Grid to agree upon a performance-based ratemaking mechanism that includes certain elements listed above, but may also include other elements, and will strike the right balance of complying with precedent and fulfilling National Grid's objectives.

To evaluate the "advantages and disadvantages" of prospective elements of the plan will require reference to a set of goals or objectives. As a first step in our engagement, we will work with National Grid to define an appropriate set of objectives. Such objectives could include:

- Strong incentives for cost control;
- Revenue adequacy to support utility service;
- Compatibility with decoupling mechanisms and existing capital trackers; and
- Administrative simplicity.

NERA will work with National Grid to complete a comprehensive list of objectives. We are currently working on an incentive mechanism for a utility, which must, by its nature, be

[1] We refer to a perceived CAPEX bias because, in practice, we believe the threat of prudence disallowance provides strong incentives to control CAPEX spend.

administratively complex in order to isolate factors that are truly within the control of the utility and to avoid windfall gains or losses from outcomes unrelated to utility performance.

We expect other objectives might include, for example:

- Improvement over the *status quo* and over traditional rate-of-return methods. Early PBR plans applied in the US were criticized for being relatively weak and not providing stronger incentives than those already implicit in rate-of-return regulation. The performance-based ratemaking plan must represent an improvement over both the *status quo* and the possible return to traditional cost of service methods.

- Streamlined regulatory process. In Alberta, one of the surprises for both the regulator and the utilities was the proliferation of new dockets addressing various elements of the new PBR regime. The utilities ended up spending considerably more time in proceedings before the Commission under PBR than they had under traditional rate-of-return approaches. Thus, another objective of the next generation plan could be to minimize the regulatory burden.

A. Our approach for developing a productivity or efficiency offset

We understand that the PBR programs for gas distributors in Massachusetts have included a productivity offset, and that National Grid's RFP anticipates that it will be calculated using a Total Factor Productivity study.

In past cases where NERA has developed a productivity offset (X factor), we have relied upon a statistical analysis of Total Factor Productivity ("TFP") to develop it. Creating an index number for relative industry TFP with the attributes of transparency, stability, and objectivity requires a high-quality, transparent, and uniform source of data that is readily available to the parties of regulatory proceedings. Such data are available for gas distributors and combination gas/electric utilities. NERA's emphasis on using objective industry data rather than company-specific data tends to set us apart from competitors. We hold objective uniformity in source data for a TFP study to be of paramount importance when such a study is part of regulatory proceedings where the interests of consumers and investors traditionally vie with one another.

B. Balancing the PBR plan with existing and potential new regulatory mechanisms

National Grid anticipates continuing the Gas System Enhancement Plan, and also potentially introducing other mechanisms that ensure timely recovery of costs. We do not view these mechanisms as being incompatible with a PBR program. In Alberta, where NERA advised the regulator and subsequently the ATCO utilities on PBR design, the two co-exist. Of course, assuring sufficient revenue to support necessary new investment can be dealt with in a number of ways and need not necessarily be treated in a mechanism separate from the PBR mechanism. For some utilities, the projected capex has been incorporated in the rate trajectory of the PBR mechanism. For others, it has been accommodated in a separate tracker. NERA will work with

National Grid to identify the approach that is most suitable to its gas distributors in Massachusetts. Importantly, the costs, benefits, and risks of any single mechanism cannot be evaluated independently. They must be considered in connection with all elements of the ratemaking framework. For example, the duration of the PBR plan can be a major driver of CAPEX recovery risk and can be mitigated through CAPEX trackers.

NERA anticipates we will need to work with National Grid personnel (including in-house regulatory counsel or outside counsel as the case may be) in such a way that National Grid provides NERA with:

- Sufficient availability to assist NERA in the definition of a complete set of objectives for the performance-based ratemaking plan. We anticipate this could be done in two meetings or teleconferences.
- Provision of feedback on NERA's TFP, benchmarking analysis, and recommendation of whether to include any stretch factor / consumer dividend.
- Provision of data on the past performance of the Massachusetts operating utilities to facilitate the benchmarking exercise and the evaluation of any targeted incentive mechanisms that receive serious consideration by the Company and NERA.
- Provision of feedback on draft testimony and accompanying schedules.
- Provision of any data needed to produce accompanying schedules.

Insofar as the PBR plan includes targeted incentives around performance metrics, NERA will request data from National Grid sufficient to permit our team to estimate how the companies would have performed historically had the incentive mechanisms been in place. NERA will not require any data from National Grid for the purpose of calculating the X factor.

C. Team Organization and Individual Focus

NERA will structure our team as follows.

Personnel	Description
Mr. Kurt Strunk *Director*	Kurt will serve as project director and client liaison. He will manage the day-to-day activities of the NERA team and will serve as the primary interface with National Grid.
Mr. Eugene Meehan *Affiliated Consultant*	Eugene has over 35 years of experience advising utilities on regulatory matters, including significant experience defining incentive rates. Mr. Meehan will serve as the NERA peer reviewer for all work products supplied by NERA to National Grid.
Mr. Richard Druce *Director*	Richard is an expert in the UK's next generation incentive ratemaking program, entitled RIIO. Richard will advise the NERA team and National Grid on the successes and failures of that regime to date, as well as the regulatory and market dynamics that led to the paradigm shift in regulation there.

Mr. Willis Geffert *Associate Director*	Willis has twenty years of experience as an advisor to utilities. He has worked extensively on pricing and costing of utility services. Willis will serve as the lead economist implementing the econometrics needed to assess TFP, the benchmarking and stretch-factor assessment.
Mr. Walter Hopkins *Senior Analyst*	Walter is a Senior Analyst and has worked extensively in the utility sector for over seven years. He specializes in modeling financial outcomes of new policies and new transactions. Walter will perform most of the research and financial modeling activities, including the stress testing of the proposed PBR plan on National Grid's financials. Walter received his B.A. in the Woodrow Wilson School from Princeton University.

Mr. Kurt Strunk has extensive testifying experience, as well as experience with gas distribution, and will sponsor the NERA testimony before the Massachusetts DPU. In past assignments in Massachusetts, his testimony has helped his clients win successful outcomes to their regulatory matters.

D. Sequencing of Tasks

We anticipate carrying out the following tasks in advance of the Company's filing.

- Step 1: work with National Grid to define an appropriate set of objectives for the performance-based ratemaking mechanism.
- Step 2: summarize relevant precedent and academic literature, as an input to testimony and to guide policy choices taken by National Grid;
- Step 3: perform TFP study.
- Step 4: perform benchmarking analysis.
- Step 5: review results with National Grid and incorporate client feedback.
- Step 6: where required, obtain data from National Grid to permit backcasting of the performance of the proposed mechanism and simulation of future outcomes.
- Step 7: gain understanding of how the incentive mechanism would affect the financial health of the utility under specified scenarios of poor performance. Use quantitative examples.
- Step 8: elaborate public policy rationale for performance-based ratemaking plan that will be important to the acceptance by the DPU. Include in draft testimony.
- Step 9: explain consistencies with and departures from precedent in Massachusetts, and other jurisdictions as appropriate. On an *ex ante* basis, we do not anticipate significant departure from precedent in Massachusetts.
- Step 10: finalize draft testimony and supporting schedules and share with National Grid.
- Step 11: provide feedback on testimony of Company witnesses. Gain consensus on package to be submitted to the DPU.

NERA puts its client's scheduling needs first. We pride ourselves on being responsive and would certainly structure the project in such a way that National Grid has access to our senior economists when you need them.

V. Corporate Capabilities

NERA is an international firm of consulting economists specializing in the application of economics to industry structure, financial analysis, regulation, and competition. NERA was established in New York in 1961 and now has offices across the United States and Europe, as well as in Asia, Australia, and Latin America. Its network of over 600 professional economists provides advice to corporations, governments, law firms, regulatory agencies, trade associations, and international agencies throughout the world. NERA is wholly owned by the Oliver Wyman Group which, in turn, is a wholly owned subsidiary of Marsh and McLennan Companies, Inc (MMC). MMC's shares are listed on the London, New York, Chicago, and Pacific stock exchanges.

A. General Utility Regulatory Experience

Regulatory economics has always been a cornerstone of NERA's business. Our economists have been consultants to governments, private, and public firms on matters arising in the regulation of electric utilities, water utilities, and regulated petroleum-industry companies since our founding in 1961. We routinely address issues ranging from traditional regulatory concerns to emerging competitive and environmental challenges. During the past fifty years, NERA staff members have analyzed matters that arise under traditional regulation: rate of return, system planning, demand forecasting, cost of service, rate design, and service reliability. Our experts have been responsible for important innovations in regulatory theory and practice, with a strong focus on incentive rate design.

B. NERA's Representative Projects

In this section we summarize NERA's experience with utility regulation by listing representative projects. NERA's energy practice has considerable experience throughout the world advising governments, regulators and companies, as well as current and potential investors in the sector. NERA has worked extensively in the United States, the UK, Ireland, and in continental Europe, contributing actively to regulatory debates about market design, network regulation, and public policy issues such as security of supply, and the impact of energy markets on the environment.

1. Sample of Global Projects

United States

- **Numerous Clients**: On over 100 occasions, NERA has supplied studies, expert testimony, and training seminars on tariff and regulatory issues for dozens of utility companies in the US in hearings before state and federal regulatory bodies. Some examples of these studies are the following:
  - Regulatory advice during tariff reviews for electric and natural gas utilities;

- Electricity price forecasts in California, NEPOOL, PJM and Texas for numerous clients; and
- Retail competition advice to companies in Illinois.

Ireland and the United Kingdom

- **Dublin Airport, 2001, 2005, 2009**: Directed projects for Dublin Airport Authorities (DAA) to estimate a cost of capital and advise on wider issues of regulatory finance for DAA in the context of regulatory price reviews.

- **Water UK (Industry body of the UK Water and Sewerage companies), 2009**: Lead advisor on all aspects of cost of capital and financeability issues for the forthcoming regulatory review period 2010-2015. This project also examined the impact of increased competition on financing costs for the UK water sector.

- **Consortium of Small UK Water Companies, Cost of Capital and Transaction Cost Analysis**: Report on the transaction costs premium associated with trading in small water only companies.

- **UK National Air Traffic Services (NATS), 2008-09**: Lead advisor to NATS on all aspects of cost of capital and financeability issues for the 2010 price review

- **EdF Energy UK, 2006, 2007**: A comparative analysis of the relative risks of the UK gas and electricity distribution and transmission network businesses. The work focused on risks that influence the cost of capital and focused on risks associated with the regulatory framework.

- **Department of Public Enterprise: Financial & Technical Review of Proposed Charges for Access to the Irish Gas Transmission System**: NERA together with Ove Arup Ireland and Brown & Root Energy Services is carrying out a review of the access charges that BGN to apply for use of its gas transmission system.

- **Department of Transport, Energy and Communications: Northern Ireland Department of Economic Development; Bord Gáis; Phoenix Natural Gas Feasibility Study for Northern Ireland-Natural Gas Pipeline Inter-connector**: NERA participated with Ove Arup Ireland and Pipeline Engineering GmbH in undertaking a technical and economic Feasibility Study for a Natural Gas Pipeline Interconnector linking Ireland and Northern Ireland. The work was undertaken for a group comprising a number of interested parties.

- **Bord Gáis (The Irish Gas Board) Cost-of-Service Analysis and Market Liberalization**: NERA provided the Irish Gas Board advice on the development of cost-of-service analysis as a basis for costing unbundled gas services (1994/95), and on the gas market liberalization (1996).

- **Bord Gái**s: report on methods of allocating scarce gas transmission capacity.

- **Northern Ireland Electricity**: NERA provided a report for OFREG, comparing NIE's operating and total costs with those of other distribution businesses in Great Britain, using regression techniques and data envelope analysis.

- **CER; Northern Ireland Authority for Energy Regulation; Department of Communications, Marine and Natural Resources (Ireland); and Department of Enterprise Trade & Investment (Northern Ireland)**: NERA helped develop and implement the market power mitigation plan for the Single Electricity Market in Ireland. This plan includes elements of directed contracts, required bidding principles from generators, enhanced ringfencing, and the design and implementation of a Market Monitoring Unit (MMU). Also helped produce a full cost benefit analysis of the Single Electricity Market.

- **Northern Ireland Electricity plc**: NERA provided advice on the pricing of new connections and modifications to the electricity distribution network. Review of proposals for a wholesale electricity market.

- **BG Transco**: As part of an Ofgas consultation process designed to introduce competition for new connections and expansions in the transport and distribution sectors, NERA wrote two major reports: "Competition in Connections: An Economic Perspective," issued 31 December 1995; and "Devising an Economic Test for New Connections to Transco's Pipeline System: A NERA Report for BG Transco," issued 19 May 1997.

- **BG Transco**: As part of an Ofgas consultation designed to reform BG Transco's tariff policy, NERA wrote a paper titled "The Role for Explicit Profit Sharing in Price Cap Regulation," issued 14 March 1996. The paper showed how explicit profit sharing mechanisms can make price cap regulation more stable and can reduce overall costs of service for all customers.

- **British Gas TransCo**: NERA worked with the UK's largest supplier of gas transportation and distribution services on the design of a new pricing and services regime. On the basis of a year's intensive consultation with TransCo, as well as analysis of gas and electric industry reforms in other nations, NERA produced a public consultation document, TransCo's Pricing and Services Regime, which was published in November 1995 and was well received by Ofgas, the UK gas regulatory authority, and the UK gas industry. NERA also advised TransCo on changes to the form of regulatory control to be implemented in 1997.

- **BG Transco**: Appraisal of a proposal for discounted prices for short-haul gas transmission, to avoid uneconomic by-pass.

- **BG TransCo**: Commentary and advice on the Ofgas price control review, with particular reference to the principles of regulating revenues.

- **British Gas TransCo**: Assistance in preparation of proposals for a new commercial regime for the sale of gas transmission services, including drafting of a consultation document for publication. Advice on regulatory accounts.

- **For British Gas Transco**: Advice on gas trading arrangements in the Network Code and the costs of gas transportation.

- **British Gas**: NERA carried out a large study on storage charging, and worked with British Gas on proposals for the practical operation of open-access transport and storage, and the balancing regime to be applied, in a liberalized gas trading environment. Ofgas published some of NERA's work in February 1993 and British Gas in a joint consultation document entitled Gas Transportation and Storage.

- **Transco**: Developed a combined model of the gas and electricity markets, to examine likely behaviour and resulting prices in a 1-in-50 severe winter.

- **For a utility**: Valuation of the gas supply agreements for a utility.

Argentina

- **Natural Gas Distributor:** NERA provided a distributor of natural gas in Argentina with a critique of FIEL's proposed cost of capital methodology for the natural gas tariff review.

- **BG Plc:** NERA summarized and analyzed the scope of the natural gas transmission and distribution regulatory framework in Argentina.

- **Natural Gas Distributor:** NERA provided a distributor of natural gas in Argentina with a tariff model to recalculate its tariffs for the next five-year tariff review (2001-2002) imposed by the Argentinean regulatory framework.

- **SEYP / Government of Argentina:** NERA reviewed the Wholesale Electricity Market and made recommendations to the Secretariat of Energy on generation, transmission and distribution markets and on its interactions with the natural gas market.

- **Natural Gas Distributor:** The level of capacity contracts that could be included in the price of gas as a pass-through cost was fixed for the first five years according to the license signed between the government of Argentina and a distributor to distribute natural gas. NERA performed a study of the design standard of the distributor's network that allowed the increase of its pass-through costs in the price of gas and recovered its transportation costs.

- **ENARGAS:** NERA calculated efficiency factors for the natural gas distribution and transmission industries for the Regulatory Agency.

- **World Bank:** NERA consulted for the World Bank on questions of post-privatization industry structure, pricing and regulatory practice.

- **World Bank/Gas del Estado:** NERA advised the World Bank and Gas del Estado on the derivation of a tariff methodology and initial gas, transport and distribution tariffs to be applied to the restructured and privatized gas sector in Argentina and proposed the multiple-pipeline regime that was used to privatize Gas del Estado.

Australia

- **BHP and Incitec:** NERA advised both companies during the tariff review of natural gas tariffs for AGLGN in the State of New South Wales.

- **EPD/State of Victoria:** NERA compared different natural gas industry regulatory frameworks around the world to help in the design of the regulatory framework of the State of Victoria.

- **State of Victoria's Gas Industry Reform Unit:** NERA advised GIRU on options for developing a competitive wholesale gas market. This study culminated in a report titled Gas Competition in Victoria. Subsequently, NERA provided advice to GIRU on competition in the wholesale gas market and distribution and marketing in the retail sector.

- **Gas and Fuel Corporation of Victoria:** NERA provided a framework for producing tariffs based on sound economic and financial principles. NERA provided GFCV with five separate reports: (1) discussion of tariffs and services abroad; (2) discussion of tariffs and services in Australian states and current reforms; (3) an interim report outlining services and options for GFCV; (4) an interim report discussing costing policies and principles; and (5) a report on tariff options, including a tariff model.

Bahamas

- **Bahamas Telecommunication Company:** NERA assisted in developing a cost of capital methodology for BTC.

Belgium

- **Belgacom, 2010:** Advised Belgacom on the appropriate cost of capital for mobile and fixed line telecommunications services in Belgium taking into account forward-looking risks such as competition and new services.

- **Distrigaz:** NERA advised the management of Distrigaz, the Belgium gas wholesale and transmission company, as it faced the liberalization of European gas markets. NERA provided general advice on commercial strategy and benchmarked Distrigaz's method of cost allocation to other methods.

Bolivia

- **Comité Nacional de Despacho de Carga:** Study of natural gas reference prices for the electricity industry in Bolivia for Comité Nacional de Despacho de Carga.

- **World Bank/Ministry of Energy:** NERA offered recommendations on setting tariffs for gas transmission and distribution. NERA drafted the gas tariff regulations for the newly privatized gas distribution sector and price cap adjustment mechanism for the Ministry of Energy in Bolivia. NERA advised the Bolivian government for the newly restructured gas industry that facilitated the direct purchase and sale of gas over an open-access pipeline system.

Brazil

- **BG plc.:** NERA summarized regulation of the natural gas sector in Brazil and studied the long-term evolution of natural gas markets in Brazil.

- **Capitaltec:** NERA advised a consortium of firms working in the privatization of the natural gas distribution company in Rio de Janeiro, Brazil. NERA provided advice on the regulatory framework, pricing structure, licensing, and privatization structure.

Bulgaria

- **Bulgarian Energy Committee:** NERA performed an in-depth PHARE-funded study to assist in establishing a framework for energy policy, covering the oil, gas, electricity, and coal sectors. NERA worked closely with energy enterprises and responsible government agencies to formulate a framework that would reflect the needs of the emerging market economy. The project covered every aspect of policy formation for the energy sector, including: industry restructuring, regulation of prices and tariffs, development of new approaches to energy statistics, and selection of energy planning models. At every stage, the study took into account the social and economic impact of proposed policies.

Central America (Guatemala, Honduras and El Salvador)

- **International Private Consortium:** NERA conducted a natural gas demand study for Guatemala, Honduras and El Salvador for the period 2000-2015.

- **International Private Company:** NERA analyzed the natural gas and electricity regulatory frameworks in Guatemala, Honduras and El Salvador to study the possibility of building a natural gas pipeline from Mexico.

Chile

- **Government of Chile:** NERA advised on gas regulations to promote the development of the gas industry in Chile. These regulations specified the precise open-access conditions that would allow for competitive expansion of the gas systems in the future.

China

- **World Bank:** NERA advised on reforms in the power sector.

- **World Bank:** NERA provided studies on the pricing of gas and gas transport in China. The Sichuan Gas Allocation and Pricing Study was prepared by NERA to produce policy recommendations for an efficient gas allocation and pricing structure that will best promote the development of the gas industry in China.

France

- **Electricite de France SA, 2006:** provided a set of papers on theoretical issues in estimating the cost of capital and methodology applied to financeability for EdF.

Germany

- **BDEW, the German Association of Energy and Water Companies, 2008:** Prepared an expert report on the allowed return on equity for German electricity and gas networks

- **E.ON Ruhrgas:** Design of a regulatory method based on comparison of average tariffs, consistent with new German legislation on the regulation of gas transmission networks.

- **E.ON Ruhrgas:** Conducted a review of the latest German ordinance on tariff benchmarking for gas transmission companies and an economic interpretation of its provisions.

Ghana

- **World Bank/Ghanaian Ministry of Mines and Energy: Ghana Vision:** NERA was hired by the World Bank and the Ministry of Mines and Energy of Ghana to analyze the potential demand for a planned pipeline to import natural gas from Nigeria to Ghana. The potential sources of demand included industrial energy users and electricity generation. Our analysis included netback analysis based on the cost of residual fuel oil.

- **Ministry of Mines and Energy/Government of the Republic of Ghana:** NERA reviewed and validated results of ongoing surveys and market segment assessments conducted by the Ministry of Mines and Energy, consulted directly with independent potential users of natural gas regarding users' needs, reviewed gas marketing options that would be cost effective in local delivery systems for natural gas, and developed updated projections of peak and base load demand for natural gas in Ghana.

India

- **Asian Development Bank/India:** NERA was invited by the Government of India and the Asian Development Bank to provide advice on the development of a Regulatory Framework for the Indian Gas Sector, which included: (1) a comprehensive review of gas sector development proposals and current regulatory systems, (2) the identification of regulatory objectives and appropriate alternative regulatory systems, (3) presentation of feasible regulatory options, (4) advise on development of legislative requirements and institutional arrangements, and (5) development of an implementation plan.

Indonesia

- **Ministry of Mines and Energy:** Provided assistance to the Ministry of Mines & Energy to implement a regulatory framework for the gas sector. To date, the main emphasis has been on establishing the overall oil and gas policy framework for the law to implement the detailed regulatory arrangements.

- **Asian Development Bank:** NERA advised on ways to improve the regulation of the downstream natural gas industry in Indonesia. This assistance was linked to securing private sector investors to participate in two major gas transmission projects.

Italy

- **Enel:** Estimated the costs of capital for their transmission and distribution businesses and a report on the final regulator's decision for Enel

- **Snam and Schroeders:** NERA advised in the design of the regulatory framework of natural gas transport in Italy.

Malaysia

- **Malaysian Communications and Multimedia Commission, 2005**: Estimation of fixed and mobile network communications services cost of Capital.

Mexico

- **Multinational Client (Confidential):** Analyzed the effects of incremental and roll-in tariff policies in the Mexican gas pipelines for a private utility.

- **Government of Mexico:** NERA advised the Peña Nieto administration on reform of the power sector. NERA had performed a similar multi-year assignment for the Zedillo administration.

- **Government of Mexico:** NERA suggested alternatives for natural gas pricing for the petrochemical industry in Mexico.

- **International Natural Gas Company:** NERA consulted an international company on the natural gas market in Mexico and Texas for the tender of IPPs in Mexico.

- **Secretariat of Energy:** NERA wrote a report that the President of Mexico gave to the President of Guatemala for the signing of a Protocol to facilitate the building of a private pipeline from Mexico to Guatemala.

- **International Oil Company:** NERA analyzed the regulatory framework of natural gas and helped negotiate a natural gas contract with Pemex.

- **International Consortium:** NERA provided assistance to an international consortium during the privatization of the natural gas distribution company in Monterrey. NERA provided regulatory support, a market study of the potential gas demand and a tariff model.

- **Pemex Gas y Petroquímica Básica:** NERA advised Pemex Gas y Petroquímica Básica (oil and gas monopoly of Mexico) in the development of a methodology for tariffs, prices and the cost of service for LPG terminals and providing support for their dealings with the Energy Regulatory Commission.

- **Pemex Gas y Petroquímica Básica:** NERA directed the long-term planning of Pemex Gas y Petroquímica Básica corporate strategies with respect to the new regulations that affect oil products and gas markets.

- **Pemex Gas y Petroquímica Básica:** NERA advised Pemex Gas y Petroquímica Básica in the development of a methodology for tariffs, prices and the cost of service of natural gas regulated activities and provided support for their negotiations and discussions with the Energy Regulatory Commission.

- **Comisión Reguladora de Energía:** NERA advised the Energy Regulatory Commission in Mexico in the writing of the current Directives on the Determination of Prices and Rates for Natural Gas Regulated Activities.

Morocco

- **World Bank:** NERA reviewed and made recommendations concerning the institutional reform of the Moroccan energy sector. NERA analyzed the institutional and regulatory issues in the electricity and gas subsectors and identified and selected options for the energy sector's restructuring.

Netherlands

- **Gas Transport Services:** Economic advice in an appeal against the energy regulator's decision on a regulatory method (revenue cap) and on the precise calculation of the "x-factor" for updating it year by year.

- **Independent Dutch Post and Telecommunications Authority (OPTA), 2001-09**; Since 2001, specialist advisor to OPTA on the cost of capital for telecommunications interconnection, broadband networks and retail services in Holland.

- **Gasunie:** A study of regulatory methods of defining asset values in various European countries, for gas and electricity networks.

- **Gasunie:** Prepared a report commenting on the tariff-setting guidelines issued by energy regulator, DTe, for an appeal to the administrative court.

- **Gasunie:** Reviewed the commercial and regulatory framework proposed by DTe and drew up a suggested market model.

- **Gasunie:** Studied the accounting practices of gas transmission companies around the world.

- **For an investor:** Provided a due diligence report on regulatory framework of a Dutch gas network company.

- **For Gasunie:** Advice and a manual on basic methods of regulating an energy network.

New Zealand

- **Kapuni Gas:** NERA advised Shell Co. and Todd Co. on their dispute over gas treatment costs against the Natural Gas Corporation.

- **Maui Gas:** NERA advised the Government of New Zealand ("The Crown") regarding a litigated dispute over an abrogated contract for major on and off shore natural gas development.

- **Natural Gas Corporation of New Zealand:** NERA assisted in formulating a response to allegations of anti-competitive behaviour regarding a wholesale gas purchase contract for gas from the Kapuni field in New Zealand. Debate focused on issues relating to dedication provisions, price terms, the terms of the contract, and the life expectancy of the field.

- **Natural Gas Corporation of New Zealand:** NERA provided detailed advice on efficient rate design, including the transition to a forward-looking tariff regime, and has prepared detailed submissions to the Government on efficient tariff setting. As New Zealand has moved towards a regime of very light-handed regulation, NERA has provided economic counsel on competition policy issues, ensuring that proposed rates are both economically efficient and designed to promote competition.

Peru

- **Comisión de Tarifas de Energía,:** NERA provided strategic assessment in the determination of tariff conditions for natural gas transport and distribution in Peru.

- **Comisión de Tarifas de Energía:** NERA designed a regulatory accounting for natural gas distribution and natural gas and liquids transport in Peru.

- **Comisión de Tarifas de Energía:** NERA advised the government of Peru on the Camisea gas price and the changes in the electricity sector's legal and regulatory framework.

- **Comisión de Tarifas de Energía:** NERA advised the government of Peru in the international public tender of the natural gas transportation company from Camisea to Lima.

- **Flemings:** NERA advised Robert Fleming Co. and the Government of Peru in the concessioning of the natural gas distribution company in Lima.

- **Flemings:** NERA advised Robert Fleming Co. and the Government of Peru in the concessioning of the natural gas transportation company from Camisea to Lima.

- **Comisión de Tarifas de Energía:** NERA advised Peru's Regulatory Commission on the methodology to use to include gas prices in the generation prices calculations.

- **Perupetro, SA:** NERA advised Peru's government agency responsible for the development of hydrocarbon resources, on the prospects for field development in the Camisea basin and gas and liquids pipeline construction from Camisea to Lima. NERA reviewed the proposed Hydrocarbons Law, which would regulate such developments. NERA advised Perupetro during the government's negotiations with prospective developers of fields and pipelines.

Poland

- **World Bank:** Assistance on oil, gas and organization aspects of World Bank ESMAP to establish an Energy Regulatory Authority.

- **World Bank:** NERA prepared recommendations for appropriate tariffs, pricing systems, domestic Polish producer prices and an appropriate regulatory structure that would contribute to the promotion of an efficient expansion of domestic gas production and supply of natural gas.

Portugal

- **EDP in Portugal:** Estimated the cost of capital for its distribution, transmission and generation activities.

Russia

- **World Bank Russia:** Legal, regulatory and finance issues for World Bank-funded Gas Distribution Pricing Project.

- **Russian Federation State Committee:** NERA provided technical assistance for the Management of State Property on the privatization of the petroleum, natural gas, and electricity industries in Russia.

Singapore

- **Singapore Power Group:** General regulatory support and expert advice on the cost of capital for regulated electricity transmission and distribution assets in Singapore.

- **Energy Market Authority:** expert review of cost of capital proposals for the long-run marginal cost for electricity generation in Singapore.

South Africa

- NERA advised ESKOM on PBR development and reasons why it was not successful.

- NERA provided National Energy Regulator of South Africa ("NERSA") with training in international regulatory benchmarking during the summer of 2011. The training consisted of a two day seminar consisted a theoretical overview on benchmarking e.g. best practices, methodologies and its applicability to NERSA.

- NERA also conducted marginal cost training for NERSA. The two main components of the training consisted of rate design and marginal cost estimation. NERA also provided an overview of Regional Economic Impact Analysis ("REMI"), included illustrative case studies and applications in energy policy.

- For a client group comprising the major oil companies, air carriers, refiners and the pipeline company, NERA devised a new tariff regime for South Africa's oil products pipeline network. The Dept. of Minerals and Energy administered the project.

- Lead a business/government workgroup to determine the restructuring of Eskom's generation assets to create a competitive and financially viable set of generation companies in South Africa.

- Assisted ACSA in the negotiation with South African Airlines on new aviation charges and drafting of a note on the regulatory principles applicable to ACSA.

- Assisted ACSA in the negotiation with the aviation regulator for the publication of the new permission document on airport charges.

Spain

- **Regulatory Framework:** NERA advised in the design of a new regulatory framework for pipelines in Spain. A natural gas tariff model was developed.

- **LNG Terminals:** NERA advised private client on appropriate regulatory arrangements for LNG import terminal.

- **Gas Natural:** NERA evaluated investment alternatives for the period 1996-2000.

- **National Institute of Hydrocarbons:** NERA advised this client on the consequences for ENAGAS of a possible approval by the EEC of open-access and the liberalization of the gas sector in Spain. NERA developed a transportation tariff model.

- **Repsol:** NERA conducted a study to estimate the value of the transportation company (ENAGAS), the future evolution of the Spanish natural gas market and the tariff structure, as a preparation for the privatization of ENAGAS.

- **ENAGAS:** NERA advised in the preparation and writing of natural gas supply contracts.

- **ENAGAS:** NERA conducted an international study to compare tariff criteria for the natural gas industries in the US and Europe.

- **Ministry of Industry:** NERA advised the Ministry of Industry in the evolution of the oil, natural gas, and other products prices for a period of 10 years.

- **Spanish National Institute of Hydrocarbons and Natural Gas/Enagas:** On an ongoing basis, NERA has advised (the public gas transportation and supply company) on the reform of gas pricing and regulatory policies in Spain, including both tariff restructuring and the implications for ENAGAS of third-party access to gas pipelines. This work includes the specification of gas price indexing mechanisms and the continuing role of gas merchants in Spain.

Tanzania

- **World Bank/Tanzanian Petroleum Development Corporation:** NERA conducted a major study regarding the financing of new, upstream gas industry development. This study included evaluations of the various risks involved in the structuring of new gas ventures (e.g., product risk, delivery risk, credit risk, regulatory risk, price risk, etc.) and the practical prospect of financing a new gas market and pipeline venture given the limited role for gas use in that region of Africa.

C. Performance-Based Ratemaking Experience

For over fifty years, NERA has provided extensive tariff design consulting services to gas and electric utilities. NERA's economists have worked extensively in developing the economic theory underlying the adoption of incentive-based regulation. We have also assisted numerous gas and electric utilities in the U.S. and abroad in designing and implementing flexible pricing and price caps mechanisms in electric, gas, and telephone industries, as illustrated in the list of representative projects above.

D. Experience in the Northeast

NERA's past assignments in the Northeast include the following:

- On behalf of Public Service of New Hampshire,
  - provided an *ex ante* economic evaluation of the scrubber retrofit undertaken at the Merrimack power plant.
  - testified before the New Hampshire legislature on a bill regarding the divestiture of PSNH's three fossil-fuel power plants.
  - developed a cost-benefit analysis of cooling water intake alternatives at the Merrimack facility.
  - commented on economic issues related to the response of the New Hampshire Department of Environmental Services to the Company's request for early action bonus allowances related to the Regional Greenhouse Gas Initiative.
  - commented on economic issues related to the PSNH's request for early action credits in a New Hampshire cap-and-trade program.
  - commented on the appropriate allowance price benchmark for assigning early action credits under a New Hampshire state carbon program.
- On behalf of NSTAR Electric, prepared rebuttal testimony on electric standby rates.
- On behalf of Northeast Utilities, examined claims in a securities class action.
- Analyzed various aspects of the proposed merger between Northeast Utilities and ConEdison.

NERA's assignments in energy matters in Massachusetts include the following:

- On behalf of Boston Edison, prepared testimony in opposition to the Mass. DPU proposed rule to extend standards of conduct re relationship between gas and electric distribution companies and their unregulated marketing affiliates.

- On behalf of Verizon New York, Inc., prepared public interest analysis of NYNEX's entry into interLATA telecommunications markets in Massachusetts.

- On behalf of MHI, Inc., evaluated bids to supply power to a consortium of electricity consumers in Massachusetts.

- On behalf of Japan Electric Power Information Center, Inc., prepared a paper reviewing electricity industry unbundling in California and Massachusetts.

- On behalf of Massachusetts Electric Company, investigated the sources of total factor productivity measurements that could be used as productivity offsets in an incentive rate plan for an electricity distributor (as distinct from an integrated electric company).

- On behalf of Verizon New York, Inc., developed testimony outlining the economic and regulatory issues that establish the appropriate foundation for public policy decisions about local exchange telephone competition.

- On behalf of Bell Atlantic Corporation, provided testimony assessing the economic benefits that pertain to the implementation of intraLATA presubscription in Massachusetts.

- On behalf of the Alliance to Protect Nantucket Sound, analysis and testimony in connection with the development of the Cape Wind project.

VI. References for Similar Services Provided by NERA

Gaz Métro
Dave Rhéaume
Chef de service
Dossiers spéciaux et ONÉ
Affaires réglementaires
Montréal
Dave Rhéaume has now moved to Hydro Québec. He can be reached on 514-879-4841.

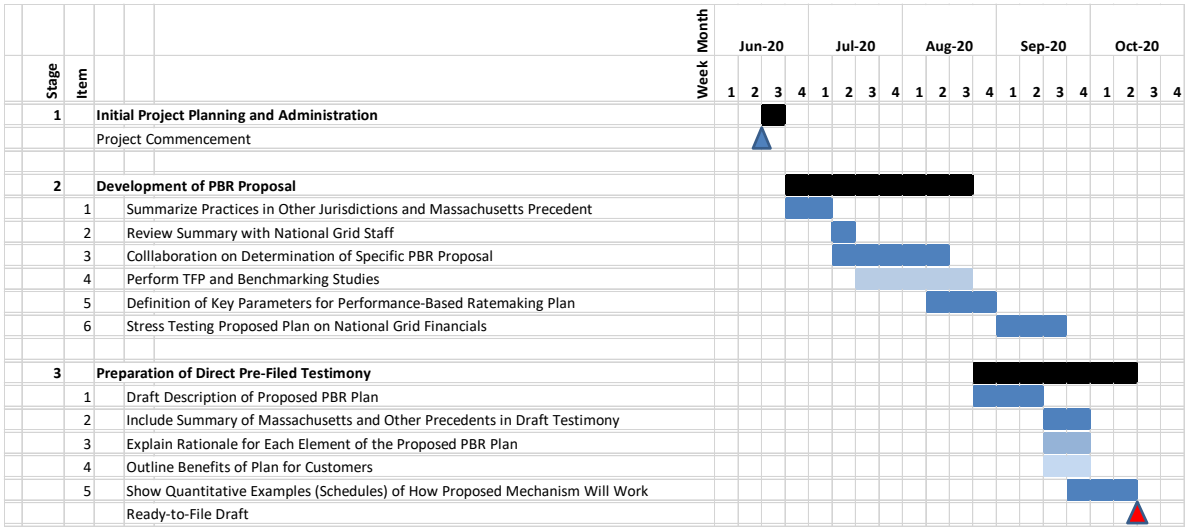
Chugach Electric Association
Arthur Miller
Director, Regulatory Affairs & Pricing
+1 (907) 762-4758
arthur_miller@chugachelectric.com

Hawaiian Electric Company
Dean Matsuura
Manager, Regulatory Rate Proceedings
+1 (808) 543-7433
dean.matsuura@hawaiianelectric.com

ESKOM
Calib Cassim
General Manager
Regulation & Financial Planning
Tel +27 11 800 3677
E-mail cassimc@eskom.co.za

VII. Proposed Work Plan

Please find below NERA's proposed timescale for elaboration of the tasks required by National Grid up through the date of filing Direct Testimony. We stand ready to work with National Grid to modify this proposed timescale to meet any internal target deadlines National Grid may need to meet.



VIII. Appendices

We include CVs for the proposed senior NERA staff in Appendix 1 to our proposal.

REDACTED

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NERA
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Kurt G. Strunk
Director

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www.nera.com

KURT G. STRUNK
Director

Mr. Strunk is an expert in applied finance and energy matters with over 25 years of experience in international arbitration, complex commercial litigation, and regulatory proceedings. Mr. Strunk is recommended as a leading energy expert by *Who's Who Legal*. He has been retained as an expert to testify in arbitrations, before the Federal Energy Regulatory Commission, US Tax Court, US Federal Court, and US Bankruptcy Court, the National Energy Board in Canada, as well as state and provincial public utilities boards in the US and Canada. His testimonies have addressed construction delay, asset and contract valuation, breach-of-contract damages, the proportionality of stipulated liquidated damages provisions, cost of capital and discount rates, just and reasonable rates, regulatory accounting, prudence, cost of service, regulatory reform, pipeline access, retail market issues, as well as trading and risk management.

In the oil and gas sectors, Mr. Strunk has consulted on rate matters, mergers and acquisitions, restructurings, contract disputes, valuation and product pricing. He has valued oil and gas assets and contracts in litigated disputes on behalf of major firms in the petroleum sector. He advised sellers of LNG in disputes with buyers (prior to international arbitration) and performed extensive quantitative analysis around appropriate prices and damages in the event of breach. He has served as an expert in regulatory hearings relating to pipeline tariffs in Canada and the United States. He has also carried out studies of the reasonableness of gas supply agreements in various jurisdictions and quantified damages in connection with the early termination of such agreements.

In electric power, Mr. Strunk has advised governments, regulators, and energy companies on industry structure, regulation, and sector reform in North America, South America, Europe, Australia, Asia and Africa. In generation, his assignments often involve analysis of new power generation resources and contracts. He has advised on the development of independent power contracts, fuel supply arrangements and competitive solicitations across the globe. He served as a key member of NERA's team advising on electric sector reform and power market design in Mexico, a project he carried out in the Spanish language. He routinely values electricity sector companies and assets in the context of disputes and advisory assignments.

Mr. Strunk's assignments often require that he determines the appropriate return on equity capital for energy firms. He has calculated and supported required rates of return for power generators, gas distribution utilities, electric distribution and transmission companies, and other energy firms in the context of traditional tariff reviews for regulated entities, litigation and advisory work. Mr. Strunk frequently collaborates with NERA's Securities and Finance Practice. He has addressed liability and damages in broker-dealer disputes, and in securities class actions.

Kurt G. Strunk

Education

1997	**INSEAD (The European Institute of Business Administration), Fontainebleau, France** MBA, with Distinction, 1997
1993	**VASSAR COLLEGE,** **New York, USA** B.A., Economics, General and Departmental Honors

Career Details

2017-present	**NERA ECONOMIC CONSULTING** Director, New York
2012–2016	**NERA ECONOMIC CONSULTING** Vice President, New York
2005–2012	**NERA ECONOMIC CONSULTING** Senior Consultant, New York
2003–2004	**NERA ECONOMIC CONSULTING** Outside Consultant, New York
2000–2002	**NERA ECONOMIC CONSULTING** Senior Consultant, New York
1998–1999	**NERA ECONOMIC CONSULTING** Senior Analyst, New York
1996	**NERA ECONOMIC CONSULTING** Associate Analyst, New York
1994–1995	**NERA ECONOMIC CONSULTING** Research Associate, New York
1993–1994	**NERA ECONOMIC CONSULTING** Research Assistant, New York
1992	**GÉNÉRALE DE BANQUE** Research Assistant, Brussels

Languages

English:	mother tongue
French:	fluent
Spanish:	fluent

Project Experience

EXPERT TESTIMONY

2020 **NV Energy**
Cost of Gas / Prudence
Direct Testimony before the Nevada Public Utilities Commission, on behalf of NV Power Company, presenting analysis on the prudence of NV Energy's physical natural gas commodity transactions. March 1, 2020.

2020 **NV Energy**
Cost of Gas / Prudence
Direct Testimony before the Nevada Public Utilities Commission, on behalf of Sierra Pacific Power Company, presenting analysis on the prudence of NV Energy's physical natural gas commodity transactions. March 1, 2020.

2019 **Municipal Light & Power, Chugach Electric Association, Inc.**
Acquisition
Oral Testimony before the Regulatory Commission of Alaska on behalf of Chugach Electric Association, Inc., addressing the acquisition of Municipal Light & Power by Chugach Electric and post-acquisition tariff structures. November 5, 2019.

2019 **Southwestern Electric Power Company**
Prudence of Investment in Power Generation Facilities
Sur-Surrebuttal testimony before the Arkansas Public Service Commission on behalf of Southwestern Electric Power Company addressing the prudence of certain investments in power generation facilities. October 2, 2019.

2019 **Central Maine Power Company**
Marginal Cost Study
Oral Testimony before the State of Maine Public Utilities Commission on behalf of Central Maine Power Company in its 2018 Distribution Rate Case, addressing time-of-use pricing, marginal cost estimation and cost recovery for distribution network investment. October 2, 2019.

2019 **NV Energy**
Cost of Capital
Rebuttal Testimony before the Nevada Public Utilities Commission, on behalf of Sierra Pacific Power Company, addressing the cost of capital for the Company's electric division. September 19, 2019.

2019 **Municipal Light & Power, Chugach Electric Association, Inc.**
Acquisition
Oral Testimony before the Regulatory Commission of Alaska on behalf of Chugach Electric Association, Inc., addressing the acquisition of Municipal Light & Power by Chugach Electric. September 5 & 6, 2019.

2019 **Corporate Commission of Arizona**
Oral Testimony on behalf of Grand Canyon State Electric Cooperative Association, Inc. before the Corporate Commission of Arizona towards contracts with Qualifying Facilities. August 27, 2019.

2019 **Central Maine Power Company**
Cost Study for Electric Distributor
Surrebuttal Testimony before the State of Maine Public Utilities Commission on behalf of Central Maine Power Company in its 2018 Distribution Rate Case, addressing the theory of electric utility costing and the implementation of a cost study for the distribution network. August 22, 2019.

2019 **Municipality of Anchorage (ML&P), Chugach Electric Association**
Reasonableness of Proposed Merger
Reply Testimony Before the Regulatory Commission of Alaska addressing the acquisition of Municipal Light & Power by Chugach Electric. August 2, 2019.

2019 **Chugach Electric Associate Inc.**
Cost of Capital
Oral Testimony Before the Regulatory Commission of Alaska addressing the cost of capital for Chugach Electric. July 15, 2019.

2019 **NV Energy**
Cost of Capital
Direct Testimony before the Nevada Public Utilities Commission, on behalf of Sierra Pacific Power Company, addressing the cost of capital for the Company's electric division. June 3, 2019.

2019 **Avangrid NY**
Marginal Cost Study
Direct Testimony before the New York State Public Service Commission on behalf of New York State Electric & Gas Corporation, providing marginal cost estimates for purposes of informing reasonable electric and gas distribution rates. May 20, 2019.

2019 **Avangrid NY**
Marginal Cost Study
Direct Testimony before the New York State Public Service Commission on behalf of Rochester Gas & Electric Corporation, providing marginal cost estimates for purposes of informing reasonable electric and gas distribution rates. May 20, 2019.

2019 **Central Maine Power Company**
Marginal Cost Study
Rebuttal Testimony before the State of Maine Public Utilities Commission on behalf of Central Maine Power Company in its 2018 Distribution Rate Case, addressing time-of-use pricing, marginal cost estimation and cost recovery for distribution network investment. April 25, 2019.

2019 **Municipality of Anchorage (ML&P), Chugach Electric Association**
Reasonableness of Proposed Merger
Pre-filed direct testimony on behalf of Chugach Electric Association, Inc. before the Regulatory Commission of Alaska supporting Chugach's proposed acquisition of ML&P from the Municipality of Anchorage. Testimony addresses the valuation of ML&P, the reasonableness of the purchase price, forecast synergy savings, market

pricing for a related Power Purchase Agreement, and the tangible benefits that will accrue to ratepayers as a result of the merger. April 1, 2019.

2019 **Public Service Company of New Mexico**
Reasonableness of Power Purchase Agreement
Affidavit before the Federal Energy Regulatory Commission including a benchmarking analysis of a solar power purchase agreement under FERC's *Edgar* and *Ocean State*s standards. March 15, 2019.

2019 **NV Energy**
Cost of Gas / Prudence
Direct Testimony before the Nevada Public Utilities Commission, on behalf of NV Energy, addressing the reasonableness of the Company's natural gas purchases. March 1, 2019.

2019 **Southwestern Electric Power Company**
Prudence of Investment in Power Generation Facilities
Direct Testimony before the Arkansas Public Service Commission on behalf of Southwestern Electric Power Company addressing the prudence of the company's investments in the Dolet Hills Power Plant. February 28, 2019.

2018 **PacifiCorp**
Cost of Capital
Rebuttal Testimony before the California Public Utilities Commission, on behalf of PacifiCorp, on the cost of capital in the Company's rate case, November 20, 2018.

2018 **LS Power Company**
Generation Capacity Market Design
Reply Affidavit (w/Willis Geffert), on behalf of LS Power Associates, L.P., before the Federal Energy Regulatory Commission, addressing flaws in the existing capacity market construct in the PJM Interconnection. November 6, 2018

2018 **LS Power Company**
Generation Capacity Market Design
Affidavit (w/Willis Geffert), on behalf of LS Power Associates, L.P., before the Federal Energy Regulatory Commission, addressing flaws in

the existing capacity market construct in the PJM Interconnection. October 2, 2018.

2018 **Maui Electric Company**
Power Generation Costs, Incentives, Fuel Adjustment Clauses
Rebuttal Testimony before the Hawai'i Public Utilities Commission on behalf of Maui Electric Company, Inc., addressing matters pertaining to its fuel costs and Energy Cost Adjustment Clause, June 22, 2018.

2018 **PacifiCorp**
Cost of Capital
Direct Testimony before the California Public Utilities Commission, on behalf of PacifiCorp, on the cost of capital in the Company's rate case, April 12, 2018.

2018 **Hawaiian Electric Company**
Power Generation Costs, Incentives, Fuel Adjustment Clauses
Affidavit before the Hawai'i Public Utilities Commission on behalf of Hawaiian Electric Company, Inc., addressing matters pertaining to Hawaiian Electric's Energy Cost Adjustment Clause, April 10, 2018.

2018 **North Carolina Utilities Commission Raleigh**
Tax, Regulatory and Utility Financial Matters
Supplemental testimony before the State of North Carolina Utilities Commission Raleigh, presenting opinions on various tax, economic, regulatory and financial matters in the Duke Energy Carolinas General Rate Case, March 20, 2018.

2018 **Hawaiian Electric Company**
Power Generation Costs, Incentives, Fuel Adjustment Clauses
Supplemental Testimony before the Public Utilities Commission of Hawaii, presenting opinions on fuel costs and energy cost adjustment clauses, February 14, 2018.

2018 **North Carolina Utilities Commission Raleigh**
Regulation and Utility Finance
Pre-filed testimony before the State of North Carolina Utilities Commission Raleigh, presenting opinions on various economic, regulatory

and financial matters in the Duke Energy Carolinas General Rate Case, January 23, 2018.

2018 **Hawaiian Electric Company**
Power Generation, Incentive Ratemaking, Fuel Adjustment Clauses
Rebuttal Testimony before the Public Utilities Commission of Hawaii, addressing fuel costs and the appropriateness of the current and proposed Energy Cost Adjustment Clause ("ECAC"), January 05, 2018.

2017 **Nevada Power Company**
Cost of Capital
Oral testimony before the Public Utilities Commission of Nevada on behalf of Nevada Power Company presenting his analysis and conclusions on the cost of capital. November 1, 2017.

2017 **Energía Limpia de Guatemala, S.A.**
EPC Contracts, Liquidated Damages, Power Industry Practices
Oral Testimony before the ICC Court of Arbitration, ICC Case No. 21361/RD, on behalf of Energía Limpia de Guatemala, S.A., addressing the proportionality of liquidated damages in a turnkey EPC contract, October 25, 2017.

2017 **Nevada Power Company**
Cost of Capital
Rebuttal testimony before the Public Utilities Commission of Nevada on behalf of Nevada Power Company presenting on the cost of capital, September 26, 2017.

2017 **Energía Limpia de Guatemala, S.A.**
EPC Contracts, Liquidated Damages, Power Industry Practices
Pre-filed Expert Report before the ICC Court of Arbitration (w/Willis Geffert), ICC Case No. 21361/RD, on behalf of Energía Limpia de Guatemala, S.A., addressing the proportionality of liquidated damages in a turnkey EPC contract, September 15, 2017.

2017 **Hawai'i Electric Light**
Power Generation, Incentive Ratemaking, Fuel Adjustment Clauses
Rebuttal Testimony before the Hawai'i Public Utilities Commission, on behalf of Hawai'i Electric Light, addressing alternative incentive mechanisms for the Company's power generation fleet, fuel costs, and the reasonableness of the Company's proposed ECAC, June 23, 2017.

2017 **Southwestern Electric Power Company**
Prudence of Investment in Power Generation Facilities
Oral Testimony before the Public Utility Commission of Texas on behalf of Southwestern Electric Power Company addressing the prudence of the company's investments in the Dolet Hills Power Plant, June 15, 2017.

2017 **NV Energy**
Cost of Capital
Direct Testimony before the Nevada Public Utilities Commission, on behalf of Nevada Power Company, addressing the cost of capital for the Company, June 5, 2017.

2017 **Southwestern Electric Power Company**
Prudence of Investment in Power Generation Facilities
Rebuttal Testimony before the Public Utilities Commission of Texas, on behalf of Southwestern Electric Power Company, addressing the prudence of retrofit investments in certain electricity generation facilities, May 19, 2017.

2017 **North Carolina Utilities Commission**
Power Contract Design, Financing New Power Plants
Direct Testimony before the North Carolina Utilities Commission, on behalf of North Carolina Sustainable Energy Association, addressing the biennial determination of avoided cost rates for electric utility purchases from qualifying facilities, March 28, 2017.

2017 **NV Energy**
Cost of Gas / Prudence
Direct Testimony before the Nevada Public Utilities Commission, on behalf of NV Energy, addressing the reasonableness of the Company's natural gas purchases, March 1, 2017.

2016 **NV Energy**
Cost of Capital
Rebuttal Testimony before the Nevada Public Utilities Commission, on behalf of Sierra Pacific Power Company, addressing the cost of capital for the Company's electric and gas divisions, September 23, 2016.

2016 **Hawai'i Electric Light**
Power Generation, Incentive Ratemaking, Fuel Adjustment Clauses
Direct Testimony before the Hawai'i Public Utilities Commission, on behalf of Hawai'i Electric Light, addressing alternative incentive

mechanisms for the Company's power generation fleet, fuel costs, and the reasonableness of the Company's proposed ECAC, September 19, 2016.

2016 **NV Energy**
Cost of Capital
Certification Testimony before the Nevada Public Utilities Commission, on behalf of Sierra Pacific Power Company, addressing the cost of capital for the Company's electric and gas divisions, August 2, 2016.

2016 **NV Energy**
Cost of Capital
Direct Testimony before the Nevada Public Utilities Commission, on behalf of Sierra Pacific Power Company, addressing the cost of capital for the Company's electric and gas divisions, June 6, 2016.

2016 **PacifiCorp**
Cost of Capital
Oral Testimony before the Washington Utilities and Transportation Commission, on behalf of PacifiCorp, on the cost of capital in the Company's expedited rate filing (Docket UE-152253), May 2, 2016.

2016 **Confidential Client**
Damages under Wind Power Purchase Agreement
Expert Report in arbitration on the valuation of damages under a PPA backed by a wind farm, with a particular focus on the reasonableness of the liquidated damages cap, April 25, 2016.

2016 **Municipality of Anchorage (ML&P), Chugach Electric Association**
Valuation of Gas Field and Reasonableness of Acquisition Price
Oral Testimony before the Regulatory Commission of Alaska on the reasonableness of the proposed acquisition of ConocoPhillips' working interest in the Beluga River Unit, April 19, 2016.

2016 **PacifiCorp**
Cost of capital
Rebuttal Testimony before the Washington Utilities and Transportation Commission, on behalf of PacifiCorp, on the cost of capital in the Company's expedited rate filing (Docket UE-152253), April 7, 2016.

2016 **NV Energy**
Cost of Gas / Prudence
Direct Testimony before the Nevada Public Utilities Commission, on behalf of NV Energy, addressing the reasonableness of the Company's natural gas purchases, March 1, 2016.

2016 **Alliance to Protect Nantucket Sound**
Financing of off-shore wind farm
Oral Testimony before the Energy Facilities Siting Board of the Commonwealth of Massachusetts on the financeability of the Cape Wind project, January 25, 2016.

2015 **PacifiCorp**
Cost of capital
Direct Testimony before the Washington Utilities and Transportation Commission, on behalf of PacifiCorp, on the cost of capital, November 24, 2015.

2015 **Chugach Electric Association, Inc.**
Regulatory principles for cost allocation
Oral testimony before the Regulatory Commission of Alaska, addressing the regulatory treatment of gas found by Cook Inlet Natural Gas Storage Alaska LLC, August 31, 2015.

2015 **Baltimore Gas & Electric Company**
Risks and rate of return for retail electricity business
Oral Testimony before the Maryland Public Service Commission, *in the Matter of Baltimore Gas & Electric's Application to Recover Cash Working Capital for Standard Offer Service*, Case No. 9221, August 5, 2015.

2015 **Baltimore Gas & Electric Company**
Risks and rate of return for retail electricity business
Rebuttal Testimony before the Maryland Public Service Commission, *in the Matter of Baltimore Gas & Electric's Application to Recover Cash Working Capital for Standard Offer Service*, Case No. 9221, July 22, 2015.

2015 **Chugach Electric Association, Inc.**
Regulatory principles for cost allocation
Pre-filed testimony before the Regulatory Commission of Alaska, addressing the regulatory treatment of gas found by Cook Inlet Natural Gas Storage Alaska LLC, June 5, 2015.

2015 **ATX Southwest, LLC.**
Cost of Capital
Direct Testimony before the Federal Energy Regulatory Commission, on behalf of ATX Southwest, addressing return on equity, May 28, 2015.

2015 **Chugach Electric Association, Inc.**
Cost of Capital
Responsive Testimony before the Regulatory Commission of Alaska, addressing return on equity for the Enstar Natural Gas Company, May 15, 2015.

2015 **Baltimore Gas & Electric Company**
Risks and rate of return for retail electricity business
Testimony before the Maryland Public Service Commission, *in the Matter of Baltimore Gas & Electric's Application to Recover Cash Working Capital for Standard Offer Service*, Case No. 9221, April 22, 2015.

2015 **NV Energy**
Cost of Gas / Prudence
Direct Testimony before the Nevada Public Utilities Commission, on behalf of NV Energy, addressing the reasonableness of the Company's natural gas purchases, March 1, 2015.

2014 **PacifiCorp**
Cost of capital
Oral Testimony before the Washington Utilities and Transportation Commission, on behalf of PacifiCorp, on the cost of capital in the Company's general rate case, December 16, 2014.

2014 **PacifiCorp**
Cost of capital
Rebuttal Testimony before the Washington Utilities and Transportation Commission, on behalf of PacifiCorp, on the cost of capital in the Company's general rate case, November 21, 2014.

2014 **PacifiCorp**
Cost of capital
Direct Testimony before the Washington Utilities and Transportation Commission, on behalf of PacifiCorp, on the cost of capital in the Company's general rate case, including the effects of transitioning away from coal, April 30, 2014.

2014 **Nevada Power Company**
Cost of capital
Direct Testimony before the Nevada Public Utilities Commission, on behalf of Nevada Power Company, on the cost of capital in the Company's general rate case, April 30, 2014.

2015 **NV Energy**
Cost of Gas / Prudence
Direct Testimony before the Nevada Public Utilities Commission, on behalf of NV Energy, addressing the reasonableness of the Company's natural gas purchases, March 1, 2014.

2013 **Sierra Pacific Power Company**
Cost of capital
Oral testimony, before the Nevada Public Utilities Commission, on behalf of Sierra Pacific Power Company, on the cost of capital for the gas and electric divisions in the Company's general rate case, October 7, 2013.

2013 **Sierra Pacific Power Company**
Cost of capital
Rebuttal Testimony before the Nevada Public Utilities Commission, on behalf of Sierra Pacific Power Company, on the cost of capital for the gas and electric divisions in the Company's general rate case, September 25, 2013.

2013 **Market Area Shippers**
(Gaz Métro, Union Gas and Enbridge Gas Distribution)
Contract Renewal Alternatives for Regulated Pipeline Service
Pre-filed Expert Report, with Jeff Makholm, before the National Energy Board of Canada, in the Matter of TransCanada's Application for Tariff Amendments, Hearing Order RH-001-2013, July 26, 2013.

2013 **Sierra Pacific Power Company**
Cost of capital
Direct Testimony before the Nevada Public Utilities Commission, on behalf of Sierra Pacific Power Company, on the cost of capital for the gas and electric divisions in the Company's general rate case, June 4, 2013.

2013 **NV Energy Operating Companies**
Cost of capital
Direct Testimony before the Federal Energy Regulatory Commission, on behalf of NV Energy Operating Companies, on the appropriate rate of return for the consolidated transmission system, May 31, 2013.

2013 **Public Intervenor**
Wholesale Margins for Regulated Motor Fuels and Heating Oil
Oral testimony before the New Brunswick Energy and Utilities Board, *In the Matter of an Application by Irving Oil Marketing GP and Irving Oil Commercial GP requesting an increase in the wholesale margins for motor fuels and heating oil*, January 29, 2013.

2013 **Public Intervenor**
Power sector modelling, deferral account policy, financial analysis
Oral testimony before the New Brunswick Energy and Utilities Board, *In the Matter of the Point Lepreau Nuclear Generating Station Deferral Account and Section 143.1 of the Electricity Act*, January 15, 2013.

2012 **Baltimore Gas & Electric Company**
Potomac Electric Power Company
Power Purchase Agreements, Retail electric competition
Oral testimony before the Maryland Public Service Commission *In the Matter of Whether New Generation Resources Are Needed to Meet Long-*

Term Demand for Standard Offer Service, Case No. 9214, November 26, 2012.

2012 **Public Intervenor**
Modelling of coal and oil plants, deferral account, financial analysis
Pre-filed Expert Report before the New Brunswick Energy and Utilities Board *In the Matter of the Point Lepreau Nuclear Generating Station Deferral Account and Section 143.1 of the Electricity Act*, November 26, 2012.

2012 **Nevada Power Company**
Cost of capital
Pre-filed testimony before the Federal Energy Regulatory Commission in the Nevada Power Company's Transmission Rate Case, October 31, 2012.

2012 **Public Intervenor**
Wholesale margins for regulated motor fuels and heating oil
Pre-filed Expert Report before the New Brunswick Energy and Utilities Board In the Matter of an Application by Irving Oil Marketing G.P. and Irving Oil Commercial G.P. Requesting an Increase in the Wholesale Margins for Motor Fuels and Heating Oil, October 26, 2012.

2012 **Nevada Power Company**
Prudence of gas costs for 2012
Pre-filed Expert Report before the Nevada Public Utilities Commission *In the Nevada Power Company's 2012 Deferred Energy Filing*, March 1, 2012.

2012 **Sierra Pacific Power Company**
Prudence of gas costs for 2012
Pre-filed Expert Report before the Nevada Public Utilities Commission *In the Nevada Power Company's 2012 Deferred Energy Filing*, March 1, 2012.

2011 **Public Intervenor**
Power system loss factors, OATT, transmission regulatory policy
Pre-filed Expert Report before the New Brunswick Energy and Utilities Board *In the Matter of a Review of the Proposed Change to the New Brunswick System Operator's Real Power Loss Factor*, October 31, 2011.

2011 **John Hancock**
Risk analysis of European power plant leveraged lease
Oral Testimony before the U.S. Tax Court, on behalf of plaintiff in *John Hancock Life Insurance Company and Subsidiaries v. Commissioner of Internal Revenue*, October 24, 2011.

2011 **John Hancock**
Risk analysis of European power plant leveraged lease
Rebuttal Expert Report before the U.S. Tax Court, on behalf of plaintiff in *John Hancock Life Insurance Company and Subsidiaries v. Commissioner of Internal Revenue*, August 19, 2011.

2011 **John Hancock**
Risk analysis of European power plant leveraged lease
Pre-filed Expert Report before the U.S. Tax Court on behalf of plaintiff in *John Hancock Life Insurance Company and Subsidiaries v. Commissioner of Internal Revenue*, July 8, 2011.

2011 **Public Intervenor**
OATT, transmission regulatory policy
Pre-filed Expert Report before the New Brunswick Energy and Utilities Board, *in the Review of the Proposed Changes to the New Brunswick System Operator's Open Access Transmission Tariff*, February 21, 2011.

2011 **Public Intervenor**
Power system loss factor, OATT, transmission regulatory policy
Pre-filed Expert Report before the New Brunswick Energy and Utilities Board, *in the Review of the New Brunswick System Operator's Proposed Change to its Loss Factor*, February 3, 2011.

2011 **Baltimore Gas & Electric Company**
Risks and rate of return for retail electricity business
Oral testimony before the Maryland Public Service Commission, *in the Matter of Baltimore Gas & Electric's Application to Recover Cash Working Capital for Standard Offer Service*, Case No. 9221, January 20, 2011.

2010 **Baltimore Gas & Electric Company**
Risks and rate of return for retail electricity business
Pre-filed Expert Report before the Maryland Public Service Commission, *in the Matter of Baltimore Gas & Electric's Application to Recover Cash Working Capital for Standard Offer Service*, Case No. 9221, September 17, 2010.

2010 **Public Intervenor**
Greenfield gas distributor, cost of service, just and reasonable rates
Oral testimony before the New Brunswick Energy & Utilities Board, in the *Enbridge Gas New Brunswick Rate Case,* March 30, 2010.

2010 **Public Intervenor**
Greenfield gas distributor, cost of service, just and reasonable rates
Pre-filed Expert Report before the New Brunswick Energy and Utilities Board, *in the Matter of Enbridge Gas New Brunswick Rate Case*, March 12, 2010.

2009 **Public Intervenor**
Greenfield gas distributor, cost of service, just and reasonable rates
Oral testimony before the New Brunswick Energy & Utilities Board, *in the Review of Matters related to the Regulation of Enbridge Gas New Brunswick*, October 23, 2009.

2009 **Public Intervenor**
Greenfield gas distributor, cost of service, just and reasonable rates
Pre-filed Expert Report before the New Brunswick Energy and Utilities Board, *in the Matter of the Annual Financial Review of Enbridge Gas New Brunswick Limited Partnership*, August 21, 2009.

2009 **Public Intervenor**
Greenfield gas distributor, cost of service, just and reasonable rates
Oral testimony before the New Brunswick Energy and Utilities Board, *in the Matter of the Annual Financial Review of Enbridge Gas New Brunswick Limited Partnership*, September 15, 2009.

2009 **Public Intervenor**
Greenfield gas distributor, cost of service, just and reasonable rates
Pre-filed Expert Report before the New Brunswick Energy and Utilities Board, *in the Matter of a Review of Matters Related to the Regulation of Enbridge Gas New Brunswick Limited Partnership*, September 21, 2009.

2009 **The City of New York**
Cost of service, incentives and taxi lease rates
Oral testimony in the District Court for the Southern District of New York in *Metropolitan Taxicab Board of Trade et al. v. The City of New York et al.,* on the issue of whether the Taxi and Limousine Commission's new maximum lease rates constitute a fuel efficiency and emissions mandate that would be preempted by Federal law, May 20, 2009.

2009 **The City of New York**
Cost of service, incentives and taxi lease rates
Pre-filed expert Report in the United States District Court for the Southern District of New York in *Metropolitan Taxicab Board of Trade et al. v. The City of New York et al.,* on the issue of whether the Taxi and Limousine Commission's new maximum lease rates constitute a fuel efficiency and emissions mandate that would be preempted by Federal law, May 18, 2009.

2009 **Public Intervenor**
Greenfield gas distributor, cost of service, just and reasonable rates
Oral testimony before the New Brunswick Energy and Utilities Board, *In the Matter of the examination of the formula for Enbridge Gas New Brunswick's market-based rate,* April 23, 2009.

2009 **Public Intervenor**
Greenfield gas distributor, cost of service, just and reasonable rates
Pre-filed Report before the New Brunswick Energy and Utilities Board, *In the Matter of the examination of the formula for Enbridge Gas New Brunswick's market-based rate,* March 26, 2009.

2009 **Public Intervenor**
Cost of service, ISO management, OATT transmission policy
Oral testimony before the New Brunswick Energy and Utilities Board, *In the Matter of the application of the New Brunswick System Operator for changes to its Charges, Rates and Tolls,* March 18, 2009.

2009 **Public Intervenor**
Cost of service, ISO management, OATT transmission policy
Pre-filed Report before the New Brunswick Energy and Utilities Board, *In the Matter of the application of the New Brunswick System Operator for changes to its Charges, Rates and Tolls,* February 24, 2009.

2008 **Allegheny Power, Baltimore Gas & Electric**
Integrated resource planning, competitive retail electric markets
Oral testimony before the Maryland Public Service Commission, *in the Matter of the Commission's Investigation Of Investor-Owned Electric Companies' Standard Offer Service for Residential and Small Commercial Customers in Maryland*, Case No. 9117, December 15, 2008.

2008 **Allegheny Power, Baltimore Gas & Electric**
Integrated resource planning, competitive retail electric markets
Pre-filed Report before the Maryland Public Service Commission, *in the Matter of the Commission's Investigation Of Investor-Owned Electric Companies' Standard Offer Service for Residential and Small Commercial Customers in Maryland*, Case No. 9117, October 1, 2008.

2008 **Public Intervenor**
Ratemaking for greenfield gas distributor
Oral testimony before the New Brunswick Energy and Utilities Board, *In the Matter of an application by Enbridge Gas New Brunswick for changes to its Charges, Rates and Tolls,* March 27, 2008.

2008 **Public Intervenor**

Ratemaking for greenfield gas distributor

Pre-filed Report before the New Brunswick Energy and Utilities Board, *In the Matter of an application by Enbridge Gas New Brunswick for changes to its Charges, Rates and Tolls,* March 10, 2008.

2007 **Public Intervenor**

Prudence, just and reasonable standard, affiliate transactions

Oral testimony before the New Brunswick Energy and Utilities Board, *In the Matter of an application by the NBP Distribution & Customer Service Corporation (Disco) for changes to its Charges, Rates and Tolls,* December 18, 2007.

2007 **Public Intervenor**

Nuclear power plant Cost of Service

Pre-filed Report before the New Brunswick Board of Commissioners of Public Utilities, *In the Matter of an application by the NBP Distribution & Customer Service Corporation (Disco) for changes to its Charges, Rates and Tolls,* December 7, 2007.

2007 **Public Intervenor**

Prudence of power generation costs

Pre-filed Report before the New Brunswick Board of Commissioners of Public Utilities, *In the Matter of an application by the NBP Distribution & Customer Service Corporation (Disco) for changes to its Charges, Rates and Tolls,* November 5, 2007.

2007 **Public Intervenor**

Prudence of power generation costs

Oral testimony before the New Brunswick Energy and Utilities Board, *In the Matter of an application by the NBP Distribution & Customer Service Corporation (Disco) for changes to its Charges, Rates and Tolls,* June 21, 2007.

2007 **Public Intervenor**

Prudence of power generation costs

Pre-filed Report before the New Brunswick Energy and Utilities Board, *In the Matter of an application by the NBP Distribution & Customer Service Corporation (Disco) for changes to its Charges, Rates and Tolls,* June 14, 2007.

2006 **Brookfield Energy Marketing Inc.**

Valuation of power purchase agreement and power plant

Deposition testimony before the United States Bankruptcy Court for the District of Maryland, on behalf of Brookfield Energy Marketing Inc., *In re: USGen New England, Inc.*, Debtor, Case No. 03-30465, May 22, 2006.

2006 **Brookfield Energy Marketing Inc.**
Valuation of power purchase agreement and power plant
Rebuttal Report before the United States Bankruptcy Court for the District of Maryland, on behalf of Brookfield Energy Marketing Inc., *In re: USGen New England, Inc.*, Debtor, Case No. 03-30465, May 5, 2006.

2006 **Brookfield Energy Marketing Inc.**
Valuation of power purchase agreement and power plant
Expert Report before the United States Bankruptcy Court for the District of Maryland, on behalf of Brookfield Energy Marketing Inc., *In re: USGen New England, Inc.*, Debtor, Case No. 03-30465, March 29, 2006.

2006 **Public Intervenor**
Application of the prudence standard to affiliate transactions
Oral testimony before the New Brunswick Board of Commissioners of Public Utilities, *In the Matter of an application by the NBP Distribution & Customer Service Corporation (Disco) for changes to its Charges, Rates and Tolls*, March 14, 2006.

2006 **Public Intervenor**
Application of the prudence standard to affiliate transactions
Pre-filed Report with Eugene Meehan before the New Brunswick Board of Commissioners of Public Utilities, *In the Matter of an application by the NBP Distribution & Customer Service Corporation (Disco) for changes to its Charges, Rates and Tolls*, January 31, 2006.

2005 **Dayton Power & Light Company**
Retail pricing for default service customers and option valuation
Oral testimony at hearings in Ohio Public Utilities Commission Case No. 05-276-EL-AIR, November 8 and 14 2005.

2005 **Dayton Power & Light Company**
Retail pricing for default service customers and option valuation
Deposition testimony in Ohio Public Utilities Commission Case No. 05-276-EL-AIR, November 8, 2005.

2005 **Dayton Power & Light Company**
Retail pricing for default service customers and option valuation
Testimony in Ohio Public Utilities Commission, in Support of Stipulation filed in support of Dayton's proposed settlement Case No. 05-276-EL-AIR, November 4, 2005.

2005 **Dayton Power & Light Company**
Retail pricing for default service customers and option valuation
Rebuttal testimony in Ohio Public Utilities Commission, application of financial options pricing techniques to assess the reasonableness of Dayton's proposed provider-of-last-resort charges, Case No. 05-276-EL-AIR, October 31, 2005.

2004 **Board of Public Utilities**
Cost of capital
Pre-filed testimony with Cindy Ma before the Board of Public Utilities, Newfoundland and Labrador, Canada, on "The Cost of Capital for Automobile Insurance Firms," October 13, 2004.

CONSULTING EXPERT EXPERIENCE

2019	**Confidential Client** **Cost of Capital** Expert in dispute related to the financial structure and cost of capital for a FERC-regulated pipeline.
2019	**Confidential Client** **Financial Structure Analysis** Expert in dispute related to the financial structure of assets owned by a midstream oil and products company.
2016	**Confidential Client** **Valuation of Solar Generation Facilities** Expert in dispute related to the valuation of rooftop solar facilities. Provided valuation options to counsel to evaluate the reasonableness of the claimed tax basis and Section 1603 cash grant.
2014	**Confidential Client** **Offshore Exploration and Production Permit Arbitration** Expert in dispute related to an agreement between two firms to develop an offshore gas field in New Zealand in arbitration at the ICC International Court of Arbitration.
2014	**Confidential client** **Breach of contract damages valuation for gas supply agreement** Valued damages in a breach-of-contract dispute regarding gas supply in Western Australia.
2013–2016	**Gaz Métro** **Cost Recovery of Gas Distribution System Upgrade** Advised client on regulatory merits of ratemaking for distribution system upgrade. Performed survey of ratemaking policies for similar upgrades in other jurisdictions in connection with proceeding before Provincial regulator.
2014-2015	**Confidential Client** **Gas Supply Agreement Negotiation** Advise on cost of service and LNG contract price issues in Western Australia.
2014- 2015	**Alliance Pipeline** **Restructuring of services and tolls**

Advised on Alliance's restructuring proposal in a matter before the National Energy Board. Supervised modelling of pipeline tolls and assessment of natural gas pipeline market power.

2014-2015 **Gazprom OAO**
Civil dispute involving gas field development and LNG importation
Supervised modelling of LNG netback prices and damage calculations in preparation for a jury trial before a Tarrant County, Texas District Court. Consulted with respect to a dispute between a U.S oil company and Russian oil company regarding ownership of a Russian gas field, tortious interference, and trade secret misappropriation with regards to a plan to import LNG into the United States in the mid-2000s.

2014 **FortisBC Energy Inc**
Tolling for pipeline in Canada
Analyzed toll methodology and advised on regulatory issues related to a tolling proposal of NGTL's North Montney Mainline, an extension of the existing NGTL Alberta System.

2014 **Royal Bank of Canada**
Gas Supply Agreement Dispute
Served as consulting expert in a gas supply agreement dispute between RBC and three municipal gas distributors in Nevada and Iowa. Case involved analysis of Basel III regulations, capital requirements, commodity swaps and interest rate swaps.

2013 **Confidential client**
Valuation and pricing analysis
Performed valuation and pricing analysis for oil pipeline dispute in Texas. Provided advice to outside counsel throughout litigation.

2012-2014 **ATCO Gas & ATCO Electric**
Cost of Service / Capital Trackers
Provided expert review of ATCO Gas and ATCO Electric's capital tracker proposals, including a survey of capital trackers in other jurisdictions.

2012–2013 **Confidential client**
Valuation of oil pipeline company and its hedging positions
Performed valuation of oil pipeline company and its hedging positions in litigation involving an alleged breach of fiduciary duty. Provided advice to outside counsel throughout litigation.

2012–2013 **Confidential client**
Approaches to regulatory accounting and cost-of-service regulation

Contributed to study assessing benefits of various approaches to regulatory accounting and cost-of-service regulation for pipelines.

2011–2013 **Confidential client**
Possible outcomes of power contract (PPA) disputes
Analyzed potential litigation and settlement outcomes in a series of power contract disputes. Provided advice to outside counsel.

2011–2012 **Confidential client**
Oil pipeline cost of service and depreciation policies
Advised counsel to a shipper in an intrastate oil pipeline company rate case before the Kansas Corporation Commission.

2011 **Confidential client**
Antitrust aspects of a proposed pipeline merger
Analyzed antitrust aspects of oil pipeline combinations in connection with a proposed merger. Provided advise to outside counsel.

2010–2011 **Confidential client**
Valuation of generation assets
Performed valuation of power plant in context of alleged expropriation.

2010 **Hydro Québec, Canada**
Grid connection and upgrade cost policy
Analyzed grid connection and upgrade cost policy. Evaluated existing policy to allocate costs of grid upgrades to generation developers and system users. Suggested modifications to policy. Prepared benchmarking analysis comparing the company's practices to those of over a dozen other entities in North America.

2008 **Confidential client**
Allegations of energy market manipulation
Advised on the evaluation of allegations of energy market manipulation in the context of physical electricity trades in RTO-managed markets.

2007 **Confidential client**
Valuation of valuation of long-dated oil warrants
Performed valuation of long-dated oil warrants priced off Venezuelan crude oil in context of damages calculation.

2006 **Confidential client**
Damages valuation in securities class action
Valued damages in a securities class action related to the bankruptcy of an energy retailer.

2003-2004 **Confidential client**

Bid process advantages: generation pricing and transmission costs

Contributed to testimony on behalf of a large electric utility regarding an affiliate transaction that resulted from a competitive solicitation. Testimony before FERC focused on whether the affiliate was advantaged during the bid process, both with respect to generation pricing and electric transmission cost.

2003 **Confidential client**

Valuation, economic, accounting, and hedging analysis

Performed valuation, economic, accounting, and hedging analysis of a gas-fired power plant in an international arbitration matter.

2002 **Confidential client**

Prudence of forward power purchases

Contributed to testimony on behalf of an electric utility regarding the prudence of forward power purchases during the Western power crisis.

2002–2003 **Pacific Gas & Electric**

Valuation of Damages Due to Gas Pipeline Capacity Withholding

Performed analyses of damages from withheld pipeline capacity into California. Analyses led to $1 billion settlement.

2002–2003 **Confidential client**

Prudence of forward power purchases

Contributed to testimony regarding the prudence of Department of Water Resources's forward power purchases during the Western power crisis.

2002 **Confidential client**

Electric and gas hedging strategies for its generation assets

Contributed to testimony on behalf of an energy marketing and trading firm regarding electric and gas hedging strategies for its generation assets, including an examination of the nature of competition among energy marketing and trading firms and strategies.

2001–2002 **Pacific Gas & Electric Company**

FERC refund and other related proceedings

Analysis and support to a California utility in the context of the FERC refund and other related proceedings, 2001-2002.

2001–2002 **Pacific Gas & Electric Company**

Value of a long-term affiliate power sales agreement

Contributed to testimony before FERC relating to the value of a long-term affiliate power sales agreement. Involved analysis and valuation of over 100 long-term power contracts (PPAs) in the context of this benchmarking analysis.

2001	**Confidential client** **Valuation of a passive equity interest** Contributed to testimony on behalf of a leading US energy company regarding the valuation of a passive equity interest in an IPP project in El Salvador.
2001	**Baltimore Gas & Electric Company** **Business separation of Constellation Energy Group** Contributed to testimony submitted to the Public Service Commission of Maryland on the business separation of Constellation Energy Group.
1998	**Baltimore Gas & Electric Company** **Valuation of generation assets** Performed valuation of Baltimore Gas & Electric Company's hydro, nuclear, coal and gas-fired generation assets in the context of stranded cost calculations during restructuring, 1998.
1995–1996	**Confidential client** **Analysis of market concentration** Performed HHI analyses to support testimony presenting a competitive assessment of the Western electric generation market in the US, 1995-1996.
1994–1995	**Confidential client** **Damages valuation in securities class action** Estimated losses and alleged damages for several mutual funds that invested in derivative securities.
1994–1995	**Confidential client** **Damages valuation in securities class action** Estimated losses and alleged damages for several mutual funds that invested in derivative securities.
1994	**Goldman Sachs** **Default risk studies on fixed income instruments** Prepared default risk studies on fixed income instruments for counsel to Goldman Sachs in a broker/dealer arbitration.
1994	**Confidential client** **Damages valuation in securities class action** Consulted to counsel for an infomercial company on materiality, liability, and damages in a shareholder class action suit.
1993	**Confidential client** **Damages valuation in securities class action**

Assessed materiality and damages in a 10b-5 class action against a major pharmaceutical company.

ADVISORY PROJECTS

2017-2019 **Valuation of Vertically-Integrated Electric Utility**
Due Diligence for Prospective Acquirer
Retained by an electric utility to advise on valuation of a target utility acquisition. Assisted client in developing reasonable offers to acquire the target electric utility. Advised utility during negotiations.

2017 **Marginal Cost Study for Value of Distributed Resource**
Due Diligence for Prospective Acquirer
Retained by NYSEG and RG&E to perform a marginal cost study to estimate key components of the value stack, to be paid to solar and other distributed energy resources,

2017 **Leveraged Lease tied to Power Plant**
Due Diligence for Prospective Acquirer
Retained by a confidential acquirer to evaluate a target utility-related investment. Provided strategic advice and due diligence relating to the financial valuation and post-acquisition benefits.

2016 **Utility Merger**
Due Diligence on Merger Benefits
Retained by a confidential acquirer to evaluate merger benefits in the context of the combination of two adjacent electric utilities. Provided strategic advice and due diligence relating to merger benefits.

2016 **Wind Power Transaction**
Due Diligence for Prospective PPA Offtaker
Retained by a confidential offtaker to evaluate the costs, benefits and risks associated with a prospective long-term power purchase transaction backed by a wind farm.

2016 **Electric Utility Acquisition**
Due Diligence for Prospective Acquirer
Retained by a confidential equity investor to evaluate key inputs for the acquirer's valuation model of an electric utility. Advised investor on key elements of the valuation.

2015 **Ministry of Energy, Mexico**
Restructuring of the Mexican energy sector
Served as leader for several work streams performed on behalf of the Mexican Ministry of Energy implementing energy sector restructuring. Advice included the design of a competitive spot market, the development of green power auctions (solar and wind), basic service supply pricing, electricity transmission pricing, upstream gas pricing and the development of a regulatory framework for the sector.

2015 **Southern Star Central Gas Pipeline**
Due Diligence for Prospective Acquirer
Retained by a confidential equity investor to evaluate regulatory and investment risk associated with the prospective acquisition of an interest in Southern Star. Analyzed likely outcomes in the pipeline's upcoming rate case, and their implications for the valuation of the target.

2015 **Independent Electricity System Operator (IESO)**
Reasonableness of 6,300 MW Power Transaction
Retained by IESO in Ontario, Canada, to prepare, together with a team of NERA experts, an Opinion as to the Fairness of the Amended and Restated Bruce Power Refurbishment Implementation Agreement.

2015 **ESKOM, South Africa**
Regulatory Strategy for Cost Recovery
Retained by ESKOM to advise on regulatory strategy, treatment of coal-plant operation and associated fuel costs, delays in unit online dates and other regulatory issues.

2015 **Bermuda Electric, Bermuda**
Regulatory Strategy, Cost of Service, and Tariffs
Advised on regulatory strategy. Developed costing and pricing model for Bermuda Electric.

2014 **Hawaiian Electric Company**
Fuel Adjustment Clause and Oil Hedging
Retained by Hawaiian Electric Company to provide analysis regarding the efficiency incentives embedded in the company's fuel adjustment clause (ECAC). Analyzed the possibility of hedging oil price volatility through commercially-available contracts.

2014 **Confidential Client**
Pricing Principles for Domestic Gas Reservation Policy
Formulated a methodology to determine a schedule of reasonable prices using a cost of service approach for gas that the company is obligated to market under the domestic gas supply policy in Western Australia.

2012/2013 **Atlantic Path 15**
Due Diligence Study for Confidential Potential Buyer
Performed regulatory due diligence in connection with the potential acquisition of Atlantic Path 15 transmission assets. Evaluated the regulatory climate at FERC and analyzed FERC decisions from prior rate cases, with a focus on allowed rate of return. Used NERA rate-of-return models to replicate the FERC methodology and to predict the rate-of-return to be allowed by FERC in the next rate case.

2013	**Energy trading entity** **Price risks and electricity transmission development** Retained by energy trading entity to perform an independent study of price risks and electricity transmission development in the ERCOT market.
2013	**Electric industry client** **Reactive power compensation** Retained by electric industry client to analyze electricity transmission tariffs and reactive power compensation in competitive electric markets.
2012/2013	**New Mexico Natural Gas Company** **Due Diligence Study for Confidential Acquirer** Performed regulatory due diligence in connection with the potential acquisition of New Mexico Natural Gas. Assessed hurdles to getting the transaction approved by regulatory authorities. Analyzed recent rate actions by the state commission and the likely outcomes of future cases. Advised on key inputs into the acquirer's financial model.
2012	**Oil industry client** **Regulation benchmarking in downstream oil sector** Retained by oil industry client to advise on margins and to perform an international benchmarking of the regulation of the downstream oil sector.
2012	**Hawaiian Electric Company** **Hedging and rate stabilization** Retained by Hawaiian Electric Company to provide analysis regarding hedging of fuel oil and diesel fuel purchases in order to stabilize customer rates.
2011	**Confidential client** **Implications of CFTC proposed definition of swap dealer** Advised on margin, capital and reporting implications of CFTC proposed definition of swap dealer under Dodd Frank.
2010	**Confidential client** **Leveraged lease transaction** Provided litigation support services with respect to a dispute over a leveraged lease transaction.
2010	**Confidential client** **Valuation, risk assessment and analysis of offtake contract options** Performed detailed valuation, risk assessment and analysis of offtake contract options for a hydroelectric power plant.

2009 **Potomac Edison Company**
Capital investment planning
Performed least-cost capital investment planning on behalf of the Potomac Edison Company.

2009 **Government of New Brunswick, Canada**
Advised on electric utility valuation
Advised Government of New Brunswick on the valuation of the vertically-integrated, provincially-owned electric utility, NB Power, in connection with the potential sale to Hydro Québec. Developed a financial and rate model reflecting the New Brunswick regulatory system and performed valuations for a stand-alone and merged case and performed numerous valuations of the benefits to the acquirer. Developed key inputs for the valuation, including the Point Lepreau Nuclear Generation Station. Coordinated development of fairness opinion.

2009 **Energy East**
Cost of capital
Advised on rate-of-return issues for electricity distributors in New York State.

2008 **Confidential client**
Contract design
Advised on design of structured contract for new renewable power plant, new electricity transmission lines and associated RFPs.

2008 **Commission for Energy Regulation**
Review of SOLR tariffs
Advise the Commission for Energy Regulation on the review of SOLR tariffs in the Republic of Ireland.

2008 **Comisión Nacional de Energía**
Market mechanisms for distributions to serve default customers
Advised on design and implementation of market mechanisms by which Spanish electric utilities buy energy to serve default customers.

2006–2009 **Hawaiian Electric Company**
Hedging options for fuel
Performed economic and accounting analysis of hedging options for low sulfur fuel oil, diesel and fuel oil on behalf of Hawaiian Electric Company.

2004–2010 **Commonwealth Edison and Ameren's Illinois utilities**
Competitive procurement for power supply
Advised Commonwealth Edison and Ameren's Illinois utilities on the design of a competitive procurement for short- and long-term power

supply, including the contractual framework for energy purchases, 2004 to 2010.

2004–Present **New Jersey and Maryland distribution utilities**
Mark-to-market issues and credit policies
Advised several utilities in the Eastern Interconnection on mark-to-market issues and credit policies.

1999–2008 **New Jersey distribution utilities**
Contract design and implementation
Worked with credit representatives of New Jersey distribution utilities on contract design and implementation of the contract credit terms. Coordinated the utilities' responses to changes to the forms of letters of credit proposed by bidders; oversaw bidder credit qualification process; managed approval process for alternate guaranty instruments, and served as advisor to utilities when contract interpretation issues arose, 1999 to 2008.

1999–2008 **FirstEnergy Companies**
Competitive procurement for power supply
Advised the FirstEnergy Companies on the design of a competitive procurement for intermediate term power supply, including the contractual framework for energy purchases, 2004-2005.

2003 **Commission for Energy Regulation**
Hedging agreement and a power plant construction agreement
Advised the Commission for Energy Regulation in Ireland on the structure of a long-term hedging agreement and a power plant construction agreement; assisted with the development of the hedging contract and the tender documentation; performed bid evaluation.

2002 **Sierra Pacific Resources**
Risk management strategies
Advised a major west coast utility in the US on the development of its risk management policy and procedures; reviewed past trading and risk management strategies; and performed an assessment of its risk measurement and reporting techniques, including credit risk management policy.

2000 **Ministry of Energy, México**
Mexican IPP solicitation program
Advised on the development of the Mexican IPP solicitation program, including transaction structure (IPP v. BLT v. BOT), credit risk management, model contracts, and bid evaluation (the Comisión Federal

de Electricidad has procured as much as 2000 MW per year of long-term power supply from IPPs).

2000 **Comisión Federal de Electricidad, Mexico**

Credit and collateral requirements for a power purchase agreement
Advised the Comisión Federal de Electricidad in Mexico on credit and collateral requirements for an-asset backed power purchase agreement with an IPP based in Mexico, including advice on the development of comparable credit and collateral requirements for an import transaction that was to be made on a firm basis with liquidated damages.

1998–2000 **Ministry of Energy, Mexico**

Restructuring and privatization of the Mexican electricity sector
Consulted to the Mexican Ministry of Energy on the restructuring and privatization of the Mexican electricity sector, the design of a competitive spot market, and the policy of IPP solicitations, electricity transmission pricing, upstream gas pricing and the development of a regulatory framework for the sector.

1998–1999 **Ministry of Energy, Mexico**

Assessing competition in restructured Mexican electric generation
Contributed to study assessing competition in restructured electric generation market in Mexico.

1999 **Swiss Re**

Novel insurance packages to hedge electric price and operations risk
Assisted Swiss Re in the development of the modeling for the creation of novel insurance packages to hedge electric price and operations risk, 1999.

1998 **Iberdrola S.A., Spain**

Seminars on the deregulated markets for gas and electricity in the US
Designed and conducted a series of three training courses for representatives of Iberdrola S.A. (Spain's principal private utility), which consisted of seminars on the deregulated markets for gas and electricity in the US, followed by a series of interviews with large utilities, IPPs, and energy marketers. Courses were designed to provide the European traders with an understanding of best practices employed by energy traders in the US, with respect to risk management (credit, market, and operational), 1998.

1998 **C.E.L.P.E, Brazil**

Risk management and energy trading
Assisted in training senior management of Iberdrola's Brazilian subsidiary C.E.L.P.E. in the area of risk management and energy trading.

1998–2000 **Baltimore Gas & Electric Company**
Sector restructuring
Consultant to Baltimore Gas & Electric Company on sector restructuring.

1998–1999 **Baltimore Gas & Electric Company**
Valuation of electric power assets
Assisted in developing market value estimates of Baltimore Gas & Electric Company's generation fleet, including Calvert Cliffs Nuclear Power Plant.

1998 **Confidential Client**
Generation and fuel strategy
Participated in the development of a generation and fuel strategy for a large merchant generator and energy trader.

1996 **Iberdrola, S.A, Spain**
Restructuring of the electricity sector
Consultant to Iberdrola, S.A. on issues relating to the restructuring of the electricity sector in Spain.

1996 **Confidential client**
Investment strategy
Consultant to a major southeastern electric utility on investment strategy in the US including valuation of various targets.

1996 **Confidential client**
Competitive analysis of electric generation
Performed competitive analysis of electric generation market for utilities in eastern US.

1996 **New York State Electric and Gas Company**
Restructuring of the electricity market in New York State
Consultant to the New York State Electric and Gas Company on issues relating to the restructuring of the electricity market in New York State.

1995–1996 **New York Power Authority**
Sector restructuring
Consultant to senior management of the New York Power Authority on issues relating to the New York Competitive Opportunities Docket.

1995 **Southern California Edison Company**
Proposed restructuring of California's electric services industry
Consultant to Southern California Edison Company on issues relating to the California Public Utilities Commission's Proposed Policies Governing

Restructuring California's Electric Services Industry and Reforming Regulation.

Publications and Presentations

2019 **Republic of Indonesia**
Presentations to Perusahaan Gas Negara, BHP Migas (regulator), and the Ministry of Energy and Mineral Resources of the Republic of Indonesia addressing the design and solicitation of natural gas distribution concessions. October, 2019.

2019 **Republic of Indonesia**
Presentations to Perusahaan Gas Negara and BHP Migas (regulator) addressing connection policies and market development strategies for greenfield natural gas distributors. October, 2019.

2019 **Florence School of Regulation**
Specialised Training on the Regulation of Gas Markets
Gas Sector Regulation: The US Experience
March 2019.

2019 **Electricity Journal**
Could Mexico's Capacity Market Design Lead to Gaming by Generators?
March 2019.

2018 **Perusahaan Gas Negara**
Specialized Training
Conducted specialized training course on the design and award of energy-sector concessions.
December 2018.

2018 **Center for Research in Regulated Industries**
Eastern Conference
Mexican Capacity Market Design and Market Power Potential
June 2018.

2018 **Florence School of Regulation**
Specialised Training on the Regulation of Gas Markets
Gas Sector Regulation: The US Experience
March 2018.

2017 **Electricity Journal**
Beyond net metering: A model for pricing services provided by and to distributed generation owners, such as rooftop solar.
April 2017.

2017 **Law Seminars International Electric Utility Rate Case Conference**
Beyond Net Metering: Ratemaking Challenges from Distributed Generation.
Las Vegas, March 16 2017.

2017 **Public Utilities Fortnightly**
Interest Rates After the Election: What They Mean for Public Utility Returns.
January 2017.

2016 **Perusahaan Gas Negara, Jakarta, Indonesia**
Provided in-depth training on regulatory practice and tariff design for gas pipelines and distribution companies.
December 2016.

2016 **Electricity Journal**
Low interest rates and unprecedented stock market volatility: What they mean for your next rate case.
January-February 2016.

2016 **An Economic Analysis of the Acquisition of ConocoPhillips' Interest in the Beluga River Unit,** A Report Prepared for Chugach Electric Association, Inc. and Anchorage Municipal Light and Power, March 11, 2016.

2016 **Law Seminars International, 12th Annual National Conference on Current Issues in Electric Utility Ratemaking**
Policy Options to Address Cross Subsidies from Self Generation, March 14, 2016

2016 **International Arbitration Group of International Law Firm**
Applications of Economic Analysis in International Arbitration (with a focus on the Energy Sector)
New York, January 12, 2016

2015 **The Electricity Journal**
Low interest rates and unprecedented stock market volatility:
What they mean for your next rate case
December 2015

2015 **Utility Regulation Conference: Rate Case, ROE, and Reliability**
Brave New World for Return on Equity
Washington DC, December 10-11, 2015

2015 **Law Seminars International, Energy in the Northeast**
Energy Sector Developments and the Cost of Capital
Boston, September 29, 2015

2015 **Law Seminars International, Rate Case Conference**
A Brave New World for Return on Equity
Las Vegas, March 5, 2014

2014 **Law Seminars International, Rate Case Conference**
Current Challenges in Determining Appropriate Rates of Return for Public Utilities
Las Vegas, February 28, 2014

2014 **National Energy Agency (China) and representatives of the State Grid**
Regulatory Accounting and the FERC Uniform System of Accounts
Beijing, January 16, 2014

2012 **Agencia Nacional de Petroleo, Gas Natural e Combustiveis (Brazil)**
Natural Gas Pipeline Regulation in the United States (training course)
Rio de Janiero, September 18-19, 2012

2012 **Center for Research in Regulated Industries Eastern Conference**
Optimal Capital Structures for Regulated Public Utilities: When Does an Imputed Debt Ratio Make Sense for Ratemaking Purposes?
Eastern Conference, Delaware May 18, 2012

2012 **Energy Policy Briefing Note**
The Real Costs of Eliminating Unsecured Credit Lines and Requiring Cash Collateral in OTC Swaps Markets
Co-author: Sharon Brown-Hruska, March 13, 2012

2012 **Law Seminars International, Electric Utility Rate Case Conference**
Marginal Cost Pricing for Rate Design
Las Vegas, February 2, 2012.

2012 **Center for Research in Regulated Industries**
Advanced Workshop in Regulation and Competition
Gas Pipeline Overearning Investigations
Newark, New Jersey, January 13, 2012.

2011 **Working Group of Commercial Energy Firms**
Cost-Benefit Analysis of the CFTC's Proposed Swap Dealer Definition
December 20, 2011.

2011	**Law Seminars International, Renewable Energy in the Pacific Northwest** Abundant Low-Cost Natural Gas? A Driver of Market Activity August 4, 2011.
2011	**Public Utilities Fortnightly** Zone of Reasonableness: Coping with Rising Profitability a Decade after Restructuring July 2011.
2011	**Law Seminars International, Electric Utility Rate Case Conference** Rate Design Issues Among Customer Classes Las Vegas, February 10, 2011.
2011	**Advanced Workshop in Regulation and Competition, Center for Research in Regulated Industries** Decoupling and the Cost of Equity Newark, New Jersey, January 14, 2011.
2010	**New York State Bar Association, Business Law Section Committee on Public Utility Law** Getting Renewables to Market: The Importance of Transmission Ratemaking Policy New York, July 24, 2010.
2009	**Law Seminars International Conference, Renewable Energy in New England** Getting Renewable Power to Market Boston, June 25, 2009.
2008	**Report for Baltimore Gas & Electric and Allegheny Power** Evaluation of Longer-Term Procurement Plans October 1, 2008.
2008	**Electricity Journal** The Continuing Rationale for Full and Timely Recovery of Fuel Price Levels in Fuel Adjustment Clauses July 2008.
2008	**Energy in the Southwest Conference** Natural Gas as a Fuel: Will There Be Enough? At What Prices? July 22, 2008.

2007 **NERA Economic Consulting**
The Line in the Sand: The Shifting Boundary Between Markets and Regulation in Network Industries.
Coauthor.

2007 **Electric Utility and Natural Gas Interdependency**
Managing Risk in Interdependent Gas and Power Markets
Houston, March 6, 2007.

2004 **Electricity Journal**
FERC Imposes New Constraints on Utility Procurement
October 2004.

2003 **Northeast Gas Storage and Supply Strategies**
Can Your Capital Structure Handle Today's Market, Credit and Liquidity Risks?
Boston, June 17, 2003.

1996 **World Bank**
Regulatory and institutional reforms in the Chinese power sector
Contributor, 1996.

1993 **World Development**
Political Economy, Convergence and Growth in Less Developed Countries
Coauthor, 1993.

January 2019

Richard Druce
Director

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London, W1H 5BT
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Overview

Richard works on projects involving the regulation of network companies and economic and statistical analysis of gas and electricity markets. He regularly supports utilities in the course of price control reviews, especially on matters related to cost forecasting and comparative benchmarking, willingness to pay analysis and incentive design. He also regularly works on electricity market modelling assignments, in the course of due diligence, long-term expansion planning studies, and policy appraisal. He has particular experience of the design and assessment of energy network tariffs, incentive mechanisms, and network and infrastructure access rules.

In the Middle East, Richard has worked extensively on electricity and water sector regulatory, restructuring and market reform assignments:

- In the UAE, Richard advised the Regulation and Supervision Bureau (RSB) on generation expansion planning in 2007 and on cost reflective tariff design in 2012. More recently, he led NERA's input into a major power and water sector restructuring assignment run by the Executive Affairs Authority, known as "Project Clean Slate". Since then, he has led NERA's work for the Emirates Water and Electricity Company (EWEC) which involves PLEXOS modelling to identify optimal expansions in production capacity and to design bulk power tariffs. He has also led similar work for the Abu Dhabi Executive Office (ADEO) and the Abu Dhabi Power Corporation (ADPC).

- In Saudi Arabia, he led NERA's work on power system modelling for the Electricity and Cogeneration Regulatory Authority (ECRA) in 2013, and after that worked as part of the NERA team supporting the Saudi Electricity Company on sector reform and privatisation. He is currently advising ECRA on various electricity sector regulatory issues. He also supported the Ministry for Environment, Water and Agriculture (MEWA) on water sector subsidy arrangements and is currently advising the Saline Water Conversion Company (SWCC) in the course of its ongoing privatisation process.

- Elsewhere in the region, he is currently advising the GCCIA on the design and implementation of a "beneficiary pays" transmission charging regime and other commercial and regulatory issues. He also supported the Omani Power and Water Procurement company (OPWP) in 2013 on electricity market design.

Richard holds an MPhil degree in Economics at St Catharine's College, Cambridge, where he specialised in microeconometrics and industrial organisation. Richard also holds a first class degree in Economics and Econometrics from the University of Bristol. Before joining NERA, he worked at the UK government's Office of Rail Regulation, where he contributed to several regulatory projects.

Qualifications

2005-2006	**ST CATHARINE'S COLLEGE, CAMBRIDGE** MPhil Economics
2002-2005	**UNIVERSITY OF BRISTOL** BSc Economics and Econometrics

Career Details

2006-Present	**NERA ECONOMIC CONSULTING** Director (2019-), London Associate Director (2016-19), London Senior Consultant (2012-16), London Consultant (2009-12), London Analyst (2006-09), London
Summer 2004 & Summer 2005	**OFFICE OF RAIL REGULATION** Temporary Assistant Economist

Project Experience

2019

- For the Emirates Water and Electricity Company (EWEC), power and water market modelling to identify optimal generation investments, in order to prepare an annual planning statement that recommends optimal investments in power and water production capacity.
- For the Electricity and Cogeneration Regulatory Authority (ECRA) in Saudi Arabia, advising on the regulation of the Saudi Electricity Company's transmission and distribution business.
- For Jersey Electricity plc, computing a standby charge for Combined Heat and Power facilities in Jersey.
- For the Saudi Saline Water Conversion Company (SWCC), providing peer review of reports prepared by SWCC's advisors in the course of the company's restructuring and privatisation.
- For Bristol Water, providing a wide-ranging review of proposed price control determination from England and Wales water regulator Ofwat, with a focus on comparative benchmarking, productivity targets and real input price inflation.
- For Affinity Water, reviewing the treatment in comparative benchmarking models by England and Wales water regulator Ofwat of regional wage variation.
- For a consortium of water companies led by Sutton and East Surrey Water, reqvireing proposals from England and Wales water regulator Ofwat regarding the funding of targets to accelerate the rate of leakage reduction achieved by regulated water companies.

2018

- For UK Power Networks, Scotia Gas Networks, Cadent Gas and Thames Water, conducting a joint study with engineers from Arcadis to identify and quantify the additional costs that utilities serving London, relative to those operating in other parts of Great Britain, and advising on how such costs can be controlled for in comparative benchmarking.
- For Affinity Water, advice on cost assessment and comparative benchmarking in preparation for the PR19 price control review.
- For Bristol Water, ongoing support on the preparation of a business plan for submission to Ofwat during the PR19 price control review, focusing on cost assessment and customer engagement issues.
- For Citipower/Powercor, SA Power Networks and United Energy (Australia), conducting an expert review of proposals from the Australian Energy Regulator to change its approach to indexing price control allowances for Distribution Network Service Providers to changes in outputs.
- For Severn Trent Water, conducting a Revealed Preference valuation study to inform cost benefit analysis required for its PR19 business plan.
- For Cadent Gas, support on the preparation of its business plan for the RIIO-GD2 price review, focusing on the economic analysis required to value outcomes for the calibration of incentives and Cost Benefit Analysis.
- For a confidential client, preparing expert testimony in the course of a potential follow-on damages claim affecting the energy sector to be brought before the Competition Appeals Tribunal.
- For National Grid, Scottish Power and Scottish and Southern Energy, conducting a stated preference willingness to pay study regarding potential changes in the service provided by the British Transmission Owners, in preparation for the RIIO-T2 price control review.
- For Edison (Italy), developing a proposed regulated tariff methodology for a proposed Small Scale LNG investment on the island of Sardinia, including regasification facilities, expansions to distribution systems, and LNG coastal deposits.
- For AES (Northern Ireland), supporting engagement with the Northern Ireland Utility Regulator on potential generation contracts for power stations not awarded with Capacity Market Agreements.
- For the States of Jersey Department of the Environment, conducting an expert review of a “standby charge” to be levied on embedded generation by Jersey Electricity.
- For the UK Environment Agency, conducting a research study to draw lessons from behavioural economics and game theory on potential improvements to the Partnership Funding policy through which state support is supplemented by voluntary contributions from the private beneficiaries of investments to prevent flooding or coastal erosion.
- For the Abu Dhabi Water and Electricity Company (ADWEC), power and water market simulation modelling to identify optimal generation investments, and developing proposals regarding the level and structure of tariffs to be offered to large energy users.
- For the Ministry for Environment, Water and Agriculture (Saudi Arabia), developing proposals for structuring a “balancing account”, aimed at reforming the ways in which subsidy is paid to the water sector in the Kingdom.
- For the Saudi Electricity Company (SEC), supporting SEC on discussions with the Electricity and Cogeneration Regulatory Authority (ECRA) on the development of regulatory methods for setting the Revenue Requirement for transmission and distribution network business units.

2017

- For Mubadala Development Company and the Executive Affairs Authority of Abu Dhabi, advising on various economic issues related to the potential reform of the power and water sector in Abu Dhabi, including on the design of cost-reflective tariffs, optimal expansion planning, and economic impact assessment.
- For Endeavour Energy (Australia), conducting a review of methods used in Europe to conduct comparative benchmarking for the purpose of efficiency assessment in electricity distribution price control review.
- For NIE Networks, support in engaging with the Utility Regulator of Northern Ireland on a wide range of benchmarking and cost assessment topics in the RP6 price control review, including providing responses to UR consultation papers.
- For Wessex Water, conducting a Revealed Preference valuation study to inform cost benefit analysis required for its PR19 business plan.
- For Anglian Water, conducting Cost Benefit Analysis to inform the 2019 Water Resources Management Plan, and conducting a study to value improvements in drought resilience from the perspective of non-domestic customers using macroeconomic data on "gross value added" by sector which provides an input into this CBA analysis.
- For Bristol Water, support in the preparation of the PR19 business plan on topics including comparative benchmarking and special cost factors, and conducting various customer valuation studies to inform Cost Benefit Analysis.
- For Northumbrian Water, various customer engagement research to inform the Cost Benefit Analyses required to support the PR19 business plan.
- For UK Power Networks (UKPN), conducting peer review of regulatory submissions in response to Ofgem's "RIIO2" consultation documents.
- For Edison (Italy), advice on development of new regulatory arrangements in the Small Scale LNG market in Italy, against the background of EU Directive 2014/94/EU, on the deployment of alternative fuels infrastructure (including LNG) across EU Member States.
- For Singapore LNG Corporation, conducting a benchmarking study comparing the costs and tariffs of the LNG import terminal in Singapore to those of comparable facilities.

2016

- For NIE Networks, advice on a wide range of benchmarking and cost assessment topics in support of preparing its business plan for submission to the Northern Ireland Utility Regulator for the RP6 price control review.
- For the Association for Decentralised Energy, advice on Ofgem's ongoing review of "embedded benefits", the transmission network charging arrangements that remunerate embedded generators for helping to avoid transmission system costs.
- For Anglian Water, providing strategic advice on the development of a strategy to provide the societal and environmental valuation assumptions for the Cost Benefit Analysis modelling to be conducted as part of the PR19 business planning process.
- For Bristol Water, acting as a strategic advisor in the context of the customer valuation research programme to be conducted in preparation for the PR19 price control review.
- For the UK Competition and Markets Authority (CMA), analysing the welfare effects of proposed reforms to implement zonal transmission loss multipliers in the British wholesale electricity market.

- For I Squared Capital, economic analysis of the Irish energy retail markets in the context of the client's acquisition of the Viridian business.
- For an Asian power sector investor, preparing a research paper reviewing the development status of smart grid and smart city projects, setting out the potential barriers to their efficient deployment, and forming policy recommendations for removing these barriers.
- For the Saudi Electric Company, ongoing support in the context of its ongoing restructuring programme, focusing on the development of new regulatory mechanisms for electricity transmission and distribution businesses.
- For the Singapore Gencos (Tuas Power, Senoko and YTL PowerSeraya), reviewing the potential future role of the vesting contract regime in the Singaporean power market, as both a means of mitigating market power and as a means of providing revenue stability to generators.

2015

- For RWE, analysing proposals put forward by the UK Competition and Markets Authority to introduce zonal transmission loss multipliers into British wholesale electricity trading arrangements. The work included cost-benefit analysis of the proposed reform.
- For the UK Energy Networks Association (DCRP P2 Working Group), advising on potential changes to Engineering Recommendation P2/6, the design standard that governs the investments that British electricity distributors are obliged to make in their networks to ensure security of supply.
- For UK Power Networks, advice in the course of the appeal to the Competition and Markets Authority of Ofgem's "RIIO-ED1" price control decision by Northern Powergrid Limited.
- For UK Power Networks (with SP Energy Networks, Electricity North West and Northern Power Grid), advice in the course of the appeal to the Competition and Markets Authority of Ofgem's "RIIO-ED1" price control decision by British Gas Trading Limited.
- For the UK Committee on Climate Change, in collaboration with Imperial College London, analysing the marginal power system integration cost associated with the connection of increased volumes of intermittent and other low carbon generation technologies.
- For the Gulf Cooperation Council Interconnection Authority, advice on the design of new tariffs and charges adopting a "beneficiary pays" transmission pricing approach, assessing the credibility of existing regulatory and commercial arrangements to enable the financing of interconnection expansion investments, and developing new tariffs for additional services offered by the Interconnector.
- For Phoenix Natural Gas Limited (Northern Ireland), providing advice in the course of the GD17 price control review, with a focus on real input price inflation and the calculation of regional wage adjustment factors in comparative benchmarking.
- For a Consortium of Australian Electricity Distribution Companies, expert review of an econometric benchmarking study published by the Australian Energy Regulator (AER), as well as the AER's regulatory treatment of distributors' investment programmes to deliver enhanced outputs for consumers, and its approach to forecasting inflation in distributors' labour costs.
- For a British distribution network operator, advice on the potential case for appealing Ofgem's Final Determination from the RIIO-ED1 price control review to the Competition and Markets Authority. Our work included preparation of expert witness evidence on the regulatory treatment of smart grid technologies.

2014

- For RWE npower (in collaboration with Imperial College London), preparing expert evidence for submission to the English High Court in the course of Judicial Review proceedings, and preparing reports in the context of Project TransmiT to (1) compare the long-run marginal cost of transmission investment with tariffs under alternative charging methodologies, (2) estimate the welfare effects of the WACM2 charging methodology using detailed market and transmission system simulation models, and (3) review an Ofgem consultation paper.
- For UKPN, support in relation to the outlook for real input price inflation in the context of the RIIO-ED1 price control review.
- For Scottish Power Energy Networks, in the context of the RIIO-ED1 price control review, providing a range of support related to Ofgem's assessment of efficient costs, including analysis of econometric benchmarking, real input price inflation, the regulatory treatment of potential smart grid savings, and regional and "special" factors.
- For Dublin Airport Authority (2014), conducting a 'stated preference' study to assess passengers' willingness to pay for improvements in airport terminal facilities using econometric modelling techniques known as conditional and mixed logit regressions.
- For the British electricity Distribution Network Operators (DNO), through the Energy Networks Association, drafting a critique of Ofgem's Draft Determination of the allowance for Real Price Effects over the RIIO-ED1 control period, and forecasting inflation in cost indices using ARIMA methods.
- For the Singapore Gencos (Tuas Power, Pacific Light Power Corp, Senoko and PowerSeraya), preparing a review and critique of the Energy Market Authority of Singapore's Draft Determination of the Vesting Contract Level for 2015/16.
- For ElecLink, a proposed interconnector between Great Britain and France, designing the auction-based mechanism for allocating long-term capacity rights through an open season.
- For Thames Water, developing a "Special Factor" case as part of the Ofwat Price Review 2014 process, identifying and quantifying factors affecting the company's costs that are not allowed for in the Ofwat cost assessment benchmarking.
- For the Saudi Electric Company (SEC), advice on power sector restructuring issues in the context of the proposed divestment of shares in SEC's generation and distribution assets, and the introduction of more competitive power procurement arrangements, with a particular focus on the design of distribution network regulatory arrangements.
- For the UK Department of Environment, Food and Rural Affairs (Defra), conducting quality assurance of a Monte Carlo simulation model, and the econometric analysis used to calibrate input assumptions.

2013

- For Western Power Distribution, a UK electricity Distribution Network Operator (DNO), conducting financial risk modelling in the context of Ofgem's RIIO-ED1 price control review.
- For Scottish Power Energy Networks (SPEN), in the context of the RIIO-ED1 price control review, providing a range of support related to Ofgem's assessment of efficient costs, including analysis of econometric benchmarking, real input price inflation, and financial risk modelling.
- For the European Commission (in collaboration with Imperial College London and KEMA), advising on the regulatory, commercial and market arrangements required to efficiently integrate renewables into the European power system. This assignment covered wholesale market design, transmission and distribution grid access and charging arrangements, and renewables subsidy mechanisms.

- For RWE npower (in collaboration with Imperial College London), preparing reports in the context of Project TransmiT assess the case for developing new transmission charging methodologies that sought to reflect better the costs that different technologies impose on the grid.
- For the Electricity and Cogeneration Regulatory Authority (ECRA) of Saudi Arabia, advising on various aspects of power market design, competition and regulatory issues, including detailed modelling of the KSA power system.
- For a confidential investor, performing regulatory due diligence for the London Array wind farm.
- For a confidential investor, valuation of UK onshore wind farms and a project to convert an existing coal-fired power station into a dedicated biomass generation facility.
- For a confidential client, providing economic analysis relating to changes in the costs of upstream oil and gas production.
- For a confidential investor, valuation of a portfolio of power generation capacity (coal-fired, gas-fired CCGTs, pumped storage and oil-fired peakers).

2012

- For the Department for Energy and Climate Change (DECC), providing analysis of the long-term "balancing challenge" driven by the integration of intermittent renewables and the electrification of the heat and transport sectors.
- For RWE npower (in collaboration with Imperial College London), review of Ofgem proposals to amend Transmission Network Use of System (TNUoS) charges following Project TransmiT to better reflect the costs imposed on the transmission system by intermittent renewable power generators.
- For Wessex Water (UK), conducting a 'stated preference' study to assess consumers' willingness to pay for improvements to the quality of water supply and sewerage service using econometric modelling.
- For Bristol Water (UK), conducting a 'stated preference' study to assess consumers' willingness to pay for improvements to the quality of water supply using econometric modelling.
- For the Regulation and Supervision Bureau (Abu Dhabi), advising on the development of cost reflective tariffs for electricity and water supply, including statistical analysis of consumption data to estimate representative consumption profiles using "quantile regression" techniques, and the development of a detailed water and power sector despatch model.
- For the Department of Environment, Food and Rural Affairs (Defra), conducting quality assurance of a Monte Carlo simulation model, and the econometric analysis used to calibrate input assumptions.
- For the UK Office of Rail Regulation (ORR), analysing the impact of an increase in rail freight access charges on the demand for coal from the Electricity Supply Industry using a model of the wholesale electricity market.
- For a major UK utility, reviewing Ofgem's proposals to implement "mandatory auctions" for the sale of electricity generated by the "big 6" utilities operating in the British market.
- For the Omani Power and Water Procurement Company (OPWP), advising on contractual, regulatory and market issues associated with the renegotiation of power and water purchase agreements (PWPAs).
- For an Irish utility, providing an independent review of the company's 5-year business plan (electricity generation, wholesale trading, renewables and retail businesses) in support of a potential refinancing.

- For a confidential investor, valuation of a portfolio of power generation capacity (coal-fired, gas-fired CCGTs, pumped storage and oil-fired peakers).

2011

- For a NW European gas trading company, providing economic advice regarding the appropriateness of the tariff charged for accessing a gas pipeline.
- For Power NI, providing regulatory advice and quantitative analysis (Monte Carlo simulation of cash balances) to estimate the margin required over the upcoming control period.
- For an Irish utility, providing an independent review of the company's 5-year business plan (electricity generation, wholesale trading, renewables and retail businesses) in support of a potential refinancing.
- For ScottishPower, modelling the impact of the UK government's Electricity Market Reform (EMR) proposals, including analysing the impact of the CO2 price floor and a targeted capacity mechanism.
- For RWE npower, in collaboration with Imperial College London, electricity market modelling work to compare the welfare effects of locational Transmission Network Use of System (TNUoS) charges with a uniform tariff.
- For a confidential investor, valuation of a portfolio of UK generation assets including gas and coal capacity, pumped storage and oil-fired peaking plant.
- For a confidential investor, valuation of UK gas-fired generators in support of a proposed transaction.
- For a confidential investor, conducting market due diligence for a proposed new nuclear power plant in the Bulgarian market, including long-term power price forecasting out to 2050.
- For NIE Energy Power Procurement Business, conducting bottom-up Monte Carlo modelling to assess the risks to which the company is exposed, and so estimate the margin required by the company through its price control.
- For NIE Energy Supply, advising on possible contract structures for the procurement of energy from renewable generators.

2010

- For a confidential investor, power price forecasting and market analysis in the South Korean power market, including detailed analysis of Asian and world gas markets with focus on the Asian LNG spot market.
- For the Ministry of Trade and Industry (Singapore), providing technical and market advise in the course of an appeal by the Singapore "gencos" against a decision by the regulator to reform the vesting contract regime.
- For a large European utility, market analysis and price forecasting in the Polish electricity market, including the assessment of coal-fired generation investments.
- For an investment bank, conducting due diligence on an Irish utility, including a review of the Single Electricity Market and the Irish and Northern Irish electricity retail markets.
- For a large European utility, market modelling work to support generation investment decision making in the UK market.
- For a consortium of investors, market due diligence, including detailed market modelling, for a proposed CCGT investment in the Balkans.

- For a private equity fund, preparing a report on the investment climate for renewable generation in the British market, including forecasting prices in the markets for power and renewables obligation certificates.

2009

- For London Underground Limited, providing ongoing support and advice in the course of the periodic review of the price clause in the PPP agreement with Tubelines Limited, focussing on the potential for future productivity growth and real input price inflation.
- For EDF Energy Networks, providing ongoing support, economic analysis and strategic advice in the course of the British electricity distribution price control review, with focus on benchmarking of costs, forecasting real input price inflation, and analysis of incentive mechanisms.
- For NIE PPB, support during the company's price control review focussing on modelling of working capital requirements.
- For the Department of Energy and Climate Change (DECC), analysing options for a regulatory framework for CO2 transportation infrastructure to enable the deployment of Carbon Capture and Storage technologies in the UK, including analysis of investment incentives under uncertainty about future demand for network infrastructure.
- For confidential investors, conducting market due diligence on UK, Irish and Italian generation assets.
- For BBL Company, advising on proposals for introducing an interruptible reverse flow service on the gas interconnector between the Netherlands and Great Britain.
- For the Lithuanian nuclear development company, market analysis and price forecasting for the Baltic markets and neighbouring European markets (Poland, Nord Pool, etc.), as an input to decision-making on a new nuclear plant in Lithuania.
- For a confidential client, support in preparation for a potential arbitration over the price clause in a gas supply agreement, reviewing the operation of gas markets in Britain and Belgium, and conducting econometric analysis of gas price series.
- For the International Finance Corporation, preparing a market report on the West African Power Pool (Ghana, Côte d'Ivoire, Benin and Togo), including wholesale electricity market modelling to establish optimal generation investment strategies.
- For a Turkish investor, modelling the evolution of the Turkish power market under a range of scenarios.

2008

- For EDF Energy Networks, forecasting future real input price inflation for the network business to support a submission to the industry regulator during distribution price control review.
- For Wales and West Utilities, helping to design an auction for "interruption rights" on their network, to ensure that the auction meets regulatory planning requirements, and advising on the design of a bid selection algorithm.
- For a grouping of Singaporean generators, reviewing the energy regulator's proposals on vesting contracts, including a review of the regulators' estimate of the long-run marginal cost of electricity generation and the level of vesting contract coverage required to mitigate market power.
- For PowerGas (Singapore), support in designing a regulatory framework for a proposed LNG terminal, including financial modelling and drafting regulatory proposals to the industry regulator for the calculation of allowed costs and tariffs.

- For a utility investor, market due diligence and revenue forecasting in support of the client's bid to acquire one of the state-owned Singaporean gencos that were being sold in 2008.
- For an investment bank, preparing detailed electricity market reports on the Romanian, Bulgarian and Polish electricity markets, including wholesale power price forecasts and a comparison of renewables investment incentives across the markets.
- For DEPA (Public Gas Corporation of Greece), reviewing the draft gas transmission network code for the Greek gas transmission system, with a focus on gas balancing, as well as transmission and LNG terminal access arrangements.
- For the Australian Energy Market Commission, writing a factual report, reviewing the arrangements that have been adopted in relation to Advanced Metering Infrastructure (AMI) in Great Britain.
- For ENBW, reviewing and appraising a regulatory benchmarking study of international electricity transmission system operators.
- For a confidential client, forecasting power prices for the Polish electricity market.
- For EOS, undertaking market due diligence and revenue forecasting for the generation capacity owned by EOS and Atel in Europe (including storage hydro, pumped storage, run-of-river, nuclear, and fossil-fuel plants in Switzerland, France, Germany, Italy, Hungary and Czech Republic).
- For a confidential asset management firm, preparing a review of the Russian electricity sector, focussing on the reform of the regulatory system for electricity distribution networks to introduce "RAB regulation".
- For confidential clients, advising on potential energy sector merger transactions.

2007

- For an investment bank, conducting due diligence on an Irish utility, including a review of the Single Electricity Market and the Irish and Northern Irish electricity retail markets.
- For E.ON UK Limited, providing support in its appeal to the UK Competition Commission against proposals to modify the gas uniform network code approved by the Gas and Electricity Markets Authority.
- For an independent power producer in the UK, preparing a report on the investment climate for renewable generation in the British market.
- For a UK electricity market investor, advising regarding investment strategies in the British electricity industry, including a description of the nature of electricity retail market competition.
- For Rede Electrica Nacional (Portuguese transmission network operator), designing an alternative regulatory system, containing incentives for cost minimisation, including financial modelling of the effects from the proposed system.
- For Fluxys, reviewing a benchmarking study undertaken at the request of the industry regulator to inform its "x-factor" decision.
- For National Grid Company, supporting an application to the EC for exemption from the Utilities Contracts Regulations, involving extensive research on European gas and electricity transmission and distribution networks.
- For the Regulation and Supervision Bureau, Abu Dhabi, modelling the electricity and water sectors to determine the least cost means of meeting electricity and water demand in Abu Dhabi over a 15-year horizon, using NERA's EESyM model.

- For Wales and West Utilities, providing economic advice during the periodic price control review, with focus on the benchmarking of operational expenditure.
- For Gas Transport Services, a review of different cost accounting methodologies, including a review of regulatory practice in other European countries.
- For an investment bank, conducting due diligence on a British electricity distribution network, including a review of the regulatory risks that the company faces.
- For a large European utility, preparing training materials regarding the structure of the British gas and electricity markets (including retail market competition and a review of regulatory policy debates).
- For a confidential client, valuing of a portfolio of EU Emissions Trading Scheme CO2 allowances, for support in litigation.
- For the Office of Rail Regulation, modelling the impact of altering rail freight track access charges on the UK wholesale electricity market using NERA's EESyM model.
- For Nuon and Essent, advising on a potential merger, in particular on consequences for the Dutch electricity market, involving modelling of Supply Function Equilibria.

2006

- For EDF Energy Networks, advising on the scope for distributed generation in the London electricity market.
- For The Gas Forum, advising on proposed reforms of the charging structure for gas transmission exit capacity in the UK, involving a cost benefit analysis of the proposed reforms and an analysis of the economics of gas pipeline capacity.
- For a grouping of Singaporean generators, reviewing the energy regulator's proposals on vesting contracts to control market power.
- For a confidential client, advising on the competition effects of mergers on British energy markets.
- For a large European utility, conducting market due diligence and revenue forecasting for a gas storage asset in the Netherlands.

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EUGENE T. MEEHAN
SPECIAL CONSULTANT

Mr. Meehan is a Special Consultant affiliated with NERA. He has over thirty-five years of experience consulting with electric and gas utilities and has testified as an expert witness before numerous state and federal regulatory agencies, as well as appeared in federal court and arbitration proceedings.

At NERA, Mr. Meehan's practice concentrates on serving energy industry clients, with a focus on helping clients manage the transition from regulatory to more competitive environments. He has performed consulting assignments for over fifty large electric, gas, and combination utilities in the areas of retail access, regulatory strategy, strategic planning, financial and economic analysis, merger and acquisition advisory services, power contract analysis, market power and market definition, stranded cost analysis, power pooling, power markets and risk management, ISO and PX development, and costing and pricing. In addition, he has advised numerous utilities on power procurement issues and administered power procurements on behalf of utilities and regulators.

Mr. Meehan has experience leading NERA's advisory work on several major restructuring and unbundling assignments. These assignments were multi-year projects that involved integration of regulatory and business strategy, as well as development of regulatory filings associated with the recovery of stranded cost and rate unbundling.

Education

Boston College, BA, Economics, *cum laude*
New York University (NYU), Graduate School of Business, completed core courses for the doctoral program.

Professional Experience

CONSULTANT
2015- Special Consultant Affiliated with NERA Economic Consulting

NERA Economic Consulting
1999-2014 Senior Vice President

1996-1999 Vice President

1973-1980 Senior Economic Analyst; Research Assistant

Deloitte & Touche Consulting Group
1994-1996 Principal

Energy Management Associates, Inc.
1980-1994 Vice President

Areas of Expertise

Restructuring/Stranded Cost Recovery

Mr. Meehan has directed several multi-year projects associated with restructuring and stranded cost recovery. These projects involved facilitating the development of an integrated regulatory and business strategy and formulating regulatory filings to accomplish strategy. As part of these assignments, Mr. Meehan facilitated sessions with senior management to set and track filing strategy. Clients include Public Service Gas & Electric and Baltimore Gas and Electric.

Unbundling/Generation Pricing

Mr. Meehan has formulated unbundling strategies, with a specialization in generation pricing. He has advised several utilities in standard offer pricing and has testified on shopping credits on behalf of First Energy and Baltimore Gas and Electric.

Power Procurement

Mr. Meehan has been involved in power procurement activities for a variety of utilities and regulatory agencies. He has advised utilities in developing and implementing evaluation processes for new generation, with the objective of achieving the best portfolio evaluation. He has helped regulators in Ireland and Canada design and implement portfolio evaluation processes. He has testified before FERC and state regulatory agencies on competitive power procurement. In addition, Mr. Meehan helped to design and implement the New Jersey BGS auction process.

Power Contracts

Mr. Meehan has extensive experience with power contracts and power contract issues. He has reviewed and testified on the three principal types of power contracts: integrated utility to integrated utility contracts, IPP to utility contract, and integrated or wholesale utility to distribution utility contracts. He has testified in power contracts disputes on behalf of Carolina Power and Light, Duke Power Company, Southern Company, Orange and Rockland Utilities, and Tucson Electric Power. He has also advised Oglethorpe Power Corporation in the reform of its wholesale contracts with its distributor cooperative members.

Retail and Wholesale Settlements

In addition to his expertise on power pooling issues, Mr. Meehan has significant experience with assignments related to the settlement process. He has focused on the issues of credit management as new entrants appear in retail and wholesale markets and has designed efficient specifications for retail settlement systems, including the use of load profiling, and examined the risk and cost allocation issues of alternative settlement systems.

Risk Management

Mr. Meehan has advised several large utilities on price risk management. These assignments have included evaluation of price management service offers solicited from power marketers in association with management of assets and entitlements, as well as provision of price managed service for various terms.

Marginal Costs

Mr. Meehan has provided comprehensive marginal cost analyses for over 25 North American Utilities. These assignments required detailed knowledge of utility operations and planning.

Production Simulation Modeling

Mr. Meehan has extensive experience designing and using production simulation models including PROMOD, Aurora, Plexos and GE-MAPS. He has utilized these models on variety of assignments for over thirty clients and as part of these assignments has validated models and input assumptions.

Power Supply and Transmission Planning

Mr. Meehan has advised electric utilities on economic evaluations of generation and transmission expansion. He has testified on the economics of particular investments, the prudence of planning processes, and the prudence of particular investment decisions.

Generation Strategy

Mr. Meehan has led NERA efforts on a client task force charged with developing an integrated generation asset/power marketing strategy.

Power Pooling

Mr. Meehan has in-depth working knowledge of the operating, accounting, and settlement processes of all United States power pools and representative international power pools. He has provided consulting services for New York Power Pool members on a continuous basis since 1980, advising the Pool and its members on production cost modeling, transmission expansion, competitive bidding and reliability, and marginal generating capacity cost quantification. In NEPOOL, he has quantified the benefits of continued utility membership in the Pool and the impact of the Pool settlement process on marginal cost. He has worked with a major PJM utility to explore the impact of PJM restructuring proposals upon generating asset valuation and examine the implications of alternative restructuring proposals. He has consulted for Central and Southwest Corporation, Entergy, and Southern Company on issues that involved the internal pooling arrangements of the utility operating companies of those holding companies, as well as for various utilities on the impact of pooling arrangements on strategic alternatives.

Representative Assignments

Worked with Public Service Electric & Gas Company (PSE&G) to direct a three year NERA advisory effort on restructuring. Facilitated a two-day senior management meeting to set regulatory strategy in 1997. Throughout 1997 and 1998, worked over half time at PSE&G to help implement that strategy and advised on testimony preparation, cross-examination, and briefing. Also advised PSE&G on business issues related to securitization, energy settlement and credit requirements for third party suppliers. During 1999, advised PSE&G during settlement negotiations and litigation of the settlement. PSE&G achieved a restructuring outcome that involved continued ownership of generation by an affiliate and the securitization of $2.5 billion in stranded costs.

Worked on separate assignments for a large utility in the Northeast and a large utility in the Southeast, advising on the evaluation of risk management offers from power marketers. The assignments included reviewing proposals, attending interviews with marketers and providing advice on these, and the developing analytical software to evaluate offers.

Worked with government of Ontario beginning in 2004 to help design the RFP and economic evaluation process for the solicitation of 2500 Mw of new generating capacity. Supervising NERA’s portfolio-based economic evaluation on behalf of the Ontario Ministry of Energy.

Testified on behalf of Pacific Gas & Electric Company before the FERC in a case benchmarking the PSA between the distribution utility and a soon-to-be-created generating company. This effort involved developing detailed expertise in applying the Edgar standard and a detailed review of DWR procurement during the western power crisis. In addition, this effort involved the review of more than 100 power contracts in the WECC.

Directed NERA's efforts, on behalf of the electricity regulator in Ireland, to design an RFP and implementation process for the purchase of 500 Mw of new generating capacity in 2003. NERA advised on the RFP, the portfolio evaluation method, and the power contract and also conducted the economic evaluation.

Reviewed the economic evaluation conducted by Southern Company Service for affiliated operating companies in connection with an RFP for over 2000 Mw of new generating capacity. Submitted testimony before FERC on behalf of Southern Company Service.

Worked with Baltimore Gas and Electric (BG&E) to conduct a one and one-half year consulting assignment that involved providing restructuring advice. The project began in March/April 1998 with senior management discussions and workshops on plan development and filing strategy. Advised BG&E in the development of testimony, rebuttal testimony, and public information dissemination. Worked to review and coordinate testimony from all witnesses and offered testimony on shopping credits and in defense of the case settlement. BG&E achieved a restructuring outcome enabling it to retain generation ownership. As part of this assignment, advised BG&E on generation valuation and unregulated generation business strategy.

Directed the efforts of a large Southeastern utility to develop a short-term power contract portfolio and to evaluate the relative value of power options, forwards, and unit contracts to determine the optimal mix of instruments to manage price risk.

Testified for XCEL Energy on the use of competitive bids for new generation needs. Examined whether XCEL was prudent not to explore a self-build plan and the reasonableness of relying on ten-year or shorter contracts as opposed to life-of-facility contracts, in order to meet needs and facilitate a possible future transition to competition. This project addressed the comparability of fixed bids to rate base plant additions.

Advised and testified on behalf of First Energy in the Ohio restructuring proceeding on the issues of generation unbundling and stranded cost. Defended the First Energy shopping credit proposal.

Advised Consolidated Edison and Northeast Utilities on merger issues and testified in Connecticut and New Hampshire merger proceedings. Testimony focused on retail competition in gas and electric commodity markets.

Directed NERA's effort to train selected representatives of a major European power company in American power marketing and risk management practices. The project involved numerous meetings and interviews with power marketing firms.

Led NERA's effort to advise the New England ISO on the development of an RTO filing. Examined performance-based ratemaking for transmission and market operator functions.

Examined ERCOT power market conditions during the period of time from 1997 to 1999 and testified on behalf of Texas New Mexico Power Company for the prudence of its power purchase activity.

Advised a Midwestern utility on restructuring of a wholesale contract with an affiliate. Involved forecasting of the unbundled wholesale cost-of-service and market prices, as well as development of a regulatory strategy for gaining approval of contract restructuring and the transfer of generation from regulated to EWG states.

Performed market price forecasts for numerous utility clients. These forecasts have employed both traditional modeling and newly developed statistical approaches.

Examined the credit issues associated with the entry of new entities into retail and wholesale settlement market. These assignments involved a review of current Pool credit procedures, examination of commodity and security trading credit requirements, coordination with financial institutions, and recommendations concerning credit exposure monitoring, credit evaluation processes, and credit requirements.

Oversight of EMA's consulting and software team in designing and implementing the LOLP capacity payment, a portion of the UK wholesale settlement system.

Advised Oglethorpe Power Corporation in the reform of its contracts with its distribution cooperative members and the evolution of full requirement power wholesale power contracts into contracts that preserve Oglethorpe's financial integrity and are suitable for a competitive environment.

Developed long run marginal and avoided costs of natural gas service, as well as avoided cost methods and procedures. These costs have been used primarily for the analysis of gas DSM opportunities. Clients include Consolidated Edison Company, Southern California Edison Company, Niagara Mohawk Power Corporation, and Elizabethtown Gas Company.

Review of power contracts and testimony in numerous power contract disputes

Development of long run avoided costs of electricity service and avoided cost methods and procedures. These costs have been used to assess DSM and cogeneration, as well as to develop integrated resource plans. Clients include Public Service Company of Oklahoma, Central Maine Power Company, Duquesne Light Company, and the New York investor-owned utilities.

Advised Central Maine Power Company (CMP) on the development of a competitive bidding framework. This framework was implemented in 1984 and was the first of its kind in the nation. CMP adopted the framework outlined in EMA's report and won prompt regulatory approval.

Advised a utility in the development of an incentive ratemaking plan for a new nuclear facility. This assignment involved strategic analysis of alternate proposals and quantification of the financial impact of various ratemaking alternatives. Presented strategic and financial results in order to convince senior management to initiate negotiations for the incentive plan.

Advised and testified on behalf of the New York Power Pool utilities on the methodology for measuring pool marginal capacity costs. This work included development of the methodology and implementation of the system for quantifying LOLP-based marginal capacity costs.

Provided testimony on behalf of the investor-owned electric utilities in New York State, concerning the proper methodology to use when analyzing the cost-effectiveness of conservation programs. This methodology was adopted by the Commission and used as the basis for DSM evaluation in New York from 1982 through 1988.

Developed the functional design of a retail access settlement system and business processes for a major PJM combination utility. This design is being used to construct a software system and develop business procedures that will be used for retail settlements beginning January 1999.

Reviewed the power pool operating and interchange accounting procedure of the New York Power Pool, the Pennsylvania, New Jersey, Maryland Interconnection, Allegheny Power System, Southern Company, and the New England Power Pool as part of various consulting assignments and in connection with the development of production simulation software.

Summarized and analyzed the operational NEPOOL to examine the feasibility of incorporating NEPOOL interchange impacts with Central Maine and accounting procedure of the New England Power Pool Power Company's buy-back tariffs.

Developed and presented a two-day seminar delivered to electric industry participants in the UK (prior to privatization), outlining the structure and operation of power pools and bulk power market transactions in North America.

Benchmark analysis and FERC testimony of PGE's proposed twelve-year contract between PG&E and Electric Gen LLC (contract value in excess of $15 billion).

Responsible for NERA's overall efforts in advising New Jersey's Electric Distribution Companies on the structuring and conduct of the Basic Generation Service auctions (the 2002 auction involved $3.5 billion, and the 2003 and 2004 auctions involved over $4.0 billion).

Publications, Speeches, Presentations, and Reports

Capacity Adequacy in New Zealand's Electricity Market, published in *Asian Power*, September 18, 2003

Central Resource Adequacy Markets For PJM, NY-ISO AND NE-ISO, a report written February 2004

Ex Ante or *Ex Post*? Risk, Hedging and Prudence in the Restructured Power Business, The Electricity Journal, April 2006

Distributed Resources: Incentives, a white paper prepared for Edison Electric Institute, May 2006

Restructuring Expectations and Outcomes, a presentation presented at the Saul Ewing Annual Utility Conference: The Post Rate Cap and 2007 State Regulatory Environment, Philadelphia, PA, May 21, 2007

Making a Business of Energy Efficiency: Sustainable Business Models for Utilities, prepared for Edison Electric Institute, August 2007

Perspectives on Ownership Issues for Traditional Generating & Alternative Resources: Should we allow utilities back in the market or limit ownership to merchants? A presentation presented at the Energy in the Northeast Conference sponsored by Law Seminars Intl., October 18, 2007

Restructuring at a Crossroads, presented at Empowering Consumers Through Competitive Markets: The Choice Is Yours, Sponsored by COMPETE and the Electric Power Supply Association, Washington, DC, November 5, 2007

*Competitive Electricity Markets: The Benefits for Customers and the Environmen*t, a white paper prepared for COMPETE Collation, February 2008

The Continuing Rationale for Full and Timely Recovery of Fuel Price Levels in Fuel Adjustment Clauses, The Electricity Journal, July 2008

Impact of EU Electricity Competition Directives on Nuclear Financing presented to: SMI – Financing Nuclear Power Conference, London, UK, May 20, 2009

Using History As A Guide, a presentation presented at the Electric Power Research Institute (EPRI) Conference: Electricity Pricing Structures for the 21st Century, July 14 – 15, 2011, Nashville, TN

Testimony

Forums

Arkansas Public Service Commission

Federal Energy Regulatory Commission

Florida Public Service Commission

Maine Public Utilities Commission

Minnesota Public Service Commission

Nevada Public Service Commission

New York Public Service Commission

New York State Department of Environmental Conservation

Nuclear Regulatory Commission – Atomic Safety and Licensing Board

Oklahoma Public Service Commission

Public Service Commission of Indiana

Public Utilities Commission of Ohio

Public Utilities Commission of Nevada

Public Utilities Commission of Texas

Public Utilities Commission of New Hampshire

United States District Court

United States Senate Committee on Energy and Natural Resources

Various arbitration proceedings

Clients

American Electric Power Company

Arkansas Power & Light Company

Baltimore Gas & Electric

Carolina Power & Light Company

Central Maine Power

Consolidated Edison Company of New York, Inc.

Dayton Power and Light Company

Florida Coordinating Group

Houston Lighting & Power Company

Minnesota Power and Light Company

Nevada Power Company

Niagara Mohawk Power Corporation

Northern Indiana Public Service Company

Oglethorpe Power Corporation

Pacific Gas and Electric Company

Power Authority of the State of New York

Public Service and Electric Company

Public Service Company of Oklahoma

Sierra Pacific Power Company

Southern Company Services, Inc.

Tucson Electric Power Company

Texas-New Mexico Power Company

Recent Expert Testimony and Expert Reports

Supplemental Testimony on behalf of Texas-New Mexico Power Company, Docket No. 15660, September 5, 1996.

Direct Testimony on behalf of Long Island Lighting Company before the Federal Energy Regulatory Commission, September 29, 1997.

Rebuttal Testimony on behalf of Texas-New Mexico Power Company, SOAH Docket No. 473-97-1561, PUC Docket No. 17751, March 2, 1998.

Prepared Testimony and deposition testimony on behalf of Central Maine Power Company, United Stated District Court Southern District of New York, 98-civ-8162 (JSM), March 5, 1999.

Prepared Direct Testimony Before the Public Service Commission of Maryland on behalf of Baltimore Gas & Electric Company, PSC Case Nos. 8794/8804, June 1999.

Rebuttal Testimony Before the Maryland Public Service Commission, on behalf of Baltimore Gas & Electric Company, PSC Case Nos. 8794/8804, March 22, 1999.

NORCON Power Partners LP v. Niagara Mohawk Energy Marketing, before the United States District Court, Southern District of New York, June 1999.

Prepared Supplemental Testimony Before the Maryland Public Service Commission, on behalf of Baltimore Gas & Electric Company, PSC Case Nos. 8794/8804, July 23, 1999.

Prepared Supplemental Reply Testimony Before the Maryland Public Service Commission, on behalf of Baltimore Gas & Electric Company, PSC Case Nos. 8794/8804, August 3, 1999.

Direct Testimony on behalf of Niagara Mohawk, Before the New York State Public Service Commission, PSC Case No. 99-E-0681, September 3, 1999.

Rebuttal Testimony on behalf of Niagara Mohawk, PSC Case No. 99-E-0681 Before the New York State Public Service Commission, November 10, 1999.

Arbitration deposition on behalf of Oglethorpe Power Corporation, last quarter of 1999.

Direct Testimony Before the Public Utilities Commission of Ohio on behalf of FirstEnergy Corporation, Ohio Edison Company, The Cleveland Electric Illuminating Company and The Toledo Edison Company, Case No. 99-1212-EL-ETP re: Shopping Credits.

Direct Testimony on behalf of Niagara Mohawk, Before the New York State Public Service Commission, PSC Case No. 99-E-0990, February 25, 2000.

Testimony on behalf of Consolidated Edison Company of New York, Inc., State of Connecticut, Department of Public Utility Control, Docket No.: 00-01-11, April 28, 2000 and June 30, 2000.

Testimony on behalf of Texas-New Mexico Power Company, Fuel Reconciliation Proceeding before the Texas PUC, June 30, 2000.

Testimony on behalf of Consolidated Edison Company of New York, Inc., Before the New Hampshire Public Service Commission, Docket No.: DE 00-009, June 30, 2000.

Rebuttal Testimony Before the Public Utilities Commission of the State of Colorado, Docket No. 99A-549E, November 22, 2000.

Testimony Before the Public Utilities Commission of the State of Colorado, Docket No. 99A-549E, January 19, 2001.

DETM Management, Inc. Duke Energy Services Canada Ltd., And DTMSI Management Ltd., Claimants vs. Mobil Natural Gas Inc., And Mobil Canada Products, Ltd., Respondents. American Arbitration Association Cause No. 50 T 198 00485 00, August 27, 2001.

State of New Jersey Board of Public Utilities, In the Matter of the Provision of Basic Generation Service Pursuant to the Electric Discount and Energy Competition Act of 1999, Before President Connie O. Hughes, Commissioner Carol Murphy on Behalf of the Electric Distribution

Companies (Public Service Electric and Gas Company, GPU Energy, Consolidate Edison Company and Conectiv) Docket No.: EX01050303, October 4, 2001.

Direct Testimony Before the Federal Energy Regulatory Commission on behalf of Pacific Gas and Electric Company, Docket No.: ER02-456-000, November 30, 2001.

Fourth Branch Associates/Mechanicville vs. Niagara Mohawk Power Corporation, January 2002 (Expert Report).

Arbitration Deposition on behalf of Oglethorpe Power Corporation, March 2002.

Direct Testimony and Deposition Testimony Before the Federal Energy Regulatory Commission on behalf of Electric Generation LLC in Response to June 12 Commission Order, Docket No.: ER02-456-000, July 16, 2002.

Rebuttal Testimony Before the Federal Energy Regulatory Commission on behalf of Electric Generation LLC in Response to June 12 Commission Order, Docket No.: ER02-456-000, August 13, 2002.

Direct Testimony Before the Public Utilities Commission of Nevada on behalf of Nevada Power Company, in the matter of the Application of Nevada Power Company to Reduce Fuel and Purchased Power Rates, PUCN Docket No. 02-11021, November 8, 2002 and subsequent Deposition Testimony.

Direct Testimony Before the Public Utilities Commission of Nevada on behalf of Sierra Pacific Power Company's Deferred Energy Case, Docket No. 03-1014, January 10, 2003.

Direct Testimony Before the Public Utility Commission Of Texas on behalf of Texas-New Mexico Power Company, Application Of Texas-New Mexico Power Company For Reconciliation Of Fuel Costs, April 1, 2003.

Rebuttal Testimony Before the Public Utilities Commission of Nevada on behalf of Nevada Power Company, PUCN Docket No. 02-11021, April 1, 2003.

Rebuttal Testimony Before the Public Utilities Commission of Nevada on behalf of Sierra Pacific Power Company, Docket No. 03-1014, May 5, 2003.

Testimony Before the Public Service Commission of New York on behalf of Consolidated Edison Company of New York, Inc., Case No.: 00-E-0612, September 19, 2003.

State of New Jersey Board of Public Utilities, In the Matter of the Provision of Basic Generation Service Pursuant to the Electric Discount and Energy Competition Act of 1999, Before President Connie O. Hughes, Commissioner Carol Murphy on Behalf of the Electric Distribution Companies (Public Service Electric and Gas Company, GPU Energy, Consolidate Edison Company and Conectiv), September 2003.

Direct Testimony Before the Public Utilities Commission of Nevada on behalf of Nevada Power Company's Deferred Energy Case, November 12, 2003.

Direct Testimony Before the Public Utilities Commission of Nevada on behalf of Sierra Pacific Power Company's Deferred Energy Case, January 12, 2004.

Rebuttal Testimony Before the Public Utilities Commission of Nevada on behalf of Sierra Pacific Power Company's Deferred Energy Case, May 28, 2004.

Direct Testimony on behalf of Texas-New Mexico Power Company, First Choice Power Inc. and Texas Generating Company LP to Finalize Stranded Cost under PURA § 39.262, January 22, 2004.

Rebuttal Testimony on behalf of Texas-New Mexico Power Company, First Choice Power Inc. and Texas Generating Company LP to Finalize Stranded Cost under PURA § 39.262, April, 2004.

State of New Jersey Board of Public Utilities, In the Matter of the Provision of Basic Generation Service Pursuant to the Electric Discount and Energy Competition Act of 1999, Before President Connie O. Hughes, Commissioner Carol Murphy on Behalf of the Electric Distribution Companies (Public Service Electric and Gas Company, GPU Energy, Consolidate Edison Company and Conectiv), September 2004.

Direct Testimony Before the Public Utilities Commission of Nevada on behalf of Nevada Power Company's Deferred Energy Case, November 9, 2004.

Direct Testimony Before the Public Utilities Commission of Nevada on behalf of Sierra Pacific Power Company's Deferred Energy Case, January 7, 2005.

Expert Report on behalf of Oglethorpe Power Corporation, March 23, 2005.

Arbitration deposition on behalf of Oglethorpe Power Corporation, April 1, 2005.

Direct Testimony Before the Public Utilities Commission of Nevada on behalf of Sierra Pacific Power Company's December 2005 Deferred Energy Case.

Direct Testimony Before the Public Utilities Commission of Nevada on behalf of Nevada Power Company's 2006 Deferred Energy Case, January 13, 2006.

Remand Rebuttal for Public Service Company of Oklahoma before the Corporation Commission of the State of Oklahoma, Cause No. PUD 200200038, **Confidential**, March 17, 2006

Answer Testimony on behalf of the Colorado Independent energy Association, AES Corporation and LS Power Associates, LP, Docket No. 05A-543E, April 18, 2006.

Cross-Answer Testimony on behalf of the Colorado Independent energy Association, AES Corporation and LS Power Associates, LP, Docket No. 05A-543E, May 22, 2006.

Rebuttal Testimony Before the Public Utilities Commission of Nevada on behalf of Nevada Power Company's 2006 Deferred Energy Case, Docket No. 06-01016, June 2006.

Direct Testimony Before the Public Utilities Commission of Nevada on behalf of Sierra Pacific Power Company's Deferred Energy Case, December 2006.

Direct Testimony Before the Public Utilities Commission of Nevada on behalf of Sierra Pacific Power Company's Application for Recovery of Costs of Achieving Final Resolution of Claims Associated with Contracts Executed During the Western Energy Crisis, December 2006.

Direct Testimony Before the Public Utilities Commission of Nevada on behalf of Nevada Power Company's Application for Recovery of Costs of Achieving Final Resolution of Claims Associated with Contracts Executed During the Western Energy Crisis, December 2006.

Direct Testimony Before the Public Utilities Commission of the State of Hawaii, on behalf of Hawaiian Electric Company, Inc., Docket No. 2006-0386, December 22, 2006.

Direct Testimony Before the Public Utilities Commission of the State of Hawaii, on behalf of Hawaiian Electric Company, Inc., Docket No. 05-0315, December 29, 2006.

Rebuttal Testimony Before the Public Utilities Commission of Nevada on behalf of Nevada Power Company's 2007 Deferred Energy Case, January 2007.

Declaration Before the State of New York Public Service Commission, on behalf of Consolidated Edison Company of New York, Inc.'s Long Island City Electric Network, Case 06-E-0894 – Proceeding on Motion of the Commission to Investigate the Electric Power Outage and Case 06-E-1158 – In the Matter of Staff's Investigation of Consolidated Edison Company of New York, Inc.'s Performance During and Following the July and September Electric Utility Outages. July 24, 2007.

Direct Testimony Before The Public Utilities Commission of Colorado, In The Matter of the Application of Public Service Company of Colorado for Approval of its 2007 Colorado Resource Plan, April 2008.

Answer Testimony Before the Public Utilities Commission of the State of Colorado on behalf of Trans-Elect Development Company, LLC, and The Wyoming Infrastructure Authority, Docket No. 07A-447E, April 28, 2008.

Rebuttal Testimony Before the Public Utilities Commission of Nevada, Application of Sierra Pacific Power Company d/b/a/ NV Energy Seeking Acceptance of its Eight Amendment to its 2008-2007 Integrated Resource Plan, Docket No. 10-02023.

Direct Testimony Before the Public Utilities Commission of Nevada on behalf of Sierra Pacific Power Company's 2008 Deferred Energy Case, February 2009.

Direct Testimony Before the Public Utilities Commission of Nevada on behalf of Nevada Power Company's 2008 Deferred Energy Case, February 2009.

Direct Testimony Before the Public Utilities Commission of Texas, on behalf of Entergy Texas, Inc. Docket No. 33687, April 29, 2009.

Direct Testimony Before The Public Utilities Commission Of Nevada On Behalf of Nevada Power Company D/B/A Nevada Energy, 2010 – 2029 Integrated Resource Plan, June 26, 2009.

Before the Public Service Commission of New York, Case 09-E-0428 Consolidated Edison Company of New York, Inc. Rate Case, Rebuttal Testimony, September 2009.

Direct Testimony Before the Public Utilities Commission of Nevada on Behalf of Sierra Pacific Power Company's 2009 Deferred Energy Case, February 2010.

Direct Testimony Before the Public Utilities Commission of Nevada on behalf of Nevada Power Company's 2009 Deferred Energy Case, February 2010.

Direct Testimony Before the Public Utilities Commission of Nevada on behalf of Nevada Power Company's 2010 – 2029 Integrated Resource Plan, Docket No. 09-07003, July 2010.

Direct Testimony Before the Public Utilities Commission of Nevada on behalf of Sierra Pacific Power Company's Eighth Amendment to its 2008 – 2027 Integrated Resource Plan, Docket No. 10-03023, July 2010.

Rebuttal Testimony Before the Public Utilities Commission of Nevada, Application of Nevada power Company d/b/a NV Energy Seeking Acceptance of its Triennial Integrated Resource Plan covering the period 2010-2029, including authority to proceed with the permitting and construction of the ON Line transmission project, Docket No. 10-02009.

Rebuttal Testimony Before the Public Utilities Commission of Nevada, Petition of Nevada Power Company d/b/a NV Energy requesting a determination under NRS 704.7821 that the terms and conditions of five renewable power purchase agreements are just and reasonable and allowing limited deviation from the requirements of NAC 704.8885, Docket No. 10-03022.

Rebuttal Testimony Before the Public Utilities Commission of Nevada, on behalf of Nevada Power Company d/b/a NV Energy, 2010 Deferred Energy Case, Docket No. 10-03003, filed August 3, 2010

Rebuttal Testimony Before the Public Utilities Commission of Nevada, on behalf of Sierra Pacific Power Company d/b/a NV Energy Electric Department, 2010 Deferred Energy Case, Docket No. 10-03004, filed August 3, 2010

Direct Testimony Before the Public Utilities Commission of Nevada, on behalf of Sierra Pacific Power Company, d/b/a NV Energy, Docket No. 11-03 __ 2011 Electric Deferred Energy Proceeding, February 2011.

Direct Testimony Before the Public Utilities Commission of Nevada, on behalf of Nevada Power Company, d/b/a NV Energy, Docket No. 11-03 __ 2011 Electric Deferred Energy Proceeding, February 2011.

Testimony Before the Atomic Safety and Licensing Board, Nuclear Regulatory Commission, In the Matter of Entergy Nuclear Operations, Inc., Dockets Nos. 50-247-LR and 50-286-LR, March 30, 2012.

Rebuttal Testimony Before the Public Utilities Commission of Ohio, In Support of AEP Ohio's Modified Electric Security Plan, Case No. 10-2929, May 11, 2012.

Prefiled Direct Testimony Before the Public Utilities Commission of Nevada, on behalf of Sierra Pacific Power Company, d/b/a NV Energy, Docket No. 12-03 __ 2012 Electric Deferred Energy Proceeding, February 2012.

Prefiled Direct Testimony Before the Public Utilities Commission of Nevada, on behalf of Nevada Power Company, d/b/a NV Energy, Docket No. 12-03 __ 2012 Electric Deferred Energy Proceeding, February 2012.

Direct Testimony Before the Public Utilities Commission of Nevada, on behalf of Sierra Pacific Power Company, d/b/a NV Energy, Docket No. 13-03 __ 2013 Electric Deferred Energy Proceeding, February 2013.

Direct Testimony Before the Public Utilities Commission of Nevada, on behalf of Nevada Power Company, d/b/a NV Energy, Docket No. 13-03 __ 2013 Electric Deferred Energy Proceeding, February 2013.

Direct Testimony Before the Public Utilities Commission of Nevada, on behalf of Sierra Pacific Power Company, d/b/a NV Energy, Docket No. 14-02 __ 2014 Electric Deferred Energy Proceeding, February 2014.

Direct Testimony Before the Public Utilities Commission of Nevada, on behalf of Nevada Power Company, d/b/a NV Energy, Docket No. 14-02 __ 2014 Electric Deferred Energy Proceeding, February 2014.

January 2016

Willis P. Geffert
Associate Director

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WILLIS P GEFFERT
Associate Director

Willis Geffert has consulted in the energy industry since 2000. Mr. Geffert's advisory practice focuses on aiding governments, regulators and power sector entities in electricity market reforms and the maintenance of power markets, as well as providing market analysis, due diligence support, and strategic and regulatory advice to energy companies, utilities, and investors. An expert modeler, he frequently assesses electricity markets using production-cost and econometric methods and builds financial models of energy companies and electricity assets.

Mr. Geffert's regulatory work includes advising on new market structures, assessing the prudence of utility investments, evaluating retail power rates, analyzing compensation for ancillary services and for owning transmission lines and distribution networks, and analyzing market power. While he works on all generation technologies, he has worked on numerous renewables projects recently, including off-shore and on-shore wind finances and valuation and PV solar PPA benchmarking. He also has focused on behind-the-meter issues, writing on the topic and serving as advisor to NYSERDA in the NY Rev proceeding.

Mr. Geffert frequently provides litigation, arbitration, and regulatory support, supporting clients before courts and regulatory bodies (including recent affidavits before the FERC on the capacity market in PJM). He has provided in depth analysis and advice in twelve ongoing or completed international arbitrations (including as expert on a recent hydroelectric case), on issues such as contract reform, BOOT/BOT concessions, regulatory economics, expropriation, and damages.

Mr. Geffert has extensive experience in US (especially PJM, NYISO, CAISO, MISO and ERCOT) and global electricity markets (particularly in Latin America and Europe), as well as with traditionally regulated utilities. With regard to the natural gas, Mr. Geffert has worked on economic and contract issues related to gas extraction and retail gas pricing, and he has assessed retail gas markets for potential investors.

Education

2004	UNIVERSITY OF PENNSYLVANIA Master of Science, Physics
2000	AMHERST COLLEGE Bachelor of Arts, Magna Cum Laude, with honors in Physics
1999	WORCESTER COLLEGE, OXFORD UNIVERSITY Coursework in Physics and Math

Career Details

NERA ECONOMIC CONSULTING, Washington, DC and New York, NY

2019 –	Associate Director
2013 – 2019	Senior Consultant
2002 – 2013	Outside Consultant*
2000 – 2002	Associate Analyst and Research Associate

* Also contracted with Bates White and Castalia

Project Experience

Electric utility in MISO, Resource Choice Analysis, 2019-Present
Advising utility as to whether it might retire a particular generation unit it owns at certain decision points in the near and mid-term, where if it does not retire the unit the utility must may for major maintenance. Project includes sophisticated decision tree analysis.

Commission for Regulation of Utilities in the Republic of Ireland (CRU) and Northern Ireland Utility Regulator (UR), Two Projects, 2018-Present
Pricing Formulas: Determine pricing formulas used by CRU and UR to set the prices of direct contracts (DCs) that largest generation company in market must offer to retail electricity suppliers in the island of Ireland. Use econometric analysis and production cost modeling.

Modeling Support: Provide advice on how the CRU and UR might update the models they use to determine the volume of DCs that the largest generation company must offer and how options to buy those DCs are allocated to electricity suppliers.

Vertically-Integrated Electric Utility Merger, Advice to Prospective Acquirer, 2017-Present
Perform various merger analyses for client, including modeling to support the pricing of a potential PPA that would be part of merger transaction and assisting client in submissions to the regulatory commission.

Solar PPA Market Assessment, 2019
Assessed utility scale solar PPA market in western US for client.

Rate setting advice, US municipal utility, 2019
Advising a municipal utility on its plan to bring its rates more in line with its marginal costs.

New York State Energy Research and Development Authority (NYSERDA), 2017-2019
Serve as economic consultant to NYSERDA during the NY REV (Reforming the Energy Vision) proceedings, specifically for the Value of Distributed Energy Resources working groups on rate design, the value stack, and low and moderate income consumers.

Central Maine Power Company, Marginal Cost Analysis, 2018-2019
Advised on probability of peak analysis for utility's marginal cost study.

Perusahaan Gas Negara, Specialized Training, 2018
Conducted a specializing training onsite with client in Indonesia on the economics of utility concessions and design and award of concessions.

Offshore Wind Auctions, US East Coast, 2018
Advisor to bidder in US east coast offshore wind auctions: assessed likely bids and bidding strategies of client and likely competitors, using auction simulations and financial modeling.

PJM Capacity Market Proceedings at FERC for LS Power, 2018
Expert witness for LS Power FERC proceeding on the reform of PJM's Capacity Market. Initial affidavit filed October 2, 2018 and subsequent affidavit on November 6, 2018. Provide an economic assessment of the effect of generator subsidies in capacity markets and comment on FERC's suggested approach and LS Power's proposal to reform PJM's capacity market. Docket Nos. EL16-49-000, et al. (consolidated).

Risk Assessment of Coal Plant Investment, 2018
Advising investment group (due diligence) on the risks it faces as lessors of an ownership share in a US coal power plant.

Commission for Regulation of Utilities in the Republic of Ireland (CRU) and Northern Ireland Utility Regulator (UR), Market Model Validation, 2018
Updating and validating the official model the regulators use for modeling the combined Ireland/N. Ireland electricity market, where notably the model covers the first five plus years of integration with the EU's Internal Energy Market for Electricity.

[Wind Tariffs], 2017-2018
Using production cost modeling (PLEXOS), estimated the integration costs and the generation cost savings of incorporating a proposed wind farm into a utility's proposal, for filing with state regulatory agency. Market included substantial hydroelectric generation.

Delayed Hydroelectric Power Plant, 2017
Co-expert in international arbitration for owner of delayed hydroelectric power plant, assessing from economic, commercial, and power-sector perspective the owner's claim to enforce payment by EPC contractor of liquidated damages due to delay.

ICSID UNCT/17/1, Mr. Joshua Dean Nelson and Mr. Jorge Blanco v. Mexico (2017)
Provided peer review and advice on damages analysis for NERA expert report on behalf of respondent, in this dispute related to a lost business opportunity in telecommunications.

CENAGAS (Mexican Gas Operator), 2016 & 2017
Forecasted natural gas consumption by the electricity sector in Mexico over a 15 year horizon, using sophisticated long-term planning and short-term dispatch electricity sector modeling (PLEXOS). Performed work initially in 2016; rehired in 2017 to produce an updated forecast.

[Government Agency], 2017
In confidential advisory case, modeled electricity sector, forecasting prices and system costs, using PLEXOS.

Prudence of Investment in Generation Asset, 2017
Performed analysis of prudence of a utility's decision to retrofit a coal power plant instead of retiring it and acquiring or building other generation resources, supporting testimony before regulatory commission.

Due Diligence of Potential Coal Plant Investment, 2017
Advised investment group on its potential investment in the common facilities of a US coal power plant, including assessing the risk the plant may retire.

[Government of Emerging Economy Country], 2017
Helped draft a new economic status and policy report to be used by the Government; focused in particular on the energy sector of the economy.

Energy companies, investors, and developers in Mexico, multiple cases, 2014-2018
Designed, developed, and built custom models of Mexican electricity sector to forecast future prices and generator margins in the restructured Mexican market, to assist investors in valuing their current or potential generation assets, including wind farms. Advised on market risks and opportunities.

[International Energy Company], 2017
Advised on opportunities and risks in entering the US retail energy (gas and electricity) business.

[Confidential Case], 2008-2017
For (counter-)claimant, modelled damages in power plant breach-of-contract case in a commercial international arbitration, calculating lost value using a discounted cash flow model. Developed detailed knowledge of power market rules, power system operation, and power market trading. Modelled power plant production costs. Assisted in drafting initial and rejoinder reports.

[Wind PPA], 2016
Advised a utility as it considered entering into a long-term wind power PPA based on an expansion of an existing wind facility.

[Confidential Case], 2016
Forecasting load (throughput) for a regional US electric utility, as part of due diligence for a potential acquisition.

[Confidential Case], 2016
Advise counsel for a generation company on allegations of improper bidding behavior in a regional US electricity market. Perform independent assessment of company's bidding.

[Confidential Case], 2016
Advised an investor on potential power plant purchase in Western European country, including forecasting of electricity prices in the relevant market.

SENER (Mexico's Ministry of Energy), 2015-2016
Advised on planned split of state electricity company (CFE) into several Gencos that will compete along with private participants in Mexican wholesale electricity market. Split informed by market power analysis, plus efficiency and fairness considerations. Additionally, drafted and reviewed several business practice manuals, including capacity markets, legacy FTRs, short-term energy markets, network modeling, and outage scheduling.

Government of Canada, ICSID Case No. ARB(AF)/12/(3) (Mercer International, Inc. v. Canada), 2013-2016
For respondent, in arbitration brought under NAFTA, provided economic and regulatory analysis of damages claim related to allegedly unequal treatment in terms offered to various pulp & paper mills with co-generation in electric power sales contracts with utility. Assisted in drafting reply and rebuttal reports.

[North American Electricity Company], 2013 and 2015-2016
Co-authored global study of how different jurisdictions pay for reactive power, and what reactive-power requirements are placed on generators, to assess reasonableness of proposed new market rules. In 2015 and 2016, updated study for same client.

[Confidential Case], 2015
Developed modeling approach for assessing effects of nuclear power generation and capacity on electricity market prices and consumer costs, working with other NERA economists.

[International Arbitration, CIAC], 2014-2015
On behalf of respondent (a state-owned energy company), provide economic and commercial contract analysis of claimant's request for modification of its royalties formula in its license contract for natural gas and natural gas liquids exploitation. Assisted in the drafting of reply and rejoinder reports.

[International Investors], 2014-2015
Designed, developed, and built custom zonal model of Mexican electricity sector to model future prices and generator margins in the upcoming restructured Mexican market. Also built long-term market equilibrium model for Mexico. Client is an international investor in a generation asset in Mexico. Performed a similar analysis for another international investor in Mexico.

African Electricity Utility, 2012-2014
Provided regulatory advice on issues of cost-recovery and reasonableness of customer class tariffs. Performed benchmarking analysis on generation and transmission construction costs including cost overruns, as well as on power system operation principles.

Power Sector Investor, 2013
Produced report for interested investor that summarized current situation in and issues affecting the ERCOT power market, and assessed key drivers that will determine future market dynamics.

Government of Philippines, ICSID Case No. ARB/11/12 (Fraport AG Frankfurt Airport Services Worldwide v. Republic of the Philippines), 2012-2013
For respondent, assisted in economic and damages analysis and in the drafting of expert reports (reply and rejoinder reports).

NYISO, 2013 and 2010
Performed econometric analysis of power prices in NYISO region to support NERA's determination of appropriate demand curves to use in setting the capacity clearing price in capacity auctions in NYISO. Reviewed and updated NERA's proposed financial model to determine the demand curves parameters. Performed similar work in an earlier demand curve reset.

[International Arbitration], 2012-2013
On behalf of international investor in power plant special vehicle company, provided independent assessment of value of shares in that company. Valuation based on cash flow model of forecasted revenues and costs for plant.

Public Intervenor, New Brunswick, Canada, 2012-2013
In separate cases, assessed on behalf of Public Intervenor rate increases requested by a power distribution company and an oil distribution company. In each case, assessed the economic merits of the costs proposed for inclusion as a basis for rate increase, and assessed the data and analysis presented by the applicants to support their cases. Assisted in drafting the report filed by NERA expert, drafting interrogatories to both applicants, and developing cross examination questions to aid lawyers in their cross of the applicants and their experts.

Commission for Energy Regulation of the Republic of Ireland (CER) and Northern Ireland Authority for Utility Regulation (NIAUR), Multiple Cases, 2006-2012
Determined pricing formula for Directed Contracts ("DCs") to be allocated to market participants for the 2012-2013 Irish Single Electricity Market (SEM) market year. Built formula using econometric regression analysis, using PLEXOS to model prices. Also determined the DC pricing formula for four prior SEM years. Built original DC pricing model, as well as models that determined quantity of DCs that legacy utilities had to make available and that determined DC purchase eligibility of suppliers.

In a separate case with the CER in 2010, assisted CER in setting ESB PES's Price Control for the 2011-12 year, including a review and critique of PES's proposal for allowed revenue.

Validated CER/NIAUR's official PLEXOS model of the SEM against the first four months of actual market data. Updated PLEXOS model for 2008-2009 SEM year, including load, hydrological, and generator data.

For the Market Monitoring Unit (MMU) of the SEM, developed and built a custom interface between the SEM PLEXOS model and the MMU's database of market data.

In a separate case with the CER in 2008, assessed the reasonableness of a proposed rate adjustment for customers of ESB Customer Supply, including effects on individual rate classes.

In 2006/2007, built models to assist CER and NIAUR's development of market power mitigation in the new SEM, including an HHI model. Member of NERA team the helped design and implement a suite of market power mitigation measures.

Government of Peru, ICSID Case No. ARB/12/5, Isolux Corsán Concesiones S.A. v. Republic of Peru, 2013
This arbitration was submitted by the shareholder of claimant in ICSID ARB/11/9 (discussed below). For respondent, assessed claimant's economic and damages arguments related to the same transmission line from ARB/11/9 as well as claimant's unsuccessful bid for another line.

Government of Peru, ICSID Case No. ARB/11/9, Caravelí Cotaruse Transmisora de Energía S.A.C. v. Republic of Peru, 2011-2012
For respondent, assessed the economic and damages arguments, and damages calculation, of company with a transmission concession contract in a dispute with the Government over payments in the contract. Assisted in drafting of expert report.

[International Arbitration, SIAC], 2010
For claimant, modeled damages in Pakistan power-plant breach-of-warranties international arbitration. Gained detailed knowledge of Pakistani power sector. Assisted in drafting of expert report. Critiqued other side's damages expert.

Hydro Quebec, 2010
For client, helped complete multi-jurisdictional review of how North America transmission systems use tariffs to fund system expansions.

Government of Dominican Republic, International Arbitration, 2008-2009
For respondent, critiqued claimant's damages claim in an international arbitration of alleged loss of equity value in a local distribution company.

Baltimore Gas and Electric (BGE), 2007-2008; and Allegheny Power, 2008
Stochastically modeled the expected average power purchase costs over a 10-year horizon, and the uncertainty around those averages, that these PJM load serving entities would face under different power procurement strategies (full requirements vs. various portfolio buying strategies). Used a random walk based on historic volatilities to model forward price movement. Modeled spot price volatility with a custom NERA Risk Model I built based on regression analysis of PJM spot prices.

Government of Peru, ICSID Case No. ARB/03/25 (Aguaytia Energy LLC v Government of the Republic of Peru), 2007-2008
For respondent, critiqued and corrected damages calculation of claimant's expert to support rebuttal testimony for client in dispute over transmission revenues. Assisted in drafting two expert reports.

Customers of US Natural Gas Retailer, 2007-2008
Built model to value damages in case that alleged natural gas was sold to clients at below market prices. Helped draft testimony.

Public Intervenor, New Brunswick, Canada, 2007
Built stacking model of New Brunswick power system to estimate changes in local distribution company's power supply costs that would result from a change from a non-dispatchable IPP contract to a dispatchable IPP contract.

ComEd, 2007
Assessed potential market exposure risk for US utility under various considered power procurement strategies, utilizing spot price covariance analysis and historical load uncertainty.

[Russian Electricity Company], 2006-2007
Built financial model to help client evaluate the financial impact of client's proposed new generating stations and proposed replacements of existing capacity. Integrated energy and capacity price output of NERA's custom model of the restructuring Russian power market into financial model. Tutored client in how to run the Russian power market model and financial model.

[North American Energy Company], 2006
Calculated damages to support testimony in a breach-of-contract case. Modeled client's lost revenues from the output of a small hydro facility over the would-be remaining lifetime of its long-term contract, which had been rejected by power buyer mid-contract.

[Legal Defense Team], 2006
Provided economic and financial analysis to support the legal defense team of defendant in energy trading case.

PG&E, 2005-2006
Used a resource stacking model to evaluate and critiqued the tens of millions of dollars claimed by a western utility as offsets to its refund obligation to the buyers of power during the California Energy Crisis, in support of testimony before the FERC on behalf of PG&E and other California Parties. Assisted in the writing of testimony.

[EPC Contractor], 2005
Analyzed a co-generation power plant's historical operational and billing data – identifying and correcting errors and inconsistencies in the data – as part of overall modeling effort to assess delay and performance damages allegedly-owed by EPC Contractor. Produced customized regional gas price forecast.

Kansas City Power & Light (KCPL), 2003-2004
Calculated damages, on behalf of plaintiff, due to coal power plant being offline due to partial explosion. Built a custom KCPL-system-wide stacking model to calculate effect on KCPL's forward looking power costs. Evaluated and critiqued defendant's modeling efforts, which were based on PROMOD and COUGAR.

PG&E (DWR Revenue Requirement), 2002-2003
For NERA testimony in the Superior Court of California (Sacramento), assessed the modeling and other information relied upon by the California Department of Water Resources (DWR) for its revenue requirement submission, examining the just and reasonableness of that submission.

PP&L, 2002-2003
Modeled the unbundled power costs that PP&L customers from various service classes would have faced upon entering into power contracts at various points in past. Modeling supported

PP&L (before the federal antitrust authorities) in defense of their activities in PJM's installed capacity market.

Entergy Corporation, 2002
Produced estimates of the additional energy costs that New York consumers would face if the Indian Point nuclear plant were shut down, for a NERA/GE-MAPS study commissioned by Entergy Corp.

PG&E (Refund), 2001-2002
For testimony before the FERC on behalf of PG&E and the California Parties, calculated damages to buyers in the California realtime electricity market allegedly owed by power sellers as a result of price manipulation during the California energy crisis.

PG&E (Benchmarking), 2001-2002
For testimony before the FERC, built model that benchmarked PG&E's proposed power supply contract between affiliates against other contracts available in the market, as part of a potential restructuring of PG&E.

[Eastern US Utility], 2001-2002
Built electricity price-volatility forecasting model to assist client in estimating the potential financial risk of participating in a multi-billion dollar Basic Generation Services (BGS) auction.

[Southeastern US Utility], 2001
Built, managed, and analyzed database on the southeastern US electricity market for NERA study of the competitiveness of utility if the region restructured its electricity markets.

[Western European Energy Company], 2001
Analyzed the US electricity market, and in particular western US markets, for NERA report that advised client on investment opportunities in the United States.

[East Asian Energy Company], 2000
Projected future production levels and O&M and capital costs for all US nuclear power plants, and used that information to estimate value of each plant as part of a NERA report for client on the US Nuclear Power industry.

Reports and Publications

"Could Mexico's capacity market design lead to gaming by generators?", The Electricity Journal, Volume 32, Issue 2, March 2019 (with Kurt Strunk)

"Validation Report for I-SEM PLEXOS Model, 2018-2023", Prepared for CRU / UREGNI, 21 November 2018 (with Jonathan Rush, Kurt Strunk, Jonathan Falk)

"An Economic Assessment of Contracts, Requests for Contract Reform, and Damages in International Arbitration" (with Bastian Gottschling), chapter in "The Use of Economics in International Trade and Investment Disputes", Theresa Carpenter, Marion Jansen, and Joost

Pauwelyn (Editors), Cambridge University Press, 2017

"Beyond net metering: A model for pricing services provided by and to distributed generation owners", The Electricity Journal, Volume 30, Issue 3, April 2017 (with Kurt Strunk)

"Getting Ready for Competition in Japan, Lessons from Abroad", Public Utilities Fortnightly, October 2016 (with Robert Southern, Glenn George, and Sean Gammons)

"Independent Study to Establish Parameters of the ICAP Demand Curve for the New York Independent System Operator", August 2, 2013 (with Eugene Meehan, Jonathan Falk, Anthony Schmitz, Christopher Ungate, Laura J. Schwer, Thomas J. Muszalski , Jeffrey M. Cobb, John Wroble, and Richard W. Knoebel)

"Evaluation of Longer-Term Procurement Plans", Prepared for Allegheny Power and Baltimore Gas & Electric, October 1, 2008 (with Eugene Meehan, Kurt Strunk, Kushal Patel, Mark LeBel, Funto Phillips)

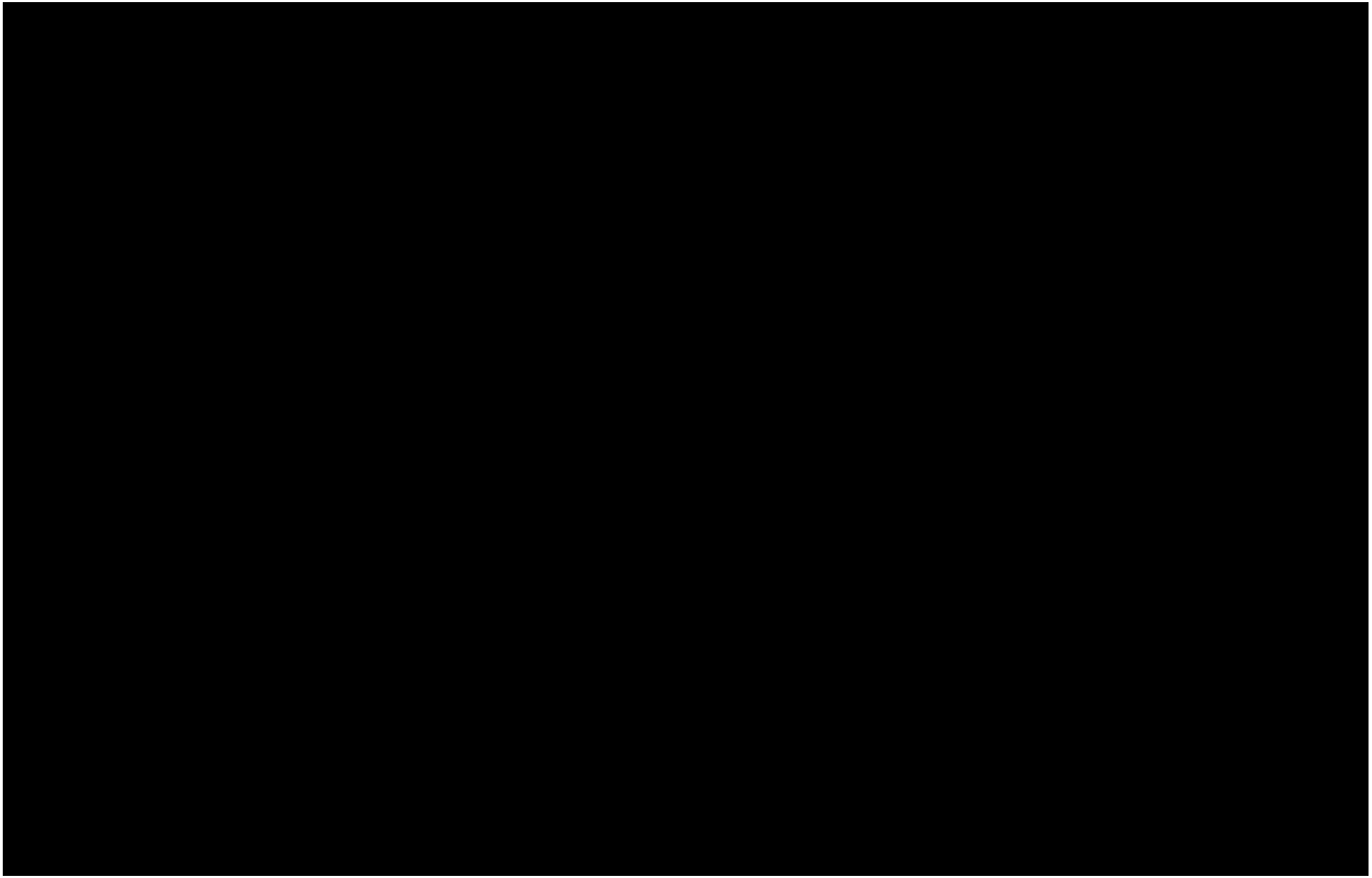
"Market Simulation Data & Model Validation Final Report", Prepared for the Commission for Energy Regulation and the Northern Ireland Authority for Utility Regulation, 13 May 2008 (with Eugene Meehan and Hamish Fraser)

Presentations

"Capacity Market Design in Mexico and Other Markets, Incentives to Exercise Market Power", CRRI's 37th Annual Eastern Conference: Advanced Workshop on Regulation and Competition, 6-8 June 2018, Ellicott City, Maryland

"Net Metering: Benefit-Cost Studies and Policy Options for DG [Distributed Generation] Solar.", CRRI's 2017-2018 Advanced Workshop on Regulation and Competition in Network Industries, 12 January 2018, Newark, NJ

"Power Industry Transformation: How Fast is it Happening and Gaining Force?", Infocast's Projects & Money 2015, New Orleans, LA, January 13, 2015



Proposal to serve as expert witness on productivity factor and performance-based regulation for Boston Gas Company and Colonial Gas Company

prepared for National Grid by London Economics International LLC

May 7, 2020

London Economics International LLC ("LEI") is pleased to submit this proposal to National Grid (the "Company") to serve as its Expert Witness to its Massachusetts operating company affiliates, Boston Gas Company and Colonial Gas Company, (jointly the "MA Gas Companies" or "MAGAS") in the area of performance-based ratemaking ("PBR") methods in anticipation of a base distribution rate filing in late 20200. LEI is a leading international firm that has advised regulators, electric and natural gas utilities, and specific customer classes for over 20 years worldwide on PBR, cost of service and rate design methodologies. LEI is particularly qualified for this engagement, given its numerous past projects advising utilities and strategizing on their PBR plans (design and components). Also, LEI has considerable expertise in having conducted several Total Factor Productivity ("TFP"), Input Pricing ("IP"), and benchmarking studies and follow-up testimony to defend its findings in various rate case engagements. Most recently, LEI has been working with another Massachusetts-based gas local distribution company ("LDC"), NSTAR Gas, on its PBR plan. LEI, therefore, has a reliable and extensive database from which to prepare the studies being requested by the Company. Finally, LEI's team consists of highly educated and experienced professionals that will be dedicated to delivering thorough, articulate, and meaningful results for National Grid on time and within budget. This proposal lays out LEI's qualifications and proposed plan and budget to address the Scope of Work described in the RPP.

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1 Executive Summary

National Grid (the "Company" or the "MA Gas Companies") is considering proposing a PBR rate design modeled on the same principles as approved recently for electric operations in Massachusetts, as referenced in the Massachusetts Department of Public Utilities' ("MADPU's" or "the Department's") directive in D.P.U. 18-150. LEI is submitting this proposal to serve as the consultant to perform and defend the total factor productivity ("TFP") study, Input Pricing ("IP") and the Benchmarking study; provide support and guidance in developing capital recovery and efficiency carryover mechanisms; and serve as expert witness on key elements of the PBR rate design, namely the X factor (based on the TFP study, IP, and benchmarking study), I factor (based on the Input Pricing study), and other relevant PBR components to be developed by LEI.

LEI's services offer:

- Deep understanding of ratemaking and PBR in particular
- Has worked with a large number of both electric and gas utilities in their PBR submissions and provided expert testimony in all of these engagements
- Has US and Northeast gas LDC database for total factor productivity ("TFP") and benchmarking analyses
- Extensive experience testifying before the MADPU and other regulatory agencies
- LEI has reviewed and critiqued the recent work of other consultants that have performed electric and gas distribution TFP studies
- Extensive experience in managing large scale projects, with several moving pieces
- Very familiar with North American natural gas markets, and the Massachusetts regulatory framework

LEI is a global economic, financial, and strategic advisory professional services firm specializing in energy and infrastructure. The firm combines a detailed understanding of specific network and commodity industries, such as electricity generation, transmission, and electric and gas local distribution, with sophisticated analysis and a suite of proprietary quantitative models to produce reliable and understandable results. The firm's roots stem from the initial round of privatization of electricity, gas, and water companies in the UK in the late 1980s. Since then, LEI has advised private sector clients, market institutions, and government on policy initiatives, market and tariff design, asset valuation, market power, and strategy in virtually all deregulated markets worldwide. Figure 1 shows a sample of the local and global clients that we had supported and worked with in recent years.

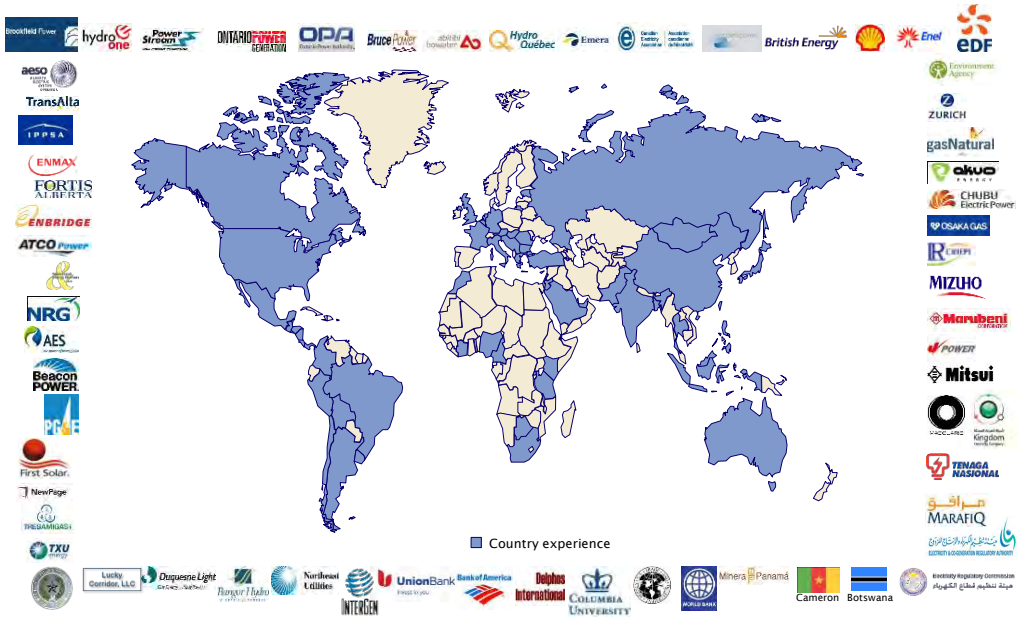
LEI is active across the gas transmission and distribution sector and has a comprehensive understanding of the issues faced by utilities and regulators alike. LEI's gas-related areas of expertise include regulatory economics, performance-based ratemaking ("PBR"), and market design; expert testimony and litigation consulting; gas distribution advisory; and asset valuation and price forecasting. LEI has also advised gas utilities in a variety of jurisdictions, provided an analysis of potential market opportunities, examined pipeline expansion plans and other gas commodity-related issues, supported rate design filings, authored reviews of gas distribution regulatory frameworks including incentive-based ratemaking, among other issues.

The following attributes make LEI unique:

- ***clear, readable deliverables*** grounded in substantial topical and quantitative evidence

- ***extensive experience in regulatory filings*** provides expertise to advise on network tariffs and design rates under PBR
- ***a wealth of knowledge of energy and infrastructure regulation*** worldwide to provide expert testimony services on regulatory best practices and innovation
- ***balance of private sector and governmental clients*** enables us to advise both regarding the impact of regulatory initiatives on private investment and the extent of possible regulatory responses to individual firm actions
- ***A Boston-based firm*** with in-depth knowledge of MA policies and regional issues.

Figure 1. Selected LEI clients throughout the world



LEI has also included a high-caliber expert in the field of productivity analysis and performance-based rate design on its team –Dr. John Fallon. Dr. Fallon has extensive experience working with various regulators such as the Australian Competition and Consumer Commission, Queensland Competition Authority, and Commerce Commission of New Zealand. He has advised and acted as an expert witness on a wide range of economic regulation and governance matters. He has also authored seminal studies and reports on pricing principles and pricing methodologies. Dr. Fallon has repeatedly worked with LEI on PBR-related engagements around the world, including advising on local gas distribution PBR plans for utilities in the US and Canada. His role will be that of advisor (not testifying witness) in this engagement.

1.1 Understanding of the assignment

National Grid, in its scope of work, states that it will be required to perform a total productivity study and input pricing study and benchmarking study in the US and the Northeast region for its distribution rate case. It is also expecting that the consultant will provide support in testimony to both the findings of the studies and the general advantages of the PBR plan in helping the Company to meet its obligations to customers at a reasonable cost.

LEI understands that National Grid is considering proposing a PBR plan modeled on the same principles as approved recently for electric operations in Massachusetts, as referenced in MADPU's directive in D.P.U. 18-150, the Order Establishing National Grid's Revenue Requirement. LEI is very familiar with this rate case, having monitored the key aspects of this rate case while working with another Massachusetts-based LDC that was about to file its PBR plan. LEI understands the Department found that the TFP Study submitted on behalf of National Grid's electric LDC on the whole was acceptable, and that provided the foundation for getting National Grid's electric PBR plan approved by the Department. That TFP study was based on the following key parameters:

- 15-year period from 2002-2016;
- national sample of 66 electric distribution companies; and
- capital cost specification method based on the one hoss shay method.

On the number of years used for the TFP time period, the Department stated that "a well-designed PBR should be of sufficient duration to give the plan enough time to achieve its goals and to provide utilities with the appropriate economic incentives and certainty to follow through with medium- and long-term strategic business decisions."[1] With regards to the sample size, the Department stated that "while generally speaking, a larger sample size of companies is more representative of the industry, we find that the Company's sample of national electric distribution companies is of sufficient size to be representative of the industry for the purpose of determining the X factor."[2] The Department also had no issues with the use of the one hoss shay method utilized by National Grid.

LEI will follow the principles outline in the Department's decision-making in D.P.U. 18-150 when designing and implementing the TFP Study for the MA Gas Companies. LEI already has an extensive gas LDC database ready for the US and the Northeast region, that can be leveraged in this engagement with the MA Gas Companies. Currently, it has a 15-year period from 2003-2017[3]

[1] DPU-18-150. P. 55.

[2] D.P.U.18-150. P. 58.

[3] The dataset will need to be updated to include 2018 and 2019 data, if available. However, the effort involved in such updates in incremental and not as significant as creating a completely new database. Such synergies have been considered in LEI's cost proposal.

and a national sample of 83 gas LDCs and Northeast Region sample of 29 gas LDCs. The model also uses the one hoss shay method to determine its capital inputs.

For the purposes of the Benchmarking Study, LEI can apply the methodology used in D.P.U. 18-150 (using unit cost and TFP level index values) or an econometric total cost study approach, which LEI has leveraged in its ongoing work with NSTAR Gas. Both methods rely on the same underlying data and have been found to be acceptable measures of relative efficiency by regulators in other jurisdictions. The ultimate purpose of a total cost benchmarking study is to be able to compare an LDC's actual costs to its predicted cost, given input prices, the size of the LDC, and key business drivers. In an approach relying on comparison of index values, controlling for business conditions and other distinguishing factors between LDCs would require careful identification of peers in advance. On the other hand, in an econometrics study, those business drivers and other factors can be controlled through statistical techniques. In either case, LEI is confident that it would be able to deploy a rigorous methodology to produce a robust Benchmarking study for the MA Gas Companies.

LEI also acknowledges that there are challenges that gas utilities are facing in the coming years that were not present in the historical data that is used as the foundation for the empricial analysis underpinning the TFP study and Benchmarking study. For exmaple, the gas LDC industry is expecting to see stricter safety requirements (imposed through legislation and regulations) as a result of the Merrimack Valley incident. LEI understands that utilities and regulators are re-evaluating safety standards, practices, and procedures to enhance the safety and reliability of the natural gas distribution system. Such requirements will raise the costs of service. In addition, Massachusetts implemented decoupling to remove barriers to distribution companies' pursuit of energy efficiency. The expansion of energy efficiency is eroding the growth in sales volumes of gas utilities in the State, which will have implcaitions on achievable TFP growth in the future. Lastly, the aging infrastructure in the State requires increased levels of capital and operating expenditures. The increased capital investment may not be fully consistent with the "steady state" implcit in the empirical consdierations around the X factor. The Department has also stated that it would consider company-specific proposals to adjust target revenues to account for capital spending and/or inflation.[4] LEI is well-prepared to advise on these issues, given similar fact patterns have been prominently discussed in other jurisdictions as well.

1.1 About LEI

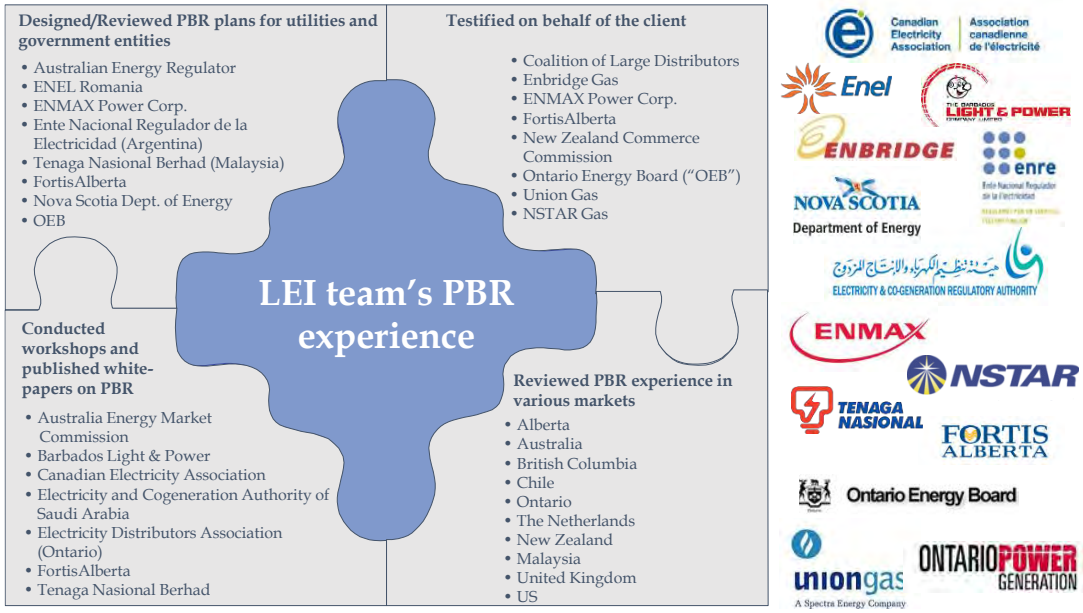
LEI is well qualified to work with MA Gas Companies on preparing a TFP, input pricing, and cost benchmarking studies that speak to the same elements that the Department found commendable and acceptable for purposes of ratemaking in prior PBR rate cases. LEI is also

[4] DPU 07-50-A at 50 states "[W]e will consider company-specific ratemaking proposals that account for: (1) the impact of capital spending on a company's required revenue target; and (2) the inflationary pressures with respect to the prices of goods and services used by distribution companies. We recognize that circumstances will vary from company to company and, as such, we will permit a certain amount of flexibility when establishing a revenue requirement for a distribution company. Such ratemaking proposals could be similar in structure to the PBR rate plans that most electric and gas companies have in place today. As always, such proposals must be fully supported, and the distribution company will have the burden of proof to demonstrate the reasonableness of its proposal."

equipped to prepare analysis and author expert testimony that supports the use of these empirical findings within a PBR plan.

PBR is an area that the LEI team has specialized in with respect to regulatory design. LEI has extensively studied regulatory regimes involving PBR and advised utilities, regulators, and investors on best practices with respect to the design of PBR formula and implementation. In some of LEI's work, we have advised on how PBR implementation may affect consumers, while in other engagements, we have focused on implications for regulated utilities and regulators. That work has exposed LEI to various forms of PBR and the technical studies that regulators and utilities use to calibrate the trajectory of future rates, consider investment needs and align the incentives of customers, the regulated utility, and the regulator.

Figure 2. Sample PBR clients



LEI is also very familiar with the evaluation of productivity trends and the development of TFP studies. LEI has examined TFP trends in electric transmission, distribution, and generation sectors and gas distribution. LEI also has advised utilities on the appropriate inflation factor and the reasonableness of stretch factors/consumer dividends as well as other features of PBR such as earnings sharing mechanisms, efficiency carryover schemes, and capital trackers. LEI has advised on the formulaic approach of an "I-X" application and have studied the building-blocks approach historically applied in the United Kingdom ("UK") and Australia, as well as the "RIIO" model currently adopted in the UK.

LEI team members have also testified before several regulators in various aspects of rate design, and PBR specifically. Some of the LEI team members have served as an expert witness in a number of Canadian jurisdictions that have applied PBR to regulated electric and gas utilities. These include the Ontario Energy Board (on behalf of the Coalition of Large Distributors, Ontario Power Generation, Enbridge Gas, and Union Gas) and Alberta Utilities Commission (on behalf

of FortisAlberta and ENMAX). Figure 2 above illustrates LEI's extensive client portfolio and engagements, while Section 2 provides a sample of LEI's previous projects relevant to this engagement. LEI has provided references in Section 1.1 below.

1.1 Selected references

Below are references from utilities for which LEI provided similar services:

Company: NSTAR Gas
Name/Title: Douglas Horton
Phone number/Email: Douglas.Horton@eversource.com

Company: Enbridge Gas Distribution
Name/Title: Michael Lister/Sr. Manager, Regulatory Policy & Proceedings
Phone number/Email: (416) 495-5043/michael.lister@enbridge.com

Company: FortisAlberta
Name/Title: Jennifer Walsh/Director, Regulatory and Corporate Planning
Phone number/Email: (403) 514-4128/jennifer.walsh@fortisalberta.com

Company: Ontario Power Generation
Name/Title: Lindsey Arseneau-MacKinnon/Director, Regulatory Research and Analysis, Regulatory Affairs
Email: lindsey.arseneau@opg.com

Company: Tenaga Nasional Berhad (Malaysia)
Name/Title: Ahmad Lutfi bin Mohayiddin/Regulatory Economics Department
Phone number/Email: +6017-370 9608/ahmadlutfi@tnb.com.my

Company: TransAlta Corporation
Name/Title: Marcy Cochlan/Director, Market Regulation
Phone number/Email: (403)267-3663/marcy_cochlan@transalta.com

2 Sample of relevant experience

This section provides a selection of projects relevant to the present engagement. LEI has advised in natural gas and electricity market engagements for both public and private clients worldwide. Moreover, LEI has extensive knowledge of the natural gas and electricity market in New England. Finally, LEI has performed a broad range of regulatory services for various utilities around the world, including providing regulatory support pertaining to rate cases, TFP studies, and benchmarking analyses over the last two decades. For specific project experience performed by each team member, please see the full resumes in Section 5.

2.1 Advisory on PBR submission and rate case strategy

- ***Advised NSTAR Gas on its PBR filing:*** LEI supported NSTAR Gas in its PBR filing for the 2021-2025 regulatory term. More specifically, LEI performed a TFP study to determine the X factor that will be used for the PBR plan. LEI also conducted a benchmarking study to assess the empirical basis for a consumer dividend. In addition, LEI advised NSTAR Gas on the Gas Systems Enhancement Plan, and capital arrangements and discussed the benefits of PBR for consumers. Finally, LEI will serve as an expert witness on the PBR piece.

- ***Advised Ontario Power Generation rate case:*** LEI advised OPG on the different PBR structure, how the I-X should be applied (revenue vs. price cap), the overlap of PBR with other incentives, functional application to variance accounts, and provided recommendations on the inflation factor of choice.

- ***Analysis of productivity trends for hydroelectric generation and applicability of a TFP-derived X-factor and composite I-factor to performance-based ratemaking of OPG's hydroelectric business:*** LEI was engaged by Ontario Power Generation ("OPG") to prepare a report for OPG entitled "Empirical Analysis of Total Factor Productivity Trends in the North American Hydroelectric Generation Industry." The purpose of this report was to share findings from LEI's TFP study, which estimated TFP trends for a select group of peers from the North American hydroelectric generation industry. Completed in December 2014, data for this study covered an eleven-year period from 2002-2012. LEI updated this report in February 2016, to cover a thirteen-year period from 2002-2014. LEI's report was filed as part of OPG's application for orders approving payment amounts for its prescribed generating facilities. In the course of this engagement, LEI provided a review and critique evidence submitted by Board Staff and other intervenors. LEI testified before the OEB in 1Q 2017 presenting and defending the findings of its report. [EB-2016-0152]

- ***Advised Enbridge Gas Distribution Inc on its IRM rate filing:*** LEI performed a review and analysis of ratemaking approaches applied to the client's capital expenditure profile, including a demonstration of the potential negative impact of "I-X" ratemaking approaches on a utility's ability to earn a fair return. The objective of this engagement will be to demonstrate to stakeholders and the Ontario Energy Board the reasonableness of the revenue cap per customer model that the client has previously relied upon and planned to propose in its next ratemaking review Furthermore, the secondary objective was to conceptualize the insufficiency of the "I-X" regime, even with a revenue cap per customer model, in consideration of the fair return standard and given the client's business is operating in an

environment where substantial capital expenditure needs are projected over the next Incentive Regulation Plan ("IRP") period. Docket Number EB 2012-0459

- ***Advised Union Gas on its IRM filing:*** LEI was engaged by Union Gas to review Union Gas' proposed 2014 to 2018 incentive ratemaking ("IR") plan as presented to stakeholders on April 29th, 2013 and to examine case studies of approaches to IR applied to other North American gas distribution utilities. In the case study analysis, Union particularly requested LEI to investigate approaches to a set list of ratemaking parameters: productivity and X-factor trends, alternative approaches to designing an I-X framework, approaches to establishing inflation factors, approaches in other jurisdictions to applying an Earnings Sharing Mechanism ("ESM"), use of capital trackers for unknown costs, appropriateness of deferral accounts for unaccounted-for gas, and service quality indicators and how they are measured. LEI was subsequently requested by Union to provide comments on Union's draft Settlement Agreement.

- ***Advised the Ontario Energy Board on PBR of electricity distributors***. The project involved performance measurement of Ontario's almost 200 distributors and setting of efficiency improvement targets for use in the next round of CPI-X regulation *(Economic Insights Pty Ltd)*

- ***Advised FortisAlberta on its first PBR submission:*** LEI advised FortisAlberta Inc., a Canadian electricity utility, in its filing for a PBR plan. LEI advised on the underpinning PBR economic theory and reviewed best practices in various North American and International jurisdictions. LEI also guided each of the multiple components of the PBR plan that is being proposed by FortisAlberta, Inc.

- ***Formula-based regulation transmission tariff re-opener filing support for an Alberta network service provider:*** LEI prepared a paper to support to the ENMAX Power Corporation's transmission FBR reopener application. In particular, the client wanted LEI to support their argument (i) to amend the G factor calculation to eliminate the G-factor lag effective January 1, 2011, and (ii) to reduce EPC's current X-factor of 1.2% to 0.0%. LEI provided support throughout the whole litigation proceeding by responding to information requests which involved additional research and analysis, including synthesis of publications on recent technological advances in the electricity transmission sector, and updating the Ontario LDCs TFP model to ten years.

- ***Designing IR strategy for Canada's largest independent electricity transmission company:*** LEI designed a regulatory strategy for its interaction with the relevant provincial utilities board regarding IR methods. LEI utilized the capital asset pricing model (CAPM) to independently develop a range of ROEs and suggested an "earnings sharing" (shared savings) approach to rate design based on the need to demonstrate a transition to incentive rates while maintaining simplicity and predictability in rate design. LEI also facilitated a workshop on how to dovetail company attributes with the type of IR advocated for, on specific examples of areas of cost declines because of incentive regulation, and on the impact of performance standards for transmission companies.

- ***Advising on IBR filing and review of the Malaysian electricity regulatory framework:*** LEI was engaged by TNB in Malaysia to work as the project manager of its Incentive-Based

Regulation submission for the 2nd regulatory term. LEI's role in this project includes two phases. In phase 1, LEI's role includes advising on the policy and governance framework for the implementation of IBR, providing strategic advice to IBR Council and TNB management regarding the IBR submission, managing and monitoring the submission process, coordinating with business entities and attending IBR Council meetings, progress meetings, and challenge workshops. Furthermore, LEI reviewed the current Regulatory Implementation Guidelines ("RIGs") set by the Energy Commission and proposed enhancements to the RIGs. LEI was also in the process of negotiation with the Energy Commission regarding proposed changes to the RIGs. LEI was also responsible for reviewing and providing an enhancement to the Revenue Requirement Model, which sets the IBR tariff for each business entity. In addition, LEI was also co-drafting the IBR submission report with TNB and will review the final IBR report before the submission. In phase 2, LEI will be working with TNB to participate in the negotiation of the IBR framework and tariff with the Energy Commission.

- ***Review of gas distribution IR regimes across North American jurisdictions:*** LEI was engaged by Union Gas to review Union's proposed 2014 to 2018 incentive ratemaking ("IR") plan as presented to stakeholders on April 29th, 2013 and to examine case studies of approaches to IR applied to other North American gas distribution utilities. In the case study analysis, Union particularly requested LEI to explore approaches to a set list of ratemaking parameters: productivity and X-factor trends, alternative approaches to designing an I-X framework, approaches to establishing inflation factors, approaches in other jurisdictions to applying an Earnings Sharing Mechanism, use of capital trackers for unknown costs, appropriateness of deferral accounts for unaccounted-for gas, and service quality indicators and how they are measured. LEI was subsequently requested by Union to provide comments on Union's draft Settlement Agreement.

2.2 Reviewed PBR rate design

- ***Review of IBR tariff-setting regimes in the UK, Australia, and the Netherlands***: LEI prepared a white paper on the comparative advantages and drawbacks of various tariff-setting regimes, from performance-based regimes to cost-of-service. This project involved a general overview of tariff-setting practices across Canadian provinces as well as highly detailed Canadian and international case studies and an examination of the key lessons to be learned from each case. Detailed case studies covered the tariff-setting regimes in place in the UK, the Australian National Electricity Market, and the Netherlands. As part of its deliverables, two workshops were conducted with a variety of regulators and utilities.
- ***IBR project management:*** LEI was retained by the largest electric utility company in Malaysia to provide project management services for the client's 2nd regulatory period ("RP2") performance-based regulation ("PBR") (2018-2020) submission. LEI's scope of work consists of several tasks: propose the policy and governance framework for the PBR submission; provide detailed project plan; assess the PBR Regulatory Requirement Model; ensure accuracy and timely delivery of RP2 submission workshops and; review of overall RP2 report.
- ***Applicability of PBR to OPG:*** LEI was engaged by Ontario Power Generation ("OPG") to support senior management through regulatory processes related to performance-based rates. LEI prepared a discussion paper on incentive regulation mechanisms currently in place

in Ontario for electricity and natural gas distribution utilities and presented it at a technical workshop at the Ontario Energy Board. LEI also provided expert testimony regarding the cost of capital and risk factors associated with OPG's prescribed assets, as well as creating a risk-return continuum on which power sector assets could be placed. LEI continues to support OPG as it moves to consider its next generation of rates.

- ***PBR review for Caribbean utility***: LEI was retained by a power utility in the Caribbean to perform an intensive study of the types of PBR employed by regulators worldwide and the implications for key stakeholders, culminating in workshops for the regulator, utility managers, and government representatives. Key issues covered in LEI's analysis included the tradeoffs between using RPI-X style formulations and revenue sharing techniques, accounting for the unique nature of island systems, impacts on employment, and calculation of an appropriate return on equity.

- ***IR case study:*** For the Nova Scotia Department of Energy, LEI prepared a comprehensive literature review report covering four key areas: (i) Global experience related to the electricity sector restructuring and liberalization, (ii) PBR – including discussion of various structures of PBR implemented globally and associated challenges, (iii) Performance and Accountability discussing performance monitoring and performance standard measures used in the generation, transmission, and distribution sectors, and (iv) Customer and Service Provider Risks addressing various risks and how these may be impacted or mitigated through the energy market and regulatory structures.

- ***Advised on operating expenditure incentives:*** LEI provided advice to the owner of two Jordanian power distribution companies in the principles behind incentive-based mechanisms for operating expenditure. LEI also provided a detailed analysis of earning sharing mechanisms, sharing savings mechanisms, price cap regulation, and experience in other jurisdictions.

2.3 Reviewed components of PBR

- ***Cap-ex recovery mechanisms used in Australia, New Zealand, Ontario, and the UK:*** For a Canadian client, LEI prepared a report that looks into the different capital expenditure recovery mechanisms utilized in four markets, namely Australia, New Zealand, Ontario, and the UK, for electric network utilities. The report also provided different options that the client can propose for its performance-based ratemaking filing.

- ***Advised on Hong Kong electricity regulatory regime:*** LEI was retained by the Hong Kong Special Administrative Region government to assess certain aspects of the Hong Kong regulatory regime for electricity, such as cost of capital, rate base calculations, efficiency incentives, and fuel cost pass through mechanisms, in order to help prepare the Government for negotiations with the utilities to change the regime after contracts' expiration.

- ***Prepared various reports related to PBR to the Commission:*** Reports on IBRs: For the Queensland Competition Authority, prepared reports on Incentive Regulation, Parameters for the Cost of Capital, the Split Cost of Capital, the Trailing Average Cost of Debt, Risk and the Form of Regulation, Financial Capital Maintenance, Depreciation and Price Smoothing,

Issues in the Application of Annuities in Economic Regulation, Regulatory Pricing Objectives and Principles, Capacity Expansion and Access Pricing (Dr. Fallon).

- ***Reviewed Manitoba cost of service methodology:*** LEI was retained by Hill Sokalski Walsh Olson to provide independent evidence to assist the Manitoba Public Utilities Board in understanding the views and positions of the general service small and general service medium ("GSS/GSM") customers in Manitoba Hydro's 2017/18 & 2018/19 general rate application ("GRA") proceeding. In a PUB letter dated September 15, 2017, the scope of LEI's role was expanded to include key issues for the Keystone Agricultural Producers. LEI's analysis included the impact of the proposed rate increases of GSS, GSM and agricultural ratepayers, Manitoba Hydro's capital plan, and a review of the utility's operating efficiencies and service quality.

- ***Malaysia PBR workshops:*** LEI was retained by the largest electric utility company in Malaysia to conduct a workshop on incentive-based ratemaking ("PBR"). The topics for the workshop include a theoretical, conceptual overview of PBR regulatory framework, key elements of comprehensive PBR regimes, best practices of PBR in various jurisdictions, timing and framework in other jurisdictions, how to convince regulators and stakeholders, identifying barriers to the successful implementation of the PBR, and moving from first to second generation PBR, to name a few. This workshop was conducted in Kuala Lumpur in 2014.

- ***Training workshop on WACC and optimal capital structure for Jordan distribution utilities:*** LEI provided training workshops for local staff on the weighted average cost of capital and optimal capital structure for Jordan's three distribution companies. The workshop included identifying salient risk factors for the distribution companies, identifying appropriate local and international metrics and benchmarks, developing a usable cost of capital model, and providing training workshops for local staff.

- ***Malaysia rate and productivity review:*** LEI was retained by the largest electric utility company in Malaysia, to conduct a workshop on IR. As part of the review, it surveyed productivity measures used worldwide and analyzed productivity measurement best-practice, including significant use of Ontario and Alberta as case studies. This workshop was conducted in Toronto, Canada in 2015.

2.4 Performed Total Factor Productivity study

- ***TFP study in support of NSTAR Gas' rate filing***: LEI performed a gas LDC industry TFP study for NSTAR Gas' PBR filing. LEI relied on the index method and used the chained Fisher Ideal index for calculating the trends in the TFP Study for the LDC industry. LEI's industry study was constructed based on the aggregation of data from 83 US LDCs. In addition, LEI also conducted a TFP for the Northeast regional LDC industry, which includes 29 LDCs.

- ***TFP study in support of IR filing:*** LEI provided supporting testimony for a Canadian electric utility in its filing for an IR plan. The testimony provided detailed data analysis (including inflation and TFP trends), underpinning IR economic theory, and reviews of best practices in various North American and international jurisdictions. The testimony offered backup

elements for each of the multiple components of the IR plan that was being proposed by FortisAlberta, Inc. LEI also responded to the information requests by interveners and advised the client on issues raised by these interveners.

- ***Constructed detailed total factor productivity model of the South Australian and Queensland gas distribution networks*** and assessed performance against the three Victorian gas distribution networks *(Economic Insights Pty Ltd)*

- ***Developed a productivity-based regulation framework*** that allows for the inclusion of both billed and non–billed functional outputs and allowed for the existence of sunk costs. The framework also allows for ex-ante financial capital maintenance *(Economic Insights Pty Ltd)*

- ***OPG Total Factor Productivity study 2013:*** LEI assisted the Ontario Power Generation in performing a productivity study on their hydroelectric assets to fulfill the mandate of the Ontario Energy Board ("OEB"). LEO proposed a structured approach to address how productivity should be measured, what methods are available, identify a peer relevant group, and ultimately provide the client with a productivity study for filing with the OEB.

- ***Analysis of productivity trends for hydroelectric generation and applicability of a TFP-derived X-factor and composite I-factor to performance-based ratemaking of OPG's hydroelectric business:*** LEI was engaged by Ontario Power Generation ("OPG") to prepare a report for OPG entitled "Empirical Analysis of Total Factor Productivity Trends in the North American Hydroelectric Generation Industry." The purpose of this report was to share findings from LEI's TFP study, which estimated TFP trends for a select group of peers from the North American hydroelectric generation industry. Completed in December 2014, data for this study covered an eleven-year period from 2002-2012. LEI updated this report in February 2016, to cover a thirteen-year period from 2002-2014. LEI's report was filed as part of OPG's application for orders approving payment amounts for its prescribed generating facilities. In the course of this engagement, LEI provided a review and critique evidence submitted by Board Staff and other intervenors. LEI testified before the OEB in 1Q 2017 presenting and defending the findings of its report. [EB-2016-0152]

- ***Design of Second Generation IR:*** LEI advised the Ontario Energy Board ("OEB") on the design of second-generation IR for electricity distribution companies. As part of the engagement, LEI examined methods of quantifying TFP, determined the appropriateness of yardstick competition models, identified service quality indicators, and explored the role of demand-side management. LEI also conducted extensive stakeholder interaction, built databases, advised on a final draft plan, and testified during associated regulatory proceedings.

- ***TFP analysis of Ontario distributors' performance and cost data:*** LEI has advised a Coalition of Large Distributors ("CLD") on key aspects of the incentive ratemaking framework and proceedings. As part of the engagement, LEI has analyzed the Total Factor Productivity study performed by the Board expert witness and has performed its own TFP analysis, including benchmarking the performance of the CLD members against the peers in Ontario and the US to support the CLD's position regarding the determination of the cohort group for stretch factor adjustments.

- ***Review of TFP report from NERA as part of LEI's advisory on Alberta's performance-based ratemaking:*** LEI reviewed a NERA report regarding total factor productivity and provided observations on the study. LEI ultimately determined that the NERA report and calculations have minimal relevance to the task of setting an ongoing X-factor for use in Formula Based Ratemaking ("FBR") in Alberta and that further research and calculations would be necessary.

- ***Presentation on the use of TFP in North America:*** LEI presented on the experience with TFP methods in the regulation of North American electric utilities (California, Canada, New England). Key messages include: the use of TFP is the exception, rather than the norm, for North America; where TFP is used, no agreed model exists for either analysis or the regulatory framework; hybrid models incorporating earnings sharing mechanisms often preferred; regulators struggle with the choice of relevant geographical regions and historical time periods for comparative analysis; on the wires side of the business, North American regulators have tended to be followers rather than leaders, with limited awareness of trends overseas.

2.5 Performed Econometric Benchmarking Study

- ***Econometric benchmarking analysis of gas distribution utility performance:*** LEI was engaged by NSTAR Gas to support its rate filing for PBR. LEI performed an econometric benchmarking analysis of utility performance in terms of O&M and capital costs. The econometric analysis used a transcendental logarithmic ("translog") cost function to help set expectations for further efficiency improvement, for use in the setting of the X- factor.

- ***Benchmarking analysis of hydroelectric facilities:*** LEI was engaged to support Ontario Power Generation in relation to its second-generation hydroelectric payment amounts price-cap application before the OEB. The project involved performing independent benchmarking analysis of OPG's regulated hydroelectric facilities. This project involved selecting an appropriate peer group, selection of appropriate metrics to be benchmarked, and model development. LEI also aided OPG in public consultations and the OEB regulatory process.

- ***Estimation of econometric and index number models*** for economic benchmarking of the efficiency of NSW, ACT and Queensland electricity distribution businesses' operating expenditure for the Australian Energy Regulator *(Economic Insights Pty Ltd)*

- ***Benchmarking study on the efficiency of electric and gas transmission operators:*** John Fallon co-led a team providing a series of reports to Netherlands Authority for Consumers and Markets on topics relating to benchmarking the efficiency of electricity and gas transmission system operators in Europe, including in relation to selecting cost drivers, estimating the cost of capital, choosing the modeling method and explaining the results. *(Economic Insights Pty Ltd)*

- ***Undertook initial economic benchmarking of Western Power's*** combined distribution and transmission network for the Western Australia Public Utilities Office *(Economic Insights Pty Ltd)*

- ***Econometric estimation*** of cost functions and productivity measures for benchmarking Australian, New Zealand, and US gas distribution businesses *(Economic Insights Pty Ltd)*

- ***Prepared a presentation regarding benchmarking in the distribution business:*** In this instance, LEI was retained by an industry advocacy group in the electricity industry to provide a presentation on the benchmarking regimes in the electricity industry, which included theory, application, and case studies.

- ***Performed corporate costs benchmarking for Ontario Power Generation ("OPG"):*** LEI performed an independent benchmarking assessment of OPG's corporate support costs. In addition to the independent benchmarking analysis, LEI supported OPG through the rate application process, in the preparation of evidence, and provision of expert testimony, supporting OPG in attaining its reasonable costs for the provision of corporate support services.

- ***Performed a benchmarking analysis for a major Australian investment bank:*** LEI was retained by a major Australian Investment bank to research embedded costs for electric distribution companies, which included benchmark analysis for Emera, Hydro One, and National Grid.

- ***Proposed a benchmarking method to arrive at a reasonable return margin for the Regulated Rate Option service providers:*** LEI provided an expert opinion regarding an appropriate return margin for the Regulated Rate Option service providers ("RSP"), which was filed with the Alberta Utilities Commission as evidence in the proceeding to review the RSPs' current energy price-setting plans ("EPSP"). LEI concluded that a reasonable return margin could be established using a benchmarking method and that competitive electricity retailers in Alberta were the most appropriate peer set against which to benchmark RRO returns. LEI recommended a comprehensive return margin, expressed in $/MWh, calculated using the average competitive retailer markup as a base and adjusting for customer acquisition costs.

- ***Utilizing benchmarking analysis for the cost of capital and capital structure analysis:*** LEI advised Jordan's power regulator on the weighted average cost of capital and optimal capital structure for the country's three distribution companies: EDCO, IDECO, and JEPCO. LEI's work included identifying salient risk factors for the distribution companies, identifying appropriate local and international metrics and benchmarks, developing a usable cost of the capital model, and providing training workshops for local staff. The recommended optimal capital structure was consistent with targeted debt service and interest coverage ratios in line with the rating methodology for distribution companies from the global credit rating agencies.

2.6 Served as Expert Witness

- ***Provided expert witness services to NSTAR Gas in its 2019 application to move to PBR***: LEI's testimony provided expert technical analysis for NSTAR Gas performance-based ratemaking plan. More specifically, LEI presented a total factor productivity study as the basis for the X factor that NSTAR Gas used for its "I-X" rate escalation mechanism, and the results of a total cost benchmarking study, which estimated the Company's efficiency level relative to its peers.

LEI also responded to the information requests by interveners and advised the client on issues raised by these interveners.

- ***Testimony on using building blocks approach in IR frameworks:*** LEI was engaged by Enbridge Gas Distribution to provide an analysis of building block incentive ratemaking approaches used in Australia and the UK, and how they would apply to Enbridge's circumstances in Ontario. LEI's report supported Enbridge's distribution tariff proposal submission to the Ontario Energy Board for a second-generation Customized Incentive Regulation ("IR") plan for five years (2014-2018). The testimony set out the theory behind as well as the practical experience of using the building blocks approach in incentive regulation regimes.

- ***Expert testimony on behalf of FortisAlberta in its filing for a first generation PBR plan (2012)***: LEI's testimony provided detailed data analysis (including inflation and TFP trends), underpinning PBR economic theory, and reviews of best practices in various North American and International jurisdictions. The testimony offered backup elements for each of the various components of the PBR plan that is being proposed by FortisAlberta, Inc. LEI also responded to the information requests by interveners and advised the client on issues raised by these interveners.

- ***Provided expert testimony in support of ENMAX's filing for a formula-based tariff-setting scheme***: LEI developed a formula for ENMAX for periodic adjustments to an average tariff metric based on an inflation factor, efficiency factor, the impact of capital investments, operational performance relative to defined metrics. The work defined mechanisms for additional adjustments based on force majeure and financial performance outside a defined range. LEI also provided strategic advice to the CEO and other senior managers on presenting the firm's proposal to the regulator and other stakeholders and provided expert testimony in support of the firm's filing to its regulator.

- ***Testimony in support of transmission operating rules and curtailment protocols:*** LEI Managing Director Julia Frayer provided testimony in support of transmission operating rules and curtailment protocols for interties into Alberta, as proposed by the Alberta Electricity System Operator, to support a fair, efficient and openly competitive power market. The testimony was made in front of the Alberta Utilities Commission ("AUC"), on behalf of Morgan Stanley Capital Group ("MSCG"), a customer of the Montana-Alberta Transmission Line. Julia's analysis considered commercial as well as operating protocols in deregulated power markets and considers how market rules incentivize new entry and produce dynamic efficiency gains related to more intense competition The AUC issued a favorable decision to MSCG in early 2013.

- ***White paper and market analysis on proposed market power tests in Alberta:*** In response to government-proposed policies on what defined a "fair, efficient, and openly competitive" market, LEI prepared for the Alberta provincial government a detailed white paper and market analysis on the proposed market power tests to be added to regulation, and specifically demonstrating the adverse effects of the 20% hard cap market share limit proposed by the province's Department of Energy ("DOE"). The white paper was filed as testimony with the DOE in their consultation on Section 6 of the Electric Utilities Act.

- ***Cost of capital for regulated generating assets:*** LEI provided expert testimony on behalf of the Ontario Energy Board regarding the cost of capital and risk factors associated with OPG's prescribed assets, as well as creating a risk-return continuum on which power sector assets could be placed.

- ***Review of cost-of-service rate and impact on electricity trade:*** As part of Hydro-Quebec TransÉnergie's rate application to Quebec Province's power industry regulator, LEI submitted evidence and testified on behalf of Brascan Power regarding demand elasticity of transmission services and market-based mechanisms for optimizing usage of transmission assets.

- ***Design of self-funding tariff:*** LEI provided support for ISO New England throughout the design and submission to FERC of ISO New England's self-funding tariff. LEI first defined the basic underlying economic principles for specifying the tariff, then undertook to show how the tariff should be applied to various system users. The engagement involved an intensive financial modeling effort, frequent interaction with stakeholders, and written testimony before FERC.

3 Methodology and technical approach

The team has reviewed the RFP closely and will manage the project based on a work plan composed of eleven tasks shown in Figure 3 below. Collectively, the tasks address all of the items enumerated in the RFP's scope of proposed work. Additional (optional) tasks are described for National Grid's consideration in Section 3.11. LEI categorizes the work into two project phases. The first phase involves advising on the rate case strategy, conducting a TFP and IP study and benchmarking analysis, providing guidance on additional PBR proposal components, preparing written direct (pre-filed) testimony related to the studies and written direct (pre-filed) testimony related to PBR policy and overall plan. The second phase includes the preparing for the rebuttal testimony, drafting responses to data requests and interrogatories, providing oral testimony during hearings, advising legal team on cross-examination of intervenor witnesses (if any), and providing assistance in drafting sections of briefs, as well as any ad-hoc support that may be necessary. The costs of these are outlined in LEI's separate cost proposal.

Figure 3. Tasks under this engagement

Project Phases
Phase I: Studies and Advisory
Task 1: Advise on rate case strategy
Task 2: Prepare TFP and IP Study
Task 3: Conduct an econometric benchmarking study
Task 4: Advise on additional PBR proposal components
Task 5: Prepare direct testimony
Task 6: Prepare policy testimony
Phase II: Testimony and Ongoing Case Support
Task 7: Prepare responses to interrogatories and data requests
Task 8: Prepare rebuttal testimony
Task 9: Testify as expert witness
Task 10: Assist in drafting sections of briefs
Task 11: Provide ad-hoc support

LEI's approach to project management is client-focused. The primary objective is to deliver thorough, articulate, and meaningful results on time and within budget. The project will commence with a kick-off meeting, which will be held at National Grid office.[5] LEI assumes that this will be conducted within ten business days after the signing of the contract. The purpose of such meeting will be to have an open discussion on key aspects of the project, including outstanding issues, scheduling and refinement of key milestones, data needed by LEI to perform its tasks, and deliverables.

[5] LEI is headquartered in Boston and is able to meet in-person as required by National Grid. LEI's offices are also across the street from the MADPU's offices.

The kick-off meeting will be attended by key individuals from the team. LEI expects that the agenda for the kick-off meeting will include, but not be limited to, the following:

- introductions and meeting with the staff involved in this engagement;
- expectations on the tasks and deliverables;
- scheduling and refinement of key milestones;
- scheduling of check-in calls, and agreement on communications channels and protocols;
- data requests; and
- discussion on MA Gas Companies' current PBR process and challenges that they foresee in the process.

In addition to the kick-off meeting, LEI anticipates that there will be various meetings with National Grid and the lawyers throughout this project. LEI anticipates two face-to-face meetings under Phase I, which include either kick off meeting, PBR and rate case strategy session, or presentation of TFP, IP, and benchmarking results. The other check-in meetings are expected to be conference calls only.

3.1 Task 1: advise on rate case strategy

LEI will begin its consulting engagement with National Grid by first offering advise with regards to strategizing for MA Gas Companies' rate case submission. LEI will guide the companies with regards to the potential PBR elements, and their implications on rate trajectories and outcomes. The goal of this initial task is to make sure that the MA Gas Companies' PBR plan can be supported theoretically, empirically and is practical to implement. All these objectives contribute to the formulation of a compelling rate case filing. There are various components of PBR, and selection of the individual components requires careful consideration of tradeoffs and a holistic review of the overall PBR Plan and consideration of the expected circumstances during the PBR term. The choice of one parameter may influence the selection of other components. For example, the X-factor is not independent of the inflation factor because an inflation index using macroeconomic output-based measures requires that the X factor also include estimate input price differentials between the economy and the industry, and also differences in productivity growth.

Generally, a well-designed PBR plan has the consistency of messaging across the entire plan and has a clearly delineated, challenging yet also achievable, value proposition for the regulator (and consumers) that focuses on cost efficiency and reliability. The PBR plan also needs to show that the formula and selected components create a "win-win" solution where both the interests of the customers and the utility (and its shareholders) are considered and balanced. Moreover, the PBR plan should be able to demonstrate that it is consistent with recent industry trends and is appropriate given current and expected business conditions. This can be done by backing up the submission with discussions of economic theory and with real-world experiences, such as reference to recent productivity trends in the market and regulatory developments in other jurisdictions. Lastly, the plan should highlight MA Gas Companies' success stories to show what the companies have done and will continue to do. This can be done through case study examples or "business cases." The econometric benchmarking study will also be especially useful in this regard.

LEI anticipates that there will be at least one PBR strategy session that will be held with National Grid and its legal team. In this strategy session, LEI expects that the rate case strategy will be discussed to understand any potential PBR implications of different rate case elements. LEI will also provide an overview of the different PBR regulatory frameworks, the advantages of PBR, and potential options for each PBR elements. The deliverable under Task 1 is the PowerPoint presentation for the PBR strategy session as well as LEI's participation in this session.

3.2 Task 2: prepare initial TFP and IP study

Before LEI performs the initial TFP and IP study, LEI will present to the MA Gas Companies, our proposed elements for the TFP Study. These elements include the input and output metrics, sample period, benchmark year, TFP approach (which will be discussed below), approach to use in capital input quantity (physical vs. monetary), depreciation profiles method (i.e., one hoss shay).

LEI will prepare the initial TFP study for gas utilities in line with the MADPU precedent and industry best practice. LEI has a gas LDC industry TFP database that can be used for this engagement. The database, which includes Boston Gas and Colonial Gas, consists of data for 83 gas LDCs from 1998 to 2017. [6]

TFP analysis is an essential component for designing and implementing incentive ratemaking regimes and specifically I-X formulaic based rate designs. Productivity trends are measured based on the ***change over time*** in the ratio of outputs to inputs. A TFP study attempts to consider all outputs and all relevant inputs and how they have changed over time. Moreover, for purposes of PBR, the most essential element of a TFP study is the trend or growth rate in productivity over time for the industry. As such, TFP study typically looks at *changes* in historical productivity levels over time for a group of firms that are in a specific sector. The trends are then used as empirical evidence for understanding the level of productivity growth that could be expected in the future, assuming the firm and industry is in a steady-state, and as such could inform the regulator in the choice of an acceptable rate trajectory – for example, an explicit or implicit "X" or productivity factor.

An industry TFP study involves careful consideration of three dimensions of the study: the selection of methodology, selection of input and output measures (and techniques), and identification of peers for the industry. Data must be compiled for all peers, across all inputs and outputs, for a sufficiently long timeframe as to capture average trends.

Furthermore, TFP analysis helps utilities understand whether the efficiency of resource utilization is improving. The way regulators usually use TFP analysis includes:

- establish how utilities' productivity is changing over time;

[6] For this engagement, LEI will be able to update the database to 2018.

- compare historical performance trends of the utility, spotting anomalies in submissions and flagging them for further analysis;
- for detailed performance reports of regulated entities to highlight poor performance trends; and
- for incentive ratemaking regulation, setting a productivity target.

TFP analyses differ from benchmarking studies (discussed in Section 3.3), which look at *absolute* or *relative* levels of efficiency at a specific point in time or over time by comparing different snapshots of productivity. That said, some of the data compiled for industry TFP analysis can be used for benchmarking.

There are several different approaches to conducting a TFP analysis, as outlined in Figure 4. Given its relative simplicity and robustness, index-based methods have often been employed for TFP studies geared at ratemaking and regulatory purposes. Notably, the index-based method was also used by National Grid in conducting their TFP analysis and ultimately accepted by the MADPU as per D.P.U. 18-150.[7] LEI has significant experience using index-based methods, most recently used in LEI's TFP study for NSTAR Gas.

Figure 4. Features of different approaches to TFP analysis

Method →	Index-number-based TFP methods	Econometric methods	Stochastic Frontier Analysis ("SFA")	Data Envelopment Analysis ("DEA')
Advantages	▪ relatively simple and transparent ▪ easily reproducible ▪ can measure productivity change over time or across businesses ▪ based on economic production function theory ▪ can capture all inputs conceptually	▪ second most popular econometric method ▪ can provide insights for relative performance of businesses	▪ accounts for statistical significance, magnitude of each cost driver, and random error term ▪ distinguishes random statistical noise from management controllable inefficiencies	▪ relatively simple and intuitive ▪ does not require detailed knowledge of underlying cost function
Disadvantages	▪ can be data-intensive ▪ could have bias related to technical, allocative, or scale efficiency	▪ explanatory variables need to be selected carefully ▪ may mix inefficiencies with noise in data ▪ would need extra steps to improve its credibility and reliability	▪ data- and info-intensity ▪ assumes specific form of cost function ▪ outliers and distribution error may lead to biases	▪ uses input volumes rather than prices ▪ sensitive to outliers or errors in data ▪ does not easily control for differences in business conditions ▪ does not allow for statistical significance tests
Examples of jurisdictions where method has been applied	▪ Austria ▪ California, US ▪ Germany ▪ New Zealand ▪ NTUC in Australia ▪ Ontario, Canada	▪ Austria ▪ California, US ▪ Ireland ▪ Ontario, Canada ▪ UK	▪ Germany ▪ Finland ▪ Sweden	▪ Austria ▪ Finland ▪ Germany ▪ New South Wales IPART in Australia ▪ Netherlands ▪ Norway

Source: ACCC/AER Benchmarking Opex and Capex in Energy Networks Working Paper (2012)

Although it is unlikely that National Grid would want to consider changing the TFP methodology, LEI has experience with other approaches too. In the past, LEI has used Data Envelopment Analysis ("DEA"). With respect to econometric analysis like Stochastic Frontier

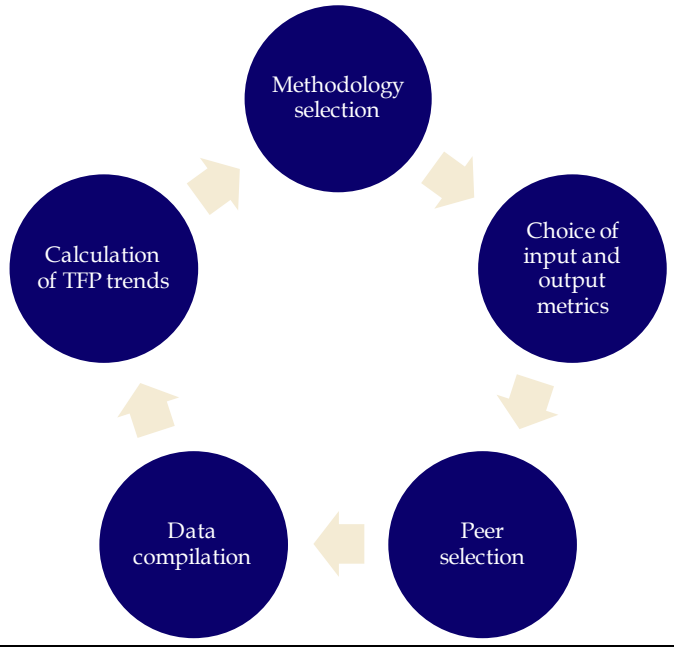
[7] Nevertheless, MADPU did not explicitly state in its Decision that this is the only method they are going to accept, nor do they mention if there is a certain method they have typically accepted in the past.

Analysis ("SFA"), LEI's team includes members with advanced degrees in economics who have performed such econometric analyses before. Using regression analysis tools such as STATA, LEI is able to employ advanced tools to address data issues and ensure the robustness of the analysis.

LEI notes that the DEA and SFA methods have not been used frequently by experts performing productivity studies or to determine X-factors in regulatory proceedings. For the DEA method, this may be related to it being difficult to communicate conceptually, often being referred to as a 'black box,' and poor experiences with DEA by regulators in the early years. With regards to the SFA method, it is typically reserved for academic studies due to the significant amount of data required, as well as its complexity.[8]

When LEI conducts a TFP analysis, we typically begin with the selection of the methodology, followed by a review of key inputs and outputs relevant to the business activities of the industry under question (see Figure 5). The following steps are not necessarily discrete tasks, but rather different parts of the continuous process to identify available data and suitable variables, and thus, select the peer group. This process will often require iterations to arrive at a best-suited set of data and peers for the analysis.

Figure 5. Iterative process of conducting TFP analysis

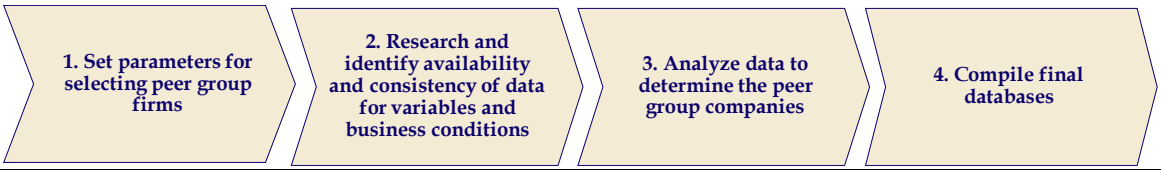


With regards to selecting inputs and output metrics, a key part of the TFP study, LEI will select inputs and outputs that most accurately represent actual productivity of gas distribution companies given the data that is available and quantifiable. Although there are many dimensions

[8] OECD. *Measuring Productivity: Measurement of aggregate and industry-level productivity growth.* 2001.

to the gas distribution industry, and theoretically, there are many viable input and output possibilities, not all are measurable. LEI will select these metrics in consultation with the MA Gas Companies' project team.

Figure 6. Steps involved in peer selection and data compilation



The next step in the process will include selecting a peer group of comparable gas distribution service providers and compiling the necessary data. The peer selection analysis will serve as a foundation for data compilation as it will elucidate whether reliable data is available for all potential peers. After the selection of peers, LEI would assemble a database of necessary data for the TFP analysis for all peers for the required time period. LEI will apply the methodical approach presented in Figure 6 and described in more detail below.

Upon discussion with MA Gas Companies, and after review of relevant materials, LEI will develop a set of parameters for selecting a peer group for the companies. LEI will work with the companies to ensure selected criteria appropriately reflect characteristics recognized by MA Gas Companies as indicators of a peer and is consistent with the definition of the relevant "industry." Ideally, a peer industry would include a large set of peers that are similar in terms of location, size, and asset allocation. In the context of the gas LDC sector in the U.S., this would be the full universe of LDCs for which reliable data is available. LEI also recognizes that a Northeast Region LDC TFP analysis will be required.

As part of the process, LEI will also research and identify data availability and consistency issues for MA Gas Companies, as well as other gas distribution providers determined to be part of the industry peer groups. It is envisioned that data will be obtained from a mix of third-party commercially available databases (that LEI has access to), public filings, such as annual reports or regulatory filings, or from other datasets and research that LEI has compiled in the past. LEI will also attempt to reach out directly to companies to clarify any data questions, omissions, and comparability issues. Once the broad sweep of available data is completed, the next task will be identifying the variables suitable for the analysis.

LEI will then aggregate the information in a time-consistent database. Once the necessary data has been gathered, LEI will proceed with the TFP analysis. The TFP analysis is an iterative process that requires rigorous checks on the quality and integrity of data (identifying errors of units, missing data, and anomalies), and recalculation of TFP results.

IP Study

Based on precedents in MADPU's prior cases, the MA Gas Companies may be interested in proposing to use the GDP-PI (since it is the precedent in MA), which is an economy-wide inflation index. If GDP-PI is used as an I factor, the X factor needs to be calibrated to reflect differences

between the industry and the entire economy. As such, adjustments will need to be made to reflect the TFP differential and an input price differential. LEI is prepared to calculate those adjustments.

The TFP differential is the difference between the industry TFP growth rate and the TFP growth rate for the overall economy. The broadest measure of TFP growth for the U.S. economy will be the BLS multifactor productivity ("MFP") index for the private business sector. LEI will use this BLS MFP index as a proxy measure of TFP trends in the U.S. economy.

The input price differential is the difference between rates of change in input prices for the overall economy and the LDC industry. The U.S. economy input price will be the sum of the MFP growth rate for the year and the BEA GDP-PI growth rate. The industry input price will be based on the weighted average of the growth rate of Operations, maintenance, and administrative ("OM&A") input price and capital input price, as estimated previously in LEI's TFP study for the industry.

Finally, the X factor will be calculated as:

$$X(I) = [(TFP_{IND}) - (TFP_{US})] + [(IP_{IND}) - (IP_{US})]$$

where $X(I)$ is the productivity factor when considering an economy-wide inflation index, TFP_{IND} is the percentage change in the industry TFP growth, TFP_{US} is the percentage change in the overall economy TFP growth, IP_{IND} is the percentage change in the industry input price growth, and IP_{US} is a percentage change in the overall economy input price growth.

The deliverable of Task 2 will be the TFP and IP Study report and work papers. The analysis will also be reflected in the Direct Testimony.

3.3 Task 3: perform an econometric benchmarking study

LEI will perform a benchmarking study to provide supportive evidence for MA Gas Companies' PBR proposal, including potentials adjustments (i.e., consumer dividend or "stretch factor") to the X factor calculated in the TFP and IP Study. There are different approaches to doing a benchmarking study and LEI will provide the advantages and disadvantages of using an indices approach vs. an econometrics approach and MA Gas Companies may decide which one LEI will utilize.

Benchmarking is a methodological approach through which a firm's performance results are measured and compared either to the firm's historical performance or the performance of its peers at a given point in time. Regulators routinely want to see such studies in order to get comfortable with the cost of service calculations of "starting" or "going in" (or "test year") rates under a PBR regime. Benchmarking involves choosing one or more evaluative parameter(s) to assess *actual* performance or *relative* efficiency levels. It is a vital tool for companies and regulators to understand future opportunities for productivity improvement better, and therefore, benchmarking analysis is commonly part of the PBR regime.

Benchmarking studies require significant amounts of analytical understanding and capabilities to be properly conducted. In this regard, LEI has extensive knowledge of the different approaches for performing said studies. LEI is also well-aware of the overarching purpose of conducting

these studies in the incentive ratemaking context, which includes helping utilities identify industry trends, performance, and opportunities for improvements. For ratemaking purposes, productivity studies serve as key evidence in filings and setting productivity targets, while benchmarking studies can aid in setting stretch factors on said productivity targets.

With regard to benchmarking experience, the LEI team has worked extensively across the North American landscape, as well as across jurisdictions internationally. For instance, LEI was engaged by NSTAR Gas to perform a total cost benchmarking study to evaluate the company's efficiency compared to other local gas distribution companies in the United States. In addition to preparing a presentation on benchmarking in the distribution business for an electricity industry advocacy group, LEI team has also performed an independent benchmarking assessment of a regulated entity's corporate support costs, supported it through the rate application processes, and testified on the said material before the OEB. Abroad, LEI has advised the largest electric utility company in Malaysia as well as Jordan's power regulator on the strategic use of benchmarking analysis in PBR, and for the cost of capital and capital structure analysis, respectively. Details regarding the depth and breadth of LEI's benchmarking experience can be found in Section 2.5.

LEI will provide a written report of the econometric benchmarking study as the deliverable for Task 3. This report will be an attachment to the Testimony.

3.4 Task 4: advice on additional PBR proposal components

Under this task, LEI will advise MA Gas Companies on the interaction of certain additional aspects with the PBR plan being proposed, including the continuance of the Gas System Enhancement Plan ("GSEP"), the feasibility of others pass through items such as pilot programs to decarbonize the gas network and some form of Efficiency Carryover Scheme ("ECS"). LEI has assisted several utilities in identifying potential PBR components such as incremental capital mechnisms (sometimes known as "capital trackers"), use of earnings sharing mechanisms, pass-through (Y factors and Z factors), off-ramps, and efficiency carry-over mechanisms.

Additionally, LEI will provide guidance and support to MA Gas Companies in assessing such additional PBR components, as well as, if necessary, provide testimony to propose such mechanism to the Department, along with all supporting documents related.

A brief summary of how LEI can help to assess each of the main additional component under discussion to the PBR plan is provided below.

3.4.1 Gas System Enhancement Plan

GSEP program provides for timely rate recovery of qualified expenditures and capital investments that repair or replace aging or leaking natural gas infrastructure, including replacement of mains, services, and other facilities.

LEI understands that one of the potential issues that the MA Gas Companies will encounter as it files its PBR plan is whether adjustments to the X factor are warranted given that GSEP is tracked. LEI believes that the GSEP and the X factor are two distinct aspects of the utility regulatory regime. The X factor measures improvements in physical productivity over time for the industry,

and as part of the I-X formula, the X factor will dictate how rates will change in the future, and that will, in turn, incentivize the Company to become more efficient.

On the other hand, the GSEP program is an accounting mechanism for the timely recovery of qualifying spending and investments in rates. GSEP simply removes the regulatory lag that would otherwise exist in recognition of certain capital investment and ensures that the utility can start earning its allowed return once the GSEP-qualified capital investment is put into service.

LEI will conduct an analysis to evaluate MA Gas Companies' historical remuneration versus the forecast capital plans to establish that there is no double remuneration.

3.4.2 Efficiency Carryover Mechanism

As stated in the scope of work, the Company is considering some form of efficiency carryover mechanism ("ECM") as part of its PBR plan. ECM is one of the mechanisms used in other jurisdictions to maximize the incentives for the utility to seek out both operating and capital efficiency gains over the full term of PBR. This has been adopted among jurisdictions, including Alberta, Australia, and the United Kingdom, etc.[9]

LEI will support the Company in developing the ECM as part of its PBR plan. The purpose of the ECM is to provide the regulated utility with continuous and sustained incentives to pursue operating and capital cost efficiencies every year of the PBR term. Without ECM, a utility's financial motivation to pursue efficiencies is likely to weaken as it approaches the end of the PBR term. This is because new efficiencies will result in a lower cost base for the subsequent PBR term, but the time left for the company to reap the financial benefit of those efficiencies is shorter with every passing year. To avoid this theoretical dis-incentive, the ECM allows a utility to carryover efficiency gains into the next regulatory period. Under an ECM, a utility retains the incremental efficiency gains (in present value terms) for a fixed period of time. The incentive to implement efficiency improvements is, therefore, preserved, even in the final year of the regulatory period.

Implementing an ECM entails tracking efficiency gains, which in turn requires measuring outcomes that would have occurred if the cost reductions or efficiency-enhancing investments had not occurred. ECS can be implemented through a comparison of revenue requirements in the test year of the next rate case to a benchmark or cost forecast adopted to set the annual revenue requirement. The variance between actual costs and the benchmark or forecasted costs can be used to calculated adjustments then in the next PBR term. Through the implementation of an ECM, customers benefit in the long run, as the total operating and capital cost will likely be even lower than if there was no ECM.

LEI will put together a presentation under Task 4 discussing the different ECMs implemented in other jurisdictions and recommend which ones would be applicable to MA Gas Companies' PBR

[9] 2018-2022 PBR Plans for Alberta Electric and Gas Distribution Utilities (AUC DECISION 20414-D01-2016); Final Decision Australian Gas Networks Access Arrangement 2016 to 2021. Attachment 9 – Efficiency Carryover Mechanism. May 2016; Ofgem (2012) RIIO-GD1: Final Proposals – Supporting Document – Outputs, incentives and innovation.

plan. LEI will also provide testimony to propose such a mechanism to the MADPU and submit all work papers and methodologies and a full explanation of its interaction with the other aspects of the PBR plan being proposed.

The deliverables under this task will be a write up on the co-existence of GSEP and the I-X mechanism, a memo on the different ECMs used in other jurisdictions, and the design of the ECM.

3.5 Task 5: prepare TFP and IP report (direct testimony)

Once the MA Gas Companies decide to proceed with the initial results of the TFP and IP Study, LEI will start preparing the related and supporting work papers for the TFP. Under this task, LEI will also develop a TFP and IP report, which will be an attachment to LEI's testimony. The TFP and IP report will include the overview of the LDC industry in the US and the Northeast region, TFP and IP methodology used, data sources used, TFP results, and the X factor results.

The deliverable of Task 3 will be the written Direct Testimony.

3.6 Task 6: prepare PBR policy testimony

LEI will prepare a testimony to support the Company's PBR proposal. This testimony will include, but not limited to, the following:

- Core economic rationales and general benefits to gas customers from PBR;
- Financial incentive properties of the Company's PBR proposal and its anticipated benefits for customers;
- Consistency of the Company's PBR proposal with the MADPU precedent, as well as Commonwealth energy policy goals; and
- Utility industry trends and developments in PBR, including its evolution in Canada and other jurisdictions.

This testimony will also discuss how MA Gas Companies' PBR plan works better to align the interests of customers, regulators, and shareholders.

LEI has provided reliable testimony backed by strong empirical evidence. LEI is also at the forefront of understanding the most pertinent issues and current evolutions of the market that concern distribution utilities, as well as potential opportunities that these issues may present in the future. Combined with LEI's knowledge of developments in PBR regimes not only in Massachusetts but also in other parts of the US and Canada and across jurisdictions globally, LEI will be able to utilize and incorporate utility industry trends in its PBR policy testimony for MA Gas Companies.

The deliverable under Task 6 will be incorporated in the Direct Testimony.

3.7 Task 7: participate in the discovery and prepare responses to interrogatories and data requests

As part of the hearing process, LEI is willing and able to provide MA Gas Companies support on any discovery and information requests ("IRs"). In doing so, LEI will prepare any responses to interrogatories and IRs/data requests from the MADPU staff, as well as from interveners on the studies performed, the productivity factor, the precedent of I-X in Massachusetts, and any new or innovative elements proposed.

LEI will also support MA Gas Companies in drafting interrogatory requests for other experts, to the extent that any intervenor in the case retains other experts, and they file testimony opposing MA Gas Companies' PBR plan.

LEI also has extensive experience in providing additional support during the hearing phase of regulatory proceedings. This includes (but is not limited to) drafting of direct testimony on independent studies; review of materials submitted by other parties' expert witnesses; support on discovery and information requests; preparation of rebuttal testimony or advisory services in settlement negotiations; and supporting clients and their legal teams in preparing for cross-examination.

The deliverable under Task 7 will be the responses to the interrogatories and data requests.

3.8 Task 8: prepare rebuttal testimony

LEI will also review materials submitted by other parties' expert witnesses and prepare rebuttal testimony.

LEI is equipped to produce said rebuttal testimony supporting the productivity factors, the overall results of the studies, the PBR plan, and supporting documentation; as such, this can also include any issue stemming from the scope of work specified in the RFP.

The written rebuttal testimony will be the deliverable under this task.

3.9 Task 9: testify as an expert witness

The LEI team's depth of knowledge makes them highly credible witnesses, and thus qualified to provide complete and comprehensible briefings to counsel as they prepare their cases. LEI testimony and litigation consulting are supported by a suite of proprietary quantitative models,[10] and the firm's ability to construct intricate and accurate financial models quickly. LEI Principals AJ Goulding and Julia Frayer have served as expert witnesses on behalf of utilities to supporting

[10] These include LEI's proprietary POOLMod model and hourly dispatch model which have been continuously used over the past 20 years to conduct long-term power price forecasting in all North American RTOs. At the Company's request, LEI can also conduct interactive rate modeling. LEI has on many occasions also used externally-developed macroeconomic impact models for clients in Canada and the US (including REMI PI+ and IMPLAN).

findings from LEI's productivity and benchmarking studies before the OEB in Ontario, the AUC in Alberta, the NSUARB in Nova Scotia (see Section 2 for further details).

LEI utilizes its extensive knowledge of and experiences in worldwide energy and infrastructure markets, as well as academic knowledge, to provide expert testimony services in a wide range of energy, infrastructure, and network economics-related matters. LEI principals AJ Goulding and Julia Frayer and Chief Economist Marie Fagan have served as independent experts and have testified in writing and or orally before utility regulatory boards/commissions in many jurisdictions, including Alberta, British Columbia, California, Connecticut, Illinois, Kentucky, Maine, Manitoba, Maryland, Massachusetts, Minnesota, Mississippi, New Hampshire, New York, Nova Scotia, Ontario, Oregon, Pennsylvania, Quebec, Texas, Vermont, as well as various US state and federal regulators, and in other countries.

The deliverable under Task 9 is conditionally based on Ms. Frayer serving as the testifying witness at the hearing.

3.10 Task 10: assist in drafting sections of briefs

Following the submission of the conclusion of hearings, LEI proposes to provide support to MA Gas Companies' counsel in the preparation of its initial and reply briefs. Within the scope of this task, LEI will draw on its extensive experience in the preparation of total factor productivity studies to distill the key points underpinning the TFP and IP methodology and final results. In the course of this task, LEI will also comprehensively address the shortcomings of filed opposing testimony, citing regulatory precedent where applicable and considered the context of TFP for distribution. In addition, LEI will apply its extensive expertise on PBR to provide support in the preparation of briefs on other elements of MA Gas Companies' application.

The drafted sections of the briefs will be the deliverables under Task 10.

3.11 Task 11: provide ad-hoc support for possible settlement negotiations

LEI can provide ad-hoc support for possible settlement negotiations, as well as other for engagements, as necessary. LEI's experience includes advisory services in settlement negotiations, amongst other activities pertaining to support during regulatory proceedings. For illustrative purposes, the following are examples of relevant LEI engagements that may be of interest to MA Gas Companies:

- LEI was engaged by Union Gas to review its proposed 2014 to 2018 IR plan. LEI was also subsequently requested by Union Gas to provide comments on their draft Settlement Agreement (further details in Section 2.1).

- LEI was retained by the Alberta Electric System Operator ("AESO") to develop a transmission cot causation study, used for determining AESO's Demand Transmission Service ("DTS") Rate, and consequently filed with AESO's 2014 tariff application to the Alberta Utilities Commission ("AUC"). After submission of the initial report, LEI also worked with AESO to facilitate technical sessions and Negotiated Settlement Agreement ("NSA") meetings, which involved in-depth discussions regarding methods used and

results. Through these meetings, extensive due diligence was performed by stakeholders on LEI's work, and LEI submitted a revised cost causation study. The AESO consequently applied for approval of the NSA (along with the revised cost causation study), which was "unanimously supported by all participants in the process." The NSA was approved by the AUC weeks later.

Given the unknown level of effort required throughout this process, the LEI team will ensure Project Team members are available if and when required by MA Gas Companies and the MADPU.

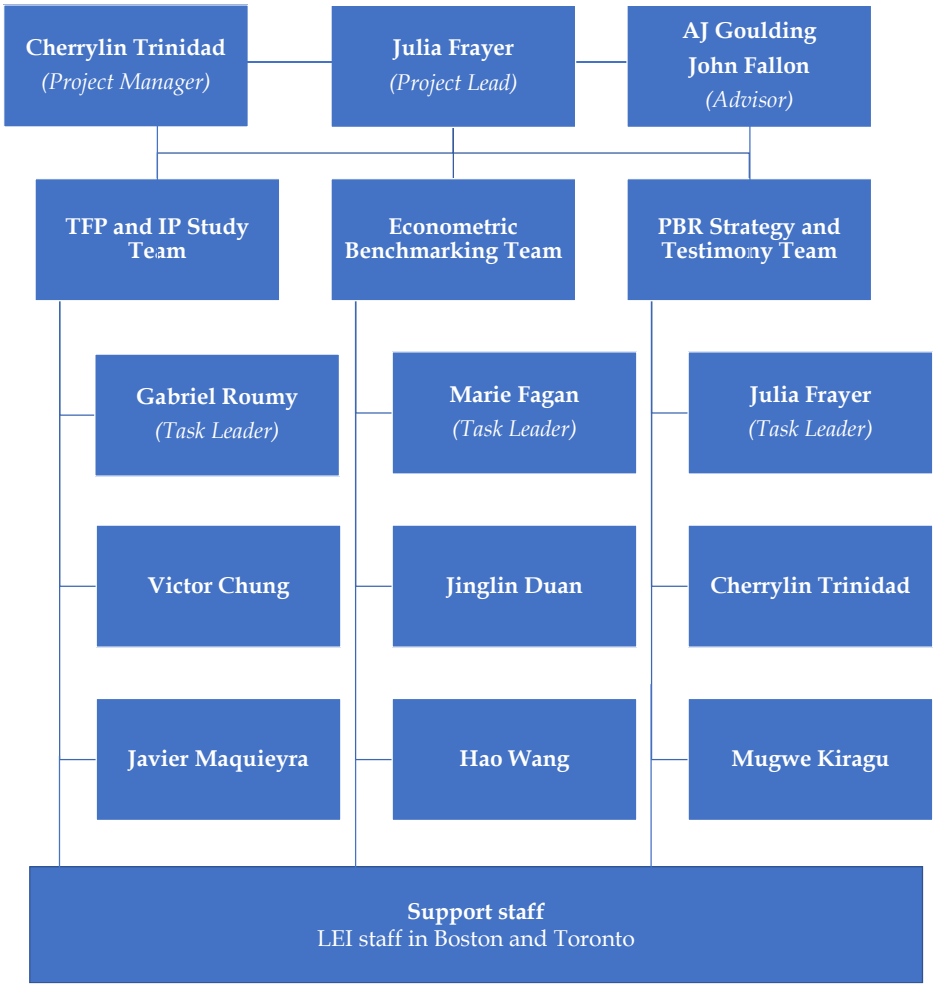
The deliverable under this task will be in the form of a written report and/or LEI's presence in the negotiations.

4 Proposed Project Team and Schedule

4.1 Proposed Project Team

LEI has gathered a select team of dedicated professionals with the required qualifications to assist MA Gas Companies in developing a performance-based alternative ratemaking mechanism. The team possesses considerable global energy and corporate expertise and technical, evaluation, and strategy experience. As shown in the chart below, there will be three teams working on this project: (i) TFP and IP Study Team, (ii) Econometric Benchmarking Team, and (iii) PBR Strategy and Testimony Team.

Figure 7. Project team organizational chart



LEI Principal and Managing Director, Julia Frayer will act as Project Lead, and primary expert available to testify. Julia will be supported by Cherrylin Trinidad, Managing Consultant, who

will serve as the Project Manager, and will be the direct point of contact on behalf of LEI throughout the engagement. Dr. Marie Fagan (Chief Economist) and Gabriel Roumy (Managing Consultant) will serve as Task Leaders. Finally, Victor Chung (Managing Consultant), Jinglin Duan (Senior Consultant), Javier Maquieyra (Research Associate), and Hao Wang (Research Associate) will be relied upon to complete key analyses. LEI may utilize junior staff to assist in research and data gathering. AJ Goulding, President of LEI, and Dr. John Fallon (Senior Advisor at Economic Insights Pty. Ltd.) will also provide support as project advisors. A summary of the LEI Project Team's experience is provided below with detailed curriculum vitae provided in Section 5.

Julia Frayer, Principal and Managing Director of LEI will serve as the **Project Lead** as well as the **Task Leader** for the PBR Strategy and Testimony Team for this engagement. Julia manages LEI's quantitative business practice area and also specializes in market issues related to electricity. Sample projects include the valuation of generators, vertically-integrated utilities, energy sales agreements; and structuring sale processes for energy assets and derivative contracts. Over the last few years, she has led over a dozen modeling exercises in the northeast US and neighboring regions. She also leads many of the firm's market design engagements, spanning such diverse issues as market power mitigation, auction design (including competitive solicitations for energy procurement), wholesale market rules design, and competitive market efficiency benchmarking.

Julia Frayer brings almost two decades of experience specializing in economic analysis and evaluation of infrastructure assets, such as electricity transmission, natural gas-related infrastructure and distribution systems, and utilities. Julia is frequently engaged in expert economic advisory services for power markets, has testified for various regulatory authorities, and her findings and recommendations have previously been accepted by the OEB, Alberta Utilities Commission, Federal Energy Regulatory Commission, Malaysian Energy Commission Suruhanjaya Tenaga, and various state regulators and international authorities. Julia has extensive natural gas distribution experience and also IR-related experience. She has also led assignments related to TFP analysis and benchmarking and generally has ample Ontario-related experience. In a relevant recent project, Julia is providing testimony in front of the OEB to support a TFP study her team performed on hydroelectric generation industry in order to support the determination of the appropriate X-factor for OPG's regulated hydro assets' first IR. Julia has also advised the largest utility in Malaysia on their second generation PBR application and is leading the effort to revise and update the framework documents, the Regulatory Implementation Guidelines.

AJ Goulding, President of LEI, will serve as **Advisor** to the Team. AJ has extensive PBR-related experience. He worked with a Canadian distribution and transmission utility in its first IBR application to the Commission. He has served as a testifying witness on PBR-related matters in both Alberta and Ontario, where he has acted for both utilities and the regulator. Furthermore, he led PBR implementation workshops for Malaysia's largest utility. He has also worked with Asian clients on different engagements spanning from generation acquisition to designing rates. AJ also serves as a Professor at Columbia University, where he teaches a course related to electricity markets and oversees several graduate workshops.

Dr. John Fallon, Senior Economic Advisor of Economic Insights Pty Ltd, will be the Team's **Advisor** for the TFP and IP Study, Econometric Benchmarking Study, and efficiency carries over

mechanism scheme. John has worked on a wide range of economic regulation matters, including benchmarking, asset valuation, the cost of capital, and incentive and efficiency carry over mechanisms. He has strong quantitative skills and a detailed understanding of key conceptual issues, principles, and regulatory precedents in economic regulation. He has worked with Australian and overseas economic regulators and for regulated utilities and has extensive experience as an expert witness.

Ma. Cherrylin Trinidad, a Managing Consultant with LEI, will serve as the **Project Manager** for this engagement. She has managed numerous rate cases. She was the Project Manager of the 2nd generation PBR filing of the largest utility in Southeast Asia. She also assisted Ms. Frayer in her expert testimony as well as in the clients' (NSTAR Gas, FortisAlberta, and Enbridge Gas) rate filing. Currently, Cherrylin is managing a project in Hawaii where different regulatory models, including PBR, are currently explored.

Marie Fagan, Managing Consultant and Chief Economist at LEI, will be the Team's **Task Leader** for the Econometric Benchmarking Team. With over 25 years of experience in research and consulting for the energy sector, Marie's career has spanned international upstream and downstream oil, gas transmission and distribution, North American gas commodity markets, and North American power markets. She has advised C-suite industry clients, buy-side and sell-side financial clients, as well as legislators and regulators. Marie has testified on behalf of clients in public utility commission and related agency hearings in a variety of state jurisdictions, including Maine, Minnesota, and Mississippi.

Jinglin Duan, a Senior Consultant at LEI, will serve on the Econometric Benchmarking Team. Jinglin lends her knowledge and skills to the firm's technical engagements with regulators, utilities, and private equity firms in the US and abroad on issues regarding project evaluation, tariff design, investment strategic consulting, litigation support, as well as power price forecasting and market analysis. Specifically, Jinglin is responsible for modeling regional and national social and economic impacts for electric projects using REMI PI+ and is the primary electricity market modeler for the New England (ISO-New England), Southeast US (SERC) and Florida (FRCC) regions. Jinglin has also been actively engaged in statistical analysis, regulatory study, as well as financial analysis for different aspects of the power sector.

Gabriel Roumy, a Managing Consultant at LEI with extensive experience in market and regulatory design for the power sector, will serve as the **Task Leader** for the TFP and IP Study Team. Gabriel has led projects in both North American and international jurisdictions. He has led numerous engagements, including performing TFP and benchmarking analyses for a large regulated utility, evaluating multiple legislative and regulatory options to reduce electricity rates on behalf of the Kansas Legislative Coordinating Council, and leading the quantitative analyses as part of an assessment of various ownership and regulatory models for the power sector (including evaluating the benefits and drawbacks of various PBR mechanisms) on behalf of the Hawaii State Energy Office. Gabriel's other areas of expertise include modeling of power markets; identifying and quantifying revenue streams and valuating generation and transmission assets; identifying and quantifying societal and economic benefits of power infrastructure investments; and auditing energy companies.

Victor Chung, a Managing Consulting at LEI with experience in North American as well as international energy markets, will serve on the TFP and IP Study Team. Victor has worked in various engagements in both North America and global energy markets. He led the team in updating Malaysia's largest utility's revenue requirements model for its performance-based ratemaking submission. He also advised the Hong Kong SAR Government on potential changes to the city's economic, regulatory framework of the electricity sector. Victor also reviewed the regulatory structure and pricing mechanism of a gas distributor in Southeast Asia and analyzed the potential revenue impact of a tariff structure that decouples gas commodity cost from distribution and retail charges. In Canada, Victor the practice of a regulated electricity retail option provider's practice in earning a fixed margin associated with expenses and investigated the risk of operating the RRO. In the US, for a regulated distribution company in Maine, Victor analyzed the rate impact to the company's customers if the distribution company choose to interconnect to a different transmission network. For a US state agency, Victor also quantitatively assessed various ownership and regulatory models for the power sector, evaluated the benefits and drawbacks of various PBR mechanisms.

Mugwe Kiragu, a Senior Consultant at LEI, will serve on the PBR Strategy and Testimony Team. Mugwe has been involved in a number of projects that are in line with the scope of work. For instance, as part of LEI's regulatory and ownership models study in Hawaii, Mugwe was responsible for assessing various PBR options and evaluating their technical and financial feasibility for the numerous islands in Hawaii. Among the types of PBR considered and assessed were a "light" PBR involving performance-incentive mechanisms, a conventional revenue cap PBR, and an outcomes-based PBR approach. Mugwe also lead a broad jurisdictional review into regulation around the setting of stretch factors and earnings sharing mechanisms under an incentive regulation regime for a large Ontario electricity generator. He was also tasked with providing a detailed case study review of incentive-based regulation in the UK for a large Malaysian utility. In these projects, LEI was asked to give advice on current and historical regulatory initiatives across a variety of jurisdictions and consider key lessons learned from electricity deregulation around the world.

Javier A. Maquieyra, a Research Associate at LEI, will serve on the TFP and IP Study Team. Before joining LEI, Javier was a coordinator at the electricity regulatory authority in Argentina, analyzing utilities' economic and financial performance. After that, he served as a director of project assessment and energy policy at Argentina's Ministry of Energy and Mining. He has also been involved in various cross-sectional practice areas, having excelled in energy modeling (particularly DEA), energy planning, and project assessment. Furthermore, Javier is currently the primary modeler of the ERCOT market, producing a biannual long-term price forecast using LEI's proprietary model, POOLMod.

Hao Wang, a Research Associate at LEI, will serve on the Econometric Benchmarking Team. Hao's experience and subject matter expertise comprises power market design, tariff design, renewable energy project evaluation, power market modeling, utility management/performance auditing, and market analysis. He is the primary modeler of Midcontinent Independent System Operator ("MISO") market, including energy and capacity markets, and analyzes changes in market rules and system dynamics.

4.2 Indicative Schedule

As mentioned earlier, the engagement will commence with a kick-off meeting with National Grid. During the first few weeks, the LEI team expects that there will be a discussion regarding the proposed PBR components and rate case strategy. Based on these discussions, LEI will put together an outline of the testimony and submit this to the Company for review and approval.

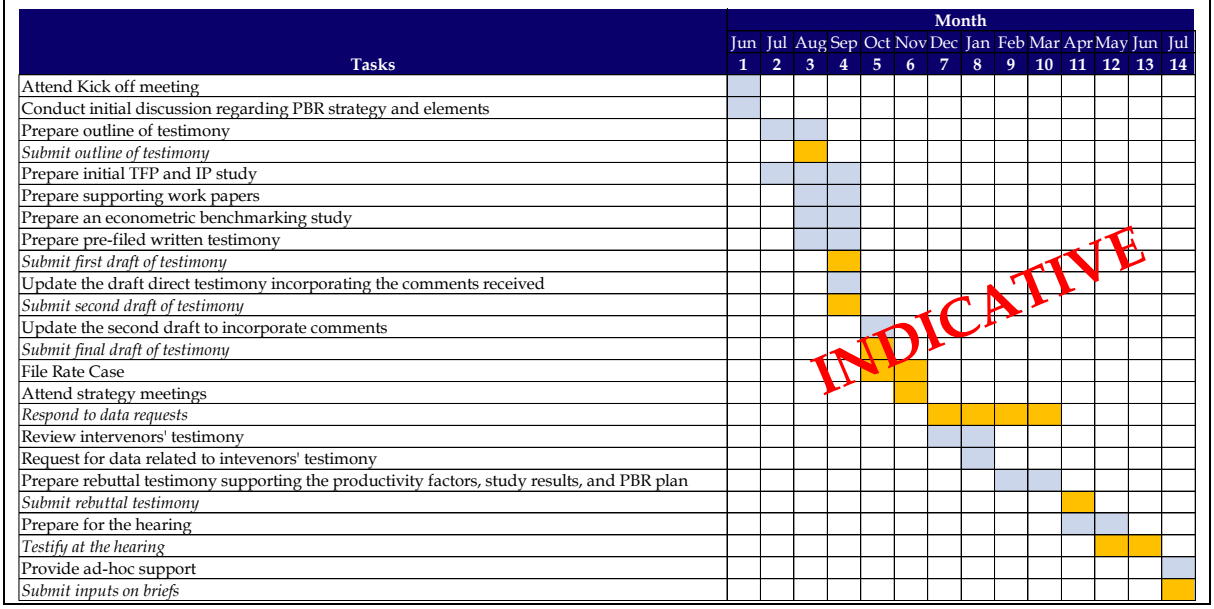
LEI has put together three teams to work simultaneously on the different tasks for this engagement (please refer to the organizational chart in Section 4.1):

- The **PBR Strategy Team** will look at the various PBR components as well as other non-traditional PBR components and assess whether some of these will be applicable and useful to MA Gas Companies.

- At the same time, the **TFP and IP Study Team** will start looking into the TFP and IP Study and prepare the supporting work papers. LEI estimates that it will take between 1-2 months to conduct this study, depending on the data available.

- The **Econometric Benchmarking Team** will also start its econometric benchmarking study, and like the TFP Study, we estimate that this will take two months to perform.

Figure 8. Illustrative schedule for the scope of work



Based on the scope of work, the first draft of testimony is expected to be submitted in the first week of September 2020, if the project is awarded by June 1, 2020. LEI anticipates that the Company will review the draft and provide its comments within two weeks. LEI will then address the comments and incorporate the suggestions into the draft and will give the second draft a week or two after receiving the comments from the Company. The Company will then do

a second review and then submit the final testimony two weeks after receiving MA Gas Companies' comments on the second draft.

LEI anticipates that after the Company has filed the rate case, LEI will start assisting in responding to data requests related to the TFP and IP Study, Econometric Benchmarking Study, and PBR-related topics. Based on the schedule provided in the scope of work, this will take around two months.

LEI will also prepare for the rebuttal testimony and testify on the hearing on the 12th and 13th month of the project, respectively. The Company expects the project to be done after a year and two months from the time that it started. Figure 8 shows an indicative schedule for the scope of work. LEI notes that this indicative schedule will be discussed and updated during the kick-off meeting.

LEI expects to complete all aspects of the work plan by July 2021 per the indicative schedule in the RFP, subject to being able to kick-off the project by the beginning of June.

5 Resumes

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JULIA FRAYER

Managing Director, London Economics International LLC

LONDON ECONOMICS

KEY QUALIFICATIONS:

Julia Frayer is a Managing Director with London Economics International LLC ("LEI"), specializing in economic analysis and evaluation of infrastructure assets, such as power plants, natural gas-related infrastructure, electricity transmission and distribution systems, and utilities, as well as market design and expert economic advisory services for regulated and competitive power markets. She has worked extensively in the US, Canada, Europe, and Asia in valuing electricity generation and wires assets, water and wastewater networks, as well as gas transportation assets. She also provides expert advice on market rules, innovative rate design, and institutional best practices for management of infrastructure assets.

Julia manages LEI's quantitative financial and business practice area, and also specializes in market and organizational design issues related to electricity. In addition to electric generation sector market power and anti-trust analysis, sample projects include cost of capital estimation; rate-setting analysis; short- and long-term forecasting of wholesale power prices; valuation of generators and vertically-integrated utilities; assessment of retail market design including provider-of-last resort portfolios and contracts; design of energy sales agreements; and advisory on structuring request for proposals and sale processes for energy assets and derivative contracts. As part of these analyses, Julia and her team of economists and consultants have developed and applied proprietary real-options based valuation tools, portfolio risk analytics, models of strategic bidding behavior, and sophisticated power system simulation tools, as well as customized econometric models. Julia also leads many of the firm's regulatory economics projects, spanning such diverse issues as cost-benefit analysis, market power mitigation, tariff ratemaking, auction design (including competitive solicitations for procurement), wholesale market rules design, productivity analysis and efficiency benchmarking.

Prior to joining LEI, Julia was working as an Investment Banker with Merrill Lynch in New York.

EDUCATION:

Boston University, Boston, MA, B.A. in Economics and International Affairs.

Boston University, Boston, MA, M.A. in Economics.

EMPLOYMENT RECORD:

From: 1998 **To:** present
Employer: *London Economics International LLC, United States*
Managing Director

PROJECT EXPERIENCE:

The projects briefly described below are typical of the work Julia has performed throughout her career at London Economics International.

Written and Oral Testimony

- ***expert witness in a performance-based ratemaking case for a gas LDC:*** LEI was retained in early 2019 to conducted Total Factor Productivity and Benchmarking analyses for the US gas distribution industry, and provide expert technical advice to a gas utility company in Massachusetts; LEI's analysis and expert testimony was submitted in a in anticipation of a performance-based distribution ratemaking application in late 2019. [DPU Docket 19-120]
- ***engaged by Eversource and National Grid to determine the economic viability of non-transmission alternatives ("NTAs")***: LEI started the analysis by screening prospective NTA technologies based on their technical characteristics, their relevance in the New England market and their technical applicability. LEI conducted a comparative cost analysis to estimate the levelized cost per kW-month over the economic life of each of the technologies. Finally the most probable combinations of NTA technologies identified in the selection process were further evaluated based on criteria including physical constraints such as land availability, siting issue, financing hurdle, etc. This NTA analysis was conducted for three separate NTA projects that together formed a part of the overall Greater Boston Reliability Project (also known as "AC Solution"). LEI also provided oral testimony about its analysis to the Massachusetts regulator for each of these projects: Wakefield-Woburn NTA Analysis (DPU 15-140 & 15-141), Mystic-Woburn NTA Analysis (DPU 15-64 & 15-65) and Merrimack Valley Reliability Project (DPU 15-44 & 15-45).
- ***prepared total factor productivity study and presented testimony in respect of Ontario Power Generation's ("OPG") hydroelectric incentive ratemaking plan:*** LEI was retained by OPG to assist in the development of its first generation IRM plan, following the formulaic I-X approach. LEI prepared an industry study of TFP trends spanning the North American hydroelectric sector. LEI also recommended an inflation index, which reflected cost drivers relevant to OPG while also aligning with the regulatory precedent in Ontario. LEI testified before the Ontario Energy Board. LEI's analysis supported the successful approval of OPG's first generation IRM plan for its regulated hydroelectric fleet. [OEB EB 2012-0340]
- ***assisted in exploring options to expand Maine's natural gas supply:*** LEI was engaged by the State of Maine Public Utilities Commission to assist the MPUC in evaluating options for expansion of natural gas supply into Maine (with a view to reducing the cost of gas and power to Maine customers). LEI reviewed and evaluated proposals for firm natural gas transportation service by pipeline developers. These evaluations included LEI's review of commercial terms include in the pipeline Precedent Agreements that underpin capacity expansion projects; review of contract provisions for Firm Transportation Agreements and Negotiated Rate Agreements; and evaluation of the status of the FERC and state-level permitting process for each pipeline proposal. The project also included natural gas network modeling (using GPCM, an industry-standard network model of the North American natural gas system) and power simulation modeling (using LEI's proprietary POOLMod model) to arrive at a quantitative cost-benefit analysis of proposals. The Regional Analysis was an additional modeling exercise, to extend the analysis to address the impact on Maine if it were

to go forward under a regional initiative to procure pipeline capacity. Testimony was filed in February 2016 and LEI testified in March 2016. [MPUC Docket Number 2014-00071]

- ***provided an analysis of building block incentive ratemaking approaches and their applicability to Enbridge, a natural gas distribution utility in Ontario:*** LEI's report supported the client's distribution tariff proposal submission to the Ontario Energy Board ("OEB") for a second-generation Customized Incentive Regulation ("IR") plan for the period of five years (2014-2018). The testimony set out the theory behind as well as the practical experience of using the building blocks approach in incentive regulation regimes. Julia Frayer appeared before the OEB for cross examination. [OEB File No. EB-2012-0459]

- ***provided expert testimony in support of FortisAlberta Inc. ("FAI") in its filing for a performance-based ratemaking ("PBR") plan with the Alberta Utilities Commission ("AUC"):*** The testimony provided detailed data analysis (including inflation and TFP trends), underpinning PBR economic theory, and reviews of best practices in various North American and International jurisdictions. The testimony offers back up elements for each of the various components of the PBR plan that is being proposed by FAI. Julia testified at the AUC in Spring of 2012. [AUC Proceeding No. 566]

- ***estimate of a stranded cost obligation payment***: LEI was retained by Tipmont REMC, an Indiana-based electric distribution cooperative to provide independent expert analysis regarding the potential stranded costs Tipmont may need to pay to its current generation and transmission ("G&T") cooperative, Wabash Valley Power Association, Inc. for terminating supply service. LEI applied the FERC formulaic approach to estimate the revenue lost for the G&T cooperative based on guidelines developed in FERC"s Order No. 888. LEI's analysis was filed with FERC pursuant to a Section 205 reply filing. [FERC Docket No. ER20-1041]

- ***rate impact analysis and study of costs and benefits of municipalization:*** LEI was retained by the Maine Public Utility Commission to fulfill a legislative mandate to study proposed legislation that would involve municipalization of the state's transmission and distribution networks. LEI submits it expert report for the Legislature on February 15, 2020 and testified before the Joint Standing Committee on Energy, Utilities and Technology on February 26, 2020. [MPUC Docket 2019-00280]

- ***independent evaluation of New England Clean Energy Connect transmission project in its siting proceeding at the Maine Public Utility Commission ("MPUC"):*** LEI was retained in 2017 to advise the MPUC staff on the wholesale electricity market impacts and macroeconomic effects of the new transmission project on Maine's economy and the economies of other New England states. LEI prepared an independent forecast of future energy and capacity market benefits, carbon emissions reductions, and local GDP and employment impacts as a result of the construction and operations of the project; LEI also critically reviewed the submission of other parties on this topic. After providing written testimony, LEI staff led by Julia Frayer testified at the MPUC in late 2018. [MPUC Docket 2017—00232]

- ***evaluation of the rate impacts associated with bankruptcy-related settlement for PREPA:*** LEI was engaged by the Committee of Unsecured Creditors to consider the implications of a proposed settlement with bondholders put forth by the Financial Management and Oversight

Board of Puerto Rico and various other parties. LEI's analysis focused on the impact that the settlement would have on the rates for electricity service that the Puerto Rico Electric Power Authority ("PREPA") would need to charge its customers. LEI also examined the likely impact on electricity demand, taking into account the increase in rates due to the settlement. LEI performed a detailed review of the current and projected costs of service for PREPA, based on certified Fiscal Plans released by PREPA and other documents related to future investment needs. LEI also studied how rates in Puerto Rico compared to other island systems. LEI's analysis was filed with the bankruptcy court in late 2019. [Case No. 17-04780]

- ***provided independent assessment of Alberta's Comprehensive Market Design:*** LEI provided a critical review of the new capacity and energy market design being proposed by the Alberta Electricity System Operator ("AESO") in a written report submitted, on behalf of a market participant, to the Alberta Utilities Commission ("AUC"). LEI identified criteria for evaluation of the new market design, compared the AESO's proposal against other well-established organized wholesale electricity markets, and then categorized associated rules based on an objective evaluation of both positive and negative features. [AUC Proceeding No. 23757]
- ***assessment of a state-wide energy efficiency plan and appropriateness of the avoided cost of energy supply:*** LEI was retained by the Maine Public Utility Commission ("MPUC") to provide an independent forecast of future natural gas prices, wholesale energy and capacity prices, which would be relevant for cost effectiveness analysis of future energy efficiency programs. LEI was also asked to review the multi-stakeholder report that Efficiency Maine Trust and other New England program administrators commissioned in 2014 (and 2015 Update), and subsequently in 2017. LEI staff testified before the MPUC on several occasions over the course of this multi-year engagement. [MPUC Docket 2018-00321]
- ***efficacy of distributed generation as a non-transmission solution to local transmission reliability problems:*** LEI prepared direct testimony and rebuttal testimony related to the technical efficacy and cost-effectiveness of various non-transmission alternatives and specifically distribution levels solar and battery storage solution to a known reliability problem in a load pocket within Massachusetts. [Massachusetts, docket EFSB 17-02/D.P.U. 17-82/17-83]
- ***conducted non-transmission alternative study:*** LEI was hired to conduct a Non-Transmission Alternatives ("NTA") analysis for the two transmission projects, which are a component of larger transmission solution being proposed by Eversource for the Greater Hartford and Central Connecticut ("GHCC") area. The objective of the NTA analysis was to determine the feasibility and viability of other non-transmission resources – such as new generation and new demand-side resources – to be developed in lieu of these two specific transmission projects to relieve transmission reliability concerns. The NTA analysis was filed as part of Eversource's application with the Connecticut Siting Council ("CSC") for each of these transmission projects. [CSC Docket No. 474]
- ***assessment of congestion in the New York power market:*** LEI was commissioned by a coalition of community groups to prepare an independent outlook of the New York power wholesale market conditions and assess the level of congestion anticipated on major transmission interfaces within the state. LEI studied multiple scenarios to illustrate the impact of major drivers on congestion levels. LEI presented the findings at a technical conference

organized by the New York Public Service Commission ("NYPSC") for the purpose of evaluating the benefits of new AC transmission projects. [NYPSC Case 12-T-0502]

- ***independent evaluation of the costs and benefits of the Northern Pass transmission project:*** LEI submitted written testimony to the Site Evaluation Committee in New Hampshire on the costs and benefits of the proposed transmission project; the analysis focused on wholesale electricity market impacts as well as macroeconomic effects of lower electricity rates and infrastructure investment at the state level in New Hampshire and other states in the region; Julia Frayer also provided oral testimony as part of the SEC's hearings on the project. [SEC Docket No. 2015-06]
- ***estimation of the spot market and forward market impacts around the discretionary timing of outages by large generation owner in Alberta:*** LEI prepared an independent analysis of the spot market and forward market impacts of outage scheduling practices by TransAlta over the period of 2010-2011; the analysis was filed with the Alberta Utilities Commission ("AUC") as part of a litigated case of alleged market power abuse. [AUC Proceeding No. 3110]
- ***testified on behalf of the NEPOOL in a jump ball filing at FERC regarding the Performance Incentive scheme proposed by ISO-NE:*** in written testimony submitted to FERC, Julia Frayer identified shortcoming in ISO-NE's proposed performance incentive scheme for tis forward capacity market. [Docket No. ER14-1050 at FERC]
- ***served as testifying witness on the issue of utility joining a wholesale market:*** Julia served as testifying witness and lead author in evaluating Entergy's decision to join the Midwest Independent Transmission System Operator ("MISO") Regional Transmission Organization ("RTO") on the behalf of the Public Utility Commission of Texas. LEI evaluated several existing cost/benefit studies related to Entergy's decision to join MISO over the Southwest Power Pool ("SPP") and will be providing quantitative and qualitative analysis of specific costs/benefits attributable to ETI and its customers following membership in either MISO or SPP, including but not limited to net trade benefits, transmission cost allocation, governance issues, and continued participation in the Entergy Service Agreement following RTO membership. [SOAH Docket No. 473-12-6206; PUC Docket No. 40346]
- ***served as Independent Expert regarding Load Following Service products:*** ENMAX retained LEI to act as an independent expert on matters related to proposed auctioning for the Load Following Service ("LFS") product. LEI provided an independent evaluation of the proposed auction, including evaluation of the both the product being auctioned and the auction mechanism and key parameters. The LFS product as proposed to be auctioned was meant to represent the "shape risk" in the RRO service. LEI's evaluation considered whether the product and auction mechanism would result in an efficient, competitive and fair outcome for the Alberta market, RRO providers, potential suppliers of the auctioned product, and customers of the RRO service. LEI prepared a report titled "Independent assessment of proposed market-based determination of shape risk in RRO supply" dated January 24, 2014, which was filed in ENMAX's Application No. 1610120 before the Alberta Utilities Commission ("AUC"). [AUC Proceeding No. 2941]
- ***testimony in support of transmission operating rules and curtailment protocols for interties into Alberta:*** Julia provided testimony in support of transmission operating rules and curtailment protocols for interties into Alberta, as proposed by the Alberta Electricity System

Operator ("AESO"), in order to support a fair, efficient and openly competitive power market. The testimony was made in front of the Alberta Utilities Commission ("AUC"), on behalf of Morgan Stanley Capital Group ("MSCG"), a customer of the Montana-Alberta Transmission Line. Julia's analysis considered commercial as well as operating protocols in deregulated power markets and considers how market rules incentivize new entry and produce dynamic efficiency gains related to more intense competition The AUC issued a favorable decision to MSCG in early 2013. [AUC Proceeding No. 1633]

- ***provided testimony regarding proposed merger of two regional utilities at PURA:*** Julia provided written testimony and oral testimony at the Connecticut Public Utility Regulatory Authority ("PURA") related to the market power consequences of proposed merger of NU-NSTAR. [PURA Docket No. 12-01-07]
- ***prepared testimony and testified in support of TransAlta in relation to a settlement for contravention of FEOC Regulation related to timing of exports from 2010:*** The settlement was crafted by the Market Surveillance Administrator and filed with the Alberta Utilities Commission ("AUC") for approval in December 2011. LEI assessed the economic and policy considerations of the settlement and its appropriateness in context of enforcement and sufficiency of penalty payment. [AUC Proceeding No. 1553]
- ***conducted RPS review:*** Pursuant to *An Act To Reduce Energy Prices for Maine Consumers*, P.L 2011, ch.413, sec. 6 (the "Act") , the Maine Public Utilities Commission ("MPUC") was directed by the Legislature to study Maine's renewable portfolio requirement established in 35-A M.R.S.A. § 3210 (3-A). LEI was engaged by MPUC to conduct an in-depth analysis of the renewable portfolio standards ("RPS") required by the Act which would support the MPUC's study and report to the Legislature. Julia led the team in preparation of the report, which was submitted to the Commission in January 2012 and later testified at the state legislature on the key findings of that report. [MPUC Docket No. 2011-271]
- ***prepared detailed cost-benefit analysis and macroeconomic impact analysis in support of the Champlain Hudson Power Express ("CHPE") application for siting approval at the New York Department of Public Service ("DPS" or also known as "NYPSC"):*** LEI's analysis on economic effects was the cornerstone of the settlement agreement reached between TDI and a number of New York agencies. Julia acted as independent expert on behalf of TDI and prepared updated study results on energy market impacts, capacity market impacts and also macroeconomic benefits stemming from the operation of the CHPE project. Julia's testimony was used in the DPS proceeding in the summer of 2012 and CHPE was successfully granted its Article VII permit. [NYPSC Case 10-T-0149]
- ***served as lead expert witness for a private equity investor in matter related to a contractual dispute regarding a long term power purchase agreement between a municipal utility located in New England and a landfill gas generator:*** Ms. Frayer analyzed key contractual terms of the PPA and provided an expert's review of how those terms compared to the industry norm when the contract was signed and became effective. Ms. Frayer provided an independent estimate of potential contractual damages. The case was scheduled to be heard in Massachusetts Superior Court, however, Julia's analysis helped support a successful settlement.
- ***merger analysis between hydroelectric operators:*** Julia and her team of economists supported the client in preparation of a merger application to the Federal Energy Regulatory

Commission ("FERC") under Section 203 of the Federal Power Act, in conjunction with the client's acquisition of a Maine-based hydroelectric generation portfolio. LEI performed a full Delivered Price Test analysis for the ISO New England control area. LEI's analysis was filed with FERC and the Merger Application was approved in early 2013; market-based rate authority was subsequently granted in mid 2013. [FERC Docket No. ER13-1613]

- ***merger analysis in support of the NRG, Inc. and GenOn merger:*** LEI staff, under Julia's direction and guidance, performed Delivered Price Tests analysis for the Federal Energy Regulatory Commission ("FERC") under Section 203 of the Federal Power Act and submitted extensive analysis to FERC in the summer of 2012. The Merger Application was successfully approved by FERC in December 2012. Subsequently, LEI assisted the client in preparation of the 205 market-based rate authority analysis. [FERC Docket No. EC12-134]
- ***provided expert testimony before FERC related to Shell Energy's sale of capacity commitments from facilities in New York to New England in an alleged market manipulation case:*** Julia examined market rules, operating procedures, and pricing arrangements in New England and New York at the time of the investigation, and examined the participation of Shell in the capacity markets and compliance offers in the energy markets, commenting on the economic rationale behind the client's must offer strategies in the energy market for capacity compliance. [FERC Docket No. EL-09-47 and EL-09-48]
- ***advised the Coalition of Large Distributors in Ontario on 3rd generation Incentive Regulation Mechanism proceedings of the Ontario Energy Board:*** The work involved expert testimony filed with the Board with detailed analysis of the theory behind the various components of PBR system, including inflation and efficiency gains factors, treatment of capital expenditures among others. The analysis was supplemented with comparison of actual factors and indices, and determination of the more robust and appropriate indices for the Ontario's distribution industry, including total factor productivity analysis for the sector. [OEB Docket No. EB-2007-0683]
- ***provided testimony on behalf of NRG Energy, Inc. in opposition to the proposed acquisition of NRG by Exelon Corp (Exelon):*** LEI performed a preliminary Herfindahl-Hirschman Index test for market power for all regions affected, and a Delivered Price Test, for the PJM East and ComEd regions. In addition, LEI examined Exelon's post-merger optimal bidding strategies using our proprietary model of strategic, known as CUSTOMBid. LEI also assessed the impact of changes in the parent company Exelon's cost of capital on the activities of the company's two regulated subsidiaries: ComEd and PECO. LEI also estimated the impact on customer costs from potential debt downgrades following the merger, and assessed the effectiveness of Exelon's proposed ring-fencing measures. LEI's written evidence was filed with FERC and Pennsylvania Public Utility commission. [FERC Docket No. EC-12-134; PaPUC Docket Nos. A-2009-2093057, A-2009-2093058, A-2009-2093059}]
- ***prepared testimony on cost-benefit analysis:*** Julia submitted testimony on behalf of the Staff of the Maryland Public Service Commission ("MPSC") to the MPSC to conduct a cost-benefit analysis in relation to the proposed transaction between Constellation Energy Group, Inc. ("CEG") and Électricité de France ("EDF") whereby EDF would purchase from CEG a 49.99% interest in Constellation Energy Nuclear Group, LLC ("CENG"). Benefits related to the decreased likelihood of a Baltimore Gas & Electric ("BGE") downgrade, increased likelihood of the Calvert Cliffs expansion being completed and several macroeconomic benefits

stipulated to by EDF. Costs related to the limitation on the allocation costs of CEG corporate support services to CENG, increased risk of capital deprivation and reduced quality of service, and implications of CEG's more aggressive nuclear development. [MPSC, Case No. 9173]

- ***assessed the costs and benefits of new transmission versus generation alternatives to the system:*** New England wholesale electricity markets were simulated in order to determine whether the Greater Springfield Reliability Project ("GSRP") would produce economic benefits to the New England region. In order to ensure that economic benefits were not subject to the forced outage and availability schedule of the simulated energy markets, LEI simulated the energy market with 30 different random forced outage and availability schedules. Using these simulations, a distribution of results was used to calculate confidence intervals and hypothesis tests run on the results, hence increasing the robustness of our findings. The study results were used to produce written testimony to the Connecticut Siting Council ("CSC") and oral testimony was provided in late August and early September 2009. [CSC Docket No. 370B]
- ***prepared proposal on pricing safeguards:*** In September 2005, Julia's proposal for pricing safeguards in the wholesale market, referred to as the Peaker Entry Test, was submitted to the Public Utility Commission of Texas as an alternate to the Commission staff's proposal initially under Project No. 24255 which was later moved to and renamed by the PUCT a Project No. 31972. In April 2006, the PUCT adopted a variant of this proposal for use as pricing safeguards – the Scarcity Pricing mechanism (as specified in the above mentioned project). Under Project No. 29042 in September 2005, Julia looked at the Pivotal Supplier Test and supplied a critique of the PUCT staff's initial market power mitigation proposal. In June 2005, Julia participated on panel discussing market monitoring issues, as well as market power safeguards for wholesale electricity markets. In 2004, she also provided testimony on pricing safeguards proceeding, which looked at alternative market power testing procedures for market power, analyzed implications on investment, and discussed efficiency consequences of certain bidding behavior. She also prepared and filed comment testimony and quantitative analysis on questions of market definition and market integration for the Public Utility Commission review in Project No. 29042. [In November 2005, pursuant to PUCT decision, both Project Nos. 24255 and 29042 were rolled into the PUCT Project No. 31972.]
- ***served as independent evaluator and RFP manager for the Connecticut Department of Public Utility Control's ("DPUC") request for proposals for incremental capacity:*** LEI was retained by the Connecticut state regulator to help realize a legislated mandate to hedge the risks of evolving capacity markets and import constraints through a competitive RFP aimed at securing incremental capacity located electrically in the state of Connecticut. LEI authored a report determining the range of investment needs that could be required in Connecticut over the next 15 years due to localized ISO-NE markets for capacity and forward reserves. LEI then designed a procurement process, including the RFP and associated contracts. The RFP solicited for that capacity from both supply side and demand side resources. LEI served as the RFP manager for the process, and provided independent evaluation services of the bids, and recommending the winning portfolio. LEI also served as the DPUC's expert witness in the hearings approving the winning portfolio. LEI's analysis helped the DPUC successfully defend the contracts from legal appeal. [DPUC Docket No. 05-07-14PH2]

- ***testimony at FERC on market power issues on behalf of intervener in proposed Exelon-PSEG merger per Section 203 of the Federal Power Act:*** In May 2005, Julia provided direct and supplemental testimony outlining key considerations relating to the potential for adverse competitive effects in light of the proposed merger and recommended additional mitigation measures to cure horizontal market power concerns through independent analysis of merger's impact on wholesale energy and capacity markets in PJM. [FERC Docket No. EC09-32]
- ***prepared MBR authorization:*** In the matter of Hawk Nest Hydro LLC acquisition of Hawk Nest-Glen Ferris Hydroelectric Project Julia and the LEI team prepared the MBR Authorization for the FERC filing. [FERC Docket No. ER06-1446-000]
- ***testimony regarding confidentiality of long range supply and demand forecasts by California utilities:*** LEI represented the California Energy Commission ("CEC") staff in a CEC and in a state regulatory proceeding at the California Public Utilities Commission ("CPUC") in respect of the merits of making public the investor owned utilities long range energy and capacity supply forecasts, as part of the integrated resource planning process. LEI served as an independent expert and supported the CEC in successfully arguing for the release of certain information, despite the utilities' assertions that such data would undermine competitive markets. [CPUC Rulemaking No. 05-06-040]
- ***provided testimony regarding the price elasticity of demand for transmission service:*** In the context of a transmission rate case for Hydro Quebec TransÉnergie, and consideration of alternative transmission rate designs, Julia led an economic analysis on behalf of Brascan Energy Marketing, Inc. that examined the impact on trade from increased transmission costs, involving multi-factor regression analysis of nodal electricity prices, price spreads across markets, and interchange flows (imports and exports) across borders. Julia also considered the impact of the elasticity of demand for transmission services between Canadian provinces and US markets in the Northeast for maximizing revenues in rate setting. Julia presented oral testimony at the Régie de l'Énergie du Québec. [Dossier R-3549-2004]
- ***served as Independent Monitor in a multi-state renewables solicitation process:*** Julia was part of a consortium that served as the Independent Monitor for PacifiCorp's renewable solicitation process for the 2008R-1 solicitation process for additional renewable power supplies. The Independent Monitor reported to the Utah Public Service Commission ("Utah PSC"), but filings were also made with the Oregon regulator. This process included review and assessment of the solicitation process, documents, and modeling methodologies; valuation of the bidder pre-approved process; development of review criteria, monitoring, auditing, and validation of bid evaluation process; bid evaluation; contract negotiation. [Docket No. UM1368]
- ***monitored power procurement processes for Connecticut Light & Power***: The Department of Public Utility Control retained the services of LEI to assist the DPUC in monitoring the power procurement processes for Connecticut Light & Power's (CL&P) Transitional Standard Offer auction in November 2004 for services in 2005 and 2006, and once again selected LEI in September 2005 to monitor the November 2005 auction for services in 2006. Julia led LEI's team in providing advisory services to the DPUC, including guidance on communications protocols, design of sales contract agreement (between CL&P and winning bidders), and also valuation of final bids vis-à-vis the forward market alternatives available to the utility. In

November 2004 and 2005, Julia filed an affidavit after completion of the procurement process which the Commissioners used to approve the process and the contracts between CL&P and the winning bidder. [DPUC Docket No. 03-07-18PH02]

- ***performed market power analysis:*** Bear Swamp Power Company LLC (a pumped storage generation unit) asked LEI to perform a market power analysis in conjunction with Bear Swamp's application for market-based rate authorization. A similar study was done for Carr Street Generating Station L.P., Erie Boulevard Hydropower L.P., Brascan Power St. Lawrence River LLC, and Piney and Deep Creek LLC. [FERC Docket No. ER05-639 et al]
- ***prepared expert testimony related to horizontal market power considerations:*** In support of various acquisitions by IPPs spanning many years, Julia has prepared expert testimony for filing with FERC, related to Market-based Rate Authorization applications, Triennial Reviews, and Section 203 (merger) applications. LEI has a 100% track record in getting its clients' applications for market-based rate authority and/or mergers approved by FERC.

Market design work

- ***conducted an empirical analysis of market design change to the Forward Capacity Market to align with states' clean energy initiatives:*** Specifically, LEI examined the Competitive Auctions with State Policy Resources ("CASPR") proposal from ISO-NE. The CASPR proposal involves adding a second or "substitution" auction to the current Forward Capacity Market ("FCM") framework. LEI examined the fundamentals for this substitution auction and integrate it within Contractor's overall FCM model. LEI evaluated the financial incentives for incumbent (existing) resources to remain in operation versus the financial incentive to retire (and therefore the bidding strategy of these resources). LEI considered critically the tradeoffs that existing generators will be making in the face of the substitution auction, including the opportunity/risk of continuing to operate versus the opportunity/risk of submitting a retirement bid and participating in the substitution auction.
- ***performed economic advisory in a matter relating to market design strategy for a large Canadian generator:*** LEI performed a case study-oriented comparative review of energy-only and energy and capacity markets in North America and abroad, with lessons learned from other jurisdictions. LEI's work plan called for the simulation modeling of three forms of market design: an energy-only market, an energy and capacity market akin to Grid of the US RTO markets, and a hybrid market with long term contracts and a spot market for capacity. The third phase involved the creation of a customized tool for future analysis, based on the simulation modeling results.
- ***provided expert insight on capacity performance schemes, on behalf of NEPOOL:*** LEI was retained by NEPOOL to provide expert insight into the proposed Performance Incentives scheme for ISO New England's Forward Capacity Market. LEI considered the implications for generators' risk profiles and ultimately the costs to consumers. LEI's report was filed with FERC as part of the Jump Ball filing.
- ***analysis of different wholesale market mechanisms:*** as part of LEI's multi-client regional market analysis program ("Continuous Modeling Initiative"), LEI staff conducted a cross-market analysis of how various market designs can accommodate increasing volumes of intermittent resources and retirement of conventional, dispatchable fossil fuel fired resources.

LEI also evaluated development/siting and operations of new dispatchable resources, including energy storage to support a decarbonzied electricity sector.

- ***evaluation of wholesale market design efforts by ISO-NE to address fuel security/winter-time energy reliability issues:*** LEI staff assisted the Massachusetts Attorney General's Office in 2018 to evaluate market design fixes being proposed by ISO-NE staff as well as other NEPOOL market participants. In early 2019, LEI has also made a counter-proposal for a new seasonal energy storage-based ancillary services product and adjustments to the existing capacity market design. ISO-NE is proposing market rules changes to FERC in 2020.
- ***prepared an independent white paper reviewing the merits of various expert's positions with respect to re-design of the competitive retail market in New York and imposition of price caps on competitive retail providers based on the embedded costs of incumbent utilities:*** LEI staff, led by Julia, reviewed the competition-related testimony of various experts in the retail case proceeding before the NY PSC and provided an independent critique of the substantive arguments (and flaws thereof). LEI concluded that certain other testifying experts mis-defined the market for competitive retail services, and mis-applied standard concepts in competition theory and anti-trust policy. LEI proposed alternative theories for observed price differences and customer switching trends.
- ***provided independent guidance to Alberta stakeholders on electricity market reforms in the face of evolving environmental and electricity industry policy:*** LEI supported the largest independent power producer in Alberta through the initial negotiations around climate change policies, including introduction of a renewable investment program, coal generation settlement, carbon taxation, and design of a capacity market. More recently, LEI has been involved in nearly two years of industry consultation and stakeholdering on what kind of capacity market design to introduce in the Province. LEI staff work closely with several industry participants, and have presented at AESO-led working groups on a variety of issues, including the setting of the demand curve, and market power rules and regulations.
- ***prepared a White Paper to identify and debunk the myths about transmission investment and prove the truth with real-world cases studies.*** In order to offer a more accurate portrayal of the need to invest in transmission infrastructure, the White Paper concluded with recommendations for practical and feasible improvements to the process of evaluating transmission projects. The paper is publicly available at www.wiresgroup.com.
- ***advised private clients on the intersection of state and Federal policies in wholesale market rules and specifically MOPR-related issues in organized capacity markets:*** LEI modeled the latest proposals from PJM and stakeholders on its evolving MOPR design, and compared and contrasted the rules with ISO-NE's FERC-approved solution for dealing with investments mandated by state policy (e.g., CASPR). LEI advised clients on FERC strategy and discussed opportunities for existing resources to enhance end-of-life economics via the CASPR.
- ***presented to the NY Public Service Commission ("PSC") regarding NYISO's proposed changes to the energy market to include social cost of carbon:*** LEI advocated in committee meetings for neutrality of treatment between imports and local resources in setting of the carbon bid adder.
- ***advised client on electricity capacity product:*** LEI advised the California Energy Commission and other stakeholders on the design and development of a web-based software system

supporting the trading of an electricity capacity product tracked by state regulators in connection with resource adequacy requirements. LEI analyzed similar systems in other jurisdictions, defined potential core functionalities of the California system – including, for example, posting of bids and offers. The engagement also required LEI to track titles, examine bilateral and/or multi-lateral trades and compliance reporting. LEI conducted a survey of industry participants to identify required and desired system capabilities.

- ***market design in support of electricity sector restructuring in Greece, specifically consideration of alternatives to physical divestiture of generation assets:*** On behalf of PPC, the government-owned vertically integrated national utility, LEI examined the following options: virtual power plant ("VPP") auctions, contract for difference ("CFD") and physical energy swaps. In case study format, the various options were compared against the following criteria: instrument objective, contract structure, contract terms, sale platform, settlement structure and the extent of physical control right transfer. Real-world experience from France, UK, Belgium, Denmark, Netherlands, Australia, and Alberta (Canada) helped shape the discussion of comparative advantages and disadvantages, taking into account the unique concerns for Greek policymakers.
- ***conducted modeling and forecasting related to the Alberta government's recent announcements to transition to a capacity market and continue meeting its carbon emissions reduction plans:*** as part of this engagement, LEI developed several scenarios that evaluated the impact of various policy and market related changes in the Alberta market on incumbent and new generators in the province. These changes included market design (energy only or energy & capacity market), plants' retirements/repowering plans, varying carbon tax regimes and different renewable investment targets. Results from these scenarios were designed to identify specific operational and regulatory risk for the client and develop a strategic best-response to optimize the client's portfolio in light of these uncertainties.
- ***advised on Strawdog related to estimation of market harm:*** LEI was retained by a market participant in Alberta to develop comments on MSA's Strawdog for the Framework for the Assessment of Market Harm. More specifically, LEI was asked to comment on the economic issues associated with the proposed Strawdog pertaining to the definition of harm in the context of Alberta's market design and the impact of the implementation of the Strawdog on wholesale power market design, market manipulation and market power abuse.
- ***prepared white paper for Canadian electricity regulators and utilities on the comparative advantages and drawbacks of various tariff-setting regimes, from performance-based regimes to cost-of-service:*** This project involved a general overview of tariff-setting practices across Canadian provinces as well as highly detailed Canadian and international case studies and an examination of the key-lessons to be learned from each case. Detailed case studies covered the tariff-setting regimes in place in the UK, the Australian National Electricity Market and the Netherlands. As part of its deliverables, two workshops were conducted with a variety of regulators and utilities.
- ***conducted a capacity market modeling exercise to evaluate the potential impacts of different resource adequacy mechanisms:*** LEI was engaged by a major US utility where the objective of the study was to identify a market design that would provide the maximum profits at the lowest possible risk, including market and regulatory risk. LEI modeled market prices, market revenues, and gross profits under three supply-demand scenarios and tried to

simulate the impact of market intervention policies on such market revenues in order to understand the potential risks and benefits to the client's baseload fleet under different market designs.

- ***provided economic advisory on market power mitigation tests for a large US-based utility:*** LEI consulted on market design features related to a proposed nodal market, including most significantly the market power analysis framework. LEI proposed strategy and is assisting in the development of an implementation framework for the local market, including prepared reports for the market design team and state commission. In addition, the approach will be proposed for federal review at FERC.
- ***conducted review of capacity market rules:*** DECC was interested in whether US power markets evaluate generation bids based on criteria other than the price bid, specifically, if the length of contract had a role in the auctions. LEI reviewed capacity market rules for PJM, ISO-New England and the New York ISO. LEI also examined whether and for how long a "lock-in" options for the first year capacity price is offered to new generation assets bidding into the auctions. LEI also reviewed international spectrum auctions, North American gas transmission open season rules, and international auctions for toll roads to examine whether and how duration or length of contract is incorporated into bidding rules and auction clearing processes.
- ***provided a comprehensive analysis of the proposed market power mitigation measures for Alberta's electricity market for a major utility:*** Julia and her team looked at various scenarios and presented the likely outcomes given various generation portfolio configurations under each proposal and whether these mitigation measures will result in the desired results. Led by Julia, the LEI staff made a case that more rigorous and robust approaches are needed than the proposed measures. Additionally, Julia's team conducted a comparative analysis of the procurement processes and compensation schemes of the different ancillary services products in eight markets, namely: New York, New England, Pennsylvania-New Jersey-Maryland, Texas, UK, Alberta, Australia, and Ontario. The results of this analysis were used to support the client in the Alberta's stakeholder process to redesign a system operator's procurement process.
- ***authored paper on a virtual power plant auction format:*** Julia and the LEI team prepared a white paper outlining the concept of a Virtual Power Plant product and auction format, as part of a multi-consultant engagement in support of restructuring of the Greek power sector.
- ***prepared and filed testimony and quantitative analysis on questions of market definition and market integration:*** In June 2005, Julia participated on a panel discussing market monitoring issues, as well as market power safeguards for wholesale electricity markets. In 2004, she also provided testimony on pricing safeguards proceeding, which looked at alternative market power testing procedures for market power, analyzed implications on investment, and discussed efficiency consequences of certain bidding behavior.

Electricity and Natural Gas Asset Valuation and Transaction Advisory Work

- ***engaged by an investment firm in association with its acquisition of a proposed natural gas-fired plant in Ohio:*** Work involved asset valuation, due diligence support and market analysis. LEI reviewed the documents in a virtual data room, and performed analysis related

to drivers of gross margin for the asset: macroeconomics, fuel and electricity cost projections, and overview of gas and electricity market in the region where the asset was located.

- ***provided independent market analysis to clients interested in understanding the implications of expansion of natural gas supply into New England:*** LEI began with a review and evaluation of the numerous proposals for pipeline expansions. LEI staff also performed natural gas network modeling (using GPCM, an industry-standard network model of the North American natural gas system) and power simulation modeling (using LEI's proprietary POOLMod model) to arrive at a quantitative impacts assessment of various projects on the Northeast gas markets and electricity markets.
- ***conducted price driver analysis on gas-fired asset:*** LEI was engaged by a private client to conduct a price driver analysis and strategy optimization exercise to enhance the bidding and dispatch strategy on a jointly-owned gas-fired asset. This included a report on ISO-New England's Winter Reliability Program to identify and evaluate key wholesale price drivers in the New England region. LEI also examined the generating asset's financial data to help optimize its bidding strategy.
- ***conducted gas price forecasting:*** For a private equity client, LEI forecasted the energy and capacity revenues of various gas-fired plants in PJM for a 20-year period. More specifically, LEI projected the energy and capacity prices, plants' annual generation, load factor, and operating costs. LEI's analysis influenced the client's going forward investment decisions.
- ***evaluation of the rate impacts associated with bankruptcy-related settlement for PREPA:*** LEI was engaged by the Committee of Unsecured Creditors to consider the implications of a proposed settlement with bondholders put forth by the Financial Management and Oversight Board of Puerto Rico and various other parties. LEI's analysis focused on the impact that the settlement would have on the rates for electricity service that the Puerto Rico Electric Power Authority ("PREPA") would need to charge its customers. LEI also examined the likely impact on electricity demand, taking into account the increase in rates due to the settlement. LEI performed a detailed review of the current and projected costs of service for PREPA, based on certified Fiscal Plans released by PREPA and other documents related to future investment needs. LEI also studied how rates in Puerto Rico compared to other island systems. LEI created a detailed long term model of rate impacts where the rate impacts were dynamically affecting also consumers' willingness to purchase electricity from the grid. and PREPA's customers.
- ***Grid of the Future study:*** LEI was retained by a regional utility to assess the dynamics in the wholesale market through 2050, given aggressive decarbonization goals of the states in the region, changing supply mix, and evolving consumer attitudes (and interest in DERs and self-supply). LEI began the project with a meta-survey that analyzed and compared research findings from over 100 studies, in order to develop inputs and assumptions into the simulation-based economic modeling. Scenario-based analysis was used to then consider the variety of uncertainties about future supply and demand conditions, as well as policies affecting the wholesale market out to 2050.
- ***analysis of the long term costs and benefits in the formation of a state power authority:*** LEI was retained by the Maine Public Utilities Commission to analyze the short- and long-term costs and benefits of Maine's new legislation (L.D. 1646) which will establish the Maine Power

Delivery Authority ("MPDA"). LEI examined the legal, regulatory, technical, financial and operational issues related to the L.D. 1646 proposal and its implementation, assessed the anticipated impacts on electricity rates. The results of LEI's findings will be presented to the Maine Legislatures' Joint Standing Committee on Energy, Utilities and Technology.

- ***analysis of wholesale power supply options***: LEI was retained by a Midwest electric distribution cooperative to review and evaluate alternative options for securing supply, either with third-party energy service provider or directly from the MISO-administered power markets. LEI reviewed and analyzed offer(s) from energy service providers and benchmarked the offers against long term contracts on file with FERC through the Electronic Quarterly Report. LEI also advised the Board of the electric distribution cooperative on pertinent market rules and wholesale market costs that would apply to their customers.
- ***macroeconomic benefits of the development of Compressed Air Energy Storage ("CAES")***: LEI was engaged by a developer to analyze the local economic development benefits associated with the construction and operations of a CAES project at the site of the soon-to-be-retired Intermountain Power Project plant in Millard County, Utah (the "Project") using the REMI PI+ model. LEI analyzed the macroeconomics impacts from the construction and operations of the proposed CAES project, as well as the coal plant replacement, new gas plant additions, and property tax payments associated with the project.
- ***open solicitation for an inter-regional HvDC transmission project:*** LEI was retained to design a multi-phased open solicitation for electric transmission capacity on a proposed inter-regional transmission project in the Midwest. LEI will also serve as the Independent Evaluator during the open solicitation process, in order to ensure that FERC requirements are met for the allocation of transmission capacity in a fair and non-discriminatory fashion.
- ***wholesale market supply strategy:*** LEI was retained by a rural electric cooperative to assist it evaluating wholesale market supply options. LEI prepared Board presentation materials that describe wholesale market rules and future opportunities. LEI also provided support to the rural electric cooperative in its efforts to identify competitive supply options.
- ***valuation for a cogeneration project:*** LEI assisted a private equity firm with valuation of a large urban cogeneration facility in the Northeast US. LEI developed a dispatch profile and calculated all electricity, steam, environmental, and maintenance revenues and costs to determine the gross margins of the plant for the next 20 years; LEI's analysis was prepared for purposes of independent asset valuation.
- ***analyzed opportunity for a transmission tariff rebate based on going forward financial viability of a customer:*** LEI was engaged by Emera Maine, a transmission utility in Maine, to assess the financial viability of a customer to continue to operate several power plants in coming years with and without a transmission tariff rebate. LEI's analysis supported public discussions regarding the transmission rebate and a FERC filing by Emera Maine.
- ***evaluation of the benefits of a new pumped storage project in Canada:*** LEI prepared independent economic analysis analyzing the profits to the developer and the benefits to society stemming from the development of a new pumped storage hydroelectric project. LEI measured energy price impacts, simulated operation of various ancillary service markets (given the flexible nature of the pumped storage to provide regulation and operating reserves), and also consider ramping and inertia attributes of the project to the system. Lastly,

through its power market simulation software, which considered the volatile nature of intermittent renewable generation, LEI also considered the resource adequacy and reliability attributes of the project from a public benefit perspective. LEI's analysis also considered how this particular investment would compare with other potential dispatchable generation and alternative energy storage technologies.

- ***prepared a tutorial on power markets***: For a client looking to acquire an asset in New York City, LEI prepared a tutorial on power markets tailored specifically to market rules and market drivers of electricity, capacity, and ancillary services markets in the city
- ***assisted with the evaluation of an investment in a new gas-fired power project in Alberta:*** LEI created a Baseline forecast for the Alberta market to allow the client to evaluate the energy & capacity market dynamics in the Province, which was paired with detailed reporting for the financial and operational details for the client's project. In addition, LEI also created two sensitivities to assess the upside and downside opportunities.
- ***conducted due diligence of a potential asset acquisition in MISO-South:*** LEI reviewed the contracts and financial analysis, with specific focus on the assumed market value of capacity in the long term, and locational marginal prices for energy. LEI also reviewed certain contracts and supporting materials, and participated in due diligence calls.
- ***retained by large private equity firm to present a market overview of the markets where it owns generation assets:*** These markets include PJM, New York, New England, ERCOT, and SERC. In addition to this, LEI presented an investment opportunity presentation to senior management.
- ***consulting services and forecasts related to avoided energy supply costs***: LEI conducted an empirical analysis of proposed key New England wholesale electricity market design change to the Forward Capacity Market, which, included long term modeling of the New England energy and capacity markets. Specifically, LEI examined the Competitive Auctions with State Policy Resources ("CASPR") proposal from ISO-NE. The CASPR proposal involves adding a second or "substitution" auction to the current Forward Capacity Market ("FCM") framework. LEI examined the fundamentals for this substitution auction and integrate it within Contractor's overall FCM model. LEI evaluated the financial incentives for incumbent (existing) resources to remain in operation versus the financial incentive to retire (and therefore the bidding strategy of these resources). LEI considered critically the tradeoffs that existing generators will be making in the face of the substitution auction, including the opportunity/risk of continuing to operate versus the opportunity/risk of submitting a retirement bid and participating in the substitution auction.
- ***research paper demonstrating best practices for measuring the benefits of transmission*** for a WIRES-funded research project, LEI prepared a "how-to" guide and demonstrated its application on two hypothetical transmission projects, showcasing how system planners and other decision-makers can measure objectively the benefits of transmission investment from the perspective of various stakeholders, and also over the short- medium- and longer-term.
- ***conducted empirical analysis of key features of proposed capacity markets in Alberta and Ontario:*** LEI assisted the client in understanding the capacity market design initiatives across Canada. LEI staff presented a series of work paper on various topics, related to market mechanics and resource adequacy and setting of the demand curve. LEI also assisted the

client in critical evaluation of design options from the perspective of the existing generation fleet, new entry, and consumers through detailed quantitative modeling and simulation-based analysis of the target markets.

- ***advised a major utility in Canada in its call for tenders strategy for procuring firm capacity over a long term horizon from neighboring jurisdictions:*** Julia evaluated the opportunity for purchasing capacity from interconnected jurisdictions and devising a procurement that would efficiently overcome seams issues and market design issues that attach different counting and valuation methods for capacity across jurisdictions.
- ***Design of an innovative framework for evaluating the economics, environmental, and siting costs and benefits of transmission (and generation investment) for the California Independent System Operator:*** building upon the traditional economic framework for cost-benefit analysis, the LEI team devised an approach to quantitative value the expected net benefits from various infrastructure projects, taking into account market uncertainties as well as the classic deregulated market coordination problem of planning for transmission give uncertain generation investment and vice versa. A scoring technique for environmental permitting and siting issues was also developed, in order to quantify the potential impact of the proposed project on the local environment and economy, as well as to measure the impact of such factors on the project timetable and eventual net benefits to society. Real option techniques were also considered in this engagement to assess the potential value of uncertainty and the benefits for delaying various investment strategies. The methodology was also expanded to handle the potential to evaluate numerous competing projects, in recognition of the fact that transmission and generation investments (and other potential investments) could be both complements and substitutes.
- ***served as Independent Examiner for Western Interconnect transmission line:*** LEI was selected by developers of the Western Interconnect transmission line in New Mexico to serve as Independent Examiner for their Open Season process, through which WI offered transmission capacity over the line to any interested party at the same rates, terms and conditions as those offered to anchor customers on the line. LEI designed and managed the entire process, which included creating the evaluation criteria, drafting announcements and press releases, preparing the Open Season documents and forms, conducting information sessions, overseeing the process website, and evaluating and ranking bids. At the conclusion of the process, LEI prepared and submitted a report to FERC (in docket ER15-2647) attesting that the process was market-driven, fair, transparent, and non-discriminatory.
- ***capacity price review on auction bidding:*** The UK market regulator was interested in whether US power markets evaluate generation bids based on criteria other than the price bid, specifically, if the length of contract had a role in the auctions. LEI reviewed capacity market rules for PJM, ISO-New England and the New York ISO. LEI examined whether and for how long a "lock-in" option for the first year capacity price is offered to new generation assets bidding into the auctions. LEI also reviewed international spectrum auctions, North American gas transmission open season rules, and international auctions for toll roads to examine whether and how duration or length of contract is incorporated into bidding.
- ***conducted cost of electricity comparisons across Canada:*** LEI was engaged by a consortium of private companies to estimate and compare the delivered cost of electricity for all Canadian provinces over the 2011-2015 timeframe: In addition, LEI also forecasted how the delivered

cost of electricity in Alberta could develop over the next fifteen years (2017-2031) under the Climate Leadership Plan ("CLP"). LEI forecasted energy, transmission, and distribution rate components, using three modeling scenarios in addition to a Base Case, evaluating different assumptions for renewable investments, demand levels, and reserve margin targets. The Base Case and scenarios were designed to inform the general public about the impacts of various policy and market based interventions on the delivered cost of electricity to consumers in Alberta in the future.

- ***price forecasting for wind facilities:*** LEI analyzed the revenue potential for wind facilities in CAISO, SPP and PJM, developing price forecasts through 2045 and also assessing market rules to identify any potential penalties that may apply to intermittent generation and deviations from generation profiles. Three cases of merchant forecasted revenues, Base Case, High Case and Low Case, were developed in order to identify key uncertainties and opportunities.
- ***served as Independent Examiner for a proposed merchant transmission project's Open Solicitation process***: The project entailed designing the solicitation process, meeting with potential shippers on the line to garner early interest, drafting announcements and press releases, conducting information sessions, updating the solicitation website, evaluating and ranking bids, assisting with bilateral negotiations with shippers, and submitting a report to FERC as part of the developers' Section 205 filing.
- ***conducted independent analysis on power market in support of transmission development: LEI supported*** a major transmission developer in the Northeast US in its analysis of opportunities and market impacts from a number of potential projects to bring energy into the New England region. LEI performed independent analysis measuring the impacts of numerous project designs on the power market (including energy and capacity markets, production cost savings and environmental benefits) and local macroeconomic analysis as well.
- ***retained by private equity firm to provide 20-year monthly energy and capacity prices and operating metrics results for several CCGT plants in PJM:*** LEI reviewed plant parameters, financial model, and market consultant reports provided by the seller and delivered price forecast and dispatch results to the client.
- ***conducted New England modeling:*** LEI conducted an empirical analysis of New England wholesale electricity market dynamics, including long term simulation based of the New England wholesale market to measure energy and capacity market impacts, production cost savings, generators profitability under various future market conditions. The client used LEI's modeling results to perform policy analysis and prepare a research report that the client plans to release publicly in 2017.
- ***Alberta market analysis:*** For a major stakeholder in Alberta, LEI conducted empirical analysis to identify how change in offer behavior of some resource owners affected spot and forward markets in Alberta. LEI developed two separate econometric models (a time-series analysis for spot, and a panel (or a cross-sectional time-series) regression for forward markets) to estimate the price impacts from the change in the offer behavior, lost value in wholesale markets, and foregone revenues for key market participants. The engagement also involved a detailed analysis of historical offer bid data to determine when the offer behavior changes

occurred, and an analysis of select Alberta power plants' financial losses due to uneconomic offer behavior.

- ***conducted wind price forecasting:*** LEI used its proprietary dispatch model, POOLMod, to project energy prices in ERCOT for a wind developer undertaken financing of its projects in West Texas. LEI also examined the implications of PPA related to the two wind farms. LEI also provided energy, capacity, and solar renewable revenues for an operating solar plant in New Jersey as part of the same engagement.
- ***reviewed energy storage installations in New England:*** For a transmission and distribution company in New England, LEI analyzed the cost and benefit to consumers on different configurations of energy storage installations in the ISO-NE grid. The engagement involved modeling multiple configurations of energy storage solutions, including different storage capacity and duration, as well as various charging and discharging cycles.
- ***developed a simulation model for forecasting ancillary services revenues:*** The engagement involved analyzing the dynamics of ancillary market prices and revenue under different market scenarios. The model developed was able to simulate hourly dispatch and clearing of the ancillary services market, and was integrated with LEI's Alberta energy market model.
- ***reviewed trading activities within energy market:*** On behalf on an electricity marketer, LEI liaised with NYISO Market Monitoring & Analysis (MMA) department in respect of trading activities in the energy market.
- ***serves as Independent Examiner for a proposed merchant transmission project open solicitation process:*** The project entailed designing the solicitation process, meeting with potential shippers on the line to garner early interest, drafting announcements and press releases, conducting information sessions, updating the solicitation website, evaluating and ranking bids, assisting both bilateral negotiations with shippers, and submitting a report to FERC as part of the developers' Section 205 filing.
- ***performed analysis of HVDC transmission projects:*** LEI was retained by a transmission developer to perform a high-level analysis of the cost-competitiveness of HVDC transmission as a regulated solution with respect to generation resource. The work included comparing the revenue requirement for HVDC transmission projects with the net Levelized Cost of Entry ("LCOE") of comparatively sized and located generation resources.
- ***advised on New York transmission project:*** LEI provided advisory service to a transmission developer looking to position its project in New York. LEI provided an overview of the current regulatory and legislative framework, and assisted in identifying and targeting potential shippers on the line.
- ***provided analysis on new HVDC transmission line***: Julia Frayer led an LEI team that provided strategic support and analysis of various regulated and unregulated business models for proposed new HVDC transmission line, including identification of potential shippers and RFP opportunities, as well as categorization of potential private and social benefits of the project
- ***advised on climate change policy in Alberta:*** LEI provided research, analytical and advisory support to a client in Canada as the Alberta government implemented its climate change

policy, which will shut down coal plants early, ramp up renewable generation, and put province-wide carbon tax in place.

- ***assisted a client to perform the competitive landscape analysis for projects participating in the Clean Energy RFP:*** LEI's competitive landscape study employed a three-step approach. At the Step I, LEI identified the potential projects that can qualify for the Clean Energy RFP and production of a matrix of competitors. The comparative analysis then graded each project from Step I, using the type of criteria listed in the evaluation and selection process section of the Clean Energy RFP. In summary, LEI's comparative analysis looked at both the (a) minimum threshold requirements and (b) the characteristics of each project relative to the quantitative and qualitative benefits enumerated in the Clean Energy RFP. Lastly, based on the rankings from the comparative analysis in Step II, LEI concluded with the SWOT analysis for the client's project relative to possible competitors and examine the relative strengths, weaknesses, opportunities, and threats in the Clean Energy RFP.
- ***provided a 20-year market outlook report for New England:*** The market outlook report was to include a 20-year regional price forecast for the energy and capacity markets, summary of recent market developments, comparison of monthly and peak versus off-peak prices, and a Tier-1 Renewable Energy Credits ("RECs") forward price forecast.
- ***reviewed NYISO due diligence materials:*** For an infrastructure investment fund, LEI reviewed due diligence materials for the client's potential acquisition of a cogeneration plant participating in the NYISO markets. LEI further performed an analysis to forecast future fuel and operating costs for the plant, revenues from the sale of energy and capacity in the wholesale markets, and revenues from the sale of steam to an off taker.
- ***analysis of congestion in the New York market***: For a transmission project developer, LEI performed an analysis of congestion in the NY markets for proposed renewable generation resources as well as a new transmission link. LEI relied on results from a power flow study to properly model the proposed resources and transmission constraints in POOLMod.
- ***analyzed the impact of a new transmission project between upstate and downstate New York:*** LEI used its proprietary energy and capacity market simulation models to assess the impact of the proposed transmission line on New York energy and capacity markets over a 20-year horizon. LEI further prepared a forecast of revenues for potential shippers from the results of the simulations.
- ***supported a risk management assessment:*** LEI assisted in a large provincial institution in the development and assessment of alternative risk management and investment strategies for its trading and investment businesses. As part of this work LEI completed a Risk Assessment Survey of the Board of Directors as well as additional Value-at-Risk ("VaR") modeling, scenario and stress testing.
- ***conducted New England gas price forecasting:*** LEI was retained to forecast delivered gas prices in New England (Connecticut) and PJM (New Jersey) and locational marginal prices as well as retail electricity prices in Connecticut.
- ***led workshop to review New England markets:*** LEI was hired by a New England transmission & distribution utility to prepare a two-day workshop for company executives detailing the current state of the New England markets, major players across all sectors of the industry, major investment drivers and investment analysis methodology. LEI staff prepared

workshop material and traveled to the client's office to present the material and answer client's questions.

- ***prepared a quantitative analysis to test the efficacy of a proposed cross hedging strategy for a merchant transmission project that will be bringing energy from Canada:*** The proposed strategy is to use natural gas futures contracts to hedge energy market exposure and revenues. Analysis will include ordinary least squares regressions as well as an error correction model to determine the appropriateness of the hedge.
- ***analyzed revenue/gross margin modules for various district energy assets in Illinois being considered for acquisition:*** LEI reviewed information received from the client, including detailed documents in the data room, and presented analysis in a slide deck relating to contract revenues (prices and volumes) and fuel costs (electricity) along with revenue and cost drivers. LEI also presented sensitivity analysis for high/low sales volumes, new customers, expiry dates of existing contracts, fuel costs etc.
- ***provided due diligence analysis and support on the acquisition of a portfolio of small hydropower plants in the PJM region:*** The portfolio consisted of a mix of mini and small run-of river hydropower plants. LEI's scope of work was threefold. Firstly LEI provided an overview of PJM RTO market, describing market fundamentals, key players, supply mix, retirements and new built, as well as discussing historical market trends. Then, LEI used its proprietary dispatch and simulation cost production model POOLMod to simulate power market dynamics and develop forecasts of energy prices in the assets' location over a 20 year horizon. As part of this modeling exercise, LEI used its in-house capacity market to develop capacity prices forecasts over a similar horizon. Finally given the conventional storage capability of one of the unit, the client requested LEI to provide a description of the frequency regulation market in PJM and to determine potential revenue opportunities for the plant. LEI provided results of its modeling exercise in Excel format and prepared a slide deck summarizing key messages, key findings and recommendations to the clients.
- ***provided due diligence review on New England plant:*** LEI worked with private equity investor on an M&A due diligence review of a combined heat and power generation unit in New England. LEI provided market analysis, price forecasting services, and supported the investor in its valuation of the asset.
- ***conducted review of Maine hydro facilities:*** For an infrastructure investment fund, LEI reviewed due diligence materials for the client's potential acquisition of a portfolio of hydro facilities located in Maine, and provided an independent valuation of the projects based on forecast energy market dynamics and REC opportunities.
- ***reviewed NESCOE Gas Electric Phase Three study:*** LEI conducted a comprehensive review of the NESCOE Gas Electric Phase Three study in order to ensure that the appropriate economic models and techniques were being used to accurately model the hydro and gas solutions. LEI also aided the client in identifying any assumptions and modeling approaches which may be suboptimal, and communicated how these issues can be addressed and improved in future studies.
- ***asset valuation, due diligence support and market analysis for an infrastructure fund:*** The engagement involved reviewing documents in a virtual data room, and analysis related to drivers of gross margin for the asset: macroeconomics, weather fluctuations, fuel and

electricity cost projections, and overview of gas and electricity market in the region where the asset was located.

- ***conducted market study regarding renewable generation:*** Julia led the preparation of a market study to support financing of a renewable generation portfolio in New England. The market analysis supported a successful multi-million dollar debt raise for the client.
- ***developed HHI screens in support of a valuation of a gas-fired facility:*** LEI developed simplified HHI screens looking at summer peak period for a client's potential acquisition of a gas-fired facility in New York. Several scenarios were developed to test the impact on HHI.
- ***conducted evaluation of fair market sales value of a coal-fired unit in Arizona, as required by a lease that expires in 2015:*** Results from LEI's proprietary modeling tool, PoolMod, on market prices and dispatch were used as inputs in the financial model, which used discounted cash flow techniques. Two cases (Base Case and High Case) were created to develop a range of value with a weighted average point estimate. In addition to the discounted cash flow model, the market approach, which looks at comparable transactions, and the cost approach, which looks at the cost of building the same facility were considered.
- ***provided valuation services for a waste coal facility located in the Pennsylvania-New Jersey-Maryland ("PJM") regional market:*** Specific tasks consist of i) due diligence review of documents such as past financial statements, operational statistics report, fuel agreements and power purchase agreements ("PPA"); ii) forecasts energy and capacity prices in the PJM regional market; iii) create a pro forma financial model to evaluate the market value of the plant as of expiration of its PPA; iv) writing a final report documenting assumptions, methodologies used and modeling results.
- ***provided forecasting and modeling support for a start-up company:*** Julia and her team assisted Tres Amigas LLC, a start-up company on the revenue forecasting and modeling for the second stage financing. The start-up company aims to develop, own and operate a unique three-way AC/DC transmission facility located in New Mexico. In 2010, for the feasibility analysis stage, LEI provided extensive transmission evaluation, financial modeling, price forecasting, and market analysis for the markets, including the Arizona/New Mexico/Southern Nevada sub region of the Western Electricity Coordinating Council, the Electric Reliability Council of Texas, and the Southwest Power Pool. LEI's analysis support over $15 million of development stage funding. LEI continues to serve as economic advisor to Tres Amigas, as it seeks debt and equity financing to support construction of Phase I.
- ***Market power analysis as a result of a proposed merger:*** in support of a client's opposition of a proposed utility merger in the Northeast US, LEI provided a white paper analyzing the impact of the merger on competition. The white paper covers analysis on buyer market power, concerns with utility's returning to rate base generation and vertical market power.
- ***conducting forecasting for electricity generation assets in New England:*** Using LEI's proprietary simulation model of electricity wholesale markets in ISO New England, LEI forecasted future cash flows for a portfolio of electricity generation assets and applied the net present value analysis to evaluate the portfolio's economic value under different potential future market conditions. This analysis supported the investment fund's decision to acquire and hold the generation portfolio's distressed debt.

- ***led research on biomass plants regarding renewable energy revenue options:*** Julia investigated opportunities for portfolio of biomass plants to earn renewable energy revenues from RECs, capacity markets, and carbon offsets given regulations in all states belonging to MISO, PJM, and ISO-NE. Engagement also involved formulating strategies for client to optimize the generation assets' revenue potentials by exploiting the identified renewable energy opportunities.
- ***analyzed potential revenues of pumped storage hydroelectric facilities (energy, capacity, ancillary services) proposed in various locations in ISO-NE and NYISO:*** The analysis included detailed simulations of the wholesale electricity markets, application of sophisticated statistical tools to estimate the volume and the price level of various ancillary services.
- ***assisted a major Canadian renewable power company in its economic valuation of a New England based renewable company, prior to acquisition:*** Work involved due diligence, analyzing the revenue potential of the potential acquiree's assets over the 2009-18 period across all major ISO-NE product markets, and separately analyzed the market power implications of the acquisition in preparation of a potential FERC application, including analysis of market power issues in ancillary services market.
- ***evaluated potential value of assets available under various regional auctions for a dominant IPP player:*** Julia worked with the client in composing a bid proposal by assessing market risks posed by various factors, such as fuel price shifts, merchant plant construction scenarios, site conversion potential, and transmission constraints and through extensive production cost modeling.
- ***conducted an indicative valuation of a proposed new transmission line, known as the International Transmission Line:*** LEI forecasted the revenues associated with the project and combined this revenue forecast with the estimated costs of the project to arrive at an estimate of the net present value of the project and return on investment.

Power, Gas, and Infrastructure Sector Business Development and Strategy

- ***advised on policy and government framework to Malaysia client:*** LEI was engaged by Tenaga Nasional Berhad ("TNB") to work as the project manager of its Incentive Based Regulation ("IBR") submission for the 2nd regulatory term. LEI provided advise on the policy and government framework for the implementation of IBR, providing strategic advice to IBR Council and TNB management regarding the IBR submission, managing and monitoring the submission process, coordinating with business entities and attending IBR Council meetings, progress meetings, and challenge workshops. Moreover, LEI reviewed the current Regulatory Implementation Guidelines ("RIGs") set by the Energy Commission and proposed enhancements to the RIGs. LEI is also currently involved in negotiations with the Energy Commission regarding proposed changes to the RIGs. LEI is also updating and providing enhancements to TNB's Revenue Requirement Model ("RRM") which sets the IBR tariff for each business entity. Furthermore, LEI assisted in the writing of the IBR submission report to the Energy Commission.
- ***conducted Total Factor Productivity study:*** In December 2014, London Economics International LLC ("LEI") prepared a report for Ontario Power Generation ("OPG") entitled "Empirical Analysis of Total Factor Productivity Trends in the North American Hydroelectric

Generation Industry." The purpose of this report was to share findings from LEI's TFP study, which estimated TFP trends for a select group of peers from the North American hydroelectric generation industry. Data for this study covered an eleven year period from 2002-2012. The purpose of this new engagement is to update this study for newly available data (encompassing operating costs and other statistics for calendar years 2013 and 2014).

- ***assisted an Ontario electricity generator in performing a productivity study on their hydroelectric assets to fulfill the mandate of the Ontario Energy Board ("OEB"):*** LEI proposed a structured approach to address how productivity should be measured, what methods are available, identify a relevant peer group, and ultimately provide the client with a productivity study for filing with the OEB.
- ***performed a forward analysis and market simulation of potential wholesale revenues for a proposed wind project in Wyoming:*** analysis was used by developer to attract potential counterparties for a long term PPA.
- ***conducted a comprehensive cost-benefit analysis of a proposed transmission project in New England using simulation-based analysis of the ISO-NE wholesale power markets:*** LEI's analysis included detailed examination of the benefits to consumers from lower energy and capacity prices, as well as emissions reductions and local economic impacts (associated with spending during construction and lower retail costs of electricity).
- ***"Grid of the Future" analysis of climate change policies:*** LEI conducted an impact assessment, covering a period of 2030-2050, and considering how policies and decarbonization goals will change the landscape for new supply resources; LEI also examined the impact of beneficial electrification on system demand. LEI conducted an extensive simulation-based modeling exercise that considered different capacity expansion profiles, taking account of economics of various resources, customers' willingness to pay, policy goals, and also technical constraints relevant for each technology. The capacity expansion analysis was integrated with LEI's energy simulation model to also factor in overall system reliability requirements. LEI supplemented the power market simulations with detailed analysis of other components of the customers' bill, in order to consider economically rationale customer response to different possible retail rate design and options for self-supply. Results of LEI's Grid of the Future" study will be published in the second quarter of 2020.
- ***Strategic analysis of the value of on-site peakers for an Alberta industrial client:*** LEI was engaged by an industrial client in Alberta that was considering the addition of on-site gas peakers. LEI's scope of work consisted of identifying potential technology type candidates that would suit the client's needs, reviewing historical and projected site loads, developing a status quo estimation for the cost of delivered power rates, and finally creating a relative economic model that compared the use of on-site generation against the status quo.
- ***portfolio optimization strategy:*** LEI was engaged by a Canadian client to explore options associated with entering into a service agreement with a third-party. LEI prepared a report which identified a number of firms which could provide this service, and provided a more detailed profile of the firms which best meet the requirements of the client. LEI also acted as an independent advisor to guide the client through a process to potentially contracting with a third-party service provider.

- ***conducted a Non-Transmission Alternatives ("NTA") analysis for the two transmission projects, which are components of a larger transmission solution in New England:*** The objective of the NTA analysis was to determine the feasibility and viability of other non-transmission resources – such as new generation and new demand-side resources – to be developed in lieu of these two specific transmission projects to relieve transmission reliability concerns. The NTA analysis was to be filed as part of the client's application with the Connecticut Siting Council. [Docket N5179515].
- ***supported a client in administering its compliance program:*** For all the US regions where the client (international IPP) is currently active, LEI was engaged to support the client's Regulatory Group in its administering of the company's compliance program. LEI provided a monthly report covering developments by regional market and products which included: energy, capacity, long-term transmission service, FTR auctions, ancillary services, diesel oil, PRB coal, natural gas commodity, transmission, and storage, RECs, and CO2. The purpose of this monthly update was to ensure that client's transactional and business groups were made aware of market rules and regulatory risks.
- ***provided due diligence support:*** LEI was engaged by a private equity company in association with asset valuation, due diligence support, and market analysis for a wind generation and HVDC transmission project proposing delivering wind-based renewable energy from Wyoming into California.
- ***authored report on pollutants emissions:*** LEI was hired by a large Canadian IPP to prepare a report providing an overview of past and current initiatives pertaining to pollutants emissions regulation with the purpose to inform the potential paths forward for future carbon regulation in the US. The engagement was initiated following the Executive Office of the President released the President's Climate Action Plan ("CAP") to reduce greenhouse gas ("GHG") emissions, and to prepare for the impacts of climate change. Under this engagement, LEI performed a detail literature review of the President's directive, past Environment Protection Agency ("EPA") regulations, as well as exiting regional carbon reduction programs. The overarching purpose of this exercise was to estimate the potential shape of a future carbon rule in the US (with associate features such as timing, mechanisms, and regulatory framework) based on EPA's legal authority scope, procedures and lessons learned from failed or successful rules implementation. LEI identified various market-based and non-market-based regulatory frameworks/scenarios and ranked them on their relative likelihood based on a set of established criteria including affordability of the regulatory scenario, impact on generation retirement and system reliability, alignment with EPA's precedents, congruency with Presidential directives, consistency with EPA's jurisdiction, and political palatability.
- ***evaluated the impact of the implementation of potential future Federal regulation limiting carbon emissions on ERCOT's energy markets and on Energy Future Holdings' ("EFH") portfolio:*** For a large Canadian IPP, LEI used its dispatch and simulation model POOLMod to develop forecasts of energy prices in ERCOT under a variety of potential frameworks under which carbon emissions could be regulated. The purpose of this exercise was twofold: a) evaluate the impact of a carbon rule (of any shape) on wholesale energy prices, and on the performance of the EFH' portfolios; b) determine the most impactful carbon rule regulatory framework.

- ***conducted New York price forecast:*** LEI was retained to do a 30-year (2015-2044) energy price forecast for Western New York, capacity price forecast for the Rest of the State, and revenue forecasts for a small hydroelectric plant in preparation for an asset sale process.
- ***reviewed client's risk management practices and provided meaningful insights with regards to the risk management related issues:*** Analysis included quantification of the magnitude and probability of risks being faced by trading and other operational activities of the client, as well as research into the best practices of other similar organizations.
- ***engaged by a global investment firm to provide a market outlook for three assets located in ERCOT:*** LEI provided a 10-year detailed market revenue forecast for the three plants under base case assumptions.
- ***provided independent review and assessment of cost-benefit analysis related to termination of certain PPAs between Entergy Texas Inc. and Entergy Louisiana:*** LEI's assessment was requested by the Public Utility Commission of Texas, as follow on to previous consultative services that LEI has provided.
- ***served as Independent Evaluator ("IE") for Pacific Gas & Electric Company ("PG&E") for PG&E Electric Fuels Department's Natural Gas Storage Services Request for Offer ("RFO"):*** Specifically, LEI worked with PG&E to ensure that Offers were evaluated consistently and appropriately in accordance with the solicitation protocol and in accordance with applicable rules and processes of the California Public Utilities Commission ("CPUC").
- ***prepared a study of the Value of Lost Load ("VoLL") in ERCOT and evaluated current utility practices for manual load shedding:*** LEI's report on VoLL was filed with the PUCT in June 2013 under PUCT Docket 40000.
- ***engaged by a Japanese research institute to research the environment for investment and financing of new generation in the US competitive electricity markets as well as the types of approaches used to manage investment risk:*** The LEI team researched the impact of market restructuring in the US on generation investment, methods for financing new generation, and analyzed policies promoting generation investment. LEI also performed four case studies on projects that were successfully financed and built in recent years, including assets in California (CAISO), Maryland (PJM), New York (NYISO) and Texas (ERCOT).
- ***provided support to FortisAlberta Inc. ("FAI"), a Canadian electricity utility, in its filing for its capital tracker application with the regulator:*** LEI reviewed the submissions of the interveners and advised FAI on how to address the issues raised by these interveners.
- ***led a comprehensive ratepayer-focused cost-benefit study of integrating a remote service territory of a single-state utility into a Northeast RTO's footprint:*** The cost-benefit analysis looked that at the long-run the benefits of joining an RTO versus the costs of new infrastructure that would be needed to accomplish the integration. LEI's analysis was used with regulators and state policymakers to pursue a transmission investment strategy by the utility.
- ***provided a study on electricity sector unbundling in the US for a Japanese client:*** The study starts with an overview of the electricity sector unbundling in the US, including the history of restructuring and unbundling efforts, the categorization of unbundling, and the

organizational impact of unbundling. Three case studies were also provided on specific unbundling experiences of TXU Corp., Commonwealth Edison, and Consolidated Edison.

- ***supported the negotiation of fuel supply and energy sales agreements for a biomass to energy facility:*** In particular, LEI's analysis focused on the appropriateness and risk associated with price and cost escalation factors. Reviewed similar power purchase agreements and analyzed a suite of available indices.
- ***counseled on transmission cost allocation:*** LEI advised Maine Public Utilities Commission on methodologies for transmission cost allocation by comparing and contrasting alternative planning approaches and pricing models employed within the US and one international jurisdiction, the United Kingdom. The final report provided a 'strawman' recommendation for an effective cost allocation methodology, which was used by the Maine PUC to guide it in its filings at FERC related to Order 1000 and the preceding NOPR on the same issue.
- ***served as Independent Monitor for Energy New Orleans:*** Julia acted as manager for LEI's engagement with the City of New Orleans. LEI was engaged to act as the independent monitor for Entergy New Orleans' solicitation of a Third Party Administrator to implement and deliver conservation and demand management programs on behalf of the utility. LEI provided guidance to Entergy and the City on the development of the request for proposals, including mandatory requirements and commercial terms. LEI oversaw the bid receipt as well as the review and selection process. A final report was provided outlining LEI's opinion as to the fairness of the overall process.
- ***assisted a client with certain matters pertaining to a FERC investigation:*** Specifically, the scope of this retention includes economic and market analysis in support of a market participant in ISO New England's day ahead load response program ("DALRP"). Julia also provided affidavits and deposed in connection with FERC investigation of behind-the-fence industrial generator and participation in a wholesale power market in New England. Julia helped the client to respond to assertions of market manipulation and estimate market benefit provided through its participation in demand response program.
- ***advised a major transmission company on financial implications of proposed new 400kV transmission line to New York City and Connecticut:*** LEI analyzed the impact of new transmission, assuming it delivered 100% carbon-free energy, on electricity prices and emissions levels in New York and New England.
- ***served as an independent economic expert, opinion on specific matters related to a market participant's participation in the day ahead demand response program implemented by ISO-NE:*** LEI staff reviewed the specific facts of the case related to how the customer baseline was developed and the offering strategy of the market participant in the demand response program. LEI conducted independent analysis of the decision making process that had been undertaken in support of the customer baseline and offer strategy. LEI also prepared an analysis of the market benefits created for the market as a whole through the demand reductions offered by the market participant (a customized VBA model was created to reconstruct day-ahead ("DAH") and real-time ("RT") energy market clearing prices using public historical hourly offer and bid data.
- ***supported a client in preparing an offer to provide new capacity:*** LEI evaluated projects submitted in the context of a competitive solicitation (RFP) for new capacity, aimed at

reducing Connecticut consumers' Federally Mandated Congestion Charges ("FMCC"). LEI drafted and administered the RFP. LEI then served as an independent evaluator on behalf of the DPUC and performed a comprehensive evaluation of the proposed projects, using LEI's proprietary production cost model, POOLMod. Julia testified at the Connecticut Department of Public Utility Control ("DPUC") regarding the RFP process and recommended selection of winners and award of contracts.

- ***authored FERC addendum:*** Julia wrote the report that served as an Addendum to the market power analyses that were filed with FERC in Docket No. ER05-665-001. The objective of this Addendum was to address the items requested by FERC in the deficiency letter issued on June 23, 2005 in this docket.
- ***managed theoretical analysis and quantitative simulation modeling in the design and testing of recommended new regulatory regime:*** Analysis and recommendations were presented to stakeholders.
- ***conducted market assessment:*** For a major Canadian utility, Julia undertook a comprehensive market assessment of the New England REC markets, and specifically the Massachusetts and Connecticut markets, under three different scenarios, the status quo, with the utility's resource commercialization schedule, and assuming sporadic participation by the utility.

Regulatory Economics

- ***reviewed Eversource's internal analysis and conducted a fatal flaw analysis to provide comments and critiques:*** LEI also prepared an analysis describing qualitatively the challenges to various NTA solutions identified in Eversource's internal analysis. LEI also conducted an independent analysis to estimate the costs of any possible NTA solutions. This involved talking to engineering firms, other utilities (on a no-names basis) and gathering specific data on DG and micro grid generation installations. LEI also commented on the practical feasibility/challenges associated with siting specific NTA technologies in the project region.
- ***co-authored analysis of productivity trends in the gas LDC sector:*** Julia managed a team of LEI experts in the analysis of productivity trends in the US over the last fifteen years; LEI also studied the effect of indicators that drive relative efficiency differences across LDCs. LEI's analysis supported regulatory strategy and decision-making on rates.
- ***conducted due diligence on gas-fired assets in the US:*** LEI was engaged by a private equity firm to conduct due diligence on a 3,000 MW portfolio of gas-fired assets in PJM and ISO-NE. LEI was responsible for developing the model that was used in the pro forma financial statements.
- ***drafted a white paper reviewing New York PSC's recommendation to set a price cap on competitive retailers:*** Julia reviewed and refuted the evidence submitted by the regulatory staff in support of their recommendation to institute a price cap on the competitive electricity providers in New York's retail market on the basis of market power assertions.
- ***performed benefits analysis on proposed New York transmission line:*** LEI performed an analysis of benefits to NY consumers from a proposed transmission line between New York State and New England, analyzing the impacts from the proposed project's investments on GDP, jobs, tax revenues, and system reliability. LEI also performed a cursory review of the

proposed project's environmental impact, based on criteria established by the NY DPS Staff in previous cases before the Public Service Commission

- ***conducted forecasting on gas-fired plant:*** LEI was retained by an infrastructure fund to do a 20-year energy and capacity price forecast in support of a potential acquisition of a planned gas-fired plant in Pennsylvania. The results will also be used to update the firm's valuation of its other plant in Ohio.
- ***analyzed Chicago congestion issues:*** London Economics International LLC ("LEI") was retained to do a resource analysis in the Chicago area and to analyze the congestion within the Chicago area and MISO zones surrounding Lake Michigan.
- ***reviewed energy and capacity prices in PJM:*** A private client was interested in acquiring a pumped storage hydro generation facility owned by LS Power in the PJM region. The client asked London Economics International LLC ("LEI") to prepare a proposal that will forecast the energy and capacity prices for the next 20 years of the relevant zone for this target asset. The price forecast exercise required LEI to model both energy and capacity markets on integrated basis, as well as using a Real Options Model to simulate the target unit's operational decision in arbitraging the peak versus off-peak hours in the energy market.
- ***analyzed the potential investment opportunities for a large IOU in energy storage in New England:*** Through intensive research and analysis, including simulation-based modeling, LEI identified potential opportunities for energy storage investment in New England and prepared estimate of societal benefits from such investment.
- ***conducted forecast on potential energy revenues of two proposed wind farms in Texas:*** In addition, LEI also analyzed the merchant energy, capacity, and solar renewable revenues for a solar plant in New Jersey.
- ***prepared overview of PJM market:*** LEI was hired to put together a presentation about the PJM market and investment opportunities in generation for the Public Utilities Commission of Ohio.
- ***evaluated impact of changes to Alberta's climate change and carbon emission regulations on the portfolio of the power sector as a whole, and electricity consumers:*** The analysis included modeling various scenarios using POOLMod relating to different specific regulations and assumptions to determine the financial impact on selected plants as well as the prevailing Pool Price forecasts for the province.
- ***reviewed procurement process:*** LEI was retained by Delaware Public Services Commission ("PSC") to assist with review of the procurement process for the provision of Delmarva Power & Light Company ("Delmarva Power")'s standard offer services, and to provide information and analysis regarding alternative long-term electricity procurement options for Delmarva Power to meet its Standard Offer Service residential and small commercial retail load. [Docket 14-0283]
- ***advised on market power screening analysis in contemplation of large scale utility merger:*** LEI provided advise on analytical approach and potential mitigation strategies for horizontal market power concerns.
- ***authored report on IPP investment decisions:*** LEI was engaged by a private equity company to provide a briefing paper that compares the opportunities and tradeoffs of the "Buy" versus

"Build" investment decision in the IPP sector. The paper contains quantitative and qualitative research and analysis, based on market data on purchase prices from recent transactions (focused on New York, New England, and PJM), versus the cost of new build assets.

- ***reviewed New England REC prices:*** LEI was retained by a renewable investor to review REC prices in the New England region and provide a forecast for various classes of REC prices for purpose of investment appraisal.
- ***provided assistance developing marketing materials for a transmission developer's roadshow:*** As part of this engagement, LEI developed a series of ready-to-share slide decks tailored to the specific target customers. Three categories of customers were considered: traders, utilities and wind developers.
- ***investigated the costs and benefits of proposed transmission line projects across New York State:*** The study included reviewing the proposed projects from each of the applicants to identify key characteristics of each project. LEI also undertook simulation-based modeling of the New York market to assess the potential magnitude of future congestion on the New York system under varying levels of projected gas prices. [Case 13-E-0488]
- ***conducted a simulation-based modeling exercise to determine the potential revenues for the proposed transmission project wheeling power from western MISO to eastern MISO (and eventually PJM):*** LEI evaluated both the revenue opportunities to the investors (e.g., private benefits of the line based on market price differences and the market value of the transmission) as well as social benefits to the MISO system (i.e., wholesale price reductions and capacity market price differences); and evaluated the incremental value of the business strategy of selling the energy (and capacity) out of East MISO to third parties who will serve customers ultimately in PJM. LEI's modeling exercise entailed evaluating intrinsic revenues (originating from power markets), extrinsic revenue (originating from price volatility), along with the green value of the Project (originating from the purchase of low cost renewable energy).
- ***reviewed operation status of nuclear plants:*** LEI was retained to assess the impact of the continued operations of nuclear plants in the Midwest with state subsidies versus the closure of these nuclear plants in the electricity rates and the state's local economy.
- ***provided asset valuation due diligence and market analysis in support of the evaluation of geothermal resource opportunities in Germany as well as other investment initiatives in the region:*** LEI's scope included a comprehensive review of Germany's electricity sector, renewable energy policies, and integration within surrounding European power markets.
- ***authored white paper on MRAs:*** LEI was engaged by WIRES to prepare a White Paper on Market Resource Alternatives ("MRAs") which provides external parties with a clear understanding of MRAs and a concise description of how MRAs can work effectively alongside transmission investment in US power markets to support market development, reliability, and cost-effective supply.
- ***analyzed clean energy export opportunities:*** LEI was retained by Corporate Knights Inc. to perform a high-level estimation and analysis of potential opportunity for developing clean energy exports from Canadian markets to target US power markets. Julia Frayer presented a preview of her analysis at the ABB Energy and Automation Forum in September 2014.

- ***provided a market outlook for a portfolio of assets located in ERCOT:*** For a global investment firm, LEI provided a 10-year detailed market revenue forecast for the assets under base case assumptions. LEI also used its Real Options model to estimate a scarcity premium that would be included in addition to the intrinsic energy revenues.
- ***assisted a New England incumbent utility in evaluating the economic benefits of two solutions aiming to relieve energy congestion in the metropolitan area of Boston:*** LEI modeled various transmission solutions. The objective of the economic analysis from the energy market perspective was to examine whether there are any production cost savings or market price ("LMP") impacts from either proposal, and to describe under what conditions (assumptions) these benefits are realize.
- ***prepared a 10-year energy market price outlook for the New England wholesale power market and forecast the impact of a proposed project on New England market prices:*** LEI also determined the benefits of the proposed transmission project on employment, economic activity, and tax revenues in New England. LEI utilized the dynamic input-output ("I/O") economic model developed by Regional Economic Models, Inc. ("REMI") to measure the economic benefits to various New England states from the project on employment, economic activity, and tax revenues. LEI separated the economic impact caused by the construction of the project, and the impact caused by the reduction in energy prices due to the commercial operation of the project, taking into account issues such as usage of electricity in residential, commercial, and industrial sectors in the region, and also existing long-term energy contracts that would limit the impact of the project.
- ***analyzed revenue/gross margin modules for a district cooling asset being considered for acquisition in Ohio:*** Under this engagement, LEI performed a due diligence review of the information received from the seller (including documentation from the data room) and designed a series of models aiming at quantifying the asset's potential revenues. Part of LEI's scope work also consisted of identifying and assessing the opportunities to enhance and extend the customers base within the Cincinnati existing and future market conditions. LEI also evaluated the risks associated with prospective/existing customers forgoing the asset's services in exchange of self-supplying their cooling needs.
- ***provided expert analysis and insight on how the restructuring of the US electricity markets has affected the economics of nuclear power plants:*** For a Japanese research institute, LEI provided a Briefing Memo that responded to discrete questions related to the role of government, and the impact restructuring had on nuclear plant operations and financing.
- ***assessed proposed transmission project:*** LEI assessed the economics of the proposed Lake Erie HVDC transmission project to investors and potential customers, by projecting revenue streams associated with the sale of energy, capacity and other products via transit on the Lake Erie HVDC transmission project ("LEP"). The LEP is a 100-km long 1,000 MW bi-directional HVDC transmission line that will connect the Ontario energy market with the PJM market. LEI prepared a comprehensive report that includes a review of the Ontario and PJM markets, a 20-year (2017 to 2036) market outlook and prices for electricity, capacity and renewable energy credits in Ontario and the relevant zone/s in PJM; the total gross arbitrage value for the energy congestion rents, the capacity revenue potentials for PJM, and the renewable energy credits revenue potential in PJM.

- ***for a utility in the northeastern US, LEI prepared a cost-benefit analysis of a proposed transmission line with the potential to change existing market arrangements:*** In the analysis, LEI developed a base case and multiple project cases based on different configurations of the transmission project. Using its proprietary modeling tool, POOLMod, LEI simulated energy and capacity prices in each configuration over a 15-year timeframe, and compared the price differences against various cost allocation scenarios for the transmission line's construction. LEI also tested the statistical significance of the project case results against the base case results, and conducted further analysis on the economic effects of additional renewable generation projects that construction of the transmission line would make possible.
- ***assessed proposed transmission project:*** LEI was retained to assist a private client in assessing the economics of this proposed transmission project and determining additional revenue streams or value adders from the perspective of third-party shippers. LEI was specifically asked to isolate and measure the spot market volatility premium.
- ***performed a due diligence and market study for three hydro units in PJM:*** LEI's tasks included reviewing the merchant prices and REC prices, evaluating the power purchase agreement and capacity charges and providing energy, capacity and REC forecasts.
- ***performed a review and analysis of rate making approaches applied to the client's capital expenditure profile including demonstration of the negative potential impact of "I-X" rate making approaches on a utility's ability to earn a fair return:*** The objective of this engagement will be to demonstrate to stakeholders and the Ontario Energy Board the reasonableness of the revenue cap per customer model that the client has previously relied upon and planned to propose in its next ratemaking review Furthermore, the secondary objective was to conceptualize the insufficiency of the "I-X" regime, even with a revenue cap per customer model, in consideration of the fair return standard and given the client's business is operating in an environment where substantial capital expenditure needs are projected over the next Incentive Regulation Plan ("IRP") period. Docket Number EB 2012-0459
- ***prepared 10-year (2014-2023) energy and capacity markets price outlooks for the New England market:*** This report presents results of a base case and low case long term price forecasts for the New England market using updated market information, as well as underlying assumptions, methodology, and a brief overview of the market along with a review of relevant regulatory considerations.
- ***testified in front of the New Mexico Finance Authority Oversight Committee regarding the potential economic benefits of new investment in transmission in the state of New Mexico:*** Julia considered the impacts of local spending during construction of the proposed HVDC project on the state economy, using BEA RIMS multipliers to estimate the boost to economic activity. Julia also employed the DOE's JEDI model to estimate the potential for new jobs and GDP growth as a result of new renewables development in state (wind and solar) as a result of the transmission access that would be provided by the HVDC project.
- ***provided independent review of market benefit reports:*** LEI was engaged by NRG to provide an independent review of the economic analysis in two reports: "Report and recommendations comparing repowering of Dunkirk Power LLC and transmission system reinforcements", published by National Grid ("NG") on May 17, 2013, and "NRG Dunkirk

Repowering Project Economic Impact Analysis", published by Longwood Energy Group LLC ("LEG") on March 20, 2013. Both reports forecasted market benefits, production cost savings and macroeconomic benefits. LEI's review compared methodologies and assumptions used by each report, and how these may have affected their results; LEI's review was subsequently submitted by NRG to Case 12-E-0577 at the New York Public Service Commission.

- ***conducted macroeconomic analysis of HVDC project:*** Julia was part of a team of economists that performed a macroeconomic analysis to estimate the local economic benefits accruing to taxpayers, residents, and businesses along the 800+mile route during construction of the Zephyr HVDC project, which runs from Wyoming to Colorado, Utah, and Nevada. LEI performed the analysis using the REMI P1+ model.
- ***conducted regulatory review in PJM:*** LEI was hired to review regulatory and market drivers of energy and capacity prices in PJM, and forecast prospective revenues of a portfolio of pumped storage and conventional hydro generation facilities offered by FirstEnergy, over a 20 year horizon.
- ***assessed market opportunities for industry-scale battery storage technology in the US and selected European jurisdictions for energy arbitrage and ancillary services provision:*** Under this assignment, LEI modeled the operation regime of a battery operating in energy and ancillary services markets in order to monetize added revenues for a wind and solar generators. Findings and modeling results were analyzed and presented before the client's management team and were then deployed to develop strategy for marketing battery technology to renewable developers and utilities. Another objective of the project was to identify most suitable markets and products to optimize the strategy of the battery's market entry.
- ***managed a market study reviewing historical electric rates (and projecting forward electric rates) for large commercial customers in the New England market:*** The electric rates analysis was composed of a number of components, such as the commodity costs of electricity, compliance costs for certain state programs (like RPS), delivery charge for delivering electricity, and ancillary services and administrative supply charges. LEI created projection for each of these components and considered state retail sales requirements for renewables, etc.
- ***advised on regulatory processes:*** LEI was engaged by Ontario Power Generation ("OPG") to support senior management through regulatory processes related to performance-based rates. Julia and her team of experts prepared a discussion paper on incentive regulation mechanisms ("IRM") currently in place in Ontario for electricity and natural gas distribution utilities and presented it at a technical workshop at the Ontario Energy Board ("OEB").
- ***triennial market power analysis:*** in support of various clients' application to renew market-based rate authorization under the provision of the Federal Energy Regulatory Commission ("FERC"), LEI performed Pivotal Suppliers Analysis and Market Share Analysis for the Northeast region, including New England, New York, PJM as well as the Connecticut, NYC and PJM East submarkets; as well as California and Southwest US markets.
- ***conducted a modeling analysis, in which the market price impact of incremental wind resources was projected:*** LEI staff completed a simulation-based forecast of the New England system for a future test year (2015) with varying levels of wind generation. Using the multi-

scenario approach, we then estimated the energy market price reductions across a range of incremental wind generation scenarios. The simulation modeling was further supplemented with statistical analysis. The one year analysis was also supplemented with sensitivities employing different baseline assumptions with respect to fuel prices.

- ***conducted market analysis on Maine transmission:*** LEI performed a fifteen (15) year simulation analysis to estimate the market impacts resulting from a new transmission interconnection (covering the timeframe 2015-2029) and project the impact on Maine customers (including Northern Maine customers). LEI evaluated the market evolution with and without the interconnection and described the potential ramifications for purchasing electricity for Northern Maine customers. The analysis also estimated the potential impact on ratepayers from the re-allocation of the ISO-NE Pool Transmission Facility rate to incorporate the Northern Maine load and franchise area under a pro forma 10-year transitional agreement. LEI performed the modeling using our up-to-date ISO-NE simulation model (which covers the energy and capacity markets), extended to represent in detail the Maritimes control area.
- ***prepared presentation material on the electricity market impacts and the benefits of Northern Pass Transmission project for New Hampshire and New England consumers:*** In addition, LEI staff assisted the client in preparation of an op-ed piece for dissemination to New Hampshire press outlets. LEI staff also attended an internal company meeting and testified on behalf of the client. Lastly, LEI staff assisted in the preparation for and attended the live New Hampshire Public Radio program "The Exchange" to discuss the benefits of the Northern Pass Transmission over the hour-long live show.
- ***provided extensive late stage development due diligence for investor in four potential merchant transmission investments:*** LEI prepared three presentations analyzing four proposed merchant HVDC transmission projects across the US. Analysis included detailing the development roadmap for HVDC projects and the current status of the proposed projects, identifying potential competitive threats from other similar competing transmission lines and proposed local generation, and examining the renewable needs and willingness to pay of utilities in the "sink".
- ***authored report on capital expenditure recovery mechanisms:*** For a Canadian client, Julia prepared a report that looks into the different capital expenditure recovery mechanisms utilized in four markets namely Australia, New Zealand, Ontario, and the UK for electric network utilities. The report also provided different options that the client can propose for its performance-based ratemaking filing.
- ***evaluated third-party energy price forecast for the New England and Texas (ERCOT) regions, with a specific eye on the underlying assumptions:*** LEI recommended that certain key assumptions should be updated, including demand projections and CO2 price forecasts. We also argued that some underlying assumptions were unrealistic given actual market conditions, and should be adjusted or eliminated.
- ***assisted the Maine Public Utilities Commission in developing an electric resource adequacy plan to aid MPUC in the development of a strategy for the pursuit of the long-term contracts:*** The LEI team, led by Julia, submitted a report that builds up a set of recommendations for a long-term investment strategy based on an analysis of the current supply-demand situation, a review of the existing wholesale market rules for energy and the Forward Capacity Market,

an examination of historical price trends, and review of the investment needs assessments prepared by the utilities and ISO-NE, as well as relevant sub-regional planning studies.

- ***led a due diligence team and assisting in the exclusivity negotiations with respect to an acquisition of a 400+ MW coal fired plant in the PJM market by a group of private investors:*** Julia's role included management of LEI's economic appraisal, coordination of preliminary technical due diligence, negotiations with third parties on possible off-take arrangements, and oversight over financial modeling.
- ***prepared a market study of the Ontario electricity market for a major potential investor in Ontario's generation assets:*** This report contained an overview of the Ontario electricity market, including a description of market evolution, a summary of key institutions, regulatory and policy initiatives that have impacted the market landscape, and a long term projection for the market going forward.
- ***authored report on California capacity markets:*** LEI prepared for the California Energy Commission a background report on the design evolution of a capacity market in California and its potential future impact on the generating assets in Mexico that import into the California ISO market.
- ***Analyzed Kentucky electricity industry:*** To satisfy the requirements of a recently passed statutory mandate, Julia and the LEI team conducted a broad-based analysis of current practices and the potential for reform within Kentucky's electricity industry in four areas: (i) energy efficiency and demand side management; (ii) use of renewables; (iii) full cost accounting; and (iv) tariffs. Reported results to the state's regulatory commission, including a full set of recommendations in each of the four areas for overcoming existing impediments to legislative objectives for improvements in the industry's overall efficiency and reductions in its environmental impact.
- ***offered feedback on benchmarking methodology:*** Julia provided comments on the benchmarking methodology suggested by OEB consultants, looking at the analytical aspects of defining and benchmarking the performance of multiple utilities across long period of time. The critique provided details on how each criterion affects the benchmarking study and what are the remedies available to improve the results.
- ***conducted review on Ontario transmission:*** Julia led a team that reviewed industry best practices in other jurisdictions and the current situation in Ontario to advise OEB on the appropriateness of the uniform transmission rate, as well as on the feasibility of moving to long-run zonally-differentiated marginal cost pricing. As part of this process, LEI undertook a comprehensive stakeholder review.
- ***prepared MBR filings:*** Over the course of 2007 and 2008, LEI prepared over a dozen MBR filings for various markets coming under the FERC's triennial schedule as established in Order 697.
- ***electricity price forecasting:*** For an infrastructure fund, LEI used our propriety production cost simulation model to forecast electricity prices and generation from each plant. In addition, LEI provided capacity price forecasts for California based on the Resource Adequacy Requirement (RAR) at the system and local level.

- ***conducted price forecasting analysis throughout North America:*** Julia headed the analysis of long-term price forecasts and energy market dynamics for many of the regions in the US and Canada, including New England, Pacific Northwest, California, Alberta, Southwest Power Pool, SERC, the Midwest US (ECAR, MAIN, and MAPP), Maritimes, Ontario, New England, and PJM. In this practice area, she manages a team of economists that use a variety of modeling tools to forecast one-year to fifteen-year wholesale energy, capacity (where relevant), and market-based ancillary services price forecasts. As part of the modeling effort, LEI proprietary dispatch simulation model, POOLMod, as well as other tools that have been developed by LEI, such as CUSTOMBid, ConjectureMod, ViTAL, and LEI's real options spark-spread module. This type of modeling effort required detailed investigation of the micro and macro-economic issues facing these regional markets: demand profiling, growth forecasting, reserve margin and new entry activity assessment. Such analyses are used by clients in establishing market values for assets they have targeted to acquire, consideration of portfolio risk and exposure, and assessments of procurement opportunities. This same modeling has supported regulatory analysis of utility acquisitions and planning strategies, consideration on the impact of market rules and as "reservation prices" for sale processes.
- ***reviewed power purchasing options at a large industrial customer's Southeastern facilities over three years:*** LEI assessed the probability of a supply interruption over the next three years due to the state of the transmission system in this region. We also assessed the facility's options for purchasing power for this load in the wholesale market.

Development and Strategy

- ***assisted in strategizing for the upcoming Clean Energy RFP:*** For a leading New England law firm, LEI modeled a number of potential eligible projects that could offer into the RFP, and then performed a mock evaluation, with various cost-benefit ratios. Through this analysis, LEI identified key drivers and assumptions that could affect project ranking.

SPEAKING ENGAGEMENTS AND PUBLICATIONS:

"A holistic assessment of the challenges associated with powering the electric grid with 100% renewable energy", Internal Association for Energy Economics International Conference, Paris, France. June 21-24, 2020. [Invited]

"Wind energy at the crossroads of an era: evolving utility business models, more aggressive decarbonization policies, and mounting consumer involvement in the electricity sector" Keynote Speaker at the Canadian Wind Energy Association Annual Spring Forum, Montreal, Quebec. April 28, 2020. [Invited]

"Renewables & Storage" Panelist. NECA 2019 Power Markets Conference, Massachusetts. November 7, 2019.

"Investing Trends in Canadian Energy", Energy Roundtable, Calgary, Alberta. October 10, 2019.

"Reflections on US Market Developments", IPPSA Annual Conference 2019, Banff, Alberta. March 12, 2019.

"Outlook for US Eastern Electricity Markets: ISO-NE, NYISO and PJM", Bank of America Merrill Lynch 2019 Ga, Power and Solar Leaders Conference, Boston, Massachusetts. March 5, 2019.

"Alternate Regulatory Approaches" CAMPUT 2018 Conference. May 10, 2018.

"The Transformation of the Energy Sector" and "Role of Women in Energy" SIPA's Women in Energy Event at Columbia University. March 28, 2018.

"Market pricing of oil: are there lessons for the electricity market?" Gulf Coast Power Association 31st Annual Spring Conference - Session VIII -Valuing Dispatchable Resources, Houston, Texas. April 20, 2017.

"Studying the impact of environmental policies on electricity market design." AIEE Energy Symposium: Current and Future Challenges to Energy Security, The University of Milan – Bicocca, Milan, Italy. December 1, 2016.

"Energy storage – how will it be part of "Grid of Things" in the future?" WIRES' 2016 Spring Meeting. April 16, 2016.

"Implications of Energy Infrastructure Investment on Local Economies in New England," REMI E3 Conference 2015: Energy, the Environment and the Economy, Amherst, Massachusetts, United States. July 30, 2015.

"Renewables: No Longer a Noble Way to Lose Money?" Moderator. SuperReturn US 2015 Conference, Boston, Massachusetts, United States. June 15, 2015

"Perspectives on future trade opportunities between Canada and the US, and benefits to US consumers" EUCI US/Canada Cross Border Power Summit Conference, Boston, Massachusetts, United States. April 8, 2015.

"Are transmission expansions and upgrades compatible with both small and large scale clean energy?" Panelist. Southwest Clean Energy Transmission Summit, Albuquerque, New Mexico, United States. April 1, 2015.

"CEO Panel" Moderator. ABB Energy & Automation Forum, Calgary, Alberta, Canada. September 10, 2014.

"International Views and Addressing the Need for More Underground Transmission in the US" Panelist. Platts 2014 Transmission Planning and Development Conference: Ensuring Grid Reliability, Planning Timelines, and a Robust Market's Relationship with New Build, Arlington, Virginia, United States. June 18, 2014.

Julia Frayer "System Operator's Response to 1000 – How Can the Various Regions Work Together?" Moderator. Platts 2013 Transmission Planning and Development Conference, Washington DC, United States. September 23, 2013.

"Merchant Transmission: Planning and Development and Lessons Learned from North America," Integrated Transmission Planning and Delivery, Imperial College - Workshop for OFGEM, London, United Kingdom. January 11, 2013.

"Demand for wind in New England: an economist's perspective," AWEA Regional Wind Energy Summit, Portland, Maine, USA (with Shawn Carraher). September 5, 2012.

"Cost effective procurement of Renewables to Meet Policy Requirements," NECPUC Symposium, Rockport, Maine, USA. May 22, 2012.

"Best Practices for Transmission Asset Valuation," Transmission Grid Conference, London, United Kingdom (with Shawn Carraher and Yifei Zhang). March 16, 2012.

"How effective is US technology policy on clean energy." 30th USAEE/IAEE North American Conference, Washington, DC, USA. October 10, 2011.

"Are Markets Ready for New Energy Storage Technologies?" 34th IAEE, Stockholm, Sweden. June 21, 2011.

"Long Term Market Impact of Demand Response" 33rd IAEE International Conference, Rio de Janeiro, Brazil (with Furhana Hasani and Yunpeng Zhang). June 7, 2010.

"Applications of Information Policy Principles from Auction Theory in the Deregulated Electricity Market" 32nd IAEE International Conference, San Francisco, California (with Zvika Neeman and Matthew Wittenstein). June 21-24, 2009.

"Prepared Presentation of Julia Frayer for Market Monitoring and Surveillance in the context of Market Design." Panelist, PUCT Workshop for Project #28500, Austin, Texas. June 10, 2005.

"Written Statement of Julia Frayer for the January 27th 2005 Technical Conference in Docket RM04-7-000" Panelist, FERC Technical Conference, Washington D.C. January 27, 2005.

"Competitive procurement options for Ontario's LDCs" Speaker, APPrO 2004 Conference, Toronto, Ontario (Canada). November 24, 2004.

"Beyond market shares and cost plus pricing: designing a horizontal market power mitigation framework for today's electricity markets." *Electricity Journal* (with Nazli Uludere, and Sam Lovick). November 2004.

"Alternative to LMP pricing for transmission: a case study of the ICRP approach used by National Grid Company in the UK." Speaker, Electric Power Conference 2004, Baltimore, Maryland. March 31. 2004.

"The World Changed on August 14th: the (Second) Great Northeast blackout." Chairman of Panel Session, Electric Power Conference 2004, Baltimore, Maryland. March 30, 2004.

"Big ticket leasing - what next for the future?" Panelist, Big Ticket Leasing 2003, London (United Kingdom). March 12, 2003.

"Evaluating the Electron Highway" Speaker, IPPSO 2001 Conference, Richmond Hill, Ontario (Canada). November 2001.

"What is it worth? Application of real options theory to the valuation of generation assets" *Electricity Journal* (with Nazli Uludere). November 2001.

"X Marks the Spot: How UK Utilities Have Fared Under Performance-Based Ratemaking" *Public Utilities Fortnightly* (with AJ Goulding and Jeffrey Waller). July 15, 2001.

"How much is it worth? Applying real options valuation framework to generation assets" Speaker, Electric Power 2001, Baltimore, Maryland. March 22, 2001.

"Dancing with Goliath: Prospects After the Breakup of Ontario Hydro" *Public Utilities Fortnightly* (with AJ Goulding and Nazli Z. Uludere). March 1, 2001.

A.J. GOULDING

President, London Economics International LLC

LONDON ECONOMICS

KEY QUALIFICATIONS:

In his role as president of London Economics International LLC, A.J. Goulding manages a growing international consulting firm focused on finance, economic, and strategic consulting to the energy and infrastructure industries. In addition to serving as a sector expert in electricity and gas markets, his responsibilities include project management, marketing, budget and financial control, and recruiting. A.J. also serves as an Adjunct Associate Professor at Columbia University, where he teaches a course on electricity market design and regulatory economics while also supervising graduate workshops.

With over twenty years of experience in evolving electricity and natural gas markets, A.J.'s diverse background enables him to work effectively in both emerging markets and OECD countries. In North America, A.J. has been articulate in describing market relationships between wholesale power marketers, merchant plants, aggregators, and the existing investor owned utilities. In emerging markets, A.J. has considerable experience dealing with the challenges of mixed private and public ownership, difficulties in creating credit-worthy distribution and retail entities, and the realities of line losses, unreliable fuel deliveries, and politicized labor relations.

A.J. began his career performing natural gas market analysis for the ICF Resources subsidiary of ICF Kaiser International. Later, he lived for two years in New Delhi, India, where he advised the United States Agency for International Development (USAID) on electric power sector restructuring in India. He continued his work on India while pursuing his MA at Columbia University, leading to the publication of an article on Indian privatization. Simultaneously, he researched the process of power sector reform in Pakistan, contrasting it with the Indian experience. Upon completion of his MA, A.J. served as business development associate for Citizens Power LLC, a top ten US wholesale power marketer. He then moved to London Economics, where he has held roles of progressively increasing responsibility.

EDUCATION:

Earlham College, Richmond, Indiana, B.A. in Economics, 1991. College honors, scholar-athlete, public service graduate fellowship.

Columbia University, New York, New York, M.A. in International Business, 1997. Foreign Language and Area Studies fellowship, Cordier prize.

EMPLOYMENT RECORD:

From: 1996	**To:** present
Employer:	*London Economics International LLC, United States* President (July 1999 to present), Senior Consultant (January 1998 to July 1999), Summer Associate (June 1996 to August 1996)
From: September 2003	**To**: present
Employer:	*Columbia University* Adjunct Associate Professor (2014 to present), Adjunct Assistant Professor (2003-2014)
From: 1997	**To**: 1997
Employer:	*Citizens Power LLC; Boston, MA* Associate
From: 1994	**To**: 1995
Employer:	*USAID; New Delhi, India* Energy Consultant
From: 1991	**To**: 1993
Employer:	*ICF Resources, Inc.; Fairfax, VA* Analyst

SAMPLE PROJECT EXPERIENCE:

The projects briefly described below are typical of the work A.J. has performed throughout his career at London Economics, Citizens Power, USAID/India, and ICF Resources. A.J. also serves as an adjunct professor at Columbia University, where he teaches a course in electricity market design.

Electricity and Natural Gas Asset Valuation and Transaction Advisory Work

- ***Member of OEB's Advisory Committee on Innovation:*** AJ, as LEI's President, was selected to serve on the Ontario Energy Board ("OEB")'s Advisory Committee on Innovation, to assist the OEB in sharpening its focus on enhancing efficiency, cost effectiveness, innovation and value for electricity customers. The Committee, reporting directly to the Chair of the OEB, focused on identifying actions that a regulator can take that will support and enable cost effective innovation, grid modernization, and consumer choice to help inform regulatory policy development. The Committee's overarching goal was to support the OEB's embarkment on a process that would evaluate whether and how best to adapt regulation in order to keep pace with an evolving sector.
- ***led Ontario gas LDC performance-based ratemaking project:*** LEI was engaged by Union Gas to review Union's proposed 2014 to 2018 incentive ratemaking ("IR") plan as presented to stakeholders on April 29th, 2013 and to examine case studies of approaches to IR applied to other North American gas distribution utilities. In the case study analysis, Union particularly requested LEI to examine approaches to a set list of ratemaking parameters: productivity and

X-factor trends, alternative approaches to designing an I-X framework, approaches to establishing inflation factors, approaches in other jurisdictions to applying an Earnings Sharing Mechanism ("ESM"), use of capital trackers for unknown costs, appropriateness of deferral accounts for unaccounted-for gas ("UFG"), and service quality indicators ("SQIs") and how they are measured. LEI was subsequently requested by Union to provide comments on Union's draft Settlement Agreement

- ***led Alberta performance review:*** LEI was engaged to perform an assessment of the Alberta Energy Framework, which encompasses the wholesale generation market, retail market, agencies, transmission planning, access and distribution, as well as the operations of the Alberta Interconnected Electricity System. The analysis included both qualitative and quantitative components
- ***conducted overview of hydro-dominated market:*** LEI was hired to provide an understanding of the dynamics underpinning hydro-dominated power markets as opposed to thermal systems. As part of this project, LEI reviewed in details the dynamics and key drivers of energy markets in a sample of Latin America countries including Colombia, Panama, Brazil and Chile. Colombia was the point of focus of the report, in this respect LEI compared and contrast several aspects of the Colombian markets to other jurisdictions and created a scoring card to evaluate Colombia against similar jurisdictions.
- ***evaluated peaker units in New England:*** London Economics International LLC ("LEI") was retained to evaluate the economics of constructing peaking units in two possible existing New England hydro facilities. Specifically, LEI conducted an analysis on existing peaker technologies, the permits required, and determined how much investment would be justified to make the project economic.
- ***evaluated cost economics of installing energy storage technologies at existing hydro power plants in Massachusetts and New York:*** The analysis was conducted in three phases – phase 1 consisted of literature reviews and primary information collection (from manufacturers and service providers) on the available types of energy storage technologies and associated fixed and variable costs. Phase 2 consisted of an economic cost-benefit analysis of the least cost storage technologies to understand the viability of the investment. Phase 3 consisted of developing comprehensive criteria for selecting the energy storage manufacturer/service provider and presenting implementation recommendations.
- ***conducted PJM price forecasting:*** London Economics International LLC ("LEI") was retained to provide forecasted energy and capacity prices as well as supply curves for a plant located in PJM's SWMAAC region
- ***submission to Ontario LTEP consultations regarding value of capacity imports:*** On behalf of a large Canadian hydropower generator, LEI analyzed the potential economic benefits of the export of capacity and energy from Quebec to Ontario. The engagement included a review of the treatment of imports in capacity markets in the Northeast, an examination of the impact on capacity prices of imports, and a discussion of the reliability benefits that long term contracts for capacity imports provide. In addition, LEI discussed how Ontario can create a level playing field for clean energy imports relative to other potential future sources of supply in Ontario

- ***market briefing on renewables in El Salvador:*** LEI was engaged by a private equity firm focused on small-scale renewable energy projects considering expanding into South America to develop a market briefing on El Salvador, focused on the challenges and opportunities in developing small hydro projects in the country
- ***cost benefits analysis of US transmission line:*** for a utility in the northeastern US, LEI prepared a cost-benefit analysis of a proposed transmission line with the potential to change existing market arrangements. In the analysis, LEI developed a base case and multiple project cases based on different configurations of the transmission project. Using its proprietary modeling tool, POOLMod, LEI simulated energy and capacity prices in each configuration over a 15-year timeframe, and compared the price differences against various cost allocation scenarios for the transmission line's construction. LEI also tested the statistical significance of the project case results against the base case results, and conducted further analysis on the economic effects of additional renewable generation projects that construction of the transmission line would make possible
- ***review of RRO in Alberta:*** London Economics International LLC ("LEI") was asked by ENMAX Energy Corporation ("EEC") to review EEC's request for continuation of the practice of earning a fixed margin associated with expenses incurred as a result of operation of the Regulated Rate Option ("RRO"). For the client, LEI reviewed the settled practice in Alberta, investigated the risk of operating the RRO, and calculated an indicative range of margin for EEC
- ***review of risk management practices:*** LEI was engaged by the client to review its risk management practices and provide meaningful insights with regards to the risk management related issues. Analysis included quantification of the magnitude and probability of risks being faced, as well as research into the best practices of other similar organizations
- ***conducted Independent Evaluation review:*** LEI provided advisory services to assist the OPA in evaluations of applications made to the Aboriginal Renewable Energy Fund ("AREF") and the Aboriginal Transmission Fund ("ATF"). LEI provided advice and analysis related to the technical, financial and regulatory viability of each proposed project
- ***conducted a report on net metering programs in New Hampshire and New York:*** for a private equity power sector investor, LEI conducted a report on net metering programs to determine if the client's facilities would qualify. Project work included determining load at the sites, examination of net metering in the applicable regions, assessment of potential solar installation, exploration of installation options to determine which would be most suitable, and analyzing potential returns
- ***assessment of small hydro properties:*** as part of a retainer agreement with a growing private equity firm focused on the roll-up of small hydro properties, LEI performed a variety of supporting activities, including examination of forward markets, review of PPAs, assessment of renewable energy policies, and strategic analysis
- ***review of North American hydro assets:*** LEI was engaged by a large Canadian hydro generator to evaluate the potential renewable premium associated with its hydro assets in North America. LEI developed an economic model to project legacy Renewable Energy Certificate ("REC") prices in New York and New England. LEI also provided alternative

methodologies such as projecting the premium based on forecasted carbon allowance prices and analyzing potential sales to large corporations on a voluntary basis

- ***analyzed current and future dynamics in the British Columbia power markets for of British Columbia power producers:*** topics analyzed included costs of independent power producers ("IPPs") relative to BC Hydro, uncertainty around future demand levels in BC, implications of moving away from use of Critical Water Year analysis in planning, risks and uncertainties regarding import availability, and the overall macroeconomic contributions of IPPs. LEI also analyzed the provincial government's Review of BC Hydro and provided an assessment
- ***valuation of distribution company in Bolivia:*** LEI provided inputs into the valuation of a Bolivian distribution company, including developing the cost of capital; assessing demand, cost, and tariff forecasts; and reviewing the overall cash flow model. LEI also reviewed the company's historical performance relative to efficiency and performance targets
- ***wrote paper on investments by electric and natural gas utilities:*** LEI authored a paper on the successes and failures associated with international investment by electric and natural gas utilities for a major Japanese utility. The paper focused on the activities of over forty companies, both within North America and internationally
- ***European power market analysis:*** LEI worked with one of North America's largest independent operator of power generation facilities to develop a comprehensive analysis of central European power markets including price forecasts and renewable energy policies. As part of its client's efforts to acquire a portfolio of hydroelectric power generating facilities, LEI's team developed a medium-term price forecast, stress tested critical assumptions, and provided detailed insight into federal and state renewable energy policies
- ***developed several forecasts of the long-term Alberta electricity power pool prices (2010 to 2030) based on different market parameters and build decisions:*** the forecast also made special note of the effect on the market, if any, of the following conditions: (i) greenhouse gas legislation; (ii) increase in unconventional (shale) natural gas production; (iii) effect of the enactment of Bill 50; and (iv) effect on the market by external jurisdictions
- ***market analysis for a client interested in purchasing a portfolio of global generation assets:*** in this project, the LEI team, led by AJ, provided a market analysis of California, Mexico, and the Philippines. This market analysis included the following aspects: description of portfolio assets in the jurisdiction, supply/demand balance in the jurisdiction, regulatory framework, contract description and impact of competition on specific portfolio assets in the jurisdiction, indicative position of target asset on supply curve presently and in the future, impact of climate change and other environmental regulations, observations from material in dataroom, review of pool price projections, and remarks about the jurisdiction. In addition, LEI performed a 20-year price forecast for these markets, which was delivered in a spreadsheet form and incorporated into the management presentation
- ***review of business plans for hydrokinetics technology company:*** for start up hydrokinetics technology company, LEI reviewed business plans and applicability of technology worldwide. Tasks included commenting on strategic plan, advising board members on the evolution of renewable energy markets worldwide, and assessing US Federal Energy Regulatory Commission polices towards hydrokinetic projects

- ***due diligence and valuation of engineering consulting firm:*** for a Middle Eastern investment fund, A.J. led the evaluation of the acquisition of an engineering consulting firm with offices in the US, Europe, and the Middle East focused on the power sector; the project included creation of a pro forma for the business, evaluation of business prospects and strategy, and an examination of the relevant economic conditions and their impact on value
- ***assessment of plant pro formas and underlying market environment in six Asian countries:*** for leveraged buyout of major global IPP developer, assessed plant financial models, state of reform efforts, and potential for unbundling in Bangladesh, China, India, Philippines, Thailand, and Turkey
- ***valuation of Singapore generating asset:*** on behalf of a large Asian generating company, provided revenue forecasts from spot, retail, and vesting contracts for successful acquisition of Singapore generator Analysis included review of repowering options, assessment of regulatory evolution, assessing the relevant cost of capital, and potential for strategic behavior; A.J. later performed a similar exercise for a second Asian generating company also seeking to purchase a similar set of assets in Singapore, as well as subsequently assisting in analysis associated with refinancing of the acquisition performed by initial client
- ***modeling future Japanese electricity market dynamics:*** for a leading Japanese financial institution, led workshop and directed the creation of an interactive model of the Japanese electric power sector. Issues addressed included quantification of plant asset values under various market scenarios, an assessment of the potential for stranded costs, review of debt coverage ratios, and exploration of the evolution of transmission assets
- ***due diligence support associated with the evaluation of the possible acquisition of a minority stake in a major Ontario transmission and distribution company:*** LEI prepared reports and analysis which contributed to the analytic framework for this proposed transaction, including analysis of the regulatory framework, review of impact of PBR on revenues, strategic issues, and the potential for revenue growth
- ***advised Japanese company on potential US power sector acquisitions:*** reviewed project economics for multiple acquisition targets of Japanese investor. Tasks included providing long term revenue forecasts, reviewing motivations of sellers, providing insights on the associated market, and examining the role of hedge funds and private equity
- ***examination of markets and generation asset values in Mexico, Philippines, and California:*** assisted Asian IPP in assessing generating assets in Mexico and Philippines, as well as export potential from Mexican plants to the US; mandate included developing long run marginal cost forecasts for Philippines and Mexico, and providing detailed dispatch modeling of the California market
- ***valuation of generation and distribution assets in Philippines and the Caribbean:*** provided detailed analysis of regulatory trends in the Philippines and in selected Caribbean countries. Used regulatory filings, PPAs, and public information to develop a value for generation and distribution assets in these markets. Advised potential buyer on relative risk in each country examined, including country risk, regulatory risk, and fuel supply and load growth issues
- ***power price forecast for Balkans:*** to support potential bid to acquire nuclear station in Bulgaria, led team forecasting revenues from future spot power market sales. Issues included

treatment of carbon emission credits, extent of regional integration, and availability of existing transmission capacity

- ***revenue forecast and financing advisory for renewables acquisition:*** for newly established private equity firm, managed acquisition process for small hydro and biomass site. Process included revenue forecasting, negotiating term sheets with banks, obtaining quotes for power purchase agreements, reviewing operating agreements, and overseeing all aspects of transaction process
- ***prices for merchant generators and IPPs:*** provided expert opinion on the extent to which value of a generating station could change over a 12 to 18 month period, based on historical analysis of price changes for individual generation assets as well as for generation asset portfolios
- ***biomass investment evaluation:*** on behalf of growing private equity investor, performed extensive analysis of economics of restart of several biomass plants in California and elsewhere. Tasks included PPA review, examination of permits, assisting in arranging financing, and examination of California market dynamics
- ***advised on purchase of small hydro station:*** for a newly established hydro-focused private equity investor, valued and performed regulatory review associated with successful purchase of a small hydro facility in Maine. Tasks including creating pro forma, reviewing material contracts, negotiating purchase and sale agreement, hiring operator, and monitoring ongoing performance
- ***bid for New York City gas and oil fired stations:*** for a major financial institution, A.J. led a team of analysts in examining potential future revenues for a portfolio of peaking plants in New York City. Assignment included using proprietary models to forecast future capacity and energy revenues, and the application of real option techniques to determine value of plant flexibility
- ***bid for PJM coal-fired power station:*** worked closely with private equity fund in creating deal team, preparing first round bid, and valuation of facility, including coal supply, environmental compliance, site options, and forecast of future revenues; helped to develop second round bid, including assisting in arranging financing and risk management
- ***collateralized debt obligations ("CDOs"):*** led projects associated with detailed statistical analysis of the underlying economics of CDOs associated with distressed debt in the power sector, and with examining whether such a CDO could have been launched in the wake of the Enron collapse
- ***valuation of New England based generation portfolio:*** worked with potential acquirer of New England's largest generation portfolio to determine the costs of ongoing obligations associated with the portfolio, provide an understanding of long term market dynamics, and assess value of overall portfolio, including revenue forecasts and review of market rules
- ***valuation of integrated IOUs:*** coordinated evaluation effort for acquisition of Southeastern US utility and of Ontario municipal electric utility; tasks included assessment of impact of PBR, calculation of difference in profits from generation portfolio under ratebase versus in open market, and analysis of ratebase settlement

- ***valuation and regulation of LNG facilities:*** assessed potential for combination of strategically situated LNG facility with US wholesale power marketer; for separate client, advised on third party access requirements for LNG facilities in the US and relevance to potential regulatory changes in Japan
- ***valuation of Ontario generating plants, including assessment of regional electricity markets:*** organized and implemented major modeling effort to determine potential value of generation stations in Ontario. Assessed impact of transmission constraints and restructuring efforts in neighboring markets on future wholesale market prices
- ***assessment of value of coal station contracts circa year 2000:*** developed analysis of value of contracts to bear costs and benefits associated with output from coal fired power stations in Alberta. Engagement involved considering only information known as of 2000, for inclusion in tax litigation case. Created pro forma valuation of the contracts as of 2000, including forecast costs and revenues, as well as opining on the appropriate cost of capital to be used
- ***price forecasts in key Canadian markets and associated export zones:*** provided long term electricity price forecasts in multiple engagements for key Canadian markets, including Alberta, British Columbia, and Ontario, as well as related export markets such as New York, Midwest ISO, and PJM. Results used by clients for obtaining financing and assessing contract pricing
- ***revenues to wind generators in Alberta:*** A.J. led the examination of merchant revenues to a portfolio of existing and under construction wind generators in the province of Alberta. Tasks included review of market design issues, 20 year scenario analysis for merchant revenues, review of contract terms and conditions, and an examination of the potential for additional revenues from the sale of emissions reduction credits and renewable energy certificates. Deliverables included market study supporting issuance of income trust units
- ***revenues to hydro portfolio in Ontario:*** for a large North American industrial company, A.J. led the creation of a market study and report underlying the issuance of income trust securities. Tasks included multiple scenario analysis of merchant revenues, review of ancillary services revenues, and an examination of the Ontario hybrid market structure
- ***assessment of role of peaking plant in Ontario power sector:*** for Ontario government body, performed extensive scenario analysis to determine extent to which peaking plant should be a part of future procurement plans in the province; this analysis included assessment of revenues from ancillary services and of optionality
- ***developed price trends, in conjunction with the valuation of several Colombian power plants:*** LEI also provided an evaluation of the Colombian market, an overview of modeling methodologies and assumptions, and modeling results. The modeling results included forecast spot market prices, plant dispatch and revenues (energy and capacity), under a variety of scenarios
- ***conducted tariff review for Ente Nacional Regulador de la Electricidad ("ENRE"):*** the Argentine regulatory authority for the electricity sector (ENRE) awarded a contract for a tariff review of Edenor, a large utility serving the northern portion of Buenos Aires to a consortium led by LEI. The engagement entailed evaluating the performance of Edenor in the 1992-2002 tariff period; advising ENRE on international best-practice design of distribution tariffs;

proposing a tariff setting methodology for the 2002-2007 tariff period; providing technical assistance in the analysis of information presented to ENRE by Edenor; proposing tariffs for the 2002-2007 tariff period; and assisting ENRE during public hearings on the proposed tariffs. The consortium proposed that tariffs be set via an RPI-X approach employing Data Envelopment Analysis (DEA) for establishment of the X-factor

- ***revenue forecasting in Nicaragua:*** LEI developed revenue forecasts for two generating companies (GeCsa and GeOsa) being auctioned by the Nicaraguan government as part of the privatization of the country's electric power industry. The revenue forecasting was conducted in three stages: a production cost-based spot price and dispatch forecasting stage, a contracts valuation stage, and a Monte Carlo Simulation stage. Out Monte Carlo simulation quantified the impacts of hydrological and fuel price variation on the values GeCsa and GeOsa
- ***advised on bid strategy for Mexican IPP:*** LEI assisted a large foreign utility in its bid strategy for acquisition of generating assets in international jurisdictions (across North America, Europe, and Asia). The LEI team led the market analysis for assets located in Mexico; more specifically, LEI analyzed a series of macroeconomic risks (including political, economic, and regulatory risks) likely to impact operations of the assets in the long run, performed a full due diligence review of the targeted assets, and developed forecast of the Mexican wholesale spot energy prices in order to determine future profitability of the assets.

Power, Gas, and Infrastructure Sector Business Development and Strategy

- ***conducted workshop on generation reliability standard review in Malaysia:*** LEI held a two-day workshop on Generation Reliability Standard Review Seminar for TNB in Kuala Lumpur, Malaysia. The topics included: Malaysia reliability standard policy overview, jurisdiction review on reliability indices and benchmarking Malaysia's reliability standard against other countries, inter-play between government agencies in formulating the reliability standard, lessons learned from other counties, incorporating renewable energy, interconnection and distributed generation in calculating reliability indices, input parameter to derive the value of reliability indices, and lesson learned from LOLE studies from other jurisdictions.
- ***performed a peer-group analysis of Independent Power Producers ("IPPs") in the US market:*** LEI presented research to Osaka Gas with insights on the key economic, financial and strategic factors contributing to growth of mid-sized companies in the US merchant generation market. LEI identified nine categories of IPPs in the US merchant market and defined a subset of companies to be considered as the peer-group of Osaka Gas. For the peer-group, LEI reviewed key success criteria of each company including business focus, leadership, growth strategy and financial performance. LEI presented three peer-group companies as case studies to highlight examples of successful players in the US IPP market. Overall, LEI highlighted the implications that current market trends and key success factors of Osaka's peer-group would have on the company's future growth strategy in the US market.
- ***conducted water pricing in California:*** London Economics International LLC ("LEI") was retained to conduct a 30-year price curve for Metropolitan Water District of Southern California ("MET Water") in relation to a potential acquisition of a proposed desalination plant in California. The desalination plant's water rate specified in the draft Term Sheet of the Water Purchase Agreement is based on MET Water's prices plus avoidable charge, subsidy, and a premium. LEI reviewed the regulatory arrangements of MET Water, supply-demand

dynamics in Southern California, and water pricing mechanisms used by MET Water. LEI also assessed the different key drivers for each component of the MET Water price. Lastly, LEI created a cost of service model and projected the MET Water prices for the next 30 years.

- ***transmission review in Canada:*** LEI was hired by a French consulting firm to provide commentary insights on the state of the transmission and distribution market in a number of Canadian provinces including Alberta, Ontario, British Columbia, Manitoba, Saskatchewan and Quebec
- ***study on transmission and distribution:*** LEI collaborated with SratOrg, a French consultancy on the development of strategic recommendations for market penetration in the US transmission and distribution markets . As part of this work, LEI and StratOrg performed a detailed analysis of the US market structure, identifying key market players and recent development, as well as barriers of entry and market opportunities for a prospective European investor. LEI travelled to Paris for an internal workshop session with Stratorg and actively participated in the final presentation of the team findings before the client's top managers.
- ***analyzed cost implications of Ontario's Green Energy Act:*** on behalf of the Official Opposition in Ontario, analyzed the cost implications of the government proposed 2009 Green Energy Act. This included costing of the feed in tariff program, interconnection costs, conservation and demand management initiatives and the implementation of the smart grid. The company presented key results in a press conference
- ***advisory services on the development of a 75 MW hydroelectric power plant in Cameroon:*** under a USTDA contract, AJ Goulding acted as a Senior Energy Market Specialist in the LEI portion of the work for a consortium to provide financial and technical advisory assistance to the Ministry of Energy and Water Resources of the Government of Cameroon with respect to the development of a 75 MW hydroelectric power plant at Bini à Warak. Specific tasks included review of Cameroon's existing regulatory system, regional market demand analysis and assessment of developmental impact of the project
- ***business development opportunities in India:*** for UK electricity and mining conglomerate, provided detailed assessment of opportunities in construction of integrated mining and mine-mouth power stations and in distribution of electricity
- ***assessment of US natural gas storage business:*** for a large Japanese gas utility, examined trends in regulation and investment in the US natural gas storage business. Engagement included comparison of natural gas storage business risks to that of IPP investment
- ***European renewables investment strategy:*** on behalf of a global power and real estate investment company, reviewed policies towards renewable energy in Europe and individual European companies, as well as available assets, sites, and investment climate
- ***distressed asset acquisition strategy:*** advised a major Japanese utility on entry strategies to the US market, including performing a workshop on due diligence, US regional market analysis, and asset valuation; arranging for introductions to major asset sellers, potential investment partners, and advisors; and creating a screening methodology and database of potential acquisition targets

- ***unbundling of French state-owned vertically integrated monopoly:*** worked with leading French electricity generator and supplier to examine how to create independent profit and loss statement for its generation assets, benchmark performance against expectations, and separate revenues from plant operations from those gained through trading
- ***renewables value chain investment analysis:*** for Dutch foundation based in Switzerland, examined macro trends associated with renewable energy in several major global economies, including the global supply chain from component manufacturers to installation to operation. Objective was to determine where on the renewables value chain the most profitable opportunities could be found
- ***workshop on performance-based ratemaking strategy:*** for first stand-alone transmission company in North America, conducted day long workshop on issues associated with PBR, including the types of PBR and which one is most appropriate for what type of company, the sources of efficiency gains observed in other transmission companies worldwide, and the impact of performance standards on profitability and flexibility
- ***global generation investment strategy:*** for a major Canadian generation company, used modern portfolio theory to identify combination of asset classes and geographic locations which would result in optimal risk-reward combination for generator given its core competencies. Deliverables included interactive model to be used by generator staff on an ongoing basis
- ***development of regulatory and financing strategy for transco:*** for first stand-alone transmission company in North America, evaluated key transaction parameters, assessed allowed ROE, proposed strategy for attaining favorable incentive rates, and helped to identify potential cost savings
- ***impact of Ontario market changes on industrial consumers:*** for association of large power consumers in Ontario, assessed market trends and future entry and exit scenarios to determine long term price dynamics in the face of changes in government deregulation policies

Regulatory Economics

- ***supported Manitoba cost of service review:*** London Economics International LLC ("LEI") was retained by Christian Monnin Law Corporation, at the request of Manitoba Public Utilities Board, to represent the interests of small commercial customers in its review of Manitoba Hydro's cost of service review
- ***supported setting of Nova Scotia Performance Standards:*** LEI was engaged by the Nova Scotia Regulatory Authority – the Nova Scotia Utility and Regulatory Board (NS UARB) to assist in setting performance standards for NSPI in respect of reliability, response to adverse weather conditions, and customer service for Nova Scotia
- ***served as Ukraine Electricity Tariff Expert:*** As part of a team hired by the Anti-Crisis Energy Group of the Cabinet of Ministers of Ukraine, LEI was tasked with identifying opportunities to streamline and enhance procedures used to set tariffs and prices for electricity produced. LEI performed an extensive literature review of the Ukrainian electricity market, assessed the current tariff-setting regulations and procedures and carried out in-person interviews with stakeholders. LEI wrote a briefing memo on the Ukrainian market and a recommendations

paper in line with its scope of work. The recommendations were incorporated into an Energy Resiliency Plan that would aid decision-making to the Cabinet of Ministers and the Verkhovna Rada

- ***conducted IBR workshop in Malaysia:*** LEI was retained by the largest electric utility company in Malaysia to conduct a workshop on incentive-based ratemaking ("IBR"). The topics for the workshop include theoretical conceptual overview of IBR regulatory framework, key elements of comprehensive IBR regimes, best practices of IBR in various jurisdictions, timing and framework in other jurisdictions, how to convince regulators and stakeholders, identifying barriers to successful implementation of the IBR, and moving from first to second generation IBR, to name a few.
- ***Ratemaking:*** LEI was selected by the Kansas Legislative Coordinating Council ("LCC") to perform a study of the retail rates of Kansas electric public utilities. The study, which involved two main sections, aimed to inform electric sector policies and result in competitive electric rates and reliable electric service in Kansas. Section 1 of the study evaluated the effectiveness of current Kansas ratemaking practices and their ability to attract required capital investments, and balance utility profits with public interest objectives and reliable service. Section 2 focused on exploring options available to the State Corporation Commission and the Kansas Legislature to affect Kansas retail electricity prices for a better regional competition, while providing the best practicable combination of price, quality and service.
- ***Market report:*** LEI was retained to develop a technical report of the Ontario electricity market in order to support a client's consideration for refinancing a portfolio of hydroelectric assets in Ontario. The report discussed the following items: an overview of the Ontario market; the dynamics of the provincial supply and demand; a range of potential re-contracting outcomes based on new-build referent assets (SCGT and solar + storage); forecasts of New York Zone A prices (Zone A has interties with Ontario), as well as an overview of market dynamics relevant to Zone A; and a review of the client's approach to netting back LEI's outlook.
- ***Grid resiliency:*** On behalf of LEI, AJ Goulding contributed to drafting US Secretary of Energy Rick Perry's grid resiliency pricing rule, which instructs FERC to put in place cost-of-service mechanisms for power plants with 90 days of onsite storage, as part of an overall strategy aiming at addressing threats to US electrical grid resiliency.
- ***Way forward regulation:*** LEI was retained by the Ontario Energy Board to assist in developing regulatory reforms with respect to utility remuneration, to support the evolution of the sector. As part of this engagement, the LEI team prepared a concept paper on approaches to utility remuneration and incentives, assisted in the final preparation of staff's paper, developed an empirical model for OEB staff to use in evaluating alternative approaches, and carried out empirical modeling to demonstrate the impact of the alternative approaches on utilities and ratepayers
- ***Analysis of electricity transmission:*** LEI was retained by a state-owned utility responsible for transmission and distribution throughout Tasmania, Australia, to leverage its expertise on electricity transmission pricing to provide support on the adoption of a 'beneficiary pays' approach .
- ***Valuation of Electricity rate impact***: LEI was engaged by an industry association for an Industrial Electricity Rate Economic Impact Study in Ontario's manufacturing sector. The

scope of work consisted of the review of current Ontario industrial electricity rates and rate designs; assessment of competitive electricity rate levels; development of options to change rates in a manner consistent with rate setting principles, which is beneficial to industrial consumers and the Province in overall; quantification of economic benefits from appropriate rate adjustments; and consultation with relevant industry stakeholders including government officials and various experts.

- ***conducted NYC entities capacity portfolio analysis:*** For a large Canadian hydropower generator, LEI performed a review and analysis of the capacity portfolio of several entities operating within New York City
- ***Conducted 2015 Review of Non-Energy Margin***: London Economics International LLC ("LEI") was asked by ENMAX Energy Corporation ("EEC") to review EEC's proposed non-energy return/risk margin associated with expenses incurred as a result of operation of the Regulated Rate Option ("RRO"). For the client, LEI reviewed the settled practice in Alberta, recent proposed changes providing for an all-inclusive return margin, and calculated an indicative range of margin for EEC.
- ***overview of Colombia market and revenue forecasts for target assets:*** LEI was hired by an electric operator for the purposes of valuing a portfolio of generating assets in Colombia. LEI's scope of work consists of a comprehensive review of the Colombia energy market (including fuel and power market drivers), describe in details the functioning of both wholesale power market and firm energy market (capacity market), develop forecasts of spot prices in order to derive expected revenues for the portfolio. Colombia being a hydro dominated system, as part of its modeling exercise, LEI ran a Monte Carlo simulation to develop a series of probabilities associated with generation profiles of Colombia's hydro resources to reflect the impact of weather conditions and water inflows on hydropower plants' output. LEI summarized its research and modeling results in a final report that was presented to lenders and other interested parties
- ***conducted analysis of Nova Scotia electricity systems:*** LEI was retained by Nova Scotia Department of Energy ("NS DOE") to perform analysis of the organization and governance of electricity systems both cross-jurisdictionally and within the province of Nova Scotia. The scope of work was divided into two main phases: (i) Review of international best practices and lessons learned; and (ii) Translation of best practices and lessons learned into best fit for NS
- ***assessed consistency of proposed Clean Energy Standard with existing Alberta electricity market design characteristics:*** Paper included discussion of potential additional program attributes, indicative cost assessment, impact on investment and reliability, and assessment of further required research
- ***Ontario electricity market paper:*** on behalf of a respected Canadian think tank, LEI provided an assessment of the ways in which the Ontario electricity sector could be improved to increase economic efficiency and reduce costs for consumers over the long run
- ***assisted generator in hydro development strategy:*** assisted Alberta generator on strategy related to new large scale hydro development, including justification as inflation hedge for potential pension fund investors, integration into competitive market while maintaining ability to finance, and other strategic and regulatory support

- ***developed a transmission cost causation study for the Alberta Electric System Operator ("AESO"):*** the study will be used for the determination of the AESO's Demand Transmission Service Rate DTS, and is expected to be filed with AESO's 2014 tariff application to the Alberta Utilities Commission ("AUC"). The study is intended to cover four main topics: (i) Functionalization of Capital Costs; (ii) Functionalization of Operating & Maintenance ("O&M") costs; (iii) Classification of Bulk and Regional System Costs; and (iv) Implementation Considerations
- ***conducted review of gas transmission sector in the US:*** for a European economic advisory firm, LEI reviewed the US gas transmission sector focusing on its regulatory structure. Tasks included researching the regulatory approach, legal framework, allowed capital costs and incentive mechanisms of the US gas industry
- ***review of rate of permitted return in Hong Kong:*** for the Hong Kong Government, LEI reviewed the rate base and the rate of permitted return for the power companies in Hong Kong under the Scheme of Control Agreements. This required reviewing the alternatives to using Average Net Fixed Assets as the rate base, examining the assumptions used and methodology to calculate the WACC of power companies, updating the indicative range for the permitted rate of return, and recommending changes to existing rates of return by identifying new international best practices
- ***provided a briefing for Alberta's Minister of Energy:*** briefings consisted of two 90 minute presentations – the first was a review of the Alberta Retail Market, and the second was a wholesale market review of ERCOT, Australia, Singapore, UK and Ontario
- ***supported client's transmission FBR reopener application:*** in particular, the client wanted LEI to provide an independent opinion on their argument (i) to amend the G factor calculation to eliminate the G-factor lag effective January 1, 2011 and (ii) to reduce EPC's current X factor of 1.2% to 0.0%. LEI provided support throughout the whole litigation proceeding by responding to information requests which involved additional research and analysis, including synthesis of publications on recent technological advances in electricity transmission sector, and updating the Ontario LDCs TFP model to ten years
- ***reviewed the US gas transmission sector focusing on its regulatory structure:*** on behalf of a European economic advisory firm, an LEI team, led by AJ, reviewed the US gas transmission sector. Tasks included researching the regulatory approach, legal framework, allowed capital costs, and incentive mechanisms of the US gas transmission industry. Analysis focused on US Federal Energy Regulatory Commission ("FERC") regulatory proceedings, as well as state commission findings, related to allowed returns, capital investment requirements, and treatment of capacity
- ***developed financial, commercial, and regulatory framework, in addition to drafting an investment strategy and model for Saudi clean energy institution:*** deliverables included: (i) A master plan on how to develop renewable and atomic energies based on local value chains in Saudi Arabia; (ii) An economic framework to create a favorable environment in order to follow this master plan; (iii) An investment strategy to make use of KSA resources and available funds in an efficient way; (iv) A multitude of international case studies to avoid costly mistakes in the future and to know when to adopt; (v) A final report on 'National Policy

for Investment in Alternative Energy Sources'; and (vi) Two 'sales pitch' documents for submittal to the King's Supreme Council and for the financial community

- ***advised Jordan regulator:*** advised the regulator on the weighted average cost of capital and optimal capital structure for Jordan's three distribution companies: EDCO, IDECO and JEPCO. The recommended optimal capital structure was consistent with targeted debt service and interest coverage ratios in line with the rating methodology for distribution companies from the global credit rating agencies. Work also included identifying salient risk factors for the distribution companies, identifying appropriate local and international metrics and benchmarks, developing a usable cost of capital model, and providing training workshops for local staff
- ***drafting National Renewable Energy Plan for Saudi Arabia:*** on behalf of the regulator, developed proposal for renewable energy plan for Saudi Arabia, including assessment of procurement methods, new institutions required, and determination of resource eligibility
- ***rate design for water and wastewater services in Saudi Arabia:*** on behalf of utility serving industrial areas in the Kingdom, examined appropriate regulatory structure and recommended approach to establishing new regulatory body, including composition of regulator, incentive structure, and tariff modeling
- ***design of wheeling tariff and pilot program for Saudi Arabia:*** for Saudi regulator, developed proposed plan for wheeling of power in Saudi Arabia, including proposed pilot program, assessment of impact on incumbent, relative economics of wheeling versus the industrial tariff, and review of associated commercial and regulatory issues
- ***tariff design for Kingdom of Saudi Arabia:*** led engagement with international team assessing tariff design, modeling, and electricity market evolution in Saudi Arabia; engagement resulted in a revised tariff system, including performance based rates, tolling agreements for generation, and an open access tariff. Included holding workshops for regulator in explaining cost of capital, tariff design, and other regulatory issues
- ***Electricity Industry Restructuring Plan for Saudi Arabia:*** A.J. developed the blueprint for industry restructuring in Saudi Arabia, including unbundling of the current monopoly vertically integrated utility, introduction of wholesale competition, and creation of a Single Buyer
- ***developed regulatory incentives in Jordan:*** examined regulatory framework in Jordan, with particular focus on creating specific regulatory incentives for distribution companies to optimize their operational expenses. Proposals envision move away from cost of service regime to incentive based structure benefiting customers and shareholders
- ***global regulatory review:*** assisted private equity player in assessing electricity markets in Eastern Europe, Turkey, Asia, and Latin America to determine potential regulatory and market issues associated with proposed purchase of diverse portfolio of generation, distribution, natural gas pipeline, and retail fuels businesses
- ***assessed retail margin review for generator in India:*** reviewed retail margins on electricity sales worldwide, in order to provide Indian generator insight with regards to appropriate retail margins that could be charged to selected customers in one Indian jurisdiction. Engagement involved review of case studies of electricity retail margins around

the world, including the US, UK, and Australia. In addition, retail margins in other industries were reviewed, along with the progression of margins as an industry progresses from infancy to maturity

- ***institutional development for IPP promotion:*** contributed to Indian private power promotion efforts through technical assistance program to state electricity boards, central government agencies, and private firms, with particular emphasis on role of PURPA in creating US IPP industry
- ***bagasse cogeneration:*** worked extensively with Indian sugar mills, equipment suppliers, government investment promotion agencies, and state electricity boards to develop cost-effective targeted loan and technical assistance program to promote bagasse cogeneration
- ***barriers to introduction of new coal combustion technologies in emerging markets:*** served as liaison between India's National Thermal Power Corporation (NTPC) and US research institutions to assess ways to adapt US coal combustion technologies to Indian conditions
- ***recommendations for next Scheme of Control in Hong Kong:*** worked with the Hong Kong government to develop a series of recommendations regarding appropriate allowed returns, calculation of asset base, prevention of over-investment, and rate stability
- ***lessons from North American experience for Chinese regulators and grid companies:*** for a set of Chinese state-owned companies, including grid operators, the nuclear operating company, and provincial power companies, London Economics International LLC prepared a series of detailed briefings on developments in electricity market design worldwide, with a particular emphasis on lessons from the North American experience. This experience was then used to highlight the various alternatives for market design in China, and the potential outcomes
- ***implications of restructuring the Japanese power sector:*** for a major Japanese development bank, we analyzed the impact of proposed reforms on a Japanese transmission and generation company, including the potential for stranded costs, opportunities for expansion of transmission, and future tariff setting regimes. The engagement included extensive training of the development bank's staff, as well as the creation of a working model of the Japanese power sector
- ***preparing appropriate framework for private investment in Romanian distribution sector:*** on behalf of a private client, worked with Romanian regulators to develop a consensus on approaches to capital recovery, PBR application, performance standards, supply cost-pass through, and cost of capital. These elements served as preconditions for the private investor's participation in the privatization process
- ***arguments for retaining vertical integration:*** for large French utility, reviewed cases worldwide in which during liberalization incumbents were allowed to remain active across the value chain, including retail. Our work included an assessment of the minimum competition enhancing measures regulators may require in order for the utility to continue operating in all or most of its traditional supply chain activities
- ***implications of performance based ratemaking (PBR) in the Caribbean:*** for a privately owned integrated electric company based on a well developed Caribbean island, directed strategic analysis of implications of PBR, suggested approach to regulators, and provided indicative benchmarking analysis

- ***review of stranded cost settlement and default supply pricing:*** prepared support for regulatory filing in Pennsylvania assessing benefits to customers from a proposal to extend recovery period for competitive transition charge while extending fixing price for default supply
- ***assessment of changes in market power for a FERC Section 203 filing:*** in connection with a proposed combination of generation portfolios, developed testimony concerning the change in market concentration as a result of the transaction, including an assessment of changes in HHIs under various market definitions
- ***review of durability of gas franchises in the face of competition:*** reviewed state regulator decisions and FERC rulings regarding sanctity of natural gas distribution franchises, assessed relevance in the face of deregulation of gas markets
- ***market response to tax credit:*** performed in-depth analysis of impact of Section 29 tax credit for non-conventional fuels production on supply and price response in US southwestern gas markets
- ***economic efficiency effects of retail market design:*** for major US electricity retailer, analyzed various forms of retail electricity competition and default service parameters and compared them to retail/wholesale structure in other industries to determine welfare effects
- ***assessed potential cost of Ontario Green Energy Act:*** explored costs of Green Energy Act, including feed in tariff provisions, grid connection funding, institutional development, loss of local control, and stakeholder mandates
- ***cost of capital for regulated generating assets:*** provided expert testimony on behalf of the Ontario Energy Board regarding risk factors associated with Ontario Power Generating's prescribed assets, as well as creating a risk-return continuum on which power sector assets could be placed
- ***incentive-based contract design:*** for Ontario Power Authority, advised on provisions of power purchase agreement associated with incentives for optimization of production in peak periods for hydro facility owned by a major generator
- ***upstream capability to deliver conservation and demand management:*** for Ontario Power Authority, performed examination of capabilities of Ontario to provide necessary inputs to assure that Ontario meets is conservation and demand management targets; report incorporated into Integrated Power System Plan submission to OEB
- ***design of incentive rate structure for Alberta utility:*** for a large metropolitan Alberta utility, A.J. advised on design of a proposed incentive based rate structure, including a multi-year term, operating cost incentive structure, and earnings sharing mechanism. Deliverables aided in development of regulatory filings and included testimony before the Alberta Utilities Board
- ***regulation of generation in Ontario:*** for Ontario Energy Board, A.J. authored paper described the ways in which legacy assets of Ontario Power Generation could be regulated, including incentive regulation and a set of regulatory contracts. Deliverables included providing technical advisory during public workshop

- ***potential for regulation of retail market auctions:*** for Ontario Energy Board, A.J. led engagement to review practice of regulatory oversight of load auctions to serve default supply across North America
- ***examination of contracting processes in Ontario:*** on behalf of the Ontario Power Authority, met with over 50 stakeholder groups to determine potential ways in which contracting process for new supply could be improved. Engagement included assessing practices in other jurisdictions and review of standard offer processes
- ***critiquing and improving electricity market structure in Alberta:*** for market institutions and regulators in the Canadian province of Alberta, performed extensive analysis of current industry market structure, including role of Power Pool, Transmission Administrator, Market Surveillance Administrator, the Scheduling Coordinator, and the Balancing Pool. Directed detailed analysis of market power issues associated with divestiture of specific assets and advised on particular market rules to ameliorate strategic behavior
- ***recommendations regarding market power mitigation and retail market design:*** in two separate engagements, advised the Government of Alberta on alternatives for rate designs for small customers and on measures to monitor, measure, and ameliorate market power; both engagements included extensive modeling of Alberta wholesale market and of retail supply tariffs
- ***evaluation of rates across Canada:*** reviewed rates charged to final consumers across Canada and identified distortions in rate design across provinces; performed modeling to adjust for distortions; developed appropriate calculations to appropriately compare rates across jurisdictions
- ***resource adequacy mechanisms for Alberta:*** worked with generators association to assess alternative approaches to assuring resource adequacy. Reviewed mechanisms for capacity and default supply procurement worldwide, developed alternatives for Alberta, and engaged in intensive stakeholder consultation
- ***strategic implications of US deregulation:*** performed in-depth study of the impact of unbundling in the US on the fundamental economics of the electric power industry at all points on the value chain; identified regional investment opportunities congruent with these dynamics
- ***2nd generation PBR in Ontario:*** led Cdn. $1.5 million engagement focusing on design of second generation PBR in Ontario. Key components include estimating total factor productivity (TFP), determining appropriateness of yardstick competition, analyzing demand-side management programs in the context of PBR, and examining service quality indicators
- ***market power concerns in Ontario:*** determined concentration ratios for existing configuration of generation plant, developed set of recommended portfolios to minimize market power across all timeslots in hourly market in preparation for divestiture or other market power mitigation mechanisms
- ***Regulatory review of power markets for Chilean client:*** at the request of a major Chilean generating company, LEI performed a detailed review of the regulatory regimes of four restructured power markets (California, Colombia, Nord Pool, and Spain), as well as an

analysis of the current Chilean regulatory regime and the changes to that regime that the regulator has proposed. The review addressed the positions of all stakeholders, with a particular focus on the implications of various types of market design on generators

Written and oral expert testimony

Note: expert testimony was also a component of some projects listed above, particularly regulatory projects for Ontario Power Authority, Ontario Energy Board, and involving incentive rates in Alberta.

- ***Reviewing and analyzing the application of NOVA Gas transmission Limited:*** LEI was asked to review the application and intervener evidence, as well as assist the client in preparing cross-examination of interveners, review of the argument, and replies.
- ***Oversight of wholesale market rules:*** LEI was retained by the Ontario Energy Board ("OEB") to provide regulatory expertise on an as-needed basis as the OEB evaluated the Independent Electricity System Operator's ("IESO") Market Rules and Market Rule Amendments ("MRAs").
- ***Review Financial management and Oversight board of Puerto Rico:*** LEI's expert services included performing economic analyses, preparing an opening expert testimony report, preparing a rebuttal testimony, sitting for a deposition, and testifying at the hearing on the motion.
- ***Valuation of onsite gas peakers***: LEI's scope of work consisted of identifying prospective technology types that would suit the client's operational needs. LEI's work consisted of reviewing historical and projected site load, developing a status quo estimation for the cost of delivering power, and finally creating an economic model that compared the use of on-site generation against the status quo.
- ***examination of Swiss electricity market:*** for a US financial institution, A.J. reviewed the development of the Swiss electricity market and specifically the position of hydro stations within that market. Analysis included a discussion of the factors that influence the value of hydro stations, presence of foreign owners in the Swiss electricity market, and use of post-tax cash flow to evaluate potential investments
- ***Electricity regulation in Newfoundland & Labrador***: LEI was engaged by the Commission of Inquiry Respecting the Muskrat Falls Project to serve as an expert to the Inquiry. LEI's scope of work consisted of preparing a report addressing the following topics: a comparison of Newfoundland and Labrador's electricity regulation system relative to other jurisdictions; assessing the system's ability to deal with challenges stemming from interconnection, including energy marketing; exploring the province's energy policy; recommending changes to the province's electricity pricing model; and assessing the potential role for renewable energy generation expansion.
- ***review of valuation metrics used in conjunction with tax payment challenge for an Alberta generator:*** assessed the appropriateness of valuations utilized to determine depreciation deductions related to the acquisition of a coal-fired generating station. Engagement also required creating forecasts that would have been appropriate at the time the acquisition was made several years previously, as well as calculating asset values using multiple valuation

approaches. Multiple forecasting tools were used. Engagement included developing critiques of work by opposing expert witnesses

- ***analysis of potential customer impacts due to holding company acquisition of merchant generator:*** discussed ways in which customer rates would be impacted by potential credit rating downgrades of regulated subsidiaries due to holding company parent's acquisition of merchant generator; engagement included examination of impact on default supply as well as reliability
- ***assessment and valuation of quantum merit claims:*** for advisor and developer of biomass facilities, provided expert opinion on value of services provided based on industry knowledge, review of correspondence, and experience providing or commissioning similar services
- ***conservation and demand management (C&DM) in Ontario:*** wrote testimony related to the alternative ratemaking approaches available regarding C&DM; addressed innovative alternatives and compared and contrasted various schemes in the Ontario context
- ***review of Dutch electricity market regulatory dynamics:*** in a case before the US Federal Court of Claims related to economic substance, provided understanding of how Dutch electricity market was structured in the mid-1990s, how it was expected to evolve, and how it did actually evolve. Issues addressed included market structure, regulation, role of non-utility investors, and role of private and international investors
- ***valuation of PPAs associated with IPPs in Thailand:*** as an expert witness in an arbitration case, A.J. quantified the change in value resulting from modifications to several PPAs associated with a power project in Thailand. Engagement included review of PPAs, evaluation of Thai power sector restructuring process, extensive modeling of financial aspects of PPAs, and assessment of financing alternatives; client won on all claims

PUBLICATIONS:

Goulding, AJ and Jarome Leslie. "***Dammed If You Do: How Sunk Costs Are Dragging Canadian Electricity Ratepayers Underwater***." C.D. Howe Institute. January 2019.

Goulding, AJ and Stella Jhang. "***Secretary Perry's Grid Resiliency Pricing Rule: On Market Interventions and Minimizing the Damage***." Columbia University. SIPA – Center on Global Energy Policy. October 2017.

Goulding, AJ. "***Railroads, Utilities and Free Parking: What the Evolution of Transport Monopolies Tells Us About the Power Network of the Future***." Columbia University. SIPA – Center on Global Energy Policy. November 2016.

Goulding, A.J. "A New Blueprint for Ontario's Electricity Market." C.D. Howe Institute. Commentary No. 389. September 2013.

Goulding, A.J. and Serkan Bahçeci. "Stand-by rate design: Current issues and possible innovations." *Electricity Journal*, June 2007, pp 87 – 96.

Goulding, A.J. and Bridgett Neely. "Picture of a Stalled Competitive Model" *Public Utilities Fortnightly*, February 2005, pp 35 - 42.

Goulding, A.J. and Bridgett Neely. "Acceding to Succeed" *Public Utilities Fortnightly*, July 2004.

Goulding, A.J. "Let's Get This Party Started: Why Ontario needs a competitive market" *Public Utilities Fortnightly*, May 2004, pp 16 - 20.

Goulding, A.J. and Nazli Z. Uludere. "Uncovering the *true value* in merchant generation" *Electricity Journal*, May 2004, pp 49-58.

Goulding, A.J. "On the Brink: Avoiding a Canadian California" *Public Utilities Fortnightly*, February 5, 2003.

Goulding, A.J., Julia Frayer, Jeffrey Waller. "X Marks the Spot: How UK Utilities Have Fared Under Performance-Based Ratemaking" *Public Utilities Fortnightly*, July 15, 2001.

Goulding, A.J., Julia Frayer, Nazli Z. Uludere. "Dancing with Goliath: Prospects After the Breakup of Ontario Hydro" *Public Utilities Fortnightly*, March 1, 2001.

Goulding, A.J., Carlos Rufin, and Greg Swinand. "Role of Vibrant Retail Electricity Markets in Assuring that Wholesale Power Markets Operate Effectively." *Electricity Journal*, December 1999.

Adamson, Seabron and A.J. Goulding. "The ABCs of Market Power Mitigation: Use of Auctioned Biddable Contracts to Enhance Competition in Generation Markets." *Electricity Journal*, March 1999.

Goulding, A.J. "Retreating from the Commanding Heights: Privatization in an Indian Context." Columbia University: *Journal of International Affairs*, Winter 1997, pp. 581-612.

Hass, Mark R. and A.J. Goulding. "Impact of Section 29 Tax Credits on Unconventional Gas Development and Gas Markets." Society of Petroleum Engineers: SPE 24889, presented at 67th Annual Technical Conference, Washington, DC, October 6, 1992.

SPEAKING ENGAGEMENTS:

"***System and Tariffs impacts of increasing distributed generation.***" Speaker, CAMPUT. Calgary, Alberta, Canada. May 7th, 2019.

"Rate design and fixed cost recovery revisited." Panelist, Ivey Energy Policy and Management Centre ("EPMC"). Toronto, Ontario, Canada. October 22nd, 2019.

"Alternative Regulatory Approaches". Speaker, Electricity Distributors Association Energy Business Innovation Conference. Toronto, Ontario, Canada. October 22nd , 2019.

"Regulation" – Keeping up with the pace of change." Panelist, APPrO. Toronto, Ontario, Canada. November 12th, 2018.

"Blockchain and the Grid." Panelist, Wires Conference. Washington, DC, USA. October 25th, 2018.

"Considerations for policymakers regarding capacity mechanism design." Speaker, Independent Power Producers Society of Alberta ("IPPSA"). Calgary, Alberta, Canada. July 17th, 2017.

"Future Models for Utility Ownership and Regulation in Hawaii." Speaker, VERGE Hawaii: Asia Pacific Clean Energy Summit. Hilton Hawaiian Village, Honolulu, Hawaii, US. June 20th, 2017.

"Capacity Market Review: Workshop #2." Speaker, Independent Power Producers Society of Alberta ("IPPSA"). Calgary, Alberta, Canada. June 14th, 2017.

"Capacity Market Review: Workshop #1." Speaker, Independent Power Producers Society of Alberta ("IPPSA"). Calgary, Alberta, Canada. May 18th, 2017.

"Distributed Energy Resources: Regulatory Framework and Ratemaking Considerations." Speaker, CAMPUT Annual Conference 2017's CEA's Regulatory Innovation Task Group. Vancouver, British Columbia, Canada. May 10th, 2017.

"From Theory to Practice: Disruptive Technologies, Innovation and the Future of the Utility." Panelist, Northwind Professional Institute 13th Annual Electricity Invitational Forum, Langdon Hall, Cambridge, Ontario, Canada. January 27th, 2017.

"Ontario's Electricity Sector: Does the Current Institutional Framework Serve the Public Interest? Is it Times for Ontario to Consider a Fundamental Redesign?" Discussion Leader, Northwind Professional Institute 11th Annual Electricity Invitational Forum, Langdon Hall, Cambridge, Ontario, Canada. January 30th, 2015.

"What's Next for Ontario's Electricity Market?" Panelist, C.D. Howe Institute Roundtable, Toronto, Ontario, Canada. September 16th, 2014.

"Prices and Costs, Why Rates Don't Tell the Whole Story" Speaker, Making Markets Work Symposium – Manning Centre, Calgary, Alberta, Canada. June 25th, 2014.

"Examining the Future Structure of Ontario's Electricity Market: Should Ontario Incorporate a Capacity Market or Alternative Structural Framework?" Panelist, Ontario Power Conference, Toronto, Ontario, Canada. April 15th, 2014.

"Electricity Prices – Economics, Public Policy, Technologies and Affordability" Panelist, CCRE Energy Leaders Roundtable, Hockley Valley Resort, Orangeville, Ontario, Canada. March 27th, 2014.

"Priorities for enhancing Ontario's electricity market: What direction forward?" Panelist, APPrO, Toronto, Ontario, Canada. November 20th, 2013.

"Evolving Regulation in Ontario: Best Practices from Other Jurisdictions" Panelist, Ontario Energy Association's ENERGYCONFERENCE13, Toronto, Ontario, Canada. September 11th, 2013.

"Points to consider when valuing hydro in the US" Speaker, HydroVision 2013, Denver, Colorado, US. July 26th, 2013.

"Pricing Power in Ontario: Perspectives and Competitive Analysis on the Future Direction of Ontario Electricity Rates" Panelist, Ontario Power, Toronto, Ontario, Canada. April 17th, 2013.

"***Why Alberta* is *Still Standing***" Panelist, Independent Power Producers Society of Alberta's 19th Annual Conference – Last Market Standing?, Alberta, Canada. March 11th, 2013.

"***Market Evolution in the context of the EMF and the post-election environment***" Panel Moderator, Association of Power Producers of Ontario, Toronto, Ontario, Canada. November 16th, 2011.

"***Green Energy Economics***" Panelist, Electricity Distributors Association's ENERCOM, Toronto, Ontario, Canada. March 30th, 2011.

"***Projected Supply-Demand Balance in Ontario: A Call to Inaction***" Speaker, APPrO, Toronto, Ontario, Canada. November 18th, 2010.

"***Changes in electricity policy: what will it cost?***" Speaker, 2010 Ontario Energy Association Annual Conference, Niagara Falls, Ontario, Canada. September 21st, 2010.

"***Energy Infrastructure Spending***" Debate Panelist, Canadian Association of Members of Public Utility Tribunals (CAMPUT), Montreal, Ontario, Canada. May 5th, 2010.

"***Strategic implications of the Ontario Green Energy Act***" Presentation to Ontario Energy Association Green Energy and Conservation Joint Sector Committee, Toronto, Ontario, Canada. June 24th, 2009.

"***Strategic implications of evolution of North American utilities sector in response to environmental initiatives***" Presentation to Mitsui Canada Leadership Forum, Toronto, Ontario, Canada. June 17th, 2009.

"***Making retail competition work in electricity***" Speaker, Illinois Commerce Commission Retail Competition Workshop, Chicago, Illinois, US. October 2nd, 2006.

"***Gods and monsters: the role of the Ontario Power Authority in Ontario's hybrid market***" Speaker, Ontario Energy Association annual conference, Niagara Falls, Ontario, Canada. September 14th, 2005.

"***Transmission investment in today's power markets: key considerations***" Presentation to the Wyoming Infrastructure Authority, Casper, Wyoming, US. May 26th, 2005.

"***The true cost of power: comparing rates for power across Canada***" Speaker, Independent Power Producers Society of Alberta conference, Banff, Alberta, Canada. March 15th, 2005.

"***Key considerations with regards to resource adequacy mechanisms in Alberta.***" Speaker, Independent Power Producers Society of Alberta luncheon, Calgary, Alberta, Canada. November 3rd, 2004.

"***Finding the silver lining: investment opportunities in Canadian power markets***" Speaker, 2004 Canada Power Conference, Toronto, Ontario, Canada. September 30th, 2004.

"***Adding value for the shareholder: Managing small utilities in a period of regulatory change.***" Speaker, Ontario Electricity Distributors Association, London, Ontario, Canada. June 8th, 2004.

"Case studies in electricity market design: learning from experience." Guest lecturer, Columbia University Center for Energy and Marine Policy graduate program, International Energy Systems and Business Structures class, New York, New York, US. April 8th, 2003.

"'The grass is always greener' vs. 'All of your eggs in one basket': investment outlook for California and foreign markets." Speaker, Platt's Global Power Markets Conference, New Orleans, Louisiana, US. March 31st, 2003.

"Transmission congestion, valuation, and investment issues in the region surrounding Ontario." Speaker, Canadian Institute conference on Inter-jurisdictional Power Transactions, Toronto, Ontario, Canada. April 8th, 2002.

"Update on new generation development in Alberta." Speaker, Canadian Institute Conference on Managing Electricity Price Volatility in Alberta, Calgary, Alberta, Canada. February 27th, 2002.

'The Alberta market structure and implications of structural change." Speaker, Insight Conferences Alberta Power Summit, Calgary, Alberta, Canada. February 22nd, 2002.

"Implications for developers of key aspects of competing Midwest ISO designs." Speaker, INFOCAST conference on Maximizing the Value of QFs and IPPs, Orlando, Florida, US. February 1st, 2001.

"Risk and rewards from PBR for US utilities: lessons from overseas." Speaker, UTECH 2000 conference, St. Petersburg, Florida, US. November 30th, 2000.

"Dancing with Goliath: increasing competition in Ontario wholesale generation market." Speaker, Canadian Independent Power conference, Toronto, Ontario, Canada. November 27th, 2000.

"Asset valuation in evolving global power markets." Speaker and case study facilitator, World Bank conference on Emerging Issues in the Power Sector, Washington, DC, US. April 19th-21st, 2000.

"***Overseas exposure: is it worth the risk?***" Speaker at Global Power Markets Conference, organized by Global Power Report and McGraw-Hill, New Orleans, Louisiana, US. April 16th -19th , 2000.

"***Profiting from retail: challenges for MEUs.***" Speaker at conference on buying and selling electric utilities in Canada, organized by IBC USA conferences, Toronto, Ontario, Canada. November 15th-17th, 1999.

"***Assessing the US electricity market and evaluating US targets***." Facilitator for workshop on US acquisition opportunities for European energy firms, organized by IIR Limited, London, England. February 9th-11th, 1999.

MA. CHERRYLIN TRINIDAD

Director, London Economics International LLC

KEY QUALIFICATIONS:

Cherrylin, a Managing Consultant at London Economics International LLC, has significant experience in the areas of regulatory economics, electricity market design, and mergers and acquisitions. Cherrylin has worked on several other merchant transmission projects in the sector, where the complementarities of generation and transmission are critical to the valuation. In addition, she has extensive experience in performance-based rate advising clients on the various components of the PBR as well as assisting them in their PBR submission. She is also very familiar with the regulatory environment and market rules in PJM, the largest wholesale electricity market in the world, having worked on various projects in this jurisdiction spanning from assessing the investment opportunities in this market to modeling and forecasting the energy and capacity prices. Finally, Cherrylin has managed multi-million projects not only in North America but internationally as well.

EDUCATION:

Columbia University, New York, New York, M.A. International Affairs (International Energy Management and Policy)

Asian Institute of Management, Manila, Philippines, Masters in Business Administration

University of the Philippines, Manila, Philippines, B.A. in Public Administration

EMPLOYMENT RECORD:

From: 2012	**To:** present
Employer:	*London Economics International LLC, United States* Managing Consultant
From: 2008	**To:** present
Employer:	*London Economics International LLC, United States* Senior Consultant
From: 2007	**To:** present
Employer:	*London Economics International LLC, United States* Consultant
From: 2005	**To:** 2007
Employer:	*USAID projects such as Philippines Climate Change Mitigation Program, Energy Environment Training Program, Energy Clean Air Program, Philippines*

Contractor/Consultant

From: 2001 **To:** 2001
Employer: *Philippines Climate Change Mitigation Program, Philippines*
Project Manager

From: 1997 **To:** 1999
Employer: *Department of Energy, Philippines*
Executive Assistant IV to the Undersecretary

SAMPLE PROJECT EXPERIENCE:

The projects briefly described below are typical of the work Ma. Cherrylin has performed throughout her career.

Market/regulatory design

- ***Performed total factor productivity and advised a gas utility on its rate case application***: Cherrylin is part of the team that is supporting a gas utility in Massachusetts in its PBR filing for 2021-2025. She is worked with the team on putting together the total factor productivity and input pricing study. She also assisted the team's expert witness in putting together the direct testimony, rebuttal testimony, and responses to the IRs. In addition, she advised on topics related to PBR and GSEP.

- ***Led the conduct of a study on the utility ownership and regulatory models that apply to the utilities in Hawaii, and that would meet the state's energy goals.*** The Team looked at the technical, financial, and legal feasibility of these models in detail and conducted multiple stakeholder outreaches in all the Hawaii islands to solicit the inputs of the different stakeholders. One of the regulatory models being studied is the incentive-based regulation. The team proposed three PBR options for Hawaii. The final deliverable will be submitted to the legislature in early 2019.

- ***Led the team that analyzed the emerging trends in utility governance, organization, performance, and accountability***. Cherrylin wrote sections of the literature review on performance-based ratemaking. Cherrylin also managed the team that prepared the Comparator Industry Design and Regulation Report, which consists of some case studies on the power market and governance structures. This report constitutes an analysis of global best practices and lessons learned based on both success and failures of some jurisdictions in restructuring and liberalization.

- ***Part of a team that reviewed the different market design alternatives for Alberta***, the client's portfolio by 2020, and the client's competitors relative to the changes in the market by 2020. The paper also provided market strategies for the client given the likely market changes by 2020.

- ***Analyzed the ancillary services products, trading arrangements, and procurement processes of several North American markets such as New York, New England, and Texas (ERCOT) as well as international markets such as UK, Australia, and Ontario***. The ancillary services in

Alberta were also studied as a background for comparison with the other markets. Cherrylin also identified the best practices in these markets that Alberta can explore. The results of this analysis were used to support the client in the stakeholder process to redesign a system operator's procurement process.

- ***Prepared a report on energy storage technologies.*** The report includes a discussion on (i) the different energy storage technologies such as pumped hydro storage, flywheels, compressed air energy storage, and batteries, (ii) applications of these technologies, (iii) economics of energy storage technologies, (iv) regulatory and legal issues, and (v) significance of energy storage to Saudi Arabia.
- ***Drafted both the Term Sheet and the RFP for long-term contracting of supply resources for Maine***. The RFP consists of the description of products being procured, the RFP process, requirements, and evaluation criteria.
- ***Prepared a paper discussing how imports are treated in the capacity markets of NYISO, New England, and PJM.***
- ***led a team in reviewing House Bill 3968 (or An Act Relative to Clean Energy Resources)*** and providing insights as to the impact of the Bill on the client's long-term contracts

Tariff design/performance-based regulation

- ***Led a team to assist the largest electricity utility company in Malaysia in its amendments to the electricity tariff regulatory implementation guidelines ("RIGs").*** The Team proposed enhancements to the RIGs and presented these proposals to the IBR Council composed of the utility's management team. The Team also presented its recommendations to the Commissioner on multiple occasions. Lastly, the Team amended the RIGs, and this was submitted to the Commission for approval.
- ***Provided support to expert testimony in support of FortisAlberta Inc. ("FAI") in its filing for a performance-based ratemaking ("PBR") plan with the Alberta Utilities Commission ("AUC"):*** The testimony provided detailed data analysis (including inflation and TFP trends), underpinning PBR economic theory, and reviews of best practices in various North American and International jurisdictions. The testimony offers back up elements for each of the various components of the PBR plan that is being proposed by FAI. Ma. Cherrylin provided support to the expert in her testimony at the AUC in Spring of 2012.
- ***Headed a team to assist the largest electricity utility company in Malaysia in its 2nd regulatory period performance-based regulation submission (2018-2020).*** The Team provided strategical advisory and reviewed the draft of the submission. The Team attended several meetings with the IBR Council and provided briefing sessions on various issues such as earning sharing mechanisms, ring-fencing, funding for innovation, etc.
- ***Led and conducted a 30-year price curve for Metropolitan Water District of Southern California ("MET Water")*** in relation to a potential acquisition of a proposed desalination plant in California. The desalination plant's water rate specified in the draft Term Sheet of the Water Purchase Agreement is based on MET Water's prices plus avoidable charge, subsidy, and a premium. Cherrylin was the Project Manager and led the team to review the regulatory arrangements of MET Water, supply-demand dynamics in Southern California, and water

pricing mechanisms used by MET Water. The Team also assessed the different key drivers for each component of the MET Water price. Lastly, Cherrylin created a cost of the service model and projected the MET Water prices for the next 30 years.

- ***Performed a 4-day workshop on Incentive-Based Ratemaking ("IBR") and accompanied the TNB delegation to a study tour.*** The team went to several Canadian utilities as well as utility commissions to learn about their experiences on implementing the IBR.
- ***Prepared an expert report on different incentive rate-making frameworks for submission as part of gas distribution company ratemaking proposal***. The report set out: the theory behind price and revenue cap frameworks including their strengths and weaknesses; included case study analysis on approaches in ten jurisdictions across Canada, the US, and the UK; and quantitatively analyzed the impacts of different rate-making frameworks on the client's revenue streams. LEI's analysis' was filed with the Ontario Energy Board in July 2013.
- ***Conducted a workshop on incentive-based ratemaking ("IBR") for the largest utility in Southeast Asia***. Cherrylin led the group in preparing the presentations for the workshop. The topics for the workshop include theoretical conceptual overview of IBR regulatory framework, key elements of comprehensive IBR regimes, best practices of IBR in various jurisdictions, timing and framework in other jurisdictions, how to convince regulators and stakeholders, identifying barriers to successful implementation of the IBR, and moving from first to second generation IBR, to name a few.
- ***Analyzed the building block incentive ratemaking approaches used in Australia and the UK, and how they would apply to the client's circumstances in Ontario:*** LEI's report supported the client's distribution tariff proposal submission to the Ontario Energy Board for a second-generation Customized Incentive Regulation ("IR") plan for the period of five years (2014-2018). The testimony set out the theory behind as well as the practical experience of using the building blocks approach in incentive regulation regimes. Julia will provide the testimony for this project.
- ***Engaged by Ontario Power Generation ("OPG") to support senior management through regulatory processes related to performance-based rates***. Cherrylin was part of a team that prepared a discussion paper on incentive regulation mechanisms ("IRM") currently in place in Ontario for electricity and natural gas distribution utilities and presented it at a technical workshop at the Ontario Energy Board ("OEB").
- ***Prepared a white paper for Canadian electricity regulators and utilities on the comparative advantages and drawbacks of various tariff-setting regimes, from performance-based regimes to cost-of-service.*** This project involved a general overview of tariff-setting practices across Canadian provinces as well as highly detailed Canadian and international case studies and an examination of the key lessons to be learned from each case. Detailed case studies covered the tariff-setting regimes in place in the UK, the Australian National Electricity Market, and the Netherlands. As part of its deliverables, two workshops were conducted with a variety of regulators and utilities.

Due diligence (market analysis, price forecasts, etc.)

- ***Led a team that prepared a regulatory checklist for a client that was interested in making investments in the US.*** Cherrylin looked into the obligations of a power plant owner as well

as filing requirements for FERC, NERC, and the Balancing Authorities. The checklist will be used for the client's future acquisitions

- ***retained by I-Squared Capital to present a market overview of the markets where it owns generation assets:*** These markets include PJM, New York, New England, ERCOT, and SERC. In addition to this, LEI presented an investment opportunity presentation from the ISQ Investment Opportunities slide deck that LEI submitted in March 2017.
- ***Provided 20-year monthly energy and capacity prices and operating metrics results for two new CCGT plants in PJM and one in SERC in connection with the client's proposed acquisitions***. LEI reviewed plant parameters, financial model, and market consultant reports provided by the seller and delivered price forecast and dispatch results to the client.
- ***Conducted gas price forecasting:*** For a private equity client, LEI forecasted the energy and capacity revenues of various gas-fired plants in PJM for 20 years. More specifically, LEI projected the energy and capacity prices, plants' annual generation, load factor, and operating costs. LEI's analysis influenced the client's going forward investment decisions.
- ***Directed a team to analyze the PJM capacity market***. The final deliverable was a PowerPoint presentation containing a comparison of LEI's forecast and the recent 2018/2019 Base Residual Auction results, as well as potential changes in the market that will impact future capacity prices.
- ***Prepared a 20-year energy and capacity price forecast for PJM.*** This is related to the firm's potential target to acquire a portfolio of hydro assets in SERC which looks to sell into PJM West.
- ***Provided analytical support to a private equity firm's due diligence process***. Cherrylin provided an updated outlook on energy prices, as well as intelligence on recent developments in selected US power markets (PJM). She also assisted in forecasting the REC prices for the next ten years and reviewing the requirements and risk exposure to hydropower facilities in PJM.
- ***Reviewed the production, demand, storage, transportation, distribution, and marketing of natural gas in Canada***. Recommended possible investment areas in the Canadian gas market for a client who was interested in investing in these sectors.
- ***Evaluated the project financing of an offshore wind project off the Dutch continental shelf.*** The team also assessed the Dutch electricity markets, the impact of the government's subsidies not only on the specific project but to other future renewable projects as well.
- ***Appraised the Alberta electricity markets a***nd part of the team that prepared an outlook on the wholesale Alberta electricity prices for the next fifteen years and implications for the company's three wind projects
- ***Reviewed and analyzed an investment portfolio for a client***. The investments include assets in the power generation, power distribution, retail fuel, natural gas transportation, and natural gas distribution in emerging markets in Latin America and Asia. In-charge of conducting the market analysis of the electricity market in the Philippines and Jamaica and made recommendations on the viability of the assets.

- ***Analyzed current and future dynamics in the British Columbia power markets***. Topics examined included costs of independent power producers ("IPPs") relative to BC Hydro, uncertainty around future demand levels in BC, implications of moving away from use of Critical Water Year analysis in planning, risks, and uncertainties regarding import availability, and the overall macroeconomic contributions of IPPs. LEI also analyzed the provincial government's Review of BC Hydro and provided an assessment.
- ***Evaluated the electricity and gas markets of Singapore*** in relation to a client's bid for a generating facility. The analysis included a review of the coal market, liquefied natural gas market, and the carbon market in Asia. She also reviewed the retail market and the ancillary services in Singapore. In addition, she conducted due diligence on the current assets of the target company as well as evaluated its coal vs. gas repowering plans. Furthermore, she prepared a market primer on the Singapore electricity and gas markets for the client.
- ***Managed the team that forecasted the energy and capacity prices for the next 20 years of the relevant zone for the target asset in PJM***. LEI modeled both energy and capacity markets on an integrated basis, as well as used the Real Options Model to simulate the target unit's operational decision in arbitraging the peak versus off-peak hours in the energy market. The client was interested in acquiring a pumped storage hydro generation facility owned by LS Power in the PJM region.
- ***Led a team in performing a 20-year energy and capacity price forecast in support of a potential acquisition of a planned gas-fired plant in Pennsylvania***. The results were used to update the firm's valuation of its other plant in Ohio.
- ***Guided a team in putting together the projected revenues of a solar plant in New Jersey for potential acquisition.*** The Team forecasted the potential energy, capacity, and solar renewable revenues for a solar plant in New Jersey using the firm's proprietary dispatch model.
- ***Managed a team in forecasting the revenues in PJM***. The forecasts include energy and capacity payments for a gas-fired plant for the next 30 years.
- ***Updated the PJM and NY energy and capacity forecast*** to facilitate private client financing.
- ***Assessed the price and macroeconomic impact of closing some nuclear plants in PJM.*** The project involved evaluating the continued operations of the nuclear plants on the energy market, assuming that some form of subsidies will be provided by the state. Through the use of its simulation model, POOLMod, LEI simulated the costs of power for consumers based on future market prices for energy and capacity (with the nuclear continuing to operate) under "baseline" or "business as usual" market conditions. LEI also looked at another scenario where the nuclear plants were prematurely shut down. LEI analyzed how the closure of these nuclear plants affected the wholesale electricity and capacity prices in the state, and evolution of replacement resources, and the implications thereof on consumers' electricity rates.
- ***Managed a team in forecasting the energy and capacity price forecasts in PJM*** as well as the potential revenues of a proposed gas-fired plant in PJM. The client was looking into acquiring the proposed plant located in Maryland. The client purchased the proposed plant.
- ***Led a team that projected the energy and capacity revenues of a proposed gas-fired plant in Ohio.*** Cherrylin specifically led the modeling of the PJM energy and capacity markets. In

addition, a market overview of PJM as well as Ohio was prepared and presented to the management.

- ***Prepared the LEI's Renewable Energy Credit ("REC") model for New England*** and forecasted the REC prices for class I resources for the next ten years (2010-2019), which was used to evaluate bids to the Maine PUC energy procurement.
- ***Managed a team that performed due diligence for a hydro plant in PJM***. Cherrylin performed an energy and capacity price forecasts for 20 years. Cherrylin also assisted the team in putting together a renewable energy credit ("REC") model to determine the long-term REC prices.
- ***Headed a team that prepared the long-term energy and capacity price forecast for the New York*** power market sand annual revenue forecast for a hydro plant located in update New York. The report was used as part of the Confidential Information Memorandum for the sale of the hydro plant.
- ***Led the team in forecasting the energy and capacity price forecasts in PJM*** as well as the potential revenues of a portfolio of pumped storage and conventional hydro generation facilities, over a 20-year horizon. LEI was hired to review regulatory and market drivers of energy and capacity prices in PJM.
- ***Performed 20-year of energy price forecasts for the Luzon island in the Philippines*** were developed based on assumptions of macroeconomics, demands, fuel prices, and new entry and retirements. The energy price modeling was customized to take into the difference between dependable capacity and installed capacity. The modeling results served as direct inputs to financial valuation models of the bidder's agent investment bank in support of the bidder's potential purchase of the company.
- ***Provided energy and capacity price forecasts*** for the client's assets in New England and PJM.
- ***Produced energy and capacity price forecasts for six U.S. markets***. Cherrylin was the primary modeler for the PJM Interconnection region, providing an analysis of market dynamics and potential revenues to value electric generation assets.
- ***Conducted an energy price forecasting (2009-2030) for PJM as well as the client's power plant in PJM***. Aside from the base case, the report also included a scenario with the Regional Greenhouse Gas Initiative ("RGGI") program. Cherrylin was responsible for making the assumptions to the price forecasting, running the POOLMod simulation, and interpreting the results of the simulation.
- ***Reviewed all investable energy sectors in the US and Canada (except oil and gas exploration and production).*** The sectors included: electricity generation (natural gas, wind, solar, hydro), AMI, distributed Resources, demand response, retail and gentailers, gas LDCs, gas storage, gas pipeline transportation, LNG-related infrastructure, vertically-integrated utilities, electric distribution, and water utilities. LEI assessed the investment potential of each sector for the next five years and proposed a methodology to screen and identify investment opportunities and execute on these opportunities.
- ***Managed the team in putting together a slide deck that includes a market overview, key drivers of the market, and recent developments*** of the following markets: PJM, New York, New England, ERCOT, and SERC for an infrastructure fund looking for investment opportunities in the US.

- ***Led a team in doing a market power analysis for a potential acquisition of a portfolio of assets***
- ***Prepared an independent market report on the client's portfolio of hydro assets in PJM***. Included int eh market report was a price forecasts for the energy and capacity markets.
- ***Provided valuation services for a waste coal facility located in the Pennsylvania-New Jersey-Maryland ("PJM") regional market:*** Specific tasks consist of i) due diligence review of documents such as past financial statements, operational statistics report, fuel agreements and power purchase agreements ("PPA"); ii) forecasts energy and capacity prices in the PJM regional market; iii) create a pro forma financial model to evaluate the market value of the plant as of expiration of its PPA; iv) writing a final report documenting assumptions, methodologies used and modeling results.

Transmission

- ***Managed a team that is assessing the economics of the proposed Lake Erie HVDC transmission project*** and determining the additional revenue streams or value adders of the Lake Erie HVDC transmission project ("LEP") from the perspective of third-party shippers. The LEP is a 100-km long 1,000 MW bi-directional HVDC transmission line that will connect the Ontario energy market with the PJM market. LEI prepared a comprehensive report that includes a review of the Ontario and PJM markets, a 20-year (2017 to 2036) market outlook and prices for electricity, capacity and renewable energy credits in Ontario and the relevant zone/s in PJM; the total gross arbitrage value for the energy congestion rents, the capacity revenue potentials for PJM, and the renewable energy credits revenue potential in PJM.
- ***Authored a paper on California ISO's transmission economic planning process ("TEPP") and transmission economic assessment methodology ("TEAM").*** Cherrylin was part of the team that reviewed the CAISO's regulations related to transmission planning and economic studies to evaluate transmission projects and co-wrote the paper describing CAISO's TEPP and TEAM with illustrative and quantitative examples.
- ***Analyzed the viability of potential investment of a client in a proposed electricity transmission line in California connecting the South California Edison and San Diego Gas & Electric utility service areas*** in light of the state's electric transmission approval process, the relative feasibility of the project compared to proposed alternatives, and the increased need for electricity reliability in the LA Basin and San Diego region in the aftermath of the shutdown of the San Onofre Nuclear Generating Station.
- ***Conducted an independent modeling exercise to determine the potential revenues for a proposed transmission project wheeling power from western MISO to eastern MISO and eventually to PJM.*** The team evaluated both the revenue opportunities to the investors as well as the societal benefits to the MISO system. The team also assessed the incremental value of the business strategy of selling the energy (and capacity) out of East MISO to third parties who will serve customers in PJM. LEI's modeling exercise entailed evaluating intrinsic revenues, extrinsic revenues, as well as the green value of the project.
- ***Evaluated the detailed cost-benefit analysis and macroeconomic impact analysis in support of the Champlain Hudson Power Express ("CHPE")*** application for siting approval at the New York Department of Public Service ("DPS"). LEI's analysis of economic effects was the

cornerstone of the settlement agreement reached between TDI and some New York agencies. Results of the modeling were filed with the Commission. The study is available on the client's website at http://www.chpexpress.com/docs/Analysis-of-the-Macroeconomic-Impacts-of-the-Proposed-CHPE-Project.pdf.

- ***Analyzed Chicago congestion issues:*** LEI was retained to do a resource analysis in the Chicago area and to analyze the congestion within the Chicago area and MISO zones surrounding Lake Michigan.
- ***Performed macroeconomic analysis of HVDC project:*** Ma. Cherrylin part of a team of economists that performed a macroeconomic analysis to estimate the local economic benefits accruing to taxpayers, residents, and businesses along the 800+mile route during construction of the Zephyr HVDC project, which runs from Wyoming to Colorado, Utah, and Nevada. LEI performed the analysis using the REMI P1+ model.
- ***Conducted New England price simulation:*** New England wholesale electricity markets were simulated in order to determine whether the Greater Springfield Reliability Project ("GSRP") would produce economic benefits to the New England region. In order to ensure that economic benefits were not subject to the forced outage and availability schedule of the simulated energy markets, LEI simulated the energy market with 30 different random forced outage and availability schedules. Using these simulations, a distribution of results was used to calculate confidence intervals and hypothesis tests run on the results, hence increasing the robustness of our findings. The study results were used to produce written testimony to the CSC and oral testimony was provided in late August and early September 2009.

Market power analysis

- ***Prepared a report on how to prevent abuse of vertical market power by transmission companies found in a holding company structure***. This report, which is for a large Middle Eastern company, shows that both the US and EU have developed affiliate relations codes to assure that transmission companies provide non-discriminatory access to all stakeholders, regardless of affiliation. The report recommends that based on international best practice, Saudi Arabia should ensure that the transmission company has a separate board from the holding company, does not share staff or premises, has separate accounts, has full transparency regarding transfer pricing, and has established codes of conduct.
- ***Assessed the wholesale power market impacts of the merger of NRG, Inc. and GenOn:*** LEI staff, performed Delivered Price Tests analysis for the Federal Energy Regulatory Commission ("FERC") under Section 203 of the Federal Power Act and submitted extensive analysis to FERC in the summer of 2012. The Merger Application was successfully approved by FERC in December 2012. Docket No. EC12-134-000 Subsequently, LEI assisted the client in preparation of the 205 market-based rate authority analysis.
- ***Supported the client in preparation of a merger application to the Federal Energy Regulatory Commission ("FERC") under Section 203 of the Federal Power Act***, in conjunction with the client's acquisition of a Maine-based hydroelectric generation portfolio. LEI performed a full Delivered Price test analysis for the ISO New England control area. LEI's analysis was filed with FERC, and the Merger Application was approved in February 2013.

- ***Performed a generation market power screening analysis on potential acquisitions in the ERCOT market***. Cherrylin conducted an HHI analysis to determine the impact of the potential acquisitions on the clients' market power.
- ***Performed an HHI analysis for the New York energy markets,*** FERC's indicative screens (Pivotal Supplier Screen and Market Share Screen) in connection with the client's potential acquisitions.
- ***Conducted an HHI analysis for the PJM energy markets***, FERC's indicative screens (Pivotal Supplier Screen and Market Share Screen) in connection with a client's potential acquisition.
- ***Performed the Delivered Price Test as required by FERC***. LEI studied the CAISO and ISO-NE markets. Cherrylin was responsible for the analysis in the ISO-NE market. The analysis included DPT for energy markets and HHI analysis for capacity markets. Cherrylin also performed several sensitivities.
- ***Evaluated PJM's capacity market*** to determine how the merger of two utilities in the market will affect the PJM capacity market.

Stakeholder outreaches

- ***Conducted the focus group discussions with the different stakeholders***, the results of which were used for the communications needs assessment of the Philippine Rural Power Sector Reforms report submitted by a client to the World Bank.
- ***Developed the communication and crisis strategy plan*** for the Cebu-Negros-Panay looming power crisis. This plan was adopted and implemented by the Philippine Department of Energy. Moreover, she was in charge of the successful Power Summit held at Cebu City, Philippines.
- ***Headed a team that conceptualized and conducted a series of follow-up public consultations*** on the implementation of the Electricity Power Industry Reform Act (EPIRA) in the Philippines.
- ***Co-handled the nationwide public consultations*** for the implementing rules and regulations of the EPIRA. The ten nationwide public consultations were targeted for all the stakeholders of the power industry namely the industry players, consumer groups, business organizations, and concerned government agencies. Cherrylin was also part of the technical team that developed the program for the public consultations and submitted an integrated report of the results of these public consultations to the Philippine Joint Congressional Power Commission.

MARIE N. FAGAN, PhD

Managing Consultant, London Economics International LLC

LONDON ECONOMICS

KEY QUALIFICATIONS:

Marie Fagan is the Chief Economist at London Economics International, LLC, based in Boston, Massachusetts. With over 30 years of experience in research and consulting for the energy sector, Marie's career has spanned international upstream and downstream oil and gas, global coal, North American gas markets, and North American power markets. She has advised C-suite industry clients, buy-side and sell-side financial clients, and regulators. At LEI, Marie's expertise across electricity markets and fuels provides integrated perspectives and supports sound strategic advice for clients.

Marie leads LEI's engagements related to oil and natural gas analysis. She directs LEI's gas pipeline modeling efforts based on a sophisticated network model, supporting outlooks for natural gas prices and basis, and analysis of flows on North American interstate pipelines. She has served as an expert witness in matters involving oil and natural gas pipeline systems, which requires detailed analysis of flows, contract terms, and activities of shippers. She provides in-depth expert testimony on issues such as basis differentials, pipeline capacity and utilization in key regions, and LNG import and export supply and demand.

Marie has experience as a project manager and lead witness for complex, multi-year engagements, include a two-year project for the Maine Public Utilities Commission in 2014-2016, and a two-year project for the Mississippi Public Service Commission in 2017-2019. She has deep experience in econometric analysis, including econometric analysis for gas utility performance benchmarking.

Marie is a member of industry and academic associations including the Boston Economic Club, the Energy Bar Association, the International Association for Energy Economics, and New England Women in Energy and Environment. She is Vice President for Business for the US Association for Energy Economics.

EDUCATION:

The American University, Washington, DC. PhD in Economics, 1995. Dissertation: "Measuring Cost and Efficiency in US Crude Oil Resource Development, 1977-1990: A Frontier Translog Cost Function Approach

The University of Connecticut, BS in Business Administration (Finance), 1984.

EMPLOYMENT RECORD:

From: 2020 **To:** present

Employer: *London Economics International LLC*
Chief Economist

From: 2016 **To:** 2019
Employer: *London Economics International LLC*
Managing Consultant and Lead Economist

From: 2014 **To:** 2015
Employer: *London Economics International LLC*
Managing Consultant

From: 2012 **To**: 2014
Employer: *IHS Markit (formerly Cambridge Energy Research Associates)*
Senior Director, Upstream Strategy

From: 2007 **To**: 2012
Employer: *IHS Markit (formerly Cambridge Energy Research Associates)*
Senior Director, North American Gas and Power

From: 2004 **To**: 2007
Employer: *IHS Markit (formerly Cambridge Energy Research Associates)*
Director/Senior Director, CERAView Institutional Investor

From: 2003 **To**: 2004
Employer: *Cambridge Energy Research Associates*
Director, North American Gas

From: 2001 **To**: 2002
Employer: *International Human Resources Development Corporation*
Director, Global Gas Program

From: 1998 **To**: 2001
Employer: *Cambridge Energy Research Associates*
Associate Director, Global Oil

From: 1996 **To**: 1998
Employer: *Cambridge Energy Research Associates*
Associate, Global Oil

From: 1994 **To**: 1996
Employer: *Energy Information Administration*
Economist

From: 1991 **To**: 1994
Employer: *Decision Analysis Corporation of Virginia*
Associate

From: 1989 **To**: 1990
Employer: *Decision Analysis Corporation of Virginia*
Research Associate

From: 1988 **To**: 1988
Employer: *United States Department of Energy*
Intern, Office of Policy Planning, and Analysis

RECENT PROJECT EXPERIENCE:

The projects briefly described below are typical of the work Marie Fagan has performed at London Economics International.

Econometric analysis and benchmarking

- ***econometric benchmarking analysis of gas distribution utility performance:*** LEI was engaged by an investor-owned local gas distribution company to support its rate filing for performance-based ratemaking. Marie led an econometric benchmarking analysis of utility performance in terms of O&M and capital costs. The econometric analysis used a transcendental logarithmic ("translog") cost function to help set expectations for further efficiency improvement, for use in the setting of the *X*- factor.
- ***econometric benchmarking analysis of generation unit performance:*** LEI was engaged by a Canadian hydropower generation company to support its rate filing. Marie led an econometric benchmarking analysis of unit-level O&M costs for a cross-section of over 300 hydropower generation units.
- ***econometric analysis of oil demand:*** Marie led a comprehensive study of price and income elasticities of oil demand for Columbia University's Center on Global Energy Policy ("CGEP"). The foundation of the study was a detailed econometric analysis which employed variety of specifications of econometric models, including static and dynamic models, symmetric and asymmetric models, and tests of time-series properties of the data. The scope of the work encompassed separate models for crude oil, gasoline, and diesel demand, and relied on combined cross-section time-series data for OECD and non-OECD countries.

Expert testimony

- ***expert witness report in support of litigation:*** In Case 15CV-04225 in the District Court of Johnson County, Kansas, LEI was retained by counsel to examine the value of the green attributes of landfill gas ("LFG") produced by a project in Kansas City, Kansas, and sold under long-term contract to the Sacramento Municipal Utility District ("SMUD"). Marie's report demonstrated several flaws in the methodology of the opposing counsel's expert witness. Marie proposed an alternative, more appropriate methodology for valuing the green attributes of LFG, based on market fundamentals driven by the California RPS requirements.

- ***independent expert in assessing role of Enbridge Line 3 for Minnesota:*** Marie served as independent market expert assisting the Minnesota Department of Commerce in evaluating the application of Enbridge Energy for a Certificate of Need for its Line 3 oil pipeline expansion project (Docket No. PL-9/CN-14-916, OAH Docket No. 65-2500-32764). Marie's analysis covered global and local trends in refined product demand and crude oil supply, refinery utilization rates and utilization of high-conversion refinery capacity in Petroleum Administration for Defense District ("PADD") 2 and in the local Minnesota region. Her analysis required detailed examination of the assumptions and methodology of an oil pipeline linear programming-based model, in order to assess another witness's testimony which relied on the model. Marie provided written testimony; responded to interrogatory requests, provided written sur-rebuttal, and oral testimony.
- ***independent market expert, and expert witness for public utilities commission:*** For the Maine Public Utilities Commission, in the evaluation of the costs and benefits of alternatives for expansion of natural gas supply into Maine (MPUC Docket #2015-00071), Marie authored reports provided to the Commission; responded to discovery from other parties; prepared discovery questions and cross-examined witnesses; reviewed testimony by other parties and provided assessments of the issues presented; and served as an expert witness in the proceedings.

Crude oil and natural gas pipelines

- ***evaluation of the costs and benefits of expansion of natural gas pipelines into New England:*** For the Maine Public Utilities Commission, Marie led analysis of the costs and benefits of a number of contracts for firm transportation ("FT") service on natural gas pipelines. She reviewed pipeline precedent agreements and rate agreements and provided a qualitative analysis and comparison of contracts offered. She led the quantitative analysis of the impacts of pipelines on gas and power prices, which was underpinned by LEI's proprietary simulation model of the New England power system ("PoolMod"), combined with a widely-used industry standard model of the gas pipeline system (known as "GPCM"). She provided insight and direction of research in gas price basis differentials, pipeline capacity and utilization in key regions, and LNG import and export supply and demand.
- ***independent expert in assessing role of Enbridge Line 3 for Minnesota:*** Marie served as independent market expert assisting the Minnesota Department of Commerce in evaluating the application of Enbridge Energy for a Certificate of Need for its Line 3 oil pipeline expansion project (Docket No. PL-9/CN-14-916, OAH Docket No. 65-2500-32764). Marie's analysis covered global and local trends in refined product demand and crude oil supply, refinery utilization rates and utilization of high-conversion refinery capacity in Petroleum Administration for Defense District ("PADD") 2 and in the local Minnesota region. Her analysis required detailed examination of the assumptions and methodology of an oil pipeline linear programming-based model, in order to assess another witness's testimony which relied on the model. Marie provided written

testimony; responded to interrogatory requests, provided written surrebuttal, and oral testimony.

- ***independent research into the role of Enbridge Line 5 in NGLs and crude oil transport in Michigan:*** For a non-governmental organization ("NGO") Marie produced three white papers examining the current and future role of Enbridge Line 5 in Michigan related to three issues: propane supply in Michigan, transportation for crude oil producers in Michigan, and supply of crude oil to Michigan-area refineries. Marie's analysis of the propane market included a comparative static econometric analysis of the supply and demand from propane in Michigan, explained in non-technical language. The white papers were used by the client in discussions with the Governor of Michigan and other stakeholders.

- ***analysis of Western Canadian natural gas costs and production:*** LEI was retained by counsel to provide support in the matter of NOVA Gas Transmission Limited ("NGTL")'s application to the National Energy Board ("NEB"). LEI reviewed evidence and prepared testimony: Marie led analysis of the natural gas and natural gas liquids ("NGLs") market in Alberta and British Columbia, and the impact of a pipeline surcharge on producers of natural gas.

Market rules and practices

- ***analysis of key characteristics of capacity markets:*** To support Board-level understanding of the implications of potential capacity market designs in Alberta, Marie prepared a detailed review and comparison of capacity markets across international and North American jurisdictions. Report concluded that "the devil is in the details" of capacity market design. Market design details with potentially large impacts on the client were resource eligibility definitions, price setting mechanism, demand curve design, performance requirements, and market power mitigation rules.

- ***advisory on a wide variety of market rules and regulatory risks:*** LEI was engaged to support a client's Regulatory Group in its administering of the company's compliance program. This involved creating and delivering a monthly report covering developments by regional market and traded products which included: energy, capacity, long-term transmission service, FTR auctions, ancillary services, diesel oil, PRB coal, natural gas commodity, transmission, and storage, RECS, and CO2. Marie served as project manager and executive editor of the monthly report.

- ***advisory for an investigation related to the timing of outage scheduling:*** For a law firm, Marie provided research and expertise covering US Federal Energy Regulatory Commission ("FERC") practices related to monitoring, enforcement, and definition and prosecution of alleged market manipulation.

- ***advisory to provincial government:*** LEI was engaged to perform analysis of the organization and governance of electricity systems both cross-jurisdictionally and within the province of Nova Scotia. Marie provided a review of the Nova Scotia gas and power sectors, including governing institutions, the legal and regulatory framework, recent developments and challenges, and SWOT analysis.

- ***advisory to UK Department of Energy and Climate Change:*** Marie participated in an evaluation of auction design for the UK DECC. The UK market regulator was interested in whether US power markets evaluate capacity bids based on criteria other than the price bid, specifically, if the length of contract had a role in the auctions. Marie reviewed capacity market auction rules for PJM, ISO-New England and the New York ISO, as well as international spectrum auctions, North American gas transmission open season rules, and international auctions for toll roads.

Electricity and natural gas asset valuation and transaction advisory

- ***evaluation of behind-the-meter solar business models****:* to support a client's due diligence related to a potential investment in business-to-business behind-the-meter solar in the Northeast United States, Marie led a project examining US federal and state incentives for solar adoption, and assessed business models used for targeting commercial, institutional, and industrial sectors. Marie's team also developed key questions the client should ask, as part of its evaluation of potential transactions in the solar sector.
- ***evaluation of contracts for firm gas transportation capacity:*** For plants located in Virginia and Connecticut, Marie evaluated the value of firm transportation and interruptible transportation legacy contracts. The client also retained LEI to forecast delivered gas prices in New England (Connecticut) and PJM (New Jersey) and locational marginal prices as well as retail electricity prices in Connecticut. Marie led the gas market analysis for this project.
- ***assessment of congestion/curtailment risk:*** Marie led a project for a wind developer, providing a quantitative assessment, of congestion/curtailment risk for a wind asset in New England. LEI incorporated information from the interconnection impact study to examine system limits and provided an assessment of risk of outages based on NERC outage data for NPCC.
- ***forecast of reserves market prices:*** To support potential acquisition of hydropower assets, Marie provided analysis of ISO-New England's Locational Forward Reserves Market.
- ***due diligence related to a district cooling asset:*** Marie reviewed contracts and developed a model for projecting revenues and gross margins for the asset. Marie provided insight by identifying the potential for lower customer contract prices at renewal (in contrast to the seller's assumptions) and other areas of revenue risk.
- ***Long-term outlook for Japan electricity sector****:* LEI was engaged by a private equity company to prepare a brief, fact-based report that would help support a view of wholesale electricity prices in Japan after 2040. Marie authored the report, which covered i) the structure of Japanese electric power industry, and ii) the status of de-regulation and environmental policy. Based on this, Marie developed two reasonable scenarios for wholesale prices based on two different paths for energy supply to 2040 and beyond.

Auditing and procurement oversight

- ***led management performance audits of Entergy Mississippi and Mississippi Power Company.*** Marie serve a director and project manager for an engagement with the

Mississippi Public Service Commission ("MPSC") to conduct a two-year audit of the annual management activities of Entergy Mississippi, major vertically integrated utility in the MISO region. Marie's team assessed the utility's practices for economical purchase and use of fuel and electric energy, assessed relevant fuel and energy contract terms, assessed the companies strategies for offering into the MISO energy market, investigated the operations of the utility's coal and nuclear generation units, reviewed the prudency of coal inventory levels and inventory control procedures. The team also assessed plant performance for coal and gas-fired plants. Following the conclusion of the two-year audit cycle, the MPSC engaged LEI to audit the Mississippi Power Company, the other major utility in the state.

- ***independent evaluator for solar procurement:*** for PacifiCorp, Marie led the independent evaluator team for PacifiCorp's system-wide 2017 Solar RFP. The project included a review of PacifiCorp's Solar RFP, the facilitation and monitoring of communications between PacifiCorp and bidders, performing a review of the initial shortlist and final shortlist evaluation and scoring.

- ***analysis of the macroeconomic impact of biomass electric power generation:*** for Maine Public Utility Commission Docket No. 2016-00084, Marie conducted a macroeconomic study comparing the impacts of a bids related to biomass power procurement. Marie used the IMPLAN model to estimate impacts on direct, indirect, and induced jobs; payments to the state and to municipalities; payments for fuel harvested in the state, and other macroeconomic impacts.

ERCOT/Texas power market

- ***assessment of political support for large-scale transmission expansion:*** to support due diligence for an investor interested in wind assets in ERCOT, Marie examined the political, legislative, and economic drivers of ERCOT's Competitive Renewable Energy Zones ("CREZ") and provided an assessment of state-level support for further expansion of CREZ transmission lines. She also provided assessment of and outlook for ERCOT's and the Public Utility Commission of Texas's views of the "system cost" (the potential increased need for ancillary services and firm capacity) of wind.

- ***investment environment for transmission in ERCOT***: LEI was engaged by a European utility to examine the investment environment for transmission in ERCOT. Marie's team provided a detailed report covering agents and institutions, the regulatory and legal framework, remuneration of investment, and transmission planning.

- ***forecast of potential energy revenues of two wind farms in Texas:*** LEI used its proprietary dispatch model, PoolMod to project energy prices for the West zone in ERCOT. Marie led the project, and also examined the implications of the PPA related to the two wind farms.

GABRIEL ROUMY

Managing Consultant, London Economics International LLC

KEY QUALIFICATIONS:

Gabriel is a Managing Consultant at London Economics International with extensive experience leading complex projects. He has 15 years of experience in the energy sector, including wholesale markets and regulatory frameworks in both North American and international jurisdictions. Throughout his career, Gabriel has worked with and advised legislators, regulators, buy-side and sell-side financial clients, system operators, asset owners, and project developers.

Gabriel is LEI's lead expert and modeler for the New York power markets and manages engagements on a variety of topics touching upon all aspects of the power sector value chain. Sample projects that Gabriel has led at LEI include modeling of energy and capacity markets; modeling the impacts and benefits of proposed infrastructure projects; assessing the benefits of regulatory and utility ownership frameworks; utility productivity analysis and performance benchmarking; and management audits of power utilities.

Gabriel's experience in the power sector includes working for a large utility involved in the Canadian and Northeast US power markets as a market specialist and business development professional. He has extensive experience following market and regulatory developments in the power sector to provide meaningful insights and analyses in the identification and development of business opportunities.

Gabriel has an engineering background, with experience working as a research engineer in the field of power grid simulation for an internationally recognized research institute to provide utility transmission engineers with robust, innovative and efficient simulation tools.

Gabriel completed his undergraduate studies at McGill University in Montréal, earning a Bachelor of Engineering degree in computer engineering. Gabriel then earned his Master of Engineering degree from McGill with a specialization in control systems.

EDUCATION:

McGill University, Montréal, Canada: Bachelor of Engineering, computer engineering, 2000.

McGill University, Montréal, Canada: Master of Engineering, electrical engineering, 2003.

EMPLOYMENT RECORD:

From: 2015	**To:** present
Employer:	*London Economics International LLC, United States*
Current position:	Managing Consultant
From: 2010	**To**: 2015
Employer:	*Hydro-Québec, Canada*
Position:	Market specialist, business development
From: 2004	**To**: 2010
Employer:	*Hydro-Québec Research Institute, Canada*
Position:	Research engineer

SAMPLE PROJECT EXPERIENCE:

The sample projects below illustrate Gabriel's wide experience in the power sector, working with both regulators and market participants:

- ***Total Factor Productivity and Benchmarking analyses:*** Gabriel led an engagement to support a large Canadian regulated utility in relation to its payment amounts price-cap application before the province's regulator. The project involved performing a TFP study reflecting the regulator's prior decisions on calculation of the price-cap index. LEI also performed an independent benchmarking analysis of the utility's operations. This project involved selecting an appropriate peer group, selection of appropriate metrics to be benchmarked, and model development. Other key tasks were the preparation of analysis and written evidence assessing whether the inflation factor and treatment of the Capacity Refurbishment Variance Account remain appropriate.

- ***Utility productivity analysis and performance benchmarking:*** Gabriel led LEI's engagement with a large Canadian generation owner in relation to its payment amounts price-cap application before the provincial regulator. LEI's team performed an analysis of recent inflation trends as well as a Total Factor Productivity study looking at productivity trends in the hydroelectric generation industry, in order to inform the establishment of the "I" and "X" factors in an "I-X" incentive ratemaking mechanism. LEI further benchmarked the generation owner's costs with an industry peer group in order to propose to the regulator a stretch factor based on the target company's performance with respect to the peer group.

- ***Analysis of ownership and regulatory models in the electricity sector*:** LEI provided a study to assess options for transforming the ownership and regulatory model used to govern the electricity sector in Hawaii. This is a large, significant initiative to provide the government of Hawaii with independent and objective research and analysis to help it scope out the most appropriate course of action in achieving Hawaii's overarching policy goals. There are four main phases to this work. 1) to determine the long-term operational and financial costs and benefits of electric utility ownership models to serve each county of the State of Hawaii. 2) to determine the long-term operational and financial costs and benefits of electric utility regulatory models to serve each county of the State of Hawaii; 3) to provide additional insight

and analysis of ownership and regulatory model changes possible under the models identified and recommended; 4) to provide for the development and delivery of the executive summary, formal presentation and final report in a format approved by the client.

- ***Electricity sector regulatory design***: LEI was hired by the US Energy Association to perform a short-term technical assistance to the Haitian Energy Regulatory Agency (ANARSE). The overarching goal of the project was to empower the newly created regulatory authority (along with other stakeholders) with theoretical knowledge (backed by practical case studies), and best practices, to support its efforts toward market liberalization and successfully achieve the goals set in its mandate. Gabriel participated in developing training materials and led three one-week workshop trainings on licensing, tariff design and ratemaking methodology, market restructuring and institutional design best practices. The training was supplemented by a series of gap analysis reviews of current market structure, tariff policy and regulatory practices. All workshops were delivered in French while the supporting materials were delivered in both French and English.

- ***Electricity market regulations***: For a major Canadian utility, Gabriel provided market insight based on his knowledge of electricity market design in US and Canadian jurisdiction in order to advise the utility in the preparation of comments in response to proposed electricity market regulations in a Canadian province.

- ***Continuous Modeling Initiative:*** As lead New York modeler, Gabriel tracks and evaluate the impact of market and regulatory changes in the New York power markets to produce detailed price forecast and associated analyses using a suite of sophisticated modeling tools, including LEI's proprietary energy markets modeling software, POOLMod. Gabriel also created a model of New York's capacity market.

- ***Stranded Cost Obligation analysis:*** Gabriel led an engagement for a Midwest cooperative seeking to cease purchasing supply from the incumbent and rather opt for an alternate supply provider. As part of the engagement, LEI prepared a critique of the stranded cost estimate provided by the incumbent provider and calculated its own estimate of the stranded cost payment based on FERC's policy guidelines in Order 888. LEI's calculation of market value for the released energy and capacity from the incumbent t provided was based on its own forecast of energy and capacity prices in the MISO markets. LEI's report was filed with FERC as part of the litigation procedures.

- ***Transmission Open Solicitation:*** LEI was selected by a transmission developer to serve as Independent Evaluator for a proposed merchant transmission project open solicitation process in the Midwest US connecting two large RTOs. Gabriel led LEI's team to design a novel process to not only solicit transmission customers, but match suppliers, buyers, and marketers so to help reduce the market risk of shippers signing up for long term transmission agreements. LEI's scope of work included designing the solicitation process, meeting with FERC staff in advance of the project's application for negotiated rate authority, preparing all solicitation documents, coordinating the marketing campaign with an outside firm, conducting information sessions, matching suppliers/buyers/marketers, allocating transmission capacity, and submitting a report to FERC demonstrating the results of the process as part of the developers' Section 205 filing.

- ***Future State energy outlook:*** For a large utility, Gabriel led an engagement to prepare an outlook of future resource adequacy and ramping requirements in New York State given the various policy mandates for greenhouse gas emission reductions, renewable energy, distributed energy, and storage. LEI notably created an Excel-based model to observe the characteristics of supply resources need to satisfy the net load requirements, considering the output from intermittent generation resources.

- ***State energy policy:*** Gabriel led LEI's engagement with the Kansas Legislative Coordinating Council to perform a study on retail rates for Kansas electric utilities. The study, which involved two sections, aimed to inform electric sector public policy with the goal of ensuring regionally competitive electric rates and reliable electric service for consumers in Kansas. LEI's team first evaluated the effectiveness of current Kansas ratemaking practices, and their ability to attract required capital investments and balance utility profits with public interest objectives and reliable service. LEI then explored options available to the State Corporation Commission and the Kansas Legislature to ensure regionally competitive retail electricity rates while providing the best practicable combination of price, quality and service.

- ***Management audit of electric utilities;*** LEI led several engagements on behalf of regulators to audit the activities of major vertically integrated utilities, specifically with respect to procurement of fuel and power. LEI notably assessed the utilities' practices for economical purchase and use of fuel and electric energy, assessed relevant fuel and energy contract terms, investigated the operations of the utility's power plant operations, and reviewed the prudency of fuel inventory levels and inventory control procedures.

- ***Market power in the energy and capacity markets***: For a large utility active in the North American power markets, Gabriel analyzed market power mitigation rules implemented in multiple jurisdictions and guided the utility in participating in the markets' stakeholder process.

- ***Pricing carbon emissions in the energy market***: On behalf of a major power marketer, Gabriel analyzed various methods of assessing carbon emission rates for electricity imports in the NYISO markets, with a focus on providing the right incentives for low-emission import resources to help NY meet its clean energy targets. Gabriel discussed the impacts and pros/cons of the various methods from the point of view of both consumers and generators, so as to optimize social benefits from the proposed regulation.

- ***Market analysis:*** For a large utility, Gabriel prepared 10-year price forecasts for the NYISO capacity markets, assuming various scenarios around major capacity market drivers, in order to assess the impact of a proposed new supply resource located in New York City

- ***Market insight***: LEI was hired by a New England transmission & distribution Utility to prepare a 2-day workshop for company executives detailing the current state of the New England markets, major players across all sectors of the industry, major investment drivers and investment analysis methodology. Gabriel prepared significant portions of the workshop material and traveled to the client's office with an LEI principal to present the material and answer client's questions

- ***Market tutorial***. For a client looking to acquire a generating asset in New York City, Gabriel prepared a tutorial on power markets tailored specifically to market rules and market drivers of electricity, capacity, and ancillary services markets in the city

- ***Carbon regulation impact on energy and capacity markets:*** For an energy consumer association, Gabriel led a team that reviewed and analyzed proposed regulation that would limit the overall use of carbon-emitting fuel for buildings. Using publicly available material, the team created a model to estimate the impact on building electrification as a result of the proposed regulations, and the resulting costs for consumers from additional load in the energy and capacity markets.

- ***Analysis of benefits from transmission infrastructure***: LEI was retained by the Maine PUC to review and critique the analysis filed by Central Maine Power ("CMP") regarding the benefits to Maine resulting from the New England Clean Energy Connect ("NECEC"), which is a 1,200 MW HVDC Transmission Line from the Quebec-Maine border to Lewiston. The analysis includes work related to the regional energy markets, including the effect of the NECEC on a) wholesale energy, capacity, and ancillary service costs for Maine ratepayers b) impact on price volatility during natural gas price spike events; and c) greenhouse gas (GHG) reduction benefits. In addition, the analysis will also include work related to economic benefits to Maine from the NECEC including a) job creation, both direct and indirect; b) employment impacts from electricity price reductions and associated cost savings; c) economic development benefits and d) municipal tax revenues.

- ***Overview of market regulatory and legislative framework for the construction of new transmission infrastructure:*** LEI provided advisory services to a transmission developer looking to position its project in New York. LEI's input included providing an overview of the current regulatory and legislative framework, and assisting in identifying and targeting potential shippers on the line.

- ***Analysis of non-transmission alternatives to address grid reliability needs***: LEI was hired by transmission utilities within New England to assess the practicality, both from a technical and economic standpoint, of Non-Transmission Alternatives to several proposed reliability-driven transmission upgrades. The modeling effort included identifying suitable non-transmission alternatives, modeling their costs and comparing these technologies with the proposed transmission solutions. Deliverables included reports discussing the modeling methodology and associated findings. Gabriel assisted in the modeling of the non-transmission alternatives as well as the redaction of the final reports.

VICTOR CHUNG

Managing Consultant, London Economics International LLC

KEY QUALIFICATIONS:

Victor Chung joined London Economics in July of 2012. He has worked in a various engagements in both North America and international energy markets. Most recently, Victor advised a large utility in New England in how the future of the electric grid would evolve driven by carbon emission reduction policies. Victor also advised a large utility in Malaysia for their strategy and revenue model related to the next generation incentive based regulation.

Outside Asia, Victor had provided advisory services to clients related to North American markets such as PJM, New England, and Alberta.

Prior his employment at London Economics, Victor completed his Master's degree at Columbia University and worked as an operations analyst for Goldman Sachs, where he advised on numerous transactions in the natural resources and energy sector.

EDUCATION:

Hong Kong University of Science and Technology, Hong Kong, Bachelor of Business Administration (Finance), 2007.

Columbia University, New York, New York, Master of International Affairs (International Energy Management and Policy), 2012.

EMPLOYMENT RECORD:

From: 2012 **To:** present
Employer: *London Economics International LLC, United States*
Research Associate (2012), Consultant (2012-2014,2016), Senior Consultant (2017 to 2020), Managing Consultant (2020 to current)

From: 2014 **To**: 2015
Employer: *Lantau Group, Hong Kong*
Consultant

From: 2008 **To**: 2010
Employer: *Goldman Sachs (Asia) LLC, Hong Kong*
Analyst

RELEVANT PROJECT EXPERIENCE:

The projects briefly described below are relevant work Victor has performed throughout his career at LEI, Lantau Group, and Goldman Sachs.

Performance-based ratemaking and revenue requirement forecast

- Assisted a large utility in Malaysia in updating its revenue requirements model that was used on its Incentive-based Ratemaking ("IBR") Regulatory Period 2 ("RP2") submission.

- Reviewed and updated sections of the electricity tariff regulatory implementation guidelines ("RIGs") incorporating the proposed enhancements of TNB.

- Reviewed the forecasted revenue requirements under an IBR regime as well as other potential models for the Hawaii State. This analysis will be included in the Study on the Ownership Utility and Regulatory Models, which will be submitted to the Hawaii legislature in early 2019.

- For a gas transportation company in a major city in Asia, conducted a global benchmarking project that compares the tariff rate and network performance of the client and over 30 other gas transportation companies. The engagement includes developing a price-versus-performance framework to allow for a multi-dimensional comparison, and provided recommendations on a suitable incentive-based regulatory framework for the client

- Developed a list of performance metrics for a fair comparison between different gas distribution networks, and developed a dynamic model to allow comparison of tariffs under different gas usage across cities.

- For the Hong Kong Government, LEI reviewed the rate base and the rate of permitted return for the power companies in Hong Kong under the Scheme of Control Agreements. This required reviewing the alternatives to using Average Net Fixed Assets as the rate base, examining the assumptions used and methodology to calculate the WACC of power companies, updating the indicative range for the permitted rate of return, and recommending changes to existing rates of return by identifying new international best practices.

Written and testimony

- ***macroeconomic impact of a solar generation facility:*** Victor prepared a written testimony to the State of Vermont Public Service Board on the economic benefits that a proposed solar project. The testimony includes macroeconomic impact to Vermont using the JEDI Project PV model.

Electricity and Natural Gas Asset Valuation and Transaction Advisory Work

- ***long-term gas price forecast in multiple North American gas pricing hubs***: Victor developed a long-term gas price forecast model based on historical basis point differences between gas pricing hubs in North America, traded forward prices, and opportunities for new pipeline developments. The model observes price difference between pricing hubs, physical distance between pricing hubs, and historical long-run marginal cost of developing new gas pipelines,

and will determine whether there are opportunities for new pipeline to be developed to reduce the price differences between trading hubs.

- ***modeling Singapore's electricity market:*** Victor modelled the Singapore electricity market to develop a long-term price forecast for the wholesale electricity market. The modelling exercise involves mapping the Singapore electricity market and understanding its regulation. It also requires analyzing of recent energy trends in the region and anticipating potential changes in market dynamics.
- ***market review of developments of the UK electricity market:*** For a private renewable generation company, Victor provided a market review of recent developments of the UK electricity market, including recent changes in regulation, renewable energy incentives, national energy plan, and market trends.
- ***long-term energy and capacity price forecast in PJM:*** For a private renewable generation company, Victor provided a market premier and a long-term energy and capacity price forecast of the PJM market using various economic, regulatory and fuel price assumptions.
- ***cost benefits analysis of US transmission line:*** for a utility in the northeastern US, LEI prepared a cost-benefit analysis of a proposed transmission line with the potential to change existing market arrangements. In the analysis, LEI developed a base case and multiple project cases based on different configurations of the transmission project. Using its proprietary modeling tool, POOLMod, LEI simulated energy and capacity prices in each configuration over a 15-year timeframe, and compared the price differences against various cost allocation scenarios for the transmission line's construction. LEI also tested the statistical significance of the project case results against the base case results, and conducted further analysis on the economic effects of additional renewable generation projects that construction of the transmission line would make possible
- ***analyzing market and macroeconomic impact of an international transmission project:*** LEI prepared a 10-year energy market price outlook for the New England wholesale power market and forecast the impact of a proposed project on New England market prices. The project proposes to build a 1,000 MW DC-based transmission line that between Quebec and Vermont and import energy into Vermont. LEI modeled the long-term price forecast for Vermont and the rest of ISO-NE over the 2019-2028 period, and examined the price differentials. LEI was analyzed the benefits of the proposed transmission project on employment, economic activity, and tax revenues in New England.
- ***due diligence support of a acquisition of a combined heat and power plant:*** LEI worked with private equity investor on an M&A due diligence review of a combined heat and power generation unit in New England. LEI provided market analysis, price forecasting services, and supported the investor in its valuation of the asset.
- ***analyzed the economic impact of constructing a transmission upgrade project:*** For the National Grid, LEI analyzed the economic impact of constructing the Interstate Reliability Project ("IRP"), a substantial transmission upgrade in ISO-NE. Using its proprietary modeling tool, POOLMod, LEI compared the forecasted energy price between a base case (where the IRP will be built) and project case (where the IRP will not be built). Furthermore, LEI conducted sensitivity tests to demonstrate the importance of the IRP under system stress conditions, such as a high demand or outage of a significant generation unit.

Regulatory Economics

- ***Grid of the Future study for a large utility in New England***. LEI assisted a large utility in New England in developing a strategic roadmap to best position itself in the changing technological and industrial landscape of the future electric grid. Specifically, Victor worked together with utility to develop a "Business Case" around several scenarios that are designed to test the impacts of the most important critical opportunities and uncertainties identified Victor used the simulation results to quantitatively assess the economic and environmental impacts in each scenario.
- ***evaluating debt restricting plan of Puerto Rico Electric Power Authority.*** LEI was engaged by a private client to provide expert services in connection with the motion of the Financial Management and Oversight Board of Puerto Rico, as representative of the Puerto Rico Electric Power Authority ("PREPA"), and the Puerto Rico Fiscal Agency and Financial Advisory Authority for approval of a settlement with PREPA's bondholders in PREPA's PROMESA Title III case. LEI's expert services included performing economic analyses, preparing an opening expert report, preparing a rebuttal expert report, sitting for a deposition, and testifying at the hearing on the motion.
- ***analyzing impact of transition to an energy and capacity market.*** LEI supported a large generator in Alberta as the government and market operator developed plans to transition from an energy-only market to an energy and capacity market. Victor conducted a quantitative analysis of what a transition to a day ahead market might entail and the economic implications of co-optimizing energy and operating reserves, as well as adding a fast ramp product; Victor also prepared discussion papers on topics including implications for Alberta's ancillary services market, a qualitative assessment of transitioning to a day ahead market, and assessment of implications for the generator's assets and future profitability as well as overall market viability and stability.
- ***modeling of ISO-NE's Competitive Auctions with Subsidized Policy Resources and Forward Clean Energy Market.*** LEI conducted an empirical analysis of two proposed New England wholesale electricity market design changes, including long term modeling of the New England energy and capacity markets. Specifically, LEI (i) created, built, and simulated the proposed market design changes, (ii) analyzed resulting market impacts, and (iii) provided observations to the Client. The first proposed market design change is the Competitive Auctions with State Policy Resources ("CASPR") proposal. The CASPR proposal involves adding a second or "substitution" auction to the current Forward Capacity Market ("FCM") framework. LEI evaluated the financial incentives for incumbent (existing) resources to remain in operation versus the financial incentive to retire (and therefore the bidding strategy of these resources). LEI considered critically the tradeoffs that existing generators will be making in the face of the substitution auction, including the opportunity/risk of continuing to operate versus the opportunity/risk of submitting a retirement bid and participating in the substitution auction. The second proposed market design change is the Forward Clean Energy Market (FCEM) proposal. The FCEM proposal is a market-based solution to the selection and procurement of clean energy supply. LEI built a model that simulates the supply and demand fundamentals of the proposed FCEM and integrate the results of the FCEM with its energy market model and FCM model.

- ***modeling macroeconomic impact of different power sector design options.*** LEI provided strategic advice to the Saudi Ministry of Energy, Industry and Mineral Resources ("MEIM") on the options for the evolution of the Saudi power sector, including the role of the Saudi Electricity Company ("SEC"). LEI considered a number of options available to SEC (e.g. retain its current form, improved, and encouraged to expand overseas, or fully unbundled, and a competitive power market created from its constituent parts). In any of these scenarios, depending on the governance structures deployed and the range of financing options available, LEI also considered how different aspects of Vision 2030 can be achieved. In this project, Victor assisted the development of a macroeconomic impact analysis model to allow MEIM to compare the differences in impact to GDP and jobs in Saudi under the options available to SEC.
- ***modeling macroeconomic impact of electricity rate increase.*** LEI was retained to provide expert testimony support to the proposed blended intervention of the general service small and medium customer classes and Keystone Agricultural Producers. Manitoba Hydro 2017/18 & 2018/19 General Rate Application. Victor supported the team in preparing a macroeconomic impact analysis of the Rate Application.
- ***advising on the revenue structure for a gas distribution company:*** for a gas distribution company in Asia, Victor reviewed the existing revenue model of the gas distribution company, and advised on the potential new revenue structure where the transportation business should be regulated based on a return on rate base approach, while the retail side of the business should be regulated based on a margin approach.
- ***prepare business process documents for gas transportation business under a third-party access regime:*** Victor was involved in prepared business process documents for a gas transportation company in Asia in preparation for the upcoming third-party access regime. The business processes include gas nomination, LNG terminal operations, gas quality monitoring, and LNG shipment scheduling.
- ***conducted 2015 Review of Non-Energy Margin***: LEI was asked by ENMAX Energy Corporation ("EEC") to review EEC's proposed non-energy return/risk margin associated with expenses incurred as a result of operation of the Regulated Rate Option ("RRO"). For the client, LEI reviewed the settled practice in Alberta, recent proposed changes providing for an all-inclusive return margin, and calculated an indicative range of margin for EEC.
- ***assisted generator in hydro development strategy:*** assisted Alberta generator on strategy related to new large-scale hydro development, including justification as inflation hedge for potential pension fund investors, integration into competitive market while maintaining ability to finance, and other strategic and regulatory support.
- ***review of rate of permitted return in Hong Kong:*** for the Hong Kong Government, LEI reviewed the rate base and the rate of permitted return for the power companies in Hong Kong under the Scheme of Control Agreements. This required reviewing the alternatives to using Average Net Fixed Assets as the rate base, examining the assumptions used and methodology to calculate the WACC of power companies, updating the indicative range for the permitted rate of return, and recommending changes to existing rates of return by identifying new international best practices

- ***developing regulatory comments on a proposed market regulation:*** LEI was retained by a market participant in Alberta to develop comments on MSA's Strawdog for the Framework for the Assessment of Market Harm. More specifically, LEI was asked to comment on the economic issues associated with the proposed Strawdog pertaining to the definition of harm in the context of Alberta's market design and the impact of the implementation of the Strawdog on wholesale power market design, market manipulation and market power abuse.

Renewable Energy Analysis and Valuation

- ***analyzed current and future dynamics in the British Columbia power markets for of British Columbia power producers:*** topics analyzed included costs of independent power producers ("IPPs") relative to BC Hydro, uncertainty around future demand levels in BC, implications of moving away from use of Critical Water Year analysis in planning, risks and uncertainties regarding import availability, and the overall macroeconomic contributions of IPPs. LEI also analyzed the provincial government's Review of BC Hydro and provided an assessment
- ***valuation of a hydropower project in China:*** For an independent power producer in China, LEI valued a hydropower project developed along a river system located in Hunan province in China. The engagement included developing three scenarios (pragmatic, optimistic, and pessimistic) based on varying hydrology, energy prices, construction and operating costs, and access to carbon credits.
- ***valuation of a pumped storage hydro generation facility:*** LEI provide a forecast the energy and capacity prices for the next 20 years of the relevant zone for a client to acquire a pumped storage hydro generation facility in PJM. The price forecast LEI modeled both energy and capacity markets on integrated basis, as well as using a Real Options Model to simulate the target unit's operational decision in arbitraging the peak versus off-peak hours in the energy market.
- ***valuation of a portfolio of hydro assets in China:*** Victor assisted a large listed renewables energy fund on its due diligence process in preparing a bid for a portfolio of hydro generation assets in four provinces in China. The due diligence includes forecasting the on-grid tariff for hydro in each province, as well as the level of excess hydro generation in each provide dur to transmission constraints in China.
- ***modeling ancillary services market in Alberta:*** For a large generator in Alberta, Victor developed a ancillary services model for a 15-year ancillary services revenue forecast for hydro and other generating assets in Alberta. The model creates hourly dispatch and clearing simulation that is integrated with the Alberta energy market model.
- ***due diligence support of a acquisition of a portfolio of hydro facilities:*** For an infrastructure investment fund, LEI reviewed due diligence materials for the client's potential acquisition of a portfolio of hydro facilities located in Maine.
- ***drafting Renewable Energy Procurement Plan for a large Middle-East Country:*** for a government-related entity of a large Middle-East Country, prepared an analysis on the macroeconomics impact of procuring renewable energy resources, and devised a procurement leverage strategy for the government to maximize the potential economic impact

DR. JOHN FALLON

Position	Senior Economic Advisor
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Qualifications

Doctor of Philosophy (Economics), University of Western Ontario, Canada.

Master of Arts (Economics), University of Western Ontario, Canada.

Bachelor of Economics (First Class Honours in Economic Statistics, University Medalist), University of Queensland.

Key Skills and Experience

I am a Senior Economic Advisor and the founder of Economic Insights Pty Ltd.

I have worked on a wide range of economic regulation, economic development and public policy matters and provided advice on all major aspects of economic and public policy. I also have strong quantitative skills.

From 2012 to 2014 I was Director of Research at the Queensland Competition Authority and have since returned to consulting. Prior to becoming a consultant, in 1992, I worked at the Australian Industry Commission on economic reforms, at the OECD on macroeconomic issues, at the Queensland Treasury on public enterprises and earlier in my career at the Reserve Bank of Australia.

From 2012 to 2015 I developed and taught a master's level course on Infrastructure Regulation Economics and Policy at the Crawford School of Economics and Public Policy Australian National University. In 2015 and 2016 I also developed and taught a master's level course on Globalization and Economic Development at the University of Queensland.

Key Projects

Access and pricing Issues

- Expert witness for foundation customers in a dispute with Aurizon Power about the pricing of risk for the Wiggins Island Rail Project (2017).
- Advisor to the potential users of West Pilbara rail and port infrastructure on access pricing and the cost of capital (2014-15).
- Report for Anglo-American Coal on asset stranding, the cost of capital and the socialisation of costs in relation to user charges for rail infrastructure in Queensland (2010).
- Report for the Minerva Joint Venture in relation to the asset value for the West Blackwater Access Undertaking Proposed by Queensland Rail Network Ltd (2009).
- Report on third party access and price regulation of the Dalrymple Bay coal loading facility in Queensland for Queensland Treasury (2000).
- Expert report on third party access price issues with respect to the Hunter Rail Network for the New South Wales Minerals Council (1998–99).
- Report on third party access and price regulation of the Dalrymple Bay coal loading facility in Queensland for Queensland Treasury (2000).
- Reports on monopoly prices in relation to the Cairns and Mackay Port Authorities and the Brisbane Markets Authority for the Queensland Treasury (1999).
- Report on asset valuation, depreciation and rate of return issues in relation to Queensland Rail for the Queensland Treasury (1999).

Other Economic Regulation

- Reports for the Netherlands Authority for Consumers and Markets on various topics in efficiency benchmarking of energy networks (2017).
- Supervised research projects and reports at the Queensland Competition Authority on: regulatory objectives and pricing principles, pricing for capacity expansion, pricing disparities for medical equipment, risk and the form of regulation, the split cost of capital, trailing average cost of debt, market parameters for the cost of capital, financial capital maintenance, depreciation, annuities and incentive regulation (2012-2014).
- Report for the New Zealand Competition Commission on regulatory precedents for setting the cost of capital within a range (2014).
- Reports for the New Zealand Commerce Commission on asset valuation and total factor productivity measurement in the presence of sunk costs, incorporating the principle of financial capital maintenance (2009).
- Report on the future of infrastructure in Australia, focussing on regulatory and other policy issues affecting investment including principles and frameworks for effective regulation, competition and vertical integration issues, the effective use of public private partnership arrangements, taxation arrangements and case studies (2005).
- Expert report on cost of capital and dividend imputation issues in relation to compensation for the acquisition of land for coal mining (2003-04).
- Various reports on cost of capital issues for electricity, gas and water utilities (2003).

- Adviser to the Commonwealth Treasury of Australia on industry self-regulation (2000).
- Asset valuation, rate of return and pricing guidelines for local councils for the Queensland Department of Local Government and Queensland Treasury (1999–2000).
- Report on the criteria for deciding whether government businesses should be declared as monopolies for the purpose of price monitoring and competitive neutrality issues for the Queensland Competition Authority (1997).

Electricity

- Reports for the Independent Competition and Consumer Commission (Australian Capital Territory) on various aspects of regulation of retail electricity prices (2016-2017).
- Reports for the Netherlands Authority for Consumers and Markets on various topics in efficiency benchmarking of energy networks (2017).
- Reports for Tenaga Nasional (Malaysian vertically integrated energy utility) with London Economics International on asset valuation, efficiency incentive schemes, form of regulation, modelling and regulatory guidelines (2016-17).
- Assisted London Economics International in the preparation of expert reports on productivity measurement for the regulation of power generation in Ontario (2016-17).
- Advisor to Horizon Power on cost escalators, the cost of capital and funding arrangements for the power sector in regional Western Australia (2010-11).
- Reports for the New Zealand Commerce Commission on asset valuation and total factor productivity measurement in the presence of sunk costs and incorporating the principle of financial capital maintenance (2009).
- Expert witness report to the Supreme Court of Queensland on behalf of Origin Energy in relation to a dispute about the benchmark retail electricity cost index in Queensland (2009).
- Advice on principles for roll forward and indexation of the asset base for electricity distribution businesses, in association with Dr Denis Lawrence, for the New Zealand Commerce Commission (2007).
- Report on cost allocation principles and practices for common and fixed costs in the electricity and gas sectors, in association with Dr Denis Lawrence, for the New Zealand Commerce Commission (2006-07).
- Development of a methodology for determining compensation in relation to the provision of ancillary generation services to the network operator in Tasmania (2004).
- Report on the recovery of costs associated with full retail contestability in New South Wales for Energy Australia (2000).
- Report on the form of regulation for electricity, particularly the issue of regulating prices, revenue or the rate of return for the Queensland Competition Authority (2000).
- Adviser to the Northern Territory Power and Water Authority on their submission to the Northern Territory Utilities Commission on the price of access to their network (1999–2000).

- Report on the form of price control for regulation of prices in the electricity distribution and retail sector in New South Wales for Energy Australia for an IPART price review (1999).
- Report on the regulation framework for the electricity industry in Queensland for the Queensland Competition Authority (1999).

Gas

- Advice to the New Zealand Commerce Commission on pricing principles and price methodologies for gas distribution businesses (2009).
- Benchmarking the performance of Australian gas distribution utilities relative to US gas distribution businesses for determining regulated prices (2007).
- Advice on various aspects of economic regulation of gas distribution businesses for the New Zealand Commerce Commission (2007).
- Peer review of a report on the rationale for policy intervention in the supply of gas to the WA domestic market for the WA government (2007).
- Advice on regulatory treatment of taxation for gas distribution businesses for the New Zealand Commerce Commission (2007).
- Advice on approaches and issues in relation to asset valuation for gas distribution businesses, in association with Dr Denis Lawrence, for the New Zealand Commerce Commission (2007).
- Reports on rate of return, asset valuation and cost allocation issues for Gascor in relation to major price arbitration (2001).
- Report on asset valuation issues in relation to gas pipelines for the Queensland Competition Authority (2001).
- Adviser and expert witness on pricing principles and various cost of capital issues in the gas, coal mining and electricity industries in relation to the price of gas supplied by the South West Queensland producers for the Pipeline Authority of South Australia and the Electricity Transmission and Supply Authority of South Australia (1996).

Water

- Reports for the Independent Competition and Consumer Commission (Australian Capital Territory) on various issues relation to the regulation of water and sewerage including the tariff structure, cost of capital, incentive schemes and developer charges (2016-18).
- Advisor to the Independent Competition and Regulatory Commission (ACT) on the cost of capital (2014).
- Bulk and retail water regulation in urban and rural Queensland. This encompassed advice on the form of regulation, incentive regulation, the cost of capital, asset valuation, cost allocation and capacity to pay (2010-11).
- Report on the competition implications and public benefits of the Queensland Water Grid Manager and associated asset aggregations (2007).

- Assessment of the competitive effects of horizontal and vertical integration and pricing options for water infrastructure in South East Queensland (2006).
- The options for water reform in North West Queensland (2005).
- Asset valuation, capital contributions, the cost of capital and pricing issues in relation to water infrastructure for the Burdekin Haughton irrigation scheme for the Queensland Competition Authority (2001–02).
- Report on the appropriate organisational structure for Sydney Water and the Sydney Water Catchment Authority for the New South Wales Cabinet Office (1999).

Telecommunications and Post

- Report for the Australian Competition and Consumer Commission on hedonic price indexes for various telecommunications services (2017-18).
- Report for the Australian Competition and Consumer Commission on regulated prices for Telstra's Domestic Transmission Capacity System (2015-16).
- Reports for Spark New Zealand and Vodafone New Zealand for their submissions on review of the Telecommunications Act in New Zealand (2015-16).
- Report for Australia Post on Methodology for costing Community Service Obligations (2016).
- International benchmarking study of the total factor productivity performance of Australia Post and six international postal services.
- Development of price index methodology for regulation of telecommunication services for the Peruvian regulator (2006).
- Optimal capacity provisioning in the context of growth and uncertainty for Telstra's submission to the regulation of the PSTN (2004).
- Estimation of average tenure for broadband subscribers as an input into imputation tests for Telstra (2004).
- Assessing the competition implications of Telstra's broadband prices and the bundling of telecommunications products including the use of imputation tests (2004).
- Quantifying differences between broadband penetration rates for Australia and other countries, report prepared for Telstra (2003).
- Privatisation and the regulatory framework for telecommunications services in Papua New Guinea for the World Bank (2000-02).

Other Transport

- Economic rationale and form of block exemption orders for liner shipping conference agreements for the Singapore Competition Commission (2006).
- Advice to the Board of Airline Representatives of Australia on landing charges at Sydney, Brisbane and Perth airports. Prepared reports on single till and dual till issues, asset valuation and the cost of capital (2000).

Mergers and Alliances

- Assisted in the preparation of a report on the application of auction theory to the proposed merger of Tabcorp and Tatts (2017).
- Advice on the competition implications of joint ownership by banks of an EFTPOS system (2007).
- Public benefit test of Water Grid Manager and water asset aggregations and associated regulatory arrangements in South East Queensland (2007).
- Assessment of the competitive effects of telecoms mergers and vertical integration issues in Portugal (2006).
- Assessment of the competitive effects of mergers in the wagering and gaming industries for TabCorp (2006).
- The competition implications of vertical and horizontal integration in the electricity industry in Australia for electricity utilities (2004-05).
- Co-ordinator of the team that advised the AGL on trade practice issues in its proposed acquisition of Loy Yang A in the electricity sector (2003).
- Airline alliances, market structure and efficiency, prepared for Qantas in relation to the proposed alliance with Air New Zealand (2003)
- Advice to a private client on the competition implications of an acquisition in the food processing sector (1997).
- The trade practices implications of an acquisition in the bathroom products market for a private client (1996).
- Report on the public benefit effects of the takeover of Queensland Independent Wholesalers by Davids for a private client (1996).
- Adviser to Composite Buyers Pty Ltd in relation to the public benefits of a merger (1995).
- Adviser to Caltex and Ampol in relation to a proposed merger (1995).
- Adviser and expert witness for the Trade Practices Commission in the proposed takeover by QUF Industries Limited of Port Curtis Dairy Association Ltd (1994).
- Adviser and expert witness for the Trade Practices Commission in the proposed takeover by Coles Myer Limited of Foodland Australia Limited (1994).
- Economic adviser and expert witness for Sagasco (a major gas exploration and distribution company) in a takeover bid by Santos (1993).
- Economic adviser and expert witness for Queensland Independent Wholesalers in the proposed takeover by Davids Holdings Pty Ltd (1992).

Other Trade Practice and Competition Issues

- Expert witness for the Commission of Inquiry into the fuel price subsidy in Queensland (2007).
- Report on the effectiveness of an on-line auction system for the allocation of timber in Victoria (2008).

- Advice on market definition and competition issues in relation to the use of a bulk cargo unloading crane system at Geelong Port (2007).
- Advice on market definition and competition issues in relation to the separation of Queensland Rail's electrification assets from the access regime for below rail services (2007).
- Economic report on regulation of stevedoring and the competitive effects of cabotage arrangements in Papua New Guinea for Steamships Pty Ltd (2006).
- Report on the competitive effects and public benefits of licensing restrictions in wagering and gaming for TabCorp (2005).
- A public benefit assessment of restrictions on competition in the provision of compulsory third party insurance (2005).
- Market definition and competition issues in relation to the allocation of timber milling licenses for the Queensland Department of Primary Industries (2003).
- Market definition issues in relation to the gaming market for Queensland Treasury (2003).
- The pricing of financial services for a private client in relation to a matter before the Administrative Appeals Tribunal (2002).
- Expert witness for Queensland Crown Law on collusive price fixing arrangements and associated damages in the concrete industry in South East Queensland (1996–2001).
- Market definition issues in relation to tourism services in North Queensland (2001).
- Market definition and competition issues in relation to the thoroughbred racing and wagering industries for Queensland Crown Law (2001).
- Market definition and competition issues in relation to an agreement between Microsoft and the Queensland Government for Queensland Crown Law (2000).
- Advice to a private client on the waste paper market in Australia (1997–98).
- Advice to the Queensland Treasury on microeconomic reform and national competition policy (1996).
- Report on the price implications of price fixing in concrete markets for a private client (1996).
- Adviser to the Australian Competition and Consumer Commission on predatory pricing (1996).
- Reports for the Queensland Treasury on public benefit criteria to assess anti-competitive restrictions, and market definition and trade practices issues in relation to sponsorship arrangements in the insurance industry, the workers compensation scheme, the assignment of timber milling licences and the assignment of rights to on sell water allocations (1996).
- Report on market definition for an industry submission to the Australian government on the activities of the Prices Surveillance Authority (1994).

Public Enterprise Reform

- Adviser to the World Bank and Asian Development Bank on public enterprise reform issues in a number of developing countries (1992-2009).
- Adviser to Queensland Treasury on public enterprise reform issues, accountability arrangements and performance indicators for public enterprises (1992–98).
- Adviser to the Brisbane City Council on the financial and economic impact of corporatisation of its transport operations (1997).
- Adviser to private clients on competition policy and valuation issues in relation to privatising certain public enterprises in Queensland (1996).
- Adviser to the Queensland Civil Contractors Federation on the competition policy implications of commercialising Queensland Transport's business activities (1996).
- Adviser to the Queensland Commission of Audit on public enterprise pricing (1996).
- While employed by the Queensland Treasury responsible for developing and implementing the Government's policy for corporatisation of government-owned enterprises. Prepared a White Paper on "Corporatisation in Queensland" that provided comprehensive guidelines for corporatisation (1991–92).
- Member of a number of steering committees on corporatisation and industry restructuring — for Electricity, Railways, Ports, Water and Queensland Investment Corporation. Queensland representative on the Commonwealth-State Steering Committee on National Performance Monitoring of Government Enterprises (1991–92).

Cost Benefit Analysis

- Team leader for several public benefit tests of existing legislation. These tests have varied from minor reviews based on key economic principles to comprehensive cost benefit analyses involving economy-wide and regional models. Key studies are outlined below.
- Public benefit test of Water Grid Manager and water asset aggregations and associated regulatory arrangements in South East Queensland (2007).
- Assessment of the economy wide effects of closure of the Tiwai Point aluminium smelter in New Zealand (2006).
- Public benefit test of regulations in relation to heavy vehicle driver fatigue (2006).
- Public benefit test of compulsory third party insurance legislation in Queensland (2005).
- Public benefit test of restrictions on interstate advertising in the racing industry in New South Wales (2004).
- Public benefit test of the home warranty insurance and builder's licensing functions of the Queensland Building Services Authority (2002).
- Public benefit test of the licensing of building certifiers and plumbers in Queensland (2002).
- Public benefit test of proposed regulation of the fitness industry in Queensland (2000).
- The costs and benefits of introducing full retail contestability in electricity in Queensland for Ergon Energy (2000).
- Public benefit test of regulation of taxis, buses and air travel in Queensland) (1999).

- Public benefit test of veterinary legislation restrictions on competition in Queensland (1999).
- Adviser to the Queensland Treasury on the public benefit test and dissenting report on the review of the Queensland Chicken Meat Industry (1998).
- Adviser to the Insurance Council of Australia on public benefit reviews of Compulsory Third Party Insurance undertaken in Western Australian and Tasmania (1998).
- Public benefit test of restrictions on competition in the dairy industry in Queensland (1998).
- Adviser to the Insurance Council of Australia on public benefit, privatisation and competition issues in relation to worker's compensation arrangements for Victoria and Queensland and development of a competitive framework (1997–98).
- Adviser to AAMI on public benefit, privatisation and competition issues in relation to compulsory third party insurance arrangements (1997).
- Adviser to a private client on public benefit, competition and economic development issues in the sugar industry (1997).
- Evaluated the costs and benefits of Australian Commonwealth government contributions to economic modelling (1995).
- Contributed to a comprehensive framework for assessing the economic impact of road investments in Queensland for the Queensland Transport Department (1994).
- Supervised a cost benefit analysis of container deposit legislation for the IAC (1987).

Publications and conference papers

- Fallon, J., M. Blake and D. Kelley (2014) "Regulatory Objectives and Pricing Principles", Network, Issue 50, March.
- Blake, M., and J. Fallon, (2012) "The Form of Regulation and Non-Diversifiable Risk, Network, Issue 44, June.
- Fallon, J., (2012), "Taxation of the Mining Sector: An Assessment of Recent Developments", Tax Policy Journal, Vol. 7.
- Diewert, E., J. Fallon and D. Lawrence, (2009), "Productivity-based Regulation and Sunk Costs", memo.
- Fallon, J. 2009, "The Taxation of Income from Capital", Tax Policy Journal, Vol. 5.
- Fallon, J. 2007, "Fuel Tax Policy: Issues and Economic Principles", Tax Policy Journal, Vol. 3.
- Fallon, J. 2006, "Market structure, regulation and performance in the airline industry: Lessons for a potential alliance", in Coelli, T., and D. Lawrence, Performance Measurement and Regulation of Network Utilities, Edward Elgar Publishing, Cheltenham.
- Fallon, J., and F. Menezes, 2006, "Exclusionary conduct: theory, tests and some relevant Australian cases", Competition and Consumer Law Journal, vol. 13.
- Goorha P. and J. Fallon, 2006, "Optimal Provisioning Theory and Regulatory Distortions", in International Journal of Regulation and Governance, Vol 6, 1.

- Fallon, J. 2005, "The ACCC's interpretation of public benefit in authorisation decisions", Agenda, December.
- Fallon, J. 1991, "Implementing and Adopting the Corporatisation Model", Institute for International Research Conference on Queensland Corporatisation, Brisbane, October.
- Fallon, J., P. Gretton, S. James and D. Luskin 1991, "Industry Assistance Trends and Regional Implications", Paper No. 4 in Background Paper on Urban and Regional Issues, Economic Planning Advisory Council.

Employment Record

Senior Economic Advisor, Economic Insights Pty Ltd (June 2014 – present)

Casual lecturer, Globalisation and Economic Development, University of Queensland (2015-2016)

Casual Lecturer, Infrastructure Regulation and Economic Policy, Crawford School of Economics and Policy, Australian National University (2012-2014)

Director of Research, Queensland Competition Authority (January 2012-May 2014)

Director, Economic Insights Pty Ltd (August 2006- January 2012).

Vice President, CRA International Pty Ltd (December 2004-July 2006).

Principal, Network Economics Consulting Group Pty Ltd (March 2003-November 2004).

Managing Director, Economic Insights Pty Ltd (September 1992-February 2003).

Director, Government Owned Enterprises Unit, Queensland Treasury (1991- 1992).

Assistant Commissioner, Economic Studies, Industry Commission, Canberra (1990-April 1991).

Casual lecturer, (Macroeconomics of Developing Countries) Australian National University (1990).

Economist, Economics and Statistics Department, OECD, Paris (1987–89).

Director, Industries Assistance Commission (IAC) Canberra (1986–87).

Teaching Assistant, University of Western Ontario, London, Canada (part-time, 1982–85).

Principal Research Officer, Assistant Director and Acting Director, IAC (1980–82).

Tutor, (Quantitative methods) University of Queensland (part-time, 1979–80).

Bank Officer, Reserve Bank of Australia, Brisbane (1971–80).

JINGLIN DUAN

Senior Consultant, London Economics International LLC

KEY QUALIFICATIONS:

Jinglin is a Senior Consultant at London Economics International LLC ("LEI"), where she lends her knowledge and skills to the firm's technical engagements with regulators, utilities and private equity firms in the US and abroad on issues regarding project evaluation, tariff design, investment strategic consulting, litigation support, as well as power price forecasting and market analysis. Specifically, Jinglin is responsible for modeling regional and national social and economic impacts for electric projects using REMI PI+ and is the primary electricity market modeler for the New England (ISO-New England), Southeast US (SERC) and Florida (FRCC) regions. Jinglin has also been actively engaged in statistical analysis, regulatory study, as well as financial analysis for different aspects of the power sector.

Jinglin obtained her bachelor's degree in environmental science at Peking University and her master's degree in public administration at Columbia University, with a special focus on environment & energy. Before joining LEI, Jinglin has worked at J.P. Morgan Chase & Co. as an operational risk management consultant.

EDUCATION:

Columbia University, New York, NY, M.P.A. in Development Practice.

Peking University, Beijing, China, B.S. in Environmental Science

EMPLOYMENT RECORD:

From: 2019 **To:** present
Employer: *London Economics International LLC, United States*
Senior Consultant

From: 2016 **To:** 2019
Employer: *London Economics International LLC, United States*
Consultant

From: 2015 **To:** 2016
Employer: *London Economics International LLC, United States*
Research Associate

From: 2015 **To:** 2015
Employer: *JP Morgan Chase & Co, United States*
Operational Risk Consultant

From: 2014 **To:** 2015
Employer: *Earth Institute, Columbia University, United States*
Associate and Program Developer

From: 2014 **To:** 2015
Employer: *United Nations Development Programme, United States*
Intern, Environment and Natural Capital, Pvt Sector Engagement

SAMPLE PROJECT EXPERIENCE:

Tariff design and regulatory study:

- ***Benchmarking study for North American hydro utilities:*** LEI was engaged to support Ontario Power Generation in relation to its second-generation hydroelectric payment amounts price-cap application before the Ontario Energy Board ("OEB"). Jinglin led the econometrics-based benchmarking study hydro utilities in the US and Canada and develop rankings based on each utility's relative efficiency.

- ***Strategy advisory on a gas utility's IBR submission:*** Jinglin worked with the LEI team in providing strategic advisory to the client in terms of the IBR components to consider in the filing. Jinglin worked on building the model for calculating the total productivity factor for the US gas utility sector and conducting an econometrics-based benchmarking for assessing the utilities' relative efficiency.

- ***Study on effective carbon prices:*** As part of a consortium, LEI was hired by the Singapore National Climate Change Secretariat ("NCCS") to undertake a study on effective carbon prices faced by energy-intensive manufacturing sub-sectors in jurisdictions across Asia, Middle East, Europe, and North America. Specifically, LEI was tasked with studying carbon policies in China, Middle East, Taiwan, USA, and Canada. The deliverables, consisting of a report and a dashboard tool, allowed the NCCS to compare effective carbon prices across competitor jurisdictions in these key manufacturing sectors and thus inform current and future policy decisions regarding the level of Singapore's carbon price and wider climate change policy. Jinglin is in charge of studying electricity market rules and carbon policies for six juristictions in China.
- ***Case study of wheeling rates in South Asia:*** LEI was engaged by TNB in Malaysia to work as the project manager of its Incentive-Based Regulation ("IBR") submission for the 2nd regulatory term. LEI's role in this project includes two phases. As part of the LEI team, Jinglin helped preparing the proposal and worked on Phase I of the project. Specifically for Phase I, Jinglin worked on reviewing the Distribution and transmission wheeling rates of TNB, and conducted a side-by-side comparison of the regulatory and tariff framework in other jurisdictions including the Philippines, Australia, and the UK. Results of the case studies and comparison were presented to the TNB management, as part of LEI's advisory work on proposing enhancement for the Malaysian Regulatory Implementation Guidelines.
- ***Study of regulatory changes and market development in the Midwest U.S. electricity market:*** Rye Development hired LEI to provide analytical support on their due diligence process. The supporting tasks entailed: providing updated outlook on energy prices, as well as intelligence

on recent developments in selected US power markets (PJM and MISO), documenting in a memo LEI's REC price forecasts, and reviewing requirements and risk exposure to hydropower facilities in selected capacity markets. Jinglin wrote the summary for recent development in the MISO market and the implications.

Utility audit:

- ***Management and fuel audit of a major utilityin the Southeastern US:*** LEI was engaged for a two-year term to conduct the annual management audits of the oil, gas, coal, nuclear fuel, and energy procurement activities of Mississippi Power Company. Jinglin, as part of the LEI team, assessed a complex array of issues including the utility's staffing, organization, risk management, and fleet operations.
- ***Management and fuel audit of a major utility in MISO:*** LEI was engaged in a management audit of the fuel (gas, coal, and nuclear) and energy procurement activities of a major vertically-integrated utility in MISO. The team assessed fuel and energy contract terms, and reviewed the prudency of coal and nuclear fuel procurement and inventory practices. In addition, the team also assessed management, organization, controls, strategies, and outcomes for the company's hourly MISO offers. As part of the team, Jinglin examined the utility's operations and compliance in MISO, investigated the fuel procurement, inventory, and operations of a nuclear power plant, and the financial implications of the utility's power purchase agreement for nuclear power.

Economic study and financial modeling:

- ***Energy infrastructure investment advisory:*** For a private equity client, LEI conducted an extensive project reviewing a wide range of investable energy sectors in the United States and Canada. The sectors included: electricity generation (natural gas, wind, solar, hydro), AMI, distributed resources, demand response, retail energy, gas LDCs, gas storage, gas pipeline transportation, LNG-related infrastructure, vertically-integrated utilities, electric distribution utilities, and water utilities. Jinglin assessed the investment potential of five sectors (including electricity transmission, distribution, storage, gas transmission and distribution), and of the Southeast US power market for the next five years, and proposed a methodology to screen and identify investment opportunities and execute on these opportunities.
- ***Study of the net going forward fixed costs for nuclear and offshore wind in New England:*** LEI is being retained by the New England States Committee on Electricity ("NESCOE") to study the New England wholesale electricity market dynamics under five scenarios of varying infrastructure investments and retirements. The analysis will be used to inform New England states on electricity policy issues under different scenarios. Jinglin worked as part of the team on refining the excel-based model for calculating the Net Going Forward Fixed Costs for nuclear and offshore wind generating units. Specifically, Jinglin examined company financial reports and relevant studies on ROE, PI risk, negative price risk, O&M, and CapEX schedule, etc.
- ***Evaluation of cross-check financial models for bids review:*** LEI was hired by the kfW as part of a consortium with the Frankfort School of Finance to assist ERA in developing a streamline process to review eligible technology types under RE-FIT program as well as training ERA staff on-site in best practice financial models, methodology and tools for this process. LEI's scope of work included designing and standardizing generic financial models to evaluate bids

for large hydropower plants. Jinglin as part of the LEI team helped review and revise the financial model. Jinglin worked on evaluating and refining the Excel-based financial model. Besides, Jinglin also designed the user guide manual and training materials.

- ***Econometric study on energy demand and its implication on future demand:*** London Economics International LLC ("LEI") has been engaged by the Columbia University Center for Global Energy Policy for an econometric study on how the demand for energy evolves and reacts to GDP growth, fuel prices, and other factors. LEI examined OECD and non-OECD countries using panel data, and also looked into China and the US separately. LEI adopted asymmetric models in order to capture the difference in response towards increase, decrease, and shocks GDP and fuel prices. Jinglin worked on data gathering and cleaning, model design, and performing STATA analysis.

Macroeconomic study, cost-benefit analysis:

- ***Identifying and measuring the life-cycle benefits of infrastructure investment:*** WIRES commissioned London Economics International LLC ("LEI") to prepare a study demonstrating the benefits of transmission investment. The benefits of transmission are frequently seen as uncertain by many policymakers and regulators; system planners have also found it a challenge to comprehensively measure benefits and identify beneficiaries. This study shows that a variety of benefits can be quantified robustly through forward-looking, simulation-based analysis. Moreover, these benefits are substantial, widespread, and long-lasting – putting dollars in the pockets of households, businesses, and governments. Jinglin was responsible for estimating the socio-economic benefits of two hypothetical transmission projects through designing the project configurations and capital costs and performing macroeconomics modeling. Jinglin also led the editing of the of the paper and preparing for presentations.
- ***White paper for debunking myths surrounding transmission investment:*** WIRES commissioned London Economics International LLC ("LEI") to provide a White Paper to identify and debunk the myths (i.e. outdated or inaccurate understanding) about transmission investment and prove the truth with real-world cases studies. In order to offer a more accurate portrayal of the need to invest in transmission infrastructure, this White Paper concludes with recommendations for practical and feasible improvements to the process of evaluating transmission projects. Jinglin was responsible for researching on real-world examples, identifying common myths, as well as leading the writing and editing of the paper. The paper is publicly available at www.wiresgroup.com.
- ***Macroeconomic impact evaluation for a transmission project in New England:*** LEI was retained by a major New England electric utility to evaluate the costs and benefits of several transmission solutions that would import power into New England. Jinglin was involved in modeling the socioeconomic impacts, including jobs creation, GDP growth, and environmental impacts, of this project in all six states of New England using the REMI PI+ model. Jinglin has also supported LEI's expert testimony work on behalf of Eversource Energy.
- ***Social & economic benefits analysis for a proposed transmission project:*** LEI was retained to conduct a comprehensive cost-benefit analysis of a proposed transmission project in New England using simulation-based analysis of the ISO-NE wholesale power markets. LEI's

analysis included detailed examination of the benefits to consumers from lower energy and capacity prices, as well as emissions reductions and local economic impacts (associated with spending during construction and lower retail costs of electricity). As the REMI modeller at LEI, Jinglin worked on analyzing the local economic benefits as part of a team and supported the testimony process by addressing data request questions.

SPEAKING ENGAGEMENTS AND PUBLICATIONS:

"Estimating Macroeconomic Benefits of Transmission Investment with the REMI PI+ Model" Presented at the REMI Webinar.

"Modeling positive externalities from carbon reduction in the energy sector using the REMI PI+ New England regional model" Presented at the 2017 REMI Conference on "Policy in the Trump Era – Energy, Economy and the Environment"

"How Does Electric Transmission Benefit You? Identifying and Measuring the Life-Cycle Benefits of Infrastructure Investment." January 8, 2018. Published by the WIRES Group. http://www.wiresgroup.com/docs/reports/WIRES_LEI_TransmissionBenefits_Jan2018.pdf

"The Truth about The Need For Electric Transmission Investment: Sixteen Myths Debunked." September 2017. Published by the WIRES Group.

MUGWE KIRAGU

Senior Consultant, London Economics International LLC

LONDON ECONOMICS

KEY QUALIFICATIONS:

Mugwe joined London Economics International ("LEI") in January 2015 as a Research Associate with a strong economics background and experience working in the Ontario government. In his time at LEI, Mugwe has been involved in a number of projects, notably leading a broad jurisdictional review into regulation around setting of stretch factors and earnings sharing mechanisms under an incentive regulation regime for a large Ontario electricity generator, as well as a detailed case study review of incentive-based regulation in the UK for a large Malaysian utility. In these projects, LEI was asked to provide advice on current and historical regulatory initiatives across a variety of jurisdictions and consider key lessons learnt from electricity deregulation around the world.

Mugwe has also been involved in the review of the cost of developing new thermal peaking generation across North America and in the writing of a research paper reviewing the market structure and identifying streamlining opportunities for a large Eastern European regulator. In Sub-Saharan Africa, Mugwe was involved in the development and execution of a workshop in the Gambia for the Public Utilities Regulatory Authority on deregulation and unbundling options for the national utility, as well as a broad regulatory review of the market structure in Kenya for a private client. He is currently the primary modeler of the Southwest Power Pool market, producing a biannual long-term price forecast using LEI's proprietary model, POOLMod.

Mugwe holds a BSc. in Biotechnology and Economics from the University of Waterloo, Ontario. Prior to joining LEI, Mugwe had worked at the Ontario Ministry of Infrastructure as a Research Analyst on the Infrastructure Finance team, maintaining an exhaustive database of large public infrastructure procured through Ontario's Alternative Financing and Procurement ("AFP") model.

EDUCATION:

University of Waterloo, Waterloo, Ontario, Canada, Bachelor of Science, Biotechnology and Economics, 2016.

EMPLOYMENT HISTORY:

From: 2015 **To:** present
Employer: *London Economics International LLC, Toronto, ON*
Senior Consultant (August 2019 to present), Consultant (July 2017 to July 2019), Research Associate (January 2015 to July 2017)

From: 2014 **To:** 2014

Employer: *Ontario Ministry of Economic Development, Employment and Infrastructure, Toronto, ON*
Research Analyst

From: 2013 **To:** 2013
Employer: *Ontario Ministry of Infrastructure, Toronto, ON*
Research Analyst

SAMPLE PROJECT EXPERIENCE:

- ***regulatory support with regards to a natural gas pipeline toll application:*** LEI was retained by Torys LLP to provide regulatory support for Black Swan Energy in its response to the application of NOVA Gas Transmission Limited ("NGTL") to the National Energy Board ("NEB"). LEI was asked to review the application and intervener evidence, as well as assist the client in preparing cross-examination of interveners, review of the argument, and replies. Upon request by the client, LEI prepared an expert report to form the basis of Black Swan's intervenor evidence and responded to information requests ("IRs"). Mugwe served as the project manager for the engagement.

- ***performed a productivity study on a large generator's hydroelectric assets:*** supported a total factor productivity study on a large generator's hydroelectric assets, the second iteration of a previous productivity study conducted by LEI. The engagement involved a review of productivity studies prepared for academic and regulatory purposes as well as a collective assessment of hydroelectric industry peers.

- ***retail rate study for Kansas:*** LEI was selected by the Kansas Legislative Coordinating Council ("LCC") to perform a study of the retail rates of Kansas electric public utilities. The study, which involved two main sections, aimed to inform electric sector policies and result in competitive electric rates and reliable electric service in Kansas. Section 1 of the study evaluated the effectiveness of current Kansas ratemaking practices and their ability to attract required capital investments and balance utility profits with public interest objectives and reliable service. Section 2 focused on exploring options available to the State Corporation Commission and the Kansas Legislature to affect Kansas retail electricity prices to become regionally competitive while providing the best practicable combination of price, quality and service.

- ***consultancy services for regulatory and organizational action plan for the Gambia***: LEI was part of a team of consultants tasked with developing a workshop on regulatory options and sector unbundling in the Gambia for the Public Utilities Regulatory Authority. LEI researched on recent developments, challenges and opportunities available to the Gambia in the electricity sector. These findings were presented by LEI at a workshop with sector stakeholders in Banjul.

- ***study of utility ownership and regulatory models in Hawaii:*** LEI provided a study to assess options for transforming the ownership and regulatory model used to govern its electricity sector in Hawaii. This is a large, significant initiative to provide the government of Hawaii with independent and objective research and analysis to help it scope out the most

appropriate course of action in achieving Hawaii's overarching policy goals. There are four main phases to this work. 1) to determine the long-term operational and financial costs and benefits of electric utility ownership models to serve each county of the State of Hawaii. 2) to determine the long-term operational and financial costs and benefits of electric utility regulatory models to serve each county of the State of Hawaii; 3) to provide additional insight and analysis of ownership and regulatory model changes possible under the models identified and recommended; 4) to provide for the development and delivery of the executive summary, formal presentation and final report in a format approved by the client.

- ***price curve suitability analysis for large generator:*** LEI was retained by a large generator as part of an asset sale to assess the suitability of its price curve included in their financial model, as well as qualitative considerations, primarily for the NYISO and Ontario markets, and to a lesser extent, the ISO-NE, PJM and MISO markets. LEI's assessment entailed providing a general commentary on the outlook for each market, an assessment of the suitability of the long-term prices in the relevant markets, and provision of relevant regulatory/political context as part of the outlook. Mugwe served as the project manager for the engagement.

- ***development of market rules for a competitive electricity market:*** LEI was engaged by the Electricity and Cogeneration Regulatory Authority ("ECRA") to develop bilateral contracting arrangements plan and market rules for competitive electricity market, as part of a wider industry restructuring efforts by the Saudi government. The project was implemented in 2 phases, focusing first on the bilateral contracting topics, and then on ISO operations and market rules. LEI has undertaken the work by collaborating with Frontier Economics LTD, a regulatory consultancy and longtime partner of LEI, and WLG Gowling, Canada-based law firm. The project work was completed drawing on consortium's knowledge and experience of electricity sector restructuring across North America, Europe and Australia.

- ***cost of capital parameters review:*** LEI was retained by the Ontario Energy Board ("OEB") to provide updates on the macroeconomic conditions of the utility sector in Ontario. As part of its advice, LEI provided an annual presentation to the OEB and senior management to discuss key issues driving changes in the utility sector. LEI provided recommendations on whether the cost of capital policy and/or methodologies for calculating and updating the parameters may warrant review due to structural changes in the sector. LEI was also asked to provide, on a case-by-case basis, analysis on where changes going forward to the approved capital structures may warrant consideration based on expected changes in risk for wires, generation and natural gas distributors in Ontario. LEI also provided variance analysis/trend analysis of cost of capital parameters, including the Return on Equity and deemed long-term and short-term debt rates based on movements of relevant economic indicators. These were presented in a quarterly report that included a number of these elements and were presented to OEB staff.

- ***evaluation of restructuring options for large Middle Eastern energy ministry:*** Mugwe served as an analyst on the in-country team for the LEI Team in providing strategic advice to a Middle Eastern energy ministry on pathways for electricity sector restructuring, including the privatization of its national vertically integrated utility and its role. LEI considered a number of options available to the national utility (e.g. retain its current form, improved, and encouraged to expand overseas, or fully unbundled, and a competitive power market created

from its constituent parts). In any of these scenarios, depending on the governance structures deployed and the range of financing options available, LEI also considered how different aspects of the country's 2030 targets can be achieved

- ***review of investment opportunities in the Middle East power sector:*** LEI was retained by a private middle eastern company in relation to developing a comprehensive study with a road map and implementation plan for its entrance in the Saudi and regional power sector. The key objective of this engagement was to determine where best the company should be positioned in the power generation ecosystem in the Kingdom of Saudi Arabia ("KSA") and the region, to create capacity and value. The assessment evaluated opportunities along the power sector value chain and across the following energy types: conventional, renewables (including hydro, wind, solar, geothermal and biomass), and nuclear.

- ***assessment of options for rate basing DERs:*** On behalf of a large provincial distribution utility, LEI conducted a review of the DER theory, applications and funding mechanisms. The engagement involved a review of the arguments and philosophy supporting the inclusion of DER in utility rate base, a cross-jurisdictional scan of DER implementations across North America and a review of potential avenues for rate basing distributed energy resources ("DER") in Ontario.

- ***load centers analysis for potential transmission investment in the US****:* For an independent transmission developer, LEI performed a review of major US load centers to assess potential needs for transmission upgrades. LEI's review included among other categories an assessment of historical energy and capacity market congestion leading into the load center, anticipated changes in supply mix (new entry/retirement), public policies (environmental, or subsidies for certain generation technologies), and state of existing transmission infrastructure

- ***investor opportunities review:*** For a private equity client, LEI reviewed all investable energy sectors in the US and Canada (except oil and gas exploration and production). The sectors included: electricity generation (natural gas, wind, solar, hydro), AMI, distributed Resources, demand response, retail and gentailers, gas LDCs, gas storage, gas pipeline transportation, LNG-related infrastructure, vertically-integrated utilities, electric distribution, and water utilities. LEI assessed the investment potential of each sector for the next five years, and proposed a methodology to screen and identify investment opportunities and execute on these opportunities. As lead SPP analyst, Mugwe provided an analysis of current market opportunities and developments in the region.

- ***market design transition support and capacity market design analysis:*** LEI supported a large generator in Alberta as the government and market operator developed plans to transition from an energy-only market to an energy and capacity market. Work included detailed analysis on revenues, reliability, and costs to consumers under different market designs, including various permutations of capacity markets; quantitative analysis of what a transition to a day ahead market might entail and the economic implications of co-optimizing energy and operating reserves, as well as adding a fast ramp product; a series of issue papers on technical topics related to capacity market design such as pros and cons of auction clearing mechanisms, the Cost of New Entry in Alberta, market power mitigation options,

implications for Alberta's ancillary services market, and a qualitative assessment of transitioning to a day ahead market; extensive support during the stakeholdering process including review of all documentation, assessment of implications for the generator's assets and future profitability as well as overall market viability and stability, and presentations to the stakeholder working groups on demand curve issues and details of capacity market mechanics and market power mitigation. Mugwe led a qualitative analysis of capacity market outcomes in comparable jurisdictions, carrying out interviews with ISO executives and academics.

- ***risk assessment and capital structure review for a large Ontario gas distributor:*** LEI was engaged by a large Ontario gas distributor to conduct an independent capital structure review to assess the reasonableness of its current common equity component. The project included completing an assessment of its business and financial risk profile compared to the last assessment that was reviewed by the OEB, completing an assessment of its business and financial risk compared to other comparable Canadian and U.S. utilities, estimating the cost of equity for groups of comparable risk utilities, examining information on average utility actual and allowed capital structures, comparing cost of equity estimates and information on average utility capital structures to its proposed cost of equity and capital structure, and, providing recommendations on the appropriate common equity level.

- ***revenue potential forecasting in Southwest Power Pool:*** This project analyzed the revenue potential for wind facilities in CAISO, SPP and PJM, developing price forecasts through 2045 and assessed market rules to identify any potential penalties that may apply to intermittent generation and deviations from generation profiles. As primary modeler of the SPP market, Mugwe focused on the SPP outlook with high and low case sensitivities.

- ***global review of capacity market design for Alberta transition:*** To support Board-level understanding of the implications of potential capacity market designs in Alberta, Mugwe supported a detailed review and comparison of capacity markets across international and North American jurisdictions. Report concluded that "the devil is in the details" of capacity market design. Market design details with potentially large impacts on the client were resource eligibility definitions, price setting mechanism, demand curve design, performance requirements, and market power mitigation rules.

- ***continuous modelling of SPP power markets:*** As lead Southwest Power Pool ("SPP") market modeler, track and evaluate the impact of on-going structural and regulatory changes in the SPP electricity market to produce detailed price forecast and associated analyses on an ongoing semi-annual basis using LEI's in-house price forecast software, POOLMod.

- ***review of permitted return in Hong Kong:*** London Economics International LLC ("LEI") has been retained by the Environment Bureau of the Government of Hong Kong Special Administrative Region ("Government") to review the permitted rate of return for Hong Kong based power companies under the Scheme of Control Agreements ("SCAs"), beginning 2019.

- ***review of Kenyan electricity supply industry:*** As part of a team assessing investment opportunities for a private power producer, LEI performed a broad review of the Kenyan

electricity supply industry and the regulatory structure. The LEI team took part in site visits and provided briefing memos for the client as part of its research in the market.

- ***examined the impact of regulatory delays on renewable project developers:*** LEI was retained to carry out a study on the impact of regulatory delays and uncertainty for renewable developers. The project intends to develop a model to estimate the cost of regulatory delays to renewable energy industry and the broader economy, and document its validity through a number of case studies.

JAVIER AGUSTIN MAQUIEYRA

Research Associate, London Economics International LLC

KEY QUALIFICATIONS:

Based in Boston, Javier is a Research Associate with London Economics International LLC ("LEI"), where he applies his knowledge and analytical skills on a variety of engagements, ranging from power market design, tariff design, renewable energy project evaluation, power market modeling, and market analysis. Javier is also an electricity market modeler for ERCOT, responsible for tracking and analyzing changes to regulatory and market conditions.

Javier obtained a bachelor's degree in economics at Universidad Argentina de la Empresa, a master's degree in economics at Universidad de San Andres (thesis in progress) and, a master's degree in public administration and economic policy management from Columbia University.

Prior to joining LEI, Javier was a coordinator at the electricity regulatory authority, analyzing utilities' economic and financial performance. After that, he served as a director of project assessment and energy policy at the Ministry of Energy and Mining in Argentina. He has also been involved in various cross-sectional practice areas having excelled in energy modeling, energy planning, and project assessment. Born in Argentina, Javier is a native-Spanish speaker.

EDUCATION:

Columbia University, New York, NY, MPA-EPM (Global Energy Management and Policy)

Universidad de San Andres, Buenos Aires, Argentina, M.A. in Economics (thesis in progress)

Universidad Argentina de la Empresa ("UADE"), Buenos Aires, Argentina, B.S. in Economics

EMPLOYMENT RECORD:

From: 2019 **To:** present
Employer: *London Economics International LLC, United States*
Research Associate

From: 2019 **To:** 2019
Employer: *Sustainable Westchester, United States*
Summer Associate

From: 2016 **To:** 2018
Employer: *Ministry of Energy and Mining, Argentina*
Director of Project Assessment and Energy Policy (May 2017 to May 2018), Chief of Staff - Undersecretariat of Scenarios and Project Assessment (February 2016 to April 2017)

From: 2012 **To:** 2016
Employer: *Ente Nacional Regulador de la Electricidad ("ENRE"), Argentina*
Coordinator

From: 2012 **To:** 2012
Employer: *KMG, Argentina*
Consultant

From: 2010 **To:** 2012
Employer: *Energy Consultant (independent), Argentina*
Consultant

From: 2005 **To:** 2010
Employer: *CEER - UADE - MinCyT, Argentina*
Scholarship Researcher

SAMPLE PROJECT EXPERIENCE:

Policy impact study and power market modeling

- ***Data Envelopment Analysis ("DEA") models for Argentine electricity distribution.*** Javier was in charge of determining if there was evidence that the scale of production was constant in the Argentine electricity distribution sector. A potential justification for the regulator to be tough at the time of choosing the envelopment surface required to determine X factors under a price cap regime with an RPI-X rule.

- ***Kansas retail electricity prices analysis.*** LEI was selected by the Kansas Legislative Coordinating Council to perform a study of the retail rates of Kansas electric public utilities. The study aimed to inform electric sector policies and result in competitive electric rates and reliable electric service in Kansas. Javier was involved in the review of tax rates paid by utilities in Kansas and neighboring states.

- ***Computable General Equilibrium ("CGE") models for energy policy analysis in Latin American countries.*** Javier was the lead market modeler for several general equilibrium models regarding the costs of lowering emissions through carbon taxes and the economic spillovers due to the discovery of new sources of energy and the implementation of innovative efficiency measures.

- ***Long-term energy policy forecast.*** Javier assessed how to optimize the Argentine electricity sector in order to align the local goals set by the executive branch with its international commitments to ensure a clean, sustainable, affordable, modern, safe and reliable energy system.

Renewable energy project evaluation and economic analysis

- ***Financial assessment of hydro and nuclear projects.*** Javier evaluated the economic viability of building major renewable energy projects in Argentina to help to achieve the local renewable energy goals and reduce the intermittency of variable renewable energy sources.

- ***Cost of offshore wind.*** For a large utility involved in the NYISO wholesale power markets, LEI performed an analysis of the levelized costs for a combination of offshore wind and battery storage resources. Javier assisted on the research and composition of the cost model.

- ***Resource adequacy and ramping requirements analysis.*** For a large utility, LEI prepared an outlook of future resource adequacy and ramping requirements in New York State given the various policy mandates for greenhouse gas emission reductions, renewable energy, distributed energy, and storage. Javier was in charge of creating an Excel-based model to observe the characteristics of supply resources need to satisfy the net load requirements, considering the output from intermittent generation resources.

Transmission and distribution lines assessment

- ***ERCOT's transmission system overview.*** LEI was engaged by a European utility to examine the investment environment for transmission in ERCOT. LEI provided a detailed report covering agents and institutions, the regulatory framework, remuneration of investment, and transmission planning. Javier assisted with research tasks.

- ***HVDC transmission line coupled with different storage options.*** For a transmission developer in the in Northeast, LEI modeled various portfolios of renewable generation assets (including wind, solar, and hydro resources) together with various quantities and technologies of storage resource to analyze, and optimize, the capacity factor and delivered price for energy on the proposed HVDC transmission line. LEI also modeled the customer load at the withdrawal end of the line together with additional storage to analyze the benefits of these storage resources to provide load-following service. Javier worked on developing the model and assessing the simulation's results.

- ***Impact of the grid of the future on utility's goals.*** LEI was retained by a large utility to assist it in developing a strategic roadmap to best position itself in the changing technological and industrial landscape of the future electric grid. Javier was responsible for developing a business case describing how Texas has been in an enviable position as a state with an abundance of renewable resource potential.

HAO WANG

Research Associate, London Economics International LLC

LONDON ECONOMICS

KEY QUALIFICATIONS:

Hao is a Research Associate at London Economics International LLC ("LEI") Boston Office, where he applies his industry knowledge and analytical skills to the firm's technical engagement with government bodies, state regulators utilities, and private investment firms in the US and abroad on a wide range of issues including power market design, tariff design, renewable energy project evaluation, power market modeling, and market analysis.

He is the primary modeler of Midcontinent Independent System Operator ("MISO") market, one of the world's leading Regional Transmission Organizations ("RTOs") and the largest geographical organization of its kind. He is responsible for modeling the energy and capacity markets and analyzing changes in market rules and system dynamics.

Hao holds a Master of Public Administration (MPA, Energy and Environment) degree from Columbia University, and a Bachelor of Arts degree in Spanish Language and Literature from Tianjin Foreign Studies University (China).

Prior to joining LEI, Hao worked for a community solar marketplace in Brooklyn, NY and a municipal bonds underwriter in Wallstreet, NY. Hao has extensive travel experiences in 40 countries across five continents and he is fluent in English, Spanish, and Mandarin.

EDUCATION:

Columbia University, New York, New York, M.P.A in Public Administration (Energy and Environment)

Universitat de Lleida, Lleida, Catalonia, Spain, Exchange Program in Spanish Language and Literature & Journalism

Tianjin Foreign Studies University, Tianjin, China, B.A. in Spanish Language and Literature

EMPLOYMENT RECORD:

From: 2019 **To:** present
Employer: *London Economics International LLC, United States*
Research Associate

From: 2019 **To**: 2019
Employer: *PowerMarket, Brooklyn, NY, United States*
Energy Data Analyst

From: 2019 **To**: 2019
Employer: *Samuel A. Ramirez & Co., Inc., NY, United States*

Graduate Consultant

From: 2019 **To**: 2019
Employer: *Columbia University, New York, NY, United States*
Teaching Assistant (Corporate Finance)

From: 2018 **To**: 2018
Employer: *Center on Global Energy Policy, Columbia University, United States*
Research Assistant in Carbon Tax Initiative

From: 2018 **To**: 2018
Employer: *AeroSpec Technologies, LLC, Boston, MA, United States*
Business Development Intern

From: 2014 **To**: 2017
Employer: *National Centre for the Performing Arts, Beijing, China*
Project Manager

From: 2013 **To**: 2014
Employer: *Embassy of Mexico in China, Beijing, China*
Assistant in Cultural and Educational Section

From: 2013 **To**: 2013
Employer: *Ministry of Agriculture of China, Beijing, China.*
Project Intern

SAMPLE PROJECT EXPERIENCE:

The projects briefly described below are typical of the work Hao has performed throughout his career at London Economics and Columbia University.

Power purchase agreement ("PPA") rider audit

- ***Independent audit of the PPA rider of Ohio Power Company.*** LEI was retained by AEP Ohio to provide audit services to establish the prudency of all of the costs and sales flowing through the PPA rider and to investigate whether the AEP Ohio's actions were in the best interest of retail ratepayers. Hao, in particular, was focused on the environmental regulations and compliance requirements in Ohio and used the Criteria-Process-Results approach to review AEP Ohio's share of OVEC's environmental compliance activities, as they pertain to fuel and reagent procurement and utilization. Hao also managed the process of issuing data requests, keeping files and information organized, and ensuring a smooth and efficient process.

Policy impact study

- ***Evaluation of the impact of tax reform on Kansas' utilities.*** LEI was retained by the Kansas Legislative Coordinating Council ("LCC") to perform a study of the retail rates of Kansas electric public utilities. Hao assisted in the overview of Kansas taxes on utilities and analyzed

the pros and cons of tax cut to utilities and ratepaying customers. Eventually, Hao provided a comprehensive analysis about how much taxes impact the competitiveness of utility tariffs.

Stranded cost assessment

- ***Extensive research on MISO and PJM transmission rules and energy marketers.*** LEI was retained by Tipmont REMC ("Tipmont") to calculate the potential stranded cost for Wabash Valley Power Association ("WVPA") as a result of the departure of Tipmont's load. Stranded costs represent costs which a utility (in this case, WVPA) would have recovered through regulated rates, but the recovery of which may be now be impeded because of regulatory changes or other circumstances. In recent years, termination of long-term arrangements between the utility and a customer have created stranded cost issues. Hao conducted extensive and detailed research on the interregional transmission rules in MISO and PJM markets, Financial Transmission Rights ("FTR"), Auction Revenue Rights ("ARR") process, wheeling costs etc.

Renewable energy tariff options examination

- LEI was retained by the Louisiana Public Service Commission to examine renewable energy tariff options with a focus on bringing new renewable resources into Louisiana. Hao was conducting research on renewable tariffs applied in different jurisdictions across the United States, demand response ("DR") programs, as well as osmotic pressure electric generation (also known as "blue energy").

Power market modeling

- As the primary modeler for Midcontinent Independent System Operator ("MISO") market, Hao is conducting a ***semi-annual MISO market updates and 10-year energy price forecasts*** for MISO. In addition to providing price projections, the reports highlight major developments in each of the regions as well as the underlying structural dynamics.

Electricity market and carbon tax analysis

- ***Analyses of the demand response application in different ISOs/RTOs in the US market*** based on sizes, locations, players, potential partnerships, as well as prevailing technologies. Hao also provided a set of assessments of business investment focus strategies.

- ***Research on the interactions between carbon tax and existing policies and regulations in the U.S.*** with a particular focus on the "Curbelo Proposal" to roll out the carbon pricing bill. I also prepared case studies on the phenomenon of single industry dependent economies on the county-level to report lessons learned from successful and failed cases to help alleviate the loss from coal phase-out to the U.S. coal communities.

Green bond program evaluation

- ***Development of a four-phase implementation plan for a multi-state tax reciprocity program*** and proposed best practices to help scale up U.S. green municipal bond issuance. Hao was

also involved in the quantitative cost-benefit analysis model to reflect the net present value and benefit cost ratio of the program and estimation of state by state trade-off by analyzing relevant data, and testing for sensitivity to different methodologies and assumptions under the program to scale the market.

Cost proposal to serve as expert witness on productivity factor and performance-based regulation for Boston Gas Company and Colonial Gas Company

prepared for National Grid by London Economics International LLC

May 7, 2018

1 Estimated Budget

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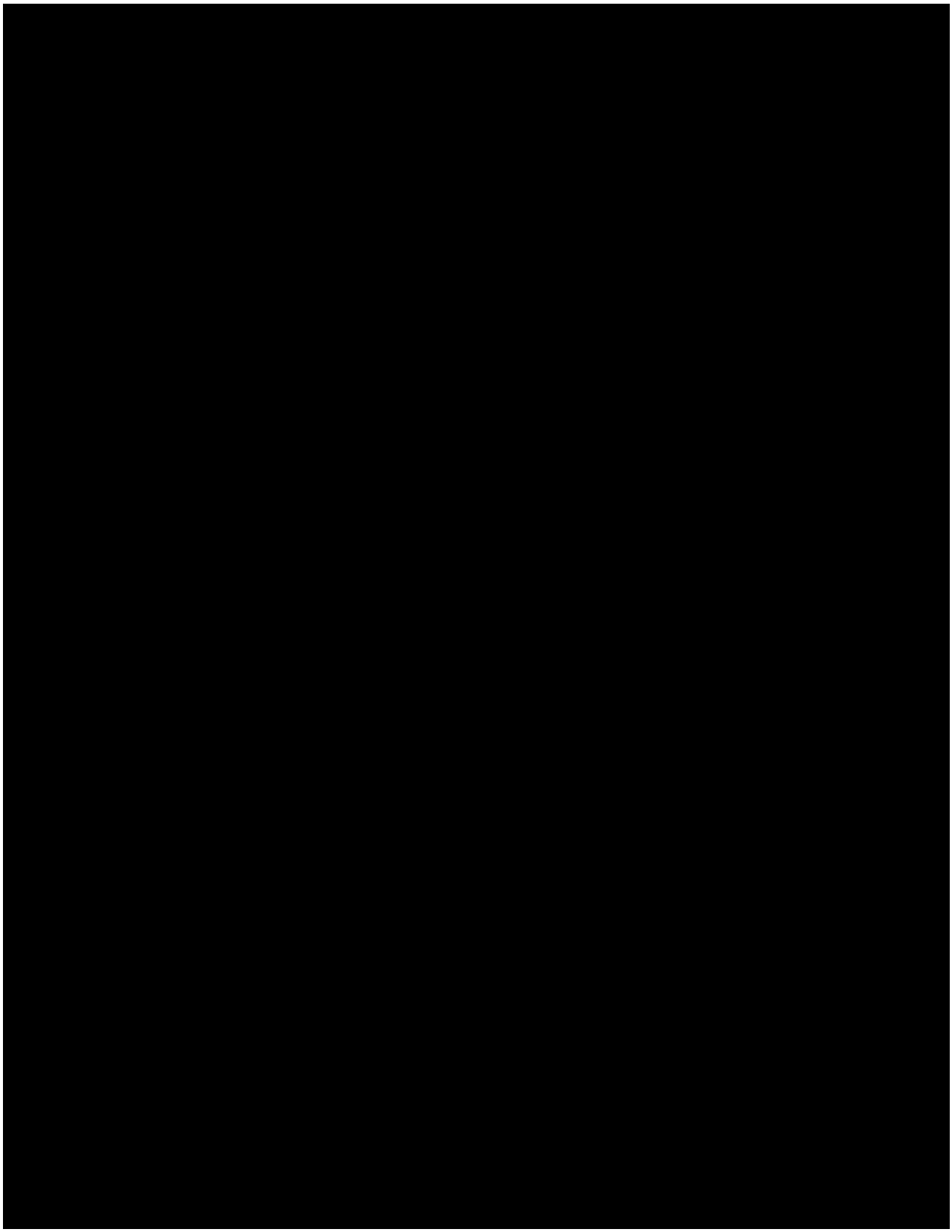

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