NSTAR ELECTRIC COMPANY
D/B/A EVERSOURCE ENERGY

MASSACHUSETTS ELECTRIC COMPANY AND NANTUCKET ELECTRIC COMPANY

D/B/A NATIONAL GRID

FITCHBURG GAS AND ELECTRIC LIGHT COMPANY
D/B/A UNITIL

AMI STAKEHOLDER GROUP

PROGRESS REPORT

D.P.U. 21-80/81/82

NOVEMBER 15, 2023

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Introduction

On November 30, 2022, the Department of Public Utilities (the "Department") approved the 2022-2025 Grid Modernization Plans filed by NSTAR Electric Company d/b/a Eversource Energy ("Eversource"), Massachusetts Electric Company and Nantucket Electric Company each d/b/a National Grid ("National Grid"), and Fitchburg Gas and Electric Light Company d/b/a Unitil ("Unitil") (together, the "Companies" or the "EDCs"). The Department's November 30, 2022, Order approving the Companies' 2022-2025 GMPs included a directive for the Companies to convene a stakeholder group no later than February 1, 2023, to address issues related to the Companies' advanced metering infrastructure ("AMI") implementation plans approved by the Department in its Track 2 Order (the "AMI Stakeholder Group"). D.P.U. 21-80-B/21-81-B/21-82-B at 325-326. The objective of the AMI Stakeholder Group is "to provide a forum for the Companies and interested stakeholders to collaborate in a non-adjudicatory setting to discuss AMI-related issues and to develop a joint proposal for Department review…." Id. The Department identified the following issues as areas of focus: "(1) customer and third-party access to customer usage data; (2) customer education and engagement; (3) billing of TVR offered by competitive suppliers; and (4) AMI deployment strategies that may expedite the ability for competitive suppliers to offer TVR products." Id. The EDCs commenced the AMI Stakeholder Group process with an initial "kick-off" meeting on January 31, 2023.

The Department further directed the EDCs to submit quarterly status reports, beginning on May 15, 2023, that include the following: (1) a list of stakeholders and attendees; (2) the status of any discussions and the process by which such discussions occurred; and (3) a summary of all issues on which the Companies and stakeholders have reached consensus. D.P.U. 21-80-B/21-81-B/21-82-B at 326.

On May 15, 2023, and August 16, 2023, the EDCs submitted their first and second quarterly reports to the Department, respectively.[1] Since August 16, 2023, the EDCs have facilitated three additional meetings on August 29, 2023, October 3, 2023, and October 31, 2023.[2] As discussed in more detail, these meetings have focused on AMI deployment and data access issues consistent with the topic timeline established at the outset of the AMI stakeholder group. The EDCs also retained a facilitator who was onboarded ahead of the October 3, 2023, meeting.

Section I: Participating Stakeholders

The EDCs initial progress report submitted on May 15, 2023, provided an overview of how participants in the AMI Stakeholder Group were identified and notified of the group; a copy of the participant list was included with the May 15, 2023, report as Attachment B. The current

[1] The EDCs' May 15, 2023 progress report provided an overview of the first three AMI stakeholder meetings. The EDCs' August 16, 2023 progress report provided an overview of the next three AMI stakeholder meetings held through July 25, 2023.

[2] The AMI stakeholder group agreed to hold two meetings in the month of October due to a scheduling conflict on the last Tuesday of September. The EDCs and Office of Attorney General were engaged in grid modernization hearings before the Department on that date.

participant list as of November 15, 2023, is provided in Attachment A to this report.

A copy of the roll call for the August 29, October 3, and October 31 meetings is included with this report as Attachment A.

Section II: AMI Stakeholder Group Meetings

A. August 29, 2023, Meeting

A copy of the August 29, 2023, AMI Stakeholder Group meeting agenda and meeting minutes are included in Attachment C of this report. As set forth in the agenda, the August 29, 2023, meeting began with roll call and discussion of administrative issues including announcing ERM as the facilitator for future AMI stakeholder meetings and gathering feedback on the quarterly report process.

The first substantive agenda item at the August meeting was to address follow-up questions from the National Grid presentation on the Worcester Smart Energy Solutions Pilot and Critical Peak Pricing ("CPP") from the July meeting. As part of this discussion, National Grid provided copies of its Worcester Pilot evaluation reports ahead of the meeting. A copy of the evaluation reports is included in Attachment C of this report.

The EDCs then presented a summary of the discussion regarding AMI deployment from the previous two meetings. A copy of Eversource's deployment overview is included in Attachment C of this report.

The EDCs also responded to stakeholder questions regarding metering requirements for electric vehicle time of use rates.

After the conclusion of the substantive agenda items, DOER presented a proposed schedule for discussion of data access issues. The DOER presentation is included in Attachment C of this report. The AMI Stakeholder Group agreed that the three data access meetings would follow DOER's proposal.

B. October 3, 2023, Meeting

A copy of the October 3, 2023, AMI Stakeholder Group meeting agenda and meeting minutes are included in Attachment D of this report. As set forth in the agenda, the October 3, 2023, meeting began with roll call and introducing ERM facilitation services for future AMI Stakeholder Group meetings.

The first substantive issue discussed at the October 3rd meeting was addressing follow-up items identified by stakeholders following the August meeting. As detailed in the meeting minutes, EDCs responded to a question from Green Energy Consumers Alliance to update language regarding deployment of time-varying rates ("TVR"), Eversource provided an update on the NH

EV TVR Pilot Program, and stakeholders asked whether it would be reasonable to revisit TVR again prior to the August 2024 Final Report. The EDCs did not express opposition to the inquiry, but also explained that material changes to the TVR implementation plans are unlikely prior to August 2024.

Consistent with DOER's proposal for addressing data access issues presented at the August meeting, data access discussions began with an overview from the EDCs regarding current data access plans.

ERM then introduced Stakeholder presentations from Unitil, Utility API, Landis + Gyr, and Oracle. Copies of these presentations are included in Attachment D of this report.

At the conclusion of the meeting, the AMI Stakeholder Group participants agreed with the EDCs' plan to present at the October 31 meeting a draft proposal for a data access framework including third-party data access; the future of data access; and the customer experience.

C. October 31, 2023, Meeting

A copy of the October 31, 2023, AMI Stakeholder Group meeting agenda and meeting minutes are included in Attachment E of this report. As set forth in the agenda, the October 31, 2023, meeting began with roll call and review of the ground rules and communications process for the meeting.

Representatives from Unitil addressed follow-up questions from stakeholders related to interval time periods, community aggregation, and on-demand requests in New Hampshire. Stakeholders requested additional information on AMI data processes in New Hampshire.

The group then moved on to a brief follow-up discussion on "bill-ready" TVR designs and how EDCs would deliver data.

Michael Murray with Mission Data presented on eligibility criteria for third parties.

ERM then introduced presentations from (1) the EDCs on a Data Access Framework; (2) Cape Light Compact on the roles and benefits of AMI data; and (3) New York State Energy Research and Development Authority ("NYSERDA") on its program overview and findings. Copies of these presentations are available in Appendix E of this report.

At the conclusion of the meeting, ERM reminded stakeholders of the upcoming schedule for reviewing the November Quarterly Report.

Section III. Summary of Consensus and Non-consensus Issues

A. Consensus Issues

No major consensus points were agreed upon during the August 29, October 3, or October 31 meetings.[3]

B. Non-consensus Issues

In the August 29, October 3, and October 31 meetings, non-consensus issues included:

- Stakeholders requested that critical peak pricing and peak time rebates be offered by the utilities as rate-ready (meaning the utilities will do the billing for these offerings). Eversource explains that they did not include these costs in Phase 1 and could not provide timing for Phase 2. According to Eversource, the costs of these offerings were not included in their AMI proposal to the DPU, and a future cost recovery strategy has not been determined.
- Timing of TVR capabilities, including potential aspirational language related to a target time sooner than 12 months after first meters are installed.
- Customer and third-party (including municipal aggregator) access to usage data, including delivery mechanisms, format and consent requirements.
- Third-party supplier (including municipal aggregators' suppliers) access to interval level data in near-real time for billing purposes. The EDCs have not committed to being able to provide municipal aggregators and/or their suppliers with AMI data for verifying ISO-NE settlements/billing.
- Cost to third-parties and municipal aggregators of offering TVR and accessing AMI data – the EDCs have not been able to provide specific information related to supplier costs for setting up TVR. Concerns over prohibitive costs have been noted.
- Metering for EV TOU – the EDCs intend to require a separate meter for EV chargers as opposed to using load disaggregation or EVSE report/vehicle telematics. Stakeholders questioned need for second AMI meter.

Section IV. Next Steps

The next AMI Stakeholder Group meeting is scheduled for November 28, 2023. The focus of this next AMI Stakeholder Group meeting will be to conclude discussions regarding AMI data access and plan for the January AMI Stakeholder meeting which will kick off a discussion of customer education and engagement.

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[3] No stakeholders have voiced opposition to most of the elements of the EDC's draft Data Access Framework presented at the October 31, 2023 meeting. However, as noted under "non-consensus" items, stakeholders have expressed concern with the EDCs' proposed privacy protections and customer consent framework; stakeholders continue to discuss how these proposals can be reconciled with supply aggregators' and program administrators' desire to obtain customer data for marketing and rate and program design.

ATTACHMENT A

Organization	First Name	Last Name	Title	Contact Information	8/29/2023	10/3/2023	10/31/2023
Eversource	Jared	Lawrence	Senior VP Cust. Ops. & Digital Strategy, CCO	jared.lawrence@eversource.com	X	X	X
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	Denise	Magaldi	Supplier Services	denise.magaldi@eversource.com			
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	Riley	Hastings					
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	Matt	Motley		Matt.Motley@nationalgrid.com			
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ATTACHMENT A

Organization	First Name	Last Name	Title	Contact Information	8/29/2023	10/3/2023	10/31/2023
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	Chris	Dube					
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	Audrey	Kiernan		akiernan@kolawpc.com			
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	Tony	Cusati	Director of Regulatory Affairs (Primary Spokesperson)	Tony.Cusati@igs.com			
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	Penny	Navaro	VO Operations	penny.navarro@actualenergy.com			
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	Marc A.	Hanks	Director, Regularoty Affairs	marc.hanks@nrg.com			
Green Energy Consumers Alliance	Larry	Chretien	Executive Director (Primary Spokesperson)	larry@greenenergyconsumers.org	X	X	X
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Organization	First Name	Last Name	Title	Contact Information	8/29/2023	10/3/2023	10/31/2023
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Just Energy	Charlie	Iannello		charlie@csienergy.net			
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Stack Energy	Greg	Geller	Founder & CEO	greg@stackenergyconsulting.com			
NYSERDA	Kyle P.	Monsees		kyle.monsees@nyserda.ny.gov			X
	Lea	Springstead		Lea.Springstead@nyserda.ny.gov			

Attachment B: Stakeholder Group Ground Rules

Roles and Responsibilities: Members

- Member Organizations shall designate an organization spokesperson who shall act as the point of contact to receive all communications, meeting invites, updates, etc. regarding the AMI Stakeholder Group. Member Organizations are allowed to be a member of the AMI Stakeholder Working Group at the time when topic of their interest is on the agenda for discussion.
- Member Organization spokespeople and participants will make every attempt to attend all applicable meetings, to be on-time, and to review all documents disseminated prior to the meeting.
- If a representative or his\her alternate cannot attend a meeting, the representative should let the Facilitator know prior to the meeting (by e-mail).
- All AMI Stakeholder Group participants are charged with participating in a constructive forum where diverse points of view are voiced and examined in a professional and balanced way. Personal attacks are not permitted.
- All AMI Stakeholder Group participants agree to act in good faith in the discussions. ‘Good faith’ means that they will be forthright and communicative about the interests and preferences of their organization and will actively seek agreement wherever possible.
- It is the responsibility of the AMI Stakeholder Group spokespersons to keep their organizations informed of developments in the working group process.
- AMI Stakeholder Group participants may confer with each other in between meetings and are encouraged to do so.
- AMI Stakeholder Group participants not permitted to quote or otherwise represent other members of the working group process to the press or other outside entities (including in blogs, social media, etc.), or to speak on behalf of the AMI Stakeholder Group.
- Member Organizations will provide the AMI Stakeholder Group service list with any materials they intend to present consistent with a meeting agenda at least one week prior to the meeting at which the materials will be discussed.

Roles and Responsibilities: Facilitator

- The Facilitator’s primary function is to manage productive and well-informed meetings. The Facilitator is not authorized to provide substantive feedback, clarifications, points of agreement or disagreement on meeting discussions, etc. The Facilitator’s responsibilities are limited to administrative/ministerial duties only.
- The Facilitator will be responsible for taking meeting minutes, including recording points of agreement and disagreement. The Facilitator will maintain a master list of final consensus positions and proposals, as well as a summary of areas of disagreement.
- The Facilitator will impartially and in a non-partisan manner (not favoring any organization over another) facilitate all AMI Stakeholder Group meetings to ensure that the group is able to discuss the meeting’s agenda topics with all member organizations having sufficient time to discuss their point(s) of view, requests, concerns, clarifications, etc.
- The Facilitator and the Electric Distribution Companies (“EDCs” collectively and Eversource, National Grid and Unitil separately) will develop each meeting agenda to ensure that all necessary topics are discussed and, where possible, consensus is reached so that the EDCs, with the assistance of the Facilitator, may prepare both the quarterly and final AMI Stakeholder Group’s reports required by the Department of Public Utilities (“DPU”).
  - All AMI Stakeholder Group member organizations are permitted and encouraged to submit proposed agenda items no later than one week in advance of a stakeholder

meeting. The Facilitator will construct agendas based on the established topic for that meeting, which should be germane to one of the four focus areas.
  - The EDCs and Facilitator will review the submissions and make a final determination as to the meeting agenda.
  - Any submitted agenda items that are not included in the next scheduled meeting agenda and are germane to one of the four focus areas will be included on a future meeting agenda to ensure that all submitted agenda items are addressed. Suggested agenda items that are not directly relevant to the four focus areas will be reviewed by the Facilitator and EDCs and added to future agendas if time permits and if they determine they will add value to the AMI scoping and design process.
- The Facilitator will prepare draft agendas and meeting summaries in a timely fashion for distribution to the AMI Stakeholder Group members. Agenda will be distributed at least three business days prior to a scheduled meeting to ensure that all member organizations have sufficient time to prepare for the meeting. Meeting summaries will be distributed within 7 business days following a meeting.
- All documents will be posted on a SharePoint site maintained by the Facilitator and the EDCs for the duration of the process, and the Facilitator will provide email notice when new documents are posted to the SharePoint.
- The Facilitator and the EDCs will take the lead in assembling the quarterly and final reports the DPU has required.
  - The Facilitator will post draft quarterly and final reports to the SharePoint site. The Facilitator will notify the AMI Stakeholder Group members that the drafts are available for review.
  - The Facilitator, with input from the EDCs, will establish the review schedules and notify AMI Stakeholder Group members via email in advance of the review periods. The review periods will be designed to provide AMI Stakeholder Group members with sufficient time for members to provide at least one round of questions, clarifications, suggestions, etc. before the report in question is filed with the DPU.
  - The Facilitator, with input from the EDCs, will establish a review protocol to ensure that all AMI Stakeholder Group members’ feedback on the reports is retained while ensuring appropriate version control. The review protocol will be posted to the SharePoint site.
  - All final filed reports will be posted on the SharePoint site.

Attachment C: August 29 Meeting Agenda, Minutes & Presentation

AMI Stakeholder Group
Meeting Agenda

August 29, 2023

1) Roll Call/Administrative Issues

   - EDCs will provide update on facilitator;

   - Discuss dates for next AMI Stakeholder Group meeting; and

   - Discuss quarterly report process.

2) Additional Follow-up National Grid Presentation-Lessons Learned from Worcester Pilot and Critical Peak Pricing

3) Finish Deployment Discussion

4) Continued Discussion on EV meters in response to Stakeholder Questions

5) Planning for Next Meeting

August 29 Meeting Minutes

AMI Stakeholder Group

August 29, 2023 Meeting Minutes

1) Roll Call/Administrative Issues
   - J. Ralston took attendance based on stakeholder participant list.

EDCs will provide update on facilitator
   - J. Ralston stated that the EDCs are in the process of onboarding ERM as the facilitator for future AMI stakeholder meetings. R. Zachas stated appreciation for the hiring of a facilitator following concerns with the latest quarterly report and previous meeting minutes, and the lack of a facilitator given that the ground rules are based on one.

Discuss dates for next AMI Stakeholder Group meeting
   - J. Ralston proposed holding two AMI stakeholder meetings in October due to a hearings conflict at the end of September. No concerns/opposition were noted.

Discuss quarterly report process
   - J. Ralston asked for comment on the quarterly report process.
   - R. Zachas responded that Cape Light Compact had concerns regarding the editing and review process (i.e., ground rules and review protocol) of the quarterly report without a facilitator. R. Zachas also expressed concern that (1) Stakeholders had no input into the first quarterly report; (2)ome Compact edits on the second quarterly report were not included in the final version of the report submitted to the Department; and (3) stated that

the Compact wants to ensure that the Department has a full picture of the quarterly report process. R. Zachas also stated that the Compact is hopeful that the facilitator coming onboard will resolve the issues.

- J. Ralston confirmed that the first quarterly report was circulated to stakeholders ahead of filing but that no feedback was received. J. Ralston also noted that some comments which were not accepted into the final report were purposefully kept in the meeting minutes.
- E. Grammer asked if there is a review process for suggested edits or comments to the quarterly report. J. Ralston responded that there is not as the quarterly report is a compliance item for the EDCs but expects the Department to set up a comment process for participants. J. Ralston suggested that participants could reach out to the hearing officer with further procedural questions.
- A. Edington suggested keeping the consensus/non-consensus items section of the quarterly report. J. Ralston agreed.
- A. Edington asked if the working group can expect to make edits that will be included in future quarterly reports. J. Ralston responded the EDCs will review all edits provided by working group participants but that that the final product rests with the EDCs as the filing party.

2) Additional Follow-up National Grid Presentation-Lessons Learned from Worcester Pilot and Critical Peak Pricing

- K. O'Shaughnessy introduced the first question: National Grid to confirm whether the municipal aggregations using their critical peak pricing ("CPP") mechanism could set the hours and price a day ahead in the same way as the Worcester Pilot Program. K. O'Shaughnessy responded that National Grid currently has no objections to a similar setup but noted this includes more requirements, including back-end billing systems and proper billing off the meters.
- J. Pasquariello asked for clarification from the suppliers/aggregators on the vision for the community choice aggregation program, meaning whether i) sending 8.14C transactions throughout the month and update the price group that applies to a specific account multiple times during the month instead of only having the option to do so once for the next billing cycle; or ii) sending updates on the value of each of the price groups set up in our system. C. Nouel responded that it was just that CPP price for this season (i.e., updated every six months with three different time buckets).
- E. Grammer asked to confirm that the model would be what was done in Worcester, where there was a set CPP price. C. Nouel responded yes, it can be done where there would be fixed pricing for periods of time.
- M. Marchand asked to confirm that National Grid can do this as rate ready (i.e., Grid doing the billing, not the supplier) not bill ready. K. O'Shaughnessy confirmed. M. Marchand then asked if Eversource is able to do this as well. J. Lawrence asked National Grid to confirm use of a TVR rate in which the CPP is set for 6-month periods. C. Nouel confirmed. J. Lawrence confirmed that Eversource could accommodate that.[1]
- M. Marchand asked if a critical peak price could be called the day before it occurs. C. Nouel responded yes, the event would activate hours within the MDMS for a certain group of customers, but National Grid cannot set a price the day ahead.
- P. Roche asked to confirm that both National Grid and Eversource can activate the CPP price day ahead, where the CPP price has been set for a defined period of time, but the question is whether to activate for a certain subset of customers.
    - C. Nouel responded yes, but from a state perspective, there is a concern about multiple suppliers calling an event/activation of CPP price at different days or similar

[1] J. Lawrence later clarified that this could be accommodated as long as the CPP period occurs at predetermined weekly intervals and does not vary (i.e. cannot be activated intra-day, day-ahead or week-ahead).

customers. Therefore, National Grid needs to think through the messaging and coordination.
  - J. Lawrence responded that Eversource is not planning to offer that in phase one of deployment, but possibly beyond phase one after achieving stability.

- J. Pasquariello asked for clarification on messaging (from supplier) and on the pricing applied to the current billing cycle versus a proration of the prior month. P. Roche responded that these are good questions but not sure at this moment.
- C. Nouel responded that the electronic data interchange (“EDI”) piece is still in development, including the activation of the event, bucketizing the hours that are different prices in the MDMS, and the flow through the EDI mechanism. P. Roche asked if there is an EDI upgrade/addition as part of the AMI. C. Nouel responded no. J. Pasquariello responded that he will need to follow up on that.
- M. Marchand asked Eversource for an estimate of when rate ready might be offered. J. Lawrence responded that it is included in the longer term functionality within the agile approach to the AMI deployment based on market response following achievement of phase one stability. C. Nouel agreed and stated that part of the process is to continue adding functionalities as the utility delivers value for the broader ecosystem.
- K. O’Shaughnessy introduced the second question: National Grid to explain why a peak could not be easily agreed upon with ISO New England, and asked J. Lawrence for input.
- J. Lawrence responded that Eversource is not establishing real time integration between communication with customers and communication with ISO-NE in the phase one AMI launch. J. Lawrence noted an alternative was considered to continue to use a demand response opportunity to enroll customers in some sort of load curtailment through AMI-enabled functionality (i.e., sending an alert to customers who sign up and receive an incentive for participation).
- E. Grammer clarified that the question was intended to ask if it would be an easier/quicker process for multiple suppliers with multiple peak hours if there was a standardized ISO New England day ahead based determination of critical peak hours.
- C. Nouel responded that it wouldn’t be necessarily quicker but definitely would be better towards an overall shift of whole system load, however this is not part of the current phase.
- J. Lawrence responded that this could theoretically work if there was only one rate table with day ahead updating, however that one rate table would have to apply to all or a large percentage of Eversource’s 1.7 million customers - if that consensus could be reached one rate table could be accommodated, however it is expected that each supplier is going to want its own definition of a critical peak and Eversource can't manually manage a whole portfolio of dynamic pricing options.
- L. Chretien asked to clarify that this would just be for CPP, not for all TVR. J. Lawrence responded that there would need to be a single definition for CPP in the rate table, so everybody would have to agree to all of the periods.
- C. Nouel agreed with J. Lawrence but asked L. Chretien to confirm whether the question was regrading different rate, i.e., a nights and weekends Rate for EVs. L. Chretien responded: both EV or whole house but unrelated to critical peak pricing.
- L. Morgera introduced the third question for National Grid: on the low-income bill savings analysis. L. Morgera stated that the evaluation reports by Navigant Consulting for 2015 and 2016 were circulated which include the description of why the analysis was done, what was put into it, and the results.
  - C. Nouel noted that the next question is also tied to the report (i.e., request for the analysis of financial benefits from CPP 30 days 175 hours versus TOU rates).
  - L. Morgera invited any follow-up questions following review of the report. J. Ralston added that questions may be directed to her in advance of the next meeting as well.

- E. Grammer asked for a summary on what the utilities have offered as means to expedite the ability of competitive suppliers to offer TVR products.
  - J. Lawrence stated that the matrix presented at the last meeting included all the planned deployments and system planning functionality. K. O'Shaughnessy agreed for National Grid.
  - M. Marchand asked about a previously proposed edit to the report regarding best efforts to offer TVR earlier than after the first year.
  - L. Morgera responded that National Grid is okay with a shorter timeframe and have discussed six months internally. C. Nouel noted that the language about trying to make it work is important, but there is a lot involved in the process. J. Lawrence responded that a lot of things need to go perfectly in order to make that 12-month timeframe and Eversource cannot commit to a shorter timeframe. P. Taylor agreed for Unitil that best efforts are being made but deployment may not be on an accelerated timeline.
- L. Chretien asked for a tweak the language to – "if possible it would be sooner" and is it possible for National Grid to put "within six months" in the report? C. Nouel responded that he will take that question back and follow-up, because despite the NY deployment and an agile approach to meters in the field, the Company is also in the middle of consolidating billing systems.
- R. Zachas noted concern on the matrix wording of "at least one year after" as too open-ended and putting no timeframe on Eversource's phase 2. C. Nouel noted the feedback.
- R. Zachas asked why National Grid could offer rate ready for CPP in phase one but Eversource cannot. J. Lawrence responded that the scope for customer information systems ("CIS") that was filed and received approval from the Department for does not include an ability for suppliers to update dynamic pricing elements of their TVR. J. Lawrence noted that Phase 1 does not contemplate CPP and EV TOU.
- R. Zachas asked why. J. Lawrence responded that this is not typically included in a first phase AMI release for a utility starting from scratch.
  - R. Zachas asked if it could be added later on. J. Lawrence responded yes, all enhancements are doable with additional investment above and beyond the base investment, however a stable network and base functionality are required first. C. Nouel added that AMI changes 75% of processes and offered to provide more information on what is involved in the deployment process if helpful. A. Edington noted interest in more information.
- M. Marchand asked when there will be an estimate of EDI for rate period upload of rates costs and noted concern over a prohibitive cost to suppliers actually being able to offer TVR. K. O'Shaughnessy responded that the actual costs will not be prohibitive, but there are no estimates at this point. C. Nouel agreed and noted that it is early for an estimate. J. Lawrence agreed as well and suggested a working group to figure how to seamlessly make the file transfer with a goal of automation. R. Zachas noted concern on the costs; prohibitive costs could make it impossible to offer TVR.
- P. Roche asked to add language in the documentation/chart on cost and appropriate cost assignment regarding first movers. J. Lawrence responded that suppliers in other jurisdictions may have useful models on appropriate cost assignment and can reach out for useful information if suggestions on those suppliers are provided.
- L. Chretien stated that the view at Green Energy Consumers Alliance is to construct time varying rates to work statewide, and on first movers, the plan from the start should be for all communities to have access to time varying rates and for every consumer to be able to participate, meaning the first communities building this out should not have biggest burden.

3) Finish Deployment Discussion

- J. Lawrence introduced a document that summarized the discussion from the last several sessions dedicated to deployment, noting a few questions on EV metering and CPP remain. J. Lawrence stated that Eversource is not opposed to CPP but cautioned against relying on jurisdictions across the country with more advanced AMI programs and services that have had stability for many years. J. Lawrence added that there will be opt-out rates and there will be some areas without coverage that will need special solutions but the goal is to be cost efficient and safe in the planned time frame.
- Within the presentation, J. Lawrence presented the following topics:
  - EDCs are integrating equity and environmental justice considerations wherever possible as long as not materially eroding cost efficiency and stability.
  - Regarding planning and engagement components, refers to Eversource's approved filings with the Department.
  - The initial focus is on the core capabilities to customers get familiar with the AMI functionality and deliver those quick value adds such as usage alerts, the ability to see their usage data checking the status of service at their premise, etc.
  - More complex functionality (i.e., load disaggregation, real-time TVR price signals) will follow phase one stability.
  - EV metering and dynamic pricing are beyond the initial scope of the Company's AMI plans – providing this advanced functionality for EV-related to time of use products and CPP will create additional costs which the Company will add subject to the market's response to the first phase.
  - J. Lawrence asked for any questions.
- E. Grammer expressed concern on issues that may come up in the first phase that will prevent utilities from going forward with additional complex functionality. J. Lawrence responded that nothing planned for phase one foundational deployment currently forecloses on any future options. C. Nouel echoed the same for National Grid.
- R. Zachas asked if Eversource will need to go back to the Department for another proceeding to approve costs in order to offer the additional functionality (for CPP, for example). J. Lawrence responded that the authorized cost for the current rate recovery mechanism did not contemplate these additions, so future cost recovery strategy has not been determined, noting that Eversource did not commit to CPP in the original proposal and estimates.
- J. Lawrence introduced the next agenda item regarding EV and metering ability: will a customer have to install a second meter in order to participate in an EV time of use rate. J. Lawrence responded that, after consultation, the technology has not matured from either a functionality or a commercial standpoint to be able to rely on either load disaggregation capabilities at the meter level or reporting capabilities that either the EVSE or the vehicle telematics level (that functionality as far as Eversource is aware does not exist in the market).
- K. Murray stated that to his understanding there are jurisdictions where they use a single meter and there is an EV rate for those for such situations. J. Lawrence noted that he would be interested in that data and noted that, to his understanding, the CA program has not commercially launched despite approval.
- E. Grammer stated that Eversource had been ordered by New Hampshire to establish a pilot program looking at the way of avoiding the need for two meters by using the charger data. J. Lawrence responded that the technical questions involved in that have not been resolved yet and would follow up with details.
- J. Howat asked whether the companies are planning to implement remote disconnection and reconnection capability?
  - J. Lawrence responded that Eversource will not be including remote disconnect and reconnect in the beginning, noting the involved stakeholder process needed for these

capabilities. However, the Company does intend to take up remote on, remote off capability following phase one.
  - C. Nouel responded that National Grid is planning to have that functionality in scope as a value driver but there is a complicated process to be considered including for collections or disconnections.
- J. Lawrence introduced final topic regarding dynamic pricing programs, noting these were not included in the initial scope of work approved by the Department and are not contemplated for 2025/2026. J. Lawrence stated another clarification point is that manual solutions have been utilized in the state up until this point, which should not be a precedent for assuming an automated solution exists for the several million customers across the state.
- J. Lawrence also stated that the Eversource is not closing the door on these innovations and is excited for them but is required to focus on the core functionality and stability considerations for the initial deployment to be followed by additional functionality as warranted by the market and stakeholders.
- R. Zachas asked what Eversource meant by needing to evaluate and assess customer demand for TVR, and what additional process would Eversource need to take before rolling out dynamic pricing? J. Lawrence referred back to the agile approach, stating that there will need to be assessment and discussions on priorities regarding demand for additional functionality following stability and foundational TVR capabilities being offered.
- R. Zachas noted concern from a supplier perspective on the gray area regarding timelines (i.e., static TVR to be offered "at least" 12 months after AMI deployment; no timeline for or commitment to offer rate ready CPP or EV TOU) and asked when Cape Light Compact will be allowed to provide dynamic pricing options beyond foundational TVR for customers. J. Lawrence responded that, as discussed earlier, 12 months is the target date for static TVR assuming that that the CIS project and deployment, MDMS development, and integration with the AMI meter and that deployment are on schedule, each of which includes additional sub-steps and items out of Eversource's control. However, if there is strong demand from the supplier community uniformly to deliver these, dynamic pricing (rate ready CPP/EV TOU) would likely rise to be a priority.
- R. Zachas asked about the process to evaluate supplier demand. J. Lawrence responded, speaking for Eversource, that dynamic pricing options are the TVR luxury, which requires discussions and positive outlook for the first year or two of TVR adoption with a static pricing component to ensure demand at that level.
- E. Grammer asked to confirm that static TVR means an off-peak time period and an on-peak time period that does not change and has a set rate associated. J. Lawrence responded yes, the supplier provides the periods and the associated prices which remain until a rate change.
- J. Lawrence concluded and welcomed any feedback/comments.
- J. Ralston stated that the document that was presented would be added to the SharePoint.

4) Continued Discussion on EV meters in response to Stakeholder Questions

- A. Edington presented the proposed structure for the next three meetings on data access. The proposed structure includes four general areas for discussion: 1) customer data access and voluntary sharing with third parties; 2) third-party stakeholder access to aggregated customer data (i.e., more general, possibly statewide data access platform); 3) data security and customer privacy; and 4) other specific functionalities.
- A. Edington presented the proposed schedule for the topics to be discussed at each upcoming meeting, including beginning each meeting with a summary of key points and items for continued discussion. Additionally, there is the opportunity for stakeholder presentations as well as for external presenters to attend. A. Edington invited comments and feedback from the group.

- E. Grammer asked to not preclude discussions regarding more granular data than aggregated data. A. Edington agreed and noted that “aggregated” is not on the slide but can be open for discussion.
- A. Edington asked to confirm if the materials will be circulated through the facilitator and if the external presenters will be presented by DOER or the facilitator. J. Ralston responded that the presentations can be attached to the meetings and DOER can suggest external presenters. A. Edington added that it may be helpful to hear updates from the EDCs on data access platforms and possibly NYSERDA on the integrated energy Data Resource platform. J. Ralston asked A. Edington to circulate a list of proposed presenters. A. Edington agreed to send some for the next meeting to the full list.

AMI Stakeholder Group: EDC deployment strategy and open questions

August 29, 2023

- The EDCs support rate innovation, and over time will continue to invest to expand capabilities beyond "Day 1" functionality
- Industry playbook for successful AMI:
  - Deployment plan emphasizing the most cost-efficient path to network stability and near-complete customer coverage
    - Equity and environmental justice considerations will influence the plan to the extent that cost-efficiency and the path to stable coverage are not materially compromised
  - Initial focus on core capabilities to acclimate customers to AMI and deliver broadly valued basic features
  - More complex functionality typically follows only after AMI network, basic features and customer engagement have achieved maturity
  - Given the AMI Stakeholder group mandate to obtain input on AMI deployment and customer engagement strategies, and the early advancement of supplier TOU, the EDCs' position on alternative EV metering and dynamic pricing offers (such as CPP) is simply that their complex requirements are well beyond the initial scope of their AMI projects, and were not included in the AMI proposals approved by the DPU. The EDCs support further consideration of these strategies as/if customer demand for such offers emerges.

- Meters do not currently have revenue-grade load disaggregation capabilities; EVSE and vehicle telematics do not currently produce revenue-grade outputs
  - In the Department Order issued in Dockets DPU 21-90/91/92, the Companies were directed to discuss EV sub-metering issues including metering capabilities with stakeholders and EVSE providers. These discussions with stakeholders are ongoing.
- Dynamic pricing program requirements are beyond the planned core AMI functionality
  - Communications channel to receive dynamic price signals and communicate them to customers (and potentially directly to smart devices in customers' premises) not in scope of initial deployments
  - Previous EDC pilots relied on manual billing of small populations by a single entity
    - Manual solutions are not feasible for state-wide deployment
    - Platform for multiple suppliers to regularly update dynamic price signals is not in scope and would constitute a significant platform investment
- The EDCs look forward to assessing customer demand for these advanced functions and working with stakeholders on long term plans to bring them to market, as warranted.

ATTACHMENT C

nationalgrid

Melissa G. Liazos
Senior Counsel

February 24, 2016

VIA HAND DELIVERY AND E-FILING

Mark D. Marini, Secretary
Department of Public Utilities
One South Station, 5th Floor
Boston, MA 02110

Re: Massachusetts Electric Company and Nantucket Electric Company each d/b/a National Grid
D.P.U. 10-82 – Smart Grid Pilot Evaluation Working Group

Dear Secretary Marini:

Enclosed for filing on behalf of Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid ("National Grid" or "Company"), please find the National Grid Smart Energy Solutions Pilot Interim Evaluation Report ("Report"). The Report provides an interim initial evaluation of the first year of customer-side results from the Company's Smart Energy Solutions Pilot ("Pilot") in Worcester, Massachusetts. The Company's evaluation of the grid-side results of the Pilot will be filed shortly with the Department.

Please contact me with any questions regarding this filing. Thank you for your assistance.

Very truly yours,

Melissa G. Liazos

Melissa G. Liazos

Enclosures

cc: Alan Topalian, Hearing Officer
Rebecca Tepper, Office of the Attorney General (electronic only)
Alexander Early, Office of the Attorney General (electronic only)
Rachel Evans, Department of Energy Resources (electronic only)
Jerrold Oppenheim, Low-Income Network
Service List (electronic only)

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ATTACHMENT C

NAVIGANT

National Grid
Smart Energy Solutions Pilot

Interim Evaluation Report

Prepared for:
National Grid

nationalgrid

Navigant Consulting, Inc.
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February 22, 2016

NAVIGANT

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NAVIGANT

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The following appendices are provided in a separate document:

- Appendix E – Graphs of Event Impacts by Hour for Residential Customers
- Appendix F – Graphs of Event Impacts by Hour for Commercial Customers
- Appendix G – Graphs of Event Impacts for Residential Customers by Demographic Subgroup

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Glossary of Key Terms and Acronyms

Pricing:

Critical Peak Pricing (CPP) – Referred to as Smart Rewards Pricing in National Grid's program marketing materials. In the Smart Energy Solutions program this rate structure combines a TOU rate with critical peak pricing in which customers are charged higher rates for energy during Peak Events.

Peak Time Rebate (PTR) – Referred to as Conservation Day Rebate in National Grid's program marketing materials. A rate structure in which customers are provided a credit, or rebate, for reducing their energy usage during Peak Events.

Time of Use (TOU) – A rate structure in which participants pay a predetermined tiered rate in which higher prices generally coincide with peak periods and lower prices with off-peak periods.

Customer Types:

Active Participant – An active participant is one who is deemed to have taken actions above simply being on a rate. This household or business is utilizing technology and taking actions to modify their behavior in reaction to the new rate and technology afforded by their participation in the Pilot. Specifically, for this evaluation active participants are those who have opted into a technology package above the default (e.g., opted into Levels 2, 3, or 4), or participants on the default technology package (Level 1) who have visited the WorcesterSmart web portal.

Passive Participant – A customer in the Pilot who is on the default technology package (Level 1) and has not visited the WorcesterSmart web portal.

Peak Times:

Peak Period – Weekdays from 8 a.m. to 8 p.m.

Off-Peak Period – All hours that are not defined as Peak Periods or Peak Events. Includes all weekend, evening and holiday hours.

Conservation Day – A day on which a Peak Event is called.

Peak Event – A period of time for which critical peak pricing will be in effect. Customers are notified in advance of the specific Peak Event hours for a given Conservation Day. CPP customers are charged a higher rate during a Peak Event and PTR customers can earn a rebate for conserving during a Peak Event.

Enabling Technologies:

AMI (advanced metering infrastructure) Meter – An advanced meter, also referred to as a "smart meter", that records consumption in intervals and communicates that information via a communications network back to the utility for monitoring and billing purposes. AMI meters enable two-way communication between the meter and the central system.

Direct Load Control Device – Device that allows customers to manage large appliances, such as an electric hot water heater or pool pump, which is controlled via broadband Internet connection.

Homeview App – Also referred to as the "mobile app" or "app". Allows customers to view their IHD remotely and access real-time energy usage and cost information.

In-home display (IHD) – Referred to as a digital picture frame in National Grid's program marketing materials. An electronic graphical display device which provides information and graphics about energy usage and cost that is updated on a regular basis based on data from the utility meter. Customers may also upload their own personal photographs for display on this device.

Programmable-Controllable Thermostat (PCT) – A programmable thermostat, also referred to as a "smart thermostat", which can also be controlled or signaled via the Home Area Network or another communications method.

Smart Plug – An intelligent 3-prong outlet that customers plug appliances into, which can also be controlled or signaled via the Home Area Network or broadband Internet connection.

WorcesterSmart Web portal – Also referred to as the "web portal". An internet website accessible to all participants that enables them to see more advanced information on their energy consumption. The web portal also provides performance feedback for Pilot participants during Conservation Days.

Acronyms:
AMI: Advanced metering infrastructure
CAC: Central Air Conditioning
CPP: Critical Peak Pricing
DPU: Massachusetts Department of Public Utilities
DRMS: Demand Response Management System
EEAC: Energy Efficiency Advisory Council
GCA: Green Communities Act
IHD: In-home display
LEAN: Low-income Energy Action Network
PCT: Programmable-Controllable Thermostat
PTR: Peak Time Rebate
SaaS: Software as a Service
TOU: Time of Use

Executive Summary

Massachusetts Electric Company and Nantucket Electric Company d/b/a/ National Grid's (the Company or National Grid) Smart Energy Solutions Pilot program (the Pilot or Smart Energy Solutions) is an innovative smart grid pilot featuring deployment of a unique combination of advanced meters, customer-facing technologies, and time-of-use (TOU) rates. The informational portion of the Pilot began in 2013, rates went live in January 2015, and implementation will run through the end of 2016. The Pilot also includes advanced distribution grid-side technologies which will be the subject of a separate report.[1] This interim evaluation, conducted by Navigant Consulting, Inc. (Navigant or the evaluation team), covers customer-side Pilot activities through November 2015. Navigant is conducting the evaluation of the Pilot in accordance with the *Common Evaluation Framework*[2] produced by the Massachusetts Smart Grid Collaborative Technical Subcommittee (the Collaborative), a stakeholder group convened by the DPU to develop consistent evaluation themes and techniques across smart grid pilot programs in the state. Key findings include demonstration of significant energy and Peak Event savings, the important role of technology, and high customer satisfaction (Figure E-1).

Figure E-1. Key Findings from Interim Evaluation of Smart Energy Solutions

Energy and Demand Savings for Active Customers	• Load reductions ranged from 10% to 31% (0.12 to 0.56 kW) during Conservation Day Peak Events depending on the combination of rates and technology • Nearly 5% (approximately 30 kWh per month) energy savings from January - September 2015 for most customers on CPP
Enabling Technologies Increase Demand Savings for Active Customers	• Customers with programmable communicating thermostats have the highest load reductions (29%-31% on CPP and 22% on PTR) • Customers with in-home displays are next (17% on CPP and 9% on PTR), followed by customers with Web Portal access only (12% on CPP and 10% on PTR)
Bill Savings	• Average per customer bill savings of $109 from Janaury - September 2015 for customers on CPP • Average total rebates of $20 for summer 2015 Conservation Day Peak Events for customers on PTR
High Retention Rate	• 98% of customers remained in the Pilot as of November 9, 2015 after rates went live on January 1, 2015.
High Customer Satisfaction	• 72% of customers are "very satisfied" or "somewhat satisfied" with Smart Energy Solutions

Source: Navigant analysis

Note: CPP refers to Critical Peak Pricing and PTR refers to Peak Time Rebate.

[1] National Grid. *Interim Grid-Facing Evaluation Report*, forthcoming.

[2] Massachusetts Smart Grid Collaborative Technical Subcommittee, *Common Evaluation Framework*, August 10, 2011.

The Smart Energy Solutions Pilot

As shown in Figure E-2, Smart Energy Solutions has four phases. Phase 1 is complete while Phases 2-4 are ongoing.

Phase 1. **Meter Deployment & Awareness.** In this initial phase the Company raised awareness about and installed advanced metering infrastructure (AMI) meters (also referred to as "smart meters") in approximately 15,000 homes and businesses.

Phase 2. **Introduction of Benefits.** In the second phase the Company introduced Smart Energy Solutions to raise customer awareness and create an expectation of more to come. Customer education efforts are ongoing.

Phase 3. **Choice.** In Phase 3 National Grid customers chose between two Pilot rates, a TOU Critical Peak Pricing (CPP) rate and a Peak Time Rebate (PTR) rate, and four technology packages that offer varying levels of information and control via web portal access, phone app, in-home displays (IHDs), programmable-controllable thermostats (PCTs), direct load control devices, and smart plugs.[3]

Phase 4. **Focus on Customer Control.** Phase 4 began with the rates going live. The Company is calling Conservation Days with specific Peak Events hours on high-demand days, educating customers about their bills, assisting them in using the tools available to understand and control their energy usage, and allowing them to customize their participation through the many options available in the Pilot.

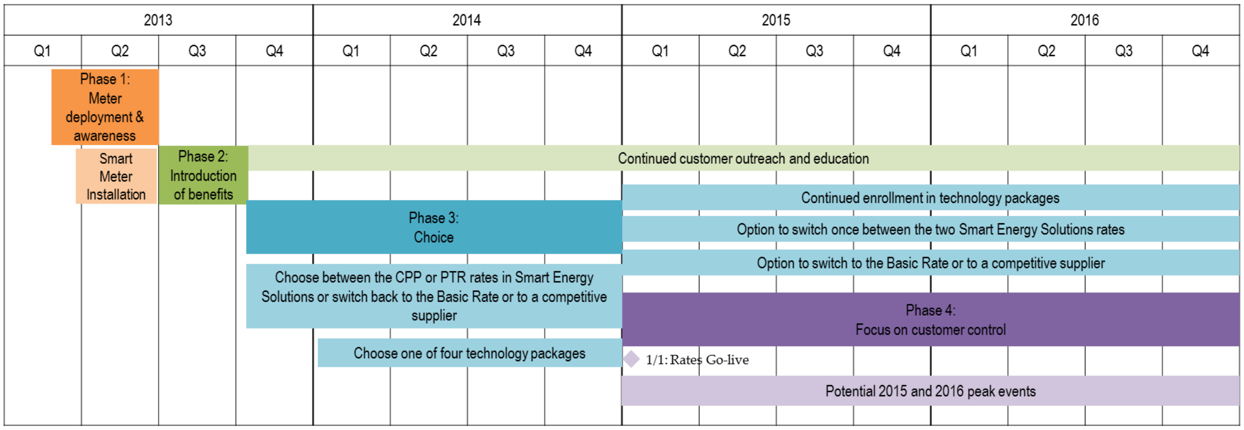
Based on its experience with the Pilot, National Grid understands the importance of gradual customer outreach and education to introduce new concepts and technologies. By introducing demand response and connected devices now, customers will better understand and benefit from incremental savings that may be realized from the introduction of AMI and time-based rates. If a proposal for extending the Pilot is approved or if the Company's Grid Modernization Plan is approved, the Company envisions offering Smart Energy Solutions participants the option to receive similar savings and benefits as they have enjoyed to date, in line with what is proposed in the Company's Grid Modernization Plan in D.P.U. 15-120. Otherwise, the Pilot participants will revert to basic rates and will be eligible for the same demand response incentives as other customers in the Company's service territory.

In addition to extending Smart Energy Solutions for Pilot participants, National Grid may offer similar services at a different scale, again pending the approval of the Grid Modernization Plan. The Company expects to transition to a more advanced demand response management system (DRMS) that will be deployed during the Grid Modernization plan period if approved. The functionalities of this more complex DRMS include the ability to control end points on the distribution network down to a transformer level controlling demand-response enabled devices based on GIS locational information, as well as the ability to accept a much larger array of communication points/inputs and gateway

[3] Customers also had the option to remain on the Basic Rate, effectively leaving the Pilot, or to leave National Grid by switching to a competitive supplier. As a result, the Pilot contains an "opt-out" element for customers who do not want TOU/CPP, and an "opt-in" element for customers choosing PTR or any of the technology packages. This design and customer flexibility sets the Pilot apart from other utility dynamic rate pilots. Therefore, comparisons to other programs will be anecdotal, as direct comparisons do not exist.

components that will not be limited to customer Wi-Fi networks for control.[4]

Figure E-2. Four Phase Rollout of Smart Energy Solutions



Source: Navigant and National Grid

Consistency with Green Communities Act

The Pilot design complies with and exceeds the requirements of Section 85 of the Green Communities Act (GCA or the Act) passed in Massachusetts in 2008. The Act mandated that each investor-owned electric utility conduct a smart grid pilot with the overall objective of reducing active participants' peak and average loads by at least 5%. The pilot program must include, at a minimum, the following:

- Deployment of advanced meters that measure and communicate electricity consumption on a real-time basis;
- Automated energy management systems in customers' home and facilities;
- Time of use or hourly pricing for a minimum of 0.25 percent of the company's customers ;
- Remote monitoring and control equipment on the Company's electric distribution system; and,
- Advanced technology to operate an integrated grid network communication system in a limited geographic area.

The Massachusetts Department of Public Utilities (DPU) has recognized four unique elements of Smart Energy Solutions that differentiate it from other Section 85 pilot programs.[5]

1. The Company is ***implementing the customer-facing and grid-facing components of the Pilot within one city***, a portion of Worcester, which will allow National Grid to ascertain whether a comprehensive deployment of smart grid technologies produces synergistic customer benefits.
2. The Company ***deployed the program on an opt-out basis***, meaning all eligible customers in the Worcester area were offered an AMI meter and enrolled in Smart Energy Solutions by default but had the option to opt-out if they weren't interested. Relative to opt-in programs where

[4] National Grid. D.P.U. 15-168. *Information Request DPU-Electric 1-1.* November 24, 2015.

[5] D.P.U. Order 11-129. *Petition of Massachusetts Electric Company and Nantucket Electric Company, each d/b/a National Grid for approval of a smart grid pilot program.* August 3, 2012.

eligible customers must actively choose to participate, opt-out programs reach many more customers and thus have higher savings potential.

3. The ***default pricing option for the Pilot is a TOU rate, and the vast majority of Pilot participants have remained on this rate***. Additionally, nearly 1,000 customers have opted into technology packages which include in-home devices. Having a significant number of customers on a TOU rate with enabling technologies represents a unique opportunity to study these smart grid pilot components across a broad segment of the population.
4. National Grid's ***comprehensive outreach and education campaign combines both traditional and community-based elements***. It is designed to encourage customers to permanently change their energy consumption behavior in response to the price signals and other Pilot messaging.

Definition of Active Customers

In the context of an opt-out pilot, the GCA's goal of reaching 5% savings for "active" customers must be interpreted carefully. Some of the participants in an opt-out pilot will never actively engage with the program components. For this interim report, Navigant defines active participants as anyone who opted into any in-home technologies and anyone with no in-home technology who has logged into the Pilot web portal at least once. Customers with no in-home technology who never logged into the web portal are considered "passive" participants in the Pilot. In other words, the passive customers have not taken any actions to adopt technologies or check their electricity usage. By this definition, just under 20% of the Pilot participants are active.

Customer Decision-Making and Flexibility

Among smart grid pilots, Smart Energy Solutions is relatively complex with several key decision points for customers, as illustrated in Figure E-3.

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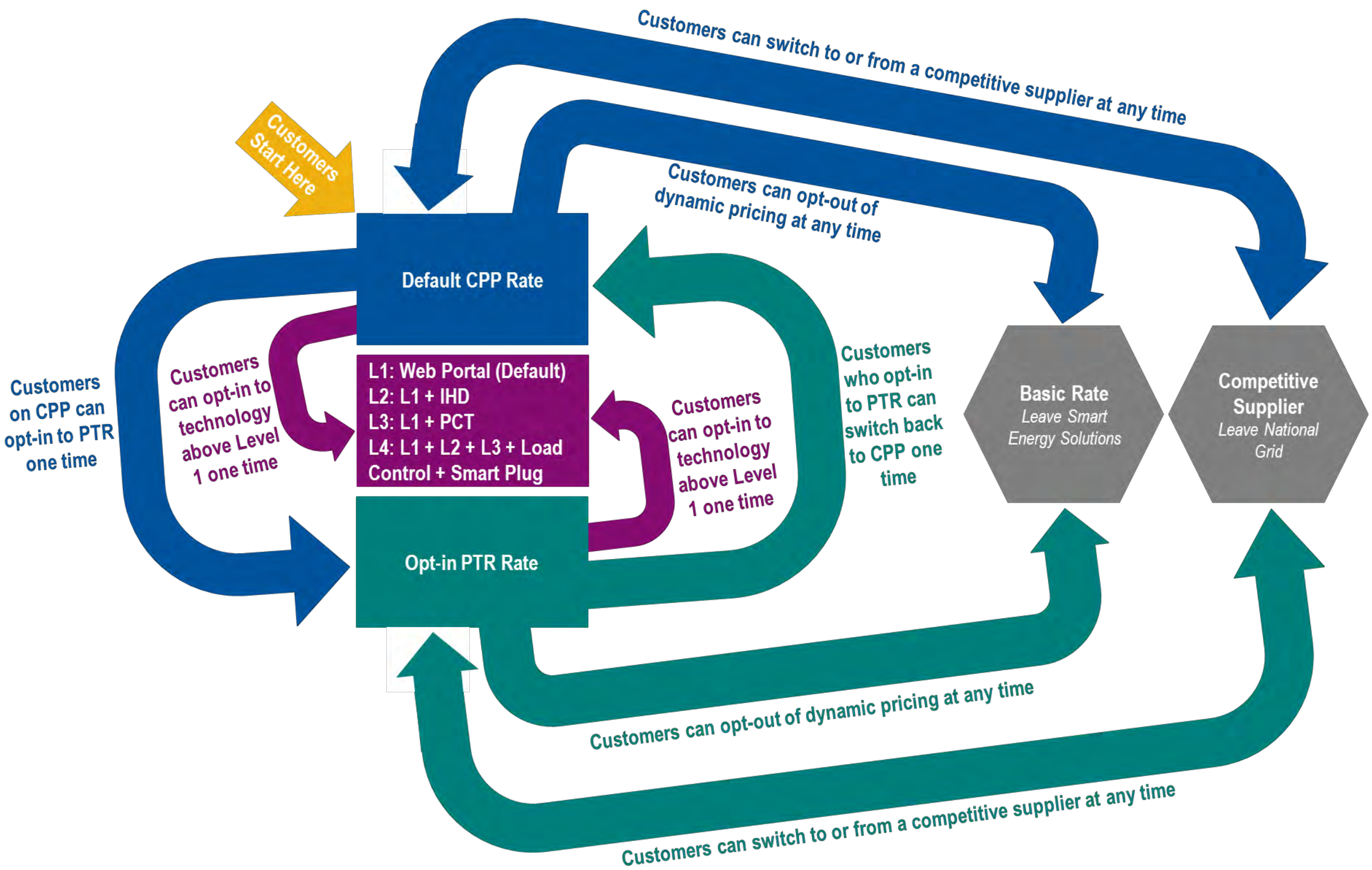
Figure E-3. Smart Energy Solutions Customer Decision Points



Source: Navigant

Note: L1 = Technology Level 1, L2 = Technology Level 2, L3 = Technology Level 3, L4 = Technology Level 4, IHD = in-home display, PCT = programmable-controllable thermostat.

Smart meters and choice of rates. Eligible customers in the Worcester area who accepted a smart meter were enrolled onto the CPP rate by default.[6] Customers have the option to opt into the PTR rate one time during the Pilot; customers who initially opted into the PTR rate can switch back to the CPP rate one time. Customers can also choose to switch back to the Basic Rate, thus opting out of the Pilot, or to switch to and from a competitive supplier, thus leaving or returning to National Grid, at any time.

Technology choice. Customers on the CPP and PTR rates also have a choice of four technology packages,[7] with Level 1 (web portal only) as the default. Technology options become more advanced, offering more electricity usage information and control, from Level 1 to Level 4:

[6] Customers also had the option to decline the smart meter and, therefore, opt out of the Pilot at the onset.

[7] There are eligibility requirements for certain technology packages. For example, in order to be eligible for the Level 2 package with a digital picture frame, customers must have a high-speed broadband Internet connection. To be eligible for Level 3 with a PCT, customers must have central air conditioning. To be eligible for Level 4 with a PCT and a smart plug and/or load control device, customers must have central air conditioning and a broadband high speed Internet connection.

- Level 1: Personal electric use information, via access to a web portal;
- Level 2: Level 1 plus an IHD with energy use and real time cost information and access to this information through the web portal;
- Level 3: Level 1 plus a programmable-controllable thermostat (PCT) and a mobile app to view the PCT schedule; or,
- Level 4: Level 1, Level 2, and Level 3 plus a smart plug and, for some customers, a wired load control device, and additional capability in the mobile app to show load control and smart plug usage.

During the summer of 2015, National Grid called 20 Conservation Days on days with expected high demand. Customers could receive notifications one day ahead as well as the day of each Conservation Day. On these days, the price of electricity increased during designated hours, called Peak Event hours, which can vary between Conservation Days. The Peak Events averaged 6.75 hours in length and totaled 135 hours over the course of the summer. National Grid's events were longer and called more days in a row than events from other comparable programs. On the CPP rate, customers are incented to conserve electricity, or shift usage to non-Peak Event hours, and thus avoid paying the high electricity prices during Peak Event hours. On the PTR rate, customers received a rebate for any electricity conserved during these hours.

Community Partnership and Sustainability Hub

To ensure that the Pilot was a collaborative effort with the community, National Grid partnered with the City of Worcester to host the September 2011 Green2Growth Summit (Summit). The Summit provided valuable insights into customers' visions regarding the future of energy delivery in their city. National Grid learned that its customers are increasingly aware of new opportunities to manage their energy consumption and are open to learning more about the potential uses and benefits of smart technology. Based on information gathered through the Summit, the Company revised the Pilot's Outreach & Education plan, implemented in Phases 2-4 of Figure E-3, and developed a Sustainability Hub in Worcester to continue engaging customers. The Sustainability Hub was envisioned and built as a focal point for the successful implementation of the Pilot. In addition to being the physical presence of the Pilot in Worcester, the Sustainability Hub serves as a model energy center in the community where National Grid provides hands-on education and engagement through a holistic approach, integrating various smart elements into a demonstration home.

Statewide Common Evaluation Framework

Navigant is conducting the evaluation of the Pilot in accordance with the *Common Evaluation Framework*[8] produced by the Massachusetts Smart Grid Collaborative Technical Subcommittee (the Collaborative), a stakeholder group convened by the DPU to develop consistent evaluation themes and techniques across smart grid pilot programs in the state. The evaluation includes quantitative measures of energy and demand impacts, and customer bill impacts, as well as qualitative measures for customer engagement, satisfaction, and perceptions through customer surveys, interviews, and focus groups.

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[8] Massachusetts Smart Grid Collaborative Technical Subcommittee, *Common Evaluation Framework*, August 10, 2011.

Impact Assessment

This interim evaluation addresses the impacts of the Pilot on demand during Peak Events, overall energy consumption, and customer bills. The impact findings in this interim report are primarily focused on residential customers. Interim results for Peak Event impacts and load shifting for commercial customers are included in this report; however, energy and bill impacts for commercial customers will be included in the final report after the conclusion of the Pilot. Where possible, each set of impacts is broken out by technology/price groups as prescribed by the Common Evaluation Framework. For Level 1, Navigant evaluated each of the impacts for both active and passive customers.

Table E-1 shows total and percentage demand and energy savings and total bill savings for residential customers in the Pilot. Total savings are the sum of savings across all residential customers in the program. Percentage savings are the weighted average of savings across the residential technology/price plan groups.

Table E-1. Total and Percentage Savings for Residential Customers

Impact Category	Total Savings	Percentage Savings – Active Customers (n=2,524)	Percentage Savings – All Customers (n=10,882)
Peak Event Savings – Average*	0.55 MW	16.8%	3.9%
Peak Event Savings – Maximum**	1.59 MW	29.0%	12.3%
Energy Savings in 2015***	2,300 MWh	4.1%	0.2%
Bill Savings in 2015****	$1,250,000	-	-

Source: Navigant analysis

* This is the total demand savings among all participants, averaged across all 20 events in the summer of 2015.

** This is the total demand savings for 6/23/2015, which was the Conservation Day with the highest savings.

*** This includes energy savings for the 10,398 CPP customers only, as energy savings were neither expected nor found for PTR customers.

**** This includes total bill savings for CPP customers and rebates for PTR customers.

The Pilot was developed to meet the GCA goal of achieving peak and average load reductions of 5% or greater for the active customers in the Pilot. In Navigant's analysis, peak load reduction is examined in the demand analysis and average load reduction in the energy analysis. From January to September 2015, for residential customers the Pilot achieved a 17% peak load reduction for active participants, and a 4% average load reduction for active CPP participants.[9] The 2015 demand savings may be slightly underestimated because hourly data from 2014 was used to estimate the baseline. In 2014, customers had access to usage information from the Pilot, so they may have already been conserving relative to their pre-2014 usage as they were more aware of their electricity usage.[10]

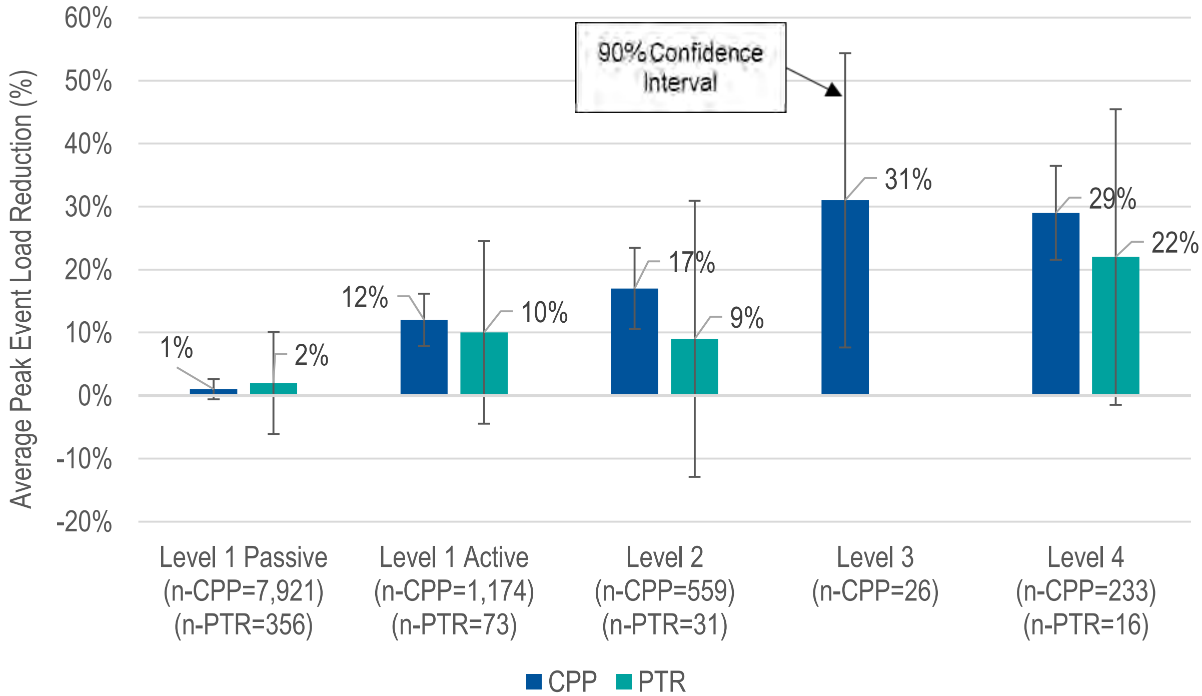
Active customers achieve average Peak Event load reductions of up to 31%, and in-home technology increases demand savings. Figure E-4 shows the average percentage peak load reduction across the 20 events of the 2015 summer for each of the technology/price groups. Whether on the CPP or PTR rate,

[9] Energy savings or average load reductions were neither expected nor found for PTR customers as these customers are not on a TOU rate.

[10] Hourly data prior to April 2014 when smart meters were installed was not available.

customers achieved greater demand reduction with more advanced technology. The savings for CPP customers were statistically significant at the 90% confidence level for all active participants, while the savings for customers on the PTR rate were not statistically significant at any technology level due to small sample sizes on that rate. Level 3 and 4 customers with smart thermostats saved the most (0.53 kW for Level 3 CPP, 0.56 kW for Level 4 CPP, and 0.50 kW for Level 4 PTR).[11] As expected, passive Level 1 customers, those who never accessed the web portal, saved the least (0.01 kW for CPP and 0.03 kW for PTR). Active Level 1 customers saved considerably more than the passive customers (0.13 kW for CPP and 0.12 kW for PTR). Level 2 customers, who have an IHD, were in the middle (0.20 kW for CPP and 0.13 kW for PTR). At each technology level, active CPP customers conserved more electricity than their PTR counterparts. Passive PTR customers saved more than passive CPP customers which could be due to a higher level of engagement since they had to opt-in to the PTR rate.

Figure E-4. Average Peak Event Load Reductions by Technology/Price Group



Source: Navigant analysis
Note: n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group.

Peak Event savings are comparable to other dynamic rate pilots. In percentage terms, the peak event impacts for active customers in the Pilot are similar to those from other, primarily opt-in, programs.[12]

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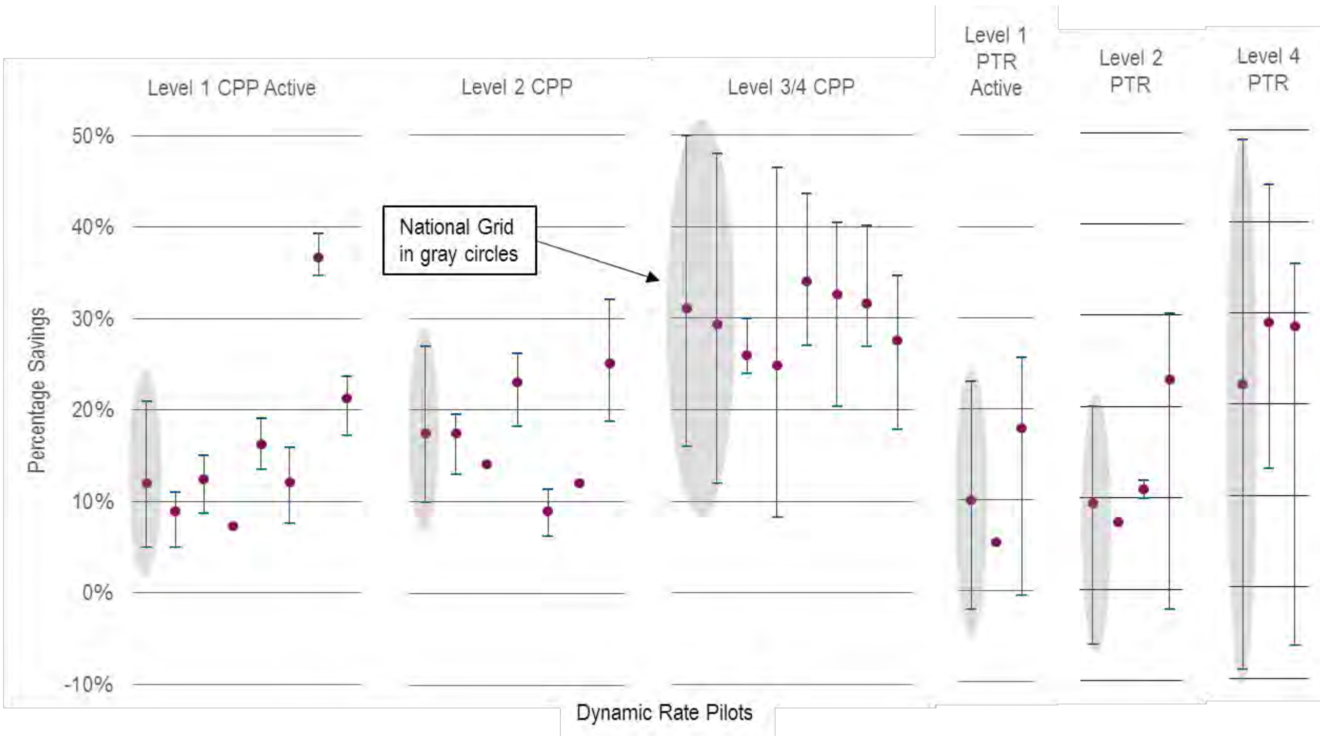
[11] Impacts were not estimated for customers with technology level 3 on the PTR plan because there was only one customer in this group.
[12] Passive customers in Level 1 CPP also have savings, but they are not shown in this figure because all of the comparison programs are opt-in. Passive customers in an opt-out program are fundamentally different from customers in an opt-in program in terms of their motivation to participate in a program.

Comparisons of the Pilot to several other programs around the country are shown in Figure E-5. The comparisons include the average, maximum, and minimum impact when possible, or the average impact when the minimum and maximum could not be found. The comparisons are grouped by the Pilot's technology/price groups, and the comparison programs are matched to the Pilot groups based on the descriptions of the price plans and the enabling technologies in the comparison program's report. The Pilot groups are highlighted in gray.[13]

Figure E-5. Peak Event Impacts Percentage Comparisons to Other Utilities

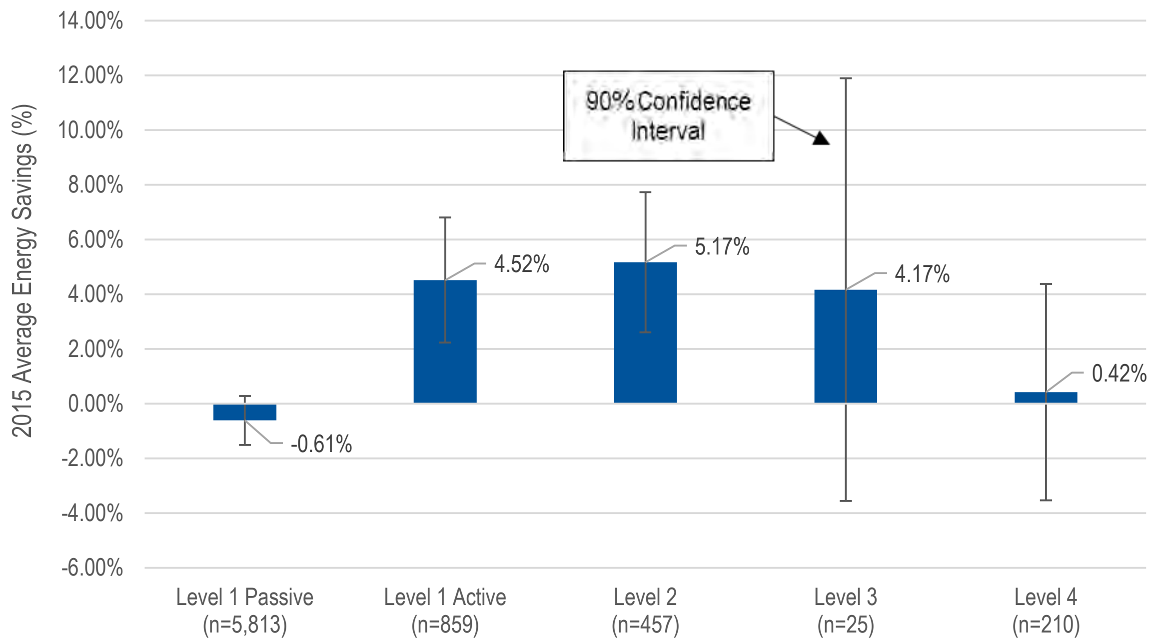


Source: Navigant analysis and the Smart Grid Investment Grant Program

CPP customers achieved average energy savings of up to 5% in 2015. Figure E-6 shows the average percentage energy impacts with 90% confidence intervals from January to September 2015 for CPP customers in different technology levels.[14] Energy savings were highest for Level 2 customers (38 kWh per month) and lowest for Level 4 customers (5 kWh per month). Active Level 1 customers saved 30 kWh per month and Level 3 customers saved 32 kWh per month. It is unclear why Level 4 customers saved less than Level 3 customers since the two groups had similar technologies; however, the 90% confidence bounds for the two estimates overlap and the sample sizes are relatively small for monthly billing analysis, which may have contributed to the discrepancy. Passive customers in Level 1 had negative energy savings, but the estimate was not statistically significant.

[13] The specific utility for each of the comparable pilots can be seen in Figure 3-2.
[14] Navigant also examined energy savings for PTR customers but did not find any significant savings outside of peak events; PTR customers are not expected to achieve significant energy savings because they do not pay TOU rates.

Figure E-6. Average Energy Impacts for CPP Customers from January to September 2015 by Technology Level

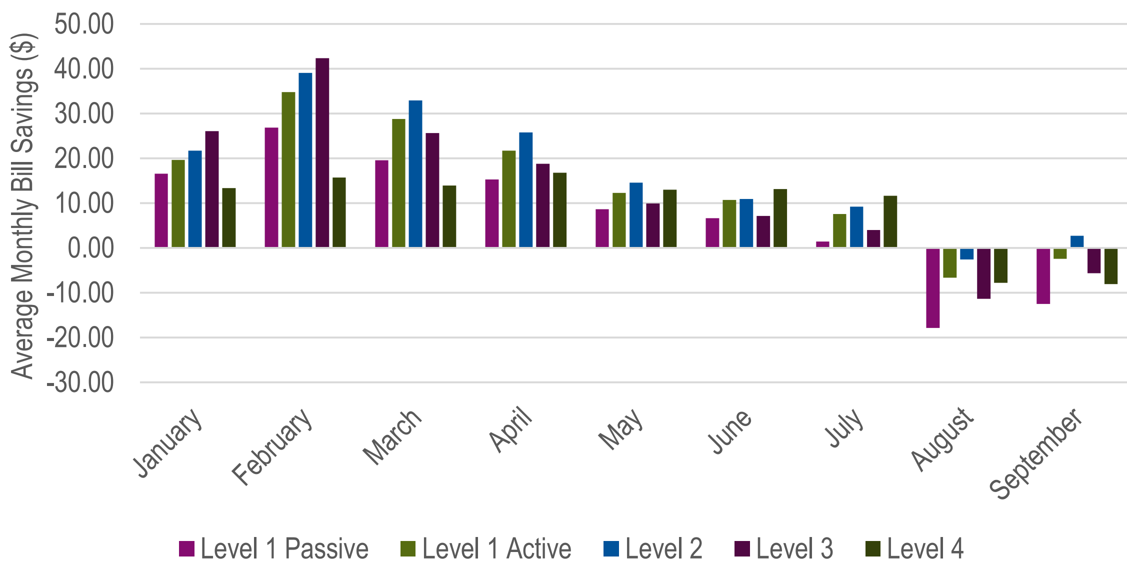


Source: Navigant analysis

Note: n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group.

CPP customers averaged $109 in bill savings from January to September 2015. Figure E-7 shows the average bill savings by month in 2015 for CPP customers. The month of each bill is defined as the last day of the billing period. This means that on average bills in each month contain an equal number of days in the current month and the previous month, for example bills in May reflect usage in the second half of April and the first half of May. On average across technologies, bill savings were highest in February, which reflect January and February usage, when customers were still adjusting to the new TOU rate. Unless there is a Peak Event, customers save money on the TOU rate because the TOU rate is lower than the Basic Rate for non-Peak Event hours. Customers' bills went up in August and September, reflecting usage in July, August, and September, which is expected since July and August were when the majority of the Peak Events were called. The expectation is that summer bills, when Peak Events are occurring, will increase but this will be balanced by bill savings throughout the rest of the year. Average per-customer bill savings from January through September 2015 were $154 for Level 2, $126 for active customers in Level 1, $117 for Level 3, $81 for Level 4, and $64 for passive customers in Level 1.

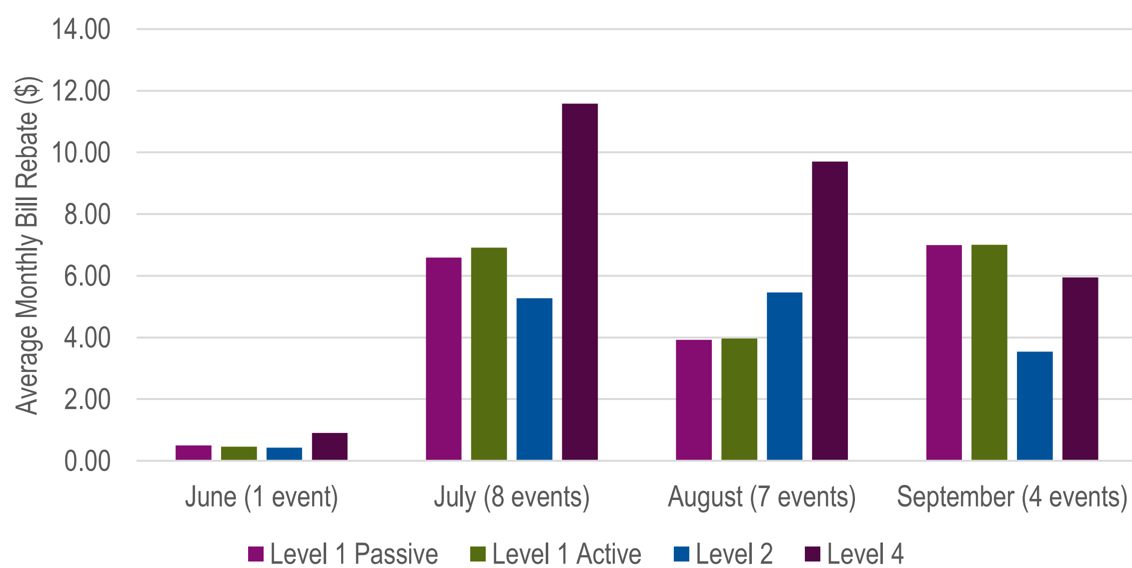
Figure E-7. Average Bill Savings for CPP Customers



Source: Navigant analysis

PTR customers averaged approximately $20 in bill rebates from January to September 2015. Since our analysis did not find energy savings for PTR customers in 2015, the bill savings for these customers come from the monthly rebate earned during Peak Events. Figure E-8 shows the average bill rebates by month in 2015 for PTR customers. Level 4 customers achieved the highest average rebate of $1.41 per event, Level 2 customers averaged $0.74 per event, active Level 1 customers averaged $0.92 per event, and passive Level 1 customers averaged $0.91 per event.

Figure E-8. Average Bill Rebates for PTR Customers



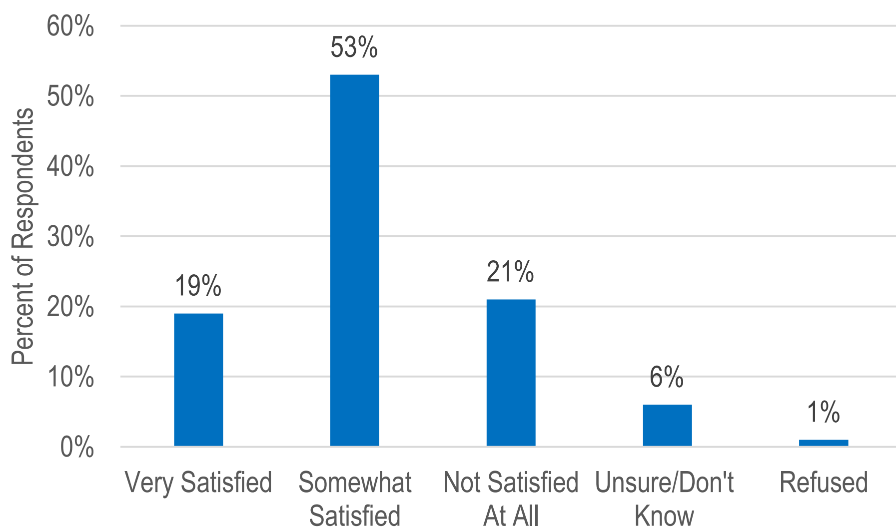
Source: Navigant analysis

Customer Engagement and Experience

The evaluation in this interim report covers customer experience in the Smart Energy Solutions program from November 2013 through November 2015. It addresses customers' expectations of the program, their reasons for participating, and their experience during the first summer of Conservation Days. Key findings include high customer satisfaction, high retention rate (i.e., few customers opting out of Smart Energy Solutions time-based rates in favor of the Basic Rate), and mixed perceptions of conservation and bill savings.

High satisfaction. As shown in Figure E-9, 72% of customers report being "very satisfied" or "somewhat satisfied" with the Pilot. This satisfaction rating is similar to customer feedback to NSTAR's[15] 2012-2013 opt-in pilot, similarly undertaken in compliance with Section 85 of the GCA. NSTAR pilot customers were asked to rate the program on a 5-point scale (5 = very positive, 1=very negative, and 3 is neutral); the average rating was 4.0,[16] which is comparable to the National Grid Pilot customers' rating on the 3-category scale of "very satisfied", "somewhat satisfied", and "not satisfied at all".[17] [18]

Figure E-9. Participant Overall Satisfaction with the Smart Energy Solutions Program



Source: Navigant analysis

High retention rate. The CPP and PTR rates went live in January 2015, so at the time of this analysis they had been in effect for approximately ten months. Compared to other utility dynamic rate pilots, National Grid has high customer retention, after 10 months, compared to one-year customer retention in other

[15] NSTAR is now called Eversource Energy.

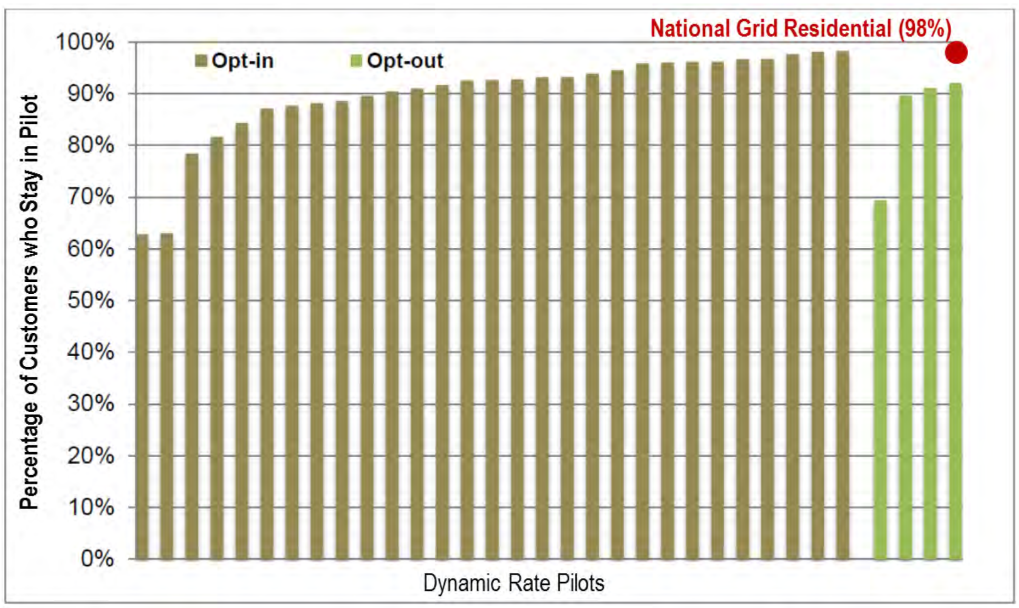
[16] Navigant. *NSTAR Smart Grid Pilot Final Technical Report: AMR Based Dynamic Pricing*. DE-OE0000292. Prepared for U.S. Department of Energy on behalf of NSTAR Gas and Electric Corporation. August 2014.

[17] National Grid customers could also indicate that they were "unsure/don't know" or refuse the question.

[18] National Grid notes that the Common Evaluation Framework emphasizes using 5-point scales, and will change the scale for this question to a 5-point scale in 2016.

pilots, as shown in Figure E-10.[19] Opt-out program design is a relatively new industry concept, and based on research to date, retention rates appear to be similar for opt-in and opt-out programs.[20] However, by definition, customers in an opt-in program have a different motivation to participate in a dynamic rate pilot than customers in an opt-out program. Customers who participate in opt-in programs tend to be enthusiastic early adopters and not likely to drop out of a program they signed up for. Opt-out programs capture all customers, many of whom may follow "default bias", which means that they tend towards the default offering rather than accepting alternative offerings. Yet, given the fact that opt-out programs target the general population, we would anticipate lower retention rates over time. In our view the 98% retention rate achieved to date by National Grid—coupled with the fact that the Company called more event days in 2015 than any other dynamic rate pilot—is remarkable.

Figure E-10. Customer One-Year Retention Rate Based on Whether the Utility Used Opt-In or Opt-Out Recruitment[21]



Source: Lawrence Berkeley National Laboratory and Navigant analysis

Lessons Learned and Potential Changes for 2016

Before and throughout the Pilot, National Grid has implemented a "listen, test, learn" approach that is based on "on the ground" conversations and reflections on the Pilot. This feedback, combined with learning, generally leads to continual improvement in program delivery. National Grid conducted extensive program marketing in the lead up to initiating meter installations, the first phase of the program. These activities included convening a public summit to discuss the proposed program,

[19] Figure E-10 shows U.S. Department of Energy Smart Grid Investment Grant (SGIG) dynamic rate pilot retention rates. 10 utilities undertook several pilot studies during the SGIG period and reported their experience in recruiting and retaining customers. Each bar in the chart represents a single treatment group within one of the utility pilots.
[20] Cappers, P., H. Liesel, R. Scheer. *American Recovery and Reinvestment Act of 2009: Interim report on customer acceptance, retention, and response to time-based rates from the consumer behavior studies*. LBNL-183029. June 2015.
[21] National Grid customer retention is shown for the first 11 months of the Pilot rates, January 1, 2015 – November 9, 2015.

development of brochures explaining the program, and establishment of the staffed, physical Sustainability Hub within the Pilot program area. National Grid also partnered with local schools. Clark University offered annual internships, and Worcester Polytechnic Institute created a student Sustainability Ambassador program. Ambassadors host Sustainability Hub tours and attend outreach events to educate customers throughout the community. Presenting the personal side of the Company is the backbone of "listen, test, learn", and is the inspiration for sending National Grid employees and Ambassadors into the community. It is also the basis for hosting visitors at the Sustainability Hub for the dual purpose of educating customers and listening to their concerns and feedback.

Several broad themes emerged regarding customer response to the Pilot design and implementation. Impacts for active customers are very close to meeting the goals established through Section 85 of the GCA, and the majority of customers are satisfied with the Pilot. That said, National Grid is striving for continual improvement of the Pilot and has several changes planned for 2016 based on lessons learned from the Pilot thus far and this interim evaluation.

Learning 1: Many customers want shorter and fewer Peak Events.
Nine of the 20 Peak Events in the summer of 2015 ran for eight hours and 17 of the 20 events were part of a back-to-back series, when events occurred multiple days in a row. In the end of the summer survey, many customers commented that they felt fatigued by the Peak Events and complained that the Peak Events were too long and occurred too many days in a row. Several customers said that the duration of the events constrained their schedules, and they had limited relief from the heat and humidity because National Grid scheduled multiple Conservation Days in a row.
Planned Adjustment 1: Increase customer understanding of how Peak Events are designed. National Grid will continue calling Peak Events in 2016, up to the approved 30 Conservation Days and 175 Peak Event hours. However, National Grid is listening to customers. The Company is revisiting the peak load threshold for which it calls Peak Events, as well as the process behind calling the events in order to reduce customer exhaustion as much as possible. Moreover, National Grid plans to improve its efforts to educate customers about the Pilot design and the reason for calling Peak Events, and provide tips for managing schedules and comfort during Peak Events.

Learning 2: Many customers want fewer or different notifications about Peak Events.
National Grid set the default Peak Event notification method as phone calls the day before, as well as the day of, Conservation Days. Many customers provided feedback that this was too much communication and appeared unaware that they could reduce the number of phone calls or request other forms of notification such as emails or text messages. As part of offering customers flexibility and the ability to customize the Pilot to their needs, National Grid has always provided the option of changing communication methods and frequency. Customers need only contact National Grid or access their online account on the Pilot's web portal.
Planned Adjustment 2: Increase ease of adjusting Peak Event notifications. Realizing that many customers may not have been aware of their notification options, National Grid will seek new ways to make it even easier for customers to manage their Peak Event notifications, and will continue to inform customers of their options.

Learning 3: Active customers in Level 1 save more – in energy, demand, and dollars – than passive customers. Active Level 1 customers have load reductions during Peak Event hours of 12% and 10% compared to 1% and 2% for passive customers on the CPP and PTR rate, respectively. Active CPP customers have energy savings from January to September 2015 of 4.5% compared to -0.6% for passive customers. Finally, active CPP customers saved $126 on their bills from January to September 2015 compared to $64 for passive customers, though active and passive PTR customers had almost the same savings at $18.

Planned Adjustment 3: Encourage and increase the use of the web portal by Level 1 customers. To help more customers increase their electricity and bill savings, National Grid will increase promotion of the web portal to passive customers through established customer outreach and education channels.

Interim Evaluation Report Structure

This report is organized in the following chapters:

- **Chapter 1: Introduction**, describes the Pilot and summarizes the evaluation focus and objectives;
- **Chapter 2: Smart Energy Solutions Program Design**, summarizes rate design, technology choice, as well as program marketing, participation and segmentation;
- **Chapter 3: Impact Assessment**, summarizes the results of the peak event impact analysis, energy impact analysis, bill savings, and load shifting;
- **Chapter 4: Customer Experience Assessment**, summarizes participation drivers, participant awareness, engagement, and satisfaction;
- **Chapter 5: Conclusions and Recommendations**, draws everything together to provide key takeaways, as well as lessons learned and potential changes for 2016;
- **Appendices A through D,** provides detailed methodologies and results; and
- **Appendices E, F, and G** are provided as a separate document, and show graphs of event impacts by hour for residential customers, graphs of event impacts by hour for commercial customers, and graphs of event impacts for residential customers by demographic subgroup, respectively.

1. Introduction

Massachusetts Electric Company and Nantucket Electric Company d/b/a/ National Grid's (the Company or National Grid) Smart Energy Solutions Pilot program (the Pilot or Smart Energy Solutions) is an innovative smart grid pilot combining deployment of advanced meters, customer-facing technologies, and time-of-use (TOU) rates. The informational portion of the Pilot began in 2013, rates went live in January 2015, and implementation will run through the end of 2016. The Pilot also includes advanced distribution grid-side technologies which are the subject of a separate report.[22] This program recruits customers through an opt-out model for residential customers and businesses across a range of income and other demographic characteristics, providing a case study across a broad population sample. This interim evaluation, conducted by Navigant Consulting, Inc. (Navigant or the evaluation team), covers customer-side Pilot activities through November 2015. Navigant is conducting the evaluation of the Pilot in accordance with the *Common Evaluation Framework*[23] produced by the Massachusetts Smart Grid Collaborative Technical Subcommittee (the Collaborative), a stakeholder group convened by the DPU to develop consistent evaluation themes and techniques across smart grid pilot programs in the state.

1.1 Smart Energy Solutions Pilot Description

Smart Energy Solutions was built on two important design principles focused on the customer and the distribution grid, respectively. First, the Pilot provides a new customer experience with regard to electricity delivery in the form of dynamic pricing, load control, and advanced communication interfaces. Second, the Company enhances grid operations through advanced distribution technologies designed to markedly improve system reliability and operational efficiency. More specifically, Smart Energy Solutions includes the following components:

- **Dynamic pricing** including TOU, critical peak pricing (CPP), and peak time rebates (PTR);
- **Advanced customer-side technologies**, including in-home displays (IHDs), programmable communicating thermostats (PCTs or smart thermostats), and other load controlling devices; and,
- **Advanced grid-side technologies**, including advanced communication systems, capacitor controls, and grid automation.

As shown in Figure 1-1, Smart Energy Solutions has four phases. Phase 1 is complete while Phases 2-4 are ongoing.

Phase 1. **Meter Deployment & Awareness.** In this initial phase the Company raised awareness about and installed advanced metering infrastructure (AMI) meters (also referred to as "smart meters") in approximately 15,000 homes and businesses.

Phase 2. **Introduction of Benefits.** In the second phase the Company introduced Smart Energy Solutions to raise customer awareness and create an expectation of more to come. Customer education efforts are ongoing.

[22] National Grid. *Interim Grid-Facing Evaluation Report*, forthcoming.

[23] Massachusetts Smart Grid Collaborative Technical Subcommittee, *Common Evaluation Framework*, August 10, 2011.

Phase 3. **Choice.** In Phase 3 National Grid customers chose between two Pilot rates, a TOU CPP rate and a PTR rate, and four technology packages that offer varying levels of information and control via web portal access, phone app, IHDs, PCTs, direct load control devices, and smart plugs.[24]

Phase 4. **Focus on Customer Control.** Phase 4 began with the rates going live. The Company is calling Conservation Days with specific Peak Event hours (Peak Events) on high-demand days, educating customers about their bills, assisting them in using the tools available to understand and control their energy usage, and allowing them to customize their participation through the many options available in the Pilot.

Based on its experience with the Pilot, the company has observed the importance of gradual customer outreach and education to introduce new concepts and technologies. By introducing demand response and connected devices now, customers will better understand and benefit from incremental savings that may be realized from the introduction of AMI and time-based rates. If a proposal for extending the Pilot is approved or if the Company's Grid Modernization Plan is approved, the Company envisions offering Smart Energy Solutions participants the option to receive similar savings and benefits as they have enjoyed to date, in line with what is proposed in the Company's Grid Modernization Plan in D.P.U. 15-120. Otherwise, the Pilot participants will revert to basic rates and will be eligible for the same demand response incentives as other customers in the Company's service territory. In addition to extending Smart Energy Solutions for Pilot participants, National Grid could offer it at a different scale pending the approval of the Grid Modernization Plan. The Company expects to transition to a more advanced demand response management system (DRMS) that will be deployed during the Grid Modernization plan period if approved. The functionalities of this more complex DRMS include the ability to control end points on the distribution network down to a transformer level controlling demand-response enabled devices based on GIS locational information, as well as the ability to accept a much larger array of communication points/inputs and gateway components that will not be limited to customer Wi-Fi networks for control.[25]

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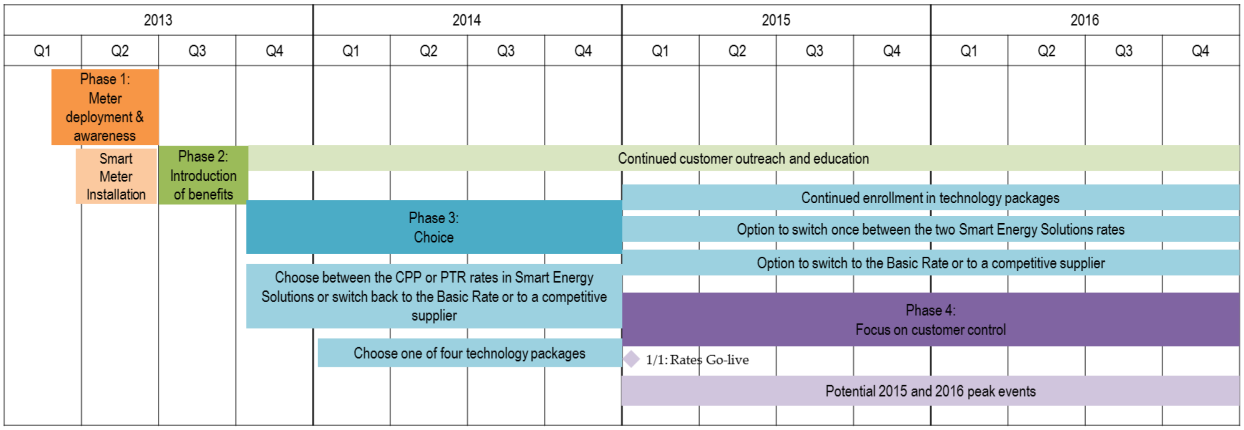
[24] Customers also had the option to remain on the Basic Rate, effectively leaving the Pilot, or to leave National Grid by switching to a competitive supplier. As a result, the Pilot contains an "opt-out" element for customers who don't want TOU/CPP, and an "opt-in" element for customers choosing PTR or any of the technology packages. This design and customer flexibility sets the Pilot apart from other utility dynamic rate pilots. Therefore, comparisons to other programs will be anecdotal, as direct comparisons do not exist.

[25] National Grid. D.P.U. 15-168. *Information Request DPU-Electric 1-1.* November 24, 2015.

Figure 1-1. Four-Phase Rollout of Smart Energy Solutions



Source: Navigant and National Grid

1.1.1 Consistency with the Green Communities Act

The Pilot design complies with and exceeds the requirements of Section 85 of the Green Communities Act (GCA or the Act) passed in Massachusetts in 2008. The Act mandated that each investor-owned electric utility conduct a smart grid pilot with the overall objective of reducing active participants' peak and average loads by at least 5%. The pilot program must include, at a minimum, the following:

- Deployment of advanced meters that measure and communicate electricity consumption on a real-time basis;
- Automated energy management systems in customers' home and facilities;
- Time of use or hourly pricing for a minimum of 0.25 percent of the company's customers ;
- Remote monitoring and control equipment on the Company's electric distribution system; and,
- Advanced technology to operate an integrated grid network communication system in a limited geographical area.

The Company adhered to these GCA principles by:

- Offering an opt-out TOU pricing option to approximately 15,000 customers, who make up more than 0.25% of National Grid's approximately 1.3 million customers;
- Seeking to achieve, for those customers who actively participate in Smart Energy Solutions, peak and average load reductions of at least 5%; and,
- Utilizing advanced technology to operate an integrated grid network communication system in a limited geographic area, including but not limited to:
    - Smart meters that provide real-time measurement and communication of energy consumption;
    - Automated load management systems embedded within current demand-side management programs; and,
    - Remote status detection and operation of distribution system equipment.

The Massachusetts Department of Public Utilities (DPU) has recognized four unique elements of Smart Energy Solutions that differentiate it from other Section 85 pilot programs.[26]

1. The Company is ***implementing the customer-facing and grid-facing components of the Pilot within one city***, a portion of Worcester, which will allow National Grid to ascertain whether a comprehensive deployment of smart grid technologies produces synergistic customer benefits.
2. The Company ***deployed the program on an opt-out basis***, meaning all eligible customers in the Worcester area were offered an AMI meter and enrolled in Smart Energy Solutions by default but had the option to opt out if they weren't interested. Relative to opt-in programs where eligible customers must actively choose to participate, opt-out programs reach many more customers and thus have higher savings potential.
3. The ***default pricing option for the Pilot is a TOU rate, and the vast majority of Pilot participants have remained on this rate***. Additionally, nearly 1,000 customers have opted into technology packages which include in-home devices. Having a significant number of customers on a TOU rate with enabling technologies represents a unique opportunity to study these smart grid pilot components across a broad segment of the population.
4. National Grid's ***comprehensive outreach and education campaign combines both traditional and community-based elements***. It is designed to encourage customers to permanently change their energy consumption behavior in response to the price signals and other Pilot messaging.

1.1.2 Definition of Active Customers

In the context of an opt-out pilot, the GCA's goal of reaching 5% savings for "active" customers must be interpreted carefully. Some of the participants in an opt-out pilot will never actively engage with the program components. For this interim report, Navigant defines active participants as anyone who opted into any in-home technologies and anyone with no in-home technology who has logged into the Pilot web portal at least once. Customers with no in-home technology who never logged into the web portal are considered "passive" participants in the Pilot. In other words, the passive customers have not taken any actions to adopt technologies or check their electricity usage. By this definition, just under 20% of the Pilot participants are active.

1.1.3 Customer Decision-Making and Flexibility

Among smart grid pilots, Smart Energy Solutions is relatively complex with several key decision points for customers, as illustrated in Figure 1-2.

[26] D.P.U. Order 11-129. *Petition of Massachusetts Electric Company and Nantucket Electric Company, each d/b/a National Grid for approval of a smart grid pilot program.* August 3, 2012.

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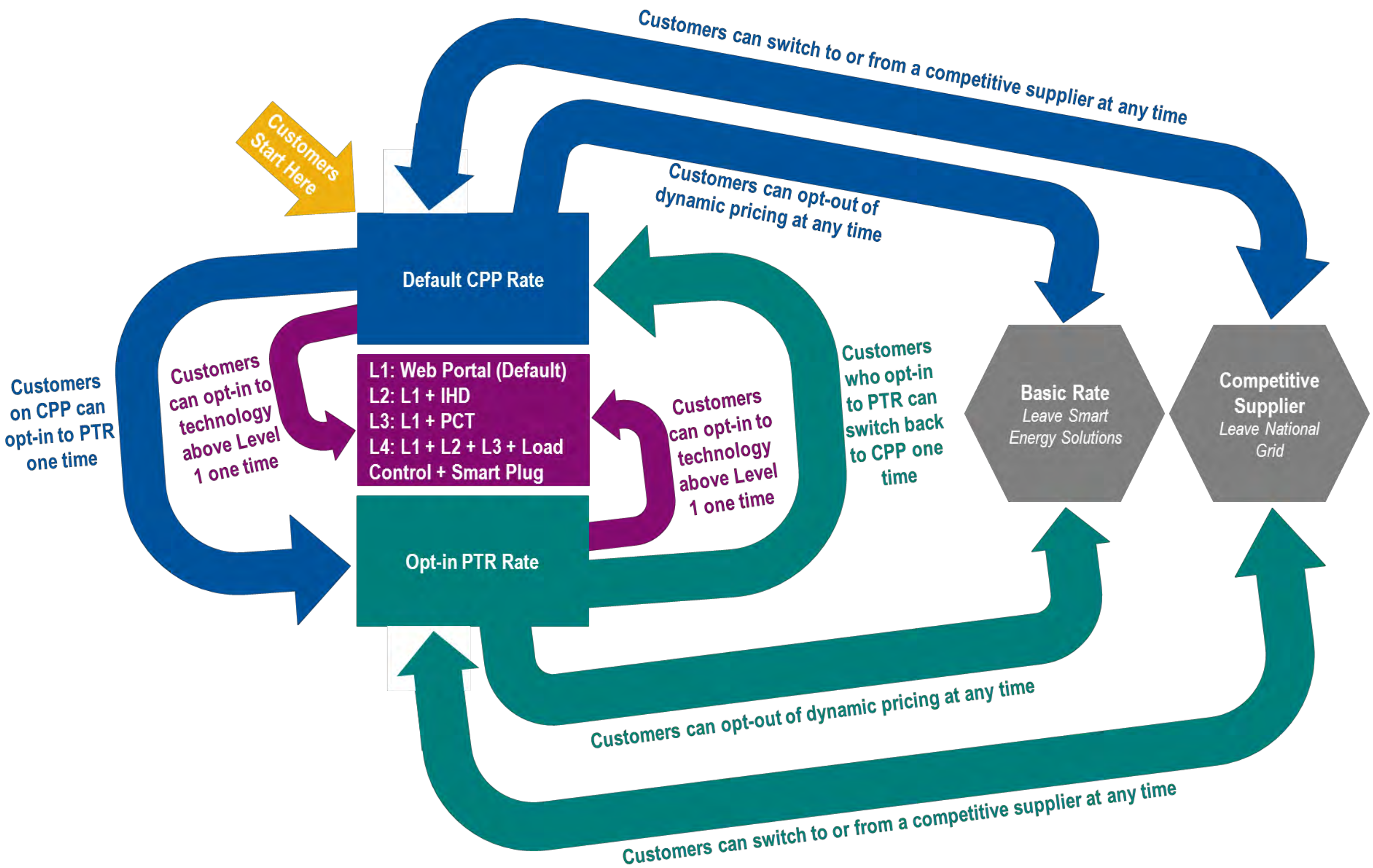
Figure 1-2. Smart Energy Solutions Customer Decision Points



Source: Navigant
Note: L1 = Level 1, L2 = Level 2, L3 = Level 3, L4 = Level 4, IHD = in-home display, PCT = programmable communicating thermostat.

Smart meters and choice of rates. Eligible customers in the Worcester area who accepted a smart meter were enrolled onto the CPP rate by default.[27] Customers have the option to opt into the PTR rate one time during the Pilot; customers who initially opted into the PTR rate can switch back to the CPP rate one time. Customers can also choose to switch back to the Basic Rate, thus opting out of the Pilot, or to switch to and from a competitive supplier, thus leaving or returning to National Grid, at any time.

Technology choice. Customers on the CPP and PTR rates also have a choice of four technology packages, [28] with Level 1 (web portal only) as the default. Technology options become more advanced, offering more electricity usage information and control, from Level 1 to Level 4:

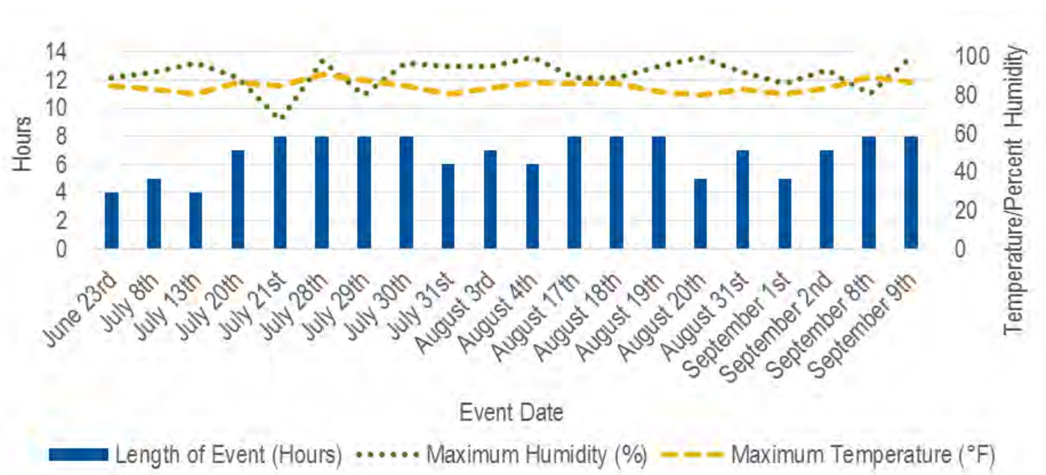
[27] Customers also had the option to decline the smart meter and, therefore, opt out of the Pilot at the onset.
[28] There are eligibility requirements for certain technology packages. For example, in order to be eligible for the Level 2 package with a digital picture frame, customers must have a high-speed broadband Internet connection. To be eligible for Level 3 with a PCT, customers must have central air conditioning. To be eligible for Level 4 with a PCT and a smart plug and/or load control device, customers must have central air conditioning and a broadband high speed Internet connection.

- Level 1: Personal electric use information, via access to a web portal;
- Level 2: Level 1 plus an IHD with energy use and real time cost information and access to this information through the web portal;
- Level 3: Level 1 plus a programmable-controllable thermostat (PCT) and a mobile app to view the PCT schedule; or,
- Level 4: Level 1, Level 2, and Level 3 plus a smart plug and, for some customers, a wired load control device, and additional capability in the mobile app to show load control and smart plug usage.

According to the Pilot design, National Grid can call up to 30 Conservation Days each year, on days with expected high demand. On these days, the price of electricity increased during designated hours, called Peak Event hours. On the CPP rate, customers are incented to conserve electricity, or shift usage to non-Peak Event hours, and thus avoid paying the high electricity prices during Peak Event hours. On the PTR rate, customers received a rebate for any electricity conserved during these hours.

National Grid called 20 Peak Events in the summer of 2015, which customers were informed of one day ahead and the day of depending on their communication preferences. Events ranged from four to eight hours in length and maximum temperature and relative humidity ranged from 80°F to 91°F and 67% to 100%, respectively. The Peak Events averaged 6.75 hours in length and totaled 135 hours over the course of the summer. Nine of the 20 Peak Events in the summer of 2015 ran for eight hours and 17 of the 20 events were part of a back-to-back series, when events occurred multiple days in a row. [29] The length of the event and weather are shown for each Peak Event in Figure 1-3.

Figure 1-3. Summary of Peak Event Length, Temperature, and Humidity



Source: Navigant analysis

1.1.4 Community Partnership and Sustainability Hub

To ensure that the Pilot was a collaborative effort with the community, National Grid partnered with the

[29] This interim report does not include any analysis of trends for Peak Events held on consecutive days, but it would be possible to do such an analysis as part of the final report.

City of Worcester to host the September 2011 Green2Growth Summit (Summit). The Summit provided valuable insights into customers' visions regarding the future of energy delivery in their city. National Grid learned that its customers are increasingly aware of new opportunities to manage their energy consumption and are open to learning more about the potential uses and benefits of smart technology. Based on information gathered through the Summit, the Company revised the Pilot's Outreach & Education plan, implemented in Phases 2-4 of Figure 1-2.

As an additional means of engaging customers, based on information gathered through the Summit, the Company developed a Sustainability Hub in Worcester (Figure 1-4). The Sustainability Hub serves as a model energy center in the community where National Grid provides hands-on education and engagement through a holistic approach, integrating various smart elements into the demonstration home. Over 6,000 people have visited the Sustainability Hub since it opened, and it has been mentioned by many customers as a useful source of information alongside direct mail, Smart Energy Solutions website, and National Grid's Customer Contact Center.[30]

Figure 1-4. National Grid Sustainability Hub

Source: National Grid

1.1.5 Statewide Common Evaluation Framework

Navigant is conducting the evaluation of the Pilot in accordance with the *Common Evaluation Framework*[31] produced by the Massachusetts Smart Grid Collaborative Technical Subcommittee (the Collaborative), a stakeholder group convened by the DPU to develop consistent evaluation themes and techniques across smart grid pilot programs in the state. The evaluation includes quantitative measures of energy and demand impacts, and customer bill impacts as well as qualitative measures for customer engagement, satisfaction, and perceptions through customer surveys, interviews, and focus groups.

1.2 Evaluation Focus and Objectives

Smart Energy Solutions focuses on understanding the customer experience with dynamic rates and

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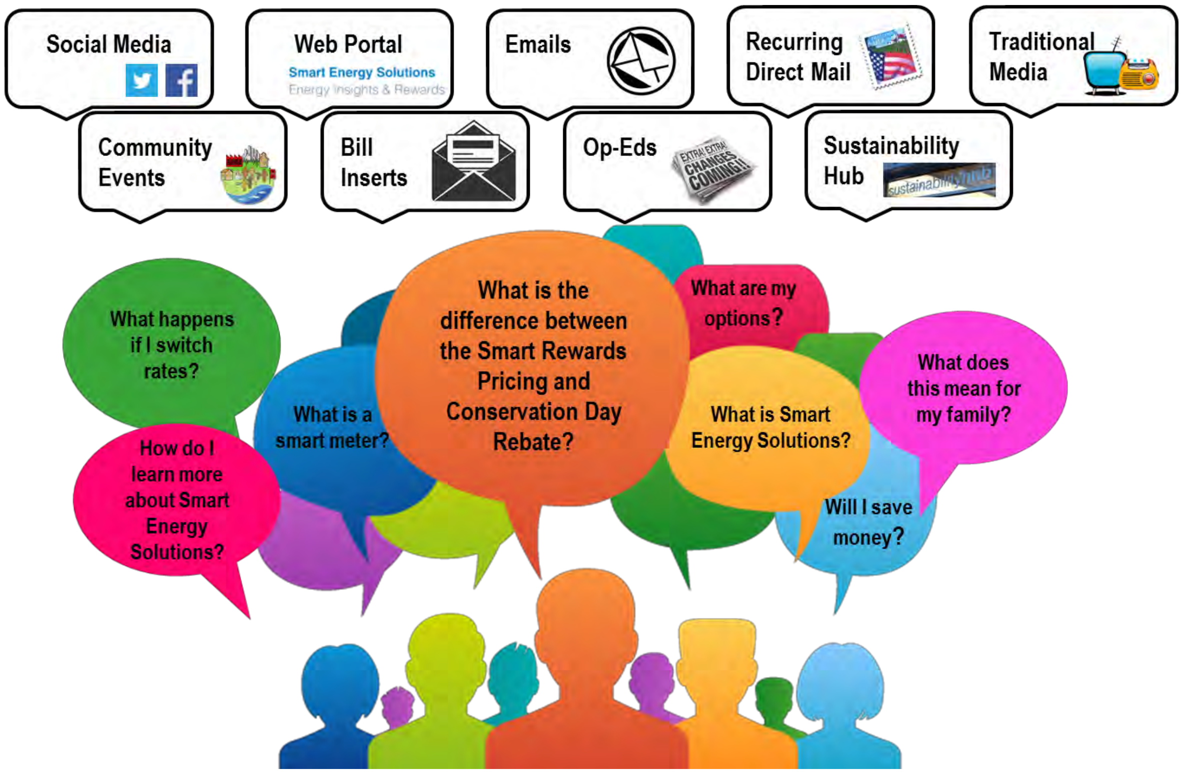
[30] National Grid. *D.P.U. 10-82 – Report on the Sustainability Hub.* September 11, 2015.

[31] Massachusetts Smart Grid Collaborative Technical Subcommittee, *Common Evaluation Framework*, August 10, 2011.

advanced technologies. As shown in Figure 1-5, National Grid has multiple communications channels to provide customers with information about the program and the rates and technologies available. This evaluation focuses on customer awareness of smart meters, rates, and technologies; the choices customers make to adopt and use smart meters, rates, and technologies; and the savings that result from the use of each technology.

Figure 1-5. National Grid's Multiple Program Communication Channels with Customers



Source: Navigant analysis

1.2.1 Impact Evaluation Objectives and Approach

The primary focus of the impact evaluation is on whether the expected energy and demand savings are realized. In particular, the impact evaluation estimated the following:

1. **Peak Event Impacts** which are demand savings (MW) during Peak Events called in the summer of 2015;
2. **Energy Impacts** which are energy savings (MWh) from the Pilot in 2014 and 2015;
3. **Bill Impacts** which are dollar savings on customer bills in 2015; and,
4. **Load Shifting** around Peak Events, including snapback and pre-cooling, and from peak to off-peak times in 2015.

Each of these objectives is explored for customers in different price plans with different levels of enabling technology. Where possible, Navigant also explores these impacts for different demographic subgroups. The impact findings in this interim report are primarily focused on residential customers.

Interim results for Peak Event impacts and load shifting for commercial customers are included in this report; however, energy and bill impacts for commercial customers will be included in the final report after the conclusion of the Pilot. Short descriptions of each methodology are presented here and detailed explanations are included in 0.

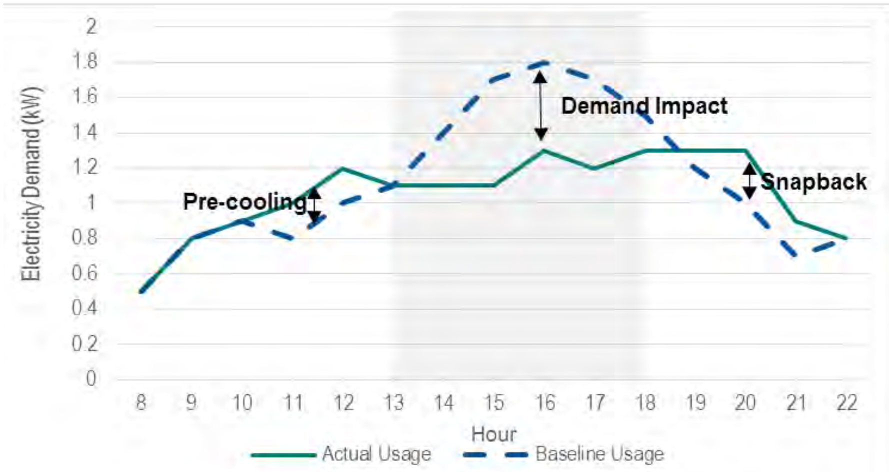
Peak Event Impacts

Navigant estimated demand savings during each Peak Event by regression to predict fitted usage from 8 a.m. to 10 p.m. on each Conservation Day controlling for temperature, humidity, day of the week, month, and a customer fixed effect that controls for all observed and unobserved customer-specific variables that do not change through time.[32] Demand savings were then determined as follows:

1. Fitted usage is the model's prediction of what usage would have been in the absence of a Peak Event, and forms the baseline or "counter-factual" usage.
2. To make fitted usage a more accurate approximation for the actual usage that would have occurred if a Conservation Day was not called by National Grid, actual usage was subtracted from fitted usage for each Conservation Day for the time from 8 a.m. until the start of the Peak Event, creating a "day-of adjustment" parameter. This kind of adjustment is used throughout the country to finalize baseline usage estimates for demand response programs.
3. The day-of adjustment was subtracted from fitted usage for the entire day to create an adjusted fitted baseline. Demand savings were then calculated by subtracting actual usage from the adjusted fitted baseline for each hour of the Peak Event. The possibility of pre-cooling and snapback were also accounted for in this process, which is illustrated in Figure 1-6.

[32] Navigant's method to determine Peak Event savings differs from the method National Grid is using internally. National Grid calculates reduced usage as the difference between metered usage during the Event and "normal" usage, defined as average usage during the ten prior non-holiday non-Conservation Day weekdays after accounting for a day of adjustment to capture weather differences, time of event, pre-cooling, etc. Details of National Grid's method can be found in: D.P.U. No. 1237, Tariff for Basic Service, September 3, 2014. Both of these methods are consistent with MA evaluation protocols.

Figure 1-6. Illustration of Hypothetical Demand Impacts for an Event from 1 p.m. to 6 p.m.

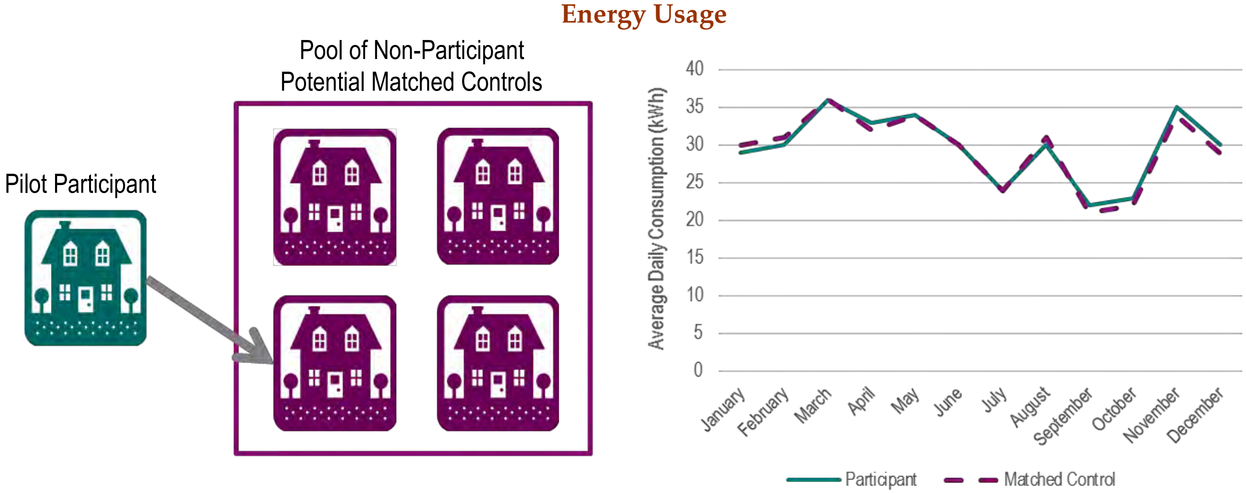


Source: Navigant

Energy Impacts

For energy impacts, the evaluation team selected a group of matched control customers from a large pool of non-participant households that had similar patterns of energy usage in the 12 months before the Pilot started, as illustrated in Figure 1-7, to provide the counter-factual usage if the Smart Energy Solutions participants had not been in the Pilot.[33] Regression analysis of monthly billing data using the participants and matched controls was then used to estimate the annual reduction in energy usage for 2014 and the reduction by month in 2015.

Figure 1-7. Hypothetical Illustration of Choosing Matched Control Households with Similar Pre-Pilot Energy Usage



Source: Navigant

[33] To avoid the issue of control customers moving out, only controls who had billing data through the end of the evaluation period, October 2015, were used.

Bill Impacts

Bill savings for customers on the CPP rate were calculated by subtracting the actual participant bill amount from the counter-factual bill amount if the participant had not joined the program. The counter-factual bill amount is based on the counter-factual usage estimated by the energy impact analysis.

Bill savings for customers on the PTR rate come from the rebate offered for reducing peak consumption during Peak Events on Conservation Days. The rebate was calculated by subtracting the actual electricity consumed during Peak Events from the counter-factual consumption during Peak Events, as calculated by the demand impact analysis, and multiplying the result by the cost of the rebate.

Load Shifting

The regressions to estimate demand savings also included coefficients to capture load shifting attributable to the Pilot in 2015. Navigant captured load shifting on the same day as a Peak Event by estimating pre-cooling and snapback. Load shifting from weekdays, when TOU rates are in effect for CPP customers, to weekends, when customers are charged a flat rate, was also estimated. Navigant also examined whether the Pilot caused non-event peak impacts where customers shift loads from on-peak to off-peak times on days when a Peak Event was not called. Load shifting to the weekend and non-event peak impacts are expected for TOU customers, but not necessarily for PTR customers since these customers are not charged a higher peak time rate which would incent them to shift usage to off-peak times or weekends.

1.2.2 Customer Experience Evaluation Objectives and Approach

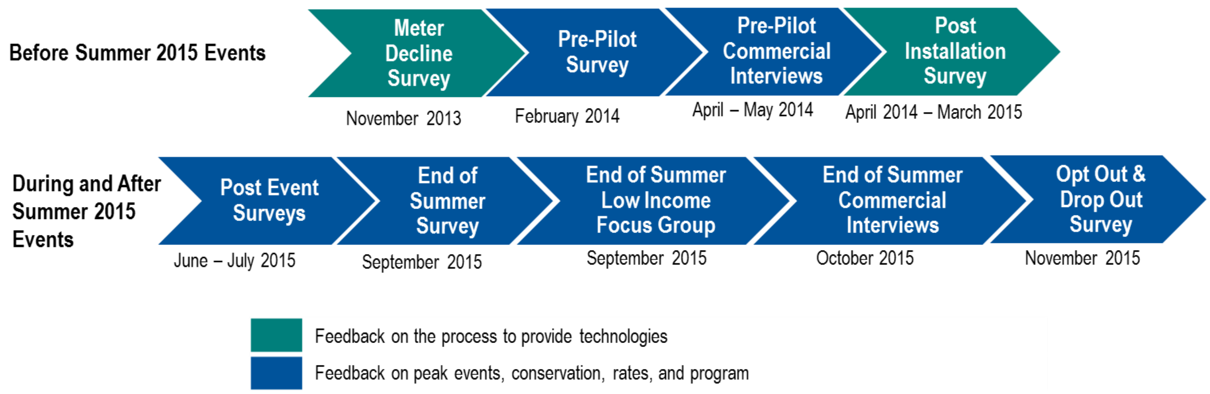
The primary focus of the customer experience evaluation is on customer engagement and experience. The Smart Energy Solutions evaluation plan was developed by an independent consultant in accord with the *Common Evaluation Framework*[34] produced by the Collaborative, a stakeholder group convened by the DPU to develop consistent evaluation themes and techniques across the three smart grid pilot programs in Massachusetts. The Collaborative recognized that each program had some unique characteristics, particularly the National Grid opt-out program design, so the framework was made broad enough to accommodate different program designs but still provide comparable data from each. The Collaborative included National Grid and other participating investor-owned utilities, the Low-income Energy Action Network (LEAN), the Massachusetts Attorney General, and the Energy Efficiency Advisory Council (EEAC) chief evaluation consultant. As part of the *Common Evaluation Framework*, the Collaborative developed a base set of required surveys, reporting requirements, protocols, and reporting tables.

The Collaborative raised a number of key research questions applicable to customer experience in the Pilot. These research questions focused on marketing and education. As Smart Energy Solutions is an opt-out program, wherein customers could opt out of the smart meter and opt out of the default time-based rate, the evaluation team has applied the *Common Evaluation Framework* marketing questions that apply to meter installations, rate selection, and adoption of the program's technology offerings. Additionally, the framework applies to marketing means and messages used for recruiting and their effects, results of multiple recruiting waves and techniques, how participants learned of the program,

[34] D.P.U. 10-82, Massachusetts Smart Grid Collaborative Technical Subcommittee, *Common Evaluation Framework*, August 10, 2011.

and their reasons for participation or nonparticipation. To address these topics, extensive surveying has been conducted and will continue through the final year of the Pilot (Figure 1-8).[35] It also includes convening focus groups for low-income participants and interviewing commercial participants to gain additional insights to supplement the pre-pilot survey and end of summer survey.

Figure 1-8. Smart Energy Solutions Surveys, Interviews, and Focus Groups Implemented as of November 2015



Source: Navigant analysis

Below is a description of the surveys depicted in Figure 1-8 and the customer experience they sought to capture.

- **Meter decline survey:** Determine why customers declined a smart meter and whether they were aware that not installing one would preclude them from participating in Smart Energy Solutions.
- **Pre-pilot survey:** Characterize participant demographics, appliance saturations, and living conditions that might impact participants' ability to adjust their energy usage during peak and Peak Event hours, such as household members who require air conditioning or special medical equipment that must operate during Peak Events.
- **Pre-pilot commercial interviews:** Anecdotally characterize commercial customer understanding of the program, rates, and technologies, as well as their ability to adjust their energy usage during Peak Events through four interviews.
- **Post installation survey:** Evaluate the experiences of customers who signed up for technology Level 2, 3, or 4 (refer to Section 2.2 for more detail on the technology levels), which provided no-cost in-home installation of an IHD, smart thermostat, and smart plug and load control device, respectively. This survey asked about the promptness and quality of the installation, problems encountered, the conduct of installers, and related issues.
- **Post event surveys:** These surveys were conducted within a one to ten day period after two of the 20 Peak Events called during the summer of 2015 to learn about the methods and efficacy of

[35] The surveys were designed by Navigant and implemented by Bellomy Research, a professional survey company, at several key points in the program. All surveys, excepting the pre-pilot survey, were conducted online, using email to invite participants to survey links. Online responses were supplemented by telephone contacts, using both inbound (participants called in) and outbound techniques, to ensure a broader sample of survey participants.

National Grid's pre-event information, energy-related actions taken by the customer before and during the event, comfort levels during the event, satisfaction with program technology, and overall satisfaction with the program.

- **End of summer survey:** After the last Peak Event called during the summer of 2015, this survey aimed to understand customer experiences with the program over the course of the summer, including how they coped with multi-day events, events lasting several hours, changes in household patterns resulting from the events, and how well technology performed and how useful it was. The survey also looked for trends or changes in these areas over the course of the summer.
- **End of summer low-income focus group:** Navigant hosted two low-income focus groups – one for L1 customers and one for L2 customers, to gauge their understanding of the program and rates, experiences with the program over the course of the summer, technology use (for L2 customers only), and recommendations to improve the program.
- **End of summer commercial interviews:** Through four interviews, anecdotally characterize commercial customer understanding of the program, rates, and technologies, as well as their experiences with the program over the course of the summer, as well as recommendations to improve the program.
- **Opt-out and drop out surveys:** Ascertain customer perceptions and motivations for moving from one rate to the other and/or dropping out of the program altogether. To date, there have been few participants taking either of those actions. Customers who left for competitive suppliers, and therefore are no longer National Grid supply customers, were not surveyed.

1.3 Interim Evaluation Report Structure

The remainder of this report is organized in the following chapters:

- **Chapter 2: Smart Energy Solutions Program Design**, summarizes rate design, technology choice, as well as program marketing, participation and segmentation;
- **Chapter 3: Impact Assessment**, summarizes the results of the peak event impact analysis, energy impact analysis, bill savings, and load shifting;
- **Chapter 4: Customer Experience Assessment**, summarizes participation drivers, participant awareness, engagement, and satisfaction;
- **Chapter 5: Conclusions and Recommendations**, draws everything together to provide key takeaways, as well as lessons learned and potential changes for 2016;
- **Appendices A through D,** provides detailed methodologies and results; and
- **Appendices E, F, and G** are provided as a separate document, and show graphs of event impacts by hour for residential customers, graphs of event impacts by hour for commercial customers, and graphs of event impacts for residential customers by demographic subgroup, respectively.

2. Smart Energy Solutions Program Design

Smart Energy Solutions offers customers a choice between two new dynamic rates and four technology packages that provided electricity usage information and control. The technology packages offer varying levels of information and control via a web portal, mobile app, IHD, PCT, smart plug, and direct load control device. Starting in the spring of 2014, customers began selecting their rate plan and technology package. To support customer choice, the Pilot allows customer to change rates one time and technology package enrollment any time.

The three key elements of this chapter are:

1. **Rate Design –** the dynamic rate that applies to pilot participants, depending on whether they accept the default CPP rate or opt into the PTR rate.
2. **Technology Choice –** the set of in-home and communications technologies selected by participants and provided by National Grid to provide customers with pricing and usage information, conservation tips, and the ability to better control their energy consumption.
3. **Program Marketing, Participation, and Segmentation –** the self-selection of customers into the various rate and technology categories, the strategy used to recruit customers into the different rates and technologies, and the demographic breakdown of the eligible customer population.

2.1 Rate Design

Smart Energy Solutions offers two dynamic rate designs: 1) a TOU rate combined with CPP and 2) a PTR rate. Participating customers have the opportunity to save money on both rates, but CPP customers can potentially incur higher bills if they do not reduce consumption during higher priced periods. These rates went live at beginning of 2015 and will remain active for the duration of the Pilot, through December 2016. As discussed in Section 1.1, customers may leave the Pilot at any point by opting out of the rates or switching to a competitive electricity supplier, and they may switch between the two Pilot rates once.[36]

According to the Pilot design, National Grid can call up to 30 high demand days per year, called Conservation Days (Figure 2-1). Customers choose the frequency and method of Conservation Day notification. They may be notified of Conservation Days one day ahead and on the day of. The price of electricity increases during designated hours, called Peak Event hours, on these days. The length of the Peak Event can vary across the Conservation Days. On the CPP rate, customers pay reduced rates outside of Peak Event hours and can conserve electricity to avoid paying high electricity prices during Peak Events. On the PTR rate, customers receive a rebate for conserving electricity during these hours.

[36] Customers who left National Grid for a competitive supplier received a letter from National Grid informing them that they could no longer participate in Smart Energy Solutions because they were no longer a National Grid customer. Customers could of course return to National Grid, and if they did so they received a letter informing them that they would be re-enrolled in the Pilot on the default CPP rate.

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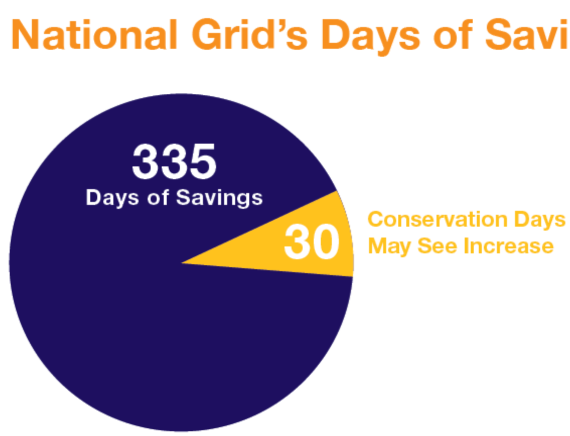
Figure 2-1. Smart Energy Solutions Conservation Days

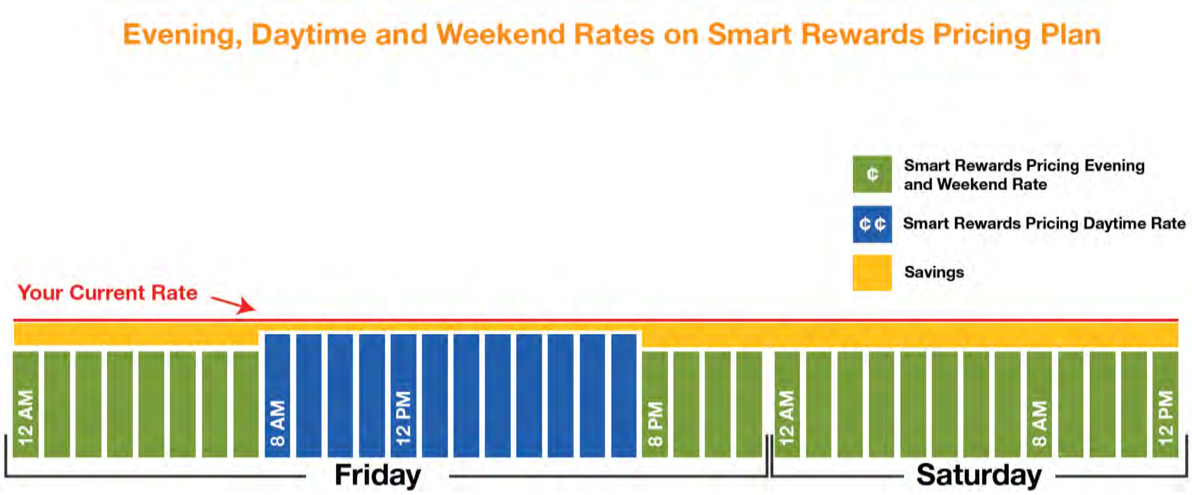


Source: National Grid

2.1.1 Critical Peak Pricing

The Pilot CPP rate combines a daytime TOU rate and a critical peak rate during Peak Event hours. The Pilot CPP rate offers a base TOU structure with lower daytime rates and even lower night, holiday, and weekend rates. Customers are encouraged to shift energy-intensive weekday activities to any time before 8:00 a.m., after 8:00 p.m., or to weekends. As shown in Figure 2-2, customers pay a lower rate than the current Basic Rate every day of the year. The TOU Evening and Weekend rate is in effect all day on weekends and holidays, and every weekday from 8:00 p.m. to 8:00 a.m. From 8:00 a.m. to 8:00 p.m. on weekdays, customers pay a slightly higher rate, called the Daytime Rate.

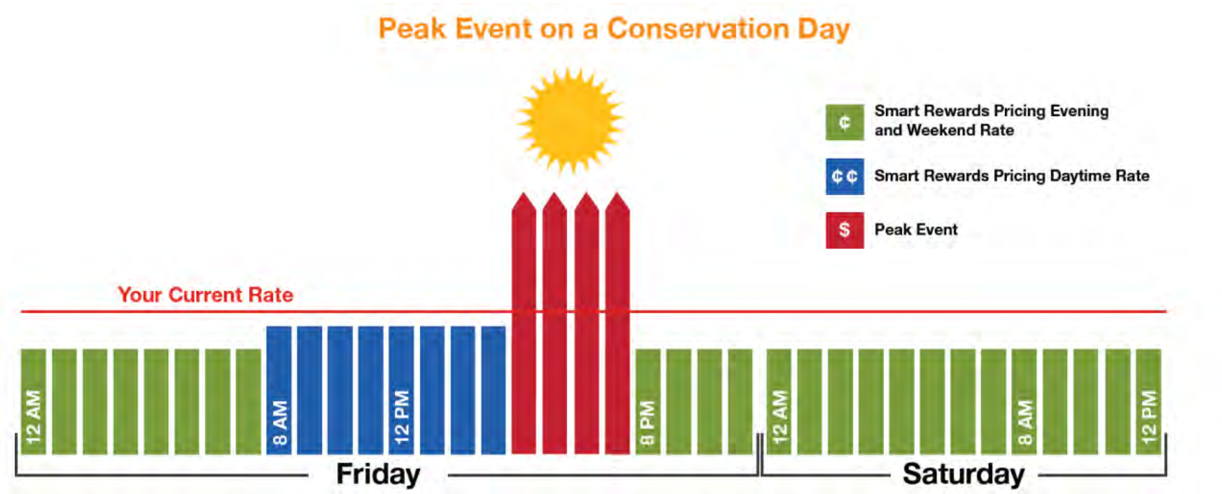
Figure 2-2. TOU for Evening, Daytime, and Weekend Rates



Source: National Grid
Note: "Your Current Rate" refers to the Basic Rate customers were on before the start of Smart Energy Solutions.

In addition to the TOU rate in effect every day, National Grid can call Conservation Days where a higher rate is charged during certain Peak Event hours. An example of these hours and the associated CPP prices are shown in red in Figure 2-3. These customers enjoy bill protection if they stay on the CPP rate for at least 12 consecutive months; this means that if at the end of the year their bills were higher than they would have been on the Basic Rate, the customer receives a credit in the amount of the difference.

Figure 2-3. Critical Peak Pricing During a Conservation Day Peak Event



Source: National Grid
Note: “Your Current Rate” refers to the Basic Rate customers were on before the start of Smart Energy Solutions.

2.1.2 Peak Time Rebate

The PTR rate allows customers to stay on their current service rate, rather than switching to the CPP rate, and earn a rebate when they reduce consumption below their normal use during Peak Event hours on Conservation Days. The rebate is given to customers in the form of a monthly credit applied at the end of each billing cycle, which is the cumulative rebate for all of the Peak Events that occurred during that billing cycle.

The rebate is based on a per kWh credit that applies to any reduced energy usage during Peak Event hours. National Grid calculates reduced usage as the difference between metered usage during the Event and “normal” usage, defined as average usage during the ten prior non-holiday non-Conservation Day weekdays after accounting for a day of adjustment to capture weather differences, time of event, pre-cooling, etc.[37] Customers are not penalized for usage which is higher than normal.

2.2 Technology Choice

The core components of National Grid’s smart technology end-to-end solution are advanced metering infrastructure (AMI), in-home energy management devices, two-way communications systems, cloud computing, National Grid system modifications and data processing, and distribution grid communication and standards. These components directly support the customer-facing portion of Smart Energy Solutions. National Grid offers Smart Energy Solutions customers an assortment of in-home energy management tools and technologies for free. Customers can sign up on the National Grid website, by mail, by calling National Grid, in person at the Sustainability Hub, or at any of the

[37] D.P.U. No. 1237, Tariff for Basic Service, September 3, 2014.

community events that National Grid attends with a Smart Energy Solutions information booth. As discussed in Section 1.1, National Grid is still allowing customers to select from these technologies in order to maximize customer choice during the Pilot, as well as providing opportunities for new customers who move into the Pilot area to sign up.

The technologies provided by National Grid include both a foundational infrastructure and several optional in-home devices:

1. **Foundational Infrastructure -** consists of smart meters and access to a web portal with electricity usage information via desktop computer or mobile device. This foundational infrastructure is provided to all participants, even those passive participants who accepted a smart meter but otherwise did not actively participate in the pilot.
2. **In-Home Devices –** consists of any of three additional levels of devices including a communicating digital picture frame (Level 2), a Wi-Fi-enabled smart thermostat (Level 3), and smart plugs and load control devices (Level 4).

2.2.1 Foundational Infrastructure

To enable Smart Energy Solutions, National Grid installed two-way AMI communications and smart meters, developed cloud computing capabilities, and, on an ongoing basis, offers customers a variety of in-home devices (further detailed in Section 2.2.2). AMI communications consist of a meter headend, WiMAX, and a network manager, which is integrated with the Company's software as a service (SaaS) systems. As a result, National Grid can provide real-time interconnection for customers to control their smart thermostats remotely and monitor their electricity usage from any online or mobile device, anytime and anywhere. The two-way communication infrastructure is also being used to enable the Pilot's distribution automation equipment, which supports reliability and efficiency gains and can facilitate distributed energy resources and electric vehicle charging station integration.

National Grid offers four technology packages, or levels, for customers to choose from. Pilot participants were automatically enrolled in Level 1 and had the option to opt into one of the three higher technology levels with in-home devices. Customers who opted in to a higher level still had access to Level 1.

In Level 1, illustrated in Figure 2-4, customers have access to their electricity usage information via the Smart Energy Solutions web portal that is accessible by desktop and mobile devices, which provides personalized online graphical electric usage information, comparisons to friends and neighbors, and the opportunity to participate in contests to win prizes for conserving electricity.[38]

[38] Logging into this web portal at least once distinguishes active customers from passive customers in Level 1.

Figure 2-4. Level 1: Web Portal (Accessible by Desktop and Mobile Device)

Source: National Grid

2.2.2 In-Home Devices

Figure 2-5 shows Level 2, which provides a digital picture frame—also called an IHD—that provides real-time energy usage and cost information as well as conservation tips from National Grid.

Figure 2-5. Level 2: Web Portal, Mobile App, and Digital Picture Frame

Source: National Grid

Interested customers with central air conditioning (CAC) qualify for Level 3, which includes a smart thermostat, also called a PCT, which can be remotely controlled by National Grid (Figure 2-6). The PCT might allow these customers to "set it and forget it" on Conservation Days, ensuring their participation in a Peak Event by conserving while maintaining comfort.

Figure 2-6. Level 3: Web Portal, Mobile App, and Smart Thermostat

Source: National Grid

Lastly, customers can opt to install all of the aforementioned devices along with smart plugs and load control devices in their home through Level 4 (Figure 2-7). The smart plugs allow customers to remotely adjust any appliance plugged into them, such as a window unit air conditioner. The load control devices, installed for only some customers in Level 4, work with devices such as water heaters and/or pool pumps.

Figure 2-7. Level 4: Web Portal, Mobile App, Digital Picture Frame, Smart Thermostat, and Load Control Devices

Source: National Grid

2.3 Program Marketing, Participation, and Segmentation

Before and throughout the Pilot, National Grid has implemented a "listen, test, learn" approach that is based on "on the ground" conversations and reflections on the Pilot. This feedback, combined with learning, leads to continual improvement. National Grid conducted extensive program marketing in the lead up to initiating meter installations, the first phase of the program. These activities included convening a public summit to discuss the proposed program, development of brochures explaining the program, and establishment of the staffed, physical Sustainability Hub within the Pilot program area. National Grid also partnered with local schools. Clark University offered annual internships, and Worcester Polytechnic Institute created a student Sustainability Ambassador program. Ambassadors host Sustainability Hub tours and attend outreach events to educate customers throughout the community. Presenting the personal side of the Company is part of "listen, test, learn", and is the inspiration for sending National Grid employees and Ambassadors into the community. It is also the basis for hosting visitors at the Sustainability Hub for the dual purpose of educating customers and listening to their concerns and feedback.

As the program progressed, additional materials were developed and disseminated, including descriptions of the technology levels, rates, and events; welcome kits; and so on. National Grid conducted extensive recruiting campaigns for the program technology options, including a variety of incentives and promotions but found participant response to be somewhat less than expected and much slower, requiring an extended signup period that extended through 2015.[39]

2.3.1 Technology and Rate Enrollment

Table 2-1 shows the distribution of customers in the various technology levels as of February 8, 2016. At that time, approximately 92% of Pilot participants were subscribed to Level 1, followed by 5% of participants in Level 2, 2% of participants in Level 4, and only 0.4% of participants in Level 3. Approximately 90% stayed on the default CPP rate.

Table 2-1. Customer Enrollment by Technology Level and Price Plan (as of February 8, 2016)

Level	Price Plan	Number of Residential Customers	Number of Commercial Customers
1 (AMI meter + web portal + mobile app)	CPP - Active	1,045	19
	CPP - Passive	7,930	495
	PTR - Active	72	1
	PTR - Passive	359	16
2 (Level 1 + digital picture frame)	CPP	599	1
	PTR	33	0
3 (Level 1 + smart thermostat)	CPP	26	0
	PTR	2	0
4 (Level 1 + Level 2 + Level 3 + load control devices)	CPP	234	0
	PTR	15	2
Total		**10,315**	**534**

Source: Navigant analysis

[39] Although active promotion has ended, Pilot customers will be able to enroll in the technology packages through the end of the Pilot if they wish to do so and meet the eligibility requirements.

National Grid's customers adopted technologies at comparable rates to similar Pilots. Note that National Grid's Pilot design is unique and challenging to compare to other Pilots for many reasons. National Grid offered its customers the choice between two different rates, with the flexibility to switch rates one time after the Pilot began. The Company also offered customers several technology packages, which customers continue to sign up for. In contrast, NSTAR's opt-in 2012-2013 time-based rate pilot offered customers specific rate and technology combinations – standard rate with an IHD, PTR with an IHD and PCT, CPP with IHD and PCT, and CPP with IHD. National Grid and NSTAR customers opted for the IHD at similar rates, 7% both utilities. [40,41] In the future, National Grid may survey Level 1 customers to ask why they did not sign up for a higher technology package. At this time, several reasons have been speculated – they might be too busy to sign up, they might be unaware of the technology, or they might have signed up but not qualified due to technical issues. Fifteen percent of customers who ordered a technology package had to cancel it due to technical issues at their home. As shown in Figure 2-8, as of May 7, 2015,[42] 13 of 39 customers had to cancel their technology installation because it was too far from the meter (meter communication issues). These reasons are categorized in 6 areas:

1. "Declined technology" are reasons why customers changed their mind or did not want any technology on the spot. In one case, the landlord had ordered the technology but did not live at the home and the tenant declined the technology;
2. "Meter communication issues" are due to technology not receiving a signal from the meter, because it was too far away from where the customer wants to install the technology;
3. "Customer no show" are instances of the technician showing up to install the technology but the customer is not home and is unresponsive to phone calls;
4. "Incompatible HVAC" are instances of furnace or central air conditioning that are incompatible with the PCT, or instances where customers do not have central air conditioning in order to use the PCT;
5. "Customer requested reschedule" are due to emergencies, or customers needing to install Wi-Fi in order to connect the technologies;
6. "Non-viable recruit" are customers who wanted the technology but could not install it for one reason or another. These reasons included inability to connect technology to the internet because they didn't have it or their equipment was incompatible, inability to schedule an appointment even after the Company made multiple attempts to reschedule.

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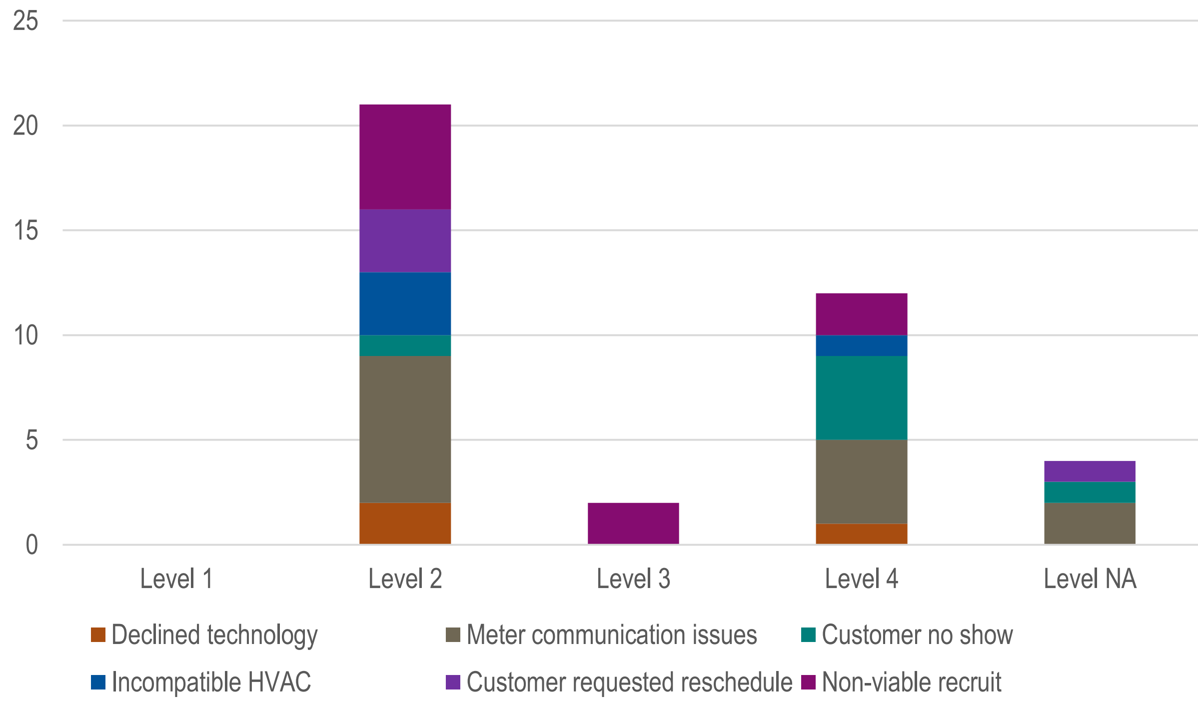
[40] NSTAR pilot customers opted-in to the pilot voluntarily, and were randomly assigned to one of the rate and technology combinations to the extent possible, given that they needed to have central air conditioning to use the PCT. All customers received an IHD when they decided to participate in the Pilot, so the IHD enrollment rate is determined to be the same as the Pilot enrollment rate of 7%. All National Grid customers who signed up for technology packages 2 and 4 received an IHD. As of September 15, 2015 the combined enrollment rate for these two technology levels was 7%.

[41] Navigant. *NSTAR Smart Grid Pilot Final Technical Report: AMR Based Dynamic Pricing*. DE-OE0000292. Prepared for U.S. Department of Energy on behalf of NSTAR Gas and Electric Corporation. August 2014.

[42] National Grid summarized reasons for customer cancelation in an information request to the Massachusetts Attorney General (Information Request AG-1-7) in D.P.U. 10-82.

Figure 2-8. Reasons for Customer Cancelation of Technology Installation by Technology Level as of May 7, 2015[43]



Source: Navigant analysis

2.3.2 Marketing and Recruitment

In an effort to attract as many customers as possible into the Pilot and the higher technology levels, National Grid used the following recruitment strategy:

- Attended community events (including farmers markets, community sporting events, concert series on town commons, and Worcester Public Library events) around Worcester to promote, discuss, and enroll customers in the technology levels; and,
- Held a continued stream of events and educational sessions at the Sustainability Hub to educate about and showcase the various technologies.
- Sent customers rate enrollment packages, technology enrollment packages, and newsletters with Pilot updates.
- Conducted a door-to-door campaign in Fall 2014 to advertise the Pilot and enroll customers;
- Conducted a practice Peak Event in May 2015 to test customer communications, meter signals and event loading, as well as to market the rates and technologies to customers;
- Allowed customers to enroll in technology Levels 2, 3, and 4 through 2015, such that enrollment increased during the summer and right after Conservation Days; and,
- Included a technology enrollment form in the monthly paper report mailed to customers in

[43] Level NA = customer's requested technology level not recorded.

August 2015 and included consistent reminders about the available technologies in other communications.

After the Pilot began, National Grid continued its marketing campaign in order to keep customers engaged and informed about their technology and rate options. National Grid used op-eds in the Worcester Telegram & Gazette, direct email newsletters, conservation tips to customers, bill inserts, and mailed materials in its marketing efforts[44]. Figure 2-9 shows an example of a Smart Energy Solutions bill insert sent before the summer 2015 season began, which is illustrative of the materials sent by email as well. Over the course of the summer, National Grid continued to send these tips and newsletters and held a Smart Energy Solutions event in August at the Worcester Public Library to answer customer questions about the program.

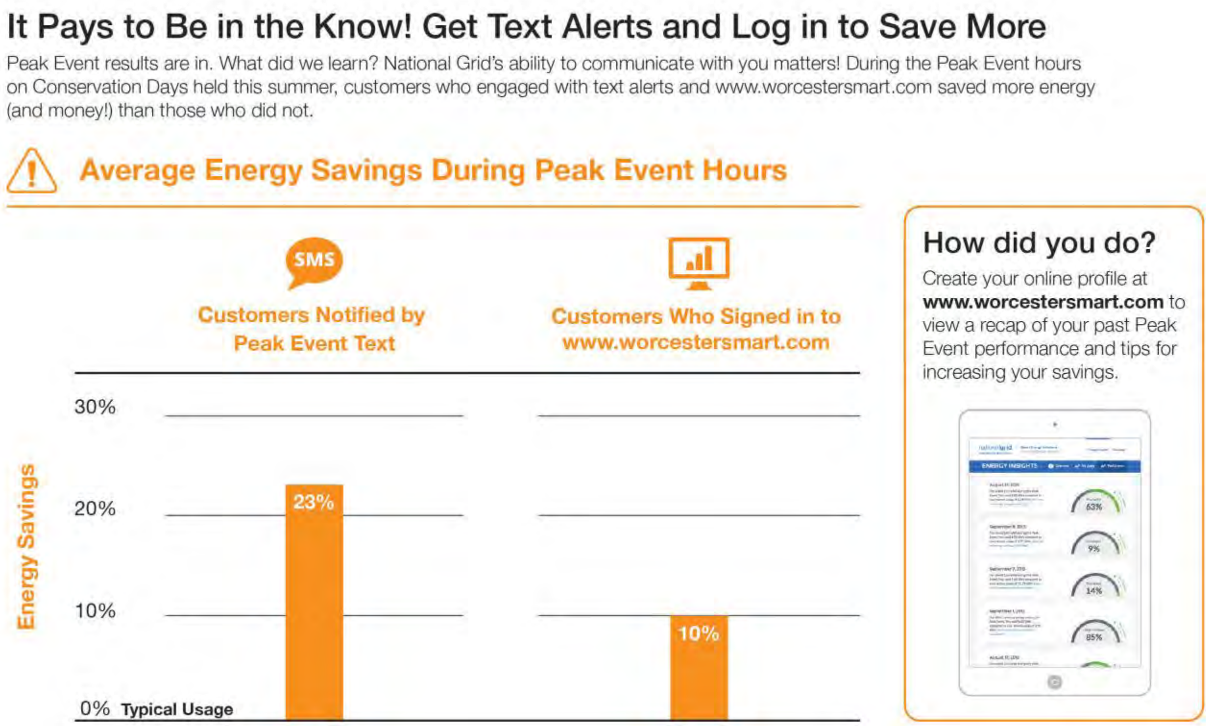
Figure 2-9. Excerpt from Smart Energy Solutions Bill Insert Sent in May 2015

Source: National Grid

After receiving customer feedback via surveys, low-income customer focus groups, and commercial customer interviews, National Grid responded to customers' need for additional information, specifically about event notifications and potential savings. Figure 2-10 is an illustrative example from one of National Grid's mailers to customers in October 2015, which reminds customers that they can be notified of Peak Events via several channels, not just phone calls. This example also shows anticipated savings achieved by customers who were notified by these alternative channels. This mailer echoes materials sent by National Grid throughout the summer to customers reminding them that they can choose to be notified about events via multiple communication channels.

[44] Though not part of National Grid's marketing effort, local media channels covered the Pilot, providing publicity and insights for customers. Refer to Appendix D for examples of media coverage.

Figure 2-10. Excerpt from Smart Energy Solutions Mailer Sent in October 2015



Source: National Grid

2.3.3 Customer Segmentation

National Grid defined eight overlapping customer segmentation subgroups based on demographic characteristics (demographic subgroups) by which the Pilot results can be segmented. The demographic data was purchased by National Grid from InfoGroup and Core Logic and matched to Pilot accounts by combinations of address, phone number, and/or customer name. The subgroups and their definitions are provided in Table 2-2.[45]

[45] In 2012, National Grid revised customer segment definitions. The Pilot area has fewer low-income customers than expected, and it was assumed that only 20% of customers would remain on the CPP rate. As a result, the number of low-income customers with medium usage decreased in the estimated customer segment. Reference: National Grid. D.P.U. 11-129: Response to Record Request AG-1. May 11, 2012.

Table 2-2. Demographic Subgroups

Demographic Subgroup	Definition
Low-income	Customers on R2 rate
High Income	Customers on R1 rate with income greater than $100,000 based on demographic data
Low Use	Customers on R1 rate with low energy use
Medium Use	Customers on R1 rate with medium energy use
High Use	Customers on R1 rate with high energy use
Seniors	Customers 65 and older
Small Home	Customers with homes 1,000 sq. ft. or less
Large Home	Customers with homes over 2,500 sq. ft.

Source: National Grid

Table 2-3 shows the demographic subgroup distribution in the Pilot as of September 15, 2015.[46]

Table 2-3. Demographic Subgroup Distribution (as of September 15, 2015)

Pilot Participation By Treatment		All Residential Accounts	Non-Low-income Standard Residential Rate			Low-income Residential Rate (R-2)	Additional Population Segments			
			Low Use	Medium Use	High Use		High Income	Seniors	Small Home	Large Home
Level 1	CPP	9,099	2,319	4,489	959	1,141	1,473	2,022	3,798	178
	PTR	431	125	192	38	72	50	93	145	3
Level 2	CPP	558	69	335	74	76	140	97	182	11
	PTR	31	4	15	7	5	4	6	11	1
Level 3	CPP	26	4	19	2	1	12	7	9	1
	PTR	2	0	2	0	0	1	1	1	0
Level 4	CPP	233	22	152	44	13	89	36	67	20
	PTR	16	1	9	3	3	4	0	4	0
Total		**10,396**	**2,544**	**5,213**	**1,127**	**1,311**	**1,773**	**2,262**	**4,217**	**214**

Source: Navigant analysis

As previously mentioned, National Grid anticipated 80% of customers would opt out of CPP and into PTR, but the data reveal that only 5% of customers had done so as of September 15, 2015.

[46] September 15, 2015 was chosen as these were the customers available to be surveyed for the end of summer survey, the last major evaluation item included in this interim evaluation. This breakdown includes all active, residential customers who did not a) switch to a competitive supplier, or b) drop out of the pilot.

3. Impact Assessment

As laid out in National Grid's 2011 Evaluation Plan and in accordance with the *Common Evaluation Framework*, Navigant conducted impact analyses on four main topics:

1. **Peak Event Impacts**, which are demand savings (MW) during Peak Events called in the summer of 2015;
2. **Energy Impacts**, which are energy savings (MWh) from the Pilot in 2014 and 2015;
3. **Bill Impacts**, which are dollar savings on customer bills in 2015; and
4. **Load Shifting** around Peak Events, including snapback and pre-cooling, and from peak to off-peak times in 2015.[47]

This interim report covers impacts for the period from the start of the Pilot through the end of September 2015. National Grid anticipates calling Peak Events during the winter of 2015 and during the summer of 2016; impacts for this period will be covered in the final evaluation report. Impacts for each of the four analyses listed above were calculated for customer groups defined by technology level and price plan.[48] Where possible, Navigant also estimated impacts by demographic subgroup. The impact findings in this interim report are primarily focused on residential customers. Interim results for Peak Event impacts and load shifting for commercial customers are included in this report; however, energy and bill impacts for commercial customers will be included in the final report. Detailed descriptions of the impact methodologies for each of the four topics above are included in 0.

The Pilot was developed to meet the GCA goal of achieving peak and average load reductions of 5% or greater for those customers who actively participate in the Pilot.[49] In Navigant's analysis, peak load reduction is examined in the demand analysis and average load reduction in the energy analysis. From January to September 2015, for residential customers the Pilot achieved a 14% peak load reduction for active participants, and a 4% average load reduction for active CPP participants.[50] The 2015 demand savings may be slightly underestimated because hourly data from 2014 was used to estimate the baseline. In 2014, customers had access to usage information from the Pilot, so they may have already been conserving as they were more aware of their electricity usage.[51] Navigant did find small energy savings from the Pilot in 2014. For the energy savings analysis, Navigant used 2013 as the pre-program year which was prior to any Pilot activities.

Table 3-1 shows total and percentage demand and energy savings and total bill savings for residential

[47] Although load shifting impacts are not specifically identified in the *Common Evaluation Framework*, the team that developed National Grid's impact evaluation plan added this component to the evaluation scope of work.
[48] Impacts were not calculated in any of the analyses for Level 3 PTR customers as this group had only 1 customer.
[49] As discussed previously, in the context of this opt-out Pilot, Navigant defines active customers as anyone who opted into one of the three higher technology packages (Levels 2-4) and anyone on the default technology package (Level 1) who logged into the web portal at least once. Customers in Level 1 who never logged into the web portal are considered passive participants in the Pilot.
[50] Energy savings or average load reductions were neither expected nor found for PTR customers as these customers are not on a TOU rate and thus do not have a monetary incentive to save energy outside of Peak Events.
[51] Hourly data was not available prior to April 2014 when smart meters were installed.

customers in the Pilot. Total savings are the sum of savings across all residential customers in the program. Percentage savings are the weighted average of savings across the residential technology/price plan groups.

Table 3-1. Total and Percentage Savings for Residential Customers

Impact Category	Total Savings	Percentage Savings – Active Customers (n=2,524)	Percentage Savings – All Customers (n=10,882)
Peak Event Savings – Average*	0.55 MW	16.8%	3.9%
Peak Event Savings – Maximum**	1.59 MW	29.0%	12.3%
Energy Savings in 2015***	2,300 MWh	4.1%	0.2%
Bill Savings in 2015****	$1,250,000	-	-

Source: Navigant analysis

* This is the total demand savings among all participants, averaged across all 20 events in the summer of 2015.
** This is the total demand savings for 6/23/2015, which was the Conservation Day with the highest savings.
*** This includes energy savings for the 10,398 CPP customers only, as energy savings were neither expected nor found for PTR customers.
**** This includes total bill savings for CPP customers and rebates for PTR customers.

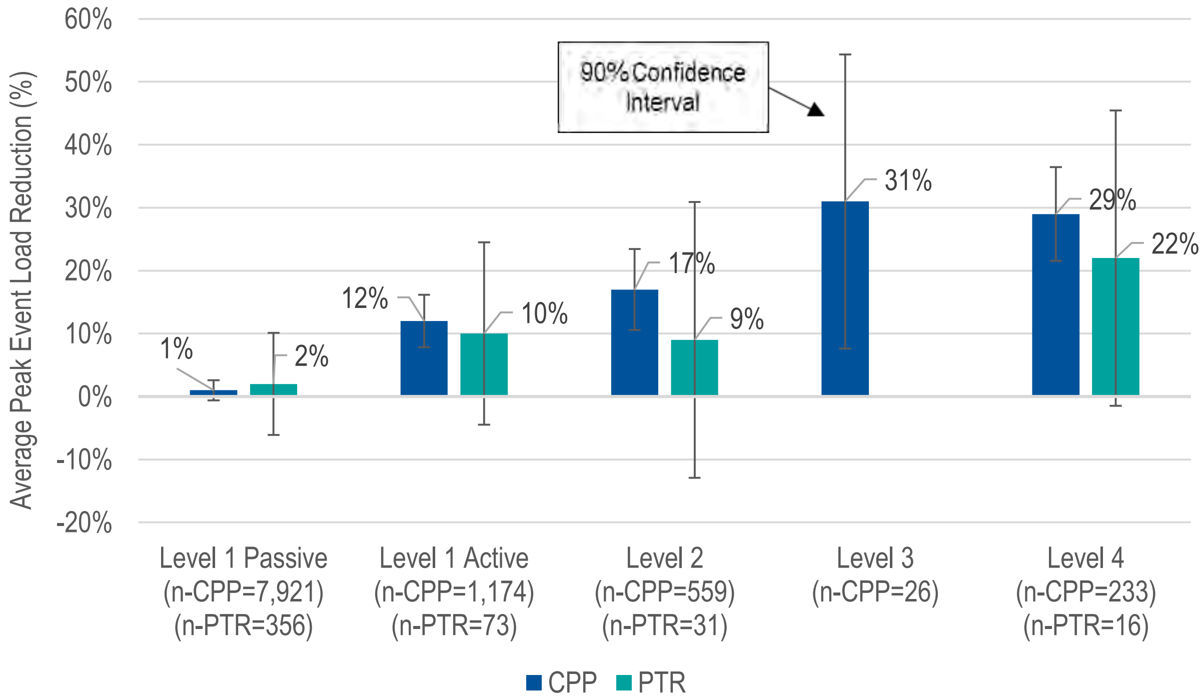
3.1 Peak Event Impacts

Navigant estimated demand savings during each Peak Event by regression to predict fitted usage from 8 a.m. to 10 p.m. on each Conservation Day, controlling for temperature, humidity, day of the week, month, and a customer fixed effect that controls for all observed and unobserved customer-specific variables that do not change through time. The evaluation team estimated savings for each technology/price group combination with the exception of the Level 3 PTR group, which only had one customer. A detailed description of the methodology is included in 0.

3.1.1 Average Peak Event Impact

Figure 3-1 shows the average percentage peak load reduction across the 20 events of the 2015 summer for each of the residential technology/price groups. Whether on the CPP or PTR rate, customers achieved greater demand reduction with more advanced technology. Level 3 and 4 customers with smart thermostats saved the most (0.53 kW for Level 3 CPP, 0.56 kW for Level 4 CPP, and 0.50 kW for Level 4 PTR). Passive Level 1 customers saved the least (0.01 kW for CPP and 0.03 kW for PTR). Active Level 1 customers saved considerably more than the passive customers (0.13 kW for CPP and 0.12 kW for PTR). Level 2 customers who have an IHD were in the middle (0.20 kW for CPP and 0.13 kW for PTR). At each technology level, CPP customers conserved more electricity than their PTR counterparts.

Figure 3-1. Average Peak Event Load Reductions by Residential Technology/Price Group

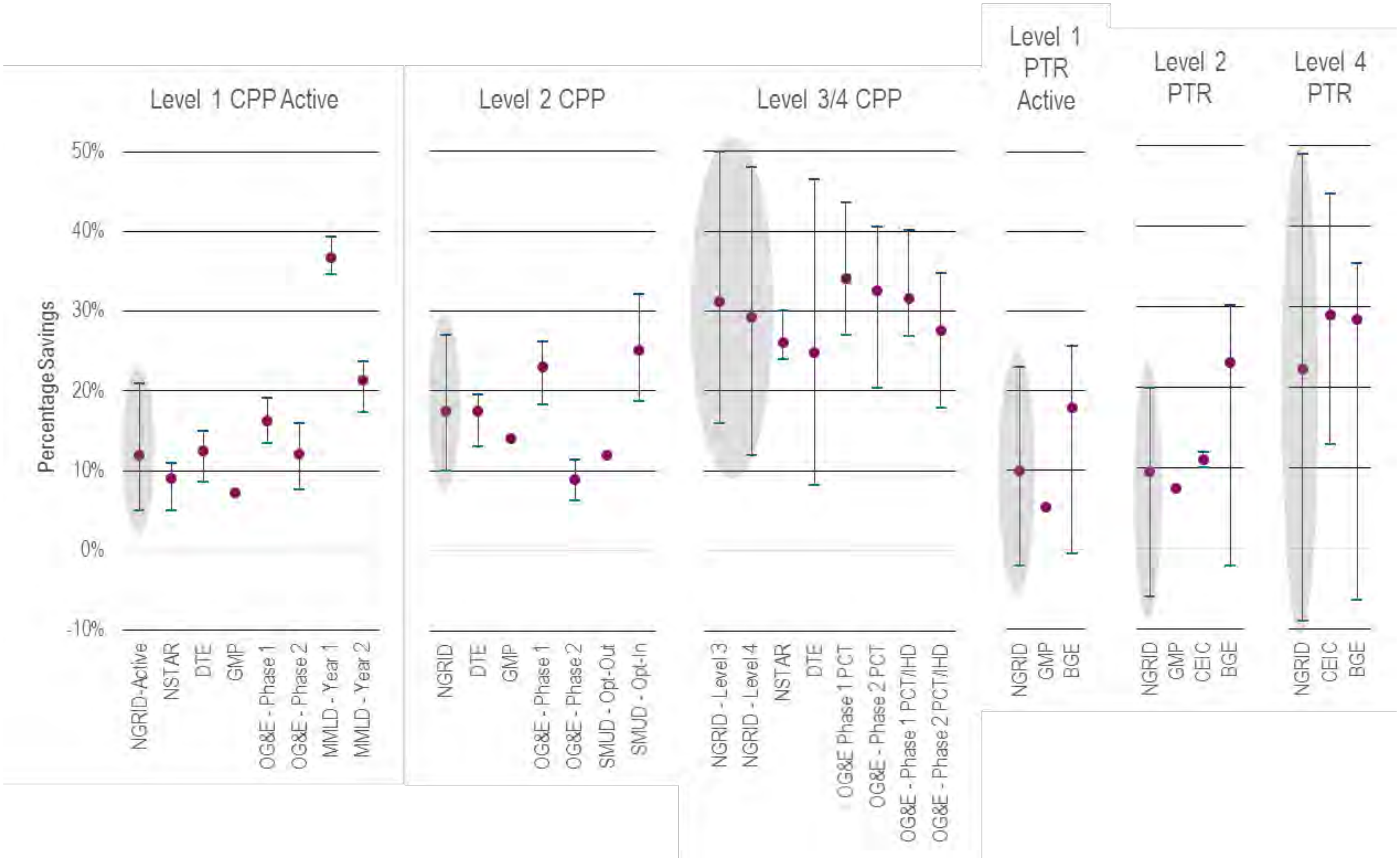


Source: Navigant analysis
Note: n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group.

In percentage terms, the impacts for active residential customers in the Pilot are similar to those from other, primarily opt-in, programs.[52] Comparisons of the Pilot to several other programs around the country are shown in Figure 3-2. The comparisons include the average, maximum, and minimum impact when possible, or the average impact when the minimum and maximum could not be found. The comparisons are grouped by the Pilot's technology/price groups, and the comparison programs are matched to the Pilot groups based on the descriptions of the price plans and the enabling technologies in the comparison program's report. The Pilot groups are highlighted in gray. A similar graph showing absolute comparisons is included in Appendix B.

[52] Passive customers in Level 1 CPP also have savings, but they are not shown in Figure 3-2 because all of the comparison programs are opt-in. Passive customers in an opt-out program are fundamentally different from customers in an opt-in program in terms of their motivation to participate in a program.

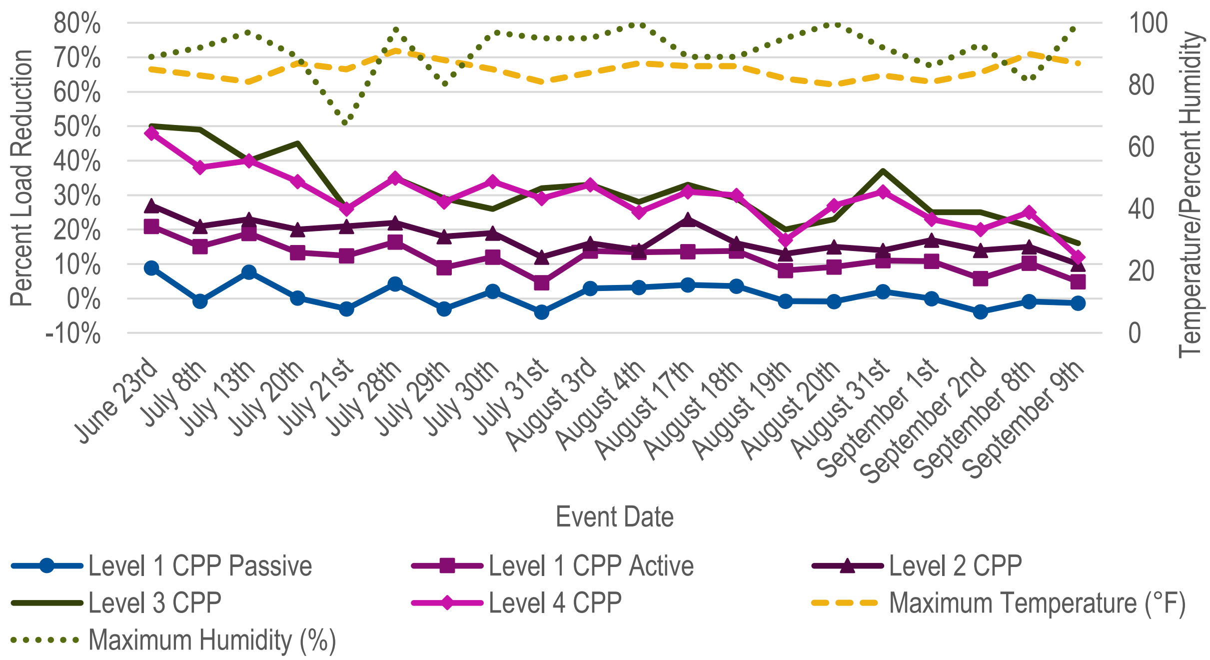
Figure 3-2. Residential Peak Event Impacts Percentage Comparison to Other Utilities



Source: Navigant analysis and the Smart Grid Investment Grant program

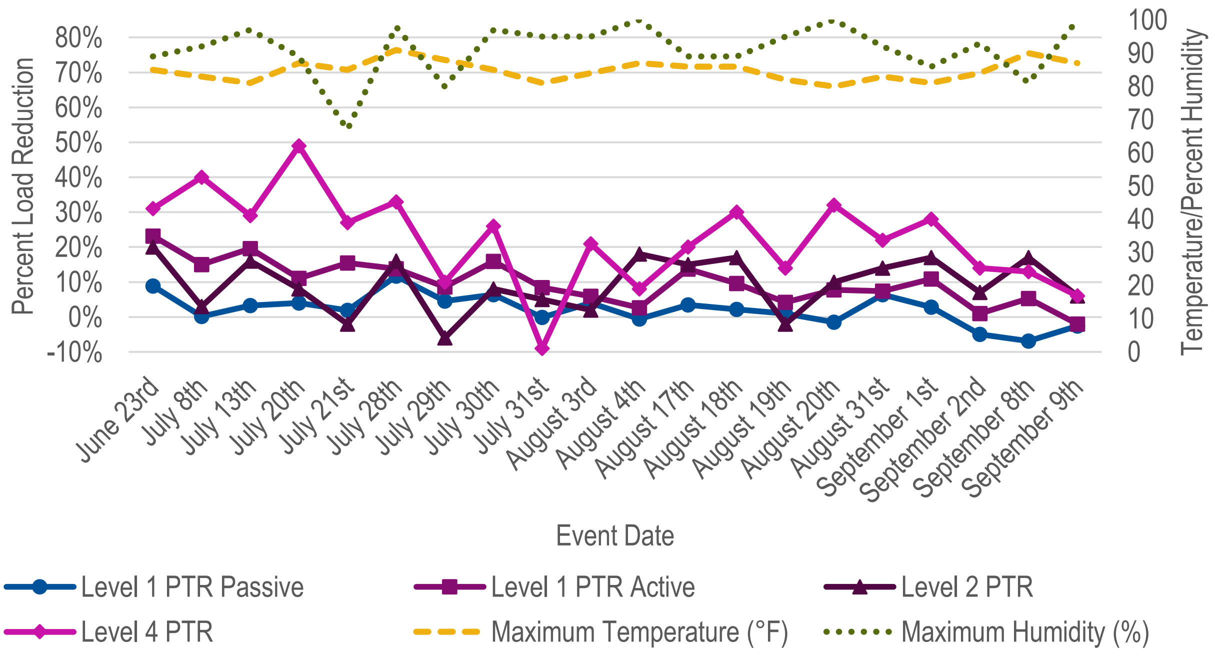
Figure 3-3 shows the average percentage impact for each event for the five residential CPP customer groups, and Figure 3-4 shows the average percentage impact for each event for the three residential PTR groups. For almost all of the technology/price groups, the impact was highest for the first event on June 23rd, this may indicate initial excitement or novelty surrounding the first event. In both price plans, Level 1 (active and passive) and Level 2 had relatively stable impacts throughout the summer, while Level 3 (CPP only) and Level 4 impacts declined throughout the summer. This matches with the survey data (Figure C-6), which show that Level 3 and 4 customers were more likely to override their thermostats as the summer went on. Similar graphs showing the absolute impact and tables showing the average percentage and absolute impact by event are in Appendix B.

Figure 3-3. Percentage Savings for CPP Customers



Source: Navigant analysis

Figure 3-4. Percentage Savings for PTR Customers



Source: Navigant analysis

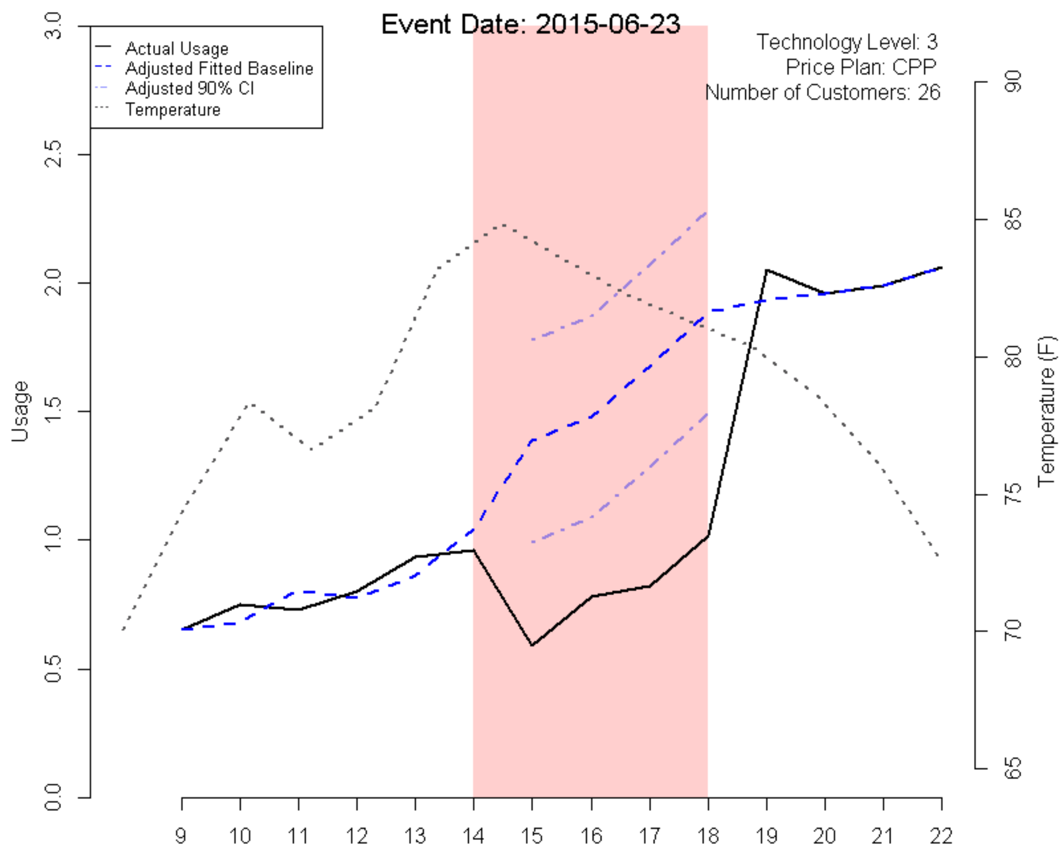
Navigant did not find any statistically significant Peak Event impacts for commercial customers. This finding matches the survey results for commercial customers, in which most businesses indicated that they were unable to adjust their usage during business hours when Peak Events were most likely to be called.

This result should not be over interpreted to conclude that the Pilot is ineffective for commercial customers. The sample sizes for commercial customers on the PTR rate and in the higher technology levels are too small to draw any conclusions. It is possible that with the proper enabling technologies commercial customers are saving during Peak Events. It is also possible that subsets of commercial customers, for example those who are able to shift energy intensive activities to the evening or overnight, are saving on the Pilot. There is not enough data for such possibilities to be explored.

3.1.2 Impacts by Event Hour

To assess the event impacts by hour, Navigant created graphs of average usage on each event day for each technology/price group. Figure 3-5 shows one such graph for Level 3 CPP for the first event of the summer on June 23. The x-axis plots the hours of the day, and the event period is highlighted in red. Usage is plotted on the primary y-axis with actual usage as the solid black line and adjusted fitted baseline usage as the dotted blue line. The 90% confidence interval on the adjusted fitted baseline during the event period and snapback period is shown in the lighter blue dot-dash lines. Temperature is plotted on the secondary y-axis as the dotted grey line. Similar graphs are available for each event for each technology and price plan group in the separately attached Appendix E for residential customers and Appendix F for commercial customers.

Figure 3-5. Level 3 CPP Actual and Baseline Usage on 2015-06-23



Source: Navigant analysis

3.1.3 Impacts by Demographic Subgroup

Impacts were estimated for 23 residential demographic subgroups as indicated by shading in Table 3-2.[53] Similar graphs to Figure 3-5 are provided in the separately attached Appendix G for each of the events

[53] Navigant did not estimate commercial customers by demographic subgroup because the overall group size was too small to yield statistically significant results.

for each demographic subgroup. A threshold of 100 customers was used to decide whether there was enough data to estimate results for a demographic subgroup.[54] Navigant made an exception to that threshold to estimate impacts for low-income customers in Level 1 CPP active and Level 2 CPP, which had 88 and 76 customers, respectively.

Table 3-2. Peak Event Impact Estimation Groups[55]

Technology/ Price Group		Non-Low-income			Low-income	High Income	Seniors	Small Home	Large Home
		Low Use	Med Use	High Use					
Level 1: Web Portal Only	CPP - Active	297	640	142	88	212	189	481	24
	CPP - Passive	2,071	3,874	818	1,096	1,287	1,922	3,566	156
	PTR – Active	21	39	6	7	12	7	22	0
	PTR - Passive	110	146	33	65	37	85	122	3
Level 2: IHD	CPP	75	334	76	76	143	98	185	11
	PTR	3	16	7	5	4	6	11	1
Level 3: PCT	CPP	3	20	2	1	12	7	9	1
	PTR	0	1	0	0	1	0	0	0
Level 4: Tech Combos	CPP	25	151	44	13	91	37	68	20
	PTR	1	9	3	3	4	0	4	0

Source: Navigant analysis

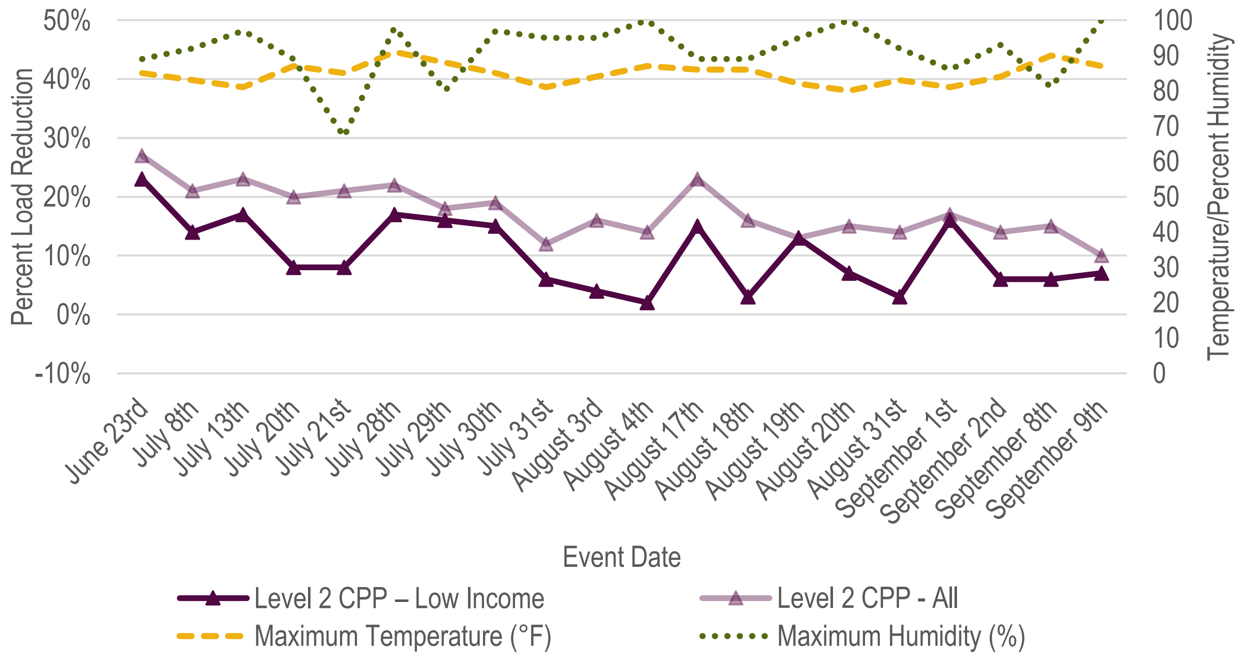
Across all the subgroups only the low-income customers in Level 2 CPP had statistically different impacts from the group as a whole. Impacts for low-income customers were also estimated for active and passive customers in Level 1 CPP, but for each of those groups no statistically significant difference was found between low-income customers and the group as whole.

Figure 3-6 shows the average percentage impact for each event for the low-income customers and all customers in Level 2 CPP. The impact for low-income customers averaged 10% compared to 17% for the group as a whole. For each event, low-income customers had lower savings than the group as a whole.

[54] A threshold of 100 was used to ensure a chance of statistical significance in the results.

[55] The customer counts in this table differ slightly from the customers count in Table 2-3 due to small differences in the logic used to include customers in the impact analysis versus in the survey. For example, customers who went inactive during the summer of 2015 were not included in the survey sample but they were included in the impact analysis up until their account went inactive.

Figure 3-6. Event Savings for Low-Income Customers in Levels 1 and 2 CPP



Source: Navigant analysis

There are several possible explanations for why low-income customers would save less than other customers. First, it is possible that the lower savings for low-income customers in this group come from lower central air conditioning (CAC) penetration for the low-income customers. For example, low-income customers may be more likely to have window AC units rather than CAC. To further examine this possibility, Navigant identified customers likely to have CAC in Level 2 CPP as described in Section A.2 of 0. Navigant then estimated the demand impacts during Peak Events for four income/CAC groups within Level 2 CPP: standard-income customers with CAC, low-income customers with CAC, standard-income customers without CAC, and low-income customers without CAC. For customers with and without CAC, the demand impacts were lower for low-income customers than standard-income customers in both percentage and absolute terms, as shown in Table 3-3. This means that although CAC penetration may be lower for low-income customers, it appears that low-income customers have lower percentage demand savings regardless of the presence of CAC. The customers in Level 2 have IHDs but not PCTs; it is possible that with a PCT the disparity between low-income and other residential customer impacts would diminish.

Table 3-3. Demand Impacts for Level 2 CPP by Income and CAC

Income	CAC	Percentage Impacts	Absolute Impacts
Standard-Income	Y	20%	0.267
Low-Income	Y	9%	0.143
Standard-Income	N	18%	0.152
Low-Income	N	11%	0.110

Source: Navigant analysis

Another possible explanation for the lower impacts for low-income customers is that they may have less discretionary energy usage and thus less energy to save which is a common result found in evaluation.[56] Low-income customers are likely to already be conscious of their energy usage and its impact on their budget and thus may have been conserving more energy than other customers before the Pilot. Since they are already engaging in conservation behaviors they have fewer improvements that they can make.

A third possible explanation for this result is that low-income customers may have been less able to shift their usage than other residential customers. This was a concern when designing the Pilot and although, according to the pre-pilot survey, low-income customers indicated that they would be able to effectively shift their usage (see Figure 4-3), it is possible that they were mistaken. Low-income customers may have medical conditions that require them to run equipment throughout the day, such as HEPA air filters. They may also be more likely to live with elderly family members who are home during Peak Events and need to stay comfortable, making them less able to adjust their AC usage.[57] Navigant will further explore demographic differences between low-income and other residential customers in the final report.

Finally, in looking at four groups of low-income customers we saw only one where the results were different from other residential customers. Thus it is possible that this results for Level 2 was simply an anomaly and that on the whole low-income customers in the Pilot are achieving results similar to other residential customers.

3.1.4 Price Responsiveness

For the residential customers on the CPP price plan, Navigant was able to estimate the price responsiveness at each technology level. Navigant estimated the arc price elasticity of substitution for

[56] See for example IEE Whitepaper (2010).

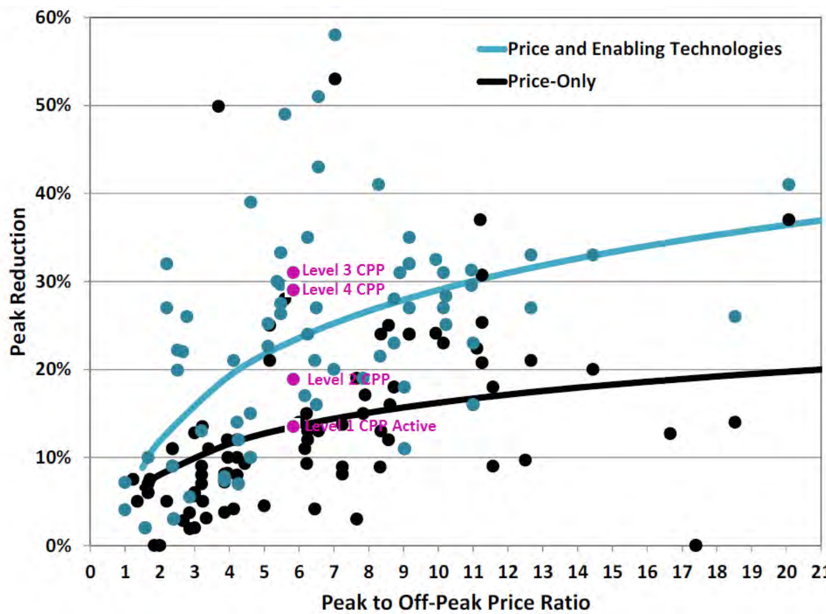
[57] The low-income focus groups suggested that some low-income customers experience these conditions but the sample sizes were not large enough to conclude that these conditions are more prevalent for low-income customers than for residential customers in general.

each CPP technology group.[58] Elasticity is defined as the percent change in quantity demanded from a 1% change in price. The price elasticity was lowest for customers in Level 1: passive customers decreased their electricity usage by 0.001% in response to a 1% increase in the price and active customers decreased by 0.008%. Price elasticity for Level 2 customers was much higher, with a 0.132% decrease in usage in response to a 1% increase in price, and Level 3 and 4 customers exhibited almost double the response of Level 2 with elasticities of 0.248 and 0.233, respectively.

As shown in Figure 3-7, the level of price responsiveness for active customers is similar to that of other pricing programs. The figure shows Faruqui and Sergici's (2013) arc of price responsiveness, which is based on 137 pricing treatments in 34 programs worldwide; the Pilot price responsiveness is plotted in red for each of the five CPP groups.[59] The arc plots the percentage peak reduction in electricity usage for various peak to off-peak price ratios for programs with and without enabling technologies. During the summer of 2015 the Pilot had an off-peak price of $0.07313/kWh and a critical peak price of $0.43544/kWh,[60] making the peak to off-peak price ratio approximately six. The responsiveness for active customers in Level 1 is right at the average for price-only programs. Level 2 is between the average for programs with and without enabling technologies, which is expected given that the IHD is a relatively low-level enabling technology. Levels 3 and 4 are slightly above the average for programs with enabling technologies but well within the range seen at a peak to off-peak ratio of six.

[58] Arc price elasticity is calculated by $(P_1+P_2)/(Q_1+Q_2) * (\Delta Q/\Delta P)$ where P_1 is the off-peak price of elasticity, P_2 is the critical peak price, Q_1 is the quantity of electricity that would have been demanded in the absence of an event, Q_2 is the quantity of electricity that was demanded, and delta (Δ) indicates the change in Q or P.
[59] Faruqui, Ahmad and Sergici, Sanem, Arcturus: International Evidence on Dynamic Pricing (July 1, 2013). Available at SSRN: http://ssrn.com/abstract=2288116.
[60] These prices were in effect during the summer of 2015, the prices will be different in the winter of 2015 and the summer of 2016.

Figure 3-7. Arc of Price Responsiveness



Source: Faruqui and Sergici (2013) and Navigant analysis

3.2 Energy Impacts

For energy impacts, the evaluation team selected a group of matched control customers from a large pool of non-participant households that had similar patterns of energy usage in the 12 months before the Pilot started to provide the counter-factual usage if the Smart Energy Solutions participants had not been in the Pilot.[61] Regression analysis of monthly billing data using the participants and matched controls was then used to estimate the annual reduction in energy usage, controlling for weather, for 2014 and the reduction by month in 2015. A detailed description of the methodology is included in 0.[62]

3.2.1 2015 Impacts (January to September)

Figure 3-8 shows the average percentage energy impacts with 90% confidence intervals from January to September 2015 for CPP customers in different technology levels. Navigant also examined energy savings for PTR customers but did not find any significant savings; PTR customers are not expected to

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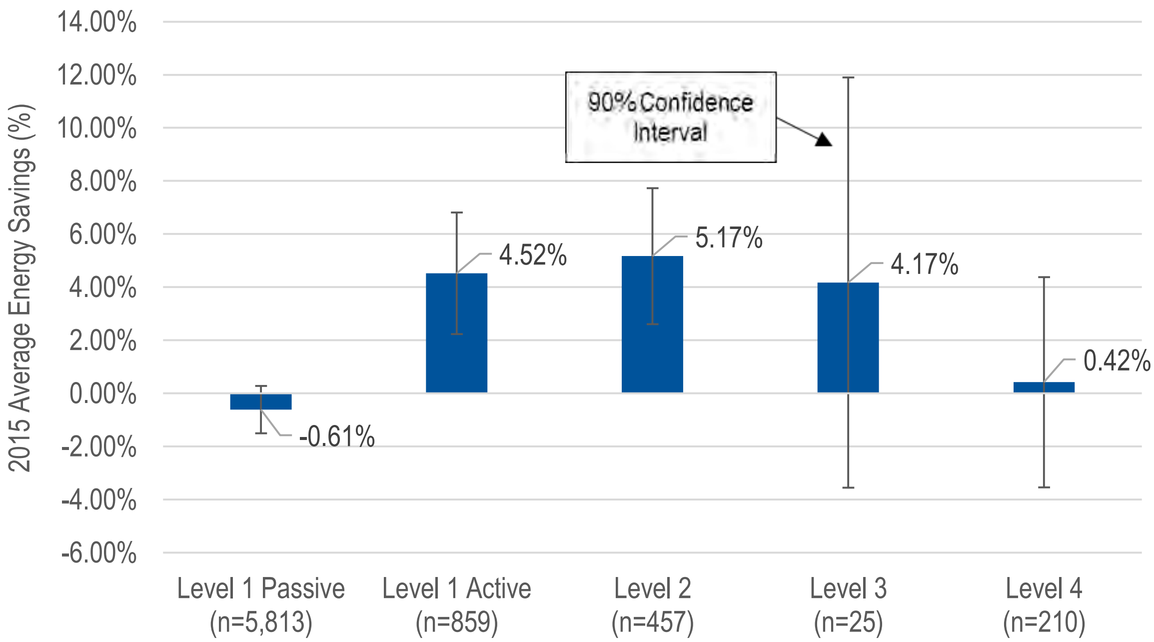
[61] To avoid the issue of control customers moving out, only controls who had billing data through the end of the evaluation period, October 2015, were used.
[62] Navigant did not estimate energy impacts by demographic subgroup because there was not enough data to do billing analysis on these smaller groups. Given that there were few differences in demand savings across the demographic subgroups it is unlikely that there are differences in energy savings.

achieve significant energy savings because they do not pay TOU rates. Energy savings were highest for Level 2 customers (38 kWh per month) and lowest for Level 4 customers (5 kWh per month). Active Level 1 customers saved 30 kWh per month and Level 3 customers saved 32 kWh per month. It is unclear why Level 4 customers saved less than Level 3 customers since the two groups had similar technologies; however, the two estimates are not statistically different and the sample sizes are relatively small for monthly billing analysis which may have contributed to the discrepancy. Passive customers in Level 1 had negative energy savings, but the estimate was not statistically significant.

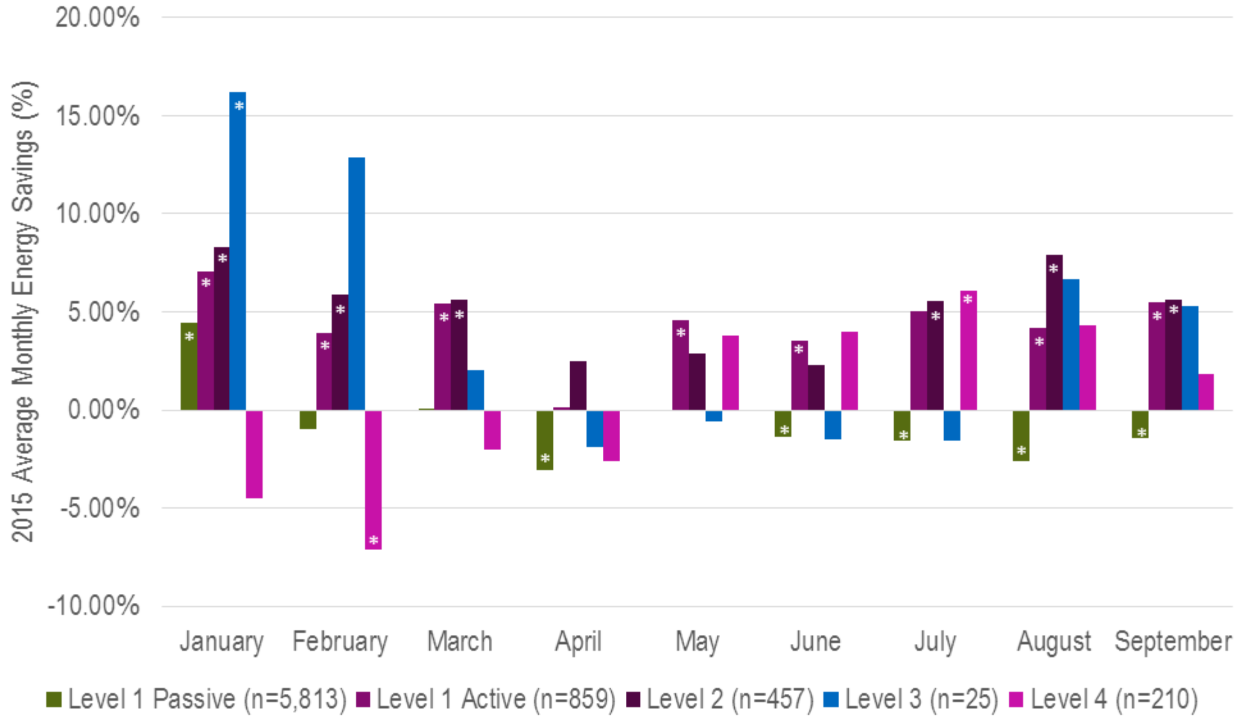
Figure 3-8. Average Energy Impacts for CPP Customers from January to September 2015 by Technology Level



Source: Navigant analysis
Note: n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group.

Energy savings by month for each technology level are shown in Figure **3**-**9**. This shows that for most of the groups there are energy savings in almost every month. Notably July, August, and September, which cover the period when the summer Peak Events were being called, show energy savings for all of the active customers, except for Level 3 in July which is not statistically significant.

Figure 3-9. Average Monthly Energy Impacts for CPP Customers by Technology Level



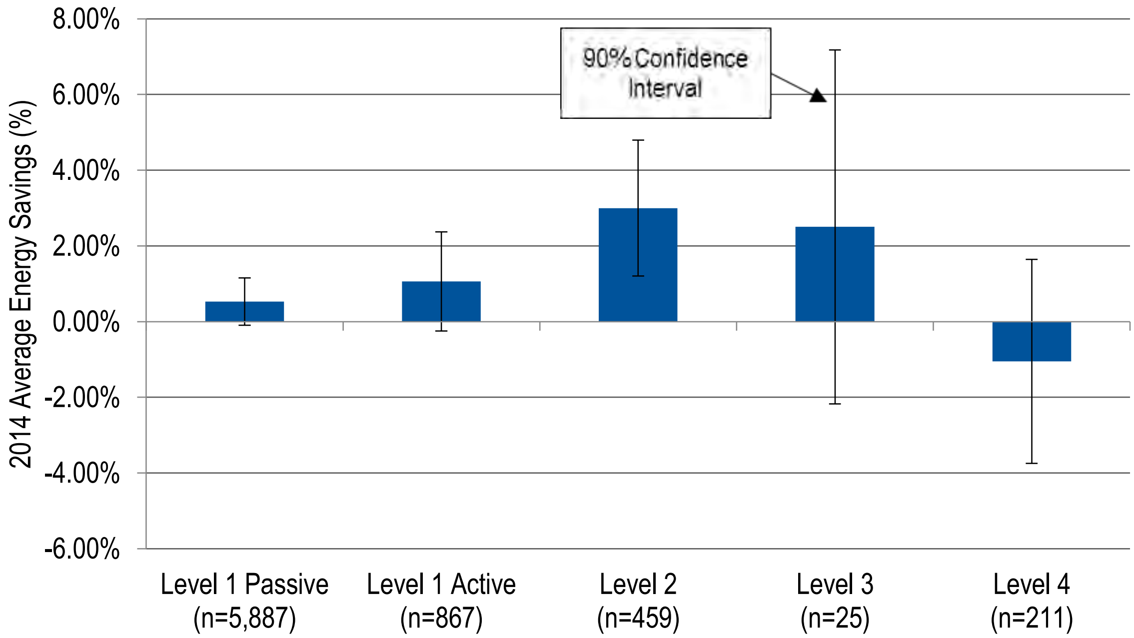
Source: Navigant analysis
Note: White asterisks (*) indicate statistical significance at the 90% confidence level. n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group.

Navigant attempted to break down the energy impacts by demographic subgroups but the sample sizes were simply too small to draw any conclusions.

3.2.2 2014 Impacts

Figure 3-10 shows the energy savings from the Pilot in 2014 with 90% confidence intervals. In 2014, only the information portion of the Pilot was in effect—i.e., customers knew the Pilot was coming and technologies were available for those who wanted them. However, there were no price changes or Peak Events. Energy savings were statistically significant at the 90% level for Level 2 CPP customers, who saved 3.00%. Savings were positive, but statistically insignificant, for active and passive Level 1 customers and for Level 3 customers, and negative, but statistically insignificant for Level 4 customers. For passive customers in Level 1 the savings were too small to see a statistically significant effect, and for the other three groups the relatively small sample sizes for billing analysis contributed to the statistical insignificance of the effects.

Figure 3-10. Energy Savings in 2014 by Technology/Price Group



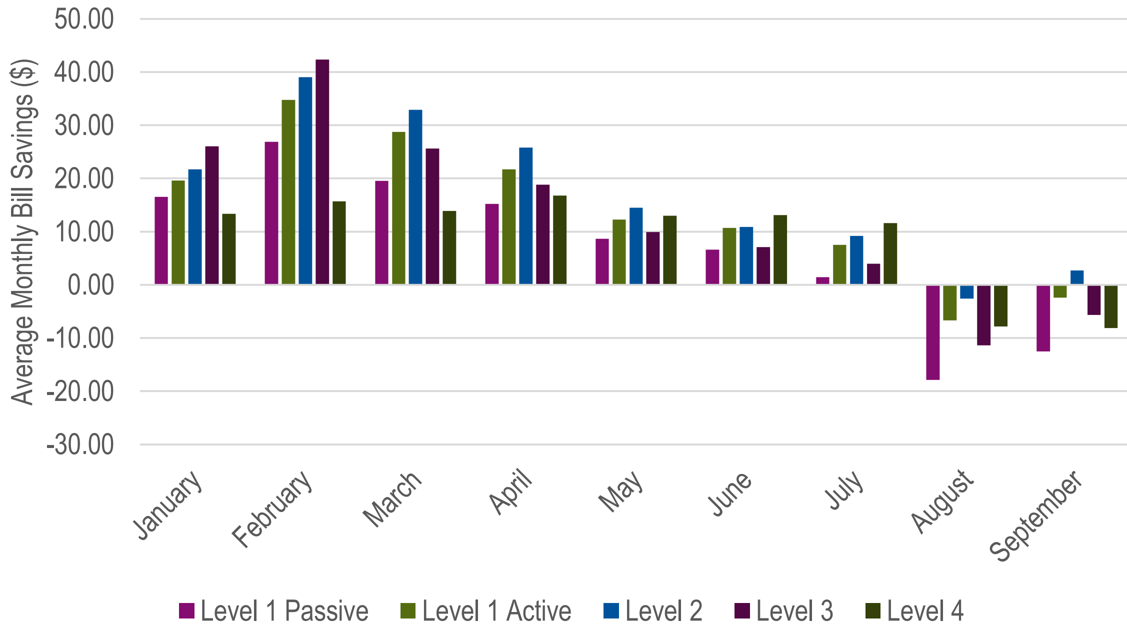
Source: Navigant analysis
Note: n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group.

3.3 Bill Savings

3.3.1 CPP Customers

Figure 3-11 shows the average bill savings by month in 2015 for CPP customers. The month of each bill is defined as the last day of the billing period. This means that on average bills in each month contain an equal number of days in the current month and the previous month, for example bills in May reflect usage in the second half of April and the first half of May. On average across technologies, bill savings were highest in February, which reflect January and February usage, when customers were still adjusting to the new TOU rate. Customers' bills went up in August and September, reflecting usage in July, August, and September, which is expected since July and August were when the majority of the Peak Events were called. Average per customers bill savings from January through September 2015 were $154 for Level 2, $126 for active customers in Level 1, $117 for Level 3, $81 for Level 4, and $64 for passive customers in Level 1.

Figure 3-11. Average Bill Savings for CPP Customers



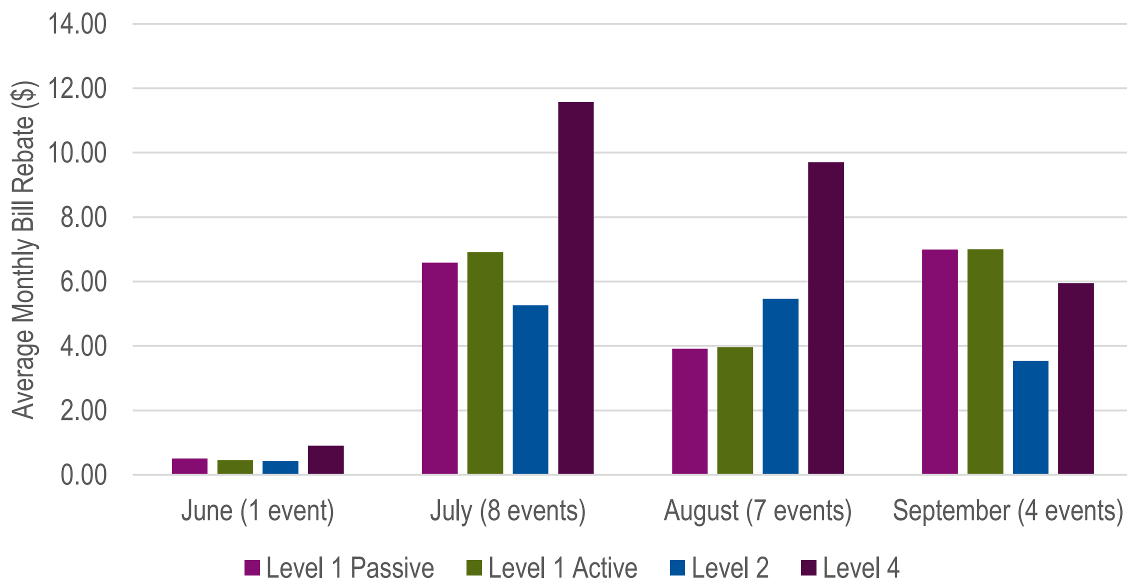
Source: Navigant analysis

3.3.2 PTR Customers

The bill savings for PTR customers come from the monthly rebates earned during Peak Events.[63] Figure 3-12 shows the average bill rebates by month in 2015 for PTR customers. Level 4 customers achieved the highest average rebate of $1.41 per event, Level 2 customers averaged $0.74 per event, active Level 1 customers averaged $0.92 per event, and passive Level 1 customers averaged $0.91 per event. The average total rebate for events called during the summer of 2015 was $19.80.

[63] Energy savings were neither expected nor found for PTR customers and thus they do not enter into our calculations of bill savings.

Figure 3-12. Average Bill Rebates for PTR Customers



Source: Navigant analysis

3.4 Load Shifting

The regressions from which Navigant estimated Peak Event impacts, which covered June to September, also included coefficients to estimate three types of load shifting:

1. **Load shifting around Peak Events,** including pre-cooling, where customers change their energy usage before a Peak Event, and snapback, where customers change their energy usage after a Peak Event. Evidence of pre-cooling in the Pilot was not found and thus pre-cooling was left out of the final regression specification, which can be seen in 0, and was not estimated.
2. **Load-shifting from weekdays to weekends**.
3. **Non-event peak impacts,** in which customers shift usage on weekdays that are not Conservation Days from peak to off-peak hours.

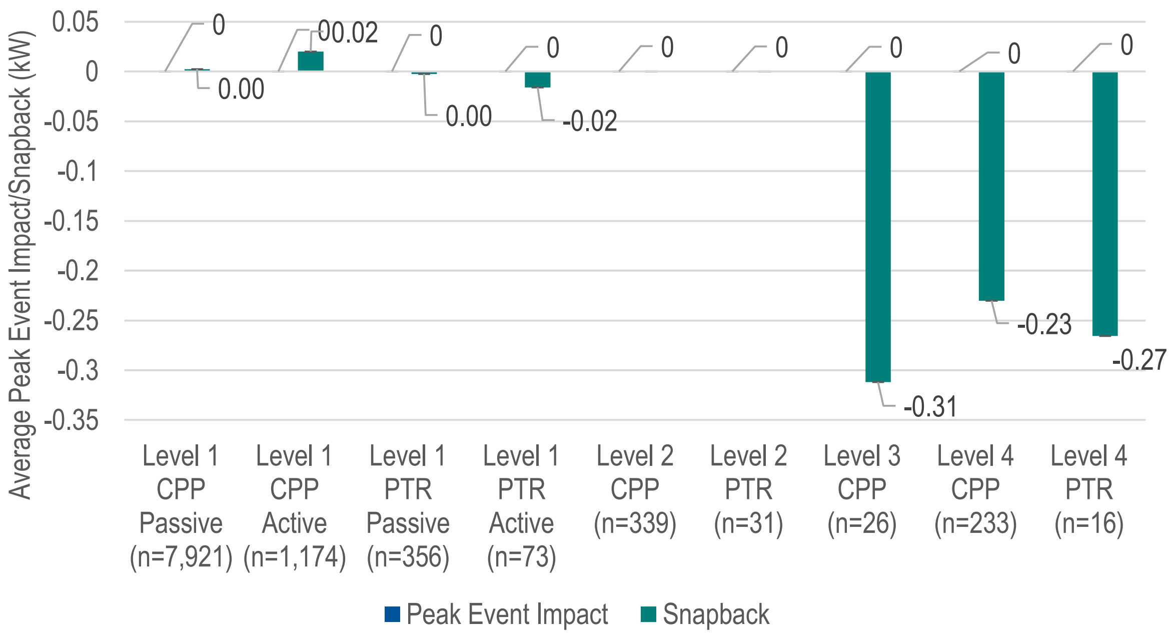
Snapback is estimated for each Peak Event while the other two types of load shifting are estimated on average for the summer.

CPP customers are expected to exhibit all three types of load shifting as they are on a TOU rate and thus have an incentive to be price conscious and shift usage to lower cost times of the day and week, i.e. off-peak hours and weekends. Load shifting contributes to bill savings for CPP customers. PTR customers may exhibit load shifting around Peak Events as they can earn money back if they reduce usage during Peak Events hours, but they do not have a strong incentive to shift loads from weekdays to weekends or from peak to off-peak hours on days that are not Conservation Days as they are not charged a TOU rate. Statistically significant load shifting effects were not found for commercial customers in any of the three categories, thus the following subsections focus on residential customer impacts.

3.4.1 Snapback

Figure 3-13 shows the average Peak Event impact and snapback for each residential technology/price group. The overall result is that for this Pilot snapback was not very prominent.

Figure 3-13. Snapback Compared to Peak Event Impacts



Source: Navigant analysis

Note: Negative numbers for snapback in this graph indicate an increase in usage in the hours after peak events. Also, n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group, not the total number of customers in each technology/price group.

For Level 1 and 2 customers in both price groups there was hardly any snapback. In fact, for Level 2 customers in both price groups there was no snapback found for any of the Peak Events. For Level 1 customers, Navigant actually found that customers continued to save electricity even after the Peak Event had ended. This phenomenon can be seen in the graphs provided in Appendix E.

Snapback was more prominent for Level 3 and Level 4 customers. The disparity in snapback across the different technology levels is almost certainly driven by PCTs which Level 3 and 4 customers have but Level 1 and 2 customers do not. The smart thermostats are adjusted remotely by National Grid during Peak Event hours and then return to the user-defined temperature once the Peak Event is over. The snapback observed for customers with these thermostats is likely from the HVAC system working hard to cool the home after running less than usual during Peak Event hours.

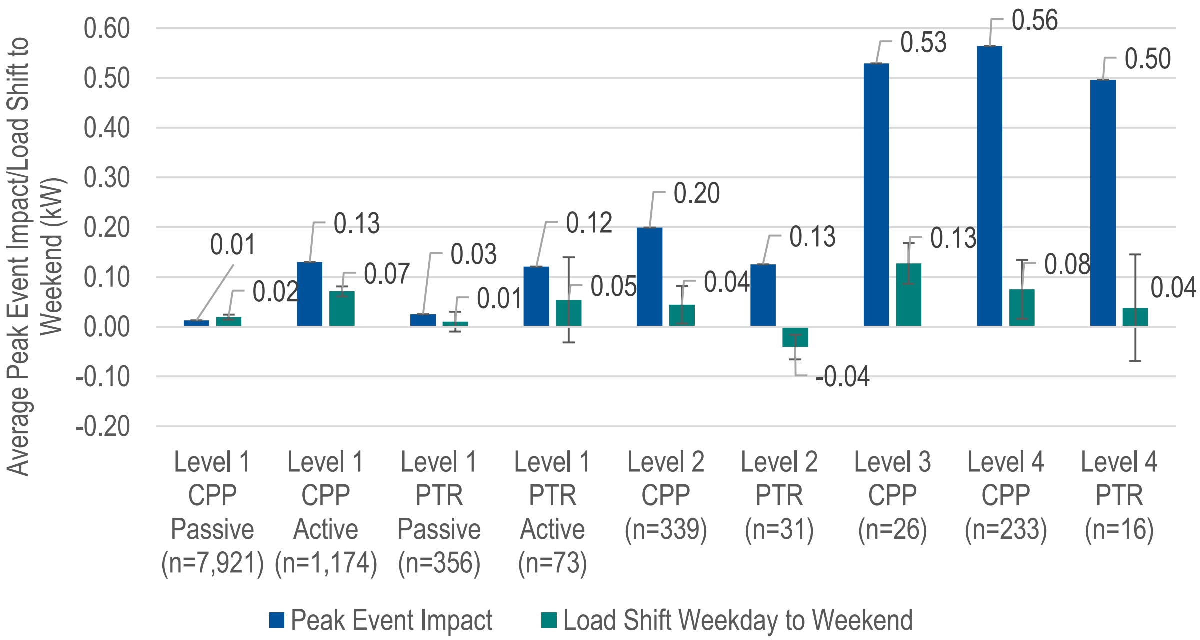
Even for Level 3 and 4 customers where significant snapback is observed it is relatively small in magnitude and short in length. On average for Level 3 and 4 customers, the snapback is about half the magnitude of the Peak Event impact. Additionally, snapback generally lasts less than two hours which is fairly short especially given the long length of the Peak Events. Graphs with snapback for each Peak Event are provided in Appendix B.

3.4.2 Weekday to Weekend Load Shifting

CPP customers have an incentive to shift their usage from weekdays to weekends in order to avoid paying the higher peak time rate than runs from 8 a.m. to 8 p.m. on weekdays. PTR customers may have an incentive to shift usage to weekends when Peak Events are being run during the week, but the incentive is much smaller as they are not charged the TOU rate. Additionally, the Pilot may cause them to form habits which involve shifting their energy intensive activities to times when Peak Events will definitely not be called.

Figure 3-14 shows the average Peak Event impact and the average shift of usage from weekdays to weekends for each residential technology/price group. For CPP customers some load shifting to weekends is observed for each technology level. PTR customers do not exhibit a statistically significant load shift at any technology level. CPP customers do exhibit statistically significant shifting to weekends. This disparity in shifting to weekends across the two rates is not surprising given the different incentives for customers on each rate discussed in the previous paragraph.

Figure 3-14. Weekday to Weekend Load Shifting Compared to Peak Event Impacts



Source: Navigant analysis

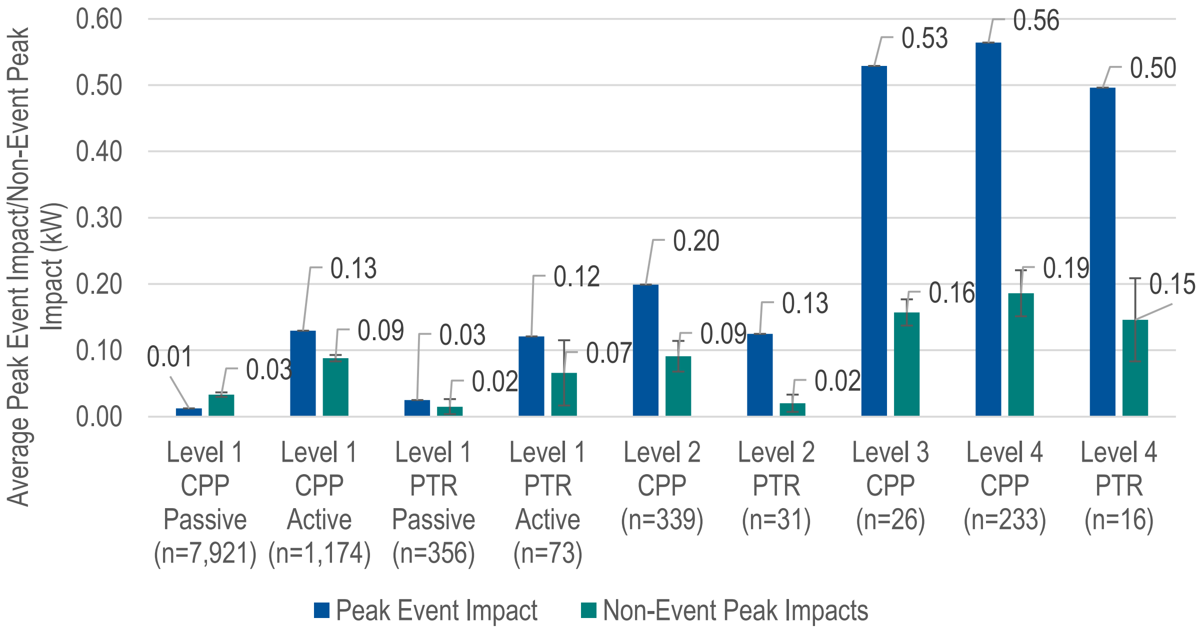
Note: Positive numbers for load shift in this graph indicate a decrease in weekday usage and an increase in weekend usage. Also, n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group, not the total number of customers in each technology/price group.

3.4.3 Non-Event Peak Impacts

CPP customers have an incentive to shift their usage from peak hours to off-peak hours, even in the absence of a Conservation Day, since electricity is cheaper for them during off-peak hours. PTR customers have no monetary incentive to shift usage to off-peak hours on days that are not Conservation Days, but the Pilot may cause them to form habits which involve shifting their energy intensive activities to times when Peak Events will definitely not be called.

Figure 3-15 shows the average Peak Event impact and the average non-event peak impacts for each residential technology/price group. For CPP customers there are non-event peak impacts at each technology level. Only Level 4 customers on the PTR rate showed non-event peak impacts of practical significance. This may indicate that the enabling technology assists them in load shifting to off-peak times even though they have little incentive to do so.

Figure 3-15. Non-Event Peak Impacts Compared to Peak Event Impacts



Source: Navigant analysis
Note: Positive numbers for non-event peak impacts indicate savings during peak hours that are not also Peak Events. Also, n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group, not the total number of customers in each technology/price group.

For CPP customers the magnitude of the non-event peak impacts is relatively small compared to the Peak Event impacts; on average, the non-event peak impacts are about 40% of the magnitude of the Peak Events impacts.

4. Customer Experience Assessment

National Grid based its Smart Energy Solutions evaluation plan for customer experience on the *Common Evaluation Framework's* research questions. The customer experience evaluation focused on these key areas:

- How well do customers understand the Pilot's purpose and its impact on their electric use and bills?
- How do customers interact with the technologies? Are the technologies informative? Do they lead to taking conserving and efficiency actions?
- How well do customers understand the rate choices and 12-month bill protection, especially if CPP increases summer bills?
- Why do customers stay in or opt out? What are the critical factors in those decisions?
- What age, income or other demographic characteristics are important to understanding customer reaction to and participation in the pilot?

In order to assess customer experience, Navigant relied upon a combination of customer surveys, interviews, and focus groups, as noted in Section 1.2. Although entry into the program is on an opt-out basis, Smart Energy Solutions actually contains a number of opt-out and opt-in decision/action points as described in Section 1.2.2. Thus, marketing, education, satisfaction, and lessons learned were assessed for each program aspect. Appendix C contains a detailed discussion of each evaluation activity.

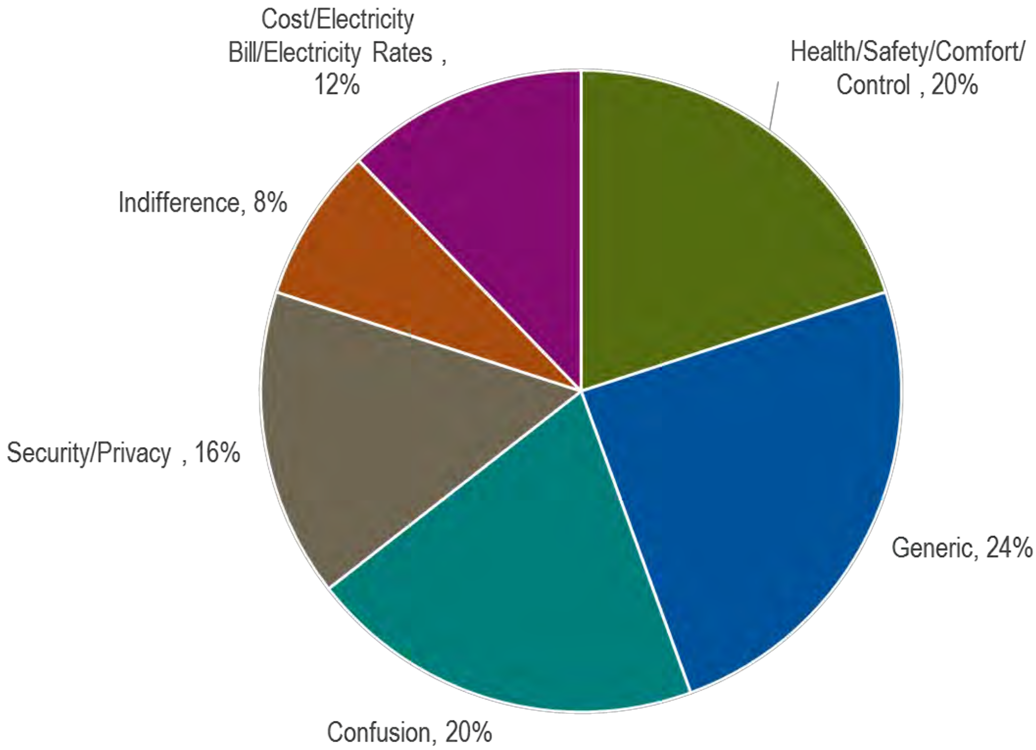
4.1 Participation Drivers

Before and throughout the Pilot, National Grid provided information to customers in the Pilot area that emphasized new pricing options that could reduce customers' electric use and cost as well as new energy management tools to assist customers in conserving energy—all provided to customers at no cost to them.

4.1.1 Meter Decline Rate is Low

The first customer decision point occurred when National Grid installed smart meters. While customers had the option to decline the meter, 95% of meters were installed; only about 5% of the eligible 15,000 customers in the Pilot program area declined the meter. Most of the customers who declined the meter appeared to have no interest in participating in the Pilot, according to the meter opt-out survey. Upon further questioning, customers who declined the smart meter expressed a variety of reasons, primarily confusion, indifference, health and safety issues, concerns about electricity costs, and data security and privacy concerns, as shown in Figure 4-1. Twenty-two customers provided "generic" reasons for declining the meter, which were divided between 13 saying they "don't think I will benefit from this" and 9 simply saying "I don't want this."

Figure 4-1. Categorical Reasons for Declining a Meter

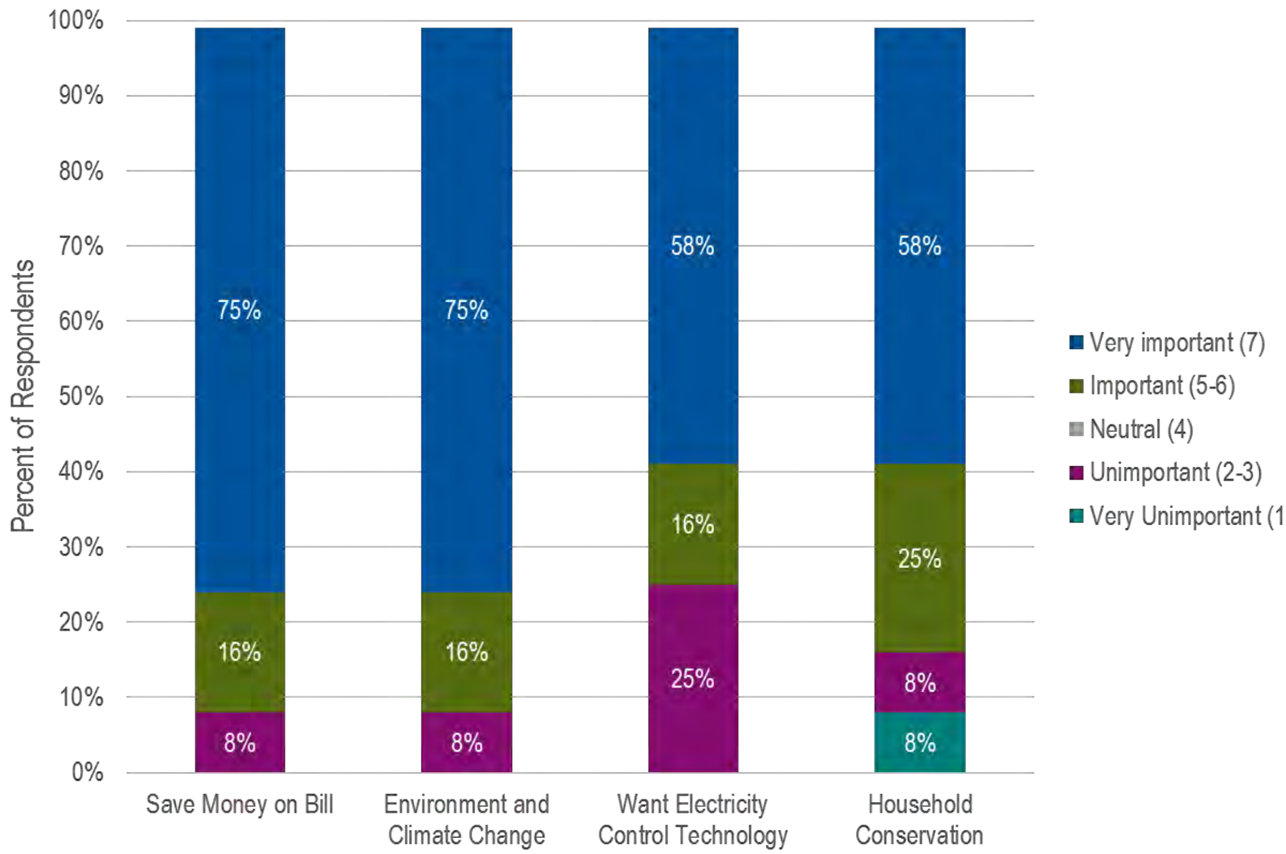


Source: Navigant analysis of meter decline survey (N=70)

4.1.2 Motives for Pilot Participation

In the pre-pilot survey, customers were asked to rate the importance of the following motives to participate in the Pilot: saving money on their electricity bills; household conservation; the environment and climate change; and receiving control technologies. As summarized in Figure 4-2, participants most often rated saving money on their electricity bill and protecting the environment as "very important" reasons for participating in the Pilot (75% for both motivations).

Figure 4-2. Customer Motivations for Pilot Participation, as Expressed in the Pre-Pilot Survey

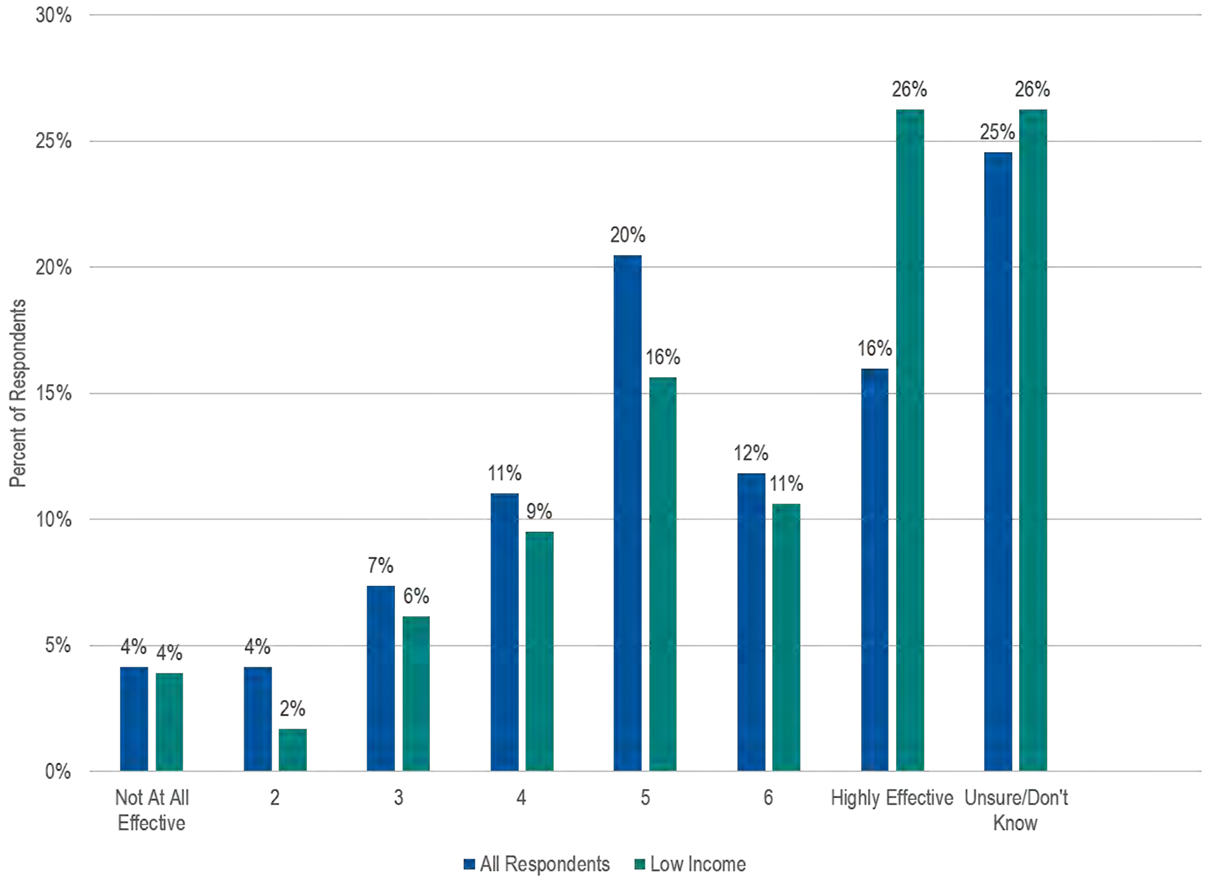


Source: Navigant analysis of pre-pilot survey (N=1,478)
Note: No survey participants provided a neutral response.

4.1.3 Low-Income Customers' Perceived Ability to Adjust Electricity Usage is High

There was concern, before the Pilot started, that low-income participants would not be able to shift their usage to take advantage of lower rates in non-peak hours. However, more of these participants expected that they would be "highly effective" at shifting usage than other participants did (Figure 4-3).

Figure 4-3. Pre-Pilot Perceived Ability of Low-Income Participants to Adjust Energy Usage



Source: Navigant analysis of pre-pilot survey (N=1,478)

4.2 Participant Awareness, Engagement, Satisfaction

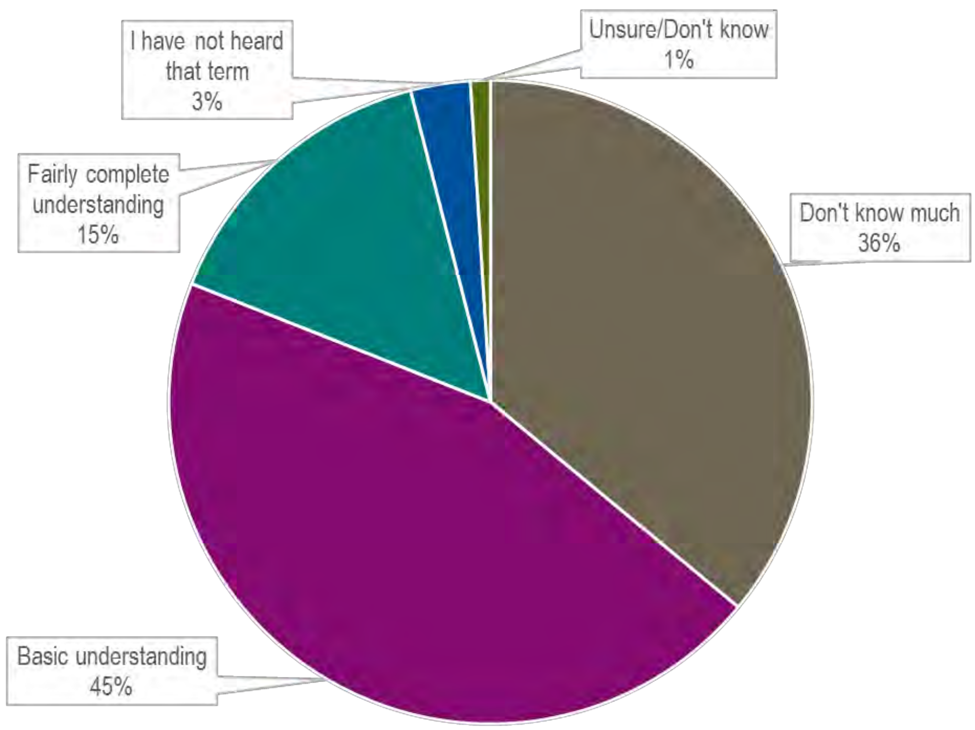
National Grid provided extensive information to customers about the program, rate, technologies, and bill protection before and during the first summer of the Pilot, as shown in Chapter 2. During the pre-pilot survey, customers expressed motivation to save money and confidence that they could shift their electricity usage. In the end of summer survey, and in focus groups with low-income customers conducted at the end of the summer, many customers indicated a desire for more information about the rates and technologies, personalized conservation tips, additional means of communication about the events, and more insights into savings. Summer 2016 may serve as an opportunity to provide more detail to customers and try new approaches with them.

4.2.1 Rate Awareness Increased over Time

Participant knowledge and understanding of the program rates is an important aspect of the Pilot. While National Grid does not favor the CPP or PTR rate, the Company offered both options to customers in order to provide flexibility in the program. At face value, customers might prefer the PTR rate over the CPP rate. A CPP rate charges customers a higher rate during Peak Events. The utility industry typically perceives that the advantage of PTR over CPP for customers is that it provides a rebate due to conservation during Peak Events but does not increase the rate, such that a customer's bill decreases in the short run.[64] However, due to National Grid's CPP rate design, which charges a lower rate than the Basic Rate for at least 335 days (the utility can hold up to 30 Peak Events per year), if customers shift their usage they will most likely save more money on the CPP rate than on the PTR rate. Additionally, customers on the CPP rate are offered bill protection in which they are given a credit at the end of the year if their expenditures exceeded what they would have spent if they had been on the Basic Rate, thus mitigating the risk of the CPP rate. The majority of National Grid customers who contacted the utility to select a rate chose the CPP rate over the PTR rate.

In the initial pre-pilot survey conducted in 2014, 8% of customers said that they had heard of the CPP rate. Of the customers who had heard of the rate, 15% of them "ha[d] a fairly complete understanding of what it means" and 46% "ha[d] a basic understanding of what it means", as shown in Figure 4-4. A few customers may have been confused about the rate, as 3% of these customers said they had never heard of the new rate, when asked whether they understood it.

Figure 4-4. Customer Pre-Pilot Knowledge of the CPP Rate



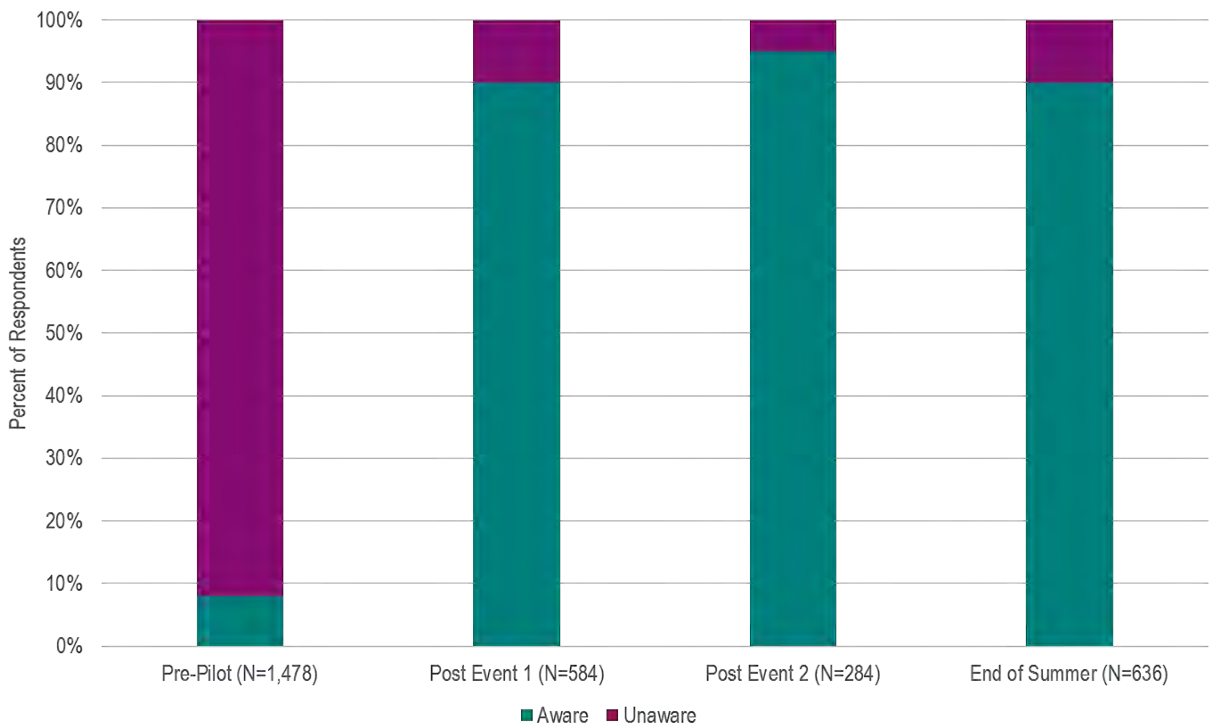
Source: Navigant analysis of pre-pilot survey (N=118)

As shown in Figure 4-5, customer awareness of the Pilot Rates increased over the course of the Pilot. In the pre-pilot survey, 8% of customers were aware of the CPP rate and by the end of the summer 90% of

[64] The Regulatory Assistance Project. *Time-Varying and Dynamic Rate Design.* July 2012.

customers were aware of the CPP or the PTR rate.

Figure 4-5. Customer Awareness of the Pilot Rates Over Time



Source: Navigant analysis of pre-pilot (N=1,478), post event (N=584, N=284), and end of summer (N=636) surveys

4.2.2 Rate Enrollment and Retention Rates On Par with Opt-Out Recruitment Methods

The majority of time-based rate pilots around the country are based on an opt-in recruitment model, in which customers volunteer to participate. By definition, opt-in customers are motivated to participate in a dynamic rate pilot. Customers who participate in opt-in programs tend to be enthusiastic early adopters and not likely to drop out of a program they signed up for.

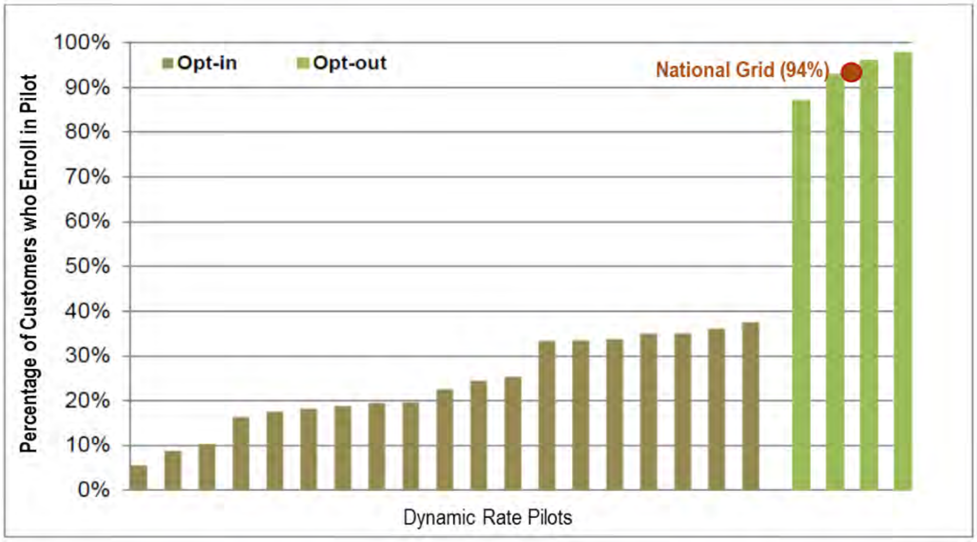
Smart Energy Solutions is rare as an opt-out program, which requires customers to contact the utility to opt out of the pricing program. Opt-out program design is a relatively new industry concept. Opt-out programs capture all customers, many of whom may follow "default bias", which means that they tend towards the default offering rather than accepting alternative offerings. Industry understanding at this time is that retention rates are similar for opt-in and opt-out programs[65].

The CPP and PTR rates went live in January 2015, so at the time of this interim report they had been in effect for approximately ten months. As shown in Figure 4-6, National Grid's enrollment rates are high compared to opt-in recruitment rates and are on par with typical opt-out recruitment rates. Customer enrollment is the percentage, as of January 2015 when the Pilot rates went live, of customers in the Pilot area who had a meter and had not yet opted out. Over time, customer retention reflects how many

[65] Cappers, P., H. Liesel, R. Scheer. *American Recovery and Reinvestment Act of 2009: Interim report on customer acceptance, retention, and response to time-based rates from the consumer behavior studies*. LBNL-183029. June 2015.

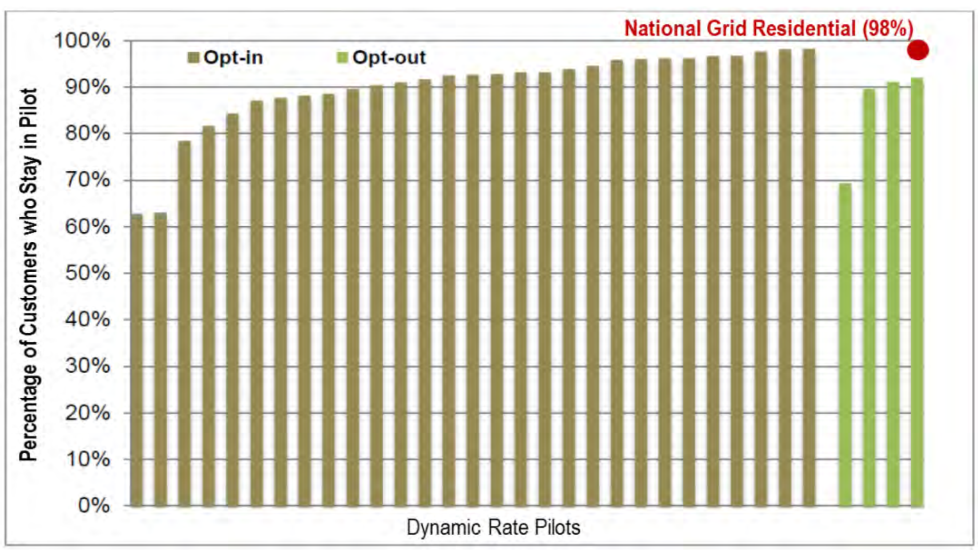
customers remain in the Pilot rather than opting out. As shown in Figure 4-7, National Grid's retention rates for residential customers are higher than other opt-out rate pilot programs, while commercial customer retention rate is within range of other opt-out rate pilot programs.

Figure 4-6. Customer Enrollment Rates Based on Opt-In vs. Opt-Out Recruitment



Source: Lawrence Berkeley National Laboratory and Navigant analysis
Note: Each bar represents a utility that has offered a dynamic rate to its customers.

Figure 4-7. Customer One-Year Retention Rate Based on Whether the Utility Used Opt-In or Opt-Out Recruitment[66]



Source: Lawrence Berkeley National Laboratory and Navigant analysis
Note: Each bar represents a utility that has offered a dynamic rate to its customers.

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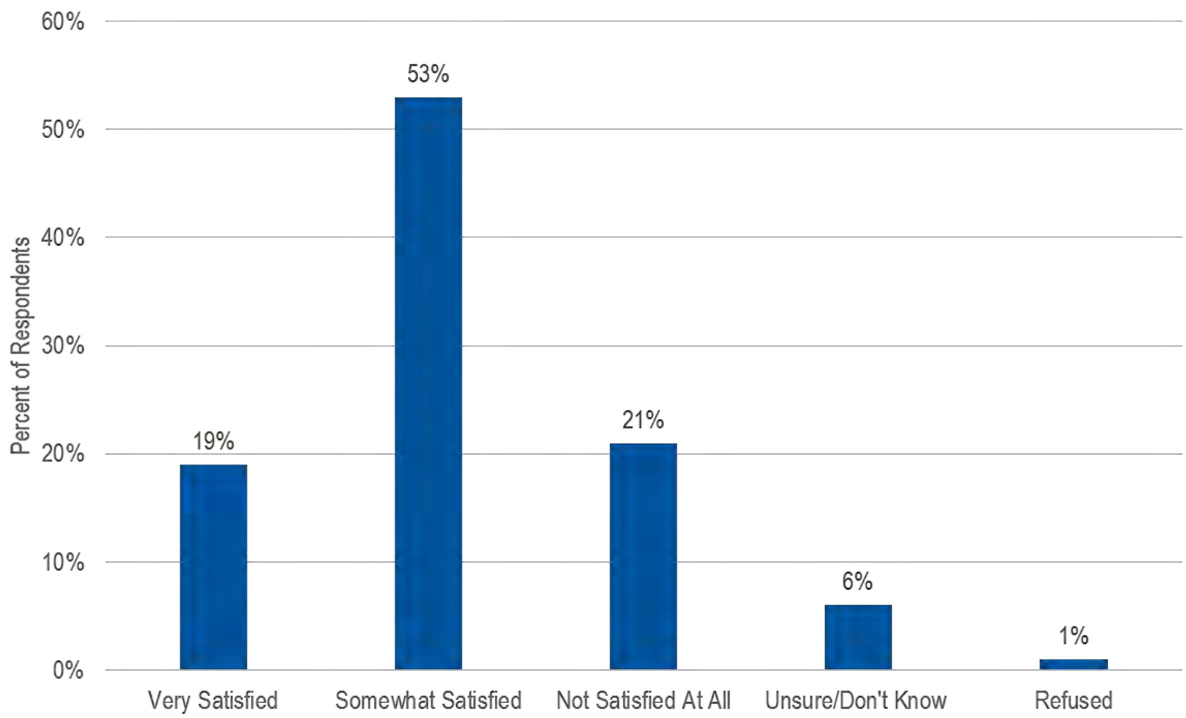
[66] National Grid customer retention is shown for the first 11 months of the Pilot rates, January 1, 2015 – November 9, 2015.

National Grid provided a lot of information about the rates, starting with an official welcome kit. It may be that the program is complex enough that having accepted a new meter and some new technology, participants tuned out the details, critical or not, past a certain point. National Grid has provided examples of participant bills to customers to illustrate the differences between the two rates. The Company will continue to provide information to explain that there are many variables determining the impact of use on cost, particularly during Peak Events, and possibly showing a few scenarios might give participants a better feel for what would work best for them.

4.2.3 High Customer Satisfaction with Program

As shown in Figure 4-8, 72% of customers report being "very satisfied" or "somewhat satisfied" with the Pilot. This satisfaction rating is similar to customer feedback to NSTAR's[67] 2012-2013 pilot, undertaken to achieve Section 85 of the GCA. NSTAR pilot customers were asked to rate the program on a 5-point scale (5 = very positive, 1=very negative, and 3 is neutral); the average rating was 4.0,[68] which is comparable to the National Grid Pilot customers' rating on the 3-category scale of "very satisfied", "somewhat satisfied", and "not satisfied at all".[69]

Figure 4-8. Participant Overall Satisfaction with the Smart Energy Solutions Program



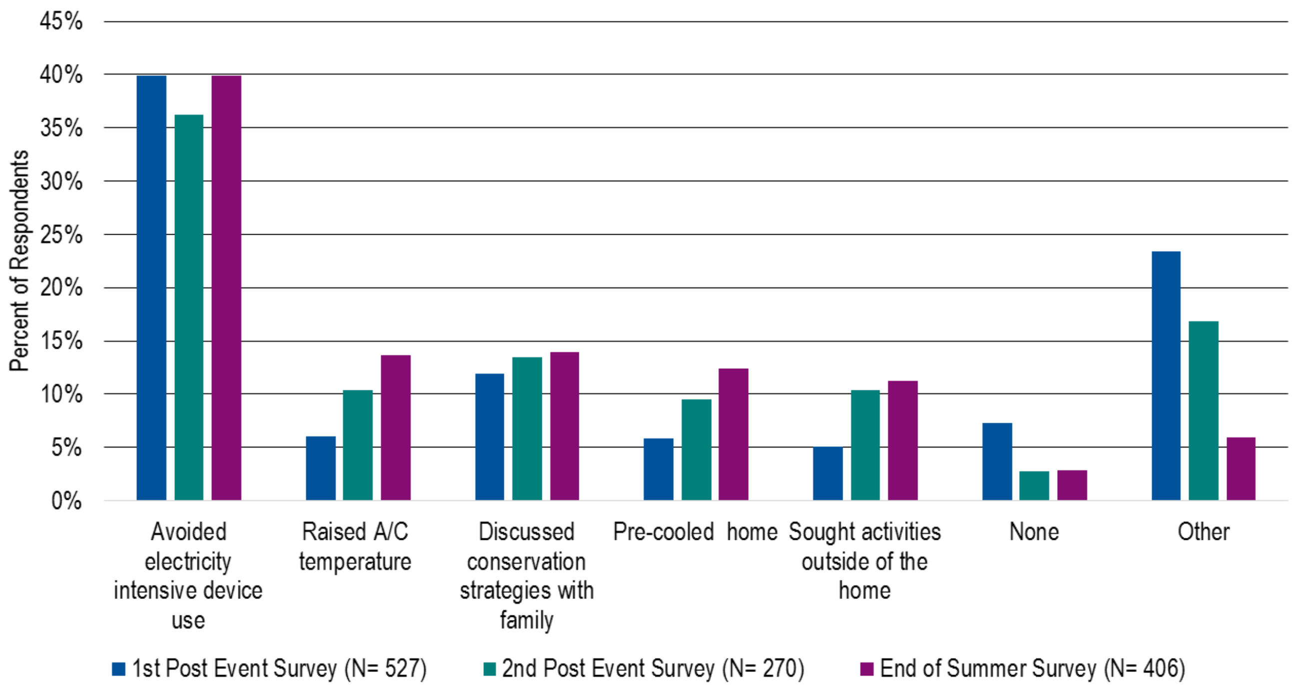
Source: Navigant analysis of the end of summer survey (N=460)

[67] NSTAR is now called Eversource Energy.
[68] Navigant. *NSTAR Smart Grid Pilot Final Technical Report: AMR Based Dynamic Pricing*. DE-OE0000292. Prepared for U.S. Department of Energy on behalf of NSTAR Gas and Electric Corporation. August 2014.
[69] National Grid customers could also indicate that they were "unsure/don't know" or refuse the question.

4.2.4 Customers Changed Electricity Usage and Behavior

In each post event survey, and at the end of the summer, as shown in Figure 4-9, many customers reported that they changed their electricity usage during Peak Events. They reduced appliance and energy-intensive device use, raised AC temperatures, and sought activities outside the home during Peak Events. The frequency with which they undertook these actions increased from the first post event survey through the end of the summer. By the end of the summer more customers took actions to reduce their electricity usage during Peak Events than at the beginning of the summer, reflecting customers' behavioral change and learning. In particular, actions such as raising AC set points increased from 6% of customers to 14% of customers by the end of the summer, pre-cooling increased from 6% of customers to 12% of customers by the end of the summer, and seeking activities outside of the home increased from 5% to 11% of customers by the end of the summer.

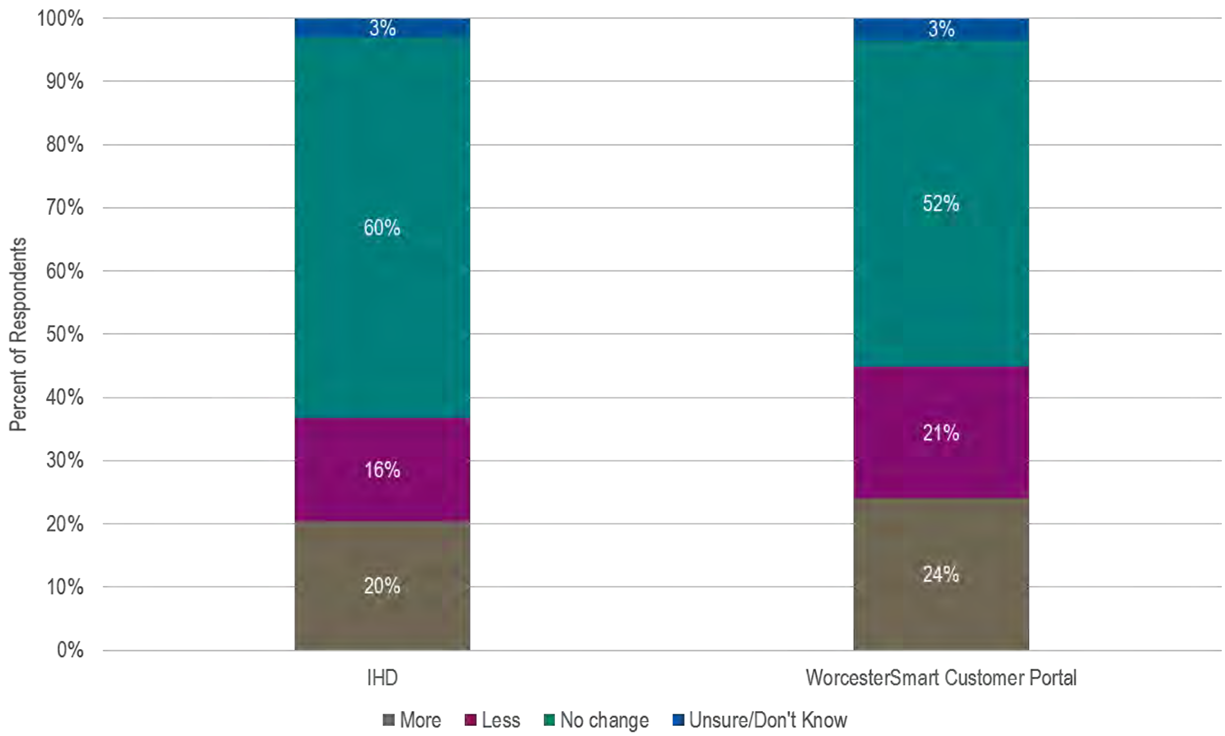
Figure 4-9. Actions Customers Took to Reduce Electricity Usage on Conservation Days



Source: Navigant analysis, post event surveys (N=527, N=270) and end of summer survey (N=406)

As shown in Figure 4-10 and Figure 4-11, most customers did not change how they used their technologies over the course of the summer. Most customers noted that they did not change the frequency with which they viewed their IHD or the WorcesterSmart web portal (60% and 52% respectively) throughout the summer.

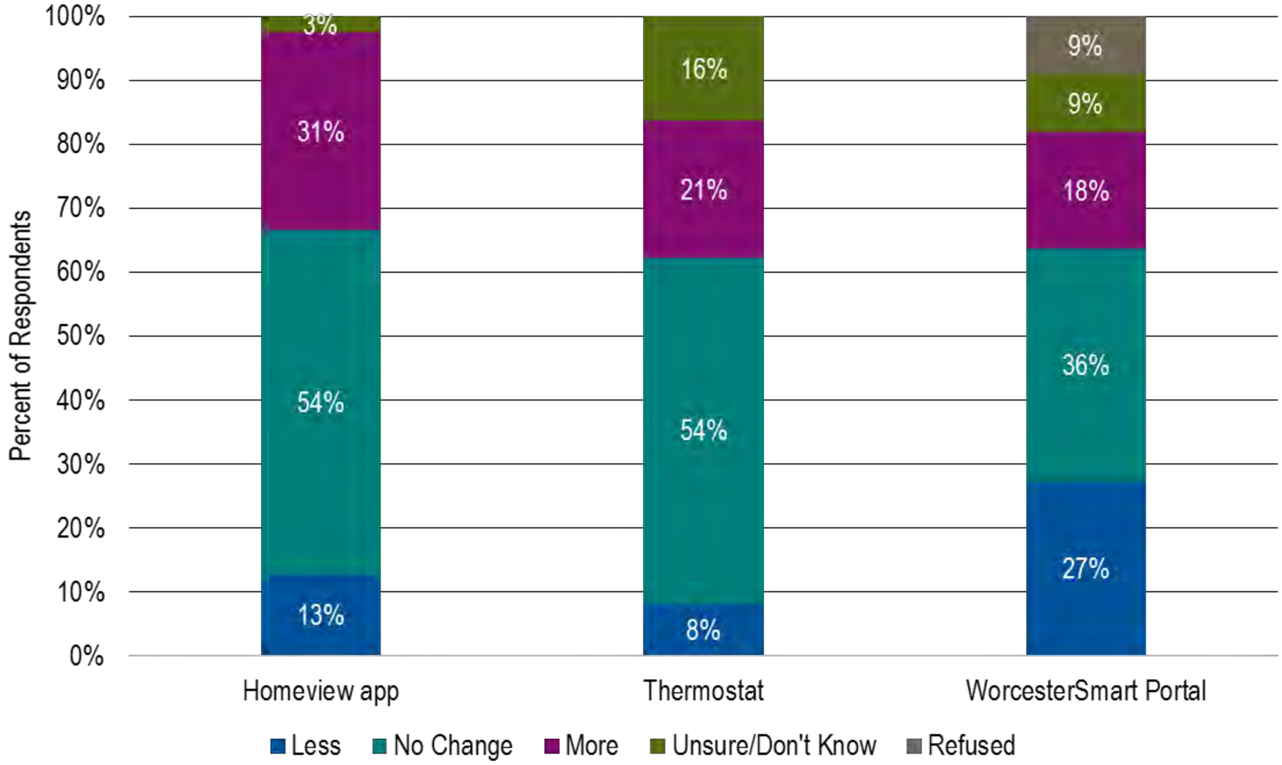
Figure 4-10. Change in Customer Viewing of Technology at the End of Summer Compared to the Beginning of Summer



Source: Navigant analysis of the end of summer survey (IHD=98, Portal =317)

When asked how they changed their remote monitoring of their Homeview app, PCT, and the WorcesterSmart web portal (Figure 4-11), most customers noted no change by the end of the summer compared to the beginning of the summer. If a customer increased remote monitoring, it was most likely their Homeview app (31%) and if they decreased remote monitoring, it was most likely the WorcesterSmart web portal (27%).

Figure 4-11. Change in Customer Remote Monitoring of Technology at the End of Summer Compared to the Beginning of Summer

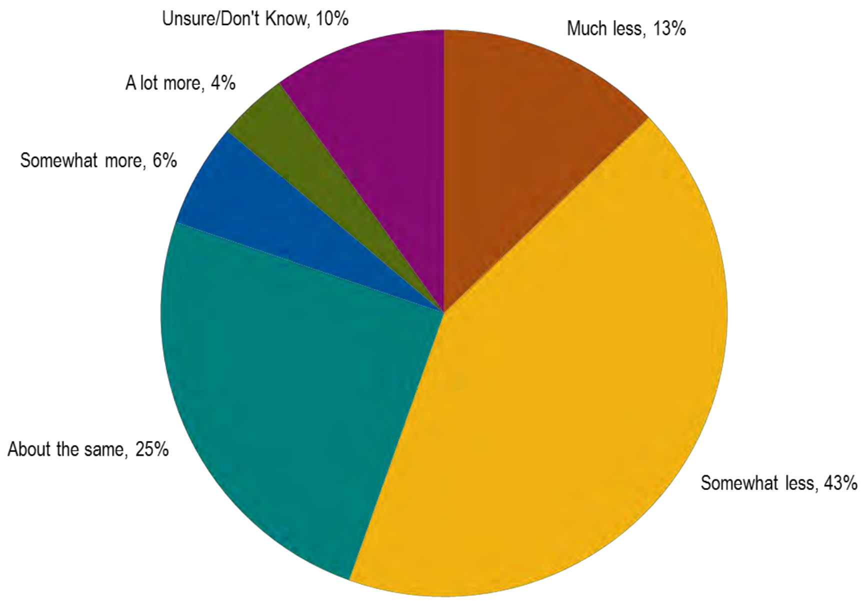


Source: Navigant analysis of the end of summer survey (App=39, PCT=60, Web Portal = 11)

4.2.5 Customers Believe they Reduced Summer Electricity Usage and Noticed Summer Bill Increase

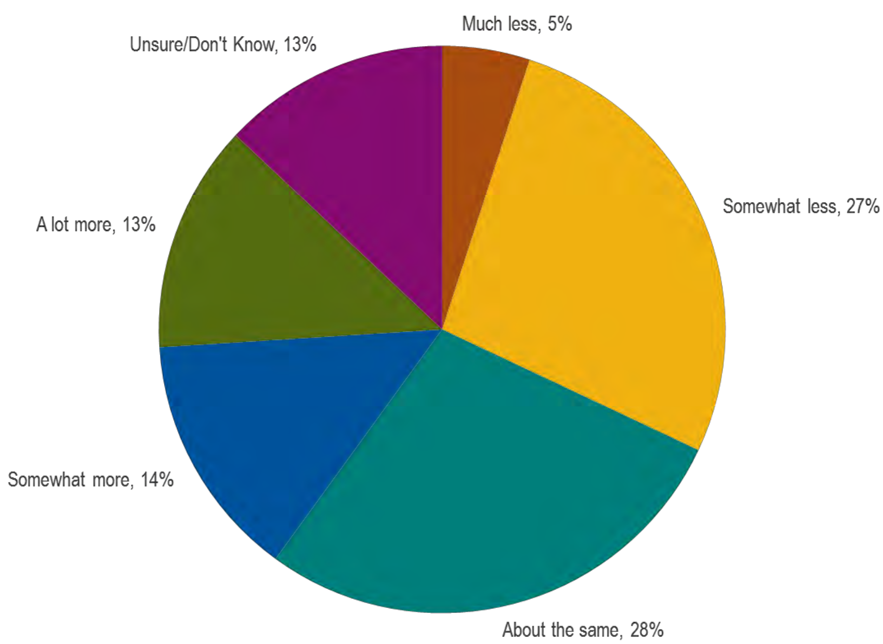
As discussed in Section 4.1.2, two of the major motivations of customers who enrolled in Smart Energy Solutions were to explore technologies that could help them reduce electricity usage and to save money on their electricity bills. Customers provided insight into their perceived savings and conservation in the end of summer survey. Most customers perceived a change in their electricity usage during the Pilot compared to a normal summer; 56% believe they reduced their electricity usage at least "somewhat" (Figure 4-12). The majority customers (32%) believe their bills decreased, perceiving the summer 2015 bill as "much less" or "somewhat less" than a normal summer (Figure 4-13), 28% said it stayed the same, while 27% believe their bill was "somewhat more" or "a lot more" compared to a normal summer. This finding that many customers said their bill increased is not surprising, as the rate is designed to save customers money over the course of the entire year rather than in any given month. The Peak Event rates were in effect for over 100 hours during the 2015 summer, so the average customer spent more on electricity during summer months than in pre-Pilot summers. Customers noticed this increase. However, they are saving during the rest of the year because the Pilot rates are lower than the Basic Rate on non-Conservation Days.

Figure 4-12. Customer Perceived Change in Summer 2015 Electricity Usage Compared to a Normal Summer



Source: Navigant analysis of the end of summer survey (N=460)

Figure 4-13. Customer Perception of Change in Summer 2015 Electric Bill Compared to a Normal Summer



Source: Navigant analysis

4.2.6 Customers Provided Feedback at the End of Summer to Improve Smart Energy Solutions

According to the post event surveys and end of summer survey, participants were aware of Conservation Days. They also acknowledged the multiple communications that they received about Conservation Days and Peak Events. National Grid provided notice of events one day prior to, and the day of, a Peak Event via a combination of telephone, email, text, notification on IHDs, and the web portal.

As part of the Company's "listen, test, learn" approach, customer feedback is sought out and taken very seriously. Some customer feedback demonstrates that customers lack understanding about the program, and National Grid will increase information and education to meet customers' needs. As shown in Figure 4-14, which summarizes feedback from the post event and end of summer surveys, participants were aware that efforts should be made to conserve electricity during critical Peak Event hours and most participants were diligent in adjusting their energy use and practices to minimize usage. According to feedback provided during the end of summer low-income focus group, low-income participants also understood that they could take steps to reduce their electricity usage during Peak Event hours. These customers also mentioned taking these energy conserving steps on days that weren't Conservation Days. Based on feedback provided via the end of summer survey and the end of summer low-income focus groups, customers wanted personalized conservation tips, transparency in bill calculations, additional information about pricing programs, and information about technologies that could help them further reduce electricity usage (Figure 4-14). Customers also desired more advance notice about Peak Events, which implies that they have limited understanding of how far in advance National Grid can confirm an event will be called. It may be of benefit to explain to customers how events are determined and that they are informed of the event as soon as National Grid is able to provide information about it.

Figure 4-14. Additional Information Customers Would Like About Smart Energy Solutions

Source: Navigant analysis, end of summer survey

In addition to wanting more specific information about the program, customers had several requests for National Grid to improve Smart Energy Solutions at the end of the summer. As shown in Figure 4-15, customers want lower rates, shorter Peak Event timeframes, fewer Peak Events, and additional information about their usage. Customers prefer text or email notifications over phone calls and voicemails and want notifications to include future events. While these comments are critical, they show that customers are aware of and engaged with the Pilot. As discussed in Section 4.2.3, 72% of customers are "very satisfied" and "somewhat satisfied." Feedback is part of National Grid's "listen, test, learn" approach, and serves as the basis for adjustments to the Pilot that will improve customer experience.

Figure 4-15. Customer Recommendations to Improve Smart Energy Solutions

Conservation Day Notification	Peak Events	Usage Information
"One mode of communication."	"Shorten the time frames on event days, 8 hours is a long time to shutdown AC, etc."	"I want a screen that tells me my real time usage. That's very important. My whole family can be involved with this program if they could see what impact their daily activities have on our bill."
"Stop calling and leaving a million voicemails."	"Don't run a peak event past 5 pm."	"Don't double the rates and simply educate your customers on how important it is to save energy. Use social media platforms and smart energy campaigns to get your customers involved. Don't just decide to test us and make us pay more."
"Make it easier to opt out of the phone calls."	"Charge lower peak rates."	"I do most of all the suggestions they recommend and yet my bill is high. Other than going out and buying all new appliances which would cost me a fortune to save maybe $10 a month, I don't know what else to do."
	"Not having 3 days in a row, maybe reducing the number of hours."	
	"The peak events go too late into the evening, 6:00 PM should be the cutoff."	

Source: Navigant analysis, end of summer survey

5. Conclusions and Recommendations

5.1 Key Takeaways

National Grid's Pilot is an innovative smart grid pilot combining deployment of advanced meters, customer-facing technologies, and TOU) rates that will run through the end of 2016. The Pilot also includes advanced distribution grid-side technologies which are the subject of a separate report.[70] This interim evaluation, conducted by Navigant, covers Pilot activities through November 2015. Key findings from this interim evaluation are shown in Figure 5-1.

Figure 5-1. Key Findings from Interim Evaluation of Smart Energy Solutions

Energy and Demand Savings for Active Customers	• Load reductions ranged from 10% to 31% (0.12 to 0.56 kW) during Conservation Day Peak Events depending on the combination of rates and technology • Nearly 5% (approximately 30 kWh per month) energy savings from January - September 2015 for most customers on CPP
Enabling Technologies Increase Demand Savings for Active Customers	• Customers with programmable communicating thermostats have the highest load reductions (29%-31% on CPP and 22% on PTR) • Customers with in-home displays are next (17% on CPP and 9% on PTR), followed by customers with Web Portal access only (12% on CPP and 10% on PTR)
Bill Savings	• Average per customer bill savings of $109 from Janaury - September 2015 for customers on CPP • Average total rebates of $20 for summer 2015 Conservation Day Peak Events for customers on PTR
High Retention Rate	• 98% of customers remained in the Pilot as of November 9, 2015 after rates went live on January 1, 2015.
High Customer Satisfaction	• 72% of customers are "very satisfied" or "somewhat satisfied" with Smart Energy Solutions

Source: Navigant analysis

Note: CPP refers to Critical Peak Pricing and PTR refers to Peak Time Rebate.

5.2 Lessons Learned and Potential Changes for 2016

Before and throughout the Pilot, National Grid has implemented a "listen, test, learn" approach that is based on "on the ground" conversations and reflections on the Pilot. This feedback, combined with learning, leads to continual improvement. National Grid conducted extensive program marketing in the lead up to initiating meter installations, the first phase of the program. These activities included

[70] National Grid. *Interim Grid-Facing Evaluation Report*, forthcoming.

convening a public summit to discuss the proposed program, development of brochures explaining the program, and establishment of the staffed, physical Sustainability Hub within the Pilot program area. National Grid also partnered with local schools. Clark University offered annual internships, and Worcester Polytechnic Institute created a student Sustainability Ambassador program. Ambassadors host Sustainability Hub tours and attend outreach events to educate customers throughout the community. Presenting the personal side of the Company is the backbone of "listen, test, learn", and is the inspiration for sending National Grid employees and Ambassadors into the community. It is also the basis for hosting visitors at the Sustainability Hub for the dual purpose of educating customers and listening to their concerns and feedback.

Several broad themes emerged regarding customer response to the Pilot design and implementation: Impacts for active customers are very close to meeting the goals established through Section 85 of the GCA, and the majority of customers are satisfied with the Pilot. That said, National Grid is striving for continual improvement of the Pilot and has several changes planned for 2016 based on lessons learned from the Pilot thus far and this interim evaluation.

Learning 1: Many customers want shorter and fewer Peak Events.
Nine of the 20 Peak Events in the summer of 2015 ran for eight hours and 17 of the 20 events were part of a back-to-back series, when events occurred multiple days in a row. In the end of the summer survey, many customers commented that they felt fatigued by the Peak Events and complained that the Peak Events were too long and occurred too many days in a row. Several customers said that the duration of the events constrained their schedules, and they had limited relief from the heat and humidity because National Grid scheduled multiple Conservation Days in a row.
Planned Adjustment 1: Increase customer understanding of how Peak Events are designed. National Grid will continue calling Peak Events in 2016 up to the approved 30 Conservation Days and 175 Peak Event hours. However, National Grid is listening to customers. The Company is revisiting the peak load threshold for which it calls Peak Events, as well as the process behind calling the events in order to reduce customer exhaustion as much as possible. Moreover, National Grid plans to improve its efforts to educate customers about the Pilot design and the reason for calling Peak Events, and provide tips for managing schedules and comfort during Peak Events.

Learning 2: Many customers want fewer or different notifications about Peak Events.
National Grid set the default Peak Event notification method as phone calls the day before, as well as the day of, Conservation Days. Many customers provided feedback that this was too much communication and appeared unaware that they could reduce the number of phone calls or request other forms of notification such as emails or text messages. As part of offering customers flexibility and the ability to customize the Pilot to their needs, National Grid has always provided the option of changing communication methods and frequency. Customers need only contact National Grid or access their online account on the Pilot's web portal.
Planned Adjustment 2: Increase ease of adjusting Peak Event notifications. Realizing that many customers may not have been aware of their notification options, National Grid will seek new ways to make it even easier for customers to manage their Peak Event notifications, and will continue to inform customers of their options.

Learning 3: Active customers in Level 1 save more – in energy, demand, and dollars – than passive customers. Active Level 1 customers have load reductions during Peak Event hours of 12% and 10%

compared to 1% and 2% for passive customers on the CPP and PTR rate, respectively. Active CPP customers have energy savings from January to September 2015 of 4.5% compared to -0.6% for passive customers. Finally, active CPP customers saved $126 on their bills from January to September 2015 compared to $64 for passive customers, though active and passive PTR customers had almost the same savings at $18.

Planned Adjustment 3: Encourage and increase the use of the web portal by Level 1 customers. To help more customers increase their electricity and bill savings, National Grid will increase promotion of the web portal to passive customers through established customer outreach and education channels.

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Appendix A. Impact Assessment Methodology

Navigant evaluated energy and demand impacts from the Pilot using regression analysis of monthly bills and hourly customer loads, respectively. Energy and demand impacts are estimated by technology/price group. A single regression is estimated for each group when the number of customers in the group is large enough or in combined regressions with dummies to separate the effect for each group individually if there are too few customers. Navigant also estimated impacts by demographic subgroup as the data allowed, i.e., when there were enough customers in a given subgroup to estimate savings via regression analysis.

A.1 Peak Event Impacts

Navigant used a residential *ex-post* model to estimate demand impacts, which includes variables to control for temperature, humidity, intra-seasonal, intra-weekly and intra-daily (i.e., hourly) seasonality, and the build-up of heat in the home over four- and 24-hour periods. The model includes additional controls for the way that the relationship between demand and temperature can vary by month and for the possibly non-linear manner in which heat build-up may affect household demand.

The impacts and snapback were estimated using a battery of dummy variables that were specific to each unique event day, quarter-hour of day combination. In effect, the model ascribes all event- and snapback hour variation in demand from the baseline to the event (or the snapback). Navigant also explored the possibility of pre-cooling but did not find significant evidence of its existence, as such pre-cooling was left out of the final model specification.

For each stratum over the period from 8 a.m. to 10 p.m. from June through September 2014 and 2015 the regression model in Equation A-1 was estimated.

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Equation A-1. Residential *Ex-post* Regression Model to Estimate Demand Savings

$$
\begin{aligned}
y_{k,t} = {} & \alpha_k + \sum_{i=1}^{55} \beta_i^h \cdot qh_{i,t} + \sum_{s=1}^{S=22} \sum_{i=1}^{55} \beta_{i,s}^e \cdot qh_{i,t} \cdot e_{s,t} + \sum_{s=1}^{S=22} \sum_{r=1}^{R=20} \beta_{s,r}^s \cdot qh_{i,t} \cdot s_{s,r,t} + \sum_{i=1}^{55} \beta_i^{CDH} \cdot qh_{i,t} \cdot CDH65_t + \sum_{i=1}^{55} \beta_i^{HDH} \cdot qh_{i,t} \cdot HDH65_t \\
& + \sum_{i=1}^{55} \beta_i^{THI} \cdot qh_{i,t} \cdot THI_t + \sum_{i=1}^{55} \beta_i^{THI_{15}} \cdot qh_{i,t} \cdot THI\_lag15_t + \sum_{i=1}^{55} \beta_i^{THI_{30}} \cdot qh_{i,t} \cdot THI\_lag30_t + \sum_{i=1}^{55} \beta_i^{THI_{45}} \cdot qh_{i,t} \cdot THI\_lag45_t \\
& + \sum_{i=1}^{55} \beta_i^{THI_{60}} \cdot qh_{i,t} \cdot THI\_lag60_t + \sum_{i=1}^{55} \beta_i^{CDTH} \cdot qh_{i,t} \cdot CDH65_t \cdot THI_t + \sum_{i=1}^{55} \beta_i^{MA24CD} \cdot qh_{i,t} \cdot MA24\_CDH65_t \\
& + \sum_{i=1}^{55} \beta_i^{MA24CDTH} \cdot qh_{i,t} \cdot MA24\_CDH65_t \cdot THI_t + \sum_{i=1}^{55} \beta_i^{MA4CD} \cdot qh_{i,t} \cdot MA4\_CDH65_t \\
& + \sum_{i=1}^{55} \beta_i^{MA4CDTH} \cdot qh_{i,t} \cdot MA4\_CDH65_t \cdot THI_t + \sum_{i=1}^{55} \beta_i^{RH} \cdot qh_{i,t} \cdot RH_t + \sum_{i=1}^{55} \sum_{d=1}^{7} \beta_d^{DoW} \cdot qh_{i,t} \cdot DoW_{d,t} \\
& + \sum_{i=1}^{55} \sum_{m=6}^{M=9} \beta_m^{Month} \cdot qh_{i,t} \cdot Month_{m,t} + \sum_{i=1}^{55} \sum_{m=6}^{M=9} \beta_m^{MonthCDH} \cdot qh_{i,t} \cdot Month_{m,t} \cdot CDH_t \\
& + \sum_{i=1}^{55} \sum_{m=6}^{M=9} \beta_m^{MonthTHI} \cdot qh_{i,t} \cdot Month_{m,t} \cdot THI_t + \sum_{i=1}^{55} \beta_i^{pmMA24CD2} \cdot pm_{i,t} \cdot MA24\_CDH65_t^{\,2} \\
& + \sum_{i=1}^{55} \beta_i^{pmMA24CD2TH} \cdot pm_{i,t} \cdot MA24\_CDH65_t^{\,2} \cdot THI_t + \sum_{i=1}^{55} \beta_i^{pmMA4CD2} \cdot pm_{i,t} \cdot MA4\_CDH65_t^{\,2} \\
& + \sum_{i=1}^{55} \beta_i^{pmMA4CD2TH} \cdot pm_{i,t} \cdot MA4\_CDH65_t^{\,2} \cdot THI_t + \sum_{i=1}^{55} \beta_i^{peak} qh_{i,t} \cdot peakhour\_2015_t + \sum_{i=1}^{55} \sum_{d=1}^{7} \beta_d^{weekend} qh_{i,t} \cdot weekend\_2015_{d,t} \\
& + \varepsilon_t
\end{aligned}
$$

Where:

$y_{k,t}$	=	The average kWh usage of household *k* in quarter-hour *t*.
$qh_{i,t}$	=	A dummy variable equal to one if *i* is equal to the quarter-hour defined by *t*. For example, if quarter-hour *t* were 12-12:15 p.m. then $h_{17,t}$ would equal one and $h_{1,t}$ to $h_{16,t}$ and $h_{18,t}$ to $h_{55,t}$ would all be equal to zero.[71]
$e_{s,t}$	=	A dummy variable equal to one if there is a Peak Event taking place in quarter-hour *t* on event day *s* (one of the 20 Peak Event days) and zero otherwise.
$s_{s,r,t}$	=	A dummy variable intended to capture the effect of snapback in the period following the end of the event period. The *r*-th dummy is equal to one if period *t* is the *r*-th period following the end of a Peak Event and the event in quarter-hour *t* corresponds to event *s*. Note that snapback is modeled only within the same day as the event, thus the highest value attained by R was 20 (for the events ending at 5 p.m.), and the lowest was 8 (for the events that ended at 8 p.m.).
$CDH65_t$	=	Cooling degree hours observed in quarter-hour *t* – base is 65 degrees F.
$HDH65_t$	=	Heating degree hours observed in quarter-hour *t* – base is 65 degrees F.
THI_t	=	Temperature humidity index in quarter-hour *t*
$MA24\_CDH65_t$	=	Cooling degree hours calculated based on a 24 hour moving average of temperatures leading up to quarter-hour *t*. This variable helps capture the effect on demand of heat build-up during periods of extended high temperatures.

[71] Recall that only hours between 8 a.m. and 10 p.m. are included in the regression.

$MA4\_CDH65_t$	=	Cooling degree hours calculated based on a 4 hour moving average of temperatures leading up to quarter-hour *t*. This variable helps capture the effect on demand of heat build-up during short periods of high temperatures followed by precipitous drops in temperature such as during a storm.
$MA4\_THI_t$	=	Temperature humidity index calculated based on a 24 hour moving average of the temperature humidity index leading up to quarter-hour *t*. This variable helps capture the effect on demand of heat build-up during short periods of high temperatures followed by precipitous drops in temperature such as during a storm.
RH_t	=	Relative humidity quarter-hour *t*.
$DoW_{d,t}$	=	A dummy variable equal to one if quarter-hour *t* falls in the day of the week indicated by subscript *d*. A value of *d* of 1 indicates a Sunday, and a value of 7 indicates a Saturday.
$Month_{m,t}$	=	A dummy variable equal to one if quarter-hour *t* falls in month *m*, and zero otherwise. Note that only the months of June through September are included in the estimation sample.
$CDD65_t$	=	Cooling degree days observed on the day in which quarter-hour *t* falls – base is 65 F.
$pm_{it,}$	=	A dummy variable equal to one if quarter-hour *t* falls between noon and 9 p.m.
$peakhour\_2015_t$	=	A dummy variable equal to one if quarter-hour *t* falls during a peak hour, 8 a.m. to 8 p.m., in 2015. This variable captures the effect of the Smart Rewards Pricing on usage during non-event peak hours.
$weekend\_2015_{d,t}$	=	A dummy variable equal to one if quarter-hour *t* falls on a weekend in 2015. This variable captures the effect of the pricing scheme and the Peak Events on weekend usage, for example, weekend usage might go up if customers shift loads to the weekend to avoid the higher weekend day and Peak Event pricing.

Each regression creates an estimated fitted average per-participant baseline for every day included in the regression. The regression in Equation A-1 is estimated using energy usage, kWh, over 15 minute periods which is then aggregated to the hour to get demand, kW, impacts. For each event day, the evaluation team estimates a day of adjustment by subtracting actual usage from the fitted usage for the time from 8 a.m. until the start of the event. The day of adjustment is subtracted from fitted usage for the entire day to create an adjusted fitted baseline. Demand savings are calculated by subtracting actual usage from the adjusted fitted baseline in each time period of the event.

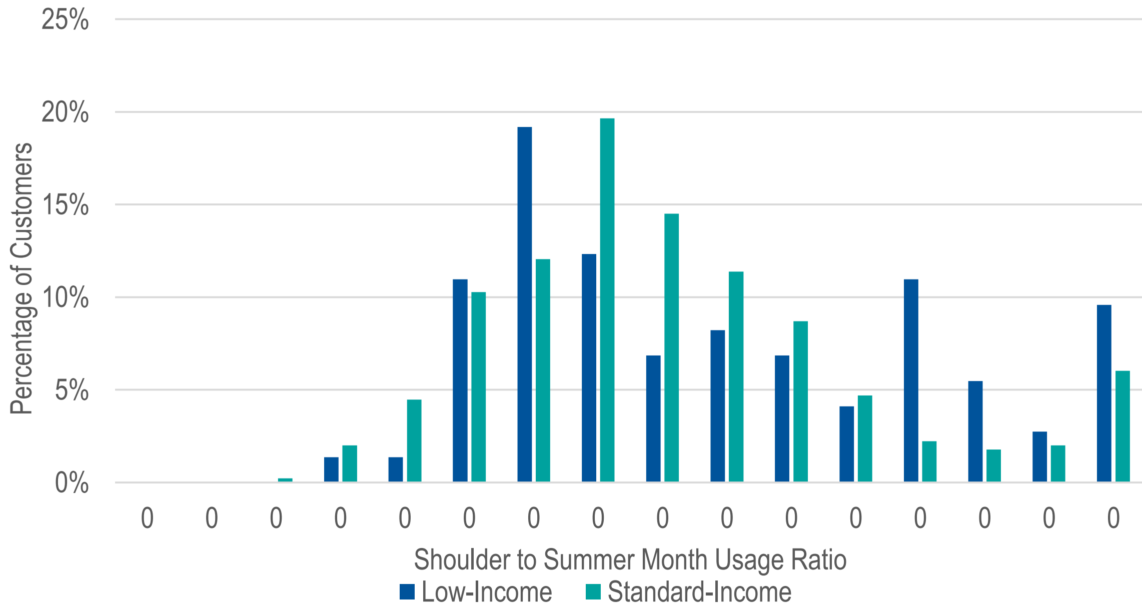
A.2 CAC Penetration

Navigant identified customers likely to have CAC in Level 2 CPP by examining the ratio of shoulder to summer month usage.[72] A customer with CAC is likely to have considerably higher usage in the summer than in the shoulder months; therefore, a lower shoulder to summer month usage ratio indicates a higher likelihood of having CAC. Figure A-1 shows the distribution of the shoulder to summer month usage ratio for low-income and standard-income customers in Level 2 CPP. The percentage of customers with a ratio below 0.9 is 52% for low-income customers and 63% for standard-income customers. This suggests that there may be lower CAC penetration for low-income customers as

[72] Navigant chose to use July and August as the summer months and May and October as the shoulder months.

a lower percentage of them have a low shoulder to summer month usage ratio.

Figure A-1. Shoulder to Summer Month Usage Ratio for Level 2 CPP Customers by Income Level



Source: Navigant analysis

A.3 Energy Impacts

Navigant estimated the reduction in energy use for 2014 when just the informational portion of the program was in effect and for 2015 when the new Smart Rewards Pricing was put into effect and 20 Peak Events were called. In order to estimate energy impacts via regression analysis Navigant drew matched controls from a large pool of non-participant households in ZIP codes near the Worcester area where the Pilot took place.[73] The basic logic of matching is to balance the participant and non-participant samples by matching on the exogenous covariates known to have a high correlation with the outcome variable. Doing so increases the efficiency of the estimate and reduces the potential for model specification bias. Formally, the argument is that if the outcome variable Y is independently distributed conditional on X and D (conditional independence assumption), where X is a set of exogenous variables and D is the program variable, then the analyst can gain some power in the estimate of savings and reduce potential model specification bias by assuring that the distribution of X is the same for treatment and control observations.

In this evaluation, the outcome variable is daily post-program period energy use, and the available exogenous covariate with by far the greatest correlation with this outcome variable is average daily use in the same month of the pre-program period, $PrekWh_{k,t}$, where k indexes the customer and t indexes the

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[73] Navigant used households in the following ZIP codes in the pool of non-participants from which to draw matched controls: 01601, 01602, 01603, 01604, 01605, 01606, 01607, 01608, 01609, 01610, 01611, 01501, 01527, 01545, 01505, 01583, 01520, 01612, 01524, 01542, 01537, 01540, 01590, 01519, 01560, 01588, 01534, 01568, 01532, 01581, 01522, 01507, and 01562.

month. After drawing matches, the evaluation team runs the regression analysis to further control for any remaining imbalance in the matching on this variable. If, for instance, after matching the participants use slightly more energy on average in the pre-program period than their matches—they are higher baseline energy users, in other words—then including $PrekWh_{k,t}$ as an explanatory variable in a regression model predicting daily energy use during the post-program period prevents this remaining slight difference in baseline energy use from being attributed to the program.

The development of a matched comparison group is viewed as a useful pre-processing step in a regression analysis to assure that the distributions of the covariates (i.e., the explanatory variables on which the output variable depends) for the treatment group are the same as those for the comparison group that provides the baseline measure of the output variable. This minimizes the possibility of model specification bias.

After matches were drawn on the pre-program period, 2013, energy impacts were estimated for each year and stratum using regression analysis of monthly billing data as shown in Equation A-2. For 2014, energy impacts were estimated for the full year, while for 2015 they were estimated from January through August, which is the most recent month for which the evaluation team has billing data. For 2015, savings were estimated separately in each month by interacting the participant variable in Equation A-2 with the monthly dummies.

Equation A-2. Post-Program Regression Model to Estimate Energy Savings

$$y_{k,t} = \beta_1 Participant_k + \sum_i \beta_{2i} Month_{i,t} + \sum_i \beta_{3i} Month_{i,t} \cdot PrekWh_{k,t} + \beta_4 cdd_{k,t} + \beta_5 hdd_{k,t} + \varepsilon_{k,t}$$

Where:

$y_{k,t}$	=	The average daily consumption of kWh by household *k* in bill period *t*.
$Participant_k$	=	A dummy variable equal to one if household *k* is a participant in the Pilot, and zero otherwise.
$Month_{i,t}$	=	A dummy variable equal to one when *i* equals *t*, and zero otherwise. In other words this is a monthly fixed effect.
$PrekWh_{k,t}$	=	Household *k*'s average daily consumption of kWh in the same calendar month of the pre-program year (2013) as the calendar month of month *t*.
$cdd_{k,t}$	=	The cooling degree days in bill period t for household *k*.
$hdd_{k,t}$	=	The heating degree days in bill period t for household *k*.

In each regression, the coefficient β_1 is the estimate of the reduction in average daily kWh consumption by program participants.

A.4 Bill Savings

CPP Customers

To estimate the monthly bill impacts of the Pilot for CPP customers, Navigant calculated the bill amount using actual usage under the Smart Rewards TOU pricing rates and the counter-factual bill amount using counter-factual usage in the absence of the program under the Basic Rate. Counter-factual usage was estimated using the energy savings estimated in Equation A-2. In cases where the energy savings were not statistically significant at the 90% level, Navigant still used the point estimate of savings to estimate counter-factual usage. In an unbiased regression, the point estimate of savings is a more accurate estimate of savings than zero, even when the point estimate is not statistically significant. Bill savings were calculated by technology level and were split out by income level.[74]

National Grid gave Navigant the actual bill amount paid by each participant in the Pilot; the TOU rates are shown in

. To estimate the counter-factual bill amount, the evaluation team calculated counter-factual usage in the absence of the program and multiplied it by the Basic Rate shown in Table A-2 to get commodity cost. Navigant then applied the non-commodity charges which were the same for the TOU rate and the Basic Rate. Once the evaluation team knows the bill amount under the program and in the absence of the program, subtraction gives the bill savings. These steps are laid out in Equation A-3.

Equation A-3. Bill Savings Calculation for CPP Customers

$$Counter\_Cost = basic\_rate * (actual\_usage * (1 - energy\_savings)) + non\_commodity\_charges$$
$$bill\_savings = Pilot\_Cost - Counter\_Cost$$

Table A-1. Smart Rewards Pricing Rate

Residential (R-1, R-2)				
Effective for Usage During the Month of:	Rate (cents / kWh) Smart Rewards Pricing			
	Peak Period	Off-Peak Period	Peak Event Period	Conservation Day Rebate
October, 2015	8.859	7.313	43.544	(43.544)
September, 2015	8.859	7.313	43.544	(43.544)
August, 2015	8.859	7.313	43.544	(43.544)
July, 2015	8.859	7.313	43.544	(43.544)
June, 2015	8.859	7.313	43.544	(43.544)
May, 2015	8.859	7.313	43.544	(43.544)
April, 2015	15.537	12.675	79.730	(79.730)
March, 2015	15.537	12.675	79.730	(79.730)
February, 2015	15.537	12.675	79.730	(79.730)
January, 2015	15.537	12.675	79.730	(79.730)

Source: National Grid

[74] Low-income customers are given a 25% discount on their entire bill, including both the commodity and non-commodity charges.

Table A-2. Basic Rate

Fixed Price Options	
Effective During the Period of:	Rate (cents / kWh)
11/1/15–4/30/16	13.038
5/1/15–10/31/15	9.257
11/1/14–4/30/15	16.273

Source: National Grid

PTR Customers

For PTR customers, the bill savings were primarily due to the rebate during Peak Events since these customers were not on the TOU rate. The rebate was calculated by subtracting the actual electricity consumed during Peak Events from the counter-factual consumption during Peak Events, as calculated by the demand impact analysis, and multiplying by the rebate amount in cents per kWh, shown in Table A-1. This calculation is shown in Equation A-4.

Equation A-4. Rebate Calculation for PTR Customers

$$rebate = (counter\_usage - actual\_usage) * rebate\_per\_kwh\_saved$$

Navigant also calculated bill savings outside of Peak Events using the energy savings analysis. In this case, the evaluation team calculated the rebate as shown in Equation A-4 and calculated counter-factual usage for the entire month similarly to how it was done for CPP customers. Navigant also calculated the bill amount for actual usage without the rebate. The bill savings were then the actual bill amount minus the rebate minus the counter-factual usage multiplied by the Basic Rate, as shown in Equation A-5.

Equation A-5. Bill Savings Calculation for PTR Customers

$$Pilot\_Cost = actual\_usage * basic\_rate$$

$$Counter\_Cost = basic\_price * (actual\_usage * (1 - energy\_savings)) + non\_commodity\_charges$$

$$bill\_savings = rebate + (Pilot\_Cost - Counter\_Cost)$$

A.5 Load Shifting

In addition to capturing demand savings during a Peak Event, Equation A-1 is also set-up to capture snapback after an event, peak savings during times outside of a Peak Event, and evidence of load shifting to weekends.

The coefficient on $qh_{i,t} \cdot s_{s,r,t}$ which is the quarter-hour dummy interacted with the snapback dummy captures whether participants increased usage after the Peak Event relative to what they would have used in the absence of the event. Such snapback would reduce the total demand reduction attributable to the Pilot. A positive coefficient indicates that snapback is occurring.

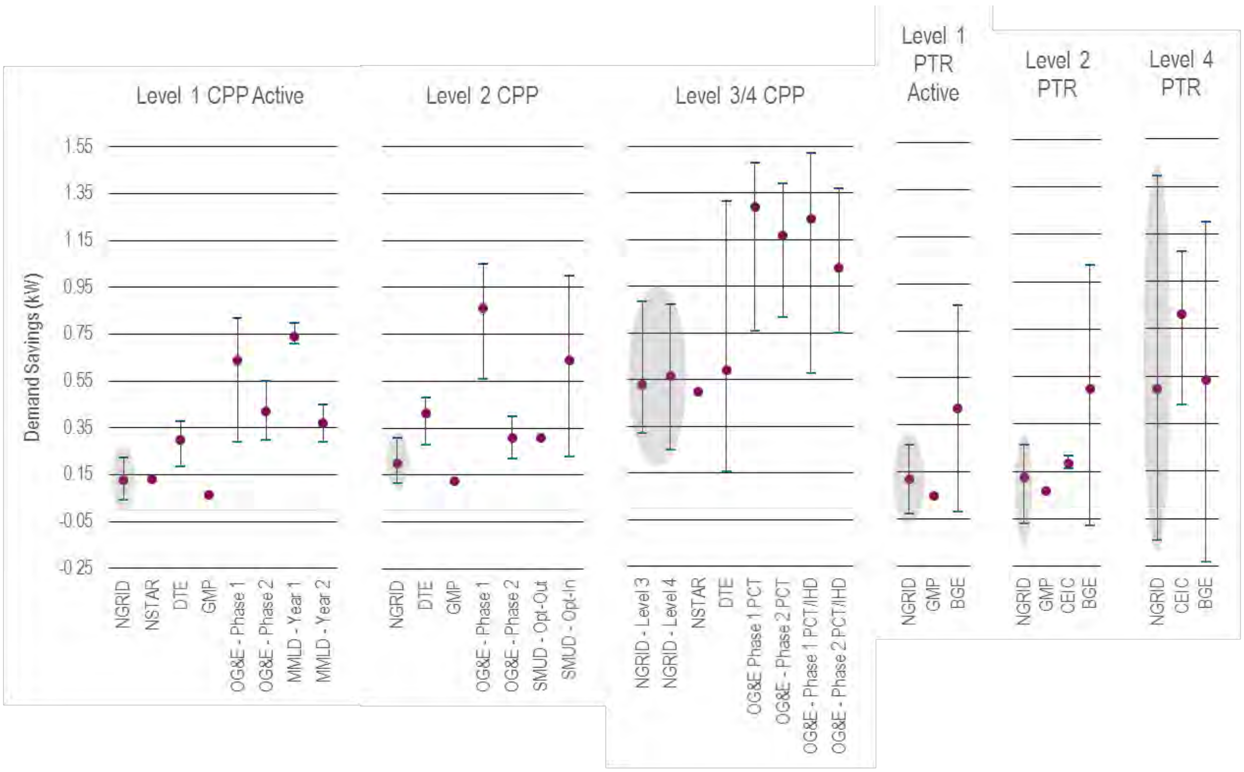
The coefficient on *peakhour_2015*$_t$ captures the demand reduction during peak hours (8 a.m. to 8 p.m.) in 2015 that are not also during Peak Events. A negative coefficient indicates a reduction in usage due to the program. This captures whether the Pilot reduces peak usage when a Peak Event is not called.

The coefficient on *weekend_2015*$_{d,t}$ captures the change in usage on weekends in 2015. This indicates whether participants are shifting usage from weekdays which have TOU pricing to weekends which have a flat rate. A positive coefficient indicates that load shifting to the weekend is occurring.

Appendix B. Additional Impact Assessment Results

Figure B-1 shows comparisons of the Pilot to other utility programs for the absolute impacts during Peak Event hours. The Pilot had slightly lower absolute impacts than the comparison programs for most of the technology/price groups. Combined with the percentage comparisons, this suggests that National Grid has slightly lower baseline usage than most of the comparison utilities.[75]

Figure B-1. Peak Event Impacts Absolute Comparison to Other Utilities

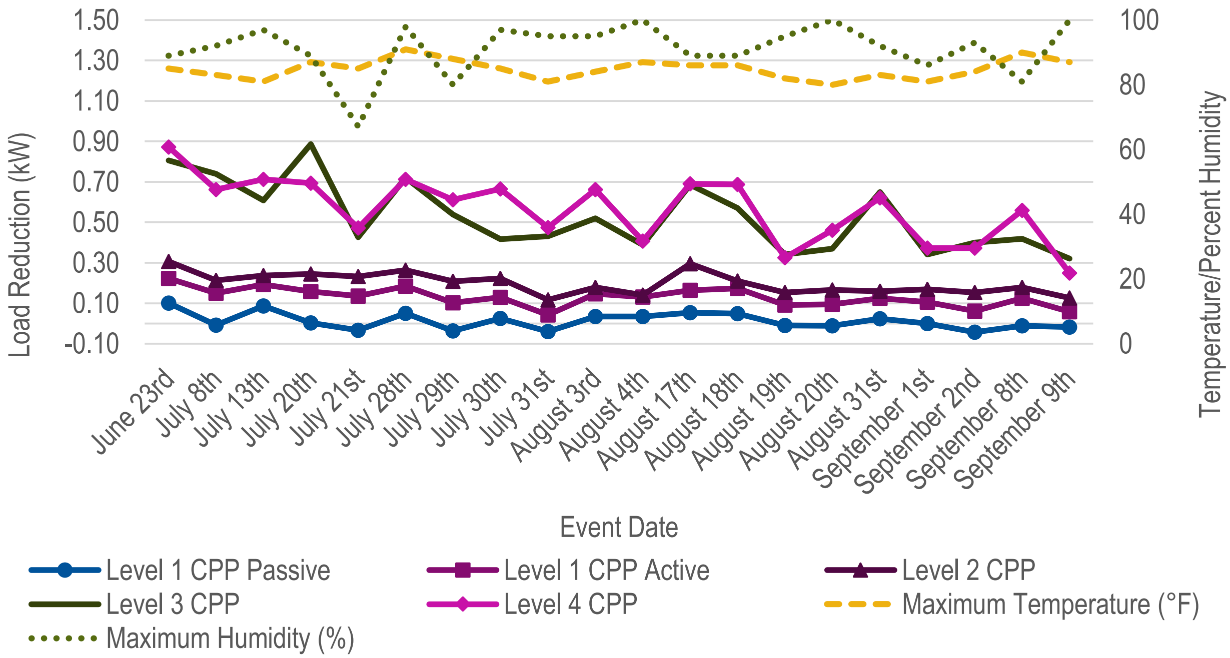


Source: Navigant analysis and the Smart Grid Investment Grant program

Figure B-2 shows the average absolute impact for each event for the five CPP customer groups, and Figure B-3 shows the average absolute impact for each event for the four PTR groups. The absolute savings followed the same patterns as the percentage savings, with steady impacts for Levels 1 and 2 and decreasing impacts throughout the summer for Levels 3 and 4.

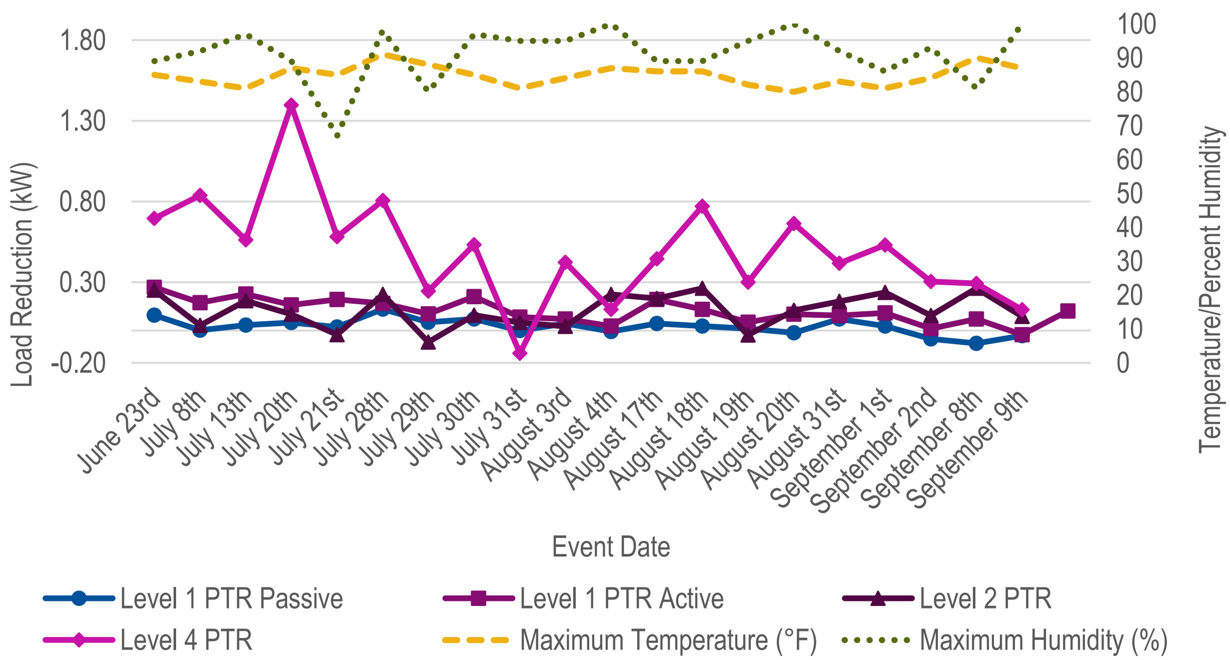
[75] National Grid having lower baseline usage could cause National Grid's total savings to be slightly lower than those for comparable programs even though the percentage savings are the same.

Figure B-2. Absolute Savings for CPP Customers



Source: Navigant analysis

Figure B-3. Absolute Savings for PTR Customers



Source: Navigant analysis

Absolute and percentage impacts by technology/price group for each Peak Event in the summer of 2015 are shown in Table B-1 and Table B-2. Positive values indicate savings, or a decrease in electricity usage, and negative values indicate dissavings, or an increase in electricity usage.

Table B-1. Percentage Demand Impact for each Peak Event by Technology/Price Group

Event Date	Level 1 CPP Passive	Level 1 CPP Active	Level 1 PTR Passive	Level 1 PTR Active	Level 2 CPP	Level 2 PTR	Level 3 CPP	Level 4 CPP	Level 4 PTR
June 23rd	9% *	21% *	9% *	23% *	27% *	20%	50% *	48% *	31% *
July 8th	-1%	15% *	0%	15%	21% *	3%	49% *	38% *	40% *
July 13th	8% *	19% *	3%	20% *	23% *	16%	40% *	40% *	29% *
July 20th	0%	13% *	4%	11%	20% *	8%	45% *	34% *	49% *
July 21st	-3% *	12% *	2%	16% *	21% *	-2%	26% *	26% *	27% *
July 28th	4% *	16% *	12% *	14%	22% *	16%	35% *	35% *	33% *
July 29th	-3% *	9% *	5%	9%	18% *	-6%	29% *	28% *	10%
July 30th	2% *	12% *	6%	16% *	19% *	8%	26% *	34% *	26% *
July 31st	-4% *	5%	0%	8%	12% *	5%	32% *	29% *	-9%
August 3rd	3% *	14% *	4%	6%	16% *	2%	33% *	33% *	21%
August 4th	3% *	13% *	-1%	3%	14% *	18%	28%	25% *	8%
August 17th	4% *	14% *	4%	14% *	23% *	15%	33% *	31% *	20%
August 18th	4% *	14% *	2%	10%	16% *	17%	29% *	30% *	30% *
August 19th	-1%	8% *	1%	4%	13% *	-2%	20%	17% *	14%
August 20th	-1%	9% *	-2%	8%	15% *	10%	23%	27% *	32% *
August 31st	2% *	11% *	6%	7%	14% *	14%	37% *	31% *	22%
September 1st	0%	11% *	3%	11%	17% *	17%	25%	23% *	28% *
September 2nd	-4% *	6% *	-5%	1%	14% *	7%	25% *	20% *	14%
September 8th	-1%	10% *	-7%	5%	15% *	17%	21% *	25% *	13%
September 9th	-1%	5% *	-3%	-2%	10% *	6%	16%	12% *	6%
Average	**1%**	**12%** *	**2%**	**10%**	**17%** *	**9%**	**31%** *	**29%** *	**22%**

Source: Navigant analysis

Note: An asterisk (*) indicates that the impact was statistically significant at the 90% confidence level.

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Table B-2. Absolute Demand Impact (kW) for each Peak Event by Technology/Price Group

Event Date	Level 1 CPP Passive	Level 1 CPP Active	Level 1 PTR Passive	Level 1 PTR Active	Level 2 CPP	Level 2 PTR	Level 3 CPP	Level 4 CPP	Level 4 PTR
June 23rd	0.101 *	0.222 *	0.267 *	0.095 *	0.307 *	0.250	0.806 *	0.872 *	0.695 *
July 8th	-0.009	0.150 *	0.173	0.002	0.213 *	0.032	0.740 *	0.662 *	0.838 *
July 13th	0.086 *	0.193 *	0.226 *	0.034 *	0.236 *	0.185	0.609 *	0.712 *	0.561 *
July 20th	0.003	0.157 *	0.159	0.049	0.244 *	0.102	0.886 *	0.694 *	1.396 *
July 21st	-0.034 *	0.135 *	0.193 *	0.021 *	0.232 *	-0.026	0.426 *	0.472 *	0.581 *
July 28th	0.050 *	0.184 *	0.168	0.133	0.264 *	0.225	0.720 *	0.712 *	0.805 *
July 29th	-0.037 *	0.102 *	0.104	0.052	0.208 *	-0.071	0.539 *	0.611 *	0.243
July 30th	0.025 *	0.129 *	0.210 *	0.072 *	0.222 *	0.095	0.417 *	0.665 *	0.532 *
July 31st	-0.040 *	0.043	0.083	-0.001	0.117 *	0.050	0.432 *	0.474 *	-0.142
August 3rd	0.035 *	0.147 *	0.072	0.044	0.178 *	0.026	0.520 *	0.662 *	0.423
August 4th	0.034 *	0.131 *	0.028	-0.006	0.141 *	0.224	0.388	0.407 *	0.131
August 17th	0.054 *	0.164 *	0.193 *	0.043 *	0.295 *	0.198	0.686 *	0.691 *	0.445
August 18th	0.049 *	0.173 *	0.130	0.028	0.210 *	0.261	0.571 *	0.687 *	0.769 *
August 19th	-0.010	0.091 *	0.052	0.012	0.153 *	-0.028	0.341	0.325 *	0.300
August 20th	-0.011	0.095 *	0.101	-0.015	0.165 *	0.124	0.370	0.462 *	0.662 *
August 31st	0.023 *	0.124 *	0.093	0.071	0.160 *	0.180	0.650 *	0.621 *	0.416
September 1st	0.000	0.105 *	0.109	0.027	0.169 *	0.237	0.341	0.372 *	0.530 *
September 2nd	-0.043 *	0.061 *	0.012	-0.051	0.153 *	0.093	0.400 *	0.373 *	0.304
September 8th	-0.011	0.125 *	0.072	-0.079	0.178 *	0.261	0.419 *	0.559 *	0.292
September 9th	-0.017	0.058 *	-0.025	-0.031	0.126 *	0.087	0.320	0.249 *	0.129
Average	**0.012**	**0.129** *	**0.121**	**0.025**	**0.199** *	**0.125**	**0.529** *	**0.564** *	**0.496**

Source: Navigant analysis

Note: An asterisk (*) indicates that the impact was statistically significant at the 90% confidence level.

Absolute snapback impacts by technology/price group for each Peak Event in the summer of 2015 are shown in Table B-3. As noted in the Section 3.4.1 no snapback was estimated for Level 2 customers on either rate, thus these groups are left out of the table. Negative values indicate snapback, or an increase in electricity usage subsequent to a Peak Event, and positive values indicate continued lower usage subsequent to a Peak Event.

Table B-3. Absolute Snapback Impact (kW) for each Peak Event by Technology/Price Group

Event Date	Level 1 CPP Passive	Level 1 CPP Active	Level 1 PTR Passive	Level 1 PTR Active	Level 3 CPP	Level 4 CPP	Level 4 PTR
June 23rd	-0.02 *	0.05 *	0.04	0.00	-0.23 *	-0.14 *	0.17
July 8th	-0.06 *	-0.04 *	0.00	-0.01	-0.42 *	-0.22 *	-0.43 *
July 13th	0.07 *	0.09 *	0.00	0.03	-0.18	0.03	0.03
July 20th	-0.14 *	0.00	-0.17 *	0.00	-0.42 *	-0.45 *	0.35
July 21st	-0.09 *	-0.01	0.02	-0.36 *	-0.53 *	-0.36 *	-0.15
July 28th	0.08 *	0.07 *	0.00	0.00	-0.01	-0.22 *	-0.27
July 29th	0.00	0.03 *	0.09 *	0.00	-0.55 *	-0.14	-0.12
July 30th	0.02 *	0.00	0.00	0.00	-0.61 *	-0.18 *	-0.14
July 31st	-0.04 *	-0.01	-0.08 *	0.00	-0.17	-0.23 *	-0.91 *
August 3rd	0.00	0.07 *	0.00	0.00	-0.43 *	-0.15 *	-0.29 *
August 4th	0.07 *	0.10 *	-0.03 *	0.00	-0.36 *	-0.11 *	-0.16
August 17th	0.14 *	0.09 *	0.03 *	0.00	0.20	-0.10 *	-0.05
August 18th	0.05 *	0.04 *	0.05 *	0.00	-0.13	-0.18 *	-0.13
August 19th	0.00	0.00	0.00	0.00	-0.47 *	-0.30 *	-0.38 *
August 20th	0.01	0.00	0.00	0.00	-0.55 *	-0.22 *	-0.31
August 31st	0.00	0.00	0.00	0.00	-0.37 *	-0.49 *	-0.50 *
September 1st	-0.02 *	0.00	0.00	0.00	-0.31 *	-0.26 *	0.00
September 2nd	-0.01	0.00	0.00	0.00	-0.43 *	-0.40 *	-0.61 *
September 8th	0.00	0.02 *	0.00	0.02	-0.15	-0.16 *	-0.69 *
September 9th	0.00	-0.09 *	0.00	0.00	-0.13	-0.34 *	-0.71 *
Average	**0.00**	**0.02**	**0.00**	**-0.02**	**-0.31** *	**-0.23** *	**-0.27**

Source: Navigant analysis

Note: An asterisk (*) indicates that the impact was statistically significant at the 90% confidence level.

Appendix C. Detailed Survey, Interview, and Focus Group Results

Throughout every stage of the Pilot, National Grid sought customer feedback in order to understand customer awareness and experiences with the rates, technologies, and operation of Peak Events. Navigant completed several surveys, interviews, and focus groups, which are summarized in the body of this report. This appendix details customer responses to the following data collection activities:

1. Meter Decline Survey, November 2013
2. Pre-Pilot Survey, February 2014
3. Pre-Pilot Commercial Interviews, April-May 2014
4. Post Installation Survey, April 2014-March 2015
5. Post Event Surveys (June-July 2015) and End of Summer Survey (September 2015)
6. End of Summer Low-Income Focus Groups, September 2015
7. End of Summer Commercial Interviews, October 2015
8. Opt Out & Drop Out Survey, November 2015

C.1 Meter Decline Survey, November 2013

The rate at which National Grid customers declined to have a smart meter installed (4%) was within the range of full-scale deployments by other utilities, some of which that did not initially offer the option to opt out of meter installation (Table C-1). Seventy customers who had actively declined a meter were interviewed by phone in order to understand why they opted out of the meter installation. Customers who did not have an installation completed due to technical problems were not addressed in this survey.

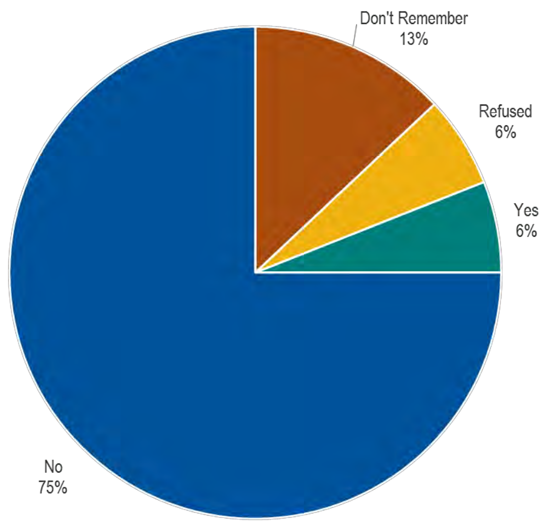
Table C-1. Comparison of Meter Decline Rate to Other Meter Installations

Utility	Total Residential Customers (#)	Opt Out (#)	Percentage Opt Out	Notes on Opt Out
BC Hydro	2,000,000	60,000	3%	Full system deployment
SCE	4,283,836	23,100	1%	Full system deployment
PG&E	5,500,000	42,905	1%	Full system deployment
Central Maine Power	620,000	8,000	1%	Full system deployment
SDG&E	1,249,104	2,227	<1%	Full system deployment

Source: Navigant analysis of the meter decline survey and other utility meter deployments

Customers who declined a meter tended to not have knowledge about the Pilot; as shown in Figure C-1, 75% were not interested in participating in the Pilot at all.

Figure C-1. Desire of Customers who Declined Meter to Participate in Pilot



Source: Navigant analysis of the meter decline survey (N=70)

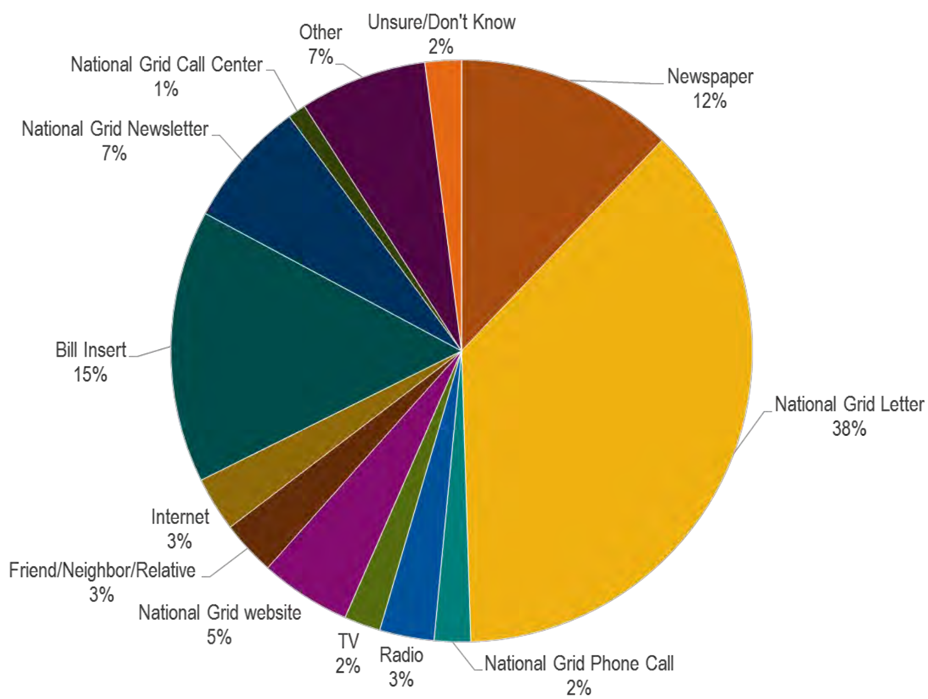
When asked why they declined to have a meter installed, 61% of customers cited only one reason for declining, 31% cited two reasons, and 7% cited three reasons. The single most often cited reason was "I won't benefit from this," followed by health and safety concerns.

C.2 Pre-Pilot Survey, February 2014

The Smart Energy Solutions Pre-Pilot survey was fielded to potential pilot participants from January 9, 2014 to February 12, 2014. The survey was available to a total population of 12,823 residential customers through an online survey and in-bound and out-bound phone calls. A total of 1,470 residential customers completed the survey, or approximately 11.5% of the eligible population. The survey contained questions about a wide range of topics including demographic information, pilot awareness and attitude, end-use appliance information, and energy usage habits. The survey was built upon the pre-pilot survey developed as part of the *Common Evaluation Framework* produced by the Massachusetts Smart Grid Collaborative Technical Subcommittee. With National Grid and Massachusetts Department of Public Utilities (DPU) approval, some modifications were made to the survey to accommodate the Smart Energy Solutions Pilot.

At the time of the survey, almost 50% of customers surveyed had read, seen, or heard information about the Smart Energy Solutions program within the previous three months. The most common way that customers had heard about the pilot was from a National Grid communication (letter or bill insert) (see Figure C-2).

Figure C-2. How Customers Heard of the Pilot

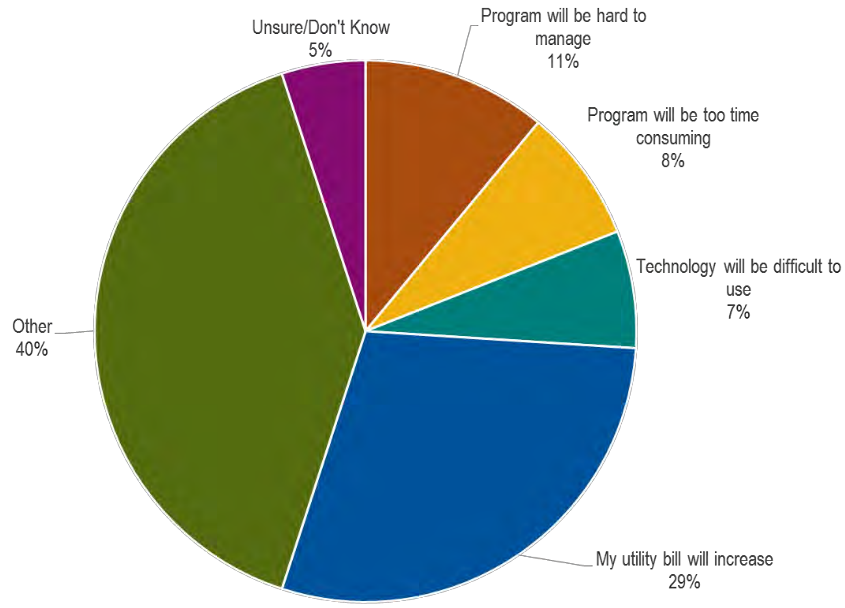


Source: Navigant analysis of pre-pilot survey (N=706)

Within the respondents' verbatim responses, many requested more information about the pilot. Many respondents across all demographic segments also expressed interest in participating in the pilot if it could provide them a better way to manage their energy usage and decrease their monthly energy bill.

The majority (53%) of customers did not have any concerns about participating in the pilot. Of those that did have concerns, the most common was with their bill increasing, as shown in Figure C-3. Verbatim responses showed a similar pattern and are represented in the "Other" category.

Figure C-3. Reasons for Concern with Pilot Participation



Source: Navigant analysis of pre-pilot survey (N=323)

C.3 Pre-Pilot Commercial Interviews, April-May 2014

Navigant contacted 99 commercial customers in the Pilot area to establish a focus group to discuss their understanding of the Pilot before it began. After five attempts and having only recruited four customers, Navigant decided to interview the customers individually rather than convene a focus group. The interviews provided insight into how much each customer knew about the Smart Energy Solutions program, how they believed it would affect them, and how much they knew about the Sustainability Hub. The customers represented a variety of services: commercial landlord, construction and real estate development, automotive services, and operations for the City of Worcester. There were no retail sales businesses among the sample.

The evaluation team found that customers appeared to be unaware of the products and services available to them, including technology packages and the Sustainability Hub. Overall, the customers' feedback emphasizes their communication desires, including the following:

- **Desire for personal National Grid contact.** Customers told us that they would appreciate more personal interactions with National Grid in order to learn about the program. They would like to receive emails about the program directly from a contact at National Grid and know that they can easily call or email a National Grid employee with questions.
- **Preference for web-based information presentment.** Besides emails, these customers would like to access information about the pilot online rather than via a smartphone app or IHD.

Although National Grid had not released any information about the program rate before the interviews took place, customers understood the program rates when the evaluation team explained them. Two of the interviewees raised concerns that they could not shift their electricity usage because their business model depends on their using energy intensive heavy equipment during weekday business hours. The participants' responses suggest that it would be important for National Grid to emphasize how the rate plans may affect commercial as well as residential customers during the pilot.

C.4 Post Installation Survey, April 2014-March 2015

Navigant completed 241 surveys out of a population of 743 National Grid residential customers who had technologies installed between April 2014 and February 2015. Customers reported strong satisfaction with installation:

- 98% of participants reported that installers appeared at the scheduled day and time
- 90% of participants received the equipment they expected
- 99% of participants received training
- 91% of participants received hands-on demonstrations
- 67% of participants found explanations of how equipment worked "very clear" and 27% found explanations "somewhat clear"
- Verbatim responses indicated some participants were not able to access expected usage/cost data or thought it insufficient for their needs

C.5 Post Event Survey (June-July 2015) and End of Summer Survey (September 2015)

Navigant surveyed 1,305 customers across two post event surveys and the end of summer survey (Table C-2). The majority of respondents were Level 1 customers, which is not surprising considering most participants have Level 1 technology. The body of this report discusses customer awareness of rates, whether they remotely monitored their technology, and their feedback on the Pilot to date.

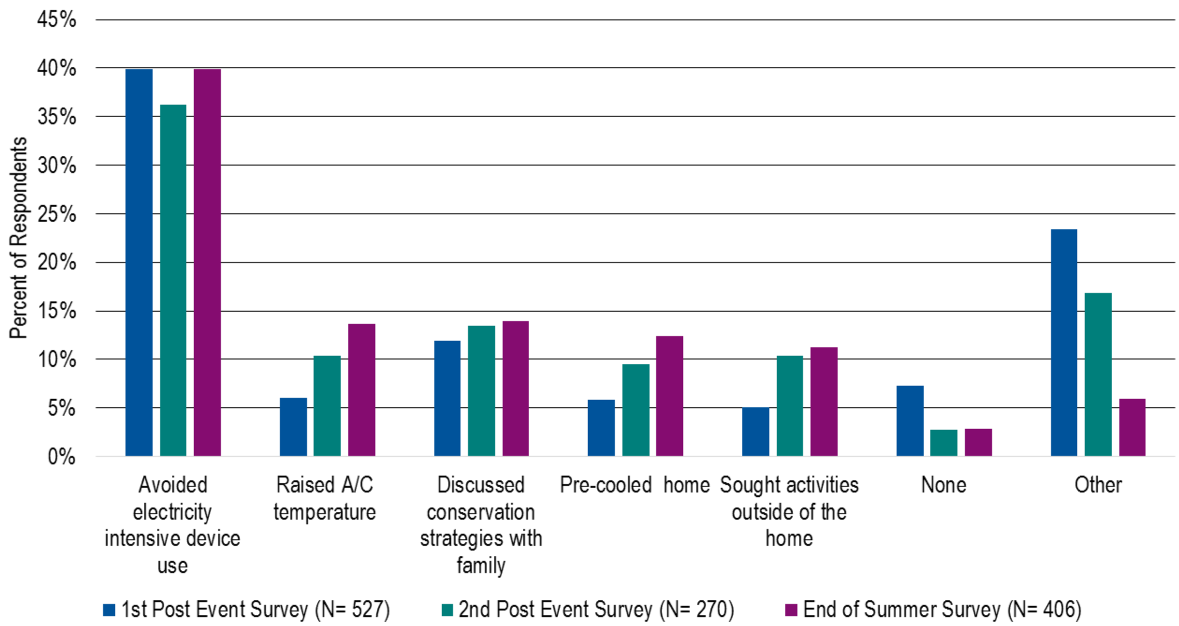
Table C-2. Number of Respondents per Post Event and End of Summer Survey by Technology Package

Survey	Level 1	Level 2	Level 3	Level 4	Totals
Post Event #1 June 2015	307	154	10	54	**525**
Post Event #2 July 2015	167	68	5	30	**270**
End of Summer September 2015	315	118	7	66	**506**

Source: Navigant analysis of the post event and end of summer surveys

The survey sought out customers' experience preparing for Peak Events, participating in Peak Events, usage of their technology package if they had one, and their feedback on the Pilot. Respondents were active and engaged in the events, with customers reporting that they changed some of their activities in response to Peak Events. As shown in Figure C-4, customers were most likely to reduce use of appliances.

Figure C-4. Actions Customers Reported Taking during Peak Events

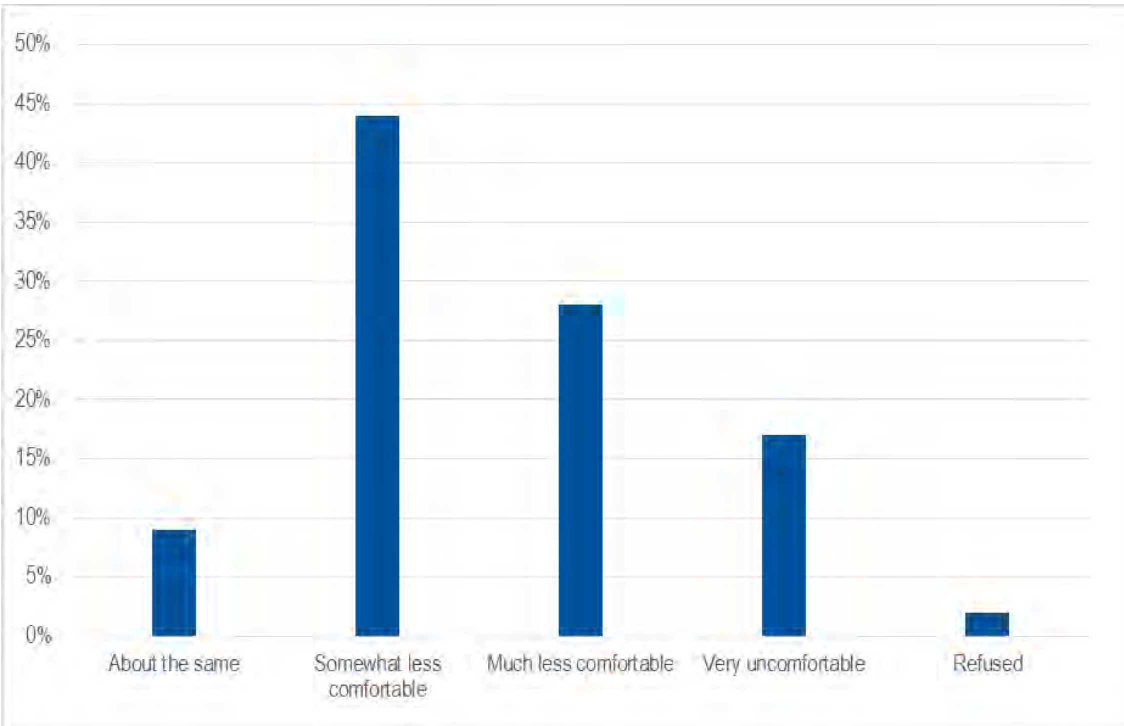


Source: Navigant analysis of the post event surveys (N=411 and N=326) and the end of summer survey (N=694)

According to the end of summer survey, most thermostat participants (98%) noticed a change in their home temperature during Peak Events. Thermostat participants experienced varied temperature changes during Peak Events—30% of respondents experienced a two to four degree increase, 31% experienced a four to six degree increase, and 37% experienced over a six degree temperature increase.

In comparison to a typical afternoon, customers were generally less comfortable in their home during the Peak Events, as shown in Figure C-5.

Figure C-5. During the Peak Event hours, how would you describe your comfort compared to a typical afternoon with similar outdoor temperatures?

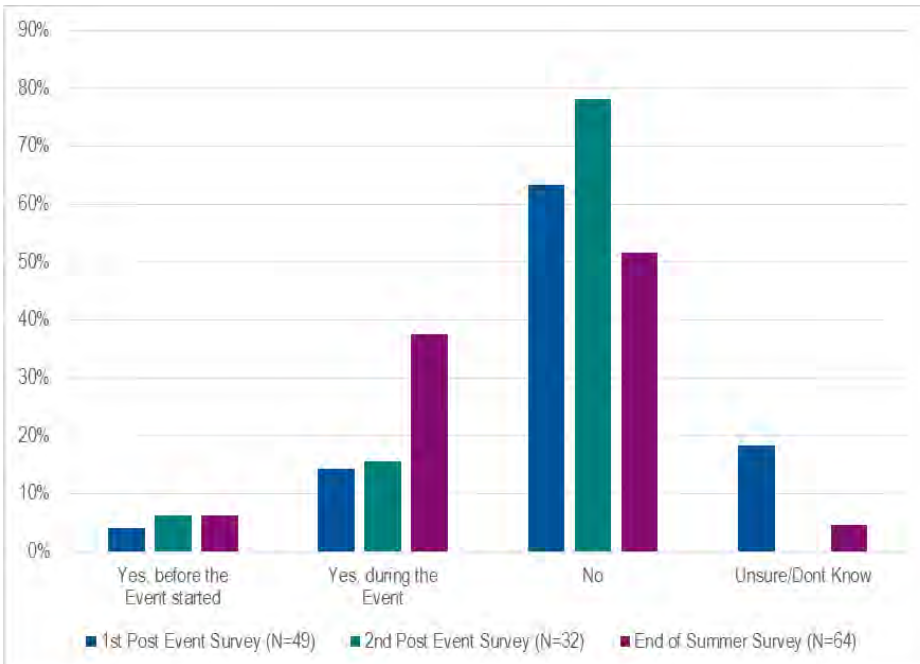


Source: Navigant analysis of end of summer survey (N=64)

As the summer progressed, respondents used the override button on their thermostat more frequently (see Figure C-6). As shown in Figure C-7, when asked in the post event and end of summer surveys, customers cited comfort and health as reasons for overriding the thermostat adjustment ("Other" responses are primarily about comfort or confirming that there are no other reasons for the override).

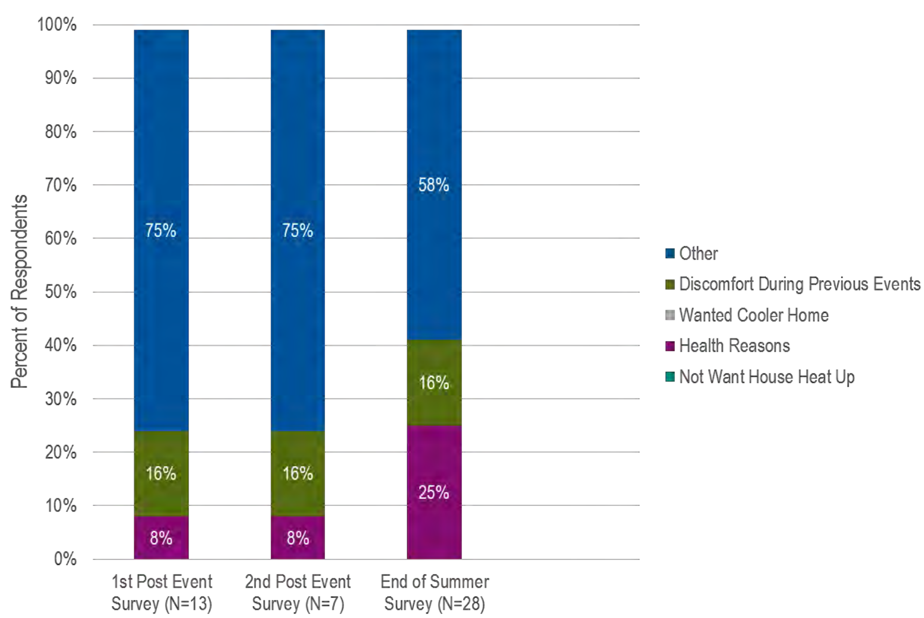
Nearly two-thirds of thermostat respondents were satisfied with their smart thermostat; few participants (7%) were unsatisfied with the smart thermostat.

Figure C-6. Did you override your smart thermostat?



Source: Navigant analysis of the post event (N=49, N=32) and end of summer survey (N=64)

Figure C-7. Why did you override your thermostat?



Source: Navigant analysis of the post event (N=13, N=7) and end of summer surveys (N=28)
Note: No respondents chose "wanted cooler home" or "not want house to heat up".

According to the end of summer survey, half of respondents that had a smart plug reported using it during Peak Events. Those who used their smart plug plugged it into small appliances and electronics (26%), lamps or other light fixtures (8%), refrigerator or freezer (4%)—although National Grid told customers not to use the smart plug for these appliances—room air conditioner or dehumidifier (4%), or other uses (8%). Most customers (63%) were satisfied or very satisfied with the smart plug.

C.6 End of Summer Low-Income Focus Groups, September 2015

In September 2015, Navigant hosted two low-income focus groups to discuss the Smart Energy Solutions Program. Customers' self-reported income was used to determine whether they qualified for fuel assistance, which is a determinant of low-income status. All customers were served a light dinner and received a $150 check for participating at the end of the 90-minute discussion. Topics covered in the focus groups were the participants' experience in the Pilot and Peak Events to date, understanding of the rates and technology packages, as well as their feedback to National Grid.

Navigant recruited Level 1 and Level 2 customers, as they represented the majority of low-income customers. As using some of the technologies included in the technology packages require Internet connection, participants were asked about their ability to access the Internet at home. All but two participants had Internet connections at home. The first focus group consisted of 13 Level 1 customers; one was on the Peak Time Rebate (PTR) rate and one had an in-home display (IHD) that was too far from the smart meter to receive consistent signal for regular updates from National Grid. The second focus group was consisted of nine Level 2 customers, all of whom were on Smart Rewards Pricing.

Through these two focus groups, low-income customers reported their concerns about participating in the Pilot:

- Keeping the home cool for homebound parents, babies, and pets;
- Electricity expenses and affordability, as well as their options to reduce electricity usage; and
- How bills and savings are calculated as well as a desire for more information and transparency.

The low-income focus group participants reported taking steps to reduce their electricity usage. For example, many mentioned short-term actions such as substituting or turning off appliances. Some participants mentioned longer-term actions such as planting trees to shade their home and reduce electricity needs for cooling and heating.

There also appeared to be a difference in electricity usage awareness and engagement between the Level 1 and Level 2 customers:

- Level 2 participants expressed more flexibility and ability to respond to Conservation Days than Level 1 participants, which may be due to having additional information provided via their IHDs
- Level 1 participants requested additional information, saying that they only received information at the beginning of the Pilot or had confused it with competitive suppliers. Level 2 participants did not express the same confusion, which may indicate more attention paid to National Grid letters, brochures, and phone calls

- More Level 2 participants were aware of energy efficiency programs or Mass Save than Level 1 participants, which might indicate more informed electricity usage

Level 1 customers expressed interest in signing up for an IHD after seeing the device and user's manual. All of the participants expressed interest in providing additional feedback to National Grid in future focus groups.

C.7 End of Summer Commercial Interviews, October 2015

As there were too few commercial customers in the Pilot area to survey, Navigant interviewed four commercial participants in order to obtain qualitative input about their 2015 summer season experience. National Grid and Navigant identified approximately 275 commercial participants on general service (G1) rates, but the majority are property owner accounts and almost all were on the Critical Peak Pricing (CPP) rate with Level 1 technology. Navigant sought a variety of participants, aiming to talk to customers with Level 2 or higher technology as well as a PTR customer, focusing on retail and office customers. Customers received a $200 honorarium or charity donation for a 30-minute interview. The four interviewed customers were all on the CPP rate with Level 1 technology.

The evaluation team found that the commercial customers interviewed were continuing business as usual and not aware of their rate choice within the Pilot. The participants knew about the CPP but not the PTR and knew about the events but were unable to adjust their usage during them.

C.8 Opt Out & Drop Out Survey, November 2015

Customers may change rates or leave the Pilot at any time. Navigant is surveying these customers on a rolling basis to understand their reasons for "opting out" (*i.e.*, switching from CPP to PTR) or dropping out of the program, based on whether enough customers have dropped out or opted out to have a statistically significant customer pool to survey. Enough customers had dropped out of the program, or switched to the PTR rate by November 2015 to field a survey. The survey will be fielded again if enough customers drop out or opt out.

To date, Navigant has surveyed 29 customers (Table C-3). Six of the PTR respondents dropped out before the Pilot rates-go-live date of January 1, 2015, and nine of them dropped out during the Pilot.

Table C-3. Drop Out Customers Surveyed by Technology Package

Technology Package	CPP	PTR
Level 1	5	14
Level 2	1	6
Level 3	1	1
Level 4	1	0
Total	**8**	**21**

Source: Navigant analysis of the opt out and drop out survey

Survey responses indicate that customers that dropped out of the program felt:

- More information was needed on the Pilot;
- Peak Event hours were inconvenient;
- The Pilot intruded on privacy and personal decision-making; and
- The Pilot increased their bills.

As Navigant surveys additional customers who leave the Pilot, more data will be available for a more robust analysis of customer reasons for dropping out.

Appendix D. Media Coverage of Smart Energy Solutions

Various media sources have covered of the Smart Energy Solutions program from different points of view. National Grid's "listen, test, learn" approach lends itself to reviewing criticism and praise, and adjusting the Pilot or providing additional information to customers.

The following summarizes a selection of these stories:

Title: A Controversy Erupts in Worcester: All Eyes on Smart Grid Plan

Date: January 30, 2014

Link: http://worcestermag.com/2014/01/30/controversy-erupts-worcester-eyes-smart-grid-plan/20499

Summary: This article, written early in the Pilot—after meter installation was completed and just as technologies and rates were offered, provides coverage of National Grid's cooperation with neighbors to build a communications tower. It details concerns that some customers have about smart meter radio frequency, as well as information National Grid provided about smart meter radio frequency strength in order to educate people about the low health risk posed by smart meters.

Title: National Grid Smart Grid Program Launches Technology Phase

Date: April 1, 2014

Link: http://www.golocalworcester.com/news/national-grid-smart-grid-program-launches-technology-phase

Summary: Released during National Grid's customer technology launch, this article discusses the customer-facing and grid-facing investments covered in the Pilot. It provides detail on the distribution and communication infrastructure investment.

Title: National Grid's Sustainability Hub Gathers Customers and Community

Date: December 16, 2014

Link: http://www.intelligentutility.com/article/14/12/national-grid-s-sustainability-hub-gathers-customers-and-community

Summary: This op-ed by National Grid's VP of Customer Strategy and Engagement, Ed White, summarizes the Sustainability Hub's first year as an educational tool and community space. It highlights events held at the Sustainability Hub, individuals and groups who visit the Hub to learn about the Pilot and sustainability, as well as community groups that use the Hub as a meeting space.

Title: Worcester Smart Grid Up and Running as National Grid Launches Pilot Program

Date: January 15, 2015

Link: http://www.masslive.com/news/worcester/index.ssf/2015/01/worcester_smart_grid_up_and_r.html

Summary: Written shortly after the Pilot rates went live, this article summarizes rate offerings and describes meters, anticipated customer savings, as well as National Grid's smart grid distribution system investments. It also cites Worcester's diversity as the driver to have the Pilot in Worcester.

Title: National Grid's Smart Energy Solutions Program Adds Interactive Energy Savings Features

Date: April 30, 2015

Link: http://3blmedia.com/News/National-Grids-Smart-Energy-Solutions-Program-Adds-Interactive-Energy-Savings-Features

Summary: Written in the first quarter that Pilot rates went live, this article summarizes the customer portal, IHD, and app, as well as how the Pilot's smart grid investments have reduced outage restoration times.

Title: A year in, Smart Energy program bright idea for most

Date: September 12, 2015

Link: http://www.telegram.com/article/20150912/NEWS/150919656/101448

Summary: This front-page article in the Sunday Worcester Telegram & Gazette documents the positive program experience of multiple customers, as well as presenting results from the first summer of Conservation Days. The article also introduces the natural link between Smart Energy Solutions and National Grid's Grid Modernization Plan that was filed with the DPU in 2015.

Title: CEIVA Energy Technology Powers 20% Additional Savings for National Grid's Smart Energy Solutions Customers

Date: October 12, 2015

Link: http://www.businesswire.com/news/home/20151012005202/en/CEIVA-Energy-Technology-Powers-20-Additional-Savings

Summary: This article, published after customers' first summer on the Pilot rates, summarizes the technologies offered. It highlights customer bill savings and other technologies offered to customers.

ATTACHMENT C

THE COMMONWEALTH OF MASSACHUSETTS

DEPARTMENT OF PUBLIC UTILITIES

Massachusetts Electric Company and Nantucket Electric Company each d/b/a National Grid Smart Grid Pilot Evaluation Working Group	)	D.P.U. 10-82

CERTIFICATE OF SERVICE

I hereby certify that I have this day caused to be served the foregoing documents in the above-referenced docket upon all parties of record in this proceeding in accordance with the requirements of 220 C.M.R. 1.05 (Department's Rules of Practice and Procedure), by hand delivery and/or E-Filing.

MASSACHUSETTS ELECTRIC COMPANY and
NANTUCKET ELECTRIC COMPANY
each d/b/a NATIONAL GRID

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Date: February 24, 2016

ATTACHMENT C

NAVIGANT

National Grid Smart Energy Solutions Pilot

Final Evaluation Report

Prepared for:

National Grid

nationalgrid

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May 5, 2017

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The following appendices are provided in a separate document:

- Appendix F – Graphs of Event Impacts by Hour for Residential Customers
- Appendix G – Graphs of Event Impacts by Hour for Commercial Customers
- Appendix H – Graphs of Event Impacts for Residential Customers by Demographic Subgroup

GLOSSARY OF KEY TERMS AND ACRONYMS

Pricing:
Critical Peak Pricing (CPP) – Referred to as Smart Rewards Pricing in National Grid's program marketing materials. In the Smart Energy Solutions program this rate structure combines a TOU rate with critical peak pricing in which customers are charged higher rates for energy during Peak Events.

Peak Time Rebate (PTR) – Referred to as Conservation Day Rebate in National Grid's program marketing materials. A rate structure in which customers are provided a credit, or rebate, for reducing their energy usage during Peak Events.

Time of Use (TOU) – A rate structure in which participants pay a predetermined tiered rate in which higher prices generally coincide with peak periods and lower prices with off-peak periods.

Customer Types:
Active Participant – An active participant is one who is deemed to have taken actions above simply being on a rate. This household or business is utilizing technology and taking actions to modify their behavior in reaction to the new rate and technology afforded by their participation in the Pilot. Specifically, for this evaluation active participants are those who have opted into a technology package above the default (e.g., opted into Levels 2, 3, or 4), or participants on the default technology package (Level 1) who have visited the WorcesterSmart web portal.

Passive Participant – A customer in the Pilot who is on the default technology package (Level 1) and has not visited the WorcesterSmart web portal.

Peak Times:
Peak Period – Weekdays from 8 a.m. to 8 p.m.

Off-Peak Period – All hours that are not defined as Peak Periods or Peak Events. Includes all weekend, evening, and holiday hours.

Conservation Day – A day on which a Peak Event is called.

Peak Event – A period of time for which critical peak pricing will be in effect. Customers are notified in advance of the specific Peak Event hours for a given Conservation Day. CPP customers are charged a higher rate during a Peak Event and PTR customers can earn a rebate for conserving during a Peak Event.

Enabling Technologies:
AMI (advanced metering infrastructure) Meter – An advanced meter, also referred to as a "smart meter", that records consumption in intervals and communicates that information via a communications network back to the utility for monitoring and billing purposes. AMI meters enable two-way communication between the meter and the central system.

Direct Load Control Device – Device that allows customers to manage large appliances, such as an electric hot water heater or pool pump, which is controlled via broadband Internet connection.

Homeview App – Also referred to as the “mobile app” or “app”. Allows customers to view their IHD remotely and access real-time energy usage and cost information. Also, allows customers to remotely monitor and control their Pilot thermostat if they have one.

In-home display (IHD) – Referred to as a digital picture frame in National Grid’s program marketing materials. An electronic graphical display device which provides information and graphics about energy usage and cost that is updated on a regular basis based on data from the utility meter. Customers may also upload their own personal photographs for display on this device.

Programmable-Controllable Thermostat (PCT) – A programmable thermostat, also referred to as a “smart thermostat”, which can also be controlled or signaled via the Home Area Network or another communications method.

Smart Plug – An intelligent 3-prong outlet that customers plug appliances into, which can also be controlled or signaled via the Home Area Network or broadband Internet connection.

WorcesterSmart Web portal – Also referred to as the “web portal”. An internet website accessible to all participants in the Pilot that enables them to see more advanced information on their energy consumption. The web portal also provides performance feedback for Pilot participants during Conservation Days.

Acronyms:
AMI: Advanced Metering Infrastructure
CAC: Central Air Conditioning
CPP: Critical Peak Pricing
DPU: Massachusetts Department of Public Utilities
DRMS: Demand Response Management System
EEAC: Energy Efficiency Advisory Council
GCA: Green Communities Act
IHD: In-Home Display
LEAN: Low-Income Energy Action Network
PCT: Programmable-Controllable Thermostat
PTR: Peak Time Rebate
SaaS: Software as a Service
TOU: Time of Use

NAVIGANT

DISCLAIMER

This report was prepared by Navigant Consulting, Inc. (Navigant) for National Grid. The work presented in this report represents Navigant's professional judgment based on the information available at the time this report was prepared. Navigant is not responsible for the reader's use of, or reliance upon, the report, nor any decisions based on the report. NAVIGANT MAKES NO REPRESENTATIONS OR WARRANTIES, EXPRESSED OR IMPLIED. Readers of the report are advised that they assume all liabilities incurred by them, or third parties, as a result of their reliance on the report, or the data, information, findings, and opinions contained in the report.

EXECUTIVE SUMMARY

Massachusetts Electric Company and Nantucket Electric Company d/b/a/ National Grid's (the Company or National Grid) Smart Energy Solutions Pilot program (the Pilot or Smart Energy Solutions) is an innovative smart grid pilot featuring deployment of a unique combination of advanced meters, customer-facing technologies, and time-of-use (TOU) rates. The informational portion of the Pilot began in 2013, rates went live in January 2015, and implementation ran through the end of 2016. National Grid filed for a two-year extension of the Pilot and the Massachusetts Department of Public Utilities (DPU) approved an interim extension that extends the Pilot until a final decision is reached in 2017. The Pilot also included advanced distribution grid-side technologies which are the subject of a separate report.[1] This evaluation, conducted by Navigant Consulting, Inc. (Navigant or the evaluation team), covers customer-side Pilot activities through the end of 2016. Navigant conducted the evaluation of the Pilot in accordance with the *Common Evaluation Framework*[2] produced by the Massachusetts Smart Grid Collaborative Technical Subcommittee (the Collaborative), a stakeholder group convened by the DPU to develop consistent evaluation themes and techniques across smart grid pilot programs in the state. Key findings include demonstration of significant energy and Peak Event savings, the important role of technology, and strong customer satisfaction (Figure E-1).

Figure E-1. Key Findings from Evaluation of Smart Energy Solutions

Energy and Demand Savings for Active Customers	• Load reductions from 4% to 31% (0.12 to 0.60 kW) during Conservation Day Peak Events depending on the combination of rate and technology • 5.4% (approximately 35 kWh per month) weighted average energy savings across the technology groups for CPP customers over the two years of the Pilot
Enabling Technologies Increased Demand Savings for Active Customers	• Customers with programmable communicating thermostats had the highest load reductions (25%-31% on CPP and 22%-29% on PTR) • Customers with in-home displays were next (17%-18% on CPP and 4%-9% on PTR), followed by customers with only Web Portal access (12%-15% on CPP and 10% on PTR)
Bill Savings	• Average per customer bill savings of $236 over the two years of the Pilot for customers on CPP • Average total rebates of $30 for Conservation Day Peak Events across both summers for customers on PTR
High Retention Rate	• 98% retention rate of customers in the Pilot at the end of 2016 after rates went live on January 1, 2015
Strong Customer Satisfaction	• 69% of customers rated their satisfaction with Smart Energy Solutions at least a 5 on a 7-point scale

Source: Navigant analysis
Note: CPP refers to Critical Peak Pricing and PTR refers to Peak Time Rebate.

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[1] National Grid. *Interim Grid-Facing Evaluation Report*, March 31, 2016.

[2] D.P.U. 10-82, Massachusetts Smart Grid Collaborative Technical Subcommittee, *Common Evaluation Framework*, March 23, 2011.

There were several changes in the Pilot design and outcomes in its second year (2016) compared to its first year (2015), which are summarized in Figure E-2. The design changes were primarily made based on customer feedback collected during the first year of the Pilot,[3] and reflect National Grid's "listen, test, learn" philosophy regarding continuous improvement to program offerings.

Figure E-2. Key Changes in Pilot Design and Outcomes in 2016

Expanded efforts to educate customers about the Pilot design, based on feedback that customers wanted fewer and shorter Peak Events, and to reinforce the reasons for calling Peak Events. Much of this education took place through the Sustainability Hub.

Created Energy Signatures to give customers personalized savings tips once they self-identified with one of five common home energy usage profiles, such as "9 to 5ers" or "Late Nighters".

Expanded, simplified, and prioritized informing customers about the options for personalizing notifications in 2016, based on customer feedback regarding Peak Event notifications.

Added a rewards platform to the Pilot web portal in 2016 in response to results showing active customers acheived higher savings than passive customers. Participants earned points for activities, like saving energy, that could be redeemed for gift cards at local and national retailers.

Decreased degree setbacks on thermostats during Peak Events and varied Peak Event start and end times more in 2016 than in 2015 to increase customer comfort, especially on consecutive Conservation Days.

The number of active customers in the Pilot increased by 22% in 2016 compared to 2015. The majority of this increase occured among participants without in-home devices, indicating that the Company's efforts to increase web portal traffic were successful.

Demand savings for passive customers increased substantially in 2016 compared to 2015, which increased total Pilot savings. Savings increased from 1% to 4% for passive CPP customers and from 2% to 5% for passive PTR customers.

Source: Navigant analysis
Note: CPP refers to Critical Peak Pricing and PTR refers to Peak Time Rebate. Active participants are those who opted to receive one of the Pilot technology packages or who had no technology but visited the program web portal at least once; any customers without technology who did not visit the web portal are characterized as passive.

The Smart Energy Solutions Pilot

As shown in Figure E-3, Smart Energy Solutions was deployed in four phases.

Phase 1. **Meter Deployment & Awareness.** In this initial phase the Company raised awareness about and installed advanced metering infrastructure (AMI) meters (also referred to as "smart meters") in approximately 15,000 homes and businesses. Five percent of customers offered AMI meters refused them.

Phase 2. **Introduction of Benefits.** In the second phase the Company introduced Smart Energy Solutions to raise customer awareness and create an expectation of more to come. Customer education efforts continued throughout the Pilot.

Phase 3. **Choice.** In Phase 3 National Grid customers chose between two Pilot rates, a TOU Critical Peak Pricing (CPP) rate and a Peak Time Rebate (PTR) rate, and four technology packages that offered varying levels of information and control via web portal access, phone app, in-

[3] See Navigant. 2016. *National Grid Smart Energy Solutions Pilot Interim Evaluation Report.* Prepared for National Grid.

home displays (IHDs), programmable-controllable thermostats (PCTs), direct load control devices, and smart plugs.[4] The Sustainability Hub was also opened during Phase 3 as a resource for customers. The Hub provides hands-on education and engagement through a holistic approach, integrating various advanced technologies into a demonstration home.

Phase 4. **Focus on Customer Control.** Phase 4 began with the rates going live in January 2015. The Company called Conservation Days with specific Peak Event hours on high-demand days, educated customers about their bills, assisted them in using the tools available to understand and control their energy usage, and allowed them to customize their participation through the many options available in the Pilot.

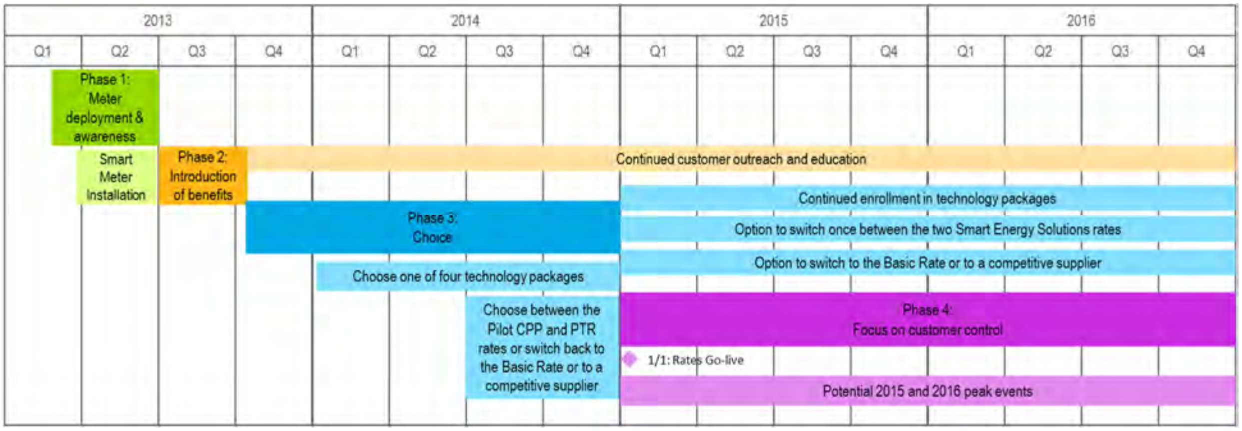
Based on its experience with the Pilot, National Grid understands the importance of gradual and ongoing customer outreach and education to introduce new concepts and technologies. By introducing demand response and connected devices early on, the hope was customers would better understand and benefit from incremental savings that may be realized from the introduction of AMI and time-based rates. National Grid has filed for a two-year extension of the Pilot and the DPU has approved an interim extension. Under the interim extension, the Pilot will remain in effect until the DPU comes to a final decision. If the proposal for extending the Pilot is approved or if the Company's Grid Modernization Plan is approved, the Company envisions offering Smart Energy Solutions participants the option to receive similar savings and benefits as they have enjoyed to date, in line with what is proposed in the Company's Grid Modernization Plan in D.P.U. 15-120. Otherwise, the Pilot participants will revert to basic rates and will be eligible for the same demand response incentives as other customers in the Company's service territory. Pilot participants who received in-home devices will be able to keep them regardless of the outcome of the extension.

The Company hopes to transition to a more advanced and integrated demand response management system (DRMS) that will be deployed during the Grid Modernization plan period if approved. The functionalities of this enterprise DRMS include the ability to schedule, dispatch, control and conduct evaluation, measurement, and verification of load curtailment demand response events.[5]

[4] Customers also had the option to remain on the Basic Rate, effectively leaving the Pilot, or to leave National Grid by switching to a competitive supplier. As a result, the Pilot contained an "opt-out" element for customers who did not want TOU/CPP, and an "opt-in" element for customers who chose the PTR rate or any of the technology packages. This design and customer flexibility set the Pilot apart from other utility dynamic rate pilots. Therefore, comparisons to other programs are anecdotal, as direct comparisons do not exist.

[5] National Grid. D.P.U. 15-120. *Grid Modernization Plan at Attachment 8.* August 19, 2015.

Figure E-3. Four-Phase Rollout of Smart Energy Solutions



Source: Navigant and National Grid

Consistency with Green Communities Act

The Pilot design complied with and exceeded the requirements of Section 85 of the Green Communities Act (GCA or the Act) passed in Massachusetts in 2008. The Act mandated that each investor-owned electric utility conduct a smart grid pilot with the overall objective of reducing active participants' peak and average loads by at least 5%. The pilot program must include, at a minimum, the following:

- Deployment of advanced meters that measure and communicate electricity consumption on a real-time basis;
- Automated energy management systems in customers' home and facilities;
- Time of use or hourly pricing for a minimum of 0.25 percent of the company's customers;
- Remote monitoring and control equipment on the Company's electric distribution system; and,
- Advanced technology to operate an integrated grid network communication system in a limited geographic area.

The DPU has recognized four unique elements of Smart Energy Solutions that differentiate it from other Section 85 pilot programs.[6]

1. The Company ***implemented the customer-facing and grid-facing components of the Pilot within one city***, a portion of Worcester, to allow National Grid to ascertain whether a comprehensive deployment of smart grid technologies produced synergistic customer benefits.
2. The Company ***deployed the program on an opt-out basis***, meaning all eligible customers in the Worcester area were offered an AMI meter and enrolled in Smart Energy Solutions by default but had the option to opt-out if they weren't interested. Relative to opt-in programs where eligible customers must actively choose to participate, opt-out programs reach many more customers and thus have higher savings potential.

[6] D.P.U. Order 11-129. *Petition of Massachusetts Electric Company and Nantucket Electric Company, each d/b/a National Grid for approval of a smart grid pilot program.* August 3, 2012.

3. The ***default pricing option for the Pilot is a TOU rate, and the vast majority of Pilot participants remained on this rate***. Additionally, nearly 1,000 customers opted into technology packages which included in-home devices. Having a significant number of customers on a TOU rate with enabling technologies represented a unique opportunity to study these smart grid pilot components across a broad segment of the population.
4. National Grid's ***comprehensive outreach and education campaign combined both traditional and community-based elements***. It was designed to encourage customers to permanently change their energy consumption behavior in response to the price signals and other Pilot messaging. The Pilot also included the creation of the Sustainability Hub which serves as a model energy center in the community where National Grid provides hands-on education and engagement through a holistic approach, integrating various smart elements into a demonstration home.

Definition of Active Customers

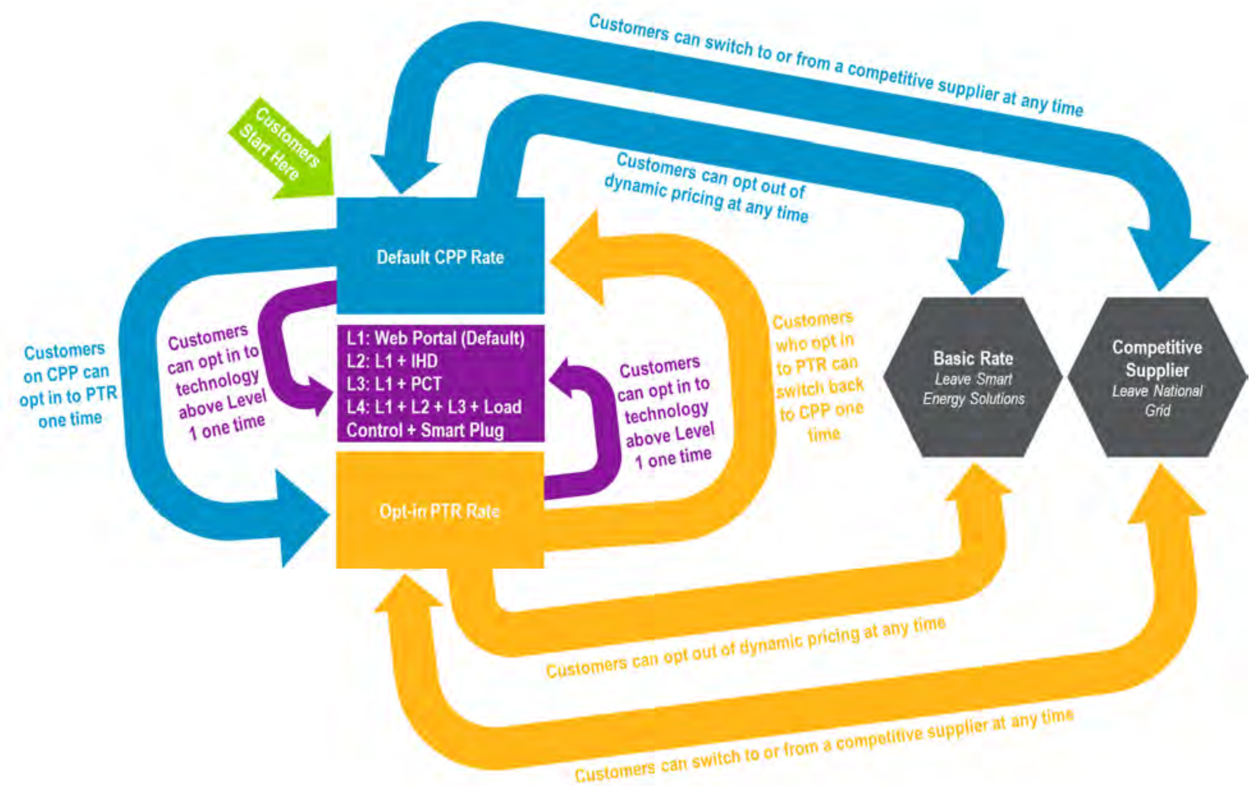
In the context of an opt-out pilot, the GCA's goal of reaching 5% savings for "active" customers must be interpreted carefully. Some of the participants in an opt-out pilot will never actively engage with the program components. For evaluation purposes, Navigant defined active participants as anyone who opted into any in-home technologies and anyone with no in-home technology who logged into the Pilot web portal at least once.[7] Customers with no in-home technology who never logged into the web portal were considered "passive" participants in the Pilot. In other words, the passive customers did not adopt technologies or check their electricity usage; these customers could still take actions to save energy as they were enrolled in the Pilot rates and received notifications for the Peak Events. By this definition, just under 25% of the Pilot participants were active at the end of 2016. This increased from just under 20% at the end of 2015.

Customer Decision-Making and Flexibility

Among smart grid pilots, Smart Energy Solutions was relatively complex with several key decision points for customers, as illustrated in Figure E-4.

[7] Active customers were defined as of October 12, 2016, which was after the last Peak Event of the 2016 summer season.

Figure E-4. Smart Energy Solutions Customer Decision Points



Source: Navigant
Note: L1 = Technology Level 1, L2 = Technology Level 2, L3 = Technology Level 3, L4 = Technology Level 4, IHD = in-home display, PCT = programmable-controllable thermostat.

Smart meters and choice of rates. Eligible customers in the Worcester area who accepted a smart meter were enrolled onto the CPP rate by default.[8] Customers had the option to opt into the PTR rate one time during the Pilot; customers who initially opted into the PTR rate could switch back to the CPP rate one time. Customers could also choose to switch back to the Basic Rate, thus opting out of the Pilot, or to switch to and from a competitive supplier, thus leaving or returning to National Grid, at any time.

Technology choice. Customers on the CPP and PTR rates also had a choice of four technology packages, with Level 1 (web portal only) as the default. Some of the technology packages had eligibility requirements related to internet access and central air conditioning.[9] Technology options became more advanced, offering more electricity usage information and control, from Level 1 to Level 4:

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[8] Customers had the option to decline the smart meter and, therefore, opt out of the Pilot at the onset. Five percent of customers offered an AMI meter declined to accept it.

[9] For example, in order to be eligible for the Level 2 package with a digital picture frame, customers had to have a high-speed broadband Internet connection. To be eligible for Level 3 with a PCT, customers had to have central air conditioning. To be eligible for Level 4 with a PCT and a smart plug and/or load control device, customers had to have central air conditioning and a high-speed broadband Internet connection.

- Level 1: Personal electric use information, via access to a web portal;
- Level 2: Level 1 plus an IHD with energy use and real time cost information and access to this information through the web portal;
- Level 3: Level 1 plus a programmable-controllable thermostat (PCT) and a mobile app to view the PCT schedule; or,
- Level 4: Level 1, Level 2, and Level 3 plus a smart plug and, for some customers, a wired load control device, and additional capability in the mobile app to show load control and smart plug usage.

Conservation Days. During each summer of the Pilot (2015 and 2016), National Grid called 20 Conservation Days on days with expected high demand. Customers received notifications one day ahead and could opt to receive them the day of each Conservation Day as well. On these days, the price of electricity increased during designated hours, called Peak Event hours, which varied between Conservation Days. In 2015, the Peak Events averaged 6.75 hours in length and totaled 135 hours. Events were slightly longer in 2016, averaging 6.95 hours in length and totaling 139 hours. National Grid's events were longer and called more days in a row than events from other comparable programs. For example, one of the most well-known critical peak pricing programs, Southern California Edison's, is limited to 60 hours per year,[10] and NSTAR's[11] smart grid pilot included a total of 15 events from 3-5 hours each over two summers.[12] On the CPP rate, customers were incented to conserve electricity, or shift usage to non-Peak Event hours, and thus avoid paying the high electricity prices during Peak Event hours. On the PTR rate, customers received a rebate for any electricity conserved during those hours.

Community Partnership and Sustainability Hub

To ensure that the Pilot was a collaborative effort with the community, National Grid partnered with the City of Worcester to host the September 2011 Green2Growth Summit (Summit). The Summit provided valuable insights into customers' visions regarding the future of energy delivery in their city. National Grid learned that its customers are increasingly aware of new opportunities to manage their energy consumption and are open to learning more about the potential uses and benefits of smart technology. Based on information gathered through the Summit, the Company revised the Pilot's Outreach & Education plan, implemented in Phases 2-4 of Figure E-3, and developed a Sustainability Hub in Worcester to continue engaging customers. The Sustainability Hub was envisioned and built as a focal point for the successful implementation of the Pilot. In addition to being the physical presence of the Pilot in Worcester, the Sustainability Hub serves as a model energy center in the community, where National Grid provides hands-on education and engagement through a holistic approach, integrating various smart elements into a demonstration home. As of the end of 2016, over 8,200 people had visited the Sustainability Hub, and it was mentioned by many customers as a useful source of information alongside direct mail, the Smart Energy Solutions website, and National Grid's Customer Contact Center (see Figure 2-15). A survey administered by the Sustainability Hub also found that customers ranked the Hub

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[10] Summer Advantage Incentive fact sheet <https://www.sce.com/wps/wcm/connect/d0d870bf-68f5-41b0-a930-3c082652b443/NR580V40410_CPP.pdf?MOD=AJPERES>

[11] NSTAR is now called Eversource Energy.

[12] NSTAR Smart Grid Pilot Final Technical Report, AMR BASED DYNAMIC PRICING. DE-OE0000292. Prepared for: U.S. Department of Energy On behalf of NSTAR Gas and Electric Corporation. August 4, 2014.

highly as a source of information (see APPENDIX C).

Statewide Common Evaluation Framework

Navigant conducted the evaluation of the Pilot in accordance with the *Common Evaluation Framework*[13] produced by the Massachusetts Smart Grid Collaborative Technical Subcommittee (the Collaborative), a stakeholder group convened by the DPU to develop consistent evaluation themes and techniques across smart grid pilot programs in the state. The evaluation included quantitative measures of energy, demand, and customer bill impacts, as well as qualitative measures for customer engagement, satisfaction, and perceptions through customer surveys, interviews, and focus groups.

Impact Assessment

This evaluation addresses the impacts of the Pilot on demand during Peak Events, overall energy consumption, and customer bills. The impact findings in this report are primarily focused on residential customers. Commercial customers were a very small portion of the Pilot participants and outcomes were explored for them to the extent possible based on the constraints of the small sample. Where possible, each set of impacts was broken out by technology/price groups as prescribed by the Common Evaluation Framework. For Level 1, Navigant evaluated each of the impacts for both active and passive customers.

Table E-1 shows total and percentage demand and energy savings and total bill savings for residential customers in the Pilot. Total savings are the sum of savings across all residential customers in the program. For the Peak Event savings, the total savings are shown for the “average event”, which is the average across all Peak Event hours across all 20 Peak Events of each summer, and for the “maximum event”, which is the single Conservation Day with the highest average savings across the Peak Event hours. Percentage savings are the weighted average of savings across the residential technology/price plan groups.

Table E-1. Total and Percentage Savings for Residential Customers

Impact Category		2015			2016		
		Total Savings	Percentage for Active Customers	Percentage for All Customers	Total Savings	Percentage for Active Customers	Percentage for All Customers
Peak Event Savings	Average Event*	0.55 MW	16.8%	3.9%	1.02 MW	16.8%	7.2%
	Maximum Event**	1.59 MW	29.0%	12.3%	2.28 MW	24.0%	14.3%
Energy Savings ***		215 MWh	4.3%	0.2%	1,358 MWh†	6.3%	2.0%
Bill Savings‡		$997,621	-	-	$772,879	-	-

Source: Navigant analysis

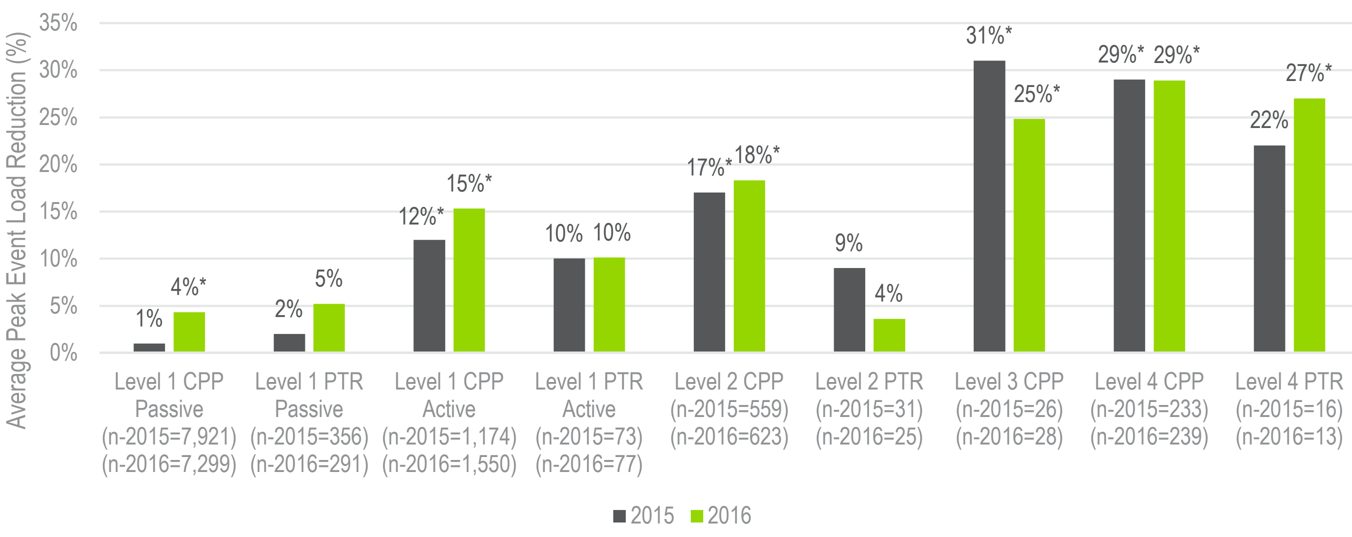
* This is the total demand savings among all participants, averaged across all 20 events in the summer of each year.
** This is the total demand savings for 6/23/2015 and 7/25/2016, the Conservation Days with the highest savings for each summer.
*** This includes energy savings for CPP customers only, as energy savings were neither expected nor found for PTR customers.
† The considerable increase in energy savings in 2016 was driven primarily by a spike in savings in July, Navigant did not find any evidence suggesting this result was erroneous. This is discussed more fully in Section 3.2.1.
‡ This includes total bill savings for CPP customers and rebates for PTR customers.

13 D.P.U. 10-82, Massachusetts Smart Grid Collaborative Technical Subcommittee, *Common Evaluation Framework*, August 10, 2011.

The Pilot was developed to meet the GCA goal of achieving peak and average load reductions of 5% or greater for the active customers in the Pilot. In Navigant's analysis, peak load reduction was examined in the demand analysis and average load reduction in the energy analysis. In both 2015 and 2016, active residential customers in the Pilot achieved an average of a 17% peak load reduction during Peak Events. Active CPP participants achieved an average load reduction of 4.3% in 2015 and 6.3% in 2016, which averaged to 5.4% over the whole of the Pilot.[14] Demand savings in 2015 and 2016 may be slightly underestimated because hourly data from 2014 was used to estimate the baseline. In 2014 customers had access to usage information through the Pilot web portal but the Pilot rates were not yet live, so they may have already been conserving relative to their pre-2014 usage as they were more aware of their electricity usage.[15]

Active customers achieved average Peak Event load reductions of up to 31%, and in-home technology increased demand savings. Figure E-5 shows the average percentage peak load reduction across the 20 events of each summer for each of the technology/price groups. Whether on the CPP or PTR rate, customers achieved greater demand reductions with more advanced technology. The savings for CPP customers were statistically significant at the 90% confidence level for all active participants in both years, and for passive participants in 2016. The savings for customers on the PTR rate were not statistically significant at any technology level in 2015, and only for Level 4 in 2016. The lack of statistical significance for the PTR rate was due to small sample sizes on that rate. At each technology level, active CPP customers conserved more electricity than their PTR counterparts. Passive PTR customers saved more than passive CPP customers, which could be due to a higher level of engagement since they had to opt in to the PTR rate.

Figure E-5. Average Peak Event Load Reductions by Technology/Price Group



Source: Navigant analysis

Note: An asterisk (*) indicates that the majority of the event hours throughout the summer were statistically significant at the 90% confidence level for the indicated group. Additionally, n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group.

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[14] Energy savings, or average load reductions, were neither expected nor found for PTR customers as these customers were not on a TOU rate.

[15] Hourly data prior to April 2014 when smart meters were installed was not available.

Absolute peak load reductions for each technology/price group in each summer are shown in Table E-2.

Table E-2. Average Absolute Peak Event Load Reductions per Customer by Residential Technology/Price Group

Technology/Price Group	2015 Absolute Savings (kW)	2016 Absolute Savings (kW)
Level 1 CPP Passive	0.01	0.05
Level 1 PTR Passive	0.03	0.07
Level 1 CPP Active	0.13	0.17
Level 1 PTR Active	0.12	0.12
Level 2 CPP	0.20	0.21
Level 2 PTR	0.13	0.05
Level 3 CPP	0.53	0.49
Level 4 CPP	0.56	0.60
Level 4 PTR	0.50	0.60

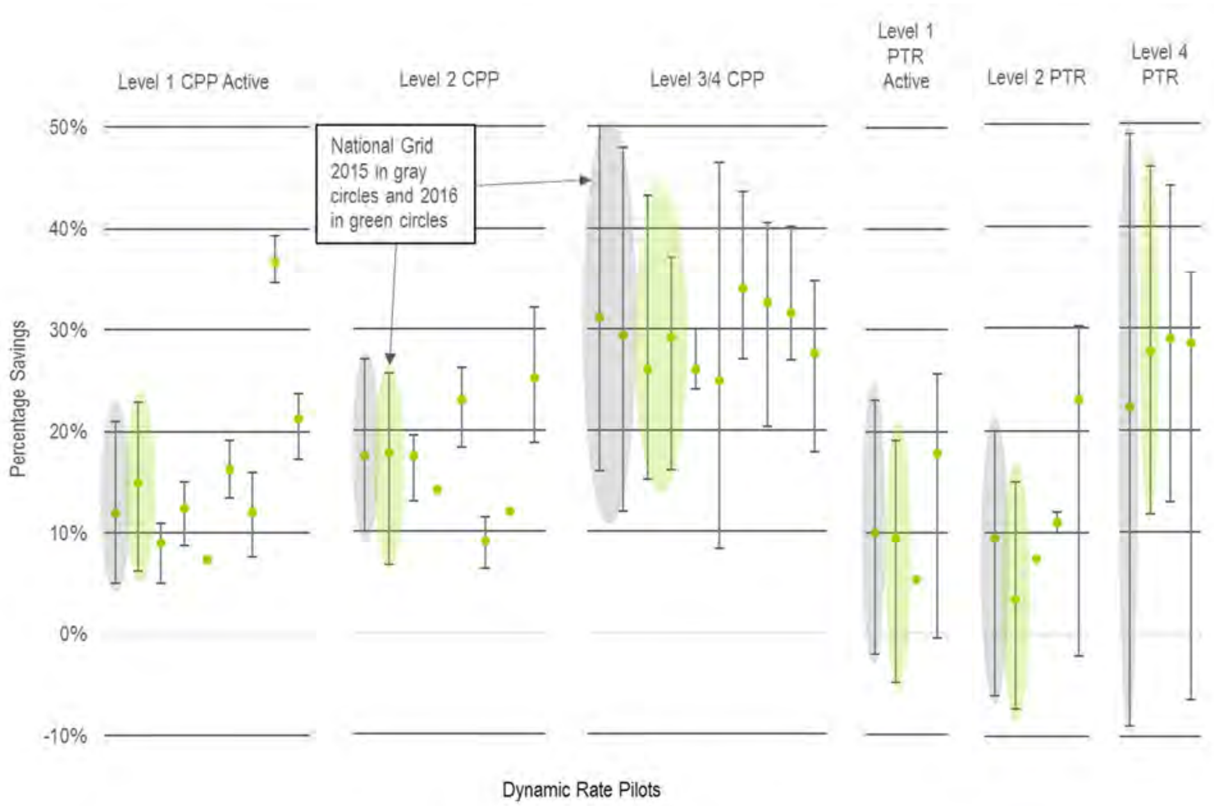
Source: Navigant analysis

Peak Event savings were comparable to other dynamic rate pilots. In percentage terms, the peak event impacts for active customers in the Pilot were similar to those from other, primarily opt-in, programs.[16] Comparisons of the Pilot to several other programs around the country are shown in Figure E-6. The comparisons include the average, maximum, and minimum impact when possible, or the average impact when the minimum and maximum could not be found. The comparisons are grouped by the Pilot's technology/price groups, and the comparison programs are matched to the Pilot groups based on the descriptions of the price plans and the enabling technologies in the comparison program's report. The Pilot groups are highlighted in gray in 2015 and green in 2016.[17]

[16] Passive customers in Level 1 also had savings, but they are not shown in Figure E-6 because all of the comparison programs are opt-in. Passive customers in an opt-out program are fundamentally different from customers in an opt-in program in terms of their motivation to participate in a program.

[17] The specific utility for each of the comparable pilots can be seen in Figure 3-2.

Figure E-6. Peak Event Impacts Percentage Comparisons to Other Utilities



Source: Navigant analysis and the Smart Grid Investment Grant Program

Low-income customers achieved Peak Event impacts similar to other customers in two of the three technology/price groups examined. Three technology/price groups (Level 1 CPP Active, Level 1 CPP Passive, and Level 2 CPP) had enough low-income customers to analyze whether their Peak Event impacts differed from the larger group. In the two Level 1 groups, the impacts for low-income customers were not statistically different from the rest of the group; 87% of all Pilot participants were in the Level 1 CPP groups, meaning for the bulk of the Pilot low-income customers had the same impacts as other customers. However, in Level 2 the low-income customers had lower Peak Event savings than the group as a whole. As discussed further in Section 3.1.3, possible reasons for this difference in Level 2 include (1) lower central air conditioning penetration for the low-income customers, (2) low-income customers may have less discretionary energy usage and thus less energy to save, and (3) low-income customers may have been less able to shift their usage than other residential customers. The difference could also be a spurious finding since low-income customers had the same impacts as other customers in two of the three groups analyzed.

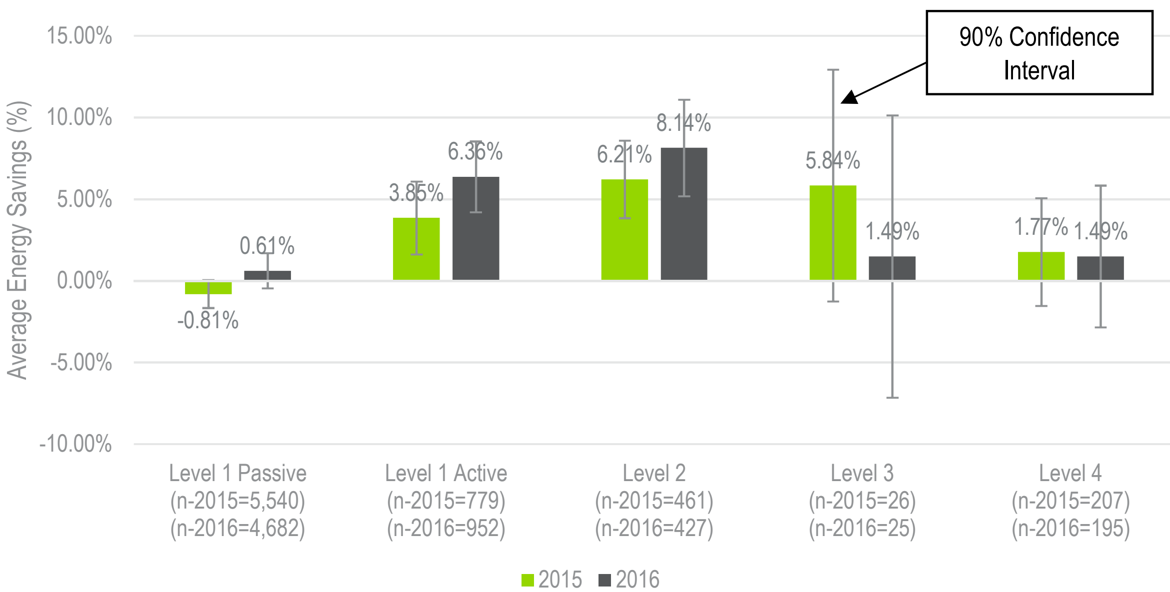
CPP customers achieved average energy savings of up to 8% over the two years of the Pilot.

Figure E-7 shows the average percentage energy impacts with 90% confidence intervals for CPP customers in different technology levels in each year of the Pilot.[18] In both years, energy savings for

[18] Navigant also examined energy savings for PTR customers but did not find any significant savings outside of peak events; PTR customers were not expected to achieve significant energy savings because they did not pay TOU rates.

active participants were highest for Level 2 customers (49 kWh per month) and lowest for Level 4 customers (12 kWh per month). Active Level 1 customers saved 32 kWh per month, and Level 3 customers saved 25 kWh per month. Although the point estimates of energy savings changed from 2015 to 2016, the changes were not statistically significant indicating the energy savings were similar across the two years of the Pilot. It is unclear why Level 4 customers saved less than Level 3 customers in 2015 since the two groups had similar technologies; however, the 90% confidence bounds for the two estimates overlap and the sample sizes are relatively small for monthly billing analysis, which may have contributed to the discrepancy; additionally, the discrepancy disappeared in 2016 when the point estimate for Level 3 customers fell considerably. The estimates of energy savings for passive customers in Level 1 were very small and not statistically significant in either year.

Figure E-7. Average Energy Impacts for CPP Customers by Technology Level

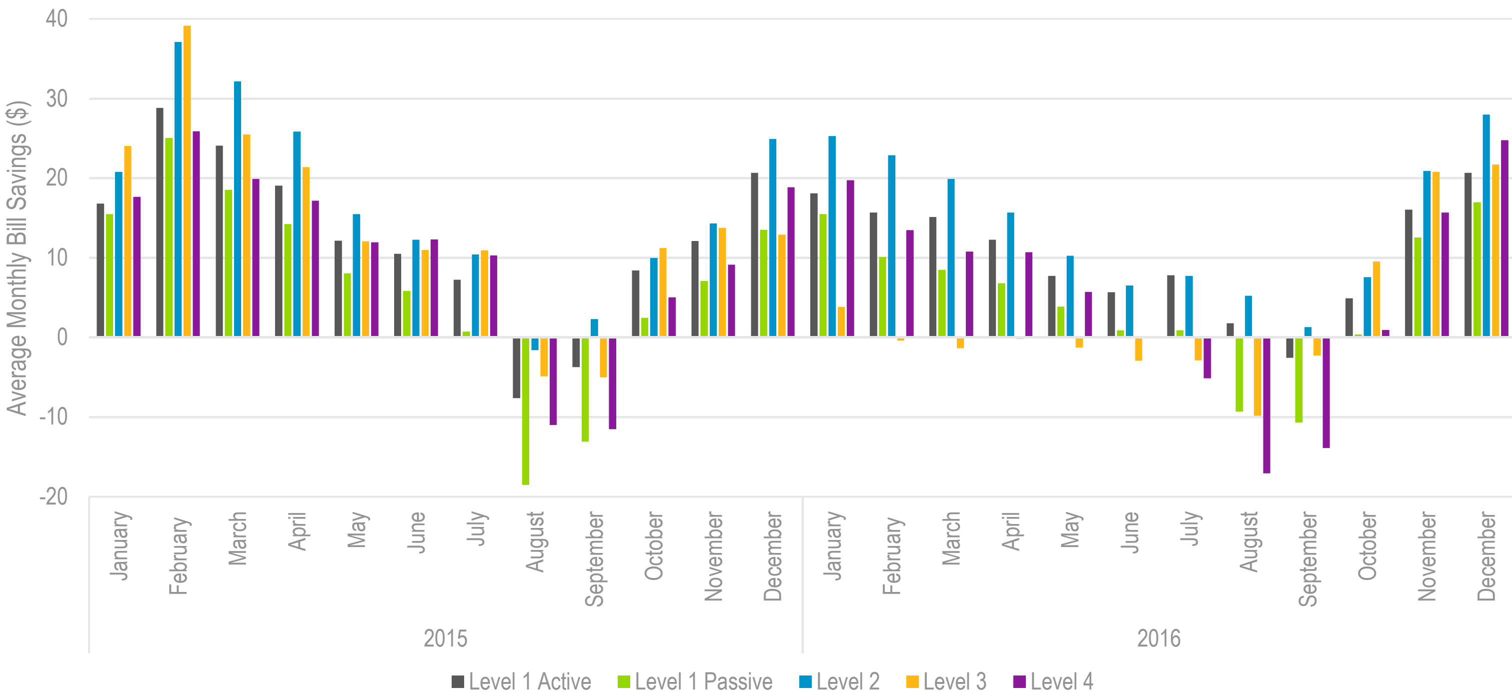


Source: Navigant analysis

Note: n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group.

CPP customers averaged $236 in bill savings over the two years of the Pilot. Figure E-8 shows the average bill savings by month and year for CPP customers. The month of each bill was defined as the last day of the billing period. This means that on average, bills in each month contain an equal number of days in the current month and the previous month, for example bills in May reflect usage in the second half of April and the first half of May. On average across technologies, bill savings were highest in February 2015, which reflects January and February 2015 usage, when customers were still adjusting to the new TOU rate. Unless there was a Peak Event, customers saved money on the TOU rate because the TOU rate was lower than the Basic Rate for non-Peak Event hours. Customers' bills went up in August and September of each year and July of 2016, reflecting usage in July, August, and September, which was expected, since July and August were when the majority of the Peak Events were called each year. The expectation was that summer bills, when Peak Events occurred, would increase but this would be balanced by bill savings throughout the rest of the year. Average per-customer bill savings over the two years of the Pilot were $375 for Level 2, $272 for active customers in Level 1, $206 for Level 3, $191 for Level 4, and $136 for passive customers in Level 1. For each group, bill savings were higher in 2015 than in 2016 despite the fact that energy savings were higher in 2016. Increases in energy savings do not necessarily produce increases in bill savings because of the high price during Peak Events. For example, the highest energy savings occurred in July 2016, but that did not produce high bill savings in that month because eleven Peak Events were called, increasing bills in that month for many customers.

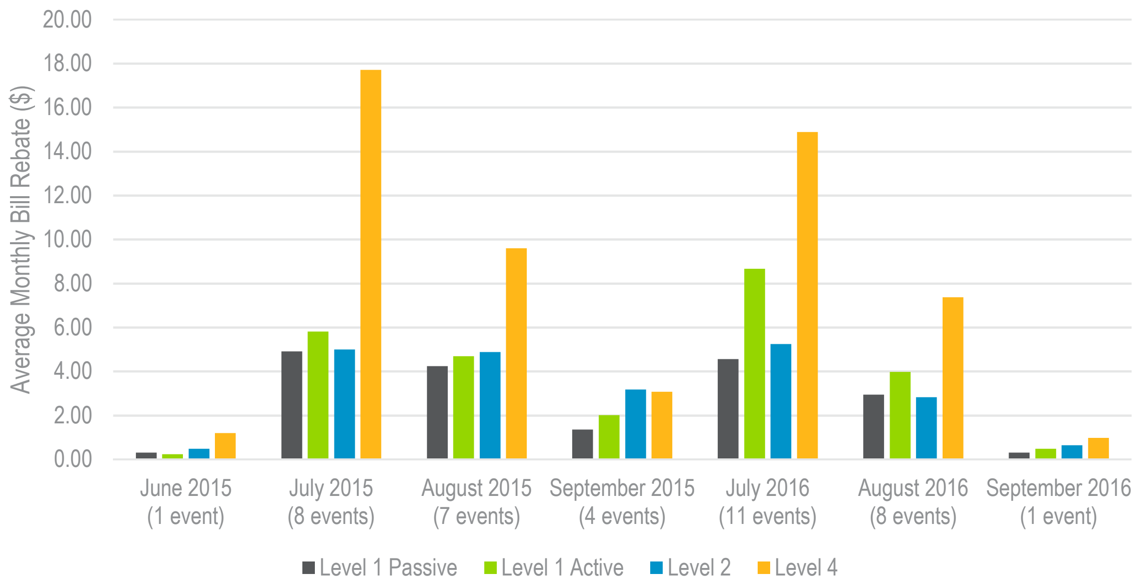
Figure E-8. Average Bill Savings for CPP Customers



Source: Navigant analysis

PTR customers averaged approximately $30 in bill rebates over the two years of the Pilot. The bill savings for PTR customers came from the monthly rebate earned during Peak Events based on the payments made by National Grid. Figure E-9 shows the average bill rebates by month and year for PTR customers. Over the two years, Level 4 customers achieved the highest average rebate of $1.37 per event, active Level 1 customers averaged $0.65 per event, Level 2 customers averaged $0.56 per event, and passive Level 1 customers averaged $0.46 per event. As with CPP customers, bill rebates for PTR customers were slightly lower in 2016 than in 2015 for most of the technology groups, while active customers in Level 1 had essentially the same rebate in both years (increasing by $0.02 in 2016 compared to 2015).

Figure E-9. Average Bill Rebates for PTR Customers



Source: Navigant analysis

The Pilot exhibited small load shifting impacts. Navigant examined load shifting around Peak Events (i.e., in the hours just before (pre-cooling) or after (snapback) the Peak Event), from weekdays to weekends, and from peak to off-peak times on non-Conservation Days. CPP customers were expected to exhibit all three types of load shifting because of the TOU nature of the rate, whereas PTR customers may have shifted load around Peak Events but did not have a strong incentive to exhibit the other two types of load shifting. Overall, Navigant found that each type of load shifting was: (1) small compared to the Peak Event impact, (2) mostly larger for CPP than PTR customers as expected, and (3) mostly larger for customers with higher levels of technology.

Customer Engagement and Experience

This evaluation addresses customers' experiences with Smart Energy Solutions through the end of 2016. It looks at customers' expectations of the program, their reasons for participating, and their experience during the two summers of Conservation Days. Key findings include strong customer satisfaction, a desire to continue with the Pilot, and a high retention rate (i.e., few customers dropping out of Smart Energy Solutions and going back to the Basic Rate).

Strong satisfaction. As shown in Figure E-10, 69% of customers reported satisfaction with the Pilot of at least 5 on a 7-point scale,[19] with 18% rating their satisfaction a 7 out of 7.[20] The weighted average satisfaction was 5.06. This satisfaction rating was similar to those from several dynamic rate pilots from

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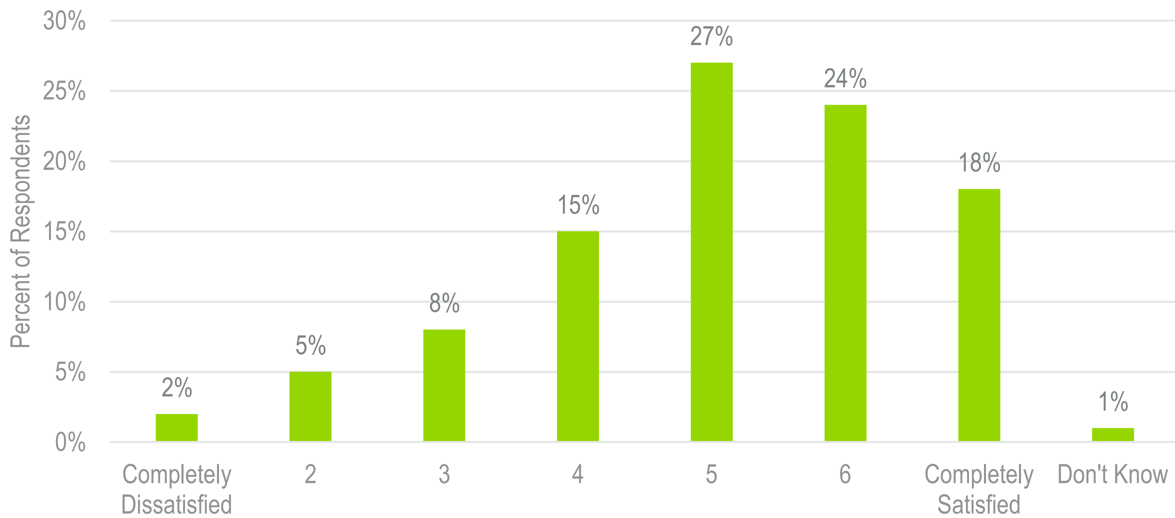
[19] National Grid customers could also indicate that they were "unsure/don't know" or refuse the question.

[20] In 2015, 72% of customers reported being "Very" or "Somewhat" satisfied with the Pilot on a 3-category scale. The satisfaction scale was changed in 2016 to better align with DPU guidelines.

other utilities, including NSTAR, DTE, and MN Power. Converted to a 7-point scale, NSTAR customers gave their pilot an average satisfaction rating of 5.6, 86% of DTE customers rated their pilot at least 4.2 out of 7, and MN Power customers rated their Pilot an average of 3.9 – 4.3 out of 7. As an opt-out Pilot, it is commendable that Smart Energy Solutions achieved satisfaction ratings similar to opt-in pilots, because customer motivations are different between opt-in and opt-out programs.

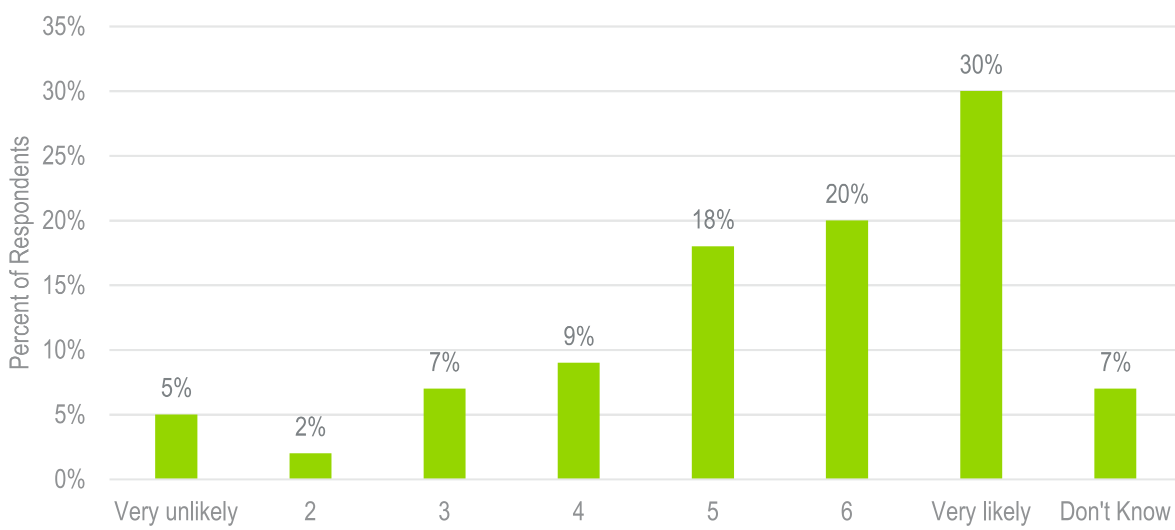
Figure E-10. Participant Overall Satisfaction with Smart Energy Solutions



Source: Navigant analysis of 2016 end of pilot survey (N=615)

Desire to Continue with the Pilot. Over two-thirds of participants indicated that they would like to continue with the Pilot if it were extended with the same conditions (Figure E-11). Almost one-third of customers (30%) indicated that their likelihood of continuing was a 7 on a 7-point scale, suggesting that these customers were enthusiastic about their experiences to date.

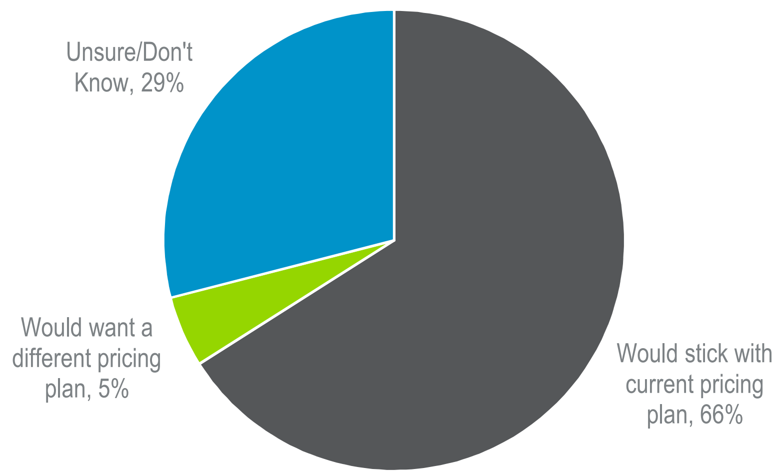
Figure E-11. Customers' Likelihood to Continue with Smart Energy Solutions



Source: Navigant analysis of 2016 end of pilot survey (N=615)

Additionally, most customers (66%) indicated that they would choose to stay on their current rate if the Pilot were extended, as shown in Figure E-12. Only 5% said they would definitely want to switch rates, with the rest being unsure.

Figure E-12. Customers' Interest in Continuing with Current Pricing Plan



Source: Navigant analysis of 2016 end of pilot survey (N=615)

High acceptance and retention rates. Since a foundational aspect of the Pilot was customer acceptance of AMI meters, National Grid monitored the percentage of customers who declined to install a meter and found it to be approximately 5% out of approximately 15,000 sites. Navigant surveyed a sample of 70 decliners. Three-quarters of those refusing the meter had no initial interest in participating in the program. Taking the categories of all reasons for declining the meter, the most common was 'Generic', which included not believing they would benefit and just not wanting a smart meter.

The CPP and PTR rates went live in January 2015 and almost 11,000 customers were enrolled.[21] Compared to one-year customer retention rates in other utility dynamic rate pilots, National Grid had high customer retention, even after two years, as shown in Figure E-13.[22] One thing of note is that, as an opt-out program, the Pilot was quite large compared to the size of a typical opt-in program. Opt-out program design is a relatively new industry concept, and based on research to date, retention rates appear to be similar for opt-in and opt-out programs.[23] However, by definition, customers in an opt-in program have a

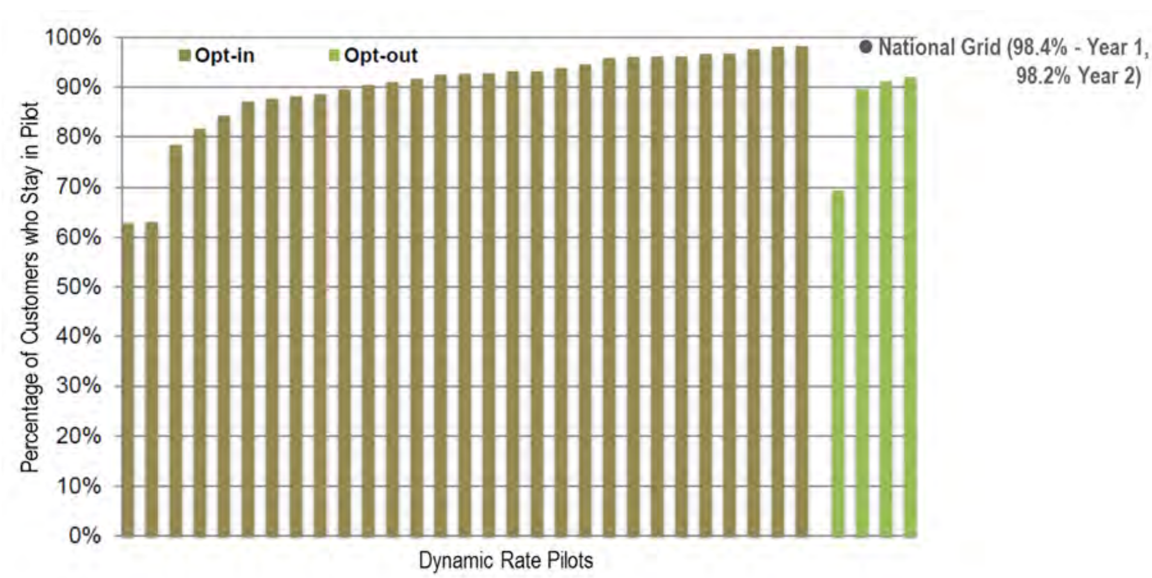
[21] The difference between the 15,000 customers offered an AMI meter and the 11,000 enrolled in the Pilot is accounted for by customers who get electricity from a competitive supplier, moved out before the Pilot rates went live, or chose to drop out of the Pilot before it started.

[22] Figure E-13 shows U.S. Department of Energy Smart Grid Investment Grant (SGIG) dynamic rate pilot retention rates. Ten utilities undertook several pilot studies during the SGIG period and reported their experience in recruiting and retaining customers. Each bar in the chart represents a single treatment group within one of the utility pilots.

[23] Cappers, P., H. Liesel, R. Scheer. *American Recovery and Reinvestment Act of 2009: Interim report on customer acceptance, retention, and response to time-based rates from the consumer behavior studies*. LBNL-183029. June 2015.

different motivation to participate in a dynamic rate pilot than customers in an opt-out program. Customers who participate in opt-in programs tend to be enthusiastic early adopters and not likely to drop out of a program they signed up for. Opt-out programs capture all customers, many of whom may follow “default bias”, which means that they tend towards the default offering rather than accepting alternative offerings. Yet, given the fact that opt-out programs target the general population, we would anticipate lower retention rates over time. The 98% retention rate achieved by National Grid after two years running the Pilot—coupled with the fact that the Company called more event days in each summer than any other dynamic rate pilot—is remarkable.[24]

Figure E-13. Customer Retention Rate Based on Whether the Utility Used Opt-In or Opt-Out Recruitment



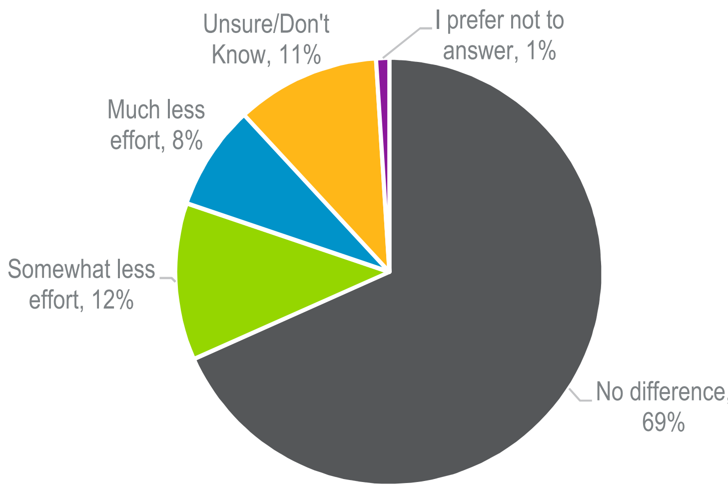
Source: Lawrence Berkeley National Laboratory and Navigant analysis

Low impact of bill protection on CPP rate customers. CPP customers were eligible for bill protection if they stayed on the CPP rate for at least 12 consecutive months; bill protection meant that if at the end of the year their bills were higher than they would have been on the Basic Rate, the customer received a credit in the amount of the difference. At the end of the Pilot, almost half of the customers on the CPP rate (40%) said that they were aware of the bill protection feature. However, as shown in Figure E-14, over two-thirds of those who knew about it said that the feature made no difference in their efforts to manage their electricity use. This means that most CPP customers likely did not reduce their energy savings behaviors because they knew they would get bill protection at the end of the year. Approximately 20% of the CPP participants did say that knowing about bill protection made them put “somewhat less” or “much less” effort into saving energy. To explore this further, Navigant matched the survey results to the usage data and examined the Peak Event impacts for active customers in Level 1 CPP who said they

[24] Over time, customer retention reflects how many customers remain in the Pilot rather than dropping out. The retention rate considers only those customers who actually drop out of the Pilot and excludes those who moved or switched to a competitive supplier, which could have happened for any number of reasons unrelated to the Pilot.

were aware or unaware of the bill protection feature.[25] This analysis did not reveal statistically significant differences in impacts and neither group had consistently higher or lower impacts than the other, supporting the conclusion that bill protection awareness did not influence customers' actions in the Pilot.

Figure E-14. Effect of Bill Protection on Customers' Efforts to Manage Electricity



Source: Navigant analysis of 2016 end of pilot survey (N=229)

Lessons Learned from Program Implementation Staff

National Grid identified lessons learned from the Pilot through meetings with members of National Grid's implementation team. This process captured key learnings, including aspects that worked well and also opportunities identified during Pilot implementation. Lessons learned that are relevant to the customer-facing evaluation in this report were identified in the following areas:

- Advanced Metering Infrastructure (AMI)
- Billing
- Outreach and Education
- Customer Service
- Peak Events
- In-Home Technology Installation

Table E-3 identifies the key success and opportunity in each of these areas. Chapter 5 discusses each of these learnings in more depth.

[25] We examined active customers in Level 1 CPP because this group contained the largest number of customers who answered this question. In this group, there were 71 customers who were aware of bill protection and 101 who were unaware.

Table E-3. Key Successes and Opportunities Compiled by Program Implementation Staff

Pilot Area	Success	Opportunity
AMI	National Grid found that the opt-out approach to the pilot was instrumental in simplifying the planning, scheduling, communication, and initial technology successes, including the Early Field Trial.	Implementing business process improvements that would streamline and accommodate evolving customer scenarios in AMI deployment and management.
Billing	National Grid was able to successfully support a wide variety of billing scenarios, under both current tariffs and Smart Grid tariffs, using AMI meter data.	Innovative bill design and presentment will allow National Grid to demonstrate the energy and bill savings to the customer.
Outreach and Education	Extensive outreach and education were critical to creating awareness and interest among customers and motivating them to participate actively in the Pilot.	Providing more customized information to help customers maximize savings in light of their specific energy usage characteristics would have supported higher savings and enhanced the customer experience.
Customer Service	Providing access to dedicated support services and the Sustainability Hub allowed customers to receive quick access to information and resolution of issues.	Increasing accessibility of the web portal via a streamlined account creation process would support customers in coming to view online access as a key interface with National Grid.
Peak Events	Optimizing peak event communications by providing and promoting communication options, and customizing peak event characteristics to make participation easier for customers, supported the achievement of higher participation and savings levels in the second year.	Creating greater understanding of the purpose of Peak Events, the ways in which they are determined, and the benefits of in-home technologies in enabling customers to save.
In-Home Technology Installation	The installation and customer education process received positive feedback from customers.	Making the steps of the installation process very clear to customers to reduce the incidence of incomplete and cancelled technology installations.

Source: National Grid

Key Learnings from Smart Energy Solutions

Before and throughout the Pilot, National Grid implemented a “listen, test, learn” approach that is based on “on the ground” conversations and reflections on the Pilot. This feedback, combined with learning, generally leads to continuous improvement in program delivery. National Grid conducted extensive program marketing in the lead up to initiating meter installations, the first phase of the program. These activities included convening a public summit to discuss the proposed program, development of brochures explaining the program, and establishment of the staffed, physical Sustainability Hub within the Pilot program area. National Grid also partnered with local schools to offer Energy Ambassador internships at the Sustainability Hub. Clark University offered annual internships, and Worcester Polytechnic Institute students worked at the Sustainability Hub as part of the Energy Ambassador program they created. Ambassadors host Sustainability Hub tours and attend outreach events to educate customers throughout the community. Presenting the personal side of the Company is the backbone of “listen, test, learn”, and is the inspiration for sending National Grid employees and Ambassadors into the community. It is also the basis for hosting visitors at the Sustainability Hub for the dual purpose of educating customers and listening to their concerns and feedback. The application of the “listen, test, learn” approach throughout the Pilot led to several important changes from the first summer to the second, which were outlined in Figure E-2.

Several broad themes emerged regarding customer response to the Pilot design and implementation.

Impacts for active customers (17% peak load reduction and 5.4% average load reduction over the two years of the Pilot) met the goals established through Section 85 of the GCA, and the majority of customers were satisfied with the Pilot. Figure E-15 summarizes key learnings from the two years of Smart Energy Solutions.

Figure E-15. Key Learnings from Smart Energy Solutions

Smart Energy Solutions shows the viability of opt-out design.

- The program enrolled ~11,000 participants, which is many more than could have been recruited in an opt-in design.
- The retention rate after two years was 98%, which is higher than many comparable opt-in programs.
- Program satisfaction was strong, with 69% of participants rating the Pilot at least a 5 on a 7-point scale.

It is important to choose the default options in an opt-out program carefully.

- Smart Energy Solutions defaulted customers onto the CPP rate and web portal, with no additional in-home technology.
- Approximately 95% of customers were still on the default price plan and 90% on the default technology level after the two years of the Pilot.
- Although satisfaction was strong, "default bias" is likely to be a factor in customers staying on the default enrollment options in the opt-out design.

Long Peak Events and Peak Events called on consecutive days did not significantly affect savings or satisfaction.

- Despite calling more Peak Events (including on consecutive days) and longer Peak Events than similar programs, Smart Energy Solutions acheived similar satisfaction and savings.
- However, some customers did express a desire for shorter events ending earlier in the evening.

In-home devices increased demand savings, but much of the total savings were acheived with just a web portal.

- Customers with in-home devices had significantly higher demand savings (up to 31%) than those without any technology (up to 15%).
- Customers without technology who visited the program web portal saved approximately twice as much in the second year of the Pilot as those who did not visit the web portal (this may be attributable to differences in motivation as well as to the web portal itself).
- Customers without technology made up 90% of the participants in the Pilot and approximately 70% of the total Peak Event savings.
- Customers with IHDs saved the most energy, followed by those with web portal access only. Those with PCTs had higher demand savings but lower energy savings.

Customers on the CPP rate saved more than those on the PTR rate.

- At each technology level, active customers on the CPP rate saved more than those on the PTR rate.
- Passive customers saved more on the PTR rate, but that could be due to a slightly higher level of engagement since they had to opt in to the PTR rate.
- The motivations to save on the CPP rate are greater than for the PTR rate, as on the CPP rate customers face higher bills if they don't save.

The PTR rate may be more appropriate than the CPP rate for those on fixed budgets or with health issues.

- Although the CPP rate saves money over the course of the year, bills do increase for many customers in the summer, potentially making the PTR rate a better choice for customers on a fixed or limited income.
- Additionally for those who have a limited ability to reduce their energy usage (because of elderly, ill, or limited mobility household members, pets who need cooler temperatures, electric medical equipment, etc.) the PTR rate may be more appropriate.

Information needs to be provided multiple times via multiple channels.

- Despite a plethora of communication from National Grid, half of customers without technology did not know it was available, and of the 40% who knew it was available, many did not understand the benefits.
- Additionally, many customers (56%) did not realize they had the option to switch price plans.
- Based on the focus groups, low-income customers had low awareness of the rates and technologies despite the high potential benefits to this group.

Customers want options to personalize notifications.

- Customers cited issues with the amount and methods of Conservation Day notifications in 2015, and responded well to additional promotion and simplification of personalization options in 2016.

Source: Navigant analysis

Evaluation Report Structure

This report is organized in the following chapters:

- **Chapter 1: Introduction**, describes the Pilot and summarizes the evaluation focus and objectives;
- **Chapter 2: Smart Energy Solutions Program Design**, summarizes rate design and technology choice, as well as program marketing, participation and segmentation;
- **Chapter 3: Impact Assessment**, summarizes the results of the peak event impact analysis, energy impact analysis, bill savings, and load shifting;
- **Chapter 4: Customer Experience Assessment**, summarizes participation drivers, participant awareness, engagement, and satisfaction;
- **Chapter 5: Lessons Learned from Program Implementation Staff**, discusses key learnings identified by program implementation staff, including aspects that worked well and also opportunities identified during Pilot implementation;
- **Chapter 6: Key Findings and Learnings**, draws everything together to provide key findings;
- **Appendices A through E,** provide detailed methodologies and results; and
- **Appendices F, G, and H** are provided as separate documents, and show graphs of event impacts by hour for residential customers, graphs of event impacts by hour for commercial customers, and graphs of event impacts for residential customers by demographic subgroup, respectively.

1. INTRODUCTION

Massachusetts Electric Company and Nantucket Electric Company d/b/a/ National Grid's (the Company or National Grid) Smart Energy Solutions Pilot program (the Pilot or Smart Energy Solutions) is an innovative smart grid pilot combining deployment of advanced meters, customer-facing technologies, and time-of-use (TOU) rates. The informational portion of the Pilot began in 2013, rates went live in January 2015, and implementation ran through the end of 2016. National Grid has filed for a two-year extension of the Pilot and the Massachusetts Department of Public Utilities (DPU) has granted an interim extension while they make a final decision. The Pilot also includes advanced distribution grid-side technologies which are the subject of a separate report.[26] This Pilot recruited customers through an opt-out model for residential customers and small businesses across a range of income and other demographic characteristics, providing a case study across a broad population sample. This evaluation, conducted by Navigant Consulting, Inc. (Navigant or the evaluation team), covers customer-side Pilot activities through the end of 2016. Navigant conducted the evaluation of the Pilot in accordance with the *Common Evaluation Framework*[27] produced by the Massachusetts Smart Grid Collaborative Technical Subcommittee (the Collaborative), a stakeholder group convened by the DPU to develop consistent evaluation themes and techniques across smart grid pilot programs in the state.

1.1 Smart Energy Solutions Pilot Description

Smart Energy Solutions was built on two important design principles focused on the customer and the distribution grid, respectively. First, the Pilot provided a new customer experience with regard to electricity delivery in the form of dynamic pricing, load control, and advanced communication interfaces. Second, the Company enhanced grid operations through advanced distribution technologies designed to markedly improve system reliability and operational efficiency. More specifically, Smart Energy Solutions included the following components:

- **Dynamic pricing** including TOU, critical peak pricing (CPP), and peak time rebates (PTR);
- **Advanced customer-side technologies**, including in-home displays (IHDs), programmable communicating thermostats (PCTs or smart thermostats), and other load controlling devices; and,
- **Advanced grid-side technologies**, including advanced communication systems, capacitor controls, and grid automation.

As shown in Figure 1-1, Smart Energy Solutions was deployed in four phases.

Phase 1. **Meter Deployment & Awareness.** In this initial phase the Company raised awareness about and installed advanced metering infrastructure (AMI) meters (also referred to as "smart meters") in approximately 15,000 homes and businesses. Five percent of customers offered AMI meters refused them.

Phase 2. **Introduction of Benefits.** In the second phase the Company introduced Smart Energy Solutions to raise customer awareness and create an expectation of more to come. Customer

[26] National Grid. *Interim Grid-Facing Evaluation Report*, March 31, 2016.

[27] D.P.U. 10-82, Massachusetts Smart Grid Collaborative Technical Subcommittee, *Common Evaluation Framework*, March 23, 2011.

education efforts continued throughout the Pilot.

Phase 3. **Choice.** In Phase 3 National Grid customers chose between two Pilot rates, a TOU CPP rate and a PTR rate, and four technology packages that offered varying levels of information and control via web portal access, phone app, IHDs, PCTs, direct load control devices, and smart plugs.[28] The Sustainability Hub was also opened during Phase 3 as a resource for customers. The Hub provides hands-on education and engagement through a holistic approach, integrating various advanced technologies into a demonstration home.

Phase 4. **Focus on Customer Control.** Phase 4 began with the rates going live in January 2015. The Company called Conservation Days with specific Peak Event hours (Peak Events) on high-demand days, educated customers about their bills, assisted them in using the tools available to understand and control their energy usage, and allowed them to customize their participation through the many options available in the Pilot.

Based on its experience with the Pilot, the Company has observed the importance of gradual and ongoing customer outreach and education to introduce new concepts and technologies. By introducing demand response and connected devices early on, the hope was that customers would better understand and benefit from incremental savings that could be realized from the introduction of AMI and time-based rates. National Grid has filed for a two-year extension of the Pilot and the DPU has approved an interim extension. Under the interim extension the Pilot will remain in effect until the DPU comes to a final decision. If the proposal for extending the Pilot is approved or if the Company's Grid Modernization Plan is approved, the Company envisions offering Smart Energy Solutions participants the option to receive similar savings and benefits as they have enjoyed to date, in line with what is proposed in the Company's Grid Modernization Plan in D.P.U. 15-120. Otherwise, the Pilot participants will revert to basic rates and will be eligible for the same demand response incentives as other customers in the Company's service territory. Pilot participants who received in-home devices will be able to keep them regardless of the outcome of the extension.

The Company hopes to transition to a more advanced and integrated demand response management system (DRMS) that will be deployed during the Grid Modernization plan period if approved. The functionalities of this enterprise DRMS include the ability to schedule, dispatch, control and conduct evaluation, measurement, and verification of load curtailment demand response events.[29]

[28] Customers also had the option to remain on the Basic Rate, effectively leaving the Pilot, or to leave National Grid by switching to a competitive supplier. As a result, the Pilot contained an "opt-out" element for customers who didn't want TOU/CPP, and an "opt-in" element for customers who chose PTR or any of the technology packages. This design and customer flexibility set the Pilot apart from other utility dynamic rate pilots. Therefore, comparisons to other programs are anecdotal, as direct comparisons do not exist.

[29] National Grid. D.P.U. 15-120. *Grid Modernization Plan at Attachment 8*. August 19, 2015.

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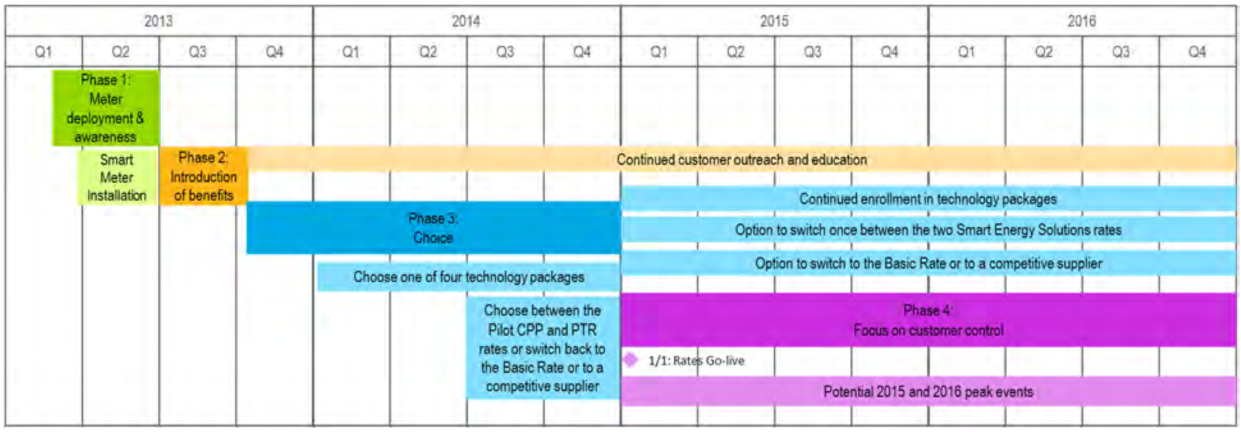
Figure 1-1. Four-Phase Rollout of Smart Energy Solutions



Source: Navigant and National Grid

1.1.1 Consistency with the Green Communities Act

The Pilot design complied with and exceeded the requirements of Section 85 of the Green Communities Act (GCA or the Act) passed in Massachusetts in 2008. The Act mandated that each investor-owned electric utility conduct a smart grid pilot with the overall objective of reducing active participants' peak and average loads by at least 5%. The pilot program must include, at a minimum, the following:

- Deployment of advanced meters that measure and communicate electricity consumption on a real-time basis;
- Automated energy management systems in customers' home and facilities;
- Time of use or hourly pricing for a minimum of 0.25 percent of the company's customers;
- Remote monitoring and control equipment on the Company's electric distribution system; and,
- Advanced technology to operate an integrated grid network communication system in a limited geographical area.

The Company adhered to these GCA principles by:

- Offering an opt-out TOU pricing option to approximately 15,000 customers, who make up more than 0.25% of National Grid's approximately 1.3 million customers;
- Seeking to achieve, for those customers who actively participated in Smart Energy Solutions, peak and average load reductions of at least 5%; and,
- Utilizing advanced technology to operate an integrated grid network communication system in a limited geographic area, including but not limited to:
    - Smart meters that provide real-time measurement and communication of energy consumption;
    - Automated load management systems embedded within current demand-side management programs; and,
    - Remote status detection and operation of distribution system equipment.

The Massachusetts Department of Public Utilities (DPU) recognized four unique elements of Smart Energy Solutions that differentiate it from other Section 85 pilot programs.[30]

1. The Company ***implemented the customer-facing and grid-facing components of the Pilot within one city***, a portion of Worcester, to allow National Grid to ascertain whether a comprehensive deployment of smart grid technologies produced synergistic customer benefits.
2. The Company ***deployed the program on an opt-out basis***, meaning all eligible customers in the Worcester area were offered an AMI meter and enrolled in Smart Energy Solutions by default but had the option to opt out if they weren't interested. Relative to opt-in programs where eligible customers must actively choose to participate, opt-out programs reach many more customers and thus have higher savings potential.
3. The ***default pricing option for the Pilot was a TOU rate, and the vast majority of Pilot participants remained on this rate***. Additionally, nearly 1,000 customers opted into technology packages which included in-home devices. Having a significant number of customers on a TOU rate with enabling technologies represented a unique opportunity to study these smart grid pilot components across a broad segment of the population.
4. National Grid's ***comprehensive outreach and education campaign combined both traditional and community-based elements***. It was designed to encourage customers to permanently change their energy consumption behavior in response to the price signals and other Pilot messaging. The Pilot also included the creation of the Sustainability Hub which serves as a model energy center in the community where National Grid provides hands-on education and engagement through a holistic approach, integrating various smart elements into a demonstration home.

1.1.2 Definition of Active Customers

In the context of an opt-out pilot, the GCA's goal of reaching 5% savings for "active" customers must be interpreted carefully. Some of the participants in an opt-out pilot will never actively engage with the program components. For evaluation purposes, Navigant defined active participants as anyone who opted into any in-home technologies and anyone with no in-home technology who logged into the Pilot web portal at least once.[31] Customers with no in-home technology who never logged into the web portal were considered "passive" participants in the Pilot. In other words, the passive customers did not take any actions to adopt technologies or check their electricity usage; however, these customers could still take actions to save energy as they were enrolled in the Pilot rates and received notifications for the Peak Events. By this definition, just under 25% of the Pilot participants were active at the end of 2016. This increased from just under 20% at the end of 2015.

1.1.3 Customer Decision-Making and Flexibility

Among smart grid pilots, Smart Energy Solutions was relatively complex with several key decision points

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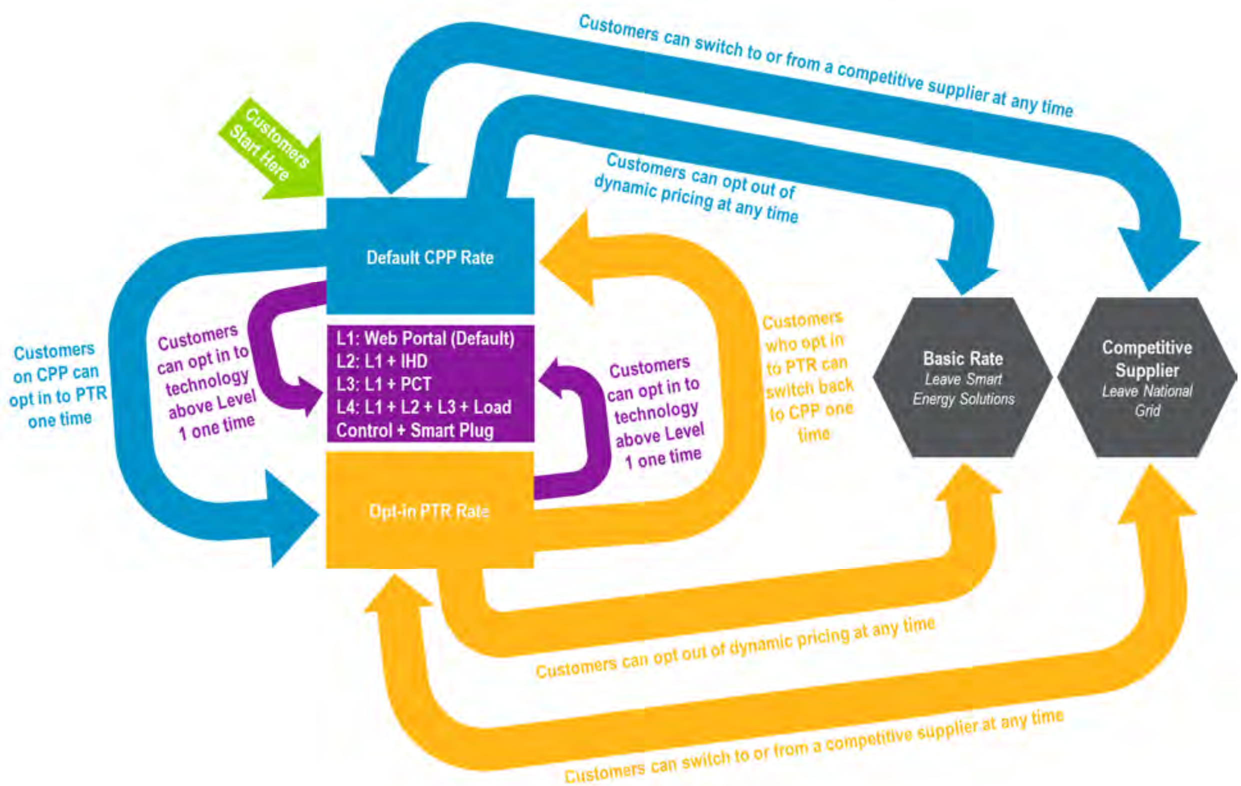
[30] D.P.U. Order 11-129. *Petition of Massachusetts Electric Company and Nantucket Electric Company, each d/b/a National Grid for approval of a smart grid pilot program.* August 3, 2012.

[31] Active customers were defined as of October 12, 2016 which was after the last Peak Event of the 2016 summer season.

for customers, as illustrated in Figure 1-2.

Figure 1-2. Smart Energy Solutions Customer Decision Points



Source: Navigant
Note: L1 = Level 1, L2 = Level 2, L3 = Level 3, L4 = Level 4, IHD = in-home display, PCT = programmable communicating thermostat.

Smart meters and choice of rates. Eligible customers in the Worcester area who accepted a smart meter were enrolled onto the CPP rate by default.[32] Customers had the option to opt into the PTR rate one time during the Pilot; customers who initially opted into the PTR rate could switch back to the CPP rate one time. Customers could also choose to switch back to the Basic Rate, thus opting out of the Pilot, or to switch to and from a competitive supplier, thus leaving or returning to National Grid, at any time. Customers using a competitive supplier effectively left the pilot, thus reducing the program population.

Technology choice. Customers on the CPP and PTR rates also had a choice of four technology packages, with Level 1 (web portal only) as the default. Some of the technology packages had eligibility

[32] Customers also had the option to decline the smart meter and, therefore, opt out of the Pilot at the outset.

requirements related to internet access and central air conditioning.[33] Technology options became more advanced, offering more electricity usage information and control, from Level 1 to Level 4:

- Level 1: Personal electric use information, via access to a web portal;
- Level 2: Level 1 plus an IHD with energy use and real time cost information and access to this information through the web portal;
- Level 3: Level 1 plus a programmable-controllable thermostat (PCT) and a mobile app to view the PCT schedule; or,
- Level 4: Level 1, Level 2, and Level 3 plus a smart plug and, for some customers, a wired load control device, and additional capability in the mobile app to show load control and smart plug usage.

Conservation Days. According to the approved Pilot design, National Grid could call up to 30 Conservation Days each year on days with expected high demand. High humidity (dew point levels) in combination with high temperatures typically drove customer usage upward and initiated the process of calling a Conservation Day. On these days, the price of electricity increased during designated hours, called Peak Event hours. On the CPP rate, customers were incented to conserve electricity, or shift usage to non-Peak Event hours, and thus avoid paying the high electricity prices during Peak Event hours. On the PTR rate, customers received a rebate for any electricity conserved during these hours.

National Grid used day-ahead ISO New England (ISO-NE) usage data and day-ahead weather forecasts for the City of Worcester to project whether to call a Conservation Day for customers in the Pilot. The ISO-NE usage forecast was adjusted based on the Worcester weather forecast and an event was proposed if a specific MW threshold[34] was met or exceeded for the next day. The suggested number of Peak Event hours (including start and end time) and the thermostat override temperature were then sent for Director approval. If approved, the event was scheduled through the CEIVA Entryway system and notifications were made to all customers the day before the event through the customer's preferred communication methods (email, SMS text message, and/or phone call). Customers who opted into day-of notification were also notified on the day of the Peak Event.

National Grid called twenty Peak Events in each summer of the Pilot (2015 and 2016). Events ranged from four to eight hours in length and maximum temperature and relative humidity ranged from 79°F to 92°F and 67% to 100%, respectively. The Peak Events averaged 6.75 hours in length and totaled 135 hours in 2015. Events were slightly longer in 2016, averaging 6.95 hours in length and totaling 139 hours. Nine of the Peak Events in 2015 and 10 in 2016 ran for the maximum length of eight hours. Seventeen of the 20 events in 2015 and 16 of the 20 events in 2016 were part of a back-to-back series, when events occurred multiple days in a row. The length of the event and weather are shown for each Peak Event in Figure 1-3.

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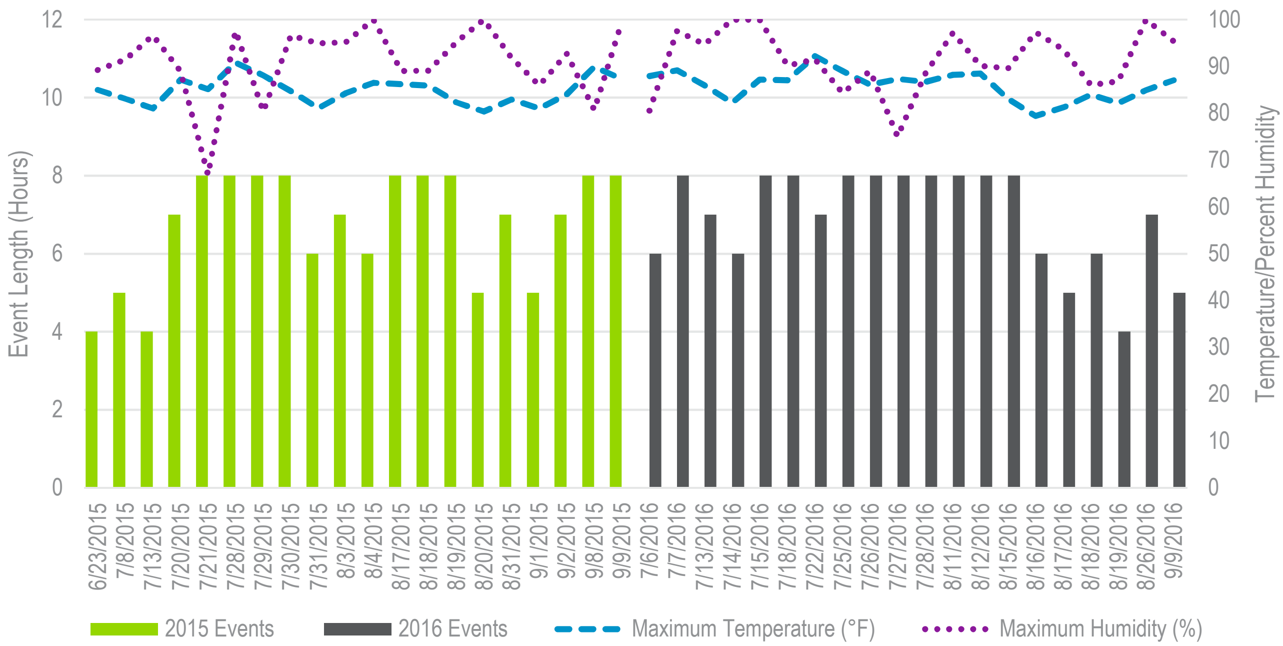
[33] For example, in order to be eligible for the Level 2 package with a digital picture frame, customers had to have a high-speed broadband Internet connection. To be eligible for Level 3 with a PCT, customers had to have central air conditioning. To be eligible for Level 4 with a PCT and a smart plug and/or load control device, customers had to have central air conditioning and a high-speed broadband Internet connection.

[34] As of the writing of this report, the threshold was 22,315 MW.

Figure 1-3. Summary of Peak Event Length, Temperature, and Humidity

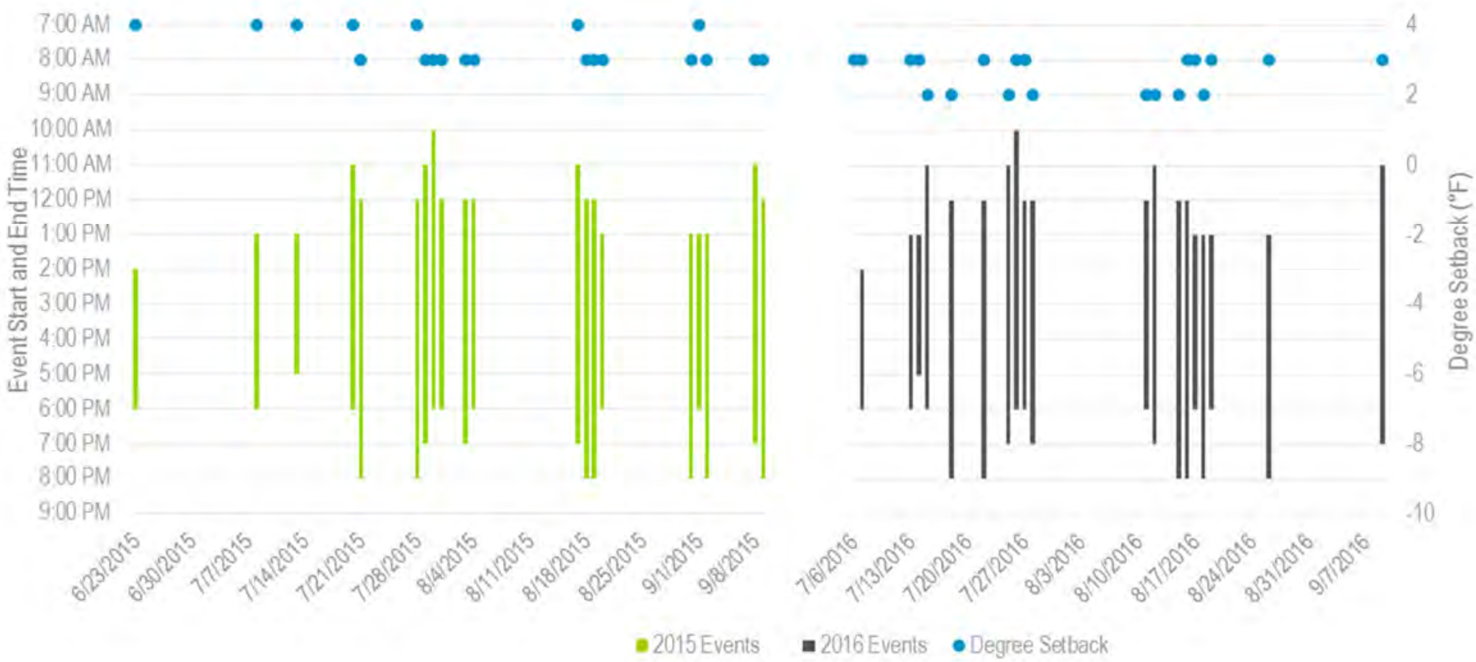


Source: Navigant analysis

The weather was relatively similar across the two summers of the Pilot. The average Conservation Day temperature was 75°F in 2015 and 76°F in 2016. Similarly, the average maximum temperature on Conservation Days was one degree hotter in 2016 than 2015, going from 85°F to 86°F. The Conservation Day humidity was also similar, averaging 67% in 2015 and 65% in 2016 and achieving average maximums of 91% in each year.

Compared to 2015, the Peak Event start and end times were more varied in 2016, especially on days of back-to-back Peak Events as shown in Figure 1-4. Additionally, the degree setbacks for the customers with PCTs were lower in 2016 than in 2015. In 2015 degree setbacks were 3 or 4°F, averaging 3.4°F, and in 2016 degree setbacks were 2 or 3°F, averaging 2.6°F. These changes were made in response to customer feedback at the end of the 2015 Peak Event season.

Figure 1-4. Summary of Peak Event Start and End Times and Degree Setback



Source: Navigant analysis

1.1.4 Community Partnership and Sustainability Hub

To ensure that the Pilot was a collaborative effort with the community, National Grid partnered with the City of Worcester to host the September 2011 Green2Growth Summit (Summit). The Summit provided valuable insights into customers' visions regarding the future of energy delivery in their city. National Grid learned that its customers are increasingly aware of new opportunities to manage their energy consumption and are open to learning more about the potential uses and benefits of smart technology. Based on information gathered through the Summit, the Company revised the Pilot's Outreach & Education plan, implemented in Phases 2-4 of Figure 1-1.

As an additional means of engaging customers, based on information gathered through the Summit, the Company developed a Sustainability Hub in Worcester (Figure 1-5). The Sustainability Hub serves as a model energy center in the community where National Grid provides hands-on education and engagement through a holistic approach, integrating various smart elements into a demonstration home. At the end of 2016, over 8,200 people have visited the Sustainability Hub since it opened, and it has been mentioned by many customers as a useful source of information alongside direct mail, the Smart Energy Solutions website, and National Grid's Customer Contact Center.[35] A survey administered by the Sustainability Hub also found that customers ranked the Hub highly as a source of information (see APPENDIX C).

[35] As of January 3, 2017.

Figure 1-5. National Grid Sustainability Hub

Source: National Grid

1.1.5 Statewide Common Evaluation Framework

Navigant conducted the evaluation of the Pilot in accordance with the *Common Evaluation Framework*[36] produced by the Massachusetts Smart Grid Collaborative Technical Subcommittee (the Collaborative), a stakeholder group convened by the DPU to develop consistent evaluation themes and techniques across smart grid pilot programs in the state. The evaluation included quantitative measures of energy, demand, and customer bill impacts, as well as qualitative measures for customer engagement, satisfaction, and perceptions through customer surveys, interviews, and focus groups.

1.2 Evaluation Focus and Objectives

Smart Energy Solutions focused on understanding the customer experience with dynamic rates and advanced technologies. As shown in Figure 1-6, National Grid had multiple communications channels to provide customers with information about the program and the rates and technologies available. This evaluation focused on customer awareness of smart meters, rates, and technologies; the choices customers made to adopt and use smart meters, rates, and technologies; and the savings that resulted from the use of each technology.

[36] D.P.U. 10-82, Massachusetts Smart Grid Collaborative Technical Subcommittee, *Common Evaluation Framework*, March 23, 2011.

Figure 1-6. National Grid's Multiple Program Communication Channels with Customers

Source: Navigant analysis

1.2.1 Impact Evaluation Objectives and Approach

The primary focus of the impact evaluation was on whether the expected energy and demand savings were realized. In particular, the impact evaluation estimated the following:

1. **Peak Event Impacts,** which are demand savings (MW) during Peak Events called in the summers of 2015 and 2016;
2. **Energy Impacts,** which are energy savings (MWh) from the Pilot in 2015 and 2016; [37]
3. **Bill Impacts,** which are dollar savings on customer bills in 2015 and 2016; and,
4. **Load Shifting** around Peak Events, including snapback and pre-cooling, and from peak to off-peak times in 2015 and 2016.

Each of these objectives is explored for customers in different price plans with different levels of enabling technology. Where possible, Navigant also explored these impacts for different demographic subgroups. The impact findings in this report are primarily focused on residential customers. Commercial customers were a very small portion of the Pilot participants and outcomes were explored for them to the extent possible based on the constraints of the small sample. Short descriptions of each methodology are

[37] To a lesser extent, Navigant also examined savings from 2014 when the informational portion of the Pilot was in effect but the Pilot pricing had not yet gone into effect.

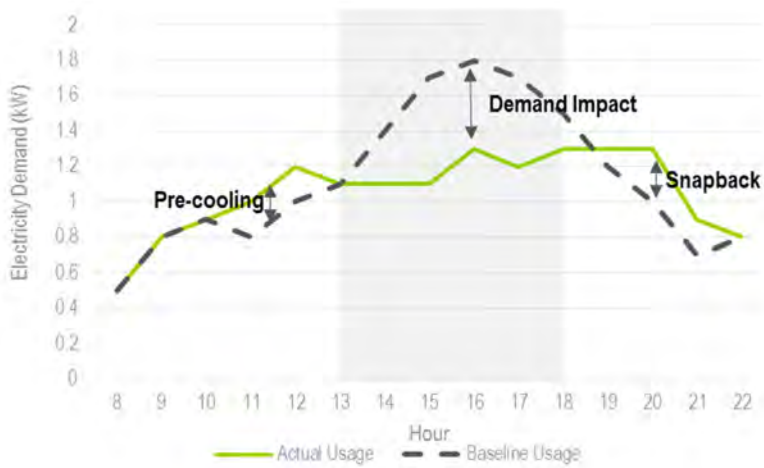
presented here and detailed explanations are included in APPENDIX A.

Peak Event Impacts

Navigant estimated demand savings during each Peak Event by regression to predict fitted usage from 8 a.m. to 10 p.m. on each Conservation Day controlling for temperature, humidity, day of the week, month, and a customer fixed effect that controlled for all observed and unobserved customer-specific variables that do not change through time.[38] 2014 was used as the pre-program baseline for each year with Peak Events. Demand savings were then determined as follows:

1. Fitted usage is the model's prediction of what usage would have been in the absence of a Peak Event, and forms the baseline or "counter-factual" usage.
2. The regression coefficient which estimated the demand savings in each hour of each Peak Event is the same as subtracting actual usage from the fitted baseline for each hour of the Peak Event.[39] The possibility of pre-cooling and snapback were also accounted for in this process, which is illustrated in Figure 1-7.

Figure 1-7. Illustration of Hypothetical Demand Impacts for an Event from 1 p.m. to 6 p.m.



Source: Navigant

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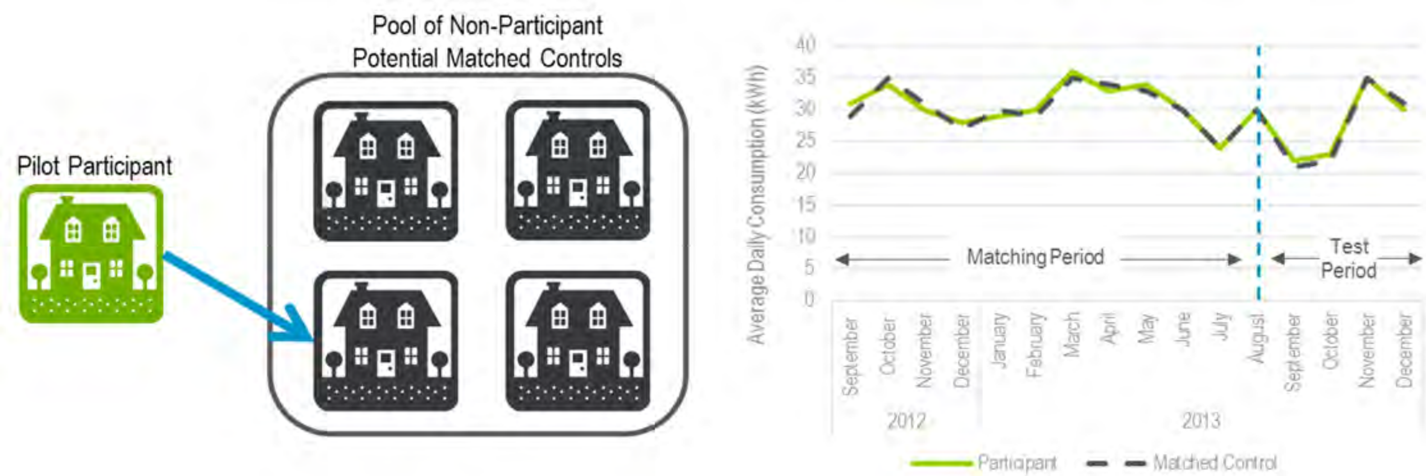
[38] Navigant's method to determine Peak Event savings differed from the method National Grid used internally. National Grid calculated reduced usage as the difference between metered usage during the Event and "normal" usage, defined as average usage during the ten prior non-holiday, non-Conservation Day weekdays after accounting for a day of adjustment to capture weather differences, time of event, pre-cooling, etc. Details of National Grid's method can be found in: D.P.U. No. 1237, Tariff for Basic Service, September 3, 2014. Both of these methods are consistent with MA evaluation protocols and are intended for different purposes. National Grid's method is intended to produce faster feedback on the program results in support of monthly customer billing, whereas Navigant's method uses more data over a longer time horizon to allow for the most robust estimate of savings for the Pilot as a whole, making it more appropriate for post hoc evaluation.

[39] In 2015, a day-of adjustment was used to make fitted usage a more accurate approximation for the actual usage that would have occurred if a Conservation Day had not been called by National Grid. For this adjustment, actual usage was subtracted from fitted usage for each Conservation Day for the time from 8 a.m. until the start of the Peak Event. This day-of adjustment was dropped in 2016 to simplify the calculation of standard errors. The adjustment was very small and did not make a statistically significant difference in program peak savings impacts.

Energy Impacts

In order to calculate energy impacts, the evaluation team selected a group of matched control customers from a large pool of non-participant households. Participants were matched by identifying a non-participant that had energy usage similar to that of each participant over a 12-month period before the Pilot started to provide the counter-factual usage if the participants had not been in the Pilot.[40] The 12-month matching period went from September 2012 to August 2013, leaving a 4-month test period from September 2013 to December 2013 to ensure that the matches were performing well (i.e., continued to have usage similar to the participants) outside of the matching period but before the program started. This matching process is illustrated in Figure 1-8. Regression analysis of monthly billing data using the participants and matched controls was then used to estimate the annual reduction in energy usage for 2014 and the reduction by month in 2015 and 2016.

Figure 1-8. Hypothetical Illustration of Choosing Matched Control Households with Similar Pre-Pilot Energy Usage



Source: Navigant

Bill Impacts

Bill savings for customers on the CPP rate were calculated by subtracting the actual participant bill amount from the counter-factual bill amount if the participant had not joined the program. The counter-factual bill amount was based on the counter-factual usage estimated by the energy impact analysis.

Bill savings for customers on the PTR rate came from the rebates paid by National Grid for reducing peak consumption during Peak Events on Conservation Days. National Grid calculated reduced peak consumption as the difference between metered usage during the Peak Event and "normal" usage, defined as average usage during the ten prior non-holiday, non-Conservation Day weekdays after accounting for a day-of adjustment to capture weather differences, time of event, pre-cooling, etc. The reduction was multiplied by the cost of the rebate to determine the rebate due to the customer.[41]

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[40] To avoid the issue of control customers moving out, only controls who had billing data through the end of 2016 were used.

[41] Details can be found in: D.P.U. No. 1237, Tariff for Basic Service, September 3, 2014.

Load Shifting

The regressions to estimate demand savings also included coefficients to capture load shifting attributable to the Pilot. Navigant captured load shifting on the same day as a Peak Event by estimating pre-cooling and snapback. Load shifting from weekdays, when TOU rates were in effect for CPP customers, to weekends, when customers were charged a flat rate, was also estimated. Navigant also examined whether the Pilot caused non-event peak impacts where customers shift loads from on-peak to off-peak times on days when a Peak Event was not called. Load shifting to the weekend and non-event peak impacts are expected for TOU customers, but not necessarily for PTR customers since these customers were not charged a higher peak time rate which would incent them to shift usage to off-peak times or weekends.

1.2.2 Customer Experience Evaluation Objectives and Approach

The primary focus of the customer experience evaluation was on customer engagement and experience. The Smart Energy Solutions evaluation plan was developed by an independent consultant in accord with the *Common Evaluation Framework*[42] produced by the Collaborative, a stakeholder group convened by the DPU to develop consistent evaluation themes and techniques across the three smart grid pilot programs in Massachusetts. The Collaborative recognized that each program had some unique characteristics, particularly the National Grid opt-out program design, so the framework was made broad enough to accommodate different program designs but still provide comparable data from each. The Collaborative included National Grid and other participating investor-owned utilities, the Low-income Energy Action Network (LEAN), the Massachusetts Attorney General, and the Energy Efficiency Advisory Council (EEAC) chief evaluation consultant. As part of the *Common Evaluation Framework*, the Collaborative developed a base set of required surveys, reporting requirements, protocols, and reporting tables.

The Collaborative raised a number of key research questions related to customer experience in the Pilot. These research questions focused on marketing and education. As Smart Energy Solutions was an opt-out program, wherein customers could opt out of the smart meter and opt out of the default time-based rate, the evaluation team applied the *Common Evaluation Framework* marketing questions that apply to meter installations, rate selection, and adoption of the program's technology offerings. Additionally, the framework applies to marketing means and messages used for recruiting and their effects, results of multiple recruiting waves and techniques, how participants learned of the program, and their reasons for participation or nonparticipation; these topics were not particularly applicable to the Pilot due to its opt-out nature.[43] To address the framework topics, extensive surveying was conducted over the two years of the Pilot (Figure 1-9).[44] The evaluation also included convening focus groups for low-income participants in both years and interviewing commercial participants to gain additional insights to supplement the surveys. In total, the surveys, focus groups, and interviews achieved approximately 4,800 completes.

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[42] D.P.U. 10-82, Massachusetts Smart Grid Collaborative Technical Subcommittee, *Common Evaluation Framework*, March 23, 2011.

[43] Survey findings regarding motivations driving customer participation in the Pilot are included in Section 4.1, and mechanism for how customers heard about the Pilot are included in APPENDIX C.

[44] The surveys were designed by Navigant and implemented by Bellomy Research, a professional survey company, at several key points in the program. All surveys, excepting the pre-pilot survey, were conducted online, using email to invite participants to survey links. Online responses were supplemented by telephone contacts, using both inbound (participants called in) and outbound techniques, to ensure a broader sample of survey participants.

Figure 1-9. Smart Energy Solutions Surveys, Interviews, and Focus Groups

Source: Navigant analysis

Below is a description of the activities depicted in Figure 1-9 and the elements of the customer experience they sought to capture.

- **Meter decline survey:** Determine why customers declined a smart meter and whether they were aware that not installing one would preclude them from participating in Smart Energy Solutions.
- **Pre-pilot survey:** Characterize participant demographics, appliance saturations, and living conditions that might impact participants' ability to adjust their energy usage during regular peak hours (8 am to 8 pm) and Peak Event hours, such as household members who require air conditioning or special medical equipment that must operate during Peak Events.
- **Pre-pilot commercial interviews:** Through five interviews in 2014, anecdotally characterize commercial customer understanding of the program, rates, and knowledge and acceptance of program technologies, as well as their ability to adjust their energy usage during Peak Events.
- **Post installation survey:** Evaluate the experiences of customers who signed up for technology Level 2, 3, or 4 (refer to Section 2.2 for more detail on the technology levels), which provided no-cost in-home installation of an IHD, smart thermostat, and smart plug and load control device, respectively. This survey asked about the promptness and quality of the installation, problems encountered, the conduct of installers, and related issues.
- **Post event surveys:** These surveys were conducted within a one to ten day period after two of the 20 Peak Events called during each summer to learn about the methods and efficacy of National Grid's pre-event information, energy-related actions taken by the customer before and during the event, comfort levels during the event, satisfaction with program technology, and overall satisfaction with the program.
- **2015 end of summer survey:** After the last Peak Event called during the summer of 2015, this survey aimed to understand customer experiences with the program over the course of the summer, including how they coped with multi-day events, events lasting several hours, changes in household patterns resulting from the events, and how well technology performed and how

useful it was. The survey also looked for trends or changes in these areas over the course of the summer.

- **2015 end of summer low-income focus groups:** Navigant hosted two low-income focus groups at the end of the 2015 summer – one for Level 1 customers and one for Level 2 customers – to gauge their understanding of the program and rates, experiences with the program over the course of the summer, technology use (for Level 2 customers only), and recommendations to improve the program.
- **2015 end of summer commercial interviews:** Through four interviews in 2015, anecdotally characterize commercial customer understanding of the program, rates, and technologies, assess their experiences with the program over the course of the summer, and collect their recommendations to improve the program.
- **Opt-out and drop out surveys:** Ascertain customer perceptions and motivations for moving from one rate to the other and/or dropping out of the program altogether. There were very few participants who took either of those actions during the Pilot. Customers who switched to competitive suppliers, and therefore are no longer National Grid supply customers, were not surveyed.
- **2016 end of pilot survey:** After the last Peak Event called in the two-year Pilot, this survey aimed to understand customer experiences with the program over the course of the entire Pilot, including many of the same themes from the 2015 end of summer survey. This survey also asked about knowledge of and response to bill protection and how customers changed their behavior from the first summer to the second. Additionally, the survey looked for trends and changes over the course of the Pilot.
- **2016 end of pilot low-income focus group:** Navigant hosted one low-income focus group at the end of the Pilot for customers with and without technology. The topics were similar to those covered in the focus groups at the end of the 2015 summer.

2. SMART ENERGY SOLUTIONS PROGRAM DESIGN

Smart Energy Solutions offered customers a choice between two new dynamic rates and four technology packages that provided electricity usage information and control. The technology packages offered varying levels of information and control via a web portal, mobile app, IHD, PCT, smart plug, and direct load control device. Starting in the spring of 2014, customers began selecting their rate plan and technology package. To support customer choice, the Pilot allowed customer to change rates one time and technology package enrollment any time.

The three key elements of this chapter are:

1. **Rate Design –** the dynamic rate that applies to Pilot participants, depending on whether they accepted the default CPP rate or opted into the PTR rate.
2. **Technology Choice –** the set of in-home and communications technologies selected by participants and provided by National Grid to provide customers with pricing and usage information, conservation tips, and the ability to better control their energy consumption.
3. **Program Marketing, Participation, and Segmentation –** the self-selection of customers into the various rate and technology categories, the strategy used to recruit customers into the different rates and technologies, and the demographic breakdown of the eligible customer population.

2.1 Rate Design

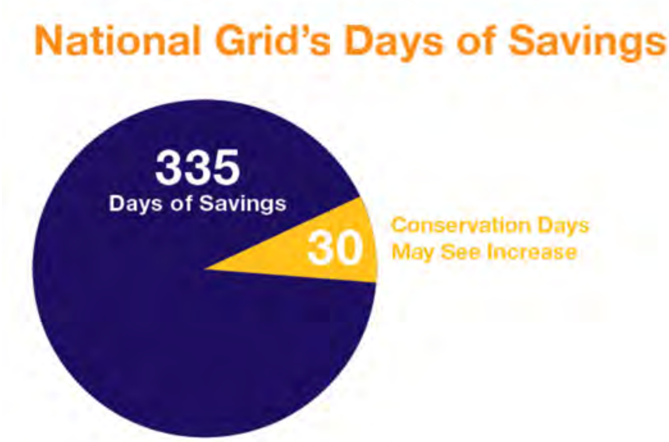
Smart Energy Solutions offered two dynamic rate designs: 1) a TOU rate combined with CPP and 2) a PTR rate. Participating customers had the opportunity to save money on both rates, but CPP customers could potentially incur higher bills if they did not reduce consumption during higher priced periods. These rates went live at beginning of 2015 and remained active through December 2016.[45] As discussed in Section 1.1, customers could leave the Pilot at any point by opting out of the dynamic rates or switching to a competitive electricity supplier, and they could switch between the two Pilot rates once.[46]

According to the Pilot design, National Grid could call up to 30 high demand days per year, called Conservation Days (Figure 2-1). Customers chose the frequency and method of Conservation Day notification. Everyone was notified of Conservation Days one day ahead and they could choose to be notified on the day of the event as well. The price of electricity increased during designated hours, called Peak Event hours, on these days. The length of the Peak Event varied across the Conservation Days. On the CPP rate, customers paid reduced rates outside of Peak Event hours and were incented to conserve electricity to avoid paying high electricity prices during Peak Events. On the PTR rate, customers received a rebate for conserving electricity during these hours.

[45] The rates continue in 2017 under the interim extension of Smart Energy Solutions granted by the DPU.

[46] Customers who left National Grid for a competitive supplier received a letter from National Grid informing them that they could no longer participate in Smart Energy Solutions because they were no longer a National Grid customer. Customers could of course return to National Grid, and if they did so they received a letter informing them that they would be re-enrolled in the Pilot on the default CPP rate.

Figure 2-1. Smart Energy Solutions Conservation Days

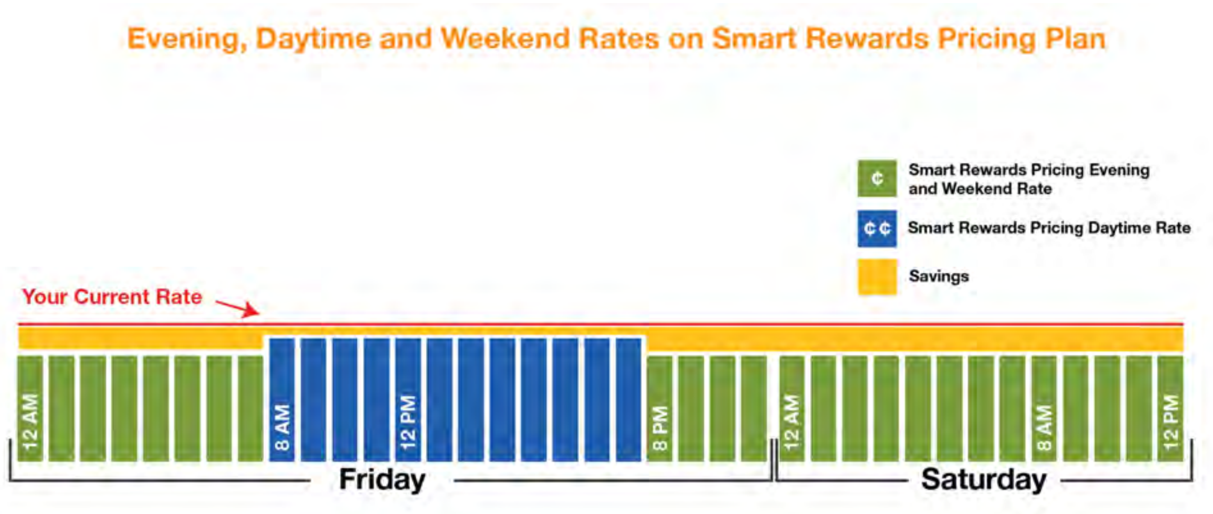


Source: National Grid

2.1.1 Critical Peak Pricing

The Pilot CPP rate combined a daytime TOU rate and a critical peak rate during Peak Event hours. The Pilot CPP rate offered a base TOU structure with lower daytime rates and even lower night, holiday, and weekend rates. Customers were encouraged to shift energy-intensive weekday activities to any time before 8:00 a.m., after 8:00 p.m., or to weekends. As shown in Figure 2-2, customers paid a lower rate than the current Basic Rate every day of the year. The TOU Evening and Weekend rate was in effect all day on weekends and holidays, and every weekday from 8:00 p.m. to 8:00 a.m. From 8:00 a.m. to 8:00 p.m. on weekdays, customers paid a slightly higher rate, called the Daytime Rate.

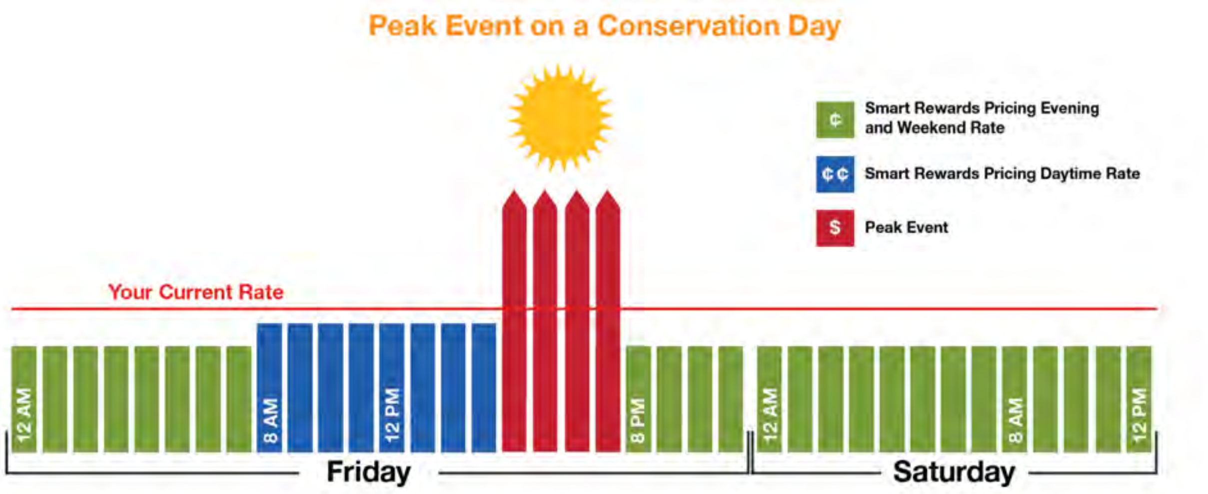
Figure 2-2. TOU for Evening, Daytime, and Weekend Rates



Source: National Grid
Note: "Your Current Rate" refers to the Basic Rate customers were on before the start of Smart Energy Solutions.

In addition to the TOU rate in effect every day, National Grid called Conservation Days where a higher rate was charged during certain Peak Event hours. An example of these hours and the associated CPP prices is shown in red in Figure 2-3. These customers were eligible for bill protection if they stayed on the CPP rate for at least 12 consecutive months; this meant that if at the end of the year their bills were higher than they would have been on the Basic Rate, the customer received a credit in the amount of the difference.

Figure 2-3. Critical Peak Pricing During a Conservation Day Peak Event



Source: National Grid
Note: "Your Current Rate" refers to the Basic Rate customers were on before the start of Smart Energy Solutions.

2.1.2 Peak Time Rebate

The PTR rate allowed customers to stay on their current service rate, rather than switching to the CPP rate, and earn a rebate when they reduced consumption below their normal use during Peak Event hours on Conservation Days. The rebate was given to customers in the form of a monthly credit applied at the end of each billing cycle, which was the cumulative rebate for all of the Peak Events that occurred during that billing cycle.

The rebate was based on a per-kWh credit that applied to any reduced energy usage during Peak Event hours. National Grid calculated reduced usage as the difference between metered usage during the Event and "normal" usage, defined as average usage during the ten prior non-holiday, non-Conservation Day weekdays after accounting for a day-of adjustment to capture weather differences, time of event, pre-cooling, etc.[47] Customers were not penalized for usage which was higher than normal.

2.2 Technology Choice

The core components of National Grid's smart technology end-to-end solution were advanced metering infrastructure (AMI), in-home energy management devices, two-way communications systems, cloud computing, National Grid system modifications and data processing, and distribution grid communication and standards. These components directly supported the customer-facing portion of Smart Energy Solutions. National Grid offered Smart Energy Solutions customers an assortment of in-home energy

[47] D.P.U. No. 1237, Tariff for Basic Service, September 3, 2014.

management tools and technologies for free. Customers could sign up on the National Grid website, by mail, by calling National Grid, in person at the Sustainability Hub, or at any of the community events that National Grid attended with a Smart Energy Solutions information booth. As discussed in Section 1.1, National Grid allowed customers to select from these technologies throughout the Pilot in order to maximize customer choice and provide opportunities for new customers who moved into the Pilot area to sign up.

The technologies provided by National Grid included both a foundational infrastructure and several optional in-home devices:

1. **Foundational Infrastructure -** consisted of smart meters and access to a web portal with electricity usage information via desktop computer or mobile device. This foundational infrastructure was provided to all participants, even those passive participants who accepted a smart meter but otherwise did not actively participate in the Pilot.
2. **In-Home Devices –** consisted of any of three additional levels of devices including a communicating digital picture frame or in-home display (IHD) (Level 2), a Wi-Fi-enabled smart thermostat, or programmable communicating thermostat (PCT) (Level 3), and smart plugs and load control devices (Level 4).

2.2.1 Foundational Infrastructure

To enable Smart Energy Solutions, National Grid installed two-way AMI communications and smart meters, developed cloud computing capabilities, and, on an ongoing basis, offered customers a variety of in-home devices (further detailed in Section 2.2.2). AMI communications consist of a meter headend, wireless mesh network and cellular backhaul, and a network manager, which is integrated with the Company's software as a service (SaaS) systems. As a result, National Grid can provide real-time interconnection for customers to control their smart thermostats remotely and monitor their electricity usage from any online or mobile device, anytime and anywhere. The two-way communication infrastructure is also being used to enable the Pilot's distribution automation equipment, which supports reliability and efficiency gains and can facilitate distributed energy resources and electric vehicle charging station integration.

National Grid offered four technology packages, or levels, for customers to choose from. Pilot participants were automatically enrolled in Level 1 and had the option to opt into one of the three higher technology levels with in-home devices. Customers who opted in to a higher level still had access to Level 1.

In Level 1, illustrated in Figure 2-4, customers had access to their electricity usage information via the Smart Energy Solutions web portal that is accessible by desktop and mobile devices, which provided personalized online graphical electric usage information, comparisons to friends and neighbors, and the opportunity to participate in contests to win prizes for conserving electricity.[48] In 2016, the web portal also included a rewards platform which allowed customers to earn points for saving energy and engaging with the program. Points could be redeemed for gift cards at national and local retailers.

[48] Logging into this web portal at least once distinguished active customers from passive customers in Level 1.

Figure 2-4. Level 1: Web Portal (Accessible by Desktop and Mobile Device)

Source: National Grid

2.2.2 In-Home Devices

Figure 2-5 shows Level 2, which provided a digital picture frame—also called an IHD—that provides real-time energy usage and cost information as well as conservation tips from National Grid.

Figure 2-5. Level 2: Web Portal, Mobile App, and Digital Picture Frame

Source: National Grid

Interested customers with central air conditioning (CAC) qualified for Level 3, which included a smart thermostat, also called a PCT, which can be remotely controlled by National Grid (Figure 2-6). The PCT allowed these customers, if they so chose, to “set it and forget it” on Conservation Days, ensuring their participation in a Peak Event. Customers with a smart thermostat also had the option to opt out of a Peak

Event before it started, maintaining the set temperature of their thermostat, or to override the utility setback temperature at any time during a Peak Event.

Figure 2-6. Level 3: Web Portal, Mobile App, and Smart Thermostat

Source: National Grid

Lastly, customers could opt to install all of the aforementioned devices along with smart plugs and load control devices in their home through Level 4 (Figure 2-7). The smart plugs allow customers to remotely adjust any appliance plugged into them, such as a window unit air conditioner. The load control devices, installed for only some customers in Level 4, work with devices such as water heaters and/or pool pumps.

Figure 2-7. Level 4: Web Portal, Mobile App, Digital Picture Frame, Smart Thermostat, Smart Plug, and Load Control Devices

Source: National Grid

2.3 Program Marketing, Participation, and Segmentation

Before and throughout the Pilot, National Grid implemented a “listen, test, learn” approach that is based on “on the ground” conversations and reflections on the Pilot. This feedback, combined with learning, leads to continual improvement. National Grid conducted extensive program marketing in the lead up to initiating meter installations, the first phase of the program. These activities included convening a public summit to discuss the proposed program, development of brochures explaining the program, and establishment of the staffed, physical Sustainability Hub within the Pilot program area. National Grid also partnered with local schools. Clark University offered annual internships, and Worcester Polytechnic Institute created a student Sustainability Ambassador program. Ambassadors host Sustainability Hub tours and attend outreach events to educate customers throughout the community. Presenting the personal side of the Company is part of the “listen, test, learn” approach, and is the inspiration for sending National Grid employees and Ambassadors into the community. It is also the basis for hosting visitors at the Sustainability Hub for the dual purpose of educating customers and listening to their concerns and feedback.

As the program progressed, additional materials were developed and disseminated, including descriptions of the technology levels, rates, and events; welcome kits; and so on. National Grid conducted extensive recruiting campaigns for the program technology options, including a variety of incentives and promotions, but found participant response in 2014 to be somewhat less than expected resulting in an extended signup period that extended throughout the Pilot.[49]

2.3.1 Technology and Rate Enrollment

Table 2-1 shows the distribution of customers in the various technology levels as of January 1, 2017. At that time, approximately 91% of Pilot participants were subscribed to Level 1, followed by 6% of participants in Level 2, 2% of participants in Level 4, and only 0.3% of participants in Level 3. Approximately 95% stayed on the default CPP rate.

Table 2-1. Customer Enrollment by Technology Level and Price Plan (as of January 1, 2017)

Level	Price Plan	Number of Residential Customers	Number of Commercial Customers
1 (AMI meter + web portal + mobile app)	CPP - Active	1,456	26
	CPP - Passive	7,459	456
	PTR - Active	92	1
	PTR - Passive	338	18
2 (Level 1 + digital picture frame)	CPP	640	1
	PTR	32	0
3 (Level 1 + smart thermostat)	CPP	28	0
	PTR	4	0
4 (Level 1 + Level 2 + Level 3 + load control devices)	CPP	237	0
	PTR	15	2
Total		**10,301**	**504**

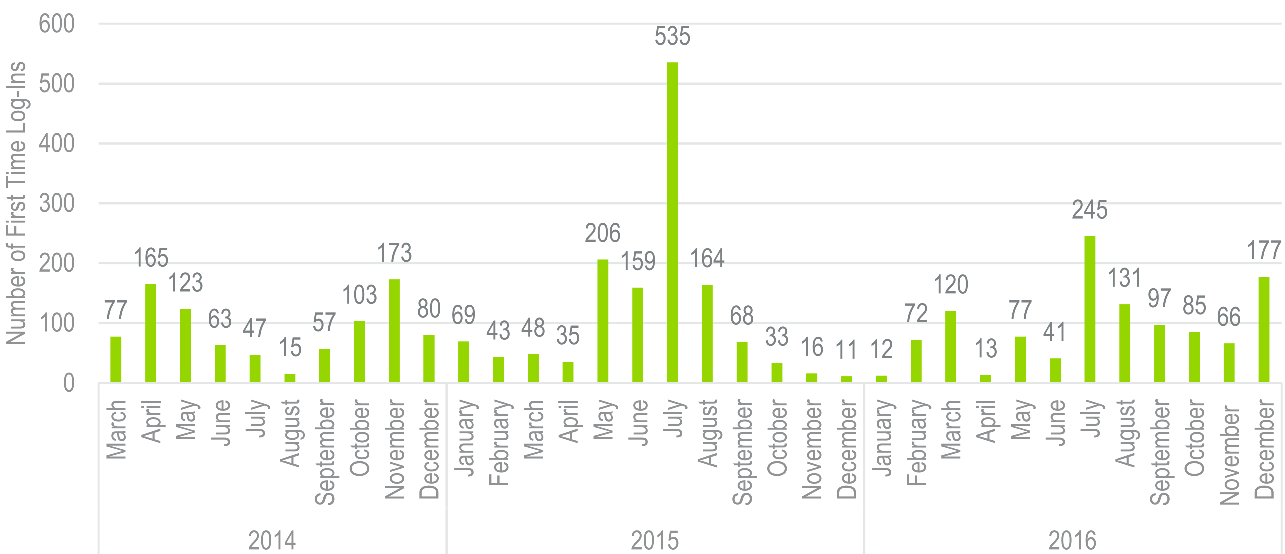
Source: Navigant analysis
Note: The active/passive status of Level 1 customers was determined as of October 12,2016 which was after the final event of the 2016 summer season.

[49] Although active promotion ended in 2015, Pilot customers were able to enroll in the technology packages through the end of 2016 if they wished to do so and met the eligibility requirements.

There were a total of 2,504 active customers in the Pilot at the end of 2016; an increase of 478 (or 22%) compared to the end of 2015. This is the net increase, meaning it includes increases resulting from new customers joining the Pilot and achieving an active status, increases from passive customers shifting to active (either by accessing the web portal or opting into a technology package), and decreases due to active customers leaving the Pilot. National Grid undertook efforts to increase active participation in the second summer of the Pilot, such as launching the rewards platform, described further in Section 2.3.2.

Figure 2-8 shows the first time that active customers logged into the portal throughout the pilot by month. In both 2015 and 2016, the highest frequency of initial log-ins to the portal was in July, which is also when Conservation Days ramped up in each summer. The high frequency of initial log-ins in July indicates that Peak Events piqued customers' interest in Smart Energy Solutions. May and June of 2015 also had a high frequency of initial log-ins, which likely related to increased program marketing before the Pilot Conservation Days started, as well as the test event held in May 2015. There was also an uptick in initial log-ins in February and March of 2016, which is when the rewards platform was launched.

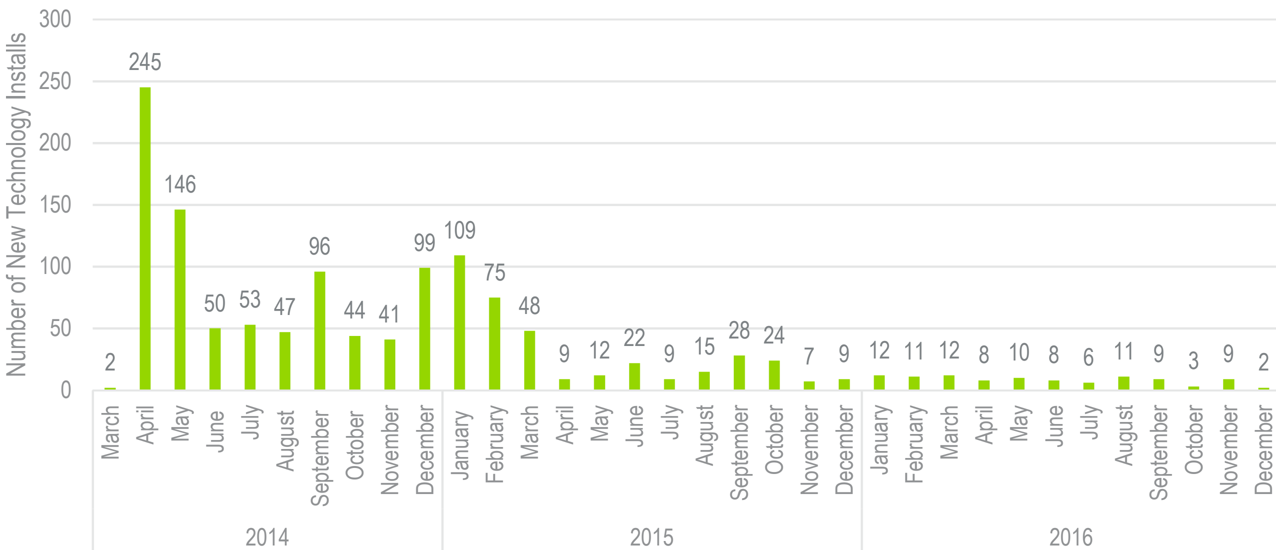
Figure 2-8. Frequency of First Time Web Portal Log-ins by Month



Source: Navigant analysis

In addition to tracking web portal log-ins, National Grid tracked when customers installed technology packages. As shown in Figure 2-9, technology installs peaked at the start of the program. There continued to be over forty new installations per month through March 2015. New technology installations tapered down significantly after the first quarter of 2015 but continued throughout 2015 and 2016. There were slight upticks in installs in June, September, and October of 2015 which may be related to messaging around the test event and first real Conservation Day in May and June and the wrap up of the first summer of Peak Events in September and October.

Figure 2-9. Number of Technology Installs by Month



Source: Navigant analysis

Although National Grid's Pilot design was unique and challenging to compare to other pilots for many reasons, a few comparisons suggest that National Grid's customers adopted technologies at comparable rates to other pilots. The Company offered customers several technology packages, which customers were able to sign up for throughout the Pilot. In contrast, NSTAR's opt-in 2012-2013 time-based rate pilot offered customers specific rate and technology combinations – standard rate with an IHD, PTR with an IHD and PCT, CPP with IHD and PCT, and CPP with IHD. National Grid and NSTAR customers opted for the IHD at similar rates: 9% for National Grid and 7% for NSTAR.[50,51]

At the end of the Pilot, National Grid asked Level 1 customers why they did not sign up for a technology package. Approximately 40% of Level 1 customers were aware of the technologies; however, those who were aware showed a lack of understanding of the benefits of the technologies and a lack of interest in them; this is discussed further in Section 4.2.2. As of May 7, 2015,[52] 15% of customers who ordered a technology package had to cancel it due to technical issues at their home. The prevalence of reasons for cancelling are shown in Figure 2-10. These reasons were categorized into six areas:

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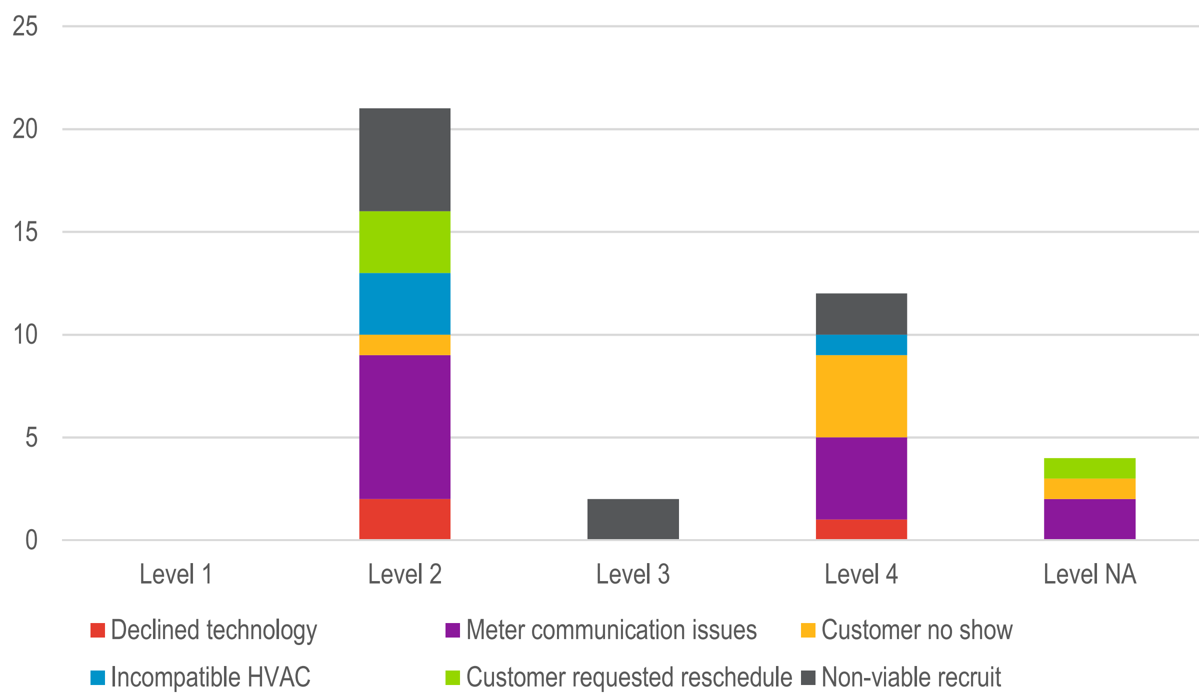
[50] NSTAR (Eversource) pilot customers opted in to the pilot voluntarily, and were randomly assigned to one of the rate and technology combinations to the extent possible, given that they needed to have central air conditioning to use the PCT. All customers received an IHD when they decided to participate in the Pilot, so the IHD enrollment rate was determined to be the same as the Pilot enrollment rate of 7%. All National Grid customers who signed up for technology packages 2 and 4 received an IHD. As of January 1, 2017 the combined enrollment rate for these two technology levels was 9%.

[51] Navigant. *NSTAR Smart Grid Pilot Final Technical Report: AMR Based Dynamic Pricing*. DE-OE0000292. Prepared for U.S. Department of Energy on behalf of NSTAR Gas and Electric Corporation. August 2014.

[52] National Grid summarized reasons for customer cancelation in a response to an information request to the Massachusetts Attorney General (Information Request AG-1-7) in D.P.U. 10-82.

1. "Declined technology" indicated that the customer changed their mind or did not want any technology on the spot. In one case, the landlord had ordered the technology but did not live at the home and the tenant declined the technology;
2. "Meter communication issues" were due to technology not receiving a signal from the meter, typically because it was too far away from where the customer wanted to install the technology;
3. "Customer no show" were instances of the technician showing up to install the technology but the customer was not home and was unresponsive to phone calls;
4. "Incompatible HVAC" were instances of furnace or central air conditioning that were incompatible with the PCT, or instances where customers did not have central air conditioning in order to use the PCT;
5. "Customer requested reschedule" were due to emergencies, or customers needing to install Wi-Fi in order to connect the technologies;
6. "Non-viable recruit" were customers who wanted the technology but could not install it for a reason other than those listed above. These reasons included inability to schedule an appointment even after the Company made multiple attempts to reschedule, inability to connect technology to the internet because they didn't have it or their equipment was incompatible, and inability to install technology because a tenant did not have landlord permission.

Figure 2-10. Reasons for Customer Cancelation of Technology Installation by Technology Level as of May 7, 2015[53]



Source: Navigant analysis

[53] Level NA = customer's requested technology level not recorded.

2.3.2 Marketing and Recruitment

In an effort to attract as many customers as possible into the Pilot and the higher technology levels, National Grid used the following recruitment strategies:

- Conducted a door-to-door campaign in Fall 2014 to advertise the Pilot and enroll customers, with a specific focus on enrolling high-potential Level 3 and Level 4 customers;
- Held a continued stream of events and educational sessions at the Sustainability Hub to educate customers about and showcase the various technologies;
- Sustainability Ambassadors from the Sustainability Hub attended community events (including farmers' markets, community sporting events, concert series on town commons, community festivals, and Worcester Public Library events) around Worcester to promote, discuss, and enroll customers in the technology levels;
- Sent customers rate enrollment packages, technology enrollment packages, monthly reports, and quarterly newsletters with Pilot updates;
- Allowed customers to enroll in technology Levels 2, 3, and 4 throughout the Pilot;
- Conducted practice Peak Events in May 2015 and May 2016 to test customer communications, meter signals and event loading, as well as to market the rates and technologies to customers;
- Included a technology enrollment form in the monthly paper report mailed to customers in August 2015 and included consistent reminders about the available technologies in other communications;
- Launched a rewards platform in February 2016 allowing customers to earn points for saving energy and engaging with the program, which could be redeemed for gift cards at national and local retailers; and,
- Created new collateral that built on data collected from the first year of the Pilot. An example is the Energy Signature graphics that illustrated the most common customer usage patterns with specific tips on how to more effectively save energy and money given the design of the Pilot. These graphics were shared with customers through existing communication channels and through the Sustainability Hub.

After the Pilot began, National Grid continued its marketing campaign in order to keep customers engaged and informed about their technology and rate options. National Grid used op-eds in the Worcester Telegram & Gazette, direct email newsletters, conservation tips to customers, bill inserts, and mailed materials in its marketing efforts.[54] Figure 2-11 shows an example of a Smart Energy Solutions bill insert, sent before the summer 2015 season began, which is illustrative of the materials sent by email as well. National Grid continued to send these tips and newsletters and held a Smart Energy Solutions event in August 2015 at the Worcester Public Library to answer customer questions about the program. Customers could also get their questions answered anytime at the Sustainability Hub.

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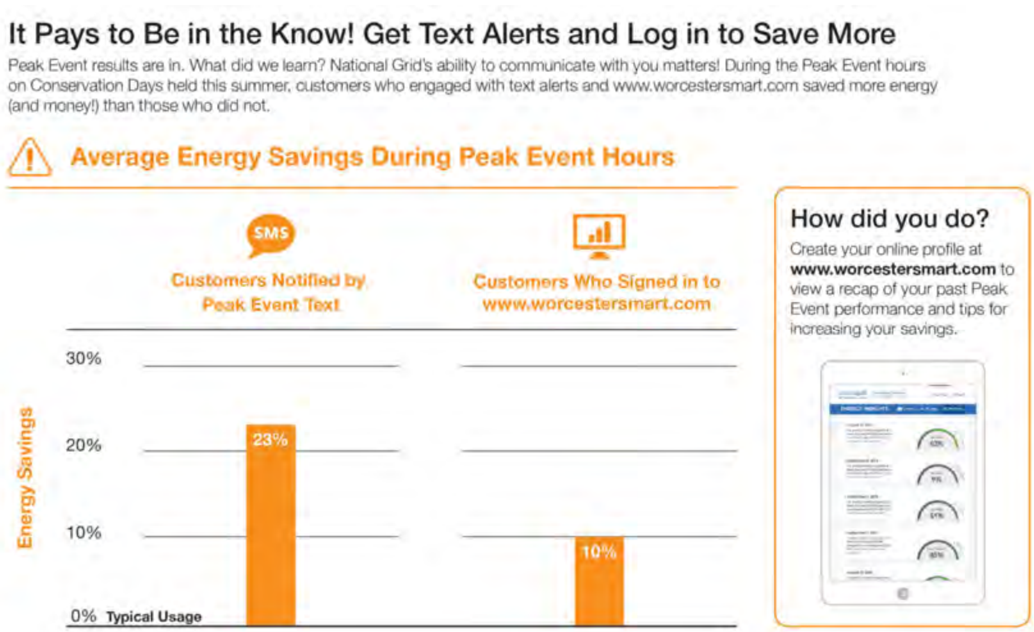
[54] Though not part of National Grid's marketing effort, local media channels covered the Pilot, providing publicity and insights for customers. Refer to APPENDIX E for examples of media coverage.

Figure 2-11. Excerpt from Smart Energy Solutions Bill Insert Sent in May 2015

Source: National Grid

After receiving customer feedback via surveys, low-income customer focus groups, and commercial customer interviews, National Grid responded to customers' need for additional information, specifically about event notifications and potential savings. Figure 2-12 is an illustrative example from one of National Grid's mailers to customers in October 2015, which reminds customers that they can be notified of Peak Events via several channels, not just phone calls. This example also shows anticipated savings achieved by customers who were notified by these alternative channels. This mailer echoes materials sent by National Grid throughout the Pilot to customers reminding them that they could choose to be notified about events via multiple communication channels.

Figure 2-12. Excerpt from Smart Energy Solutions Mailer Sent in October 2015



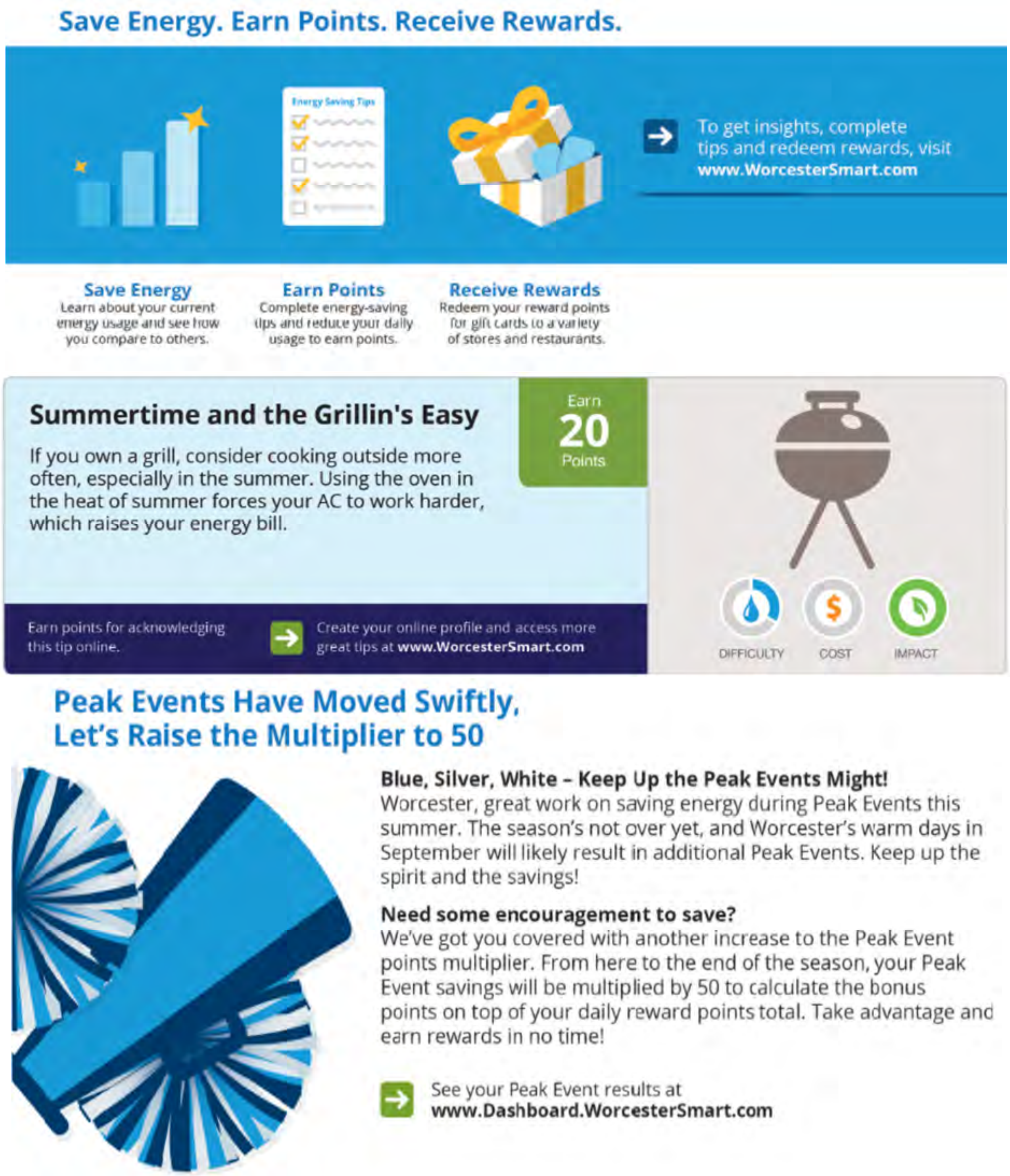
Source: National Grid

National Grid added a rewards platform to the Pilot web portal in February 2016 aimed at increasing engagement with the program. Points were earned in a variety of ways. For example, Smart Energy Solutions customers could earn points every day through saving energy. The customer's daily earnings were based on energy savings compared to their energy consumption on past similar weather days, so the more they saved the more points they earned. Customers also earned points by completing energy-savings tips, logging into the web portal for the first time, taking certain actions such as enrolling in or completing selected National Grid programs, signing up to receive Peak Event notifications via text message, completing the home profile on the WorcesterSmart web portal, or visiting the National Grid Sustainability Hub. Points could be redeemed for a variety of gift cards to national and local food, entertainment and retail establishments. Figure 2-13 contains a few illustrative examples from National Grid mailers highlighting the rewards platform. The outcomes of National Grid's internal assessment of the reward platform's effectiveness are shown in APPENDIX D. Highlights of this assessment include:

- Web portal logins increased considerably (from an average of 323 per week to 360 per week) after the launch of the rewards platform;
- The click-to-open rates for Peak Event-related emails sent the day before and the day of a Peak Event increased by 18.4% and 9.2%, respectively; and,
- In a National Grid administered survey, the rewards platform received the highest satisfaction score compared to other portions of the portal (such as Peak Event content and energy-saving tips), with 83% of customers rating the rewards feature at least a 4 on a 5-point scale.

The results of this National Grid assessment suggest that the rewards platform was a significant driver of site traffic and engagement.

Figure 2-13. Excerpts on Rewards Platform from Smart Energy Solutions Mailers in June and August 2016



Source: National Grid

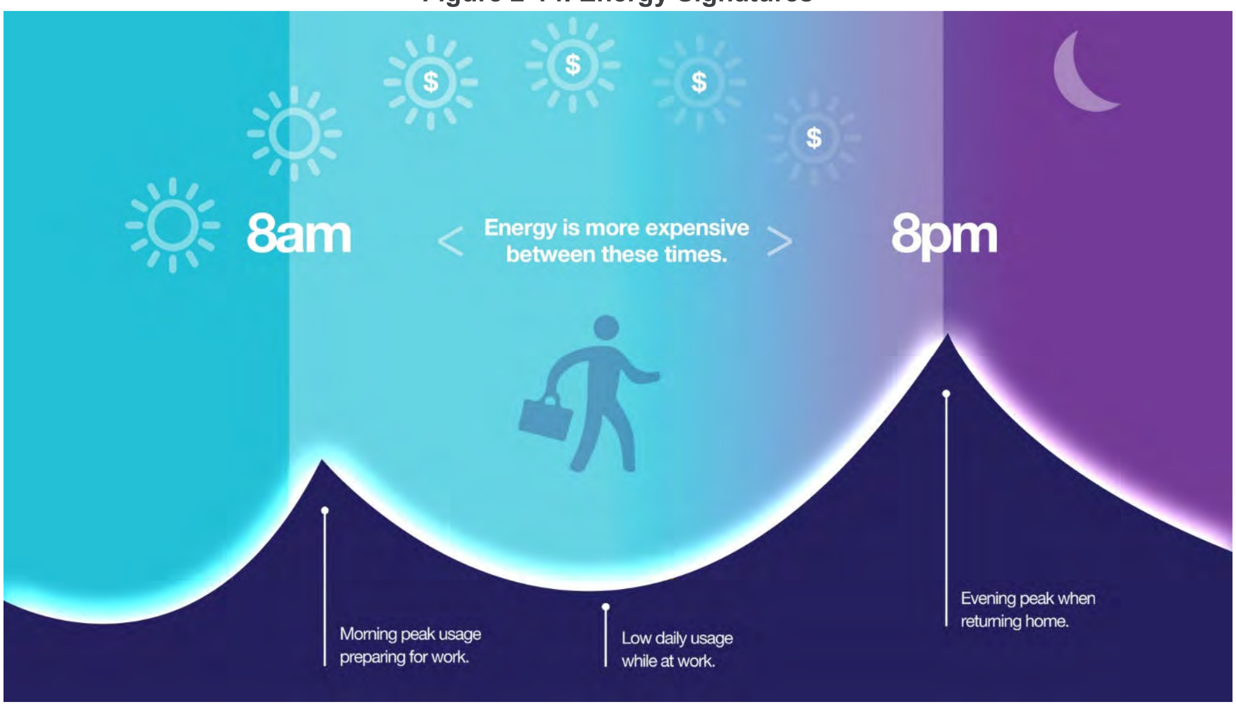
Energy Signatures were another new feature added to the Pilot in 2016. National Grid used customer data to create five common "energy signatures" or load profiles. Customers could self-identify with one of the signatures to receive personalized tips on how to conserve energy both during and outside of Peak

Events. The five signatures were:

- 9 to 5ers – These customers have a predictable, 9-5 work schedule. Their electricity use is characterized by a slight morning spike before work, low daily usage while at work, and a larger evening peak when they return home from work.
- The Late Nighters – These customers are awake late at night. Their electricity use is characterized by a morning increase before starting the day, low daily usage, and an extended increase in electricity use in the evening.
- The Even Keels – These customers have steadier electricity usage throughout the day than other signatures. Their electricity use is characterized by a very small increase in use in the morning and again in the evening, but is generally constant over the day.
- The Double Peakers – These customers are often families or group living situations. Their electricity use is characterized by a defined morning peak while everyone gets ready for the day, low daily usage while everyone is out, and a large evening peak when everyone returns home.
- Homebodies – These customers are at home during the day time hours and might work from home. Their electricity use looks like a bell shaped curve over the day – there is a steady morning increase that results in a midday peak and then decreases to low nighttime usage.

An example of the 9 to 5ers signature is shown in Figure 2-14.

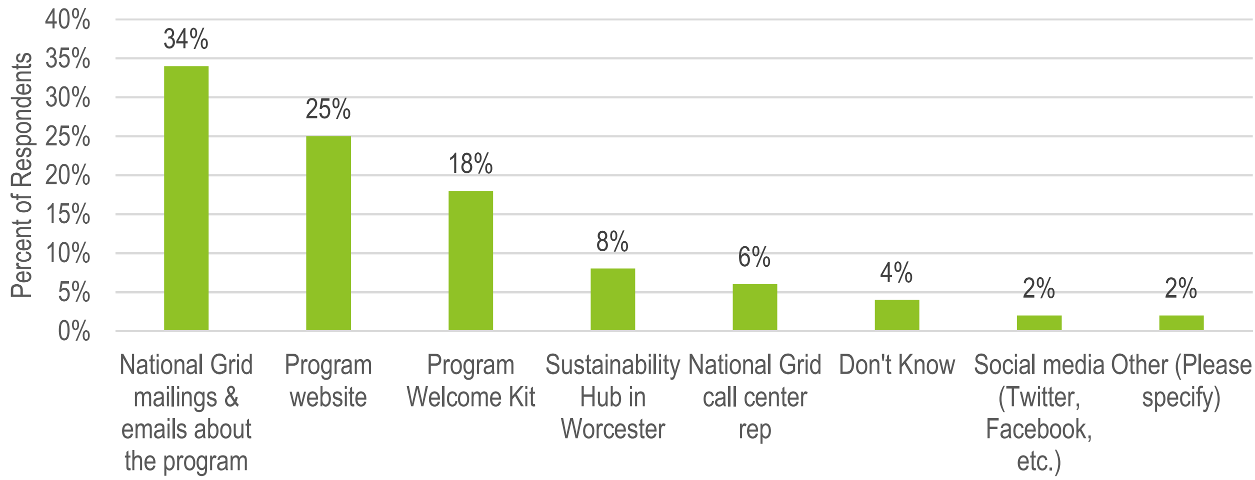
Figure 2-14. Energy Signatures



Source: National Grid

At the end of the Pilot, customers were asked which sources of information were the most useful to them in learning about the Pilot (Figure 2-15). The most frequently cited responses were the National Grid mailings and emails about the Pilot (34%), the program website (25%), and the program Welcome Kit (18%).

Figure 2-15. Most Useful Sources of Information about the Pilot



Source: Navigant analysis of end of pilot survey (N=600)

2.3.3 Customer Segmentation

National Grid defined eight overlapping customer segmentation subgroups based on demographic characteristics (demographic subgroups). With the exception of the renter data, the demographic data was purchased by National Grid from InfoGroup and Core Logic and matched to Pilot accounts by combinations of address, phone number, and/or customer name. The renter data was sourced from a combination of MA tax parcel records and the Company's customer database; customers were identified as likely renters if the name on the tax parcel did not match the name in the customer database.[55,56] The subgroups and their definitions are provided in Table 2-2.[57]

[55] These customers were identified as "likely" renters because there was not sufficient information to determine whether the account holder was a renter or a family member, etc. Customers without data in the MA tax parcel records were not classified.

[56] Renters were not included as a demographic subgroup in National Grid's original smart grid pilot evaluation plan (D.P.U. 11-129 Exhibit EHW-3. December 22, 2011). National Grid and the evaluation team chose to add the group in 2016.

[57] In 2012, National Grid revised customer segment definitions. The Pilot area had fewer low-income customers than expected, and it was assumed that only 20% of customers would remain on the CPP rate. As a result, the number of low-income customers with medium usage decreased in the estimated customer segment. Reference: National Grid. D.P.U. 11-129: Response to Record Request AG-1. May 11, 2012.

Table 2-2. Demographic Subgroups

Demographic Subgroup	Definition
Low-income	Customers on R2 rate[58]
High Income	Customers on R1 rate with income greater than $100,000 based on demographic data
Low Use	Customers on R1 rate with low energy use
Medium Use	Customers on R1 rate with medium energy use
High Use	Customers on R1 rate with high energy use
Seniors	Customers 65 and older
Small Home	Customers with homes 1,000 sq. ft. or less
Large Home	Customers with homes over 2,500 sq. ft.
Renter	Account that likely belongs to a renter

Source: National Grid

Table 2-3 shows the demographic subgroup distribution in the Pilot as of October 4, 2016, except for the renter data which was identified as of February 2017.[59]

Table 2-3. Demographic Subgroup Distribution (as of October 4, 2016)

Pilot Participation By Treatment		All Residential Accounts	Non-Low-income Standard Residential Rate			Low-income Residential Rate (R-2)	Additional Population Segments				
			Low Use	Medium Use	High Use		High Income	Seniors	Small Home	Large Home	Renter
Level 1	CPP	8,942	2,338	4,611	870	923	1,459	1,710	5,014	175	2,740
	PTR	406	87	174	38	73	66	98	243	4	96
Level 2	CPP	634	105	387	76	62	155	95	276	13	104
	PTR	30	4	17	5	3	8	4	13	1	1
Level 3	CPP	28	4	21	3	0	10	8	12	1	4
	PTR	3	0	2	0	0	1	1	0	0	0
Level 4	CPP	235	25	160	43	7	101	35	85	17	13
	PTR	14	1	7	2	2	5	0	4	0	1
Total		**10,292**	**2,564**	**5,379**	**1,037**	**1,070**	**1,805**	**1,951**	**5,647**	**211**	**2,959**

Source: Navigant analysis

As previously mentioned, National Grid anticipated that 80% of customers would opt out of CPP and into

[58] In many of the customer surveys, Navigant also collected self-reported data to capture customers whose income was at or below 200% of the federal poverty levels and 60% of the area median income. In 2015, Navigant found that the survey results did not vary based on which definition of low income was used; therefore, the R2 rate definition was used in the analyses throughout this report.

[59] October 4th, 2016 was chosen as these were the customers available to be surveyed for the end of pilot survey, the last major evaluation item included in this evaluation. This breakdown includes all active, residential customers who did not a) switch to a competitive supplier, or b) drop out of the Pilot.

PTR, but the data revealed that only 5% of customers had done so at the end of the two years of the Pilot. Further discussion of how the demographics changed across the two years of the Pilot and how the demographics of active and passive customers differed is included in Section 3.1.3.

Table 2-4 shows how the population of active customers changed across the two years of the Pilot. Each cell shows the percentage of customers in a given demographic group and technology/price group. Renters were left out of this analysis since that data was only collected for 2016. Level 1 for each price plan is split out, since there were both active and passive customers in that level, and then all active customers are shown (including active Level 1 customers and customers in Levels 2, 3, and 4). Compared to 2015, active customers in 2016 were:

- More likely to be low use (difference of +10% for all active customers)
- Less likely to be low-income (difference of -6% for all active customers)
- Less likely to be high income (difference of -4% for all active customers)
- More likely to have a small home (difference of +17% for all active customers)

As discussed in Section 3, the Pilot savings for active customers did not change significantly from the first to the second summer. This indicates that the demographic changes described in this section did not have much impact on the Pilot savings. Impacts by demographic group are discussed in Section 3.1.3, but most of the demographic groups were too small to examine. The changes in the quantity of some demographic groups across the two summers, along with the similarity in program impacts, lends anecdotal evidence to the idea that the demographic subgroups have similar savings.

Table 2-4. Demographics of Active Customers in 2015 versus 2016

Technology/Price Group	Year	Low Use	Medium Use	High Use	Low Income	High Income	Seniors	Small Home	Large Home
Level 1 CPP - Active	2015	25%	53%	12%	7%	18%	16%	40%	2%
	2016	27%	56%	10%	6%	17%	13%	55%	2%
Level 1 PTR - Active	2015	29%	53%	8%	10%	16%	10%	30%	0%
	2016	22%	55%	10%	8%	18%	17%	49%	0%
All Active Customers	2015	13%	59%	13%	13%	25%	17%	33%	2%
	2016	23%	59%	11%	7%	21%	14%	50%	2%

Source: Navigant analysis

Table 2-5 shows how the populations of active and passive customers differed in 2016. Each cell shows the percentage of customers in a given demographic group and technology/price group. Level 1 for each price plan is split out, since there are both active and passive customers in that level, and then all customers are shown. Compared to passive customers, active customers in 2016 were:

- Less likely to be low-income (difference of -4% for all customers)
- More likely to be medium use (difference of +10% for all customers)
- More likely to be high income (difference of +6% for all customers)
- Less likely to be seniors (difference of -6% for all customers)
- Less likely to have a small home (difference of -7% for all customers)

- Less likely to be renters (difference of -7% for all customers)

Since there were substantial efforts to drive customers to the web portal and convert them from passive to active status in the second year of the Pilot, looking at the groups that were less likely to be active customers in 2016 may shed light on groups that need special outreach. In particular, active customers were less likely to be low-income customers and they were less likely to be seniors; two groups which are often considered hard to reach. The focus groups also indicated that low-income customers may need focused outreach to gain as much as possible from the Pilot. Active customers were also less likely to be renters but the difference was smaller among Level 1 customers than in the Pilot population as a whole; this suggests renters were less likely to install technology packages but were almost as likely to visit the web portal. Renters had particular problems installing technologies due to the need for landlord permission and meter communication issues in multi-family housing.

Table 2-5. Demographics of Active versus Passive Customers in 2016

Technology/Price Group	Customer Type	Low Use	Medium Use	High Use	Low Income	High Income	Seniors	Small Home	Large Home	Renter
Level 1 CPP	Active	27%	56%	10%	6%	17%	13%	55%	2%	27%
	Passive	27%	49%	9%	11%	15%	19%	57%	2%	29%
Level 1 PTR	Active	22%	55%	10%	8%	18%	17%	49%	0%	23%
	Passive	21%	37%	10%	20%	16%	27%	63%	1%	26%
All Customers	Active	23%	59%	11%	7%	21%	14%	50%	2%	22%
	Passive	27%	49%	9%	11%	15%	20%	57%	2%	29%

Source: Navigant analysis

3. IMPACT ASSESSMENT

As laid out in National Grid's 2011 Evaluation Plan and in accordance with the *Common Evaluation Framework*, Navigant conducted impact analyses on four main topics:

1. **Peak Event Impacts**, which are demand savings (MW) during Peak Events called in the summer of 2015 and 2016;
2. **Energy Impacts**, which are energy savings (MWh) from the Pilot in 2015 and 2016; [60]
3. **Bill Impacts**, which are dollar savings on customer bills in 2015 and 2016; and
4. **Load Shifting** around Peak Events, including snapback and pre-cooling, and from peak to off-peak times in 2015 and 2016.[61]

This report covers impacts for the period from the start of the Pilot through the end of 2016. Impacts for each of the four analyses listed above were calculated for customer groups defined by technology level and price plan.[62] Where possible, Navigant also estimated impacts by demographic subgroup. The impact findings in this report are primarily focused on residential customers. Commercial customers made up less than 5% of the Pilot participants and outcomes were explored for them to the extent possible based on the constraints of the small sample. Detailed descriptions of the impact methodologies for each of the four topics above are included in APPENDIX A.

The Pilot was developed to meet the GCA goal of achieving peak and average load reductions of 5% or greater for those customers who actively participated in the Pilot.[63] In Navigant's analysis, peak load reduction was examined in the demand analysis and average load reduction in the energy analysis. Throughout this report, except in Section 3.1.2 where peak load reductions by Peak Event hour are discussed, the peak load reduction shown for a given Peak Event is the average load reduction across all the hours of that Peak Event. In both 2015 and 2016, active residential customers in the Pilot achieved an average of a 17% peak load reduction on Conservation Days. Active CPP participants[64] achieved an average load reduction of 4.3% in 2015 and 6.3% in 2016, which averaged to 5.4% over the whole Pilot. The demand savings may be slightly underestimated because hourly data from 2014 was used to estimate the baseline. In 2014, customers had access to usage information from the Pilot but the Pilot rates were not yet live, so they may have already been conserving as they were more aware of their

[60] To a lesser extent, Navigant also examined savings from 2014 when the informational portion of the Pilot was in effect but the Pilot pricing had not yet gone into effect.

[61] Although load shifting impacts are not specifically identified in the *Common Evaluation Framework*, the team that developed National Grid's impact evaluation plan added this component to the evaluation scope of work.

[62] Impacts were not calculated in any of the analyses for Level 3 PTR customers as this group had only one customer in 2015 and two customers in 2016.

[63] As discussed previously, in the context of this opt-out Pilot, Navigant defined active customers as anyone who opted into one of the three higher technology packages (Levels 2-4) and anyone on the default technology package (Level 1) who logged into the web portal at least once. Customers in Level 1 who never logged into the web portal were considered passive participants in the Pilot.

[64] Energy savings or average load reductions were neither expected nor found for PTR customers as these customers were not on a TOU rate and thus did not have a monetary incentive to save energy outside of Peak Events.

electricity usage.[65] Navigant did find small energy savings from the Pilot in 2014. For the energy savings analysis, Navigant used 2013 as the pre-program year which was prior to any Pilot activities.

Table 3-1 shows total and percentage demand and energy savings and total bill savings for residential customers in each year of the Pilot. Total savings are the sum of savings across all residential customers in the program. For the Peak Event savings, the total savings are shown for the "average event", which is the average across all Peak Event hours across all 20 Peak Events of each summer, and for the "maximum event", which is the single Conservation Day with the highest average savings across the Peak Event hours. Percentage savings are the weighted average of savings across the residential technology/price plan groups. Peak Event savings stayed almost the same for active customers in 2015 versus 2016, but savings for passive customers increased considerably in 2016. Energy savings also increased in 2016 compared to 2015, driven primarily by a spike in savings in July 2016 (as discussed in Section 3.2.1). Total bill savings decreased in 2016 compared to 2015 (as discussed in Section 3.3).

Table 3-1. Total and Percentage Savings for Residential Customers

Impact Category		2015 Total Savings	2015 Percentage for Active Customers	2015 Percentage for All Customers	2016 Total Savings	2016 Percentage for Active Customers	2016 Percentage for All Customers
Peak Event Savings	Average Event*	0.55 MW	16.8%	3.9%	1.02 MW	16.8%	7.2%
	Maximum Event**	1.59 MW	29.0%	12.3%	2.28 MW	24.0%	14.3%
Energy Savings***		215 MWh	4.3%	0.2%	1,358 MWh†	6.3%	2.0%
Bill Savings‡		$997,621	-	-	$772,879	-	-

Source: Navigant analysis
* This is the total demand savings among all participants, averaged across all 20 events in the summer of each year.
** This is the total demand savings for 6/23/2015 and 7/25/2016, the Conservation Days with the highest savings for each summer.
*** This includes energy savings for CPP customers only, as energy savings were neither expected nor found for PTR customers.
† The considerable increase in energy savings in 2016 was driven primarily by a spike in savings in July, Navigant did not find any evidence suggesting this result was erroneous. This is discussed more fully in Section 3.2.1.
‡ This includes total bill savings for CPP customers and rebates for PTR customers.

Navigant also broke down the total Peak Event savings in 2016 to consider how much of the savings came from the pricing versus the technologies to address the question of how much of the savings could be achieved through price plans alone. To do this Navigant looked at what portion of the total savings came from customers in Level 1. Table 3-2 shows the portion of the total Peak Event savings that were achieved by passive customers in Level 1, which is similar to a program with just price plans, and by all customers in Level 1, which is similar to a program with price plans and a web portal. Seventy percent of the average total Peak Event savings in 2016 was achieved by all Level 1 customers (active and passive) and the remaining 30% of the savings came from customers who opted into one of the technology packages (although customers with technology accounted for only 10% of the customers in the Pilot). Passive customers in Level 1 made up 42% of the average total Peak Event savings in 2016, indicating this amount could have been achieved by the price plans alone.

[65] Hourly data was not available prior to April 2014 when smart meters were installed.

Table 3-2. 2016 Peak Event Savings from Level 1 Customers

	Total Savings from All Customers	Total Savings from Passive Level 1 Customers	Portion of Savings from Passive Level 1 Customers	Total Savings from All Level 1 Customers	Portion of Savings from All Level 1 Customers
Average*	1.02 MW	0.43 MW	42%	0.72 MW	70%
Maximum**	2.28 MW	1.32 MW	58%	1.84 MW	81%

Source: Navigant analysis

Navigant did not find any statistically significant Peak Event impacts for commercial customers.[66] This finding matches the survey results for commercial customers, in which most businesses indicated that they were unable to adjust their usage during business hours when Peak Events were most likely to be called (see Section 4.2.8). This result should not be over interpreted to conclude that the Pilot was ineffective for commercial customers. The sample sizes for commercial customers on the PTR rate and in the higher technology levels were too small to draw any conclusions. It is possible that with the proper enabling technologies commercial customers were saving during Peak Events. It is also possible that subsets of commercial customers, for example those who were able to shift energy intensive activities to the evening or overnight, saved on the Pilot. There is not enough data for such possibilities to be explored.

3.1 Peak Event Impacts

Navigant estimated demand savings during each Peak Event by regression to predict fitted usage from 8 a.m. to 10 p.m. on each Conservation Day, controlling for temperature, humidity, day of the week, month, and a customer fixed effect that controlled for all observed and unobserved customer-specific variables that do not change through time. The evaluation team estimated savings for each technology/price group combination with the exception of the Level 3 PTR group, which only had one customer in 2015 and two customers in 2016. A detailed description of the methodology is included in APPENDIX A.

In both 2015 and 2016, active residential customers in the Pilot achieved an average 17% peak load reduction on Conservation Days. This means that the Pilot exceeded the GCA goal of achieving a 5% peak load reduction amongst active customers.

3.1.1 Average Peak Event Impact

Figure 3-1 shows the average percentage peak load reduction across all the events of each summer for each of the residential technology/price groups.[67] Whether on the CPP or PTR rate, customers achieved greater demand reduction with more advanced technology. For active customers at each technology level, CPP customers conserved more electricity than their PTR counterparts. Passive PTR customers

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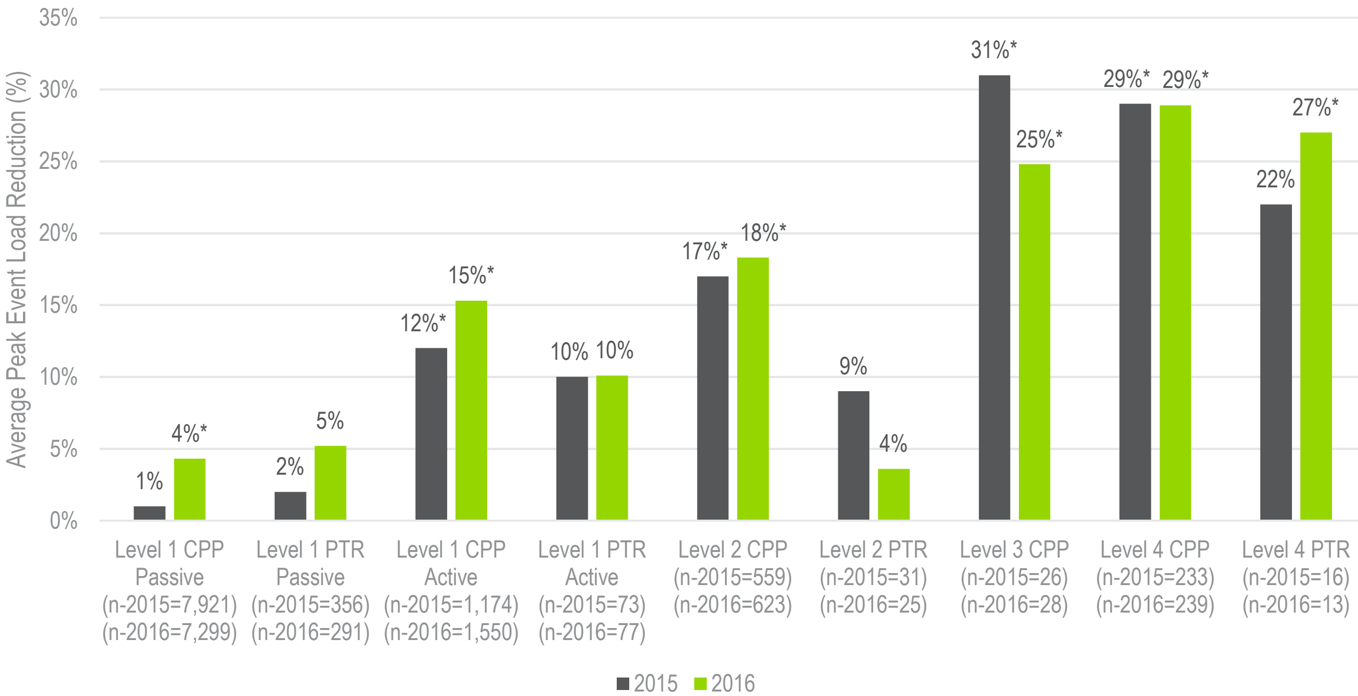
[66] Energy impacts for commercial customers were not analyzed as the group was too small to produce statistically significant results, and energy impacts were not expected because the group did not have any Peak Event impacts.

[67] This is the average across all 20 Peak Events for each summer averaged across all the hours of each individual Peak Event.

saved more than passive CPP customers, which could reflect that these customers have a higher level of engagement since they had to opt in to the PTR rate. Impacts for passive customers on both price plans increased considerably in 2016 compared to 2015. Impacts for most of the other groups stayed fairly consistent over the two years. Level 3 and 4 customers had very similar savings, suggesting that the smart thermostats received by customers in those two levels drove their savings.

Figure 3-1. Average Percent Peak Event Load Reductions by Residential Technology/Price Group



Source: Navigant analysis

Note: An asterisk (*) indicates that the majority of the event hours throughout the summer were statistically significant at the 90% confidence level for the indicated group. Additionally, n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group.

Table 3-3 shows the average absolute savings per customer across all the events of each summer for each technology/price group in each year.

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Table 3-3. Average Absolute Peak Event Load Reductions per Customer by Residential Technology/Price Group

Technology/Price Group	2015 Absolute Savings (kW)	2016 Absolute Savings (kW)
Level 1 CPP Passive	0.01	0.05
Level 1 PTR Passive	0.03	0.07
Level 1 CPP Active	0.13	0.17
Level 1 PTR Active	0.12	0.12
Level 2 CPP	0.20	0.21
Level 2 PTR	0.13	0.05
Level 3 CPP	0.53	0.49
Level 4 CPP	0.56	0.60
Level 4 PTR	0.50	0.60

Source: Navigant analysis

In percentage terms, the impacts for active residential customers in the Pilot were similar to those from other, primarily opt-in, programs.[68] Comparisons of the Pilot to several other programs around the country are shown in Figure 3-2. The comparisons include the average, maximum, and minimum impact when possible, or the average impact when the minimum and maximum could not be found. The comparisons are grouped by the Pilot's technology/price groups, and the comparison programs are matched to the Pilot groups based on the descriptions of the price plans and the enabling technologies in the comparison program's report. The comparisons for Level 1 are to other programs with no technology, comparisons for Level 2 are to programs with IHDs, and Levels 3 and 4 are grouped together and compared to other programs with PCTs. The Pilot groups are highlighted in gray for 2015 and green for 2016. A similar graph showing absolute comparisons is included in APPENDIX B.

[68] Passive customers in Level 1 also had savings, but they are not shown in Figure 3-2 because all of the comparison programs are opt-in. Passive customers in an opt-out program are fundamentally different from customers in an opt-in program in terms of their motivation to participate in a program.

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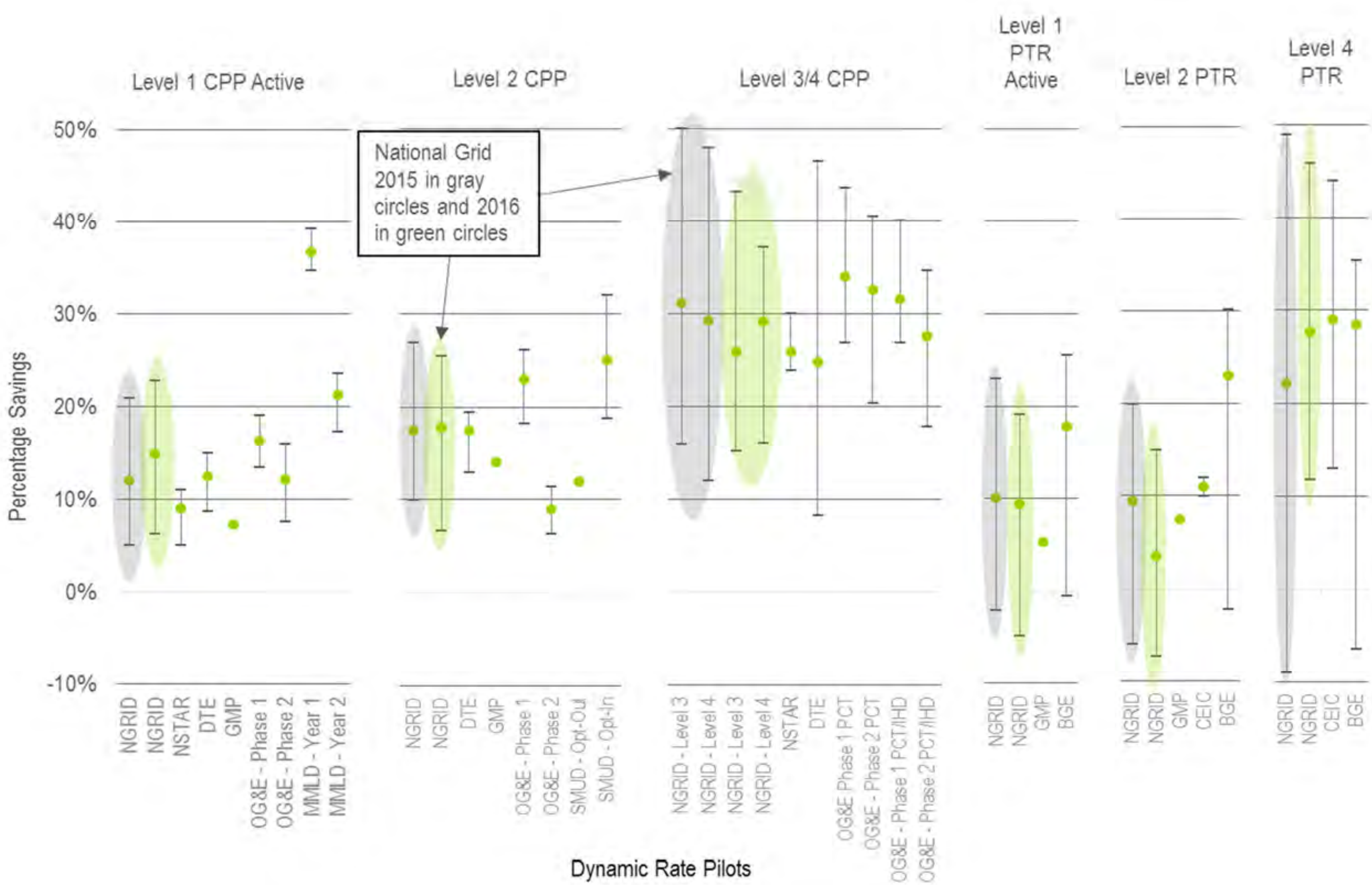
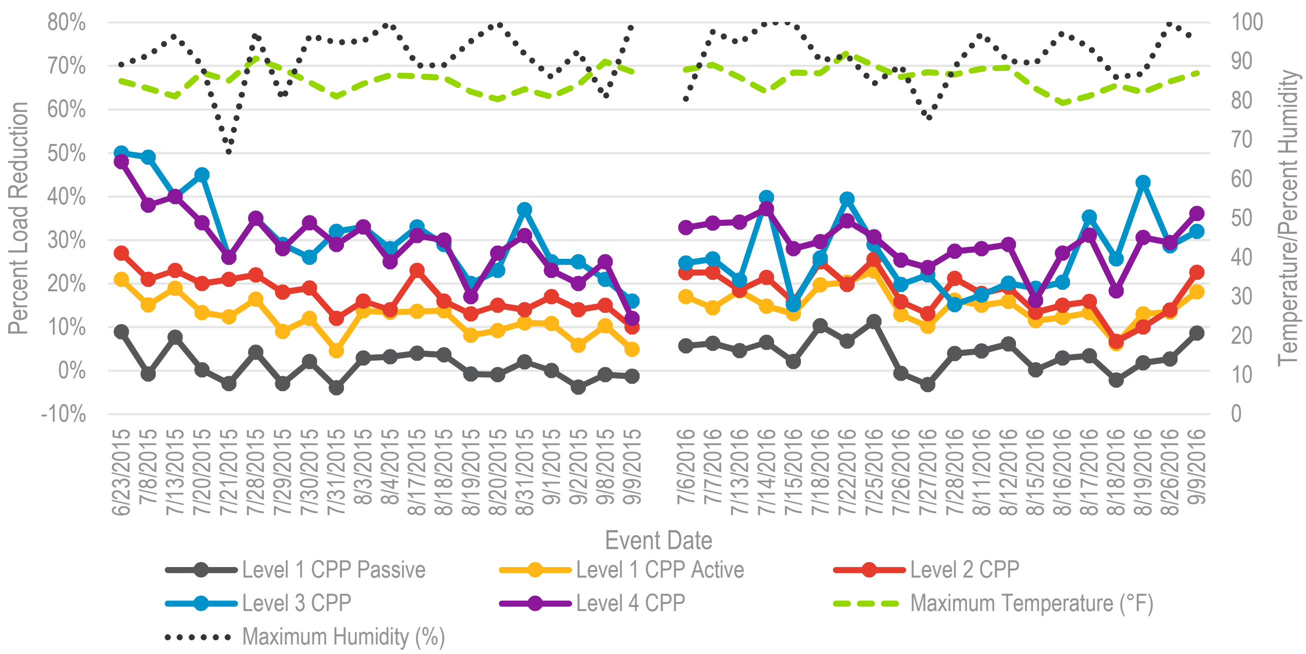
Figure 3-2. Residential Peak Event Impacts Percentage Comparison to Other Utilities



Source: Navigant analysis and the Smart Grid Investment Grant program
Note: NGRID = National Grid; NSTAR is now Eversource Energy; DTE = DTE Energy; GMP = Green Mountain Power; OG&E = Oklahoma Gas and Electric; MMLD = Marblehead Municipal Light Department; SMUD = Sacramento Municipal Utility District; BGE = Baltimore Gas and Electric; CEIC = Cleveland Electric Illuminating Company

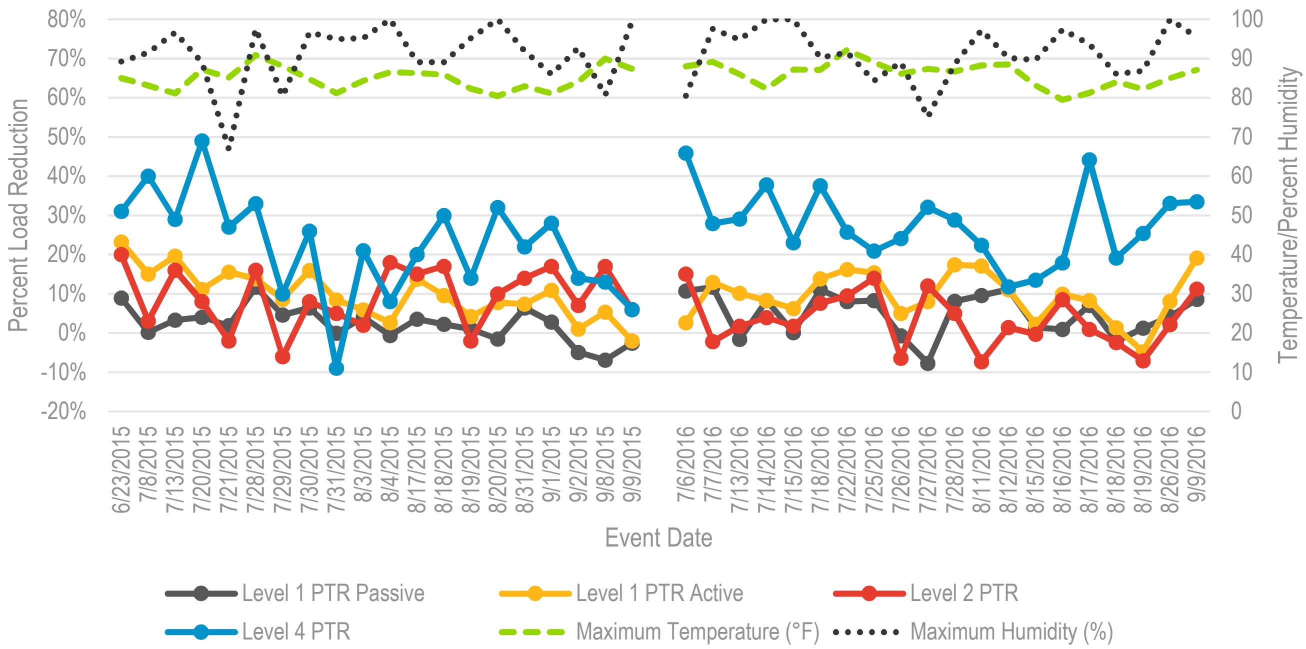
Figure 3-3 shows the average percentage impact for each event for the five residential CPP customer groups, and Figure 3-4 shows the average percentage impact for each event for the four residential PTR groups. For almost all of the technology/price groups, the impact was highest for the first Peak Event on June 23rd, 2015, and this may indicate initial excitement or novelty surrounding the first event. In 2015 for both price plans, Level 1 (active and passive) and Level 2 had relatively stable impacts throughout the summer, while Level 3 (CPP only) and Level 4 impacts declined throughout the summer. This matches with the survey data (Figure C-5), which showed that Level 3 and 4 customers were more likely to override their thermostats as the 2015 summer went on. In 2016 all of the technology/price groups had relatively stable impacts throughout the summer. This may indicate learning that occurred from the first summer to the second. Another reason for the difference may be that 2015 had more events in September than 2016 when many families are busy with back to school and change their behavior patterns compared to the rest of the summer. Another major difference from 2015 to 2016 was the increase in savings for passive customers in Level 1 which may be due to ramp-up similar to that seen in Home Energy Report programs wherein savings commonly increase from the first year into the second and sometimes even the third year of the program; examining savings for a third summer would shed further light on this trend. Similar graphs showing the absolute impact and tables showing the average percentage and absolute impact by event are in APPENDIX B.

Figure 3-3. Percentage Savings for CPP Customers



Source: Navigant analysis

Figure 3-4. Percentage Savings for PTR Customers



Source: Navigant analysis

Figure 3-5 shows the percentage savings during each Peak Event for customers with PCTs (Levels 3 and 4) and the degree setback on the thermostat for each Peak Event. National Grid remotely adjusted these customers' thermostats by the degree setback shown,[69] although customers had the option to opt-out of the event or override their thermostat at any time. Based on Figure 3-5 there do appear to be slightly higher savings associated with a higher degree setback, but the effect decays during back-to-back Peak Events. One might expect that a higher setback temperature would be correlated with a higher rate of opt-outs and overrides among thermostat customers; however, the data did not show this. A higher degree setback was slightly positively correlated with a higher percentage of customers with a thermostat opting out before the Peak Event started,[70] but it was negatively correlated with the percentage of customers overriding the thermostat during the Peak Event.[71] The rate of opt-outs and overrides was most strongly correlated with the length of the Peak Event; the longer the Peak Event the higher the percentage of customers choosing to opt out before or override during the Peak Event.[72] These trends are shown in Figure 3-6. The fact that opt-outs and overrides were more highly associated with the length of the Peak Event than the degree setback may indicate that customers noticed how long the Peak Event lasted more than they noticed how extreme the temperature shift was. This was further supported by the fact that opt-

[69] Setback was relative to the setting on the thermostat when the Peak Event began, not to the programmed temperature for that time. Thus if a customer increased or decreased their thermostat prior to the event their temperature was still increased by the specified degrees. The setback was not reinstated if the customer changed their thermostat setting once the Peak Event had started.

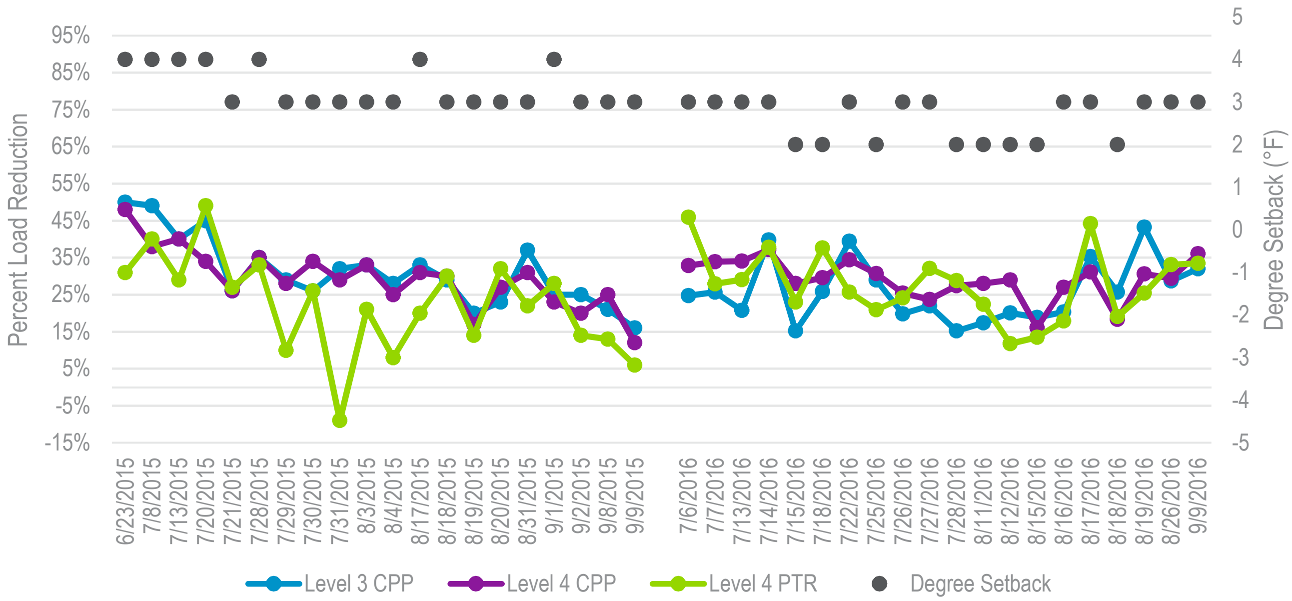
[70] Correlation coefficient of 0.30.

[71] Correlation coefficient of -0.27.

[72] The correlation coefficient between the length of the Peak Event and opt-outs and overrides was 0.30 and 0.54, respectively.

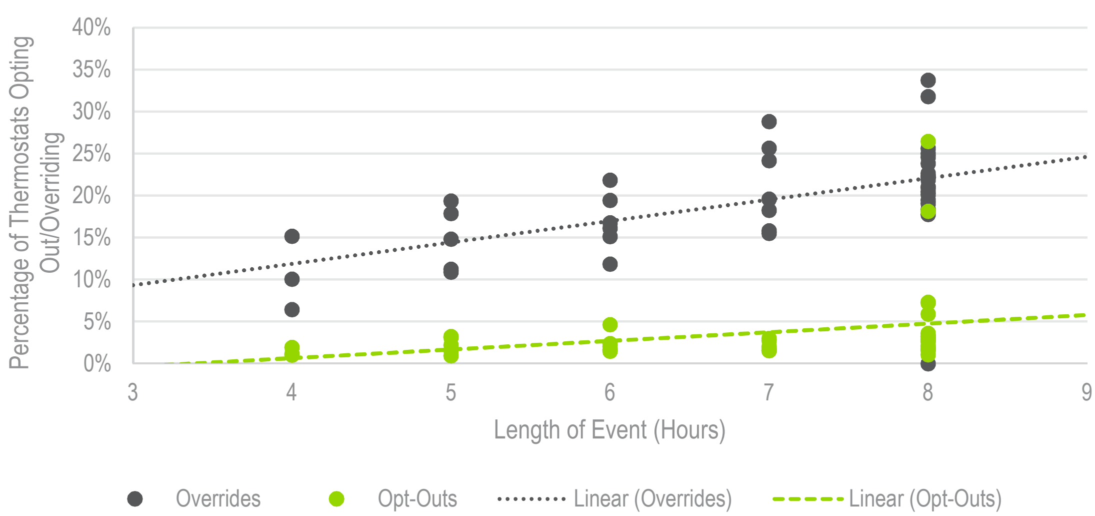
outs and overrides were also positively correlated with the end time of the Peak Event, meaning customers were more likely to opt-out/override the later into the evening a Peak Event went.[73]

Figure 3-5. Degree Setback and Percentage Savings for Customers with PCTs



Source: Navigant analysis

Figure 3-6. Length of the Peak Event and Percentage of Thermostat Customers Opting Out/Overriding



Source: Navigant analysis

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[73] The correlation coefficient between the end time of the Peak Event and opt-outs and overrides was 0.33 and 0.50, respectively.

Navigant looked at how the Peak Event load reductions differed over back-to-back events in 2016.[74] As shown in Table 3-4, the first day of a back-to-back event had average savings of 9% across all technology/price groups while subsequent days averaged 6%. The effect was slightly stronger for the lower technology groups as compared to the groups with PCTs (Level 3 and 4).

Table 3-4. Average Percentage Peak Event Load Reductions during Back-to-Back Peak Events

Technology/Price Group	Level 1 CPP Passive	Level 1 PTR Passive	Level 1 CPP Active	Level 1 PTR Active	Level 2 CPP	Level 2 PTR	Level 3 CPP	Level 4 CPP	Level 4 PTR	Weighted Average
First Day of a Back-to-Back Event	6%	7%	17%	12%	20%	6%	26%	30%	29%	9%
Subsequent Days (2-5) of a Back-to-Back Event	2%	3%	13%	8%	16%	1%	26%	28%	27%	6%

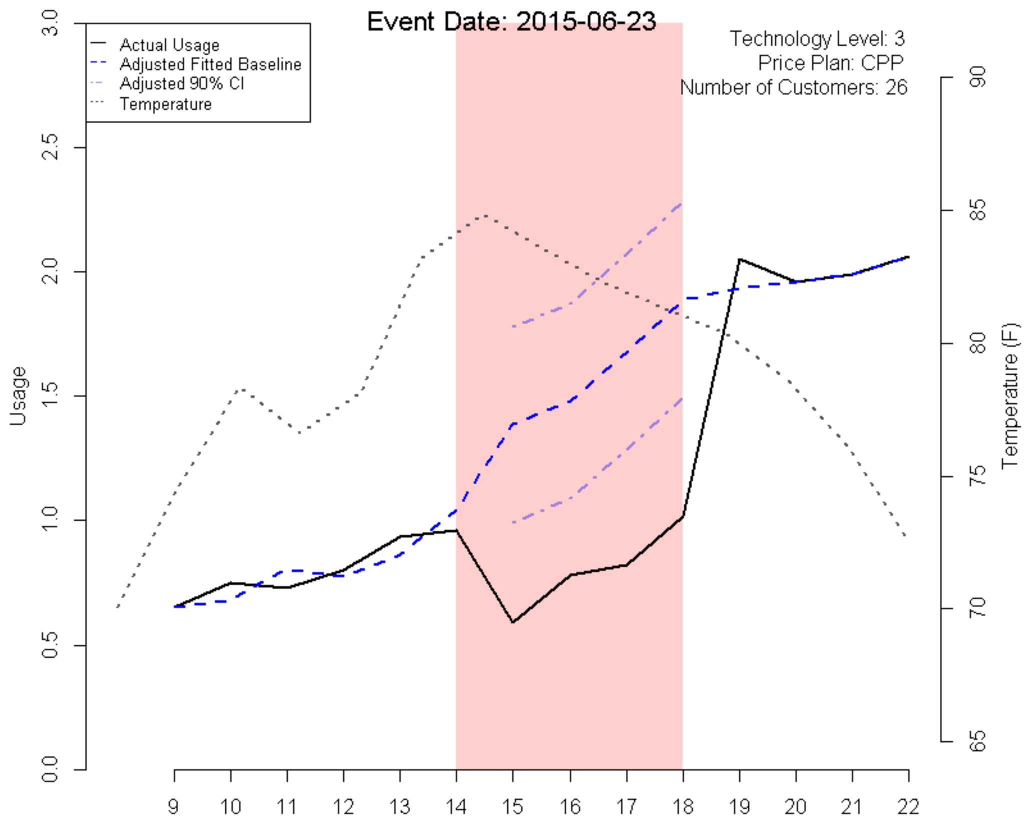
Source: Navigant analysis

3.1.2 Impacts by Event Hour

To assess the event impacts by hour, Navigant created graphs of average usage on each event day for each technology/price group. Figure 3-7 shows one such graph for Level 3 CPP for the first event on June 23rd, 2015. The x-axis plots the hours of the day, and the event period is highlighted in red. Usage is plotted on the primary y-axis with actual usage as the solid black line and fitted baseline usage as the dotted blue line. The 90% confidence interval on the adjusted fitted baseline during the event period and snapback period is shown in the lighter blue dot-dash lines. Temperature is plotted on the secondary y-axis as the dotted grey line. Similar graphs are available for each event for each technology and price plan group in the separately attached Appendix F for residential customers and Appendix G for commercial customers.

[74] Back-to-back events were defined as those where a Conservation Day occurred on two or more consecutive days. Conservation Days that spanned over a weekend, i.e., when a Peak Event was called on a Friday and the following Monday (the next day that was eligible for an event), were not counted as back-to-back.

Figure 3-7. Level 3 CPP Actual and Baseline Usage on 2015-06-23



Source: Navigant analysis

To summarize how the load reductions changed through the hours of a Peak Event, Navigant calculated the average slope of the load reduction across the Peak Event hours for each technology/price group (i.e., the slope of the difference between the dotted blue line and the solid black line during Peak Events such as that shown in Figure 3-7). This analysis shows whether the impacts, on average across all the Peak Events, increased, decreased, or stayed the same throughout the hours of a Peak Event. Figure 3-8 shows lines with the same slope as the change in load reductions over the hours of a Peak Event for each technology/price group. The three groups with PCTs had slightly negative slopes, indicating that the impacts degraded a small amount over the hours of a Peak Event. All the other groups had slightly positive slopes indicating the impacts grew slightly over the hours of a Peak Event. Despite these trends by technology/price group, in general, across the groups, the slopes of the impacts were small indicating that savings only grew or fell a small amount over the hours of a Peak Event.

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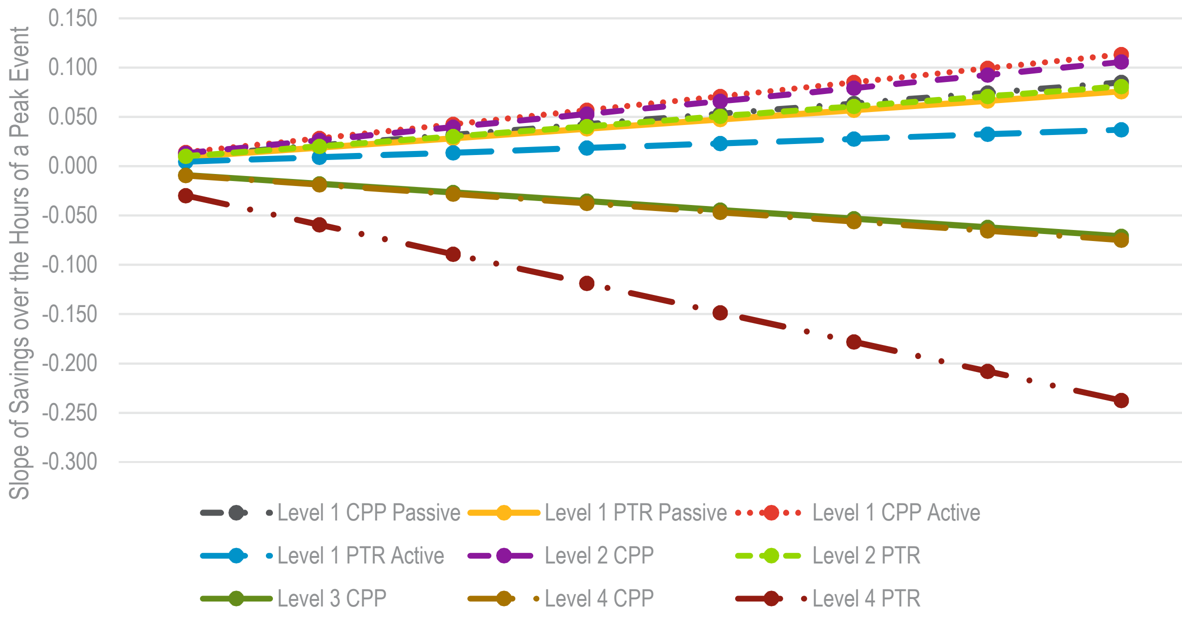
Figure 3-8. Savings Persistence Over the Course of a Peak Event



Source: Navigant analysis

3.1.3 Impacts by Demographic Subgroup

Impacts were estimated for 26 residential demographic subgroups as indicated by shading in Table 3-5.[75] Graphs similar to Figure 3-7 are provided in the separately attached Appendix H for each of the events for each demographic subgroup. A threshold of 100 customers was used to decide whether there was enough data to estimate results for a demographic subgroup.[76] Navigant made an exception to that threshold to estimate impacts for low-income customers in Level 1 CPP active and Level 2 CPP. Additionally, renter data was only collected in 2016 and so only one year of impacts was analyzed for those subgroups.[77]

Across all the subgroups only three had statistically significant differences in Peak Event impacts from the group as a whole: low-income customers in Level 2 CPP and renters in Level 1 CPP (both active and passive) had lower impacts than those technology/price groups as a whole. Impacts for low-income customers were also estimated for active and passive customers in Level 1 CPP, but for each of those groups no statistically significant difference was found between low-income customers and the group as a whole. Since 87% of all Pilot participants were in the Level 1 CPP groups we know that most of the low-income customers had the same impacts as other customers. Impacts for renters were also estimated for Level 2 CPP and while the differences were not statistically significant, impacts for renters were

[75] Navigant did not estimate commercial customer impacts by demographic subgroup because the overall group size was too small to yield statistically significant results.

[76] A threshold of 100 was used to ensure a chance of statistical significance in the results.

[77] Renters were not included as a demographic subgroup in National Grid's original smart grid pilot evaluation plan (D.P.U. 11-129 Exhibit EHW-3. December 22, 2011). National Grid and the evaluation team chose to add this group in 2016.

consistently lower than for the group as a whole, as in Level 1.

Table 3-5. Peak Event Impact Estimation Groups in 2015/2016[78]

Technology/ Price Group		Non-Low Income Low Use	Non-Low Income Medium Use	Non-Low Income High Use	Low Income	High Income	Seniors	Small Home	Large Home	Renter
Level 1: Web Portal Only	CPP - Active	297/438	640/905	142/154	88/101	212/269	189/202	481/889	24/28	427
	CPP - Passive	2,071/ 2,165	3,874/ 3,887	818/732	1,096/ 860	1,287/ 1,219	1,922/ 1,527	3,566/ 4,486	156/149	2,313
	PTR – Active	21/17	39/42	6/8	7/6	12/14	7/13	22/38	0/0	18
	PTR - Passive	110/61	146/110	33/30	65/60	37/47	85/80	122/186	3/4	78
Level 2: IHD	CPP	75/112	334/391	76/76	76/63	143/156	98/96	185/285	11/12	104
	PTR	3/1	16/15	7/5	5/3	4/8	6/3	11/10	1/1	1
Level 3: PCT	CPP	3/4	20/21	2/3	1/0	12/10	7/8	9/12	1/1	4
	PTR	0/0	1/1	0/0	0/0	1/1	0/0	0/0	0/0	0
Level 4: Tech Combos	CPP	25/26	151/164	44/42	13/9	91/103	37/34	68/87	20/18	13
	PTR	1/1	9/7	3/2	3/1	4/5	0/0	4/3	0/0	1

Source: Navigant analysis

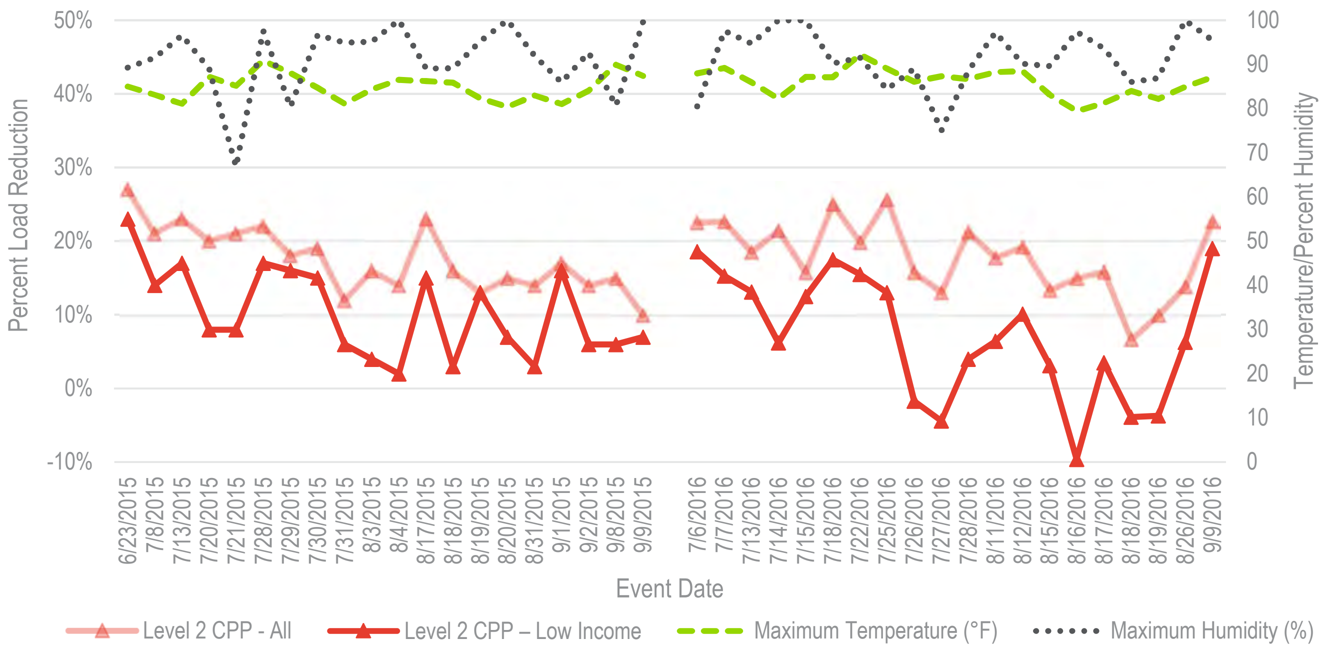
Note: The first number in each box shows the sample size in 2015 while the second shows 2016, except for the renter demographic subgroup where data was only collected in 2016. Because of the change in the number of customers, impacts were only estimated for passive low use customers in Level 1 PTR in 2015 and for low use customers in Level 2 CPP in 2016; all other shaded demographic subgroups were estimated in both years.

Impacts for Low-Income Customers

Figure 3-9 shows the average percentage impact for each event for low-income customers and all customers in Level 2 CPP. In 2015, the impact for low-income customers averaged 10% compared to 17% for the group as a whole. The difference grew in 2016, with low-income customers averaging 7% compared to 18% for the group as a whole. For each event across both summers, low-income customers had lower savings than the group as a whole.

[78] The customer counts in this table differ slightly from the customers count in Table 2-3 due to small differences in the logic used to include customers in the impact analysis versus in the survey. For example, customers who went inactive during the summer of 2015 were not included in the survey sample but they were included in the impact analysis up until their account went inactive.

Figure 3-9. Event Savings for Low-Income Customers in Level 2 CPP



Source: Navigant analysis

There are several possible explanations for why low-income customers would save less than other customers:

1. Central air conditioning (CAC) penetration may be lower among low-income customers;
2. Low-income customers may have less discretionary energy usage and thus less energy to save;
3. Low-income customers may have been less able to shift their usage than other residential customers; or
4. The finding may be an anomaly, given that two of the three technology/price groups for which low-income customers were analyzed did not show statistically significant differences.

The next several paragraphs go through the first three hypotheses sequentially. For each hypothesis, we first explain it in more detail and then discuss what, if anything, we were able to do to assess its likelihood. The fourth explanation is not discussed in more detail since we cannot assess its likelihood.

Lower CAC penetration for the low-income customers: For example, low-income customers may be more likely to have window AC units rather than CAC. To further examine this possibility, Navigant identified customers likely to have CAC in Level 2 CPP as described in Section A.2 of APPENDIX A. Navigant then estimated the demand impacts during Peak Events for each summer for four income/CAC groups within Level 2 CPP: standard-income customers with CAC, low-income customers with CAC, standard-income customers without CAC, and low-income customers without CAC. For customers with and without CAC, the demand impacts were lower for low-income customers than standard-income customers in both percentage and absolute terms in 2015, as shown in Table 3-6. In 2016, the impacts for low-income customers without CAC rose substantially, and were higher than for standard-income customers, but the group of customers was quite small. This means that although CAC penetration may have been lower for low-income customers, it appeared that low-income customers had lower percentage demand savings regardless of the presence of CAC in 2015 but they may have done better than standard-income customers without CAC in 2016. The customers in Level 2 had IHDs but not PCTs; it is possible that with a PCT the disparity between low-income and other residential customer impacts would diminish.

Table 3-6. Demand Impacts for Level 2 CPP by Income and CAC

Income	CAC	2015 Customer Count	2015 Percentage Impacts	2015 Absolute Impacts	2016 Customer Count	2016 Percentage Impacts	2016 Absolute Impacts
Standard-Income	Y	284	20%	0.267	249	20%	0.286
Low-Income	Y	37	9%	0.143	23	6%	0.090
Standard-Income	N	164	18%	0.152	148	14%	0.126
Low-Income	N	35	11%	0.110	21	24%	0.235

Source: Navigant analysis

Low-income customers may have less discretionary energy usage and thus less energy to save: The lower impacts may be due to a tendency to have less discretionary energy usage and thus less energy to save, which is a common result found in evaluation.[79] Low-income customers are likely to already be conscious of their energy usage and its impact on their budget and thus may have been conserving more energy than other customers before the Pilot. Since they are already engaging in conservation behaviors, they have fewer improvements that they can make.

Low-income customers may have been less able to shift their usage than other residential customers: This was a concern when designing the Pilot and although, according to the pre-pilot and end of pilot surveys, low-income customers indicated that they could effectively shift their usage (see Figure 4-3 and Figure 4-4), it is possible that they over-estimated their ability to adjust their usage. Low-income customers may have had medical conditions that required them to run equipment throughout the day, such as HEPA air filters. They may also be more likely to live with children or elderly family members who were home during Peak Events and needed to stay comfortable, making them less able to adjust their AC usage.[80] As reported in the focus groups, some low-income customers may also have had shift work that caused them to be home during the day.

After exploring these possibilities, it seems unlikely that lower CAC penetration drove the lower savings for low-income customers. Low-income customers have lower energy usage overall than other customers which could mean they have less discretionary usage to cut but we do not have conclusive evidence of this. The focus group discussions lend anecdotal evidence to the possibility that low-income customers have more barriers to shifting usage than other customers, but the focus groups were not large enough to

[79] See for example IEE Whitepaper (2010). *The Impact of Dynamic Pricing on Low Income Customers*.

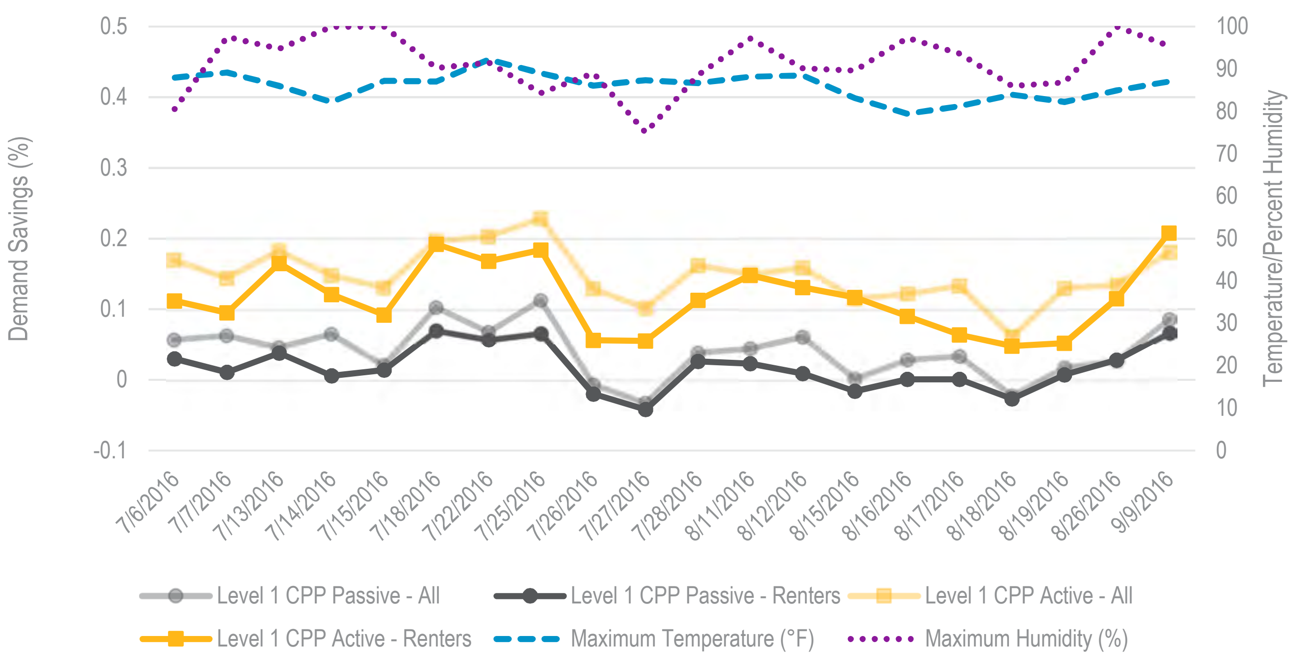
[80] The low-income focus groups suggested that some low-income customers experience these conditions but the sample sizes were not large enough to conclude that these conditions are more prevalent for low-income customers than for residential customers in general.

be considered conclusive. Finally, it is impossible to rule out the possibility that this result for Level 2 was simply an anomaly and that on the whole low-income customers in the Pilot are achieving results similar to other residential customers. This is supported by the finding that impacts for low-income customers were not statistically different from other customers in Level 1 CPP.

Impacts for Renters

Figure 3-10 shows the average percentage impact in each Peak Event for renters and all customers in Level 1 CPP, both active and passive, in 2016. Over all the events, the impact for passive renters averaged 2% compared to 4% for the group as a whole, and the impact for active renters averaged 12% compared to 15% for the group as a whole. For each event in each group, the average savings for renters were no more than for the group as a whole. Impacts for renters were also estimated for Level 2 CPP and while the differences in that group were not statistically significant, the same pattern was evident in that renters had lower impacts than the group as a whole. The lower savings for renters as compared to other customers likely stems from the particular challenges renters face in conserving electricity. For example, renters may or may not pay their own electric bill and they often have to get landlord permission for many conservation activities (such as buying new appliances).

Figure 3-10. Event Savings for Renters in Level 1 CPP



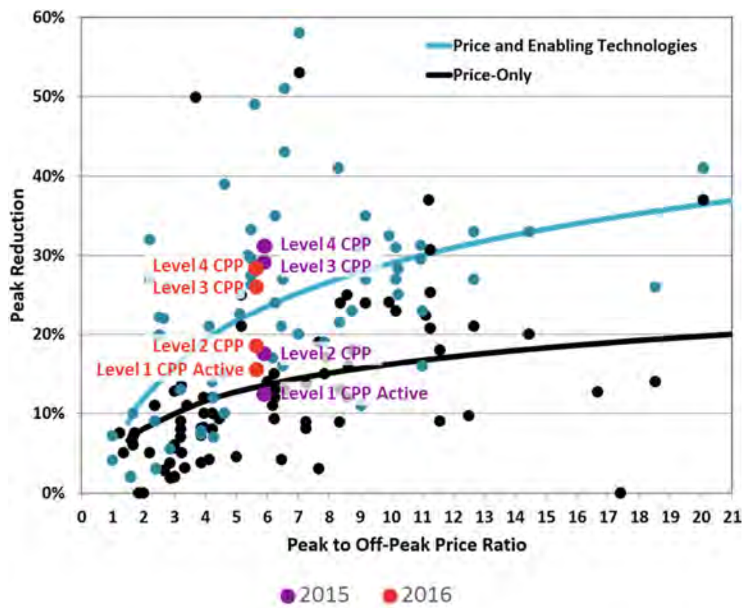
Source: Navigant analysis

3.1.4 Price Responsiveness

For the residential customers on the CPP price plan, Navigant was able to estimate the price responsiveness at each technology level. As shown in Figure 3-11, the level of price responsiveness for active customers was similar to that of other pricing programs. The figure shows Faruqui and Sergici's (2013) arc of price responsiveness, which is based on 137 pricing treatments in 34 programs worldwide; the Pilot price responsiveness is plotted in purple for 2015 and red for 2016 for each of the four active

CPP groups.[81] The arc plots the percentage peak reduction in electricity usage for various peak to off-peak price ratios for programs with and without enabling technologies. Although the off-peak and critical peak prices changed between the 2015 and 2016 summers, the peak to off-peak price ratio was approximately six in both years (note: 2016 is staggered just slightly to the left of 2015 for ease of viewing, but the ratio was actually the same in the two years).[82] The responsiveness for active customers in Level 1 was right at the average for price-only programs in 2015 and rose slightly in 2016. Level 2 was between the average for programs with and without enabling technologies in both years, which was expected given that an IHD is a relatively low-level enabling technology. Levels 3 and 4 were slightly above the average for programs with enabling technologies in both years, though slightly lower in 2016 than in 2015; both years fell well within the range seen at a peak to off-peak ratio of six.

Figure 3-11. Arc of Price Responsiveness for Active CPP Customers



Source: Faruqui and Sergici (2013) and Navigant analysis
Note: 2016 is staggered just slightly to the left of 2015 for ease of viewing, but the ratio was actually the same in the two years.

3.2 Energy Impacts

In order to calculate residential energy impacts, the evaluation team selected a group of matched control customers from a large pool of non-participant households that had similar patterns of energy usage in a 12-month period before the Pilot started to provide the counter-factual usage if the Smart Energy Solutions participants had not been in the Pilot.[83] The 12-month matching period went from September 2012 to August 2013, leaving a 4-month test period from September 2013 to December 2013 to ensure

[81] Faruqui, Ahmad and Sergici, Sanem, Arcturus: International Evidence on Dynamic Pricing (July 1, 2013). Available at SSRN: http://ssrn.com/abstract=2288116.

[82] Prices for the Pilot rates and the Basic Rate are shown in Table A-1 and Table A-2 in APPENDIX A.

[83] To avoid the issue of control customers moving out, only controls who had billing data through the end of the 2016 were used.

that the matches were performing well (i.e., continued to have usage similar to the participants) outside of the matching period but before the program started. Regression analysis of monthly billing data using the participants and matched controls was then used to estimate the annual reduction in energy usage, controlling for weather, for 2014 and the reduction by month in 2015. A detailed description of the methodology, along with graphs showing the quality of the matches, is included in APPENDIX A.[84]

Overall, active CPP participants[85] achieved an average load reduction of 4.3% in 2015 and 6.3% in 2016, which averaged to 5.4% over the whole Pilot. This means the Pilot exceeded the GCA goal of achieving a 5% average load reduction for active customers.

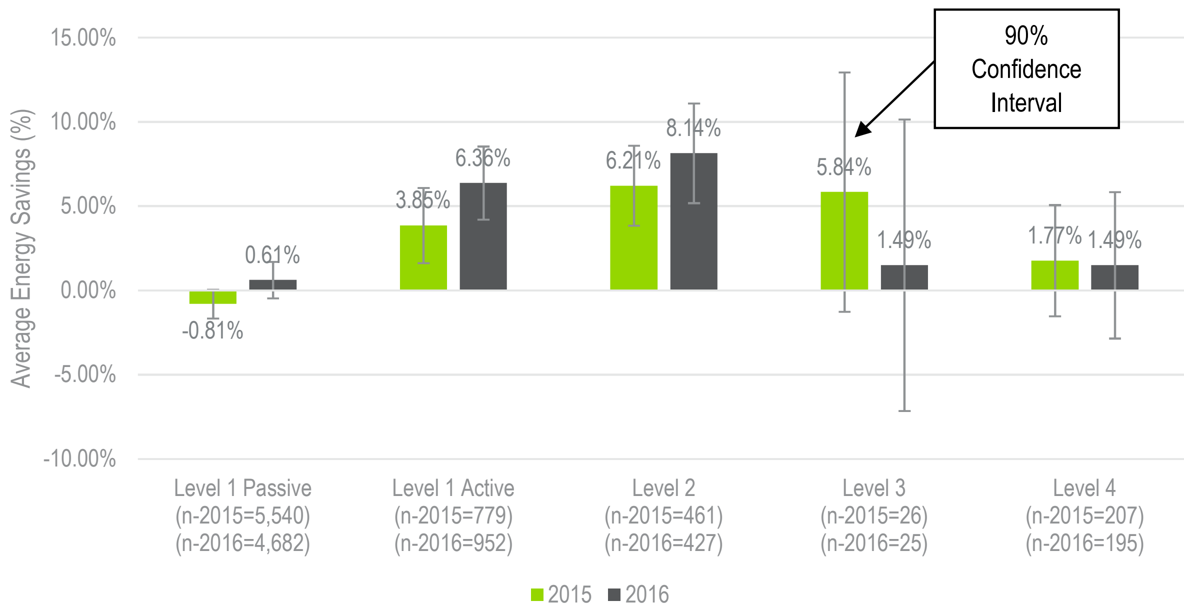
3.2.1 2015 & 2016 Impacts

Figure 3-12 shows the average percentage energy impacts with 90% confidence intervals for CPP customers in different technology levels in 2015 and 2016. Navigant also examined energy savings for PTR customers but did not find any significant savings; PTR customers were not expected to achieve significant energy savings because they did not pay TOU rates. In both years, energy savings for active participants were highest for Level 2 customers (43 kWh per month in 2015 and 55 in 2016) and lowest for Level 4 customers (13 kWh per month in 2015 and 11 in 2016). Active Level 1 customers saved 24 kWh per month in 2015 and 39 in 2016, and Level 3 customers saved 39 kWh per month in 2015 and 10 in 2016. Although the point estimates of energy savings changed from 2015 to 2016, the changes were not statistically significant, indicating that the energy savings were similar across the two years of the Pilot. It is unclear why Level 4 customers saved less than Level 3 customers in 2015 since the two groups had similar technologies; however, the 90% confidence bounds for the two estimates overlap and the sample sizes are relatively small for monthly billing analysis, which may have contributed to the discrepancy. Additionally, the discrepancy disappeared in 2016 when the point estimate for Level 3 customers fell considerably. The estimates of energy savings for passive customers in Level 1 were very small and not statistically significant in either year.

[84] Navigant did not estimate energy impacts by demographic subgroup because there was not enough data to do billing analysis on these smaller groups. Given that there were few differences in demand savings across the demographic subgroups it is unlikely that there were differences in energy savings.

[85] Energy savings, or average load reductions, were neither expected nor found for PTR customers as these customers were not on a TOU rate and thus did not have a financial incentive to save energy outside of Peak Events.

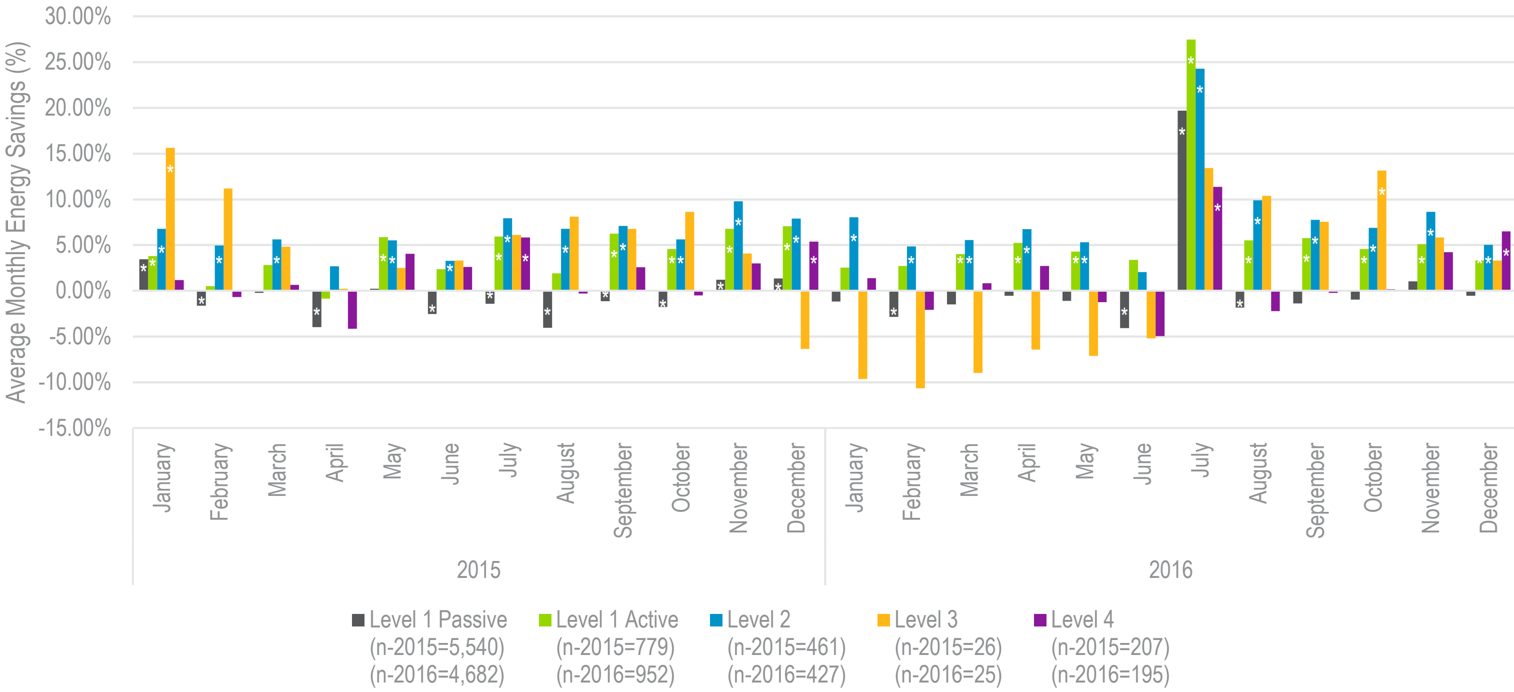
Figure 3-12. Average Energy Impacts for CPP Customers by Technology Level



Source: Navigant analysis
Note: n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group.

Energy savings by month and year for each technology level are shown in Figure 3-13. This shows that for most of the groups there were energy savings in almost every month. Level 3 customers showed negative savings in the first half of 2016, but this group was very small (only 25 customers) and these estimates were not statistically significant. Notably July, August, and September of both years, which cover the period when the summer Peak Events were being called, showed energy savings for almost all of the active customers (and the few negative estimates were not statistically significant). Energy savings for all of the groups spiked considerably in July 2016, which may have occurred because that month had 11 events (8 events was the next highest in a single month, occurring in both August 2016 and July 2015). Active customers in Level 1 and Level 2 had significant savings in most of the months of the Pilot. There were not obvious seasonal patterns in energy savings across the five CPP customer groups.

Figure 3-13. Average Monthly Energy Impacts for CPP Customers by Technology Level



Source: Navigant analysis
Note: White asterisks (*) indicate statistical significance at the 90% confidence level. n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group.

Navigant examined the billing data from July 2016 thoroughly to ensure that the spike in savings in that month was not driven by an error in the data. Navigant did find that participant usage dipped in that month compared to the matched controls' usage. However, there was no evidence suggesting that the dip was due to erroneous data as opposed to an actual drop in usage, i.e. energy savings.[86]

Navigant attempted to break down the energy impacts by demographic subgroups but the sample sizes were simply too small to draw any conclusions.

3.2.2 2014 Impacts

Figure 3-14 shows the energy savings from the Pilot in 2014 with 90% confidence intervals. In 2014, only the information portion of the Pilot was in effect—i.e., customers knew the Pilot was coming and technologies were available for those who wanted them. However, there were no price changes or Peak Events. Energy savings were statistically significant at the 90% level for Level 2 CPP customers, who saved 3.00%. Savings were positive, but statistically insignificant, for active and passive Level 1

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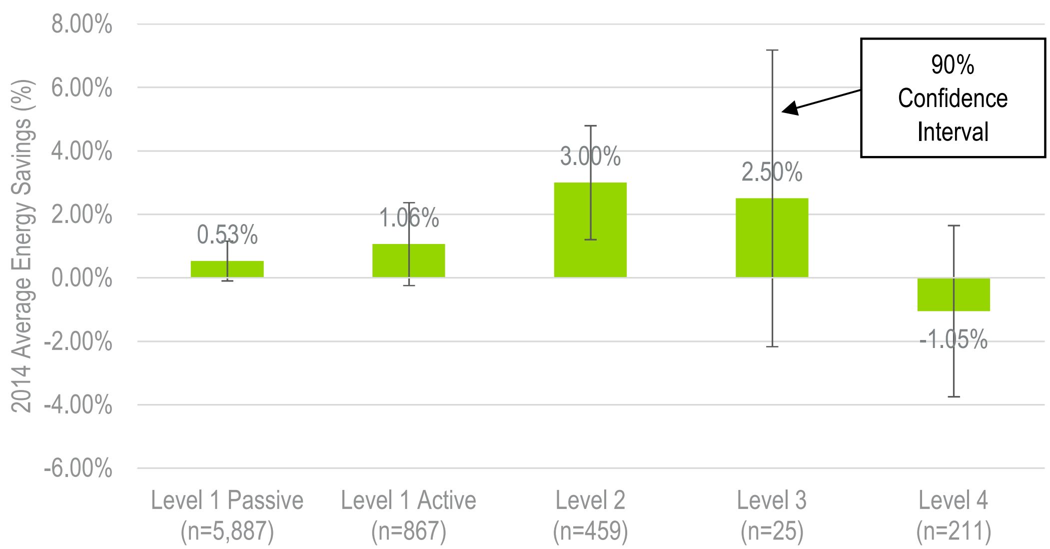
[86] There was not a drop in the number of customers or observations recorded in this month. Additionally, there was not an increase in observations of zero or negative usage for participants, nor was there a spike in high outliers for matched controls. Finally, usage was not outside the bounds of recorded usage: from 2014 to 2016 average monthly usage ranged from 16 to 26 kWh per day, usage for participants in July 2016 was 18 kWh per day while usage for matched controls was 22 kWh per day.

customers and for Level 3 customers, and negative, but statistically insignificant for Level 4 customers. For passive customers in Level 1 the savings were too small to see a statistically significant effect, and for the other three groups the relatively small sample sizes for billing analysis contributed to the statistical insignificance of the effects.

Figure 3-14. Energy Savings in 2014 by Technology/Price Group



Source: Navigant analysis
Note: n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group.

3.3 Bill Savings

Navigant calculated bill savings separately for Pilot participants on the CPP and PTR rates. To estimate the monthly bill impacts of the Pilot for CPP customers, Navigant calculated the bill amount using actual usage under the Smart Rewards TOU pricing rates and the counter-factual bill amount in absence of the Pilot using counter-factual usage under the Basic Rate. Counter-factual usage accounted for the energy savings estimated in Navigant's analysis. For PTR customers, the bill savings were due to the rebates paid by National Grid during Peak Events since these customers were not on the TOU rate. The rebate was calculated by subtracting the actual electricity consumed during Peak Events from the counter-factual consumption during Peak Events (defined as average usage during the ten prior non-holiday, non-Conservation Day weekdays after accounting for a day-of adjustment to capture weather differences, time of event, pre-cooling, etc.) and multiplying by the rebate amount in cents per kWh. These methods are detailed in APPENDIX A.

Table 3-7 shows savings for CPP and PTR customers in both years of the Pilot with the Peak Event hours that were actually called (135 in 2015 and 139 in 2016) and if the maximum of 175 Peak Event hours had been called (based on the average savings per event hour). Considering the actual number of Peak Events called, customers on both rates saved less in 2016 than in 2015 but the drop was more pronounced for CPP customers. The reduction in 2016 compared to 2015 occurred despite the increase in energy savings for CPP customers. Increases in energy savings do not necessarily produce increases in bill savings because of the high price during Peak Events. For example, the highest energy savings occurred in July 2016, but that did not produce high bill savings in that month because eleven Peak Events were called, increasing bills for many customers. If 175 Peak Event hours had been called, PTR customers would have earned more savings in rebates but CPP customers would have had slightly lower bill savings as their bills would increase due to more hours being charged at the higher Peak Event period rate.

Table 3-7. Bill Savings by Price Plan

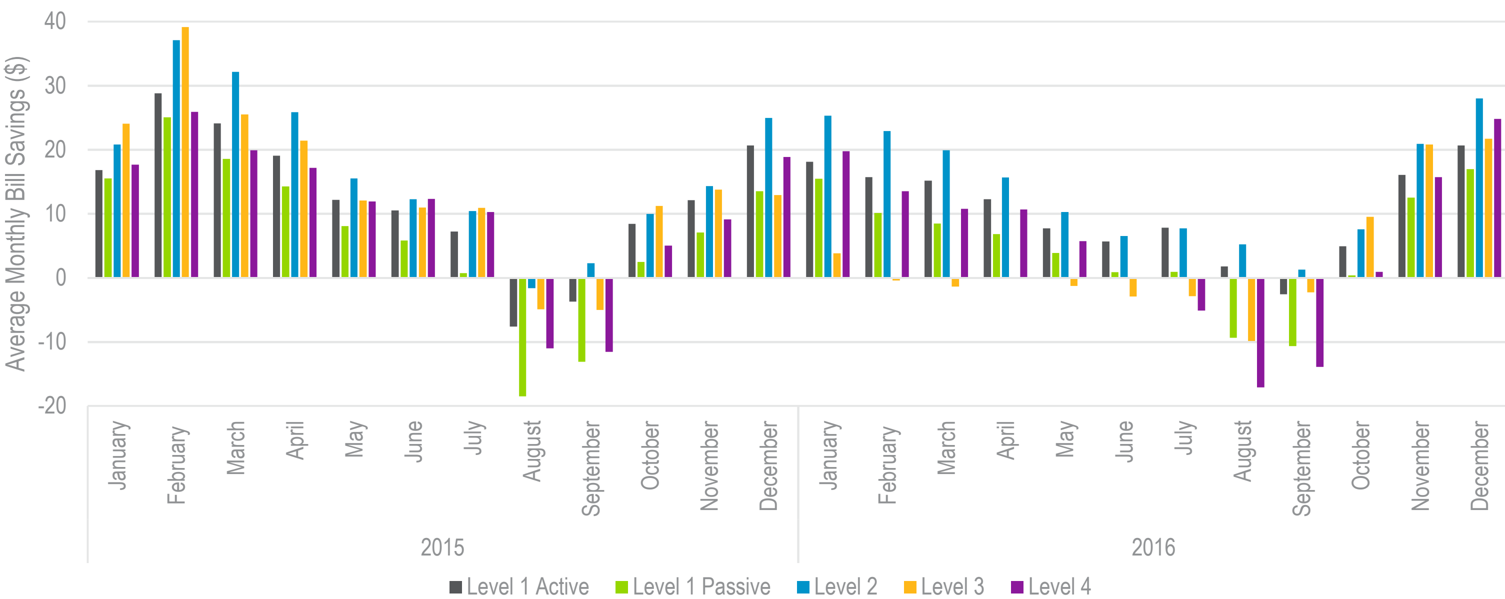
	2015		2016	
	With 135 Peak Event Hours	With 175 Peak Event Hours	With 139 Peak Event Hours	With 175 Peak Event Hours
CPP	$146	$142	$90	$87
PTR	$20	$26	$19	$25

Source: Navigant analysis

3.3.1 CPP Customers

Figure 3-15 shows the average bill savings by month and year for CPP customers. The month of each bill is defined as the last day of the billing period. This means that on average bills in each month contain an equal number of days in the current month and the previous month, for example bills in May reflect usage in the second half of April and the first half of May. On average across technologies, bill savings were highest in February 2015, which reflects January and February 2015 usage, when customers were still adjusting to the new TOU rate. Customers' bills went up in August and September of each year, reflecting usage in July, August, and September, which is expected since July and August were when the majority of the Peak Events were called in each year. Savings followed a similar pattern in both years, peaking in winter (through December, January, and February) and bottoming out during the summer months with Peak Events.

Figure 3-15. Average Bill Savings for CPP Customers



Source: Navigant analysis

Average per-customer bill savings are shown by year in Table 3-8. Savings were lower for each group in 2016 than in 2015. This occurred partially because the difference between the Basic Rate and the CPP rates fell in 2016 compared to 2015. In the summer of 2015 the CPP peak period rate was 0.40¢ less than the Basic Rate and the off-peak rate was 1.94¢ less, whereas in the summer of 2016 the peak period rate was 0.34¢ less than the Basic Rate and the off-peak rate was 1.66¢ less. The price during Peak Events fell from 34.29¢ more than the Basic Rate in 2015 to 29.33¢ more in 2016.

Table 3-8. Bill Savings for CPP Customers by Technology Group

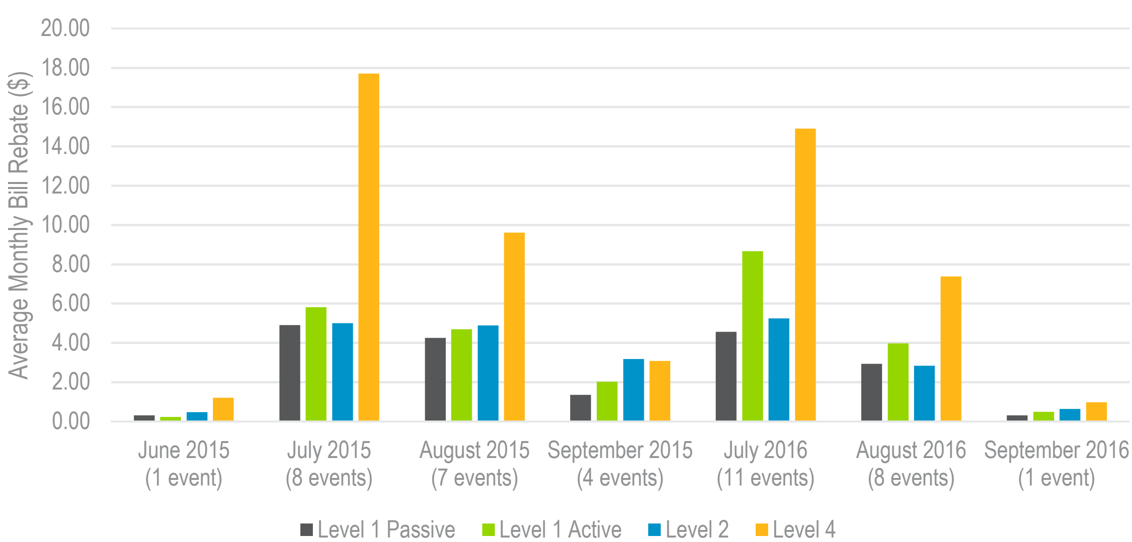
	2015	2016
Level 1 Passive	$79	$56
Level 1 Active	$148	$123
Level 2	$204	$171
Level 3	$172	$35
Level 4	$125	$66

Source: Navigant analysis

3.3.2 PTR Customers

The bill savings for PTR customers came from the monthly rebates earned during Peak Events.[87] Figure 3-16 shows the average bill rebates by month and year for PTR customers. The average total rebate for events called during the summer of 2015 was $10.80 and the average for 2016 was lower at $7.80. Table 3-9 shows the average savings per event in each year.

Figure 3-16. Average Bill Rebates for PTR Customers



Source: Navigant analysis

[87] Energy savings were neither expected nor found for PTR customers and thus changes in usage outside of Peak Events do not enter into our calculations of bill savings.

Table 3-9. Rebate Paid per Event for PTR Customers by Technology Group

	2015	2016
Level 1 Passive	$0.54	$0.39
Level 1 Active	$0.64	$0.66
Level 2	$0.68	$0.44
Level 4	$1.58	$1.16

Source: Navigant analysis

3.3.3 Arrearage Analysis

As a complement to the bill savings analysis, the evaluation team calculated credit and collection results for Pilot participants and other customers in Worcester. Comparisons between the two groups included the following metrics:

- End of Pilot arrears balances and customer counts for 30/60/90+ day periods;
- End of Pilot arrears balances and customer counts for accounts flagged as medical or life support, and therefore not subject to disconnections;
- Disconnection service history before and during the Pilot; and,
- Uncollectible account history before and during the Pilot.

Navigant found that the Pilot did not have a large impact on any of these four metrics. Overall compared to Worcester customers not in the Pilot, a smaller portion of the Pilot participants had disconnections or uncollectible balances. However, this was true in 2014, before the Pilot began, as well as during the Pilot in 2015 and 2016. A similar percentage of customers within and outside of the Pilot had arrears balances. The average dollar amounts per customer with arrears, disconnects, or uncollectible balances were also similar for Pilot and non-Pilot customers. Tables showing analysis of each of these metrics are presented in APPENDIX B.

3.4 Load Shifting

The regressions from which Navigant estimated Peak Event impacts, which covered June to September of each year, also included coefficients to estimate three types of load shifting:

1. **Load shifting around Peak Events,** including pre-cooling, wherein customers change their energy usage before a Peak Event, and snapback, wherein customers change their energy usage after a Peak Event. In 2015, evidence of pre-cooling in the Pilot was not found and thus pre-cooling was left out of the final regression specification. However, some customers did report using pre-cooling as a strategy to save energy in the surveys, especially in 2016 (see Figure 4-17).
2. **Load-shifting from weekdays to weekends**.
3. **Non-event peak impacts,** in which customers shift usage on weekdays that are not Conservation Days from peak to off-peak hours.

Snapback was estimated for each Peak Event while the other two types of load shifting ware estimated on average for each summer.

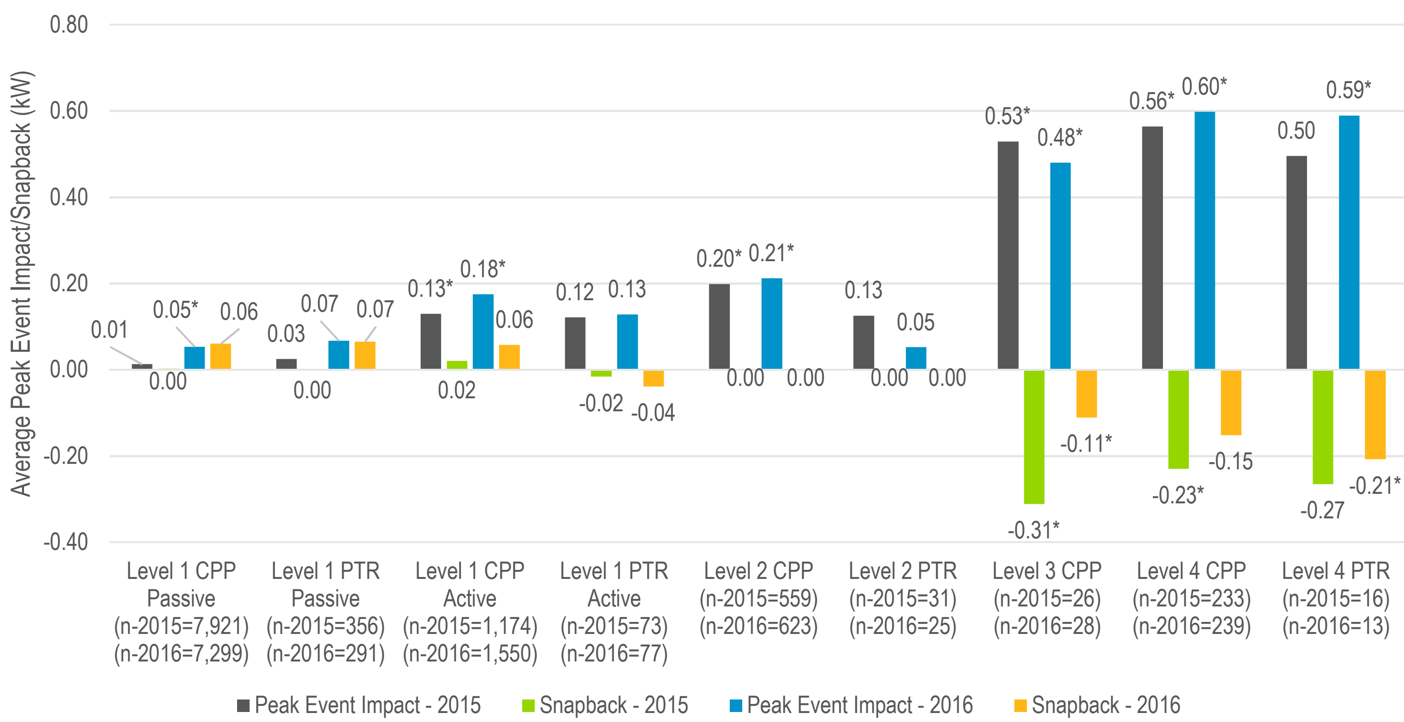
CPP customers were expected to exhibit all three types of load shifting as they were on a TOU rate and thus had an incentive to be price-conscious and shift usage to lower-cost times of the day and week, i.e. off-peak hours and weekends. Load shifting contributed to bill savings for CPP customers. PTR customers may exhibit load shifting around Peak Events as they could earn money back if they reduce usage during Peak Events hours, but they did not have a strong incentive to shift loads from weekdays to weekends or from peak to off-peak hours on days that were not Conservation Days as they were not charged a TOU rate. Overall, Navigant found that each type of load shifting was: (1) small compared to the Peak Event impact, (2) mostly larger for CPP than PTR customers as expected, and (3) mostly larger for customers with higher levels of technology.

Statistically significant load shifting effects were not found for commercial customers in any of the three categories, thus the following subsections focus on residential customer impacts.

3.4.1 Snapback

Figure 3-17 shows the average Peak Event impact and snapback for each residential technology/price group. The overall result is that for this Pilot snapback was not very prominent.

Figure 3-17. Snapback Compared to Peak Event Impacts



Source: Navigant analysis

Note: Negative values for snapback in this graph indicate an increase in usage in the hours after peak events. An asterisk (*) indicates that the majority of the event or snapback hours throughout the summer were statistically significant for the indicated group. Also, n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group.

For Level 1 and 2 customers in both price groups there was hardly any snapback in either year. In fact, for Level 2 customers in both price groups there was no snapback found for any of the Peak Events. For Level 1 customers, Navigant actually found that customers continued to save electricity even after the Peak Event had ended. This may be evidence that these customers, who have no enabling technologies, were making changes during events that they did not stop immediately at the end of the event. This phenomenon can be seen in the graphs provided in Appendix F.

Snapback was more prominent for Level 3 and Level 4 customers. For these groups, snapback was slightly lower in 2016 than in 2015 which could be due to increased awareness of and familiarity with the Pilot in the second year. The disparity in snapback across the different technology levels was almost certainly driven by PCTs which Level 3 and 4 customers had, but Level 1 and 2 customers did not. The smart thermostats were adjusted remotely by National Grid during Peak Event hours and then returned to the user-defined temperature once the Peak Event ended. The snapback observed for customers with these thermostats was likely from the HVAC system working hard to cool the home after running less than usual during Peak Event hours.

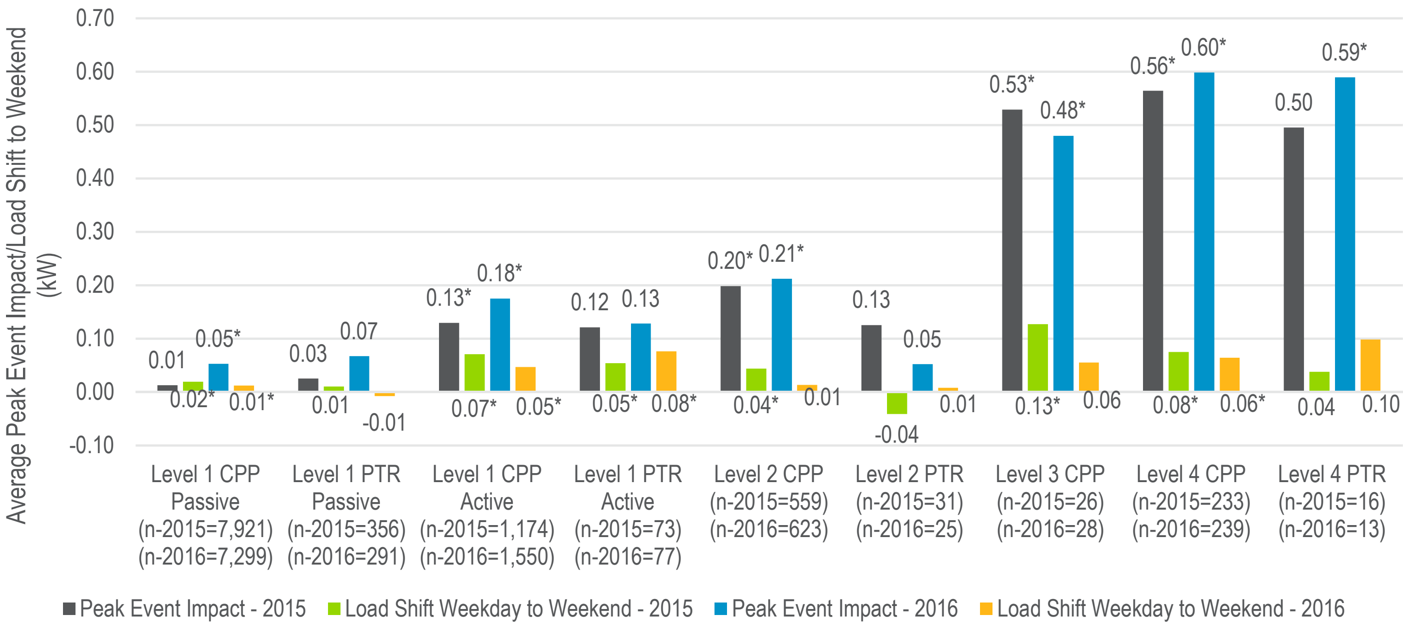
Even for Level 3 and 4 customers where significant snapback was observed it was relatively small in magnitude and short in length. On average for Level 3 and 4 customers, the snapback was about half the magnitude of the Peak Event impact. Additionally, snapback generally lasted less than two hours, which is fairly short, especially given the long length of the Peak Events. Tables with snapback for each Peak Event are provided in APPENDIX B.

3.4.2 Weekday to Weekend Load Shifting

CPP customers had an incentive to shift their usage from weekdays to weekends in order to avoid paying the higher peak time rate that ran from 8 a.m. to 8 p.m. on weekdays. PTR customers may have had an incentive to shift usage to weekends when Peak Events were being run during the week, but the incentive was much smaller as they were not charged the TOU rate. Additionally, the Pilot may have caused them to form habits which involved shifting their energy intensive activities to times when Peak Events would definitely not be called.

Figure 3-18 shows the average Peak Event impact and the average shift of usage from weekdays to weekends for each residential technology/price group in each summer (June to September) of the Pilot. For CPP customers some load shifting to weekends was observed for each technology level. The magnitude of the shifting was relatively similar across the two years of the Pilot. PTR customers did not exhibit a statistically significant load shift at any technology level. The disparity in weekday to weekend load shifting between the two rates is not surprising given the different incentives for customers on each rate discussed in the previous paragraph.

Figure 3-18. Weekday to Weekend Load Shifting Compared to Peak Event Impacts



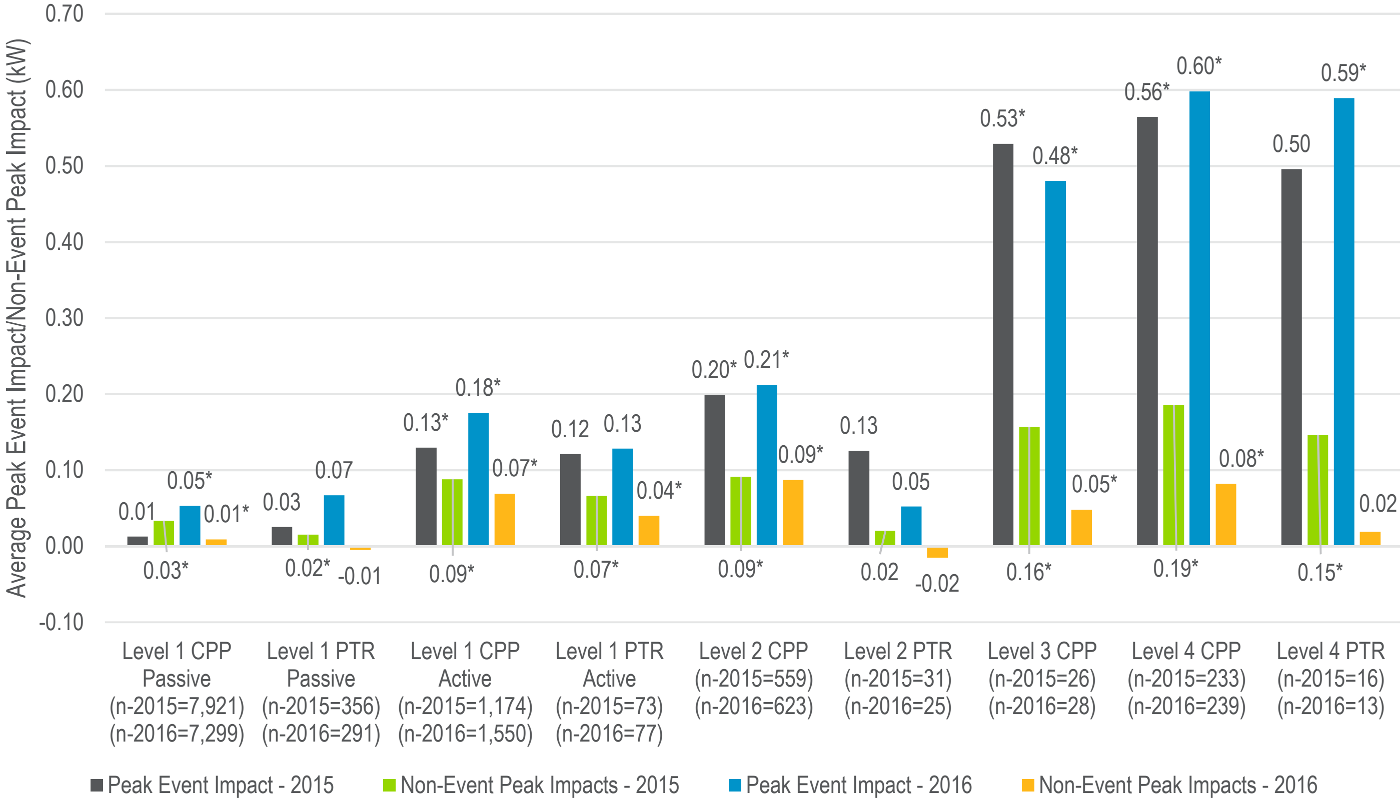
Source: Navigant analysis
Note: Positive numbers for load shift in this graph indicate a decrease in weekday usage and an increase in weekend usage. An asterisk (*) indicates that the majority of the hours throughout the summer were statistically significant for the indicated group. Also, n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group.

3.4.3 Non-Event Peak Impacts

CPP customers had an incentive to shift their usage from peak hours to off-peak hours, even in the absence of a Conservation Day, since electricity was cheaper for them during off-peak (8 pm to 8 am) hours. PTR customers had no monetary incentive to shift usage to off-peak hours on days that were not Conservation Days, but the Pilot may have caused them to form habits which involved shifting their energy intensive activities to times when Peak Events would definitely not be called.

Figure 3-19 shows the average Peak Event impacts and the average non-event peak impacts for each residential technology/price group for each year. For CPP customers there were non-event peak impacts at each technology level in both years, although they were generally smaller in 2016 than in 2015. Level 4 customers on the PTR rate showed non-event peak impacts of practical significance in 2015, but the effect dissipated in 2016.

Figure 3-19. Non-Event Peak Impacts Compared to Peak Event Impacts



Source: Navigant analysis
Note: Positive numbers for non-event peak impacts indicate savings during peak hours that were not also Peak Events. An asterisk (*) indicates that the majority of the event hours throughout the summer were statistically significant for the indicated group. Also, n refers to the number of customers used in this particular analysis, not the total number of customers in each technology/price group.

For CPP customers the non-event peak impacts were almost always smaller than the Peak Event impacts. In particular, for the three groups with PCTs the magnitude of the non-event peak impacts was small compared to the Peak Event impacts; the non-event peak impacts for these groups were always less than one-third of the Peak Event impacts.

4. CUSTOMER EXPERIENCE ASSESSMENT

National Grid based its Smart Energy Solutions evaluation plan for customer experience on the *Common Evaluation Framework's* research questions. The customer experience evaluation focused on these key areas:

- How well did customers understand the Pilot's purpose and its impact on their electric use and bills?
- How did customers interact with the technologies? Were the technologies informative? Did they lead to taking conserving and efficiency actions?
- How well did customers understand the rate choices and 12-month bill protection?
- Why did customers stay in or opt out of the program? What were the critical factors in those decisions?
- What age, income, or other demographic characteristics were important to understanding customer reaction to and participation in the Pilot?[88]

In order to assess customer experience, Navigant relied upon a combination of customer surveys, interviews, and focus groups, as noted in Section 1.2. Although entry into the program was on an opt-out basis, Smart Energy Solutions actually contained a number of opt-out and opt-in decision/action points, as described in Section 1.2.2. Thus, marketing, education, satisfaction, and lessons learned were assessed for each program aspect. APPENDIX C contains a detailed discussion of each customer experience evaluation activity.

4.1 Participation Drivers

Before and throughout the Pilot, National Grid provided information to customers in the Pilot area that emphasized the pricing and no-cost technology options available to them.

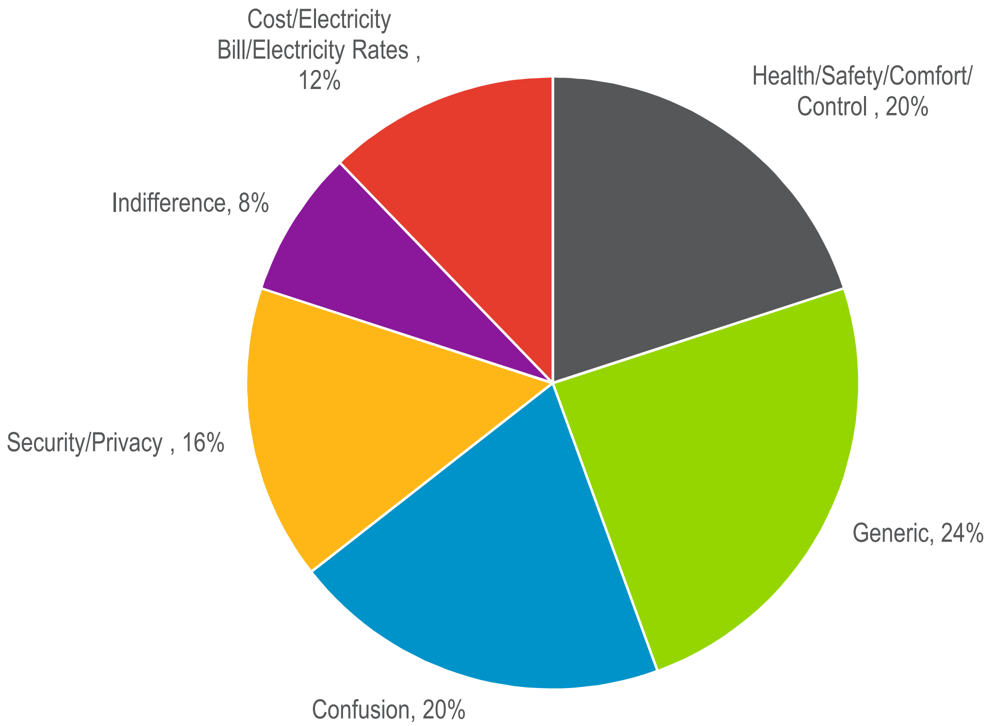
4.1.1 Most Customers Accepted the AMI Meter

The first customer decision point occurred when National Grid installed smart meters. While customers had the option to decline the meter, 95% of meters were installed; only about 5% of the eligible 15,000 customers in the Pilot program area declined the meter. According to the meter opt-out survey, most of the customers who declined the meter appeared to do so because they had no interest in participating in the Pilot. Customers who declined the smart meter expressed a variety of reasons, primarily confusion, indifference, health and safety issues, concerns about electricity costs, and data security and privacy concerns, as shown in Figure 4-1. Twenty-two customers provided "generic" reasons for declining the meter, which were divided between 13 saying they "don't think I will benefit from this" and 9 simply saying

[88] Navigant identified low-income customers using the R2 rate. Many of the surveys also collected self-reported data to capture customers whose income was at or below 200% of the federal poverty levels and 60% of the area median income. In 2015, Navigant found that the survey results did not vary based on which definition of low income was used; therefore, the R2 rate definition was used in the analyses throughout this report.

"I don't want this."

Figure 4-1. Categorical Reasons for Declining a Meter

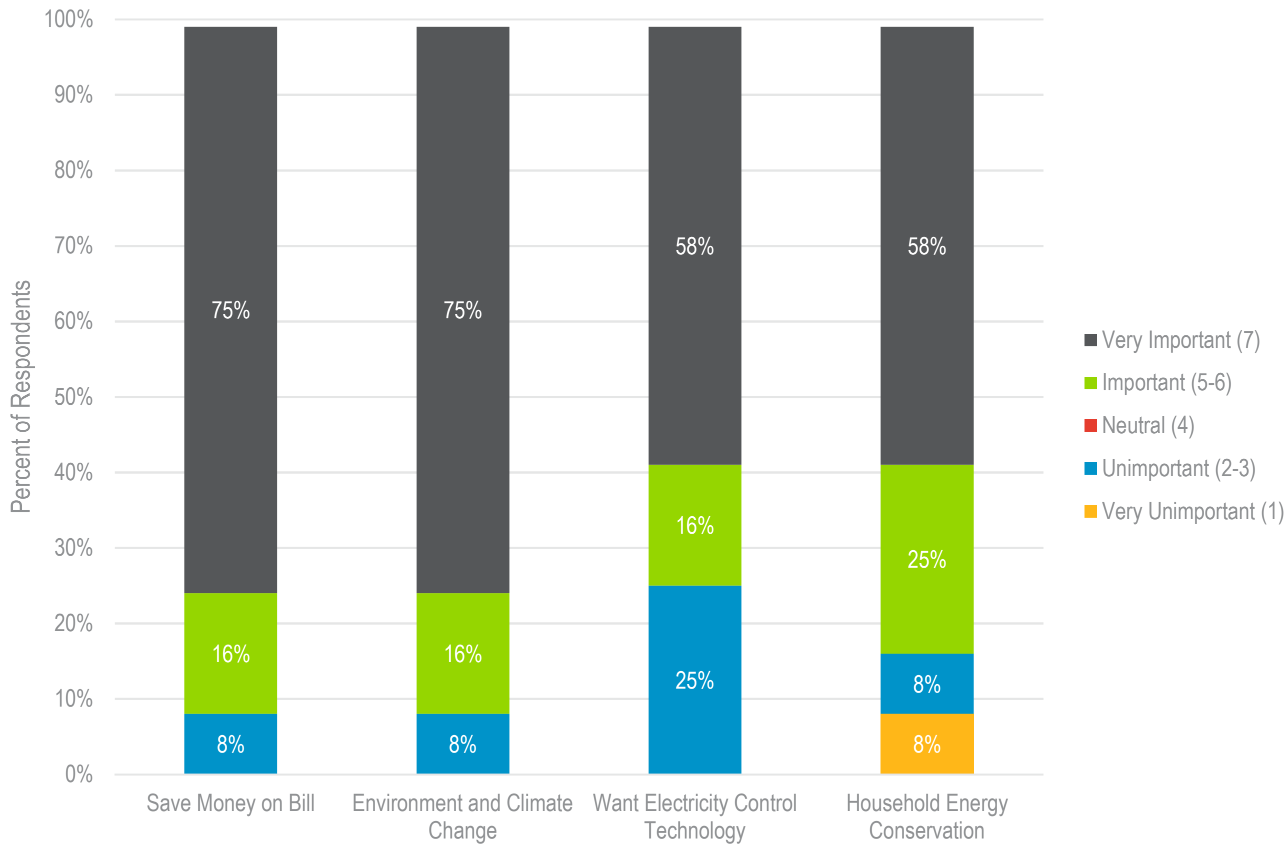


Source: Navigant analysis of meter decline survey (N=70)

4.1.2 Motives for Pilot Participation

In the pre-pilot survey, customers were asked to rate the importance of the following motives to participate in the Pilot: saving money on their electricity bills, the environment and climate change, receiving control technologies, and household energy conservation. As summarized in Figure 4-2, participants most often rated saving money on their electricity bill and protecting the environment as "very important" reasons for participating in the Pilot (75% for both motivations).

Figure 4-2. Customer Motivations for Pilot Participation, as Expressed in the Pre-Pilot Survey

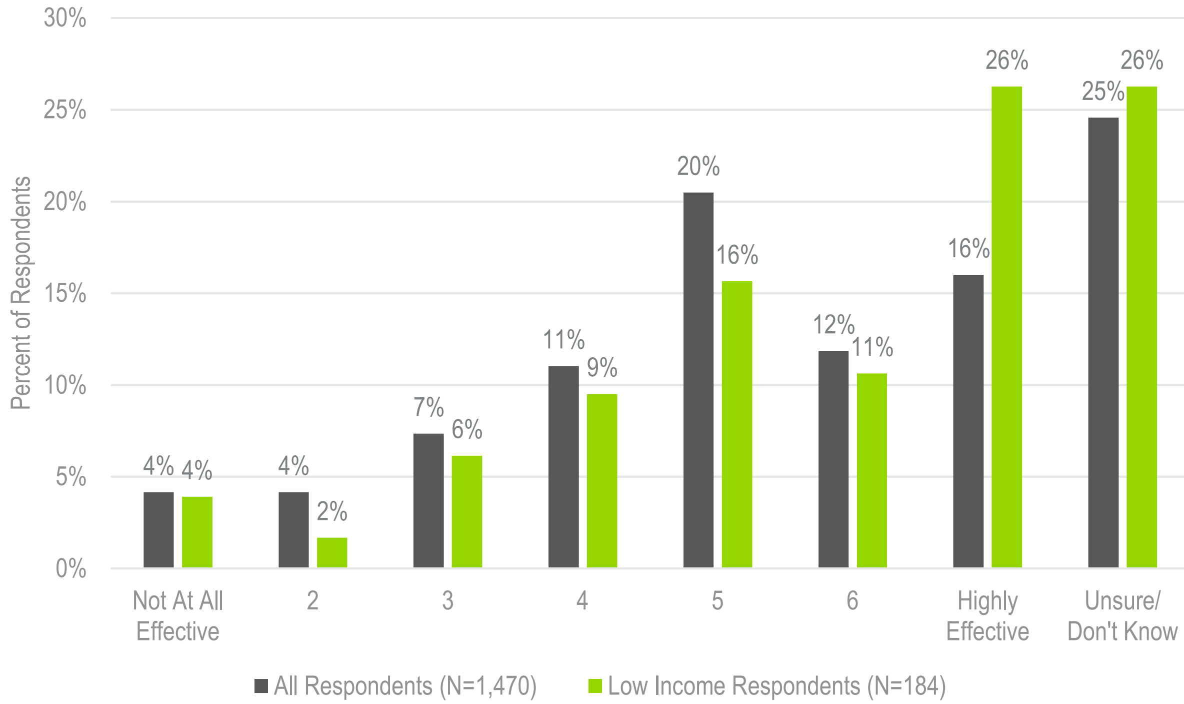


Source: Navigant analysis of pre-pilot survey (N=1,478)
Note: No survey participants provided a neutral response.

4.1.3 Low-Income Customers' Perceived Ability to Adjust Electricity Usage was High

There was concern, before the Pilot started, that low-income participants would not be able to shift their usage to take advantage of lower rates in non-peak hours. However, when asked about their expectations, more of these participants expected that they would be "highly effective" at shifting usage than other participants did (Figure 4-3).

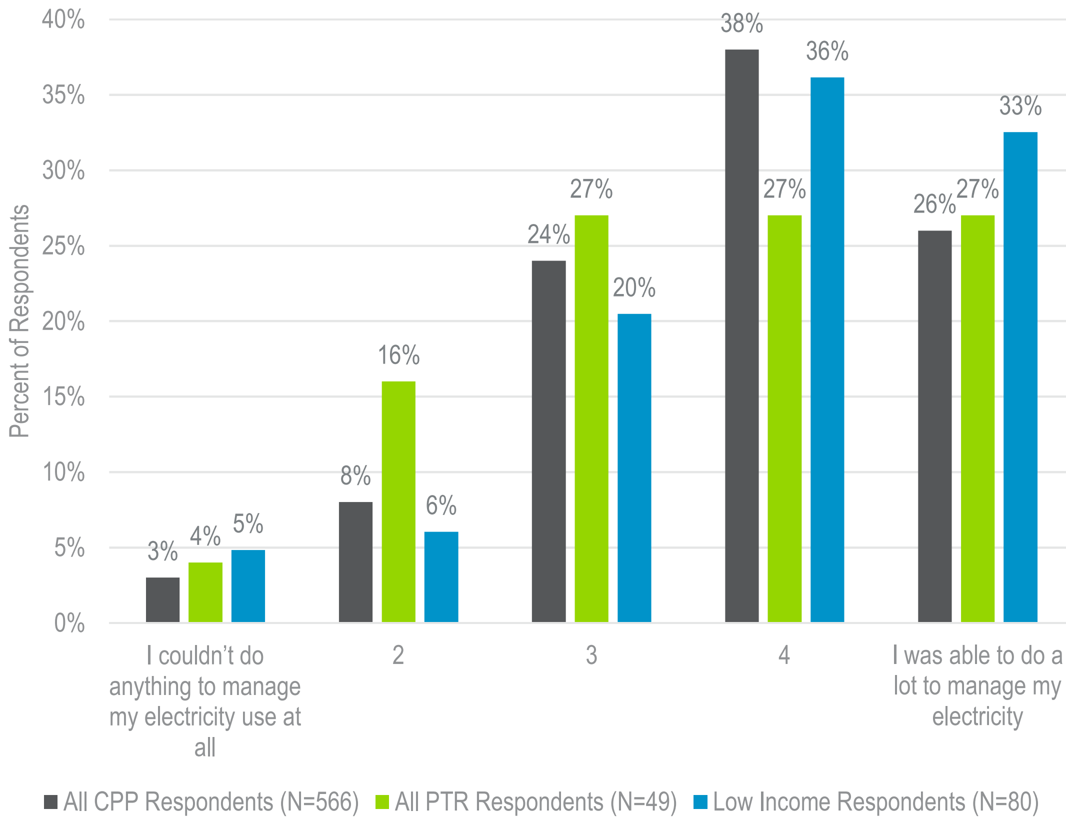
Figure 4-3. Pre-Pilot Perceived Ability of Low-Income Participants to Adjust Energy Usage



Source: Navigant analysis of pre-pilot survey (N=1,470)

As shown in Figure 4-4, when surveyed at the end of the Pilot, low-income customers again rated their ability to manage their electricity higher than all respondents on either the CPP or PTR price plan. However, within the focus groups (as discussed further in Section 4.2.7) low-income customers sometimes indicated taking extreme actions to save energy during events, such as shutting off their room AC entirely, and said that their actual options for controlling electricity use during events were often quite limited. Overall, PTR respondents rated their ability to manage their electricity usage slightly lower than CPP respondents, which makes sense as customers with a low ability to manage electricity would be more likely to switch to the PTR rate to avoid the high Peak Event rate on the CPP plan.

Figure 4-4. Reported Ability of Low-Income Customers to Manage Electricity Use at End of Pilot



Source: Navigant analysis of end of pilot survey (N=615)

4.2 Participant Awareness, Engagement, Satisfaction

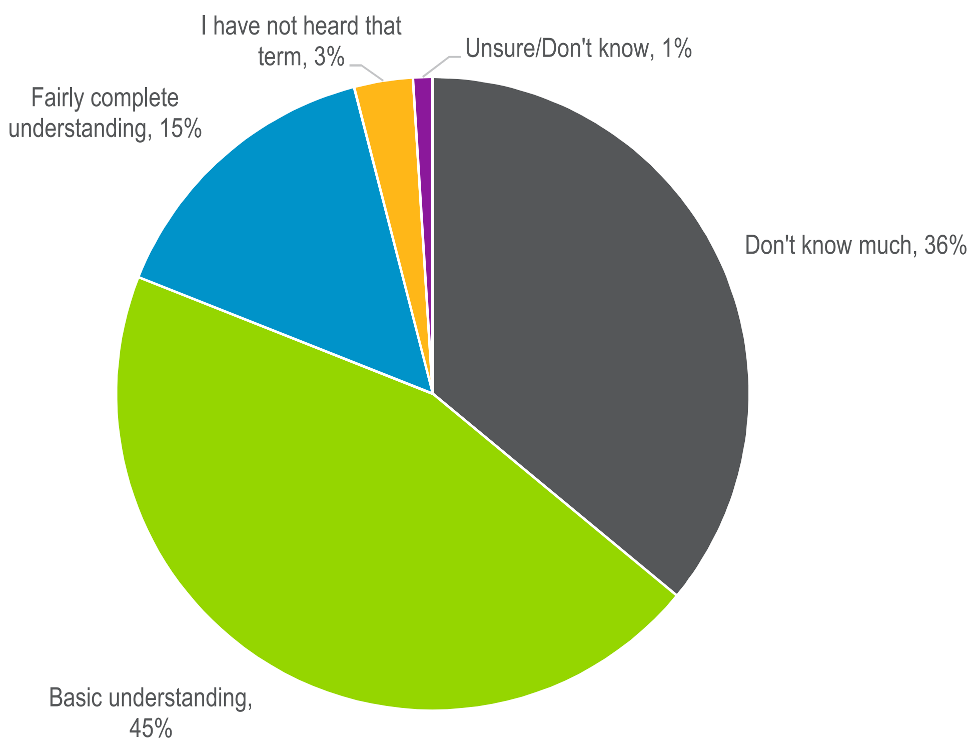
National Grid provided extensive information to customers about the program, rates, technologies, and bill protection before and during the Pilot, as shown in Chapter 2. During the pre-pilot survey, customers expressed motivation to save money and confidence that they could shift their electricity usage. In the surveys of all residential customers and focus groups with low-income customers conducted throughout the Pilot, many customers in all demographic segments indicated a desire for more information about the rates and technologies, personalized conservation tips, additional means of communication about the events, and more insights into savings. After the first summer, National Grid adapted the Pilot based on feedback from customers; for example, National Grid expanded and highlighted the options to personalize event notifications in 2016 compared to 2015 based on customer complaints about the timing and channel of the notifications. The Company also continued to send regular mailings and emails throughout the Pilot to keep customers informed and motivated.

4.2.1 Rate Awareness and Understanding Increased over Time

Participant knowledge and understanding of the program rates was an important aspect of the Pilot. National Grid offered both CPP and PTR options to customers in order to provide flexibility in the program. At face value, customers might prefer the PTR rate over the CPP rate as the CPP rate charges customers a higher rate during Peak Events. The utility industry typically perceives that the advantage of PTR over CPP for customers is that it provides a rebate due to conservation during Peak Events but does not increase the rate, such that a customer's bill decreases in the short run.[89] However, due to National Grid's CPP rate design, which charged a lower rate than the Basic Rate for at least 335 days (the utility could hold up to 30 Peak Events per year), if customers shifted their usage they would most likely save more money annually on the CPP rate than on the PTR rate. Additionally, customers on the CPP rate were offered bill protection in which they were given a credit at the end of the year if their expenditures exceeded what they would have spent if they had been on the Basic Rate, thus mitigating the risk of the CPP rate. Most customers remained on CPP and did not actively elect either plan. The majority of National Grid customers who contacted the utility to select a rate chose the CPP rate over the PTR rate.

In the initial pre-pilot survey conducted in 2014, 8% of customers said that they had heard of the CPP rate. Of the customers who had heard of the rate, 15% of them "ha[d] a fairly complete understanding of what it means" and 46% "ha[d] a basic understanding of what it means", as shown in Figure 4-5. A few customers may have been confused about the rate, as 3% of these customers said they had never heard of the new rate, when asked how well they understood it.

Figure 4-5. Customer Pre-Pilot Knowledge of the CPP Rate



Source: Navigant analysis of pre-pilot survey (N=118)

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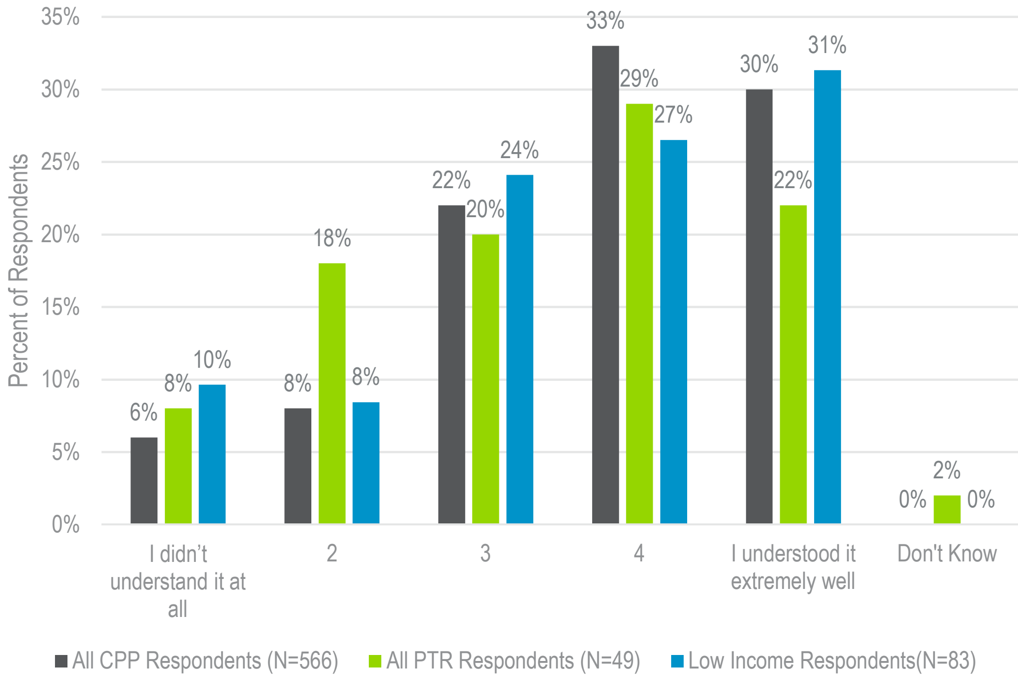
[89] The Regulatory Assistance Project. *Time-Varying and Dynamic Rate Design.* July 2012.

By the time the end of pilot survey was administered (October 2016), almost all customers (97%) were aware of the Pilot and the rate they were on. Additionally, the majority of customers on both price plans, including those with low incomes, indicated that they had a good understanding of their pricing plan (rating their understanding as a 4 or 5 on a 5-point scale), as shown in Figure 4-6.

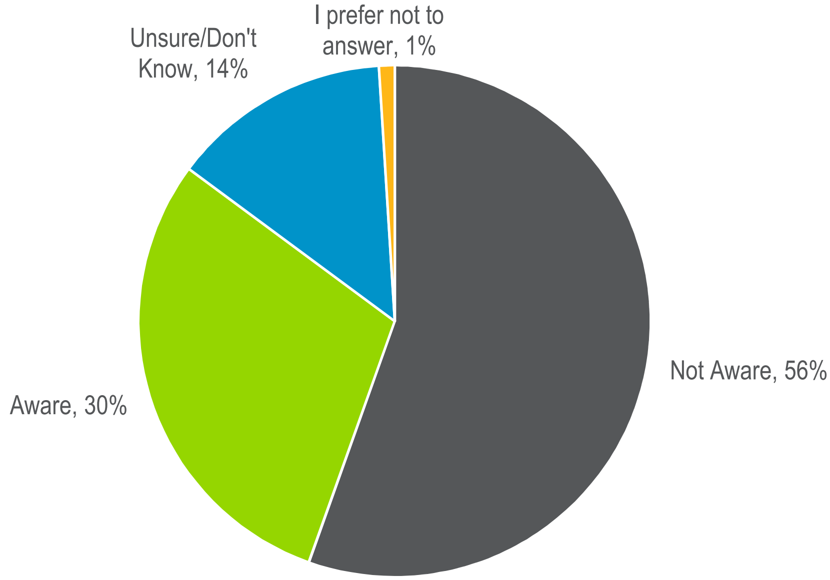
Figure 4-6. Customer Understanding of the Pilot Pricing Plan



Source: Navigant analysis of 2016 end of pilot survey (N=615)

Although customers understood the rate that they were on, most (56%) were not aware they had the option to switch pricing plans (see Figure 4-7). This lack of awareness may have contributed to the higher than expected retention of customers on the Pilot's default CPP rate. The lack of awareness occurred despite the fact that National Grid provided a lot of information about both rates, starting with an official welcome kit. National Grid provided examples of participant bills to customers to illustrate the differences between the two rates. The Company continued to provide information to explain that there were many variables determining the impact of use on cost, particularly during Peak Events, throughout the Pilot.

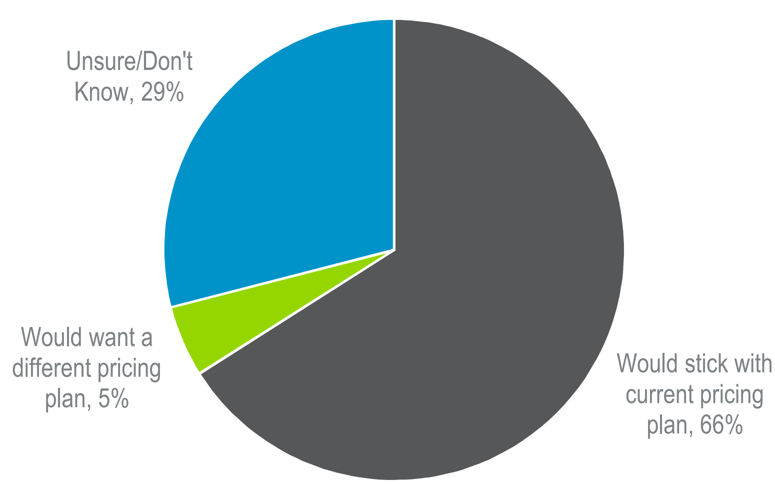
Figure 4-7. Customer Awareness of Ability to Switch Pricing Plans



Source: Navigant analysis of 2016 end of pilot survey (N=615)

Despite not realizing that they could switch price plans, most customers (66%) indicated that they would want to continue with their current price plan if they continued to be enrolled in the Pilot (Figure 4-8). Additionally, only 5% of customers said that they would want to switch to a different pricing plan. This indicates that customers were generally happy with the rate they were on and may not have been seeking options to switch, contributing to the low awareness of switching.

Figure 4-8. Customers' Interest in Continuing with Current Pricing Plan



Source: Navigant analysis of 2016 end of pilot survey (N=615)

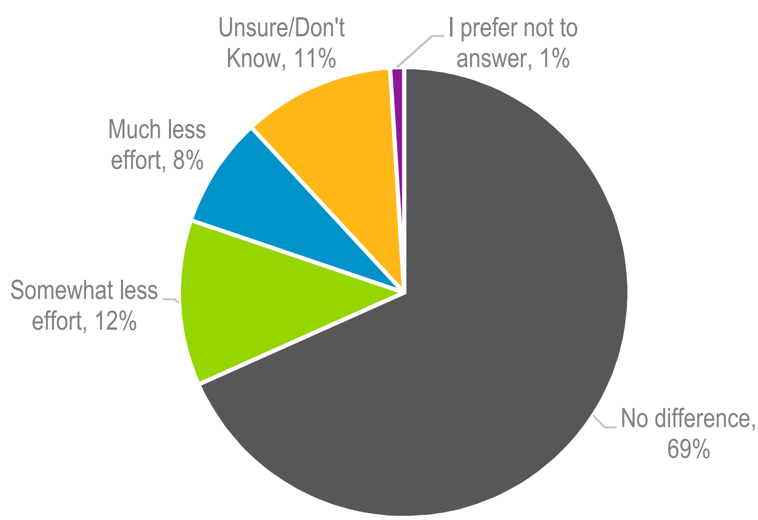
4.2.2 Customers Exhibited Mixed Awareness and Understanding of Program Features

At the end of the Pilot, customers were surveyed about their awareness and understanding of various features of the program. Survey questions focused on the bill protection available on the CPP rate, the technology packages, and the rewards platform that was added in 2016.

Bill Protection

At the end of the Pilot, almost half of the customers on the CPP rate (40%) said that they were aware of the bill protection feature. However, over two-thirds of those who knew about it said that the feature made no difference in their efforts to manage their electricity use. This means that most CPP customers likely did not reduce their energy savings behaviors because they knew they would get bill protection at the end of the year anyway. Approximately 20% of the CPP participants did say that knowing about bill protection led them to put “somewhat less” or “much less” effort into saving energy. To explore this further Navigant matched the survey results to the usage data and examined the Peak Event impacts for active customers in Level 1 CPP who said they were aware or unaware of the bill protection feature.[90] This analysis did not reveal statistically significant differences in impacts and neither group had consistently higher or lower impacts than the other, supporting the conclusion that bill protection awareness did not influence customers’ actions in the Pilot.

Figure 4-9. Effect of Bill Protection on Customers’ Efforts to Manage Electricity



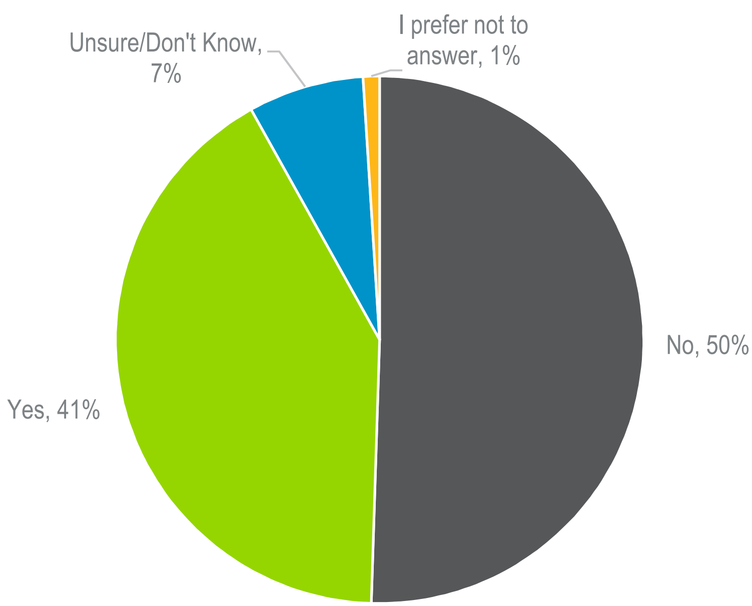
Source: Navigant analysis of 2016 end of pilot survey (N=229)

[90] We examined active customers in Level 1 CPP because this group contained the largest number of customers who answered this question. In this group, there were 71 customers who were aware of bill protection and 101 who were unaware.

Technology

Approximately 40% of the customers in Level 1, i.e., those who did not opt to receive the free Pilot technologies, were aware that the technologies were available (see Figure 4-10); the relatively low awareness occurred despite heavy promotion of the technologies. Many of those who were aware of the technology offerings chose not to opt into the technologies for reasons that indicated they did not see the benefit of the technology to them and thus expressed a lack of interest in it.[91] Additionally, several customers mentioned they could not install the technology as they were not the homeowner. This complication for renters was also reflected in the reasons reported by customers who wanted one of the technology packages but had to cancel their install (see Figure 2-10).

Figure 4-10. Customer Awareness of Free In-Home Technologies



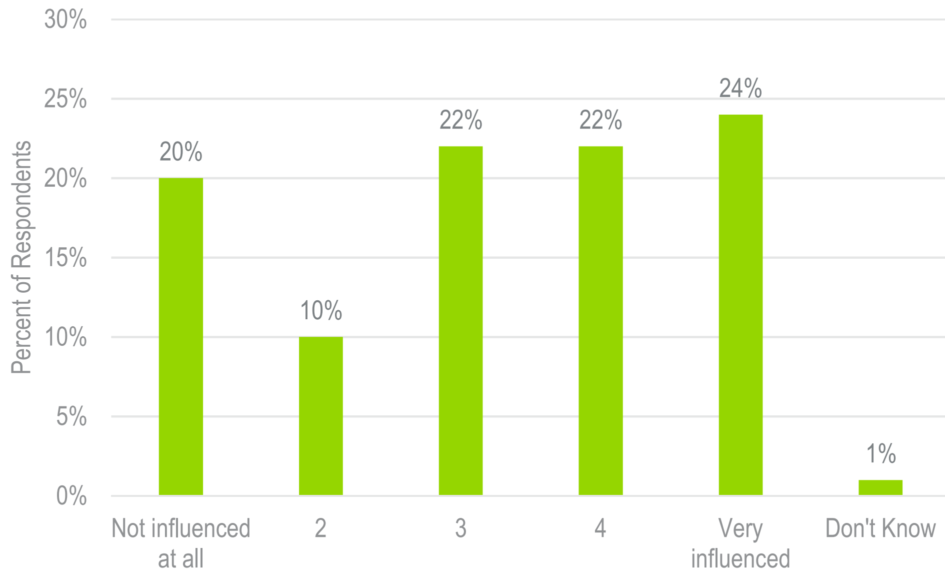
Source: Navigant analysis of 2016 end of pilot survey (N=379)

Rewards Platform

By the time of the End of Pilot survey (October 2016), 67% of customers reported awareness of the rewards platform launched in February 2016. As demonstrated in Figure 4-11, the rewards platform seemed to have varied influence on customers' efforts to save electricity. About half reported that the rewards platform had considerable influence on their efforts, while half reported little to moderate influence. There was an increase in the number of active participants in Level 1 in 2016 compared to 2015 and the increase may be partially attributable to increased traffic to the web portal because of the rewards platform. In 2016, 1,042 customers redeemed points in the rewards platform to receive 2,219 gift cards.

[91] Response options included "Too much bother", "I didn't think about it", "I wasn't sure what it would do", and "I didn't think it would help."

Figure 4-11. Reported Influence of Rewards Platform on Energy Efficient Actions



Source: Navigant analysis of 2016 end of pilot survey (N=428)

4.2.3 Rate Enrollment and Retention Rates On Par with Opt-Out Recruitment Methods

The majority of time-based rate pilots around the country are based on an opt-in recruitment model, in which customers volunteer to participate. By definition, opt-in customers are motivated to participate in a dynamic rate pilot. Customers who participate in opt-in programs tend to be enthusiastic early adopters and not likely to drop out of a program they signed up for.

Smart Energy Solutions is unusual because it is an opt-out program, which requires customers to contact the utility to opt out of the pricing program. Opt-out program design is a relatively new industry concept. Opt-out programs capture all customers, many of whom may follow “default bias”, which means that they tend towards the default offering rather than accepting alternative offerings. Industry understanding at this time is that retention rates are similar for opt-in and opt-out programs.[92]

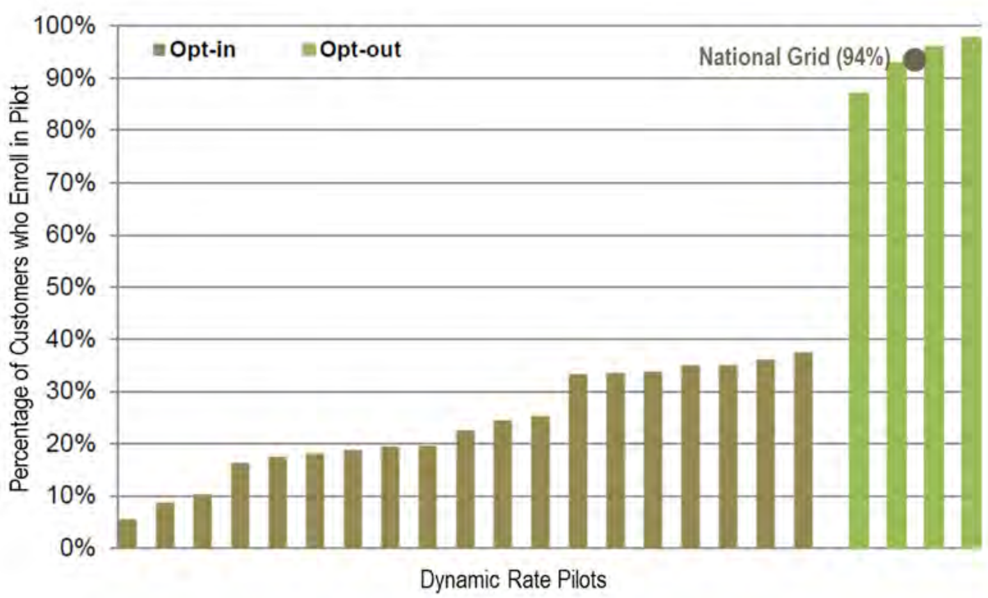
The CPP and PTR rates went live in January 2015 and had been in effect for two years at the end of 2016. As shown in Figure 4-12, National Grid’s residential enrollment rates were high compared to opt-in recruitment rates and were on par with typical opt-out recruitment rates. Customer enrollment is the percentage of customers, as of January 2015 when the Pilot rates went live, in the Pilot area who had a meter and had not yet opted out. Over time, customer retention reflects how many customers remain in the Pilot rather than dropping out.[93] As shown in Figure 4-13, National Grid’s retention rates for residential

[92] Cappers, P., H. Liesel, R. Scheer. *American Recovery and Reinvestment Act of 2009: Interim report on customer acceptance, retention, and response to time-based rates from the consumer behavior studies*. LBNL-183029. June 2015.

[93] The retention rate considers only those customers who actually dropped out of the Pilot and excludes those who moved or switched to a competitive supplier, which could have happened for any number of reasons unrelated to the Pilot.

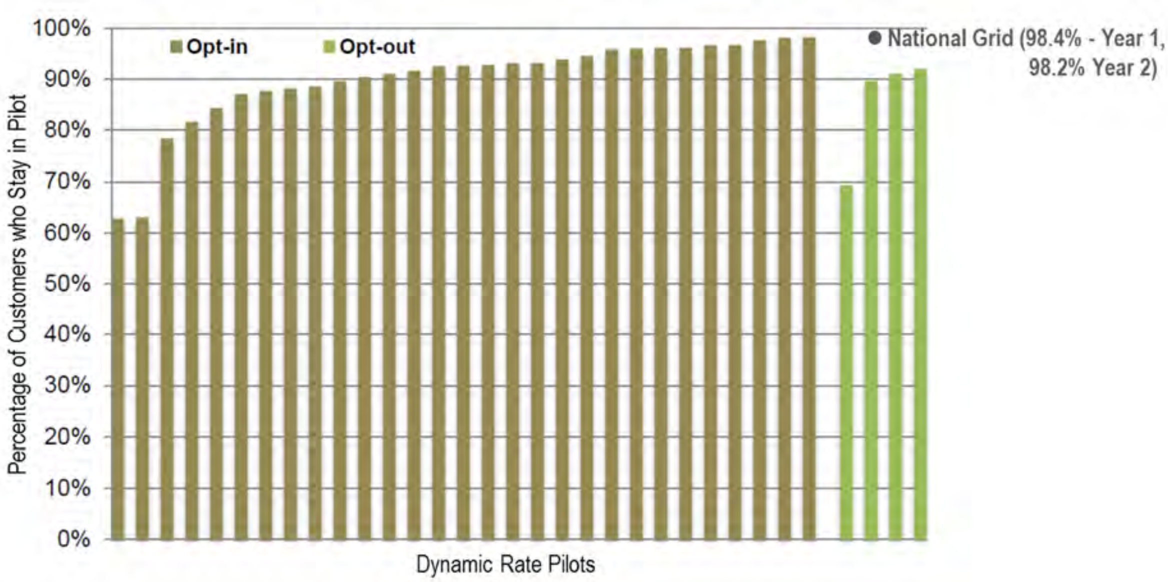
customers were higher than one-year retention rates for other opt-out rate pilot programs, even after two years of the Pilot. In fact, the Pilot had hardly any drop outs from the first year to the second year, making the first and second year retention rates virtually identical.

Figure 4-12. Customer Enrollment Rates Based on Opt-In vs. Opt-Out Recruitment



Source: Lawrence Berkeley National Laboratory and Navigant analysis
Note: Each bar represents a utility that has offered a dynamic rate to its customers.

Figure 4-13. Customer Retention Rate Based on Whether the Utility Used Opt-In or Opt-Out Recruitment

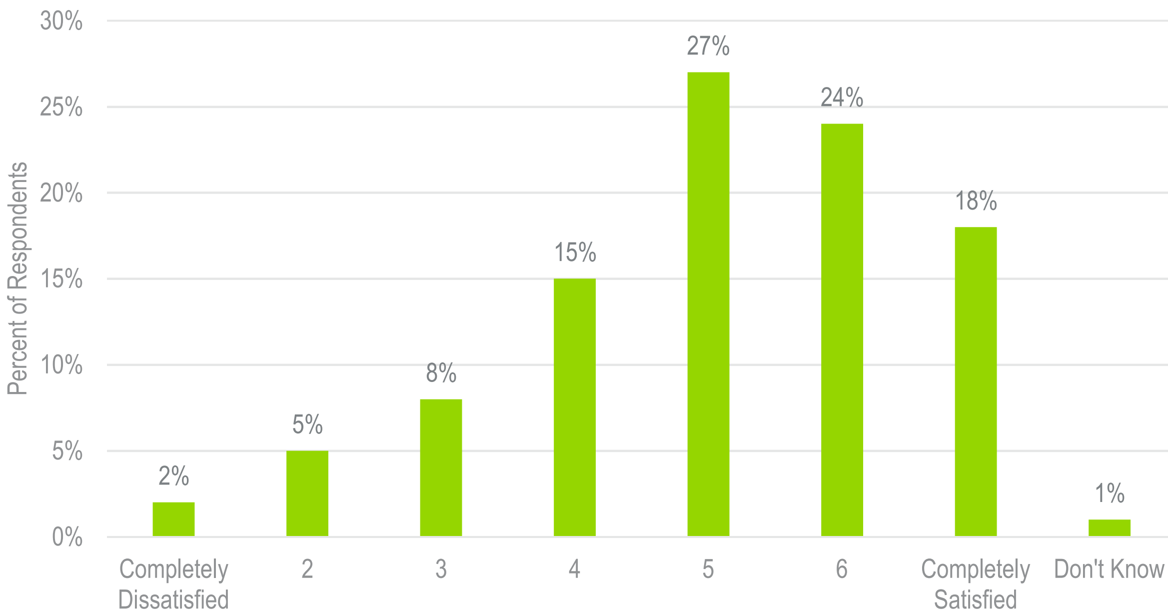


Source: Lawrence Berkeley National Laboratory and Navigant analysis
Note: Each bar represents a utility that has offered a dynamic rate to its customers.

4.2.4 Strong Customer Satisfaction with Program

At the end of the Pilot, as shown in Figure 4-14, 69% of customers indicated a strong level of satisfaction with the Pilot (rating it at least a 5 on a 7-point scale). The weighted average satisfaction rating was 5.06. This was similar to satisfaction after the first year in the Pilot when 72% of customers reported being "very satisfied" or "somewhat satisfied" with the Pilot on a 3-category scale.[94]

Figure 4-14. Participant Overall Satisfaction with Smart Energy Solutions



Source: Navigant analysis of 2016 end of pilot survey (N=615)

As described in the next several paragraphs, the Pilot's satisfaction rating was in line with the satisfaction achieved by several similar demand response pilots implemented by other utilities. In comparing satisfaction with Smart Energy Solutions to similar demand response programs, it is worth reiterating that Smart Energy Solutions is an opt-out program while the comparison programs are opt-in. Participants in opt-in programs chose to enroll and are thus expected to have a higher level of satisfaction than opt-out participants who are enrolled automatically. Satisfaction that is similar to opt-in programs in an opt-out program is commendable.

The Pilot's satisfaction rating was similar to customer feedback to NSTAR's[95] 2012-2013 pilot, undertaken in compliance with Section 85 of the GCA. NSTAR pilot customers were asked to rate the program on a 5-point scale (5 = very positive, 1=very negative, and 3 is neutral); the average rating was 4.0.[96] When translated to the 7-point Smart Energy Solutions scale, NSTAR's satisfaction would have been 5.6 out of 7, which is comparable to the 5.06 out of 7 for Smart Energy Solutions.

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[94] The scale was changed from the first to the second year of the Pilot to better align with DPU requirements.

[95] NSTAR is now called Eversource Energy.

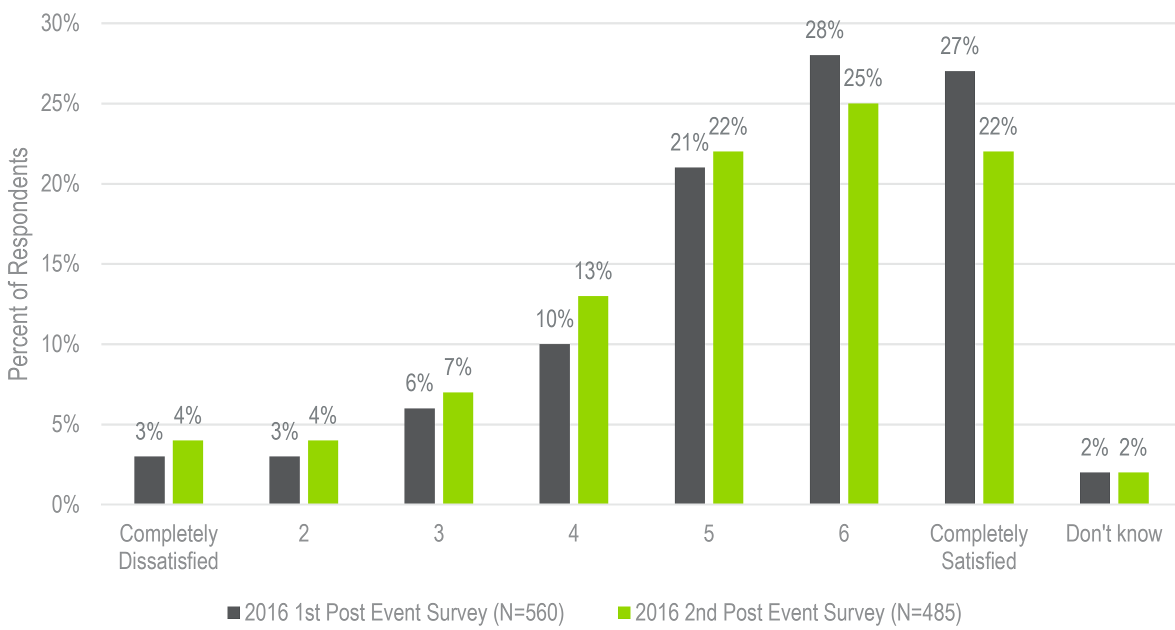
[96] Navigant. *NSTAR Smart Grid Pilot Final Technical Report: AMR Based Dynamic Pricing*. DE-OE0000292. Prepared for U.S. Department of Energy on behalf of NSTAR Gas and Electric Corporation. August 2014.

DTE conducted an opt-in pricing pilot that had a TOU/CPP price plan and included technology offerings very similar to Smart Energy Solutions'. By the end of DTE's pilot, 86% of customers rated their pilot at least a 6 on a 10-point scale.[97] Translated to the 7-point Smart Energy Solutions scale, 86% of customers rated the program at least a 4.2 out of 7 which is comparable to the 84% of Smart Energy Solutions customers that rated the Pilot at least a 4 out of 7.

MN Power held an opt-in demand response pilot that used a TOU/CPP rate but did not include technologies. The satisfaction for MN Power's program averaged 5.6 – 6.1 out of 10 across the three customer groups included.[98] When translated to a 7-point scale, the average satisfaction ranged from 3.9 – 4.3 out of 7. This is slightly lower than the average satisfaction for Level 1 customers in Smart Energy Solutions (who also had no in-home technology) at the end of the Pilot, which was 4.94 out of 7.

Satisfaction with Smart Energy Solutions was also measured in each post event survey. In 2016, the first post event survey occurred on July 7th, which was the second event in a two-day series, and the second post event survey occurred on July 28th, which was the fourth event in a four-day series. The satisfaction across these two surveys did not change significantly as shown in Figure 4-15.[99] In the first survey, 76% of customers rated the Pilot at least a 5 and in the second, 69% did the same. Since the second post event survey was done after a long series of back-to-back Peak Events, these results indicate that satisfaction did not suffer significantly due to the consecutive day Peak Events.

Figure 4-15. Participant Satisfaction with Smart Energy Solutions in 2016 Post Event Surveys



Source: Navigant analysis of 2016 post event surveys (N=560, N=485)

[97] See Cappers, P., H. Liesel, R. Scheer. 2015.

[98] Ibid.

[99] Comparisons to the 2015 post event surveys are not included because the satisfaction questions were changed from a 3 to a 7-point scale to better align with DPU requirements.

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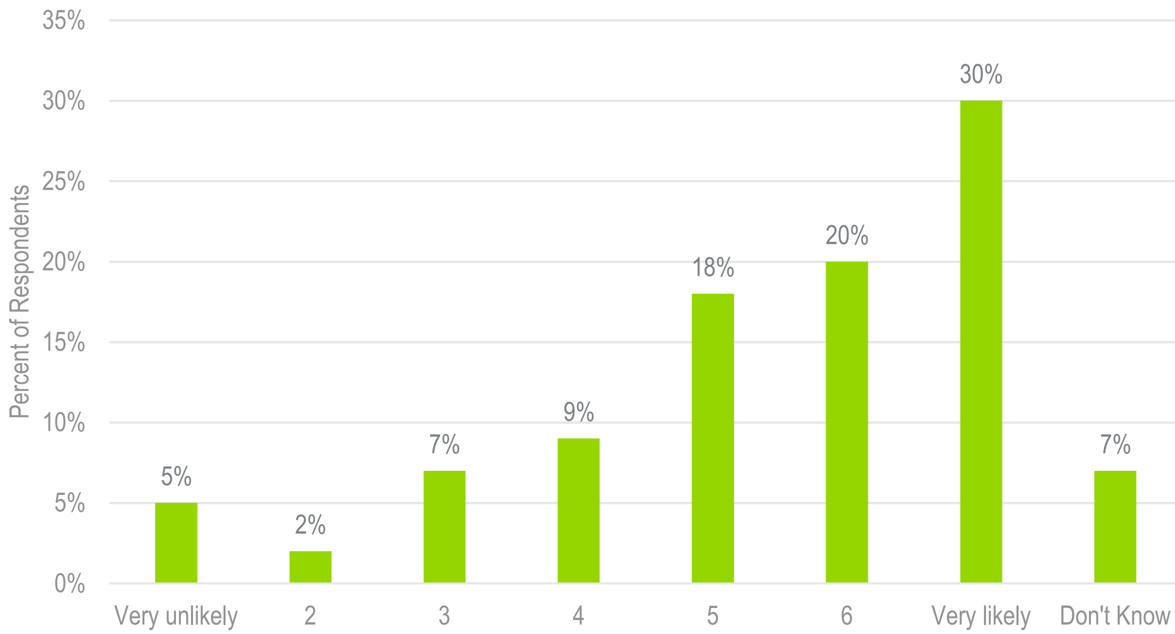
Further confirming the strong satisfaction results, over two-thirds of respondents indicated that they would like to continue with the Pilot if it were extended with the same conditions (Figure 4-16). Almost one-third of the customers (30%) indicated that their likelihood of continuing was a 7 on a 7-point scale.

Figure 4-16. Customer's Likelihood to Continue with Smart Energy Solutions

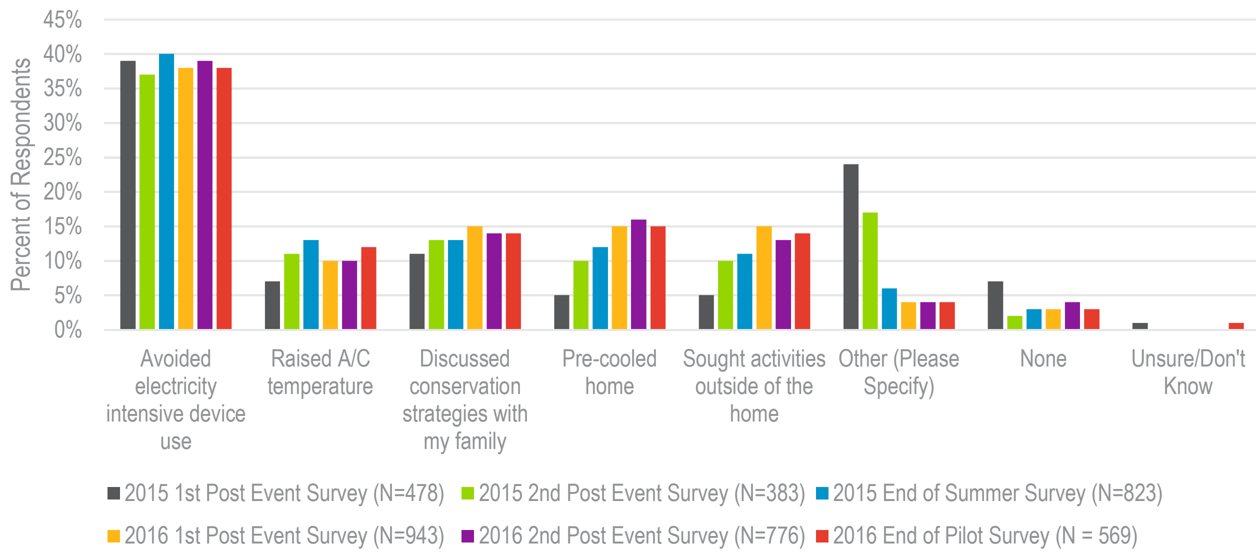


Source: Navigant analysis of 2016 end of pilot survey (N=615)

4.2.5 Customers Changed Electricity Usage and Behavior

Throughout the Pilot, as shown in Figure 4-17, many customers reported that they took actions to change their electricity usage during Peak Events. The most frequent reported action taken, across all the surveys, was to reduce the usage of electricity-intensive devices. Customers also reduced their AC usage, discussed conservation strategies with their families, pre-cooled their homes, and sought activities outside the home during Peak Events. Family discussions, pre-cooling, and leaving home all increased in frequency from the first summer of the Pilot to the second. The number of customers who took actions to reduce their electricity usage during Peak Events increased throughout the Pilot's first summer, reflecting customers' behavioral change and learning. The increased level seen at the end of 2015 was maintained through the Pilot's second summer.

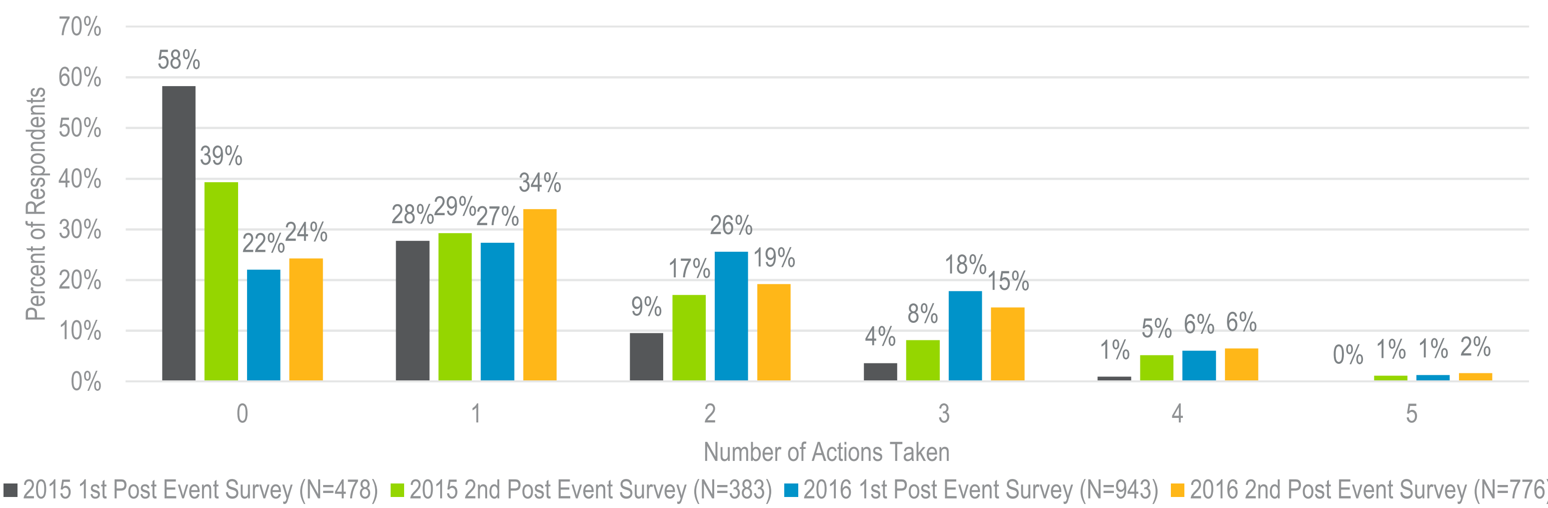
Figure 4-17. Actions Customers Took to Reduce Electricity Usage on Conservation Days



Source: Navigant analysis of post event surveys (N=527, N=270, N=943, N=776), 2015 end of summer survey (N=406), and 2016 end of pilot survey (N=569)

Navigant aggregated the number of actions customers indicated taking in the post event surveys to look at the intensity of actions across the two summers of the Pilot. The number of actions was counted from the survey, so certain actions were aggregated together. For example, "Avoided electricity intensive device use" was counted as one action, although customers may have changed their usage of several distinct devices. As shown in Figure 4-18, compared to the first summer of the Pilot, in the second summer fewer individuals took no actions to reduce their electricity usage during a Conservation Day and the average number of actions taken increased from 2.25 to 3.72.

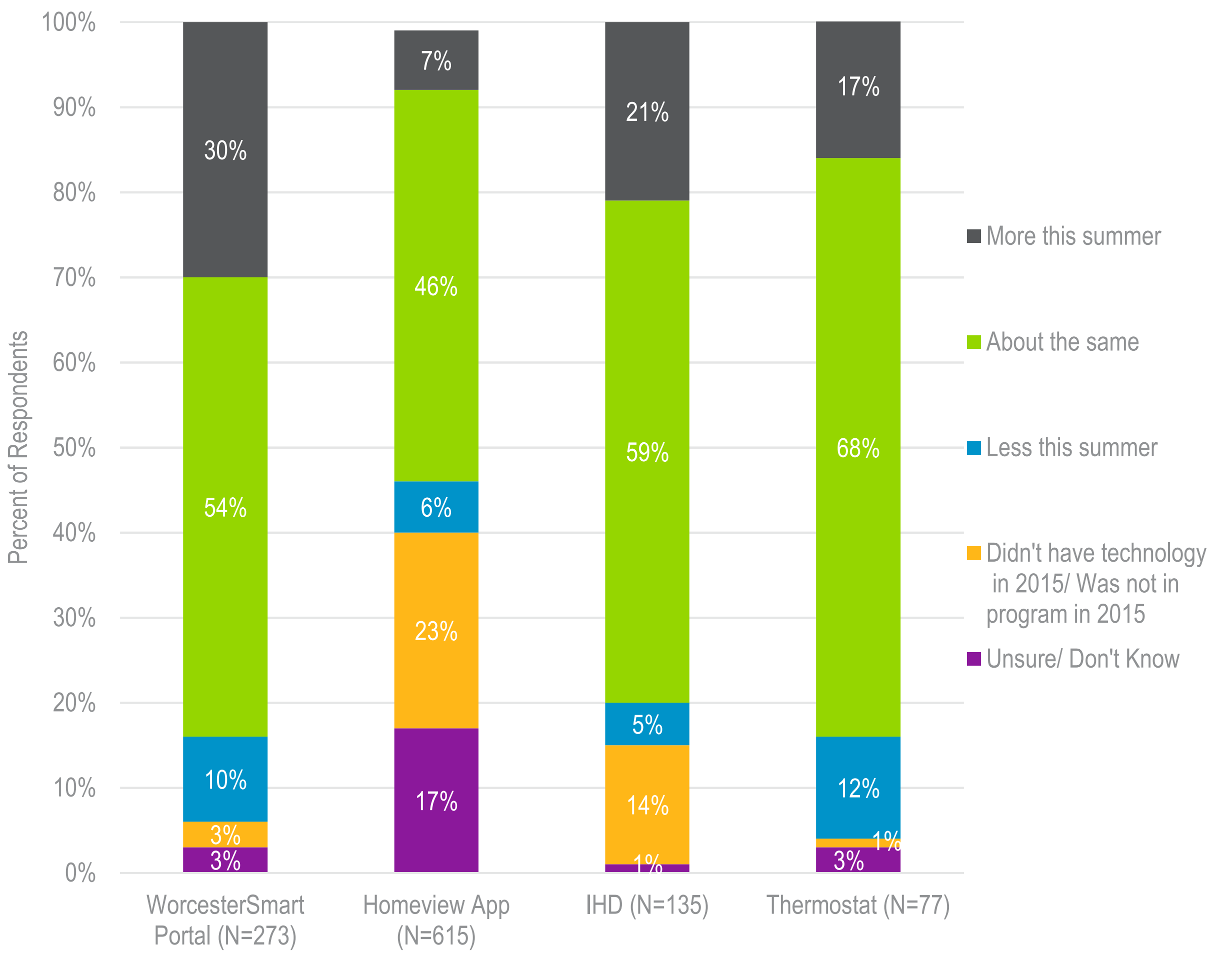
Figure 4-18. Reported Number of Actions Taken during Peak Events



Source: Navigant analysis of post event surveys (N=527, N=270, N=943, N=776)

As shown in Figure 4-19, most customers did not change the frequency with which they viewed the WorcesterSmart web portal (54%), the Homeview App (46%), their IHD (59%), or their smart thermostat (68%) through the two summers of the Pilot. The IHD and the web portal were the two technologies that had the largest increase in usage from 2015 to 2016; 21% of customers reported viewing their IHD more frequently and 30% reported viewing the web portal more frequently in 2016 than 2015. Very few customers reported viewing each technology less in 2016 than in 2015. These results suggest that the value of these technologies remained steady throughout the duration of the Pilot.

Figure 4-19. Change in Customer Viewing of Technology in the Second Summer Compared to the First

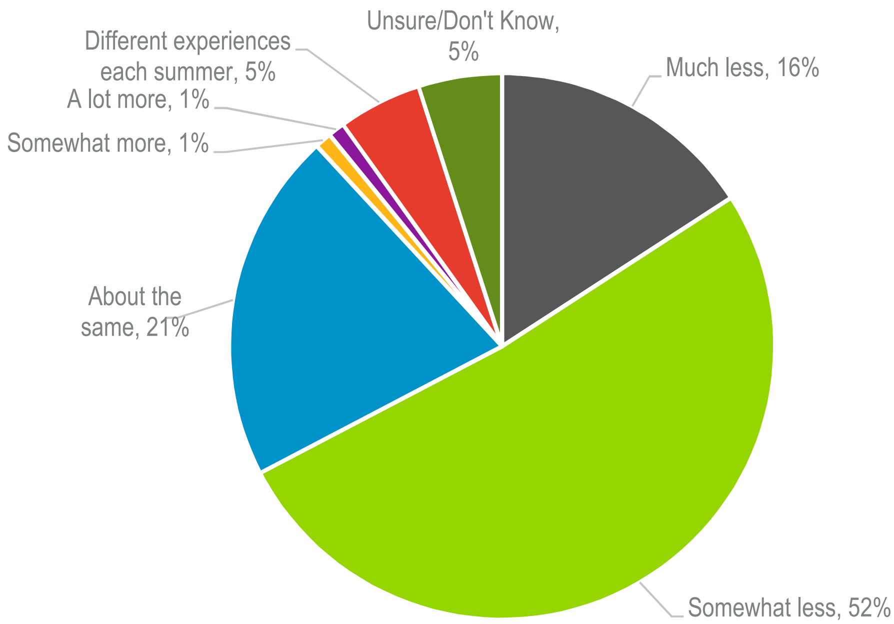


Source: Navigant analysis of 2016 end of pilot survey (N=615)

4.2.6 Customers Believed they Reduced Summer Electricity Usage and Noticed Summer Bill Increase

As discussed in Section 4.1.2, two of the major motivations of customers who enrolled in Smart Energy Solutions were to explore technologies that could help them reduce electricity usage and to save money on their electricity bills. Customers provided insight into their perceived savings and conservation in the end of pilot survey. Most customers perceived a change in their electricity usage during the two years of the Pilot compared to a normal summer. The majority of customers (68%) believed they reduced their electricity usage at least “somewhat” (see Figure 4-20).

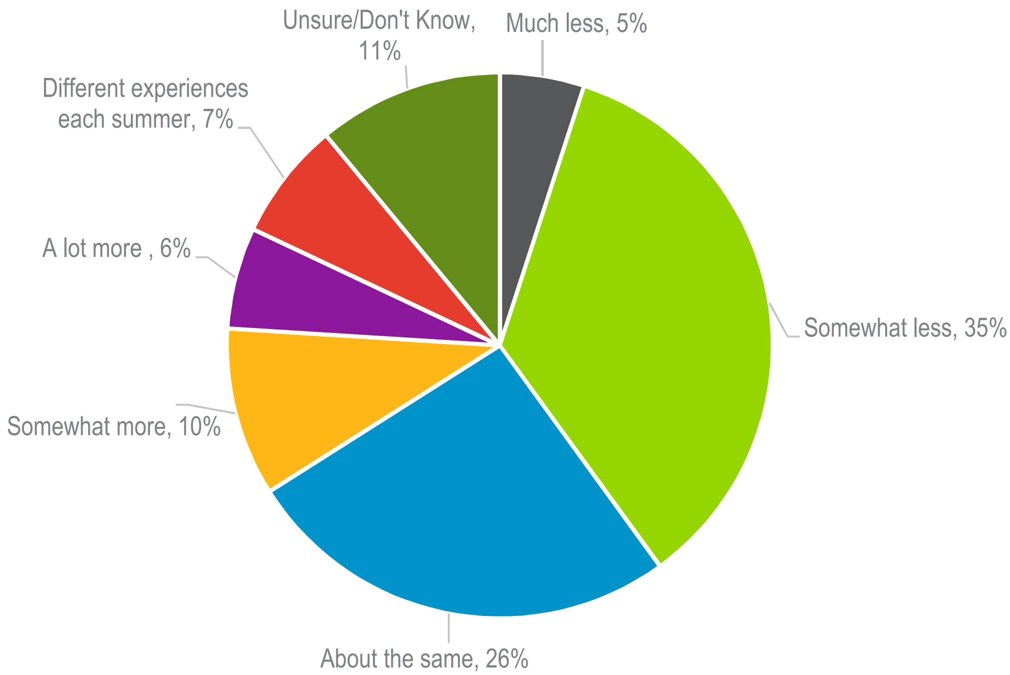
Figure 4-20. Customer Perceived Change in Summer 2015 & 2016 Electricity Usage Compared to a Normal Summer



Source: Navigant analysis of 2016 end of pilot survey (N=615)

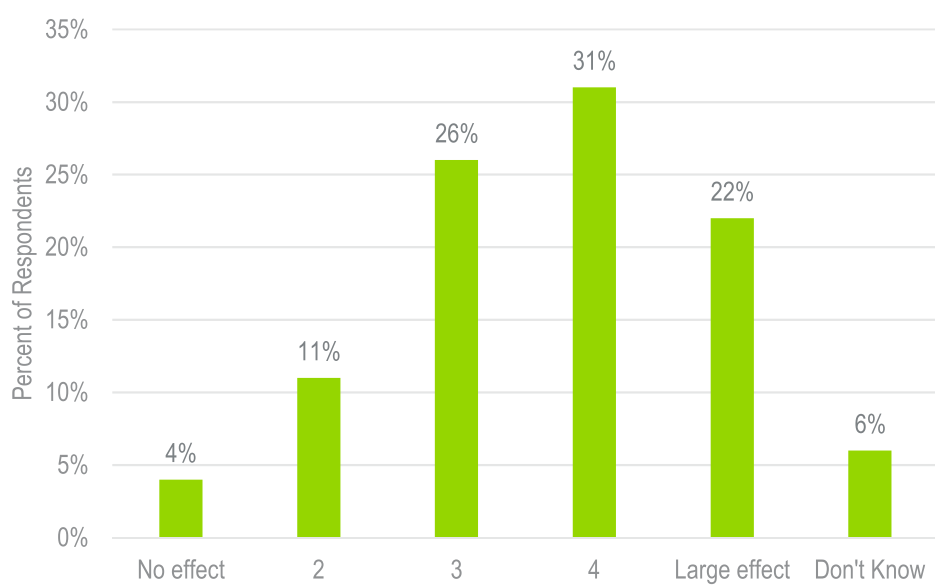
Forty percent of customers believed their summer bills decreased during the Pilot, 26% said they stayed the same, and 16% believed their summer bills increased during the Pilot (see Figure 4-21). Seven percent of customers felt they had different experiences with their bills each summer of the Pilot. As demonstrated in Figure 4-22, the majority of customers (53%) believed that Smart Energy Solutions was largely responsible for the changes in their electric bill, rating the effect of the Pilot at least a 4 on a 5-point scale. The finding that many customers said their summer bills increased was not surprising, as the CPP rate was designed to save customers money over the course of the year to balance out possible increases in summer months due to Peak Events. The Peak Event rates were in effect for over 130 hours in each summer, so the average customer spent more on electricity during summer months than in pre-pilot summers. Customers noticed this increase. However, they saved during the rest of the year because the Pilot rates were lower than the Basic Rate on non-Conservation Days. It is actually surprising that 40% said their bills decreased when the bill savings analysis clearly shows bill increases in the summer months (see Figure 3-15).

Figure 4-21. Customer-Perceived Change in Summer 2015 & 2016 Electric Bill Compared to a Normal Summer



Source: Navigant analysis of 2016 end of pilot survey (N=615)

Figure 4-22. Customer Perception of Effect of Pilot on Bill



Source: Navigant analysis of 2016 end of pilot survey (N=385)

4.2.7 Low-Income Customers were Positive about the Pilot but Need Targeted Outreach

Low-income customers who participated in focus groups were not significantly different from other customers in their behaviors. They were quite aware of events and they were knowledgeable about the WorcesterSmart portal and the rewards platform. They took care to educate household members about reducing their energy use during events, found activities outside their homes, and limited air conditioning usage (which was primarily window AC). However, we learned from the focus groups that knowledge about the most effective energy conserving behaviors was sometimes limited. These customers were not aware of energy efficiency programs offered by National Grid or available through organizations such as Worcester Community Action. They understood how the CPP rate worked but often didn’t know they had the option to switch to the PTR rate, which may have suited some of them better. They felt their options to conserve further were constrained either because they had already taken all the measures they could think of for their daily use or had elderly, ill or limited mobility household members or pets who needed cooled environments. Finally, in response to the back-to-back events that occurred in 2016, some participants said they essentially ‘gave up’ trying to conserve by the third day.

Even though focus group participants felt there were challenges, their overall reaction to the program was positive. Participants liked the ability to take more control of their electricity use and were very interested in the program technologies, though very few were aware of the technology options before the focus group. The findings suggest three areas for National Grid to tailor outreach for low-income participants:

- Outreach and education about the program rates, perhaps including a template to help participants decide which rate makes the most sense for their particular living situation;
- Outreach and education about the available technologies and how to get the most impact from them; and,
- Outreach on applicable energy efficiency programs that provide assistance with home improvements such as air sealing, insulation, appliances, and heating and cooling equipment.

4.2.8 Commercial Customers were Difficult to Identify and Engage

Small commercial customers are a ‘difficult to serve’ group in energy efficiency programs, and that was found to be the case in Smart Energy Solutions as well. Commercial customers were included in the Pilot area and were identified by their rates (G1 and G2). In attempting to recruit small commercial customers for evaluation activities, Navigant found that in many cases the customer account was limited to common area lighting or similar uses in rental buildings, making true small commercial accounts difficult to identify.

Most commercial customers were unresponsive to attempts to recruit them to focus groups and interviews. Navigant was able to complete five pre-pilot interviews in the spring of 2014 and four in-person or telephone interviews at the end of the 2015 summer. Almost every small commercial customer interviewed had only a general knowledge of and little interest in the Pilot and said they paid very little attention to it. The typical response was that they needed to run their businesses and did not see how they could adjust electricity usage without having some negative impact on their business. The single exception was a retail food service business customer who was both knowledgeable and enthusiastic about the program. He said he actively adjusted his usage during Peak Event hours and believed he benefitted substantially.

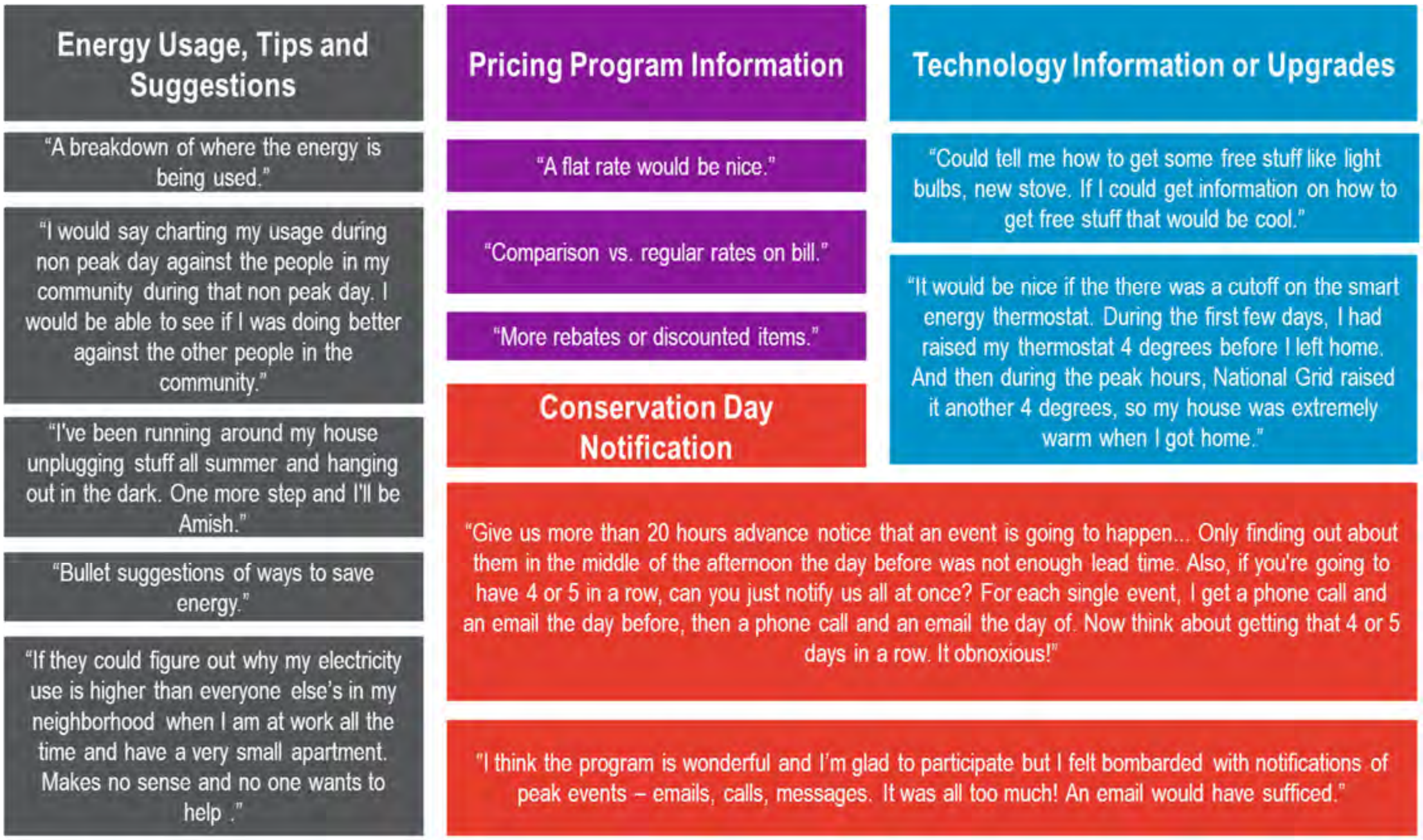
Given the responses, further work with small business customers would greatly benefit from active outreach tailored to their needs, possibly through a well-informed customer like the one cited above and/or through local business organizations, stressing the benefits and techniques of actively managing electricity use under either the CPP or PTR rate.

4.2.9 Customers Provided Feedback Throughout the Pilot to Improve Smart Energy Solutions

According to all of Navigant's customer engagement research, participants were aware of Conservation Days. They also acknowledged the multiple communications that they received about Conservation Days and Peak Events. Customers had the option to select their notification preferences for events. They could be notified of events by National Grid one day prior to, and/or the day of, a Peak Event via a combination of telephone, email, text, notification on IHDs, and the web portal.

As part of the Company's "listen, test, learn" approach, customer feedback was sought out and National Grid took actions to improve the customer experience based upon the feedback they received. Some customer feedback in 2015 demonstrated that customers lacked understanding about the program, and in 2016 National Grid increased information and education to meet customers' needs. As shown in Figure 4-23, which summarizes feedback from across the surveys, participants were aware that efforts should be made to conserve electricity during critical Peak Event hours and most participants were diligent in adjusting their energy use and practices to minimize usage. Based on feedback provided via the surveys and focus groups, customers wanted personalized conservation tips, transparency in bill calculations, additional information about the pricing plans to aid them in making the right rate choice, and information about technologies that could help them further reduce electricity usage (Figure 4-23). National Grid responded to this feedback in various ways, such as by creating the Energy Signatures and rewards platform in 2016 (see Section 2.3.2). Customers also desired more advance notice about Peak Events, which implies not having a clear understanding of how far in advance National Grid can confirm an event will be called.

Figure 4-23. Additional Information Customers Would Like About Smart Energy Solutions



Source: Navigant analysis of 2015 end of summer survey, 2016 post event surveys, and 2016 end of pilot survey

In addition to wanting more specific information about the program, customers had several requests for National Grid to improve Smart Energy Solutions in both 2015 and 2016. As shown in Figure 4-24, customers wanted lower rates, shorter Peak Event timeframes, fewer Peak Events, and additional information about their usage. In 2015, customers stated their preference for text or email notifications over phone calls and voicemails and National Grid made adjustments. While these comments were critical, they show that customers were aware of and engaged with the Pilot. As discussed in Section 4.2.4, 69% of customers rated their satisfaction at least a 5 on a 7-point scale. Feedback is part of National Grid's "listen, test, learn" approach, and serves as the basis for adjustments to the Pilot that will improve customer experience.

Figure 4-24. Customer Recommendations to Improve Smart Energy Solutions

Conservation Day Notification

- "One mode of communication."
- "Stop calling and leaving a million voicemails."
- "Make it easier to opt out of the phone calls."
- "No automated calls or email. I can just check the website. I turned off notifications and still get calls."
- "Cut down the amount of notifications. No phone calls to notify of peak events."

Peak Events

- "Shorten the time frames on event days, 8 hours is a long time to shutdown AC, etc."
- "Don't run a peak event past 5 pm."
- "Charge lower peak rates."
- "Not having 3 days in a row, maybe reducing the number of hours."
- "The peak events go too late into the evening, 6:00 PM should be the cutoff."
- "No set peak time till after 5 pm. Provide reward for less energy usage."

Usage Information

- "I want a screen that tells me my real time usage. That's very important. My whole family can be involved with this program if they could see what impact their daily activities have on our bill."
- "Don't double the rates and simply educate your customers on how important it is to save energy. Use social media platforms and smart energy campaigns to get your customers involved. Don't just decide to test us and make us pay more."
- "I do most of all the suggestions they recommend and yet my bill is high. Other than going out and buying all new appliances which would cost me a fortune to save maybe $10 a month, I don't know what else to do."

Source: Navigant analysis of 2015 end of summer survey and 2016 end of pilot survey

As shown in Figure 4-25, customers also expressed positive feedback over the course of the Pilot emphasizing that they appreciated that the Pilot helped save them money and electricity and was an avenue for them to help the environment. Customers liked that the WorcesterSmart portal provided them with information that allowed them to conserve electricity, such as tips on which appliances to avoid using during Peak Events and how much electricity they were able to save on past Conservations Days. Customers with the IHD mentioned that the frame was useful in reminding them of conservation hours and informing them of their real-time electricity usage and real time prices.

Figure 4-25. Customer's Positive Feedback on Smart Energy Solutions

Why do you rate your satisfaction with the program as…

"Because I am more knowledgeable about saving electricity."

"Because I am very conservative. And although the program affects my usage slightly, I am thankful it brings attention to others."

"I guess because it saved me some money. Otherwise, my electric bill would be higher. I know it would, I could tell. I am a happy camper."

Sentiments towards Smart Energy Solutions program:

"Any opportunity to save money/energy is excellent. "

"Gives helpful information."

"Saved me money!" – Lots of these responses

Why do you give the program that rating?

"Good idea. Makes me think twice about using appliances during those times."

"Helping environment and saving money."

"I am happy that I can use energy at a time when there is a more energy. I like saving money."

Comments on the Digital Picture Frame and its effects on decision making…

"It made it clear when the peak events were. If I didn't see it there on the frame, I wouldn't have known."

"Really good to look at electric consumption."

"Showed price and reminded times of conservation."

"I like the program so far. I like reading newsletter and may get an idea on how to improve my energy use. I like the fact that at least you are trying to help me."

"I am happy with results of information given from program."

"I like the comparison tools and energy saving tips that are provided. For example, I now usually wait until after 8 pm to do my laundry."

Comments on WorcesterSmart Portal:

"Good tips, good facts, and good info to conserve."

"I checked to see if I had saved during the event from the day before."

"It made me think about what appliances to avoid using during peak event hours."

Source: Navigant analysis of 2015 & 2016 post event surveys, 2015 end of summer survey, and 2016 end of pilot survey

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5. LESSONS LEARNED FROM PROGRAM IMPLEMENTATION STAFF

National Grid identified lessons learned from the Pilot through meetings with members of National Grid's implementation team. This process captured key learnings, including aspects that worked well and also opportunities identified during Pilot implementation. Lessons learned that are relevant to the customer-facing evaluation discussed in this report were identified in the following areas:

- Advanced Metering Infrastructure (AMI)
- Billing
- Outreach and Education
- Customer Service
- Peak Events
- In-Home Technology Installation

5.1 Advanced Metering Infrastructure

National Grid found that the opt-out approach to the Pilot was instrumental in simplifying the planning, scheduling, communication, and initial technology successes, including the Early Field Trial. The opt-out model allowed National Grid to plan the solution around the idea that most customers would stay in the program. This allowed the design of the RF Mesh solution (a wireless mesh network) to include all meter locations, facilitating a hybrid and integrated environment using a combination of RF Mesh and a small population of cellular meters. National Grid enabled a mixture of data collection time frames in an effort to identify the optimal frequency (e.g., 5- or 15-minute intervals) to support customer desires or deliver advanced analytics and asset management value.

National Grid identified the need to perform a more thorough business process impact and analysis effort to ensure the myriad of customer scenarios can be supported by any chosen solution. Some of the business processes that needed to be examined included meter installations and exchanges, billing, bill presentation, presentation of data on the web, and integration of new suppliers into the process.

5.2 Billing

National Grid was able to successfully support a wide variety of billing scenarios, under both current tariffs and Smart Grid tariffs, using AMI meter data. National Grid delivered a solution that leveraged existing customer billing capabilities and incorporated changes to support the new billing process using energy intervals and a tiered pricing structure based on time of use. This required minimal changes to the existing bill format. National Grid has been delivering the new billing capabilities since January 2015.

The approach used for bill presentation would have benefited from a more flexible and innovative bill design. Representing the energy and bill savings as well as the TOU pricing aspects on the customer bill each month would have created greater transparency and understanding for the customer, as well as promoting awareness of the value and benefits that many customers realized through participating in the Pilot. Revision of the bill presentation was not pursued because of the complexity of changing the bill format in National Grid's customer billing system and the Pilot timeline. In lieu of presenting savings on the bill itself, customers' savings were communicated from time to time in the monthly reports.

5.3 Outreach and Education

Extensive outreach and education were critical to creating awareness and interest among customers and motivating them to participate actively in the Pilot. National Grid was highly focused on achieving a positive customer experience while meeting all the pilot requirements and delivering on National Grid's Outreach and Education (O&E) Plan. From the beginning, National Grid found that carefully planned outreach and education efforts and application of the "listen, test and learn" approach created synergistic value. For example, the Green to Growth Summit informed National Grid's O&E Plan and how it sought to connect with customers. National Grid and leaders from the City of Worcester worked closely on all aspects of the Pilot and sought to properly address concerns raised in the various public forums. As the Pilot moved into the implementation phase, the opt-out design simplified communications and outreach and allowed National Grid to remain focused within the Pilot area. By delivering information and capabilities to customers in a phased manner, National Grid was able to build awareness and understanding in a focused and well-articulated manner, which supported a more positive customer experience.

Several aspects of the O&E efforts stood out as supporting the success of the Pilot in meeting its goals. The Sustainability Hub grew from a concept created by the stakeholders participating in the Green to Growth Summit. With well over 8,000 visitors since it opened, the Hub has been a place where customers, the community and interested stakeholders can learn about the program and how a smarter grid will deliver greater choice, control, and convenience. As demonstrated by this evaluation, the WorcesterSmart web portal was more successful than expected in driving peak demand reductions. National Grid would continue to highlight a web portal or similar information-provision resource in future efforts as a key tool enabling customers to learn and take action. The findings that most customers understand their pricing plan at least reasonably well, and that most would choose to stay on the CPP rate if the program were to continue (see Figure 4-6 and Figure 4-8), support that the outreach and education efforts have been successful in helping customers to embrace these changes in the ways they use and value energy.

National Grid identified a need for more personalized information and insights for Pilot customers. The monthly paper reports sent to all customers included comparative information, but providing customers with more specific and tangible advice and suggestions on how they can save within the Pilot would add considerable value. Towards this end, National Grid has been developing "Energy Signatures" that can help customers identify their patterns of daily energy use and ways to save based upon those patterns (see Section 2.3.2).

5.4 Customer Service

Providing access to dedicated support services and the Sustainability Hub allowed customers to receive quick access to information and resolution of issues. The use of dedicated personnel to support customers was critical to helping customers with any questions or concerns that arose. These dedicated personnel were well-versed in the fine details of the program, and this made it easier for the customer to access timely assistance. This group consisted of dedicated call center representatives, tier 2 support through the project team, and vendor support, including one-on-one training provided as part of the in-home technology installation process. Personalized support and instruction were also provided to Pilot participants who visited the Sustainability Hub. As of the end of 2016, over 8,200 customers had visited the Sustainability Hub and it was mentioned by many customers as a useful source of information alongside direct mail, the Smart Energy Solutions website, and National Grid’s Customer Contact Center (see Figure 2-15). A survey administered by the Sustainability Hub also found that customers ranked the Hub highly as a source of information (see APPENDIX C).

Improving access to the web portal would have enhanced customers’ access to online customer support resources. The process of signing up for the web portal could have been faster, more intuitive and streamlined. In addition, having the web portal available when meters were installed would have helped to maintain interest and engagement with the Pilot in the time before technologies were installed and pricing plans went into effect. In the future, a better design and flow for all customer web-based transactions and interactions, in concert with standard controls and security concerns, would support higher levels of customer engagement.

5.5 Peak Events

Optimizing peak event communications by providing and promoting communication options, and customizing peak event characteristics to make participation easier for customers, supported the achievement of higher participation and savings levels in the second year. The demand response program was successful in Year 1, and Year 2 saw improvements in impacts and customer engagement. In Year 1, National Grid organized a test Peak Event prior to the summer to engage customers in the process and refresh their memory, so they would be prepared for the first real Peak Event. Upon hearing from some customers that the Conservation Day communications were excessive, National Grid adjusted the default notification process and also promoted the availability of communication personalization options to participants. Calling or logging in to the web portal in order to log their communication preferences provided an opportunity for customers to become engaged in the process. National Grid also responded to customer feedback in Year 2 by making adjustments to Peak Event start and end times and thermostat offsets in order to facilitate participation.

Additional customer education could contribute to further improvement in Peak Events. Survey results indicated that some customers did not understand why and how Peak Events were called, and additional education could help customers understand, for example, why Peak Events could not be called several days in advance and why they tended to occur on the hottest days. In addition, the evaluation determined that customers with in-home technology saved more than those without any technologies apart from web portal access. Promoting the savings opportunities created by embracing technologies could help more customers take the step of signing up for technologies and increasing their participation in the program.

5.6 In-Home Technology Installation

The installation and customer education process received positive feedback from customers. National Grid received very positive feedback from customers about the process of installing home energy management technologies in their homes. The training provided in relation to operation of the technologies was also very well received. Trial installations in the homes of early adopters and “friendly” installs were valuable in National Grid’s efforts to design the process, to validate the amount of time required for installation, and to identify some potential issues that might be encountered.

National Grid observed, however, that a number of customers seemed to lose interest in installing in-home technologies after they had completed the initial online or paper-based technology enrollment process. In order to address this phenomenon, more detailed information about the actual installation process could be provided to customers. For example, customers who rent their home should receive the information needed to understand that they are responsible for obtaining the landlord's permission before a visit can be scheduled. Similarly, customers should understand that the installation process requires that a technician enter the home, rather than performing the work outdoors or in a basement. Clearly stating the available installation times is also important. Finally, the education process should inform customers that there may be additional obstacles to installation that can only be identified when the installer is on site, such as construction, the location of the AMI meter relative to the in–home technologies, and meter vaults.

6. KEY FINDINGS AND LEARNINGS

6.1 Key Evaluation Findings

National Grid's Pilot was an innovative smart grid pilot combining deployment of advanced meters, customer-facing technologies, and TOU rates that ran through the end of 2016. National Grid filed for a two-year extension of the Pilot in 2016 and the DPU approved an interim extension that extends the Pilot until a final decision is reached in 2017. The Pilot also includes advanced distribution grid-side technologies which are the subject of a separate report.[100] This evaluation, conducted by Navigant, covers Pilot activities through the end of 2016. Key findings from this evaluation are shown in Figure 6-1.

Figure 6-1. Key Findings from Evaluation of Smart Energy Solutions

Energy and Demand Savings for Active Customers	• Load reductions from 4% to 31% (0.12 to 0.60 kW) during Conservation Day Peak Events depending on the combination of rate and technology • 5.4% (approximately 35 kWh per month) weighted average energy savings across the technology groups for CPP customers over the two years of the Pilot
Enabling Technologies Increased Demand Savings for Active Customers	• Customers with programmable communicating thermostats had the highest load reductions (25%-31% on CPP and 22%-29% on PTR) • Customers with in-home displays were next (17%-18% on CPP and 4%-9% on PTR), followed by customers with only Web Portal access (12%-15% on CPP and 10% on PTR)
Bill Savings	• Average per customer bill savings of $236 over the two years of the Pilot for customers on CPP • Average total rebates of almost $30 for Conservation Day Peak Events across both summers for customers on PTR
High Retention Rate	• 98% retention rate of customers in the Pilot at the end of 2016 after rates went live on January 1, 2015
Strong Customer Satisfaction	• 69% of customers rated their satisfaction with Smart Energy Solutions at least a 5 on a 7-point scale

Source: Navigant analysis

Note: CPP refers to Critical Peak Pricing and PTR refers to Peak Time Rebate.

6.2 Key Learnings from Smart Energy Solutions

Before and throughout the Pilot, National Grid implemented a "listen, test, learn" approach that is based on "on the ground" conversations and reflections on the Pilot. This feedback, combined with learning,

[100] National Grid. *Interim Grid-Facing Evaluation Report*, March 31, 2016.

leads to continuous improvement. National Grid conducted extensive program marketing in the lead-up to initiating meter installations, the first phase of the program. These activities included convening a public summit to discuss the proposed program, development of brochures explaining the program, and establishment of the staffed, physical Sustainability Hub within the Pilot program area. National Grid also partnered with local schools to offer Energy Ambassador internships at the Sustainability Hub. Clark University offered annual internships, and Worcester Polytechnic Institute created a student Sustainability Ambassador program. Ambassadors host Sustainability Hub tours and attend outreach events to educate customers throughout the community. Presenting the personal side of the Company is the backbone of “listen, test, learn”, and is the inspiration for sending National Grid employees and Ambassadors into the community. It is also the basis for hosting visitors at the Sustainability Hub for the dual purpose of educating customers and listening to their concerns and feedback.

Several broad themes emerged regarding customer response to the Pilot design and implementation: Impacts for active customers (17% peak load reduction and 5.4% average load reduction over the two years of the Pilot) met the goals established through Section 85 of the GCA, and the majority of customers were satisfied with the Pilot. Figure 6-2 summarizes key learnings from the two years of Smart Energy Solutions.

Figure 6-2. Key Learnings from Smart Energy Solutions

Smart Energy Solutions shows the viability of opt-out design.

- The program enrolled ~11,000 participants, which is many more than could have been recruited in an opt-in design.
- The retention rate after two years was 98%, which is higher than many comparable opt-in programs.
- Program satisfaction was strong, with 69% of participants rating the Pilot at least a 5 on a 7-point scale.

It is important to choose the default options in an opt-out program carefully.

- Smart Energy Solutions defaulted customers onto the CPP rate and web portal, with no additional in-home technology.
- Approximately 95% of customers were still on the default price plan and 90% on the default technology level after the two years of the Pilot.
- Although satisfaction was strong, "default bias" is likely to be a factor in customers staying on the default enrollment options in the opt-out design.

Long Peak Events and Peak Events called on consecutive days did not significantly affect savings or satisfaction.

- Despite calling more Peak Events (including on consecutive days) and longer Peak Events than similar programs, Smart Energy Solutions acheived similar satisfaction and savings.
- However, some customers did express a desire for shorter events ending earlier in the evening.

In-home devices increased demand savings, but much of the total savings were acheived with just a web portal.

- Customers with in-home devices had significantly higher demand savings (up to 31%) than those without any technology (up to 15%).
- Customers without technology who visited the program web portal saved approximately twice as much in the second year of the Pilot as those who did not visit the web portal (this may be attributable to differences in motivation as well as to the web portal itself).
- Customers without technology made up 90% of the participants in the Pilot and approximately 70% of the total Peak Event savings.
- Customers with IHDs saved the most energy, followed by those with web portal access only. Those with PCTs had higher demand savings but lower energy savings.

Customers on the CPP rate saved more than those on the PTR rate.

- At each technology level, active customers on the CPP rate saved more than those on the PTR rate.
- Passive customers saved more on the PTR rate, but that could be due to a slightly higher level of engagement since they had to opt in to the PTR rate.
- The motivations to save on the CPP rate are greater than for the PTR rate, as on the CPP rate customers face higher bills if they don't save.

The PTR rate may be more appropriate than the CPP rate for those on fixed budgets or with health issues.

- Although the CPP rate saves money over the course of the year, bills do increase for many customers in the summer, potentially making the PTR rate a better choice for customers on a fixed or limited income.
- Additionally for those who have a limited ability to reduce their energy usage (because of elderly, ill, or limited mobility household members, pets who need cooler temperatures, electric medical equipment, etc.) the PTR rate may be more appropriate.

Information needs to be provided multiple times via multiple channels.

- Despite a plethora of communication from National Grid, half of customers without technology did not know it was available, and of the 40% who knew it was available, many did not understand the benefits.
- Additionally, many customers (56%) did not realize they had the option to switch price plans.
- Based on the focus groups, low-income customers had low awareness of the rates and technologies despite the high potential benefits to this group.

Customers want options to personalize notifications.

- Customers cited issues with the amount and methods of Conservation Day notifications in 2015, and responded well to additional promotion and simplification of personalization options in 2016.

Source: Navigant analysis

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APPENDIX A. IMPACT ASSESSMENT METHODOLOGY

Navigant evaluated energy, demand, and bill impacts from the Pilot using regression analysis of monthly bills and hourly customer loads, respectively, using anonymized customer data from National Grid. Energy and demand impacts were estimated by technology/price group. On the residential side, a single regression was estimated for each group when the number of customers in the group was large enough, or combined regressions with dummies were used to separate the effect for each group individually if there were too few customers. Navigant also estimated impacts by demographic subgroup as the data allowed, i.e., when there were enough customers in a given subgroup to estimate savings via regression analysis. On the commercial side, a pooled regression was run for G1 commercial customers on the CPP rate in Level 1 and single customer regressions were run for all other commercial customers.

A.1 Peak Event Impacts

Navigant used an *ex-post* model to estimate demand impacts, which included variables to control for temperature, humidity, intra-seasonal, intra-weekly and intra-daily (i.e., hourly) seasonality, and the build-up of heat in the home over 4- and 24-hour periods.[101] The model included additional controls for the way that the relationship between demand and temperature can vary by month and for the possibly non-linear manner in which heat build-up may affect household demand.

The impacts and snapback were estimated using a battery of dummy variables that were specific to each unique Conservation Day, hour of day combination. In effect, the model ascribes all event- and snapback hour variation in demand from the baseline to the event (or the snapback). Navigant also explored the possibility of pre-cooling but did not find significant evidence of its existence, and therefore pre-cooling was left out of the final model specification.

For each technology/price group over the period from 8 a.m. to 10 p.m. from June through September of 2014 and the year being estimated (either 2015 or 2016) the regression model in Equation A-1 was estimated. This equation shows the exact model used in 2015 and a very similar model was used in 2016. In 2015, Navigant estimated the model using quarter-hourly data and then aggregated impacts to the hourly level. In 2016, Navigant aggregated the data to the hourly level first and then ran the regression at that level, thus the quarter-hour dummies were changed to hour dummies (which was the only change for the 2016 regression model). This aggregation to the hourly level was made to simplify the calculation of standard errors and was not expected to impact the savings estimates. Navigant tested both methods in 2016 and, as expected, found that the change did not have a statistically significant impact on the coefficient estimates.

[101] In the original scope of work, Navigant proposed matching from the load research customers to construct the baseline usage, as opposed to the within subject method that was ultimately used. However, the load research group only consisted of about 200 customers and thus was not large enough to match from.

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Equation A-1. *Ex-post* Regression Model to Estimate Demand Savings

$$
\begin{aligned}
y_{k,t} = {} & \alpha_k + \sum_{i=1}^{55} \beta_i^h \cdot qh_{i,t} + \sum_{s=1}^{S=22}\sum_{i=1}^{55} \beta_{i,s}^e \cdot qh_{i,t} \cdot e_{s,t} + \sum_{s=1}^{S=22}\sum_{r=1}^{R=20} \beta_{s,r}^s \cdot qh_{i,t} \cdot s_{s,r,t} + \sum_{i=1}^{55} \beta_i^{CDH} \cdot qh_{i,t} \cdot CDH65_t + \sum_{i=1}^{55} \beta_i^{HDH} \cdot qh_{i,t} \cdot HDH65_t \\
& + \sum_{i=1}^{55} \beta_i^{THI} \cdot qh_{i,t} \cdot THI_t + \sum_{i=1}^{55} \beta_i^{THI_{15}} \cdot qh_{i,t} \cdot THI\_lag15_t + \sum_{i=1}^{55} \beta_i^{THI_{30}} \cdot qh_{i,t} \cdot THI\_lag30_t + \sum_{i=1}^{55} \beta_i^{THI_{45}} \cdot qh_{i,t} \cdot THI\_lag45_t \\
& + \sum_{i=1}^{55} \beta_i^{THI_{60}} \cdot qh_{i,t} \cdot THI\_lag60_t + \sum_{i=1}^{55} \beta_i^{CDTH} \cdot qh_{i,t} \cdot CDH65_t \cdot THI_t + \sum_{i=1}^{55} \beta_i^{MA24CD} \cdot qh_{i,t} \cdot MA24\_CDH65_t \\
& + \sum_{i=1}^{55} \beta_i^{MA24CDTH} \cdot qh_{i,t} \cdot MA24\_CDH65_t \cdot THI_t + \sum_{i=1}^{55} \beta_i^{MA4CD} \cdot qh_{i,t} \cdot MA4\_CDH65_t \\
& + \sum_{i=1}^{55} \beta_i^{MA4CDTH} \cdot qh_{i,t} \cdot MA4\_CDH65_t \cdot THI_t + \sum_{i=1}^{55} \beta_i^{RH} \cdot qh_{i,t} \cdot RH_t + \sum_{i=1}^{55}\sum_{d=1}^{7} \beta_d^{DoW} \cdot qh_{i,t} \cdot DoW_{d,t} \\
& + \sum_{i=1}^{55}\sum_{m=6}^{M=9} \beta_m^{Month} \cdot qh_{i,t} \cdot Month_{m,t} + \sum_{i=1}^{55}\sum_{m=6}^{M=9} \beta_m^{MonthCDH} \cdot qh_{i,t} \cdot Month_{m,t} \cdot CDH_t \\
& + \sum_{i=1}^{55}\sum_{m=6}^{M=9} \beta_m^{MonthTHI} \cdot qh_{i,t} \cdot Month_{m,t} \cdot THI_t + \sum_{i=1}^{55} \beta_i^{pmMA24CD2} \cdot pm_{i,t} \cdot MA24\_CDH65_t^{\,2} \\
& + \sum_{i=1}^{55} \beta_i^{pmMA24CD2TH} \cdot pm_{i,t} \cdot MA24\_CDH65_t^{\,2} \cdot THI_t + \sum_{i=1}^{55} \beta_i^{pmMA4CD2} \cdot pm_{i,t} \cdot MA4\_CDH65_t^{\,2} \\
& + \sum_{i=1}^{55} \beta_i^{pmMA4CD2TH} \cdot pm_{i,t} \cdot MA4\_CDH65_t^{\,2} \cdot THI_t + \sum_{i=1}^{55} \beta_i^{peak} qh_{i,t} \cdot peakhour\_evtyr_t + \sum_{i=1}^{55}\sum_{d=1}^{7} \beta_d^{weekend} qh_{i,t} \cdot weekend\_evtyr_{d,t} \\
& + \varepsilon_t
\end{aligned}
$$

Where:

$y_{k,t}$	=	The average kWh usage of household *k* in quarter-hour *t*.
$qh_{i,t}$	=	A dummy variable equal to one if *i* is equal to the quarter-hour defined by *t.* For example, if quarter-hour *t* were 12-12:15 p.m. then $h_{17,t}$ would equal one and $h_{1,t}$ to $h_{16,t}$ and $h_{18,t}$ to $h_{55,t}$ would all be equal to zero.[102]
$e_{s,t}$	=	A dummy variable equal to one if there is a Peak Event taking place in quarter-hour *t* on event day *s* (one of the 40 Peak Event days) and zero otherwise.
$s_{s,r,t}$	=	A dummy variable intended to capture the effect of snapback in the period following the end of the event period. The *r*-th dummy is equal to one if period *t* is the *r*-th period following the end of a Peak Event and the event in quarter-hour *t* corresponds to event *s*. Note that snapback is modeled only within the same day as the event, thus the highest value attained by *R* was 20 (for the events ending at 5 p.m.), and the lowest was 8 (for the events that ended at 8 p.m.).
$CDH65_t$	=	Cooling degree hours observed in quarter-hour *t* – base is 65°F.
$HDH65_t$	=	Heating degree hours observed in quarter-hour *t* – base is 65°F.
THI_t	=	Temperature humidity index in quarter-hour *t*.
$MA24\_CDH65_t$	=	Cooling degree hours calculated based on a 24-hour moving average of temperatures leading up to quarter-hour *t*. This variable helps capture the effect

[102] Recall that only hours between 8 a.m. and 10 p.m. were included in the regression.

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		on demand of heat build-up during periods of extended high temperatures.
$MA4\_CDH65_t$	=	Cooling degree hours calculated based on a 4-hour moving average of temperatures leading up to quarter-hour *t*. This variable helps capture the effect on demand of heat build-up during short periods of high temperatures followed by precipitous drops in temperature such as during a storm.
$MA4\_THI_t$	=	Temperature humidity index calculated based on a 24-hour moving average of the temperature humidity index leading up to quarter-hour *t*. This variable helps capture the effect on demand of heat build-up during short periods of high temperatures followed by precipitous drops in temperature such as during a storm.
RH_t	=	Relative humidity of quarter-hour *t*.
$DoW_{d,t}$	=	A dummy variable equal to one if quarter-hour *t* falls in the day of the week indicated by subscript *d*. A value of *d* of 1 indicates a Sunday, and a value of 7 indicates a Saturday.
$Month_{m,t}$	=	A dummy variable equal to one if quarter-hour *t* falls in month *m*, and zero otherwise. Note that only the months of June through September are included in the estimation sample.
$CDD65_t$	=	Cooling degree days observed on the day in which quarter-hour *t* falls – base is 65°F.
$pm_{it,}$	=	A dummy variable equal to one if quarter-hour *t* falls between noon and 9 p.m.
$peakhour\_evtyr_t$	=	A dummy variable equal to one if quarter-hour *t* falls during a peak hour, 8 a.m. to 8 p.m., in the event year (2015 or 2016). This variable captures the effect of the Smart Rewards Pricing on usage during non-event peak hours.
$weekend\_evtyr_{d,t}$	=	A dummy variable equal to one if quarter-hour *t* falls on a weekend in the event year (2015 or 2016). This variable captures the effect of the pricing scheme and the Peak Events on weekend usage, for example, weekend usage might go up if customers shift loads to the weekend to avoid the higher weekend day and Peak Event pricing.

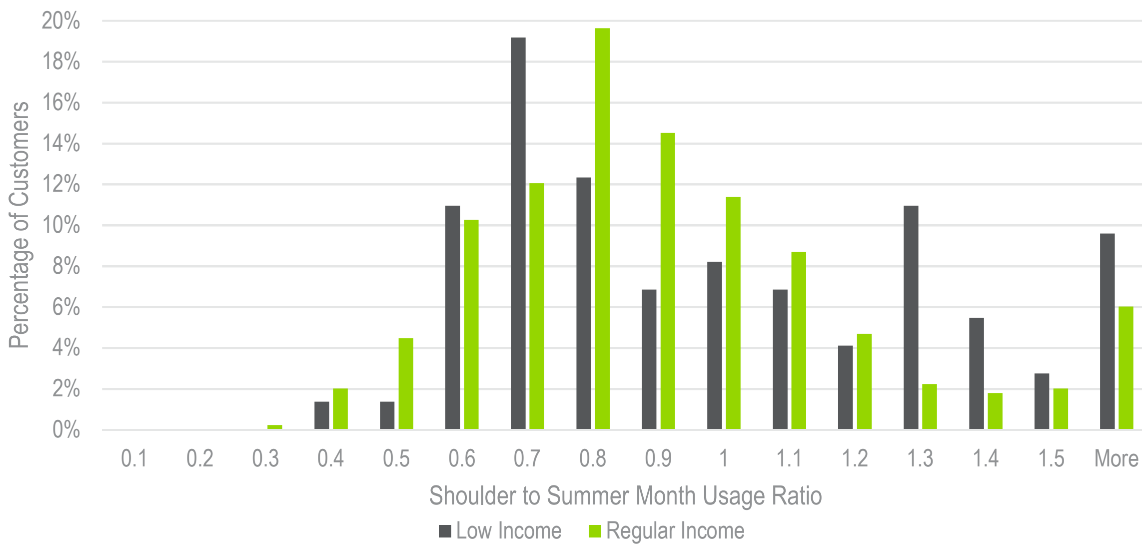
Each regression creates an estimated fitted average per-participant baseline for every day included in the regression. In 2015, the regression in Equation A-1 was estimated using energy usage (kWh) over 15 minute periods which was then aggregated to the hour to get demand (kW) impacts. In 2016, hourly demand data (kW) was used directly in the regression.

In 2015, the evaluation team estimated a day-of adjustment for each event day by subtracting actual usage from the fitted usage for the time from 8 a.m. until the start of the event. The day-of adjustment was subtracted from fitted usage for the entire day to create an adjusted fitted baseline. Demand savings were calculated by subtracting actual usage from the adjusted fitted baseline in each time period of the event. In 2016, the day-of adjustment was removed to simplify the calculation of standard errors. Navigant found that the day-of adjustment was minimal and did not have a statistically significant effect on the savings estimate.

A.2 CAC Penetration

Using 2015 data, Navigant identified customers likely to have CAC in Level 2 CPP by examining the ratio of shoulder to summer month usage.[103] A customer with CAC is likely to have considerably higher usage in the summer than in the shoulder months; therefore, a lower shoulder to summer month usage ratio indicates a higher likelihood of having CAC. Figure A-1 shows the distribution of the shoulder to summer month usage ratio for low-income and standard-income customers in Level 2 CPP. The percentage of customers with a ratio below 0.9 is 52% for low-income customers and 63% for standard-income customers. This suggests that there may be lower CAC penetration for low-income customers, as a lower percentage of them have a low shoulder to summer month usage ratio.

Figure A-1. Shoulder to Summer Month Usage Ratio for Level 2 CPP Customers by Income Level



Source: Navigant analysis

A.3 Energy Impacts

Navigant estimated the reduction in energy use for 2014, when only the informational portion of the program was in effect, and for 2015 and 2016 when the Pilot's Smart Rewards Pricing was in effect and Peak Events were called during the summer. In order to estimate energy impacts via regression analysis, Navigant drew matched controls from a large pool of non-participant households in ZIP codes near the Worcester area where the Pilot took place.[104] The basic logic of matching is to balance the participant and non-participant samples by matching on the exogenous covariates known to have a high correlation with the outcome variable. Doing so increases the efficiency of the estimate and reduces the potential for model specification bias. Formally, the argument is that if the outcome variable Y is independently distributed conditional on X and D (conditional independence assumption), where X is a set of exogenous variables and D is the program variable, then the analyst can gain some power in the estimate of savings

[103] Navigant chose to use July and August as the summer months and May and October as the shoulder months.

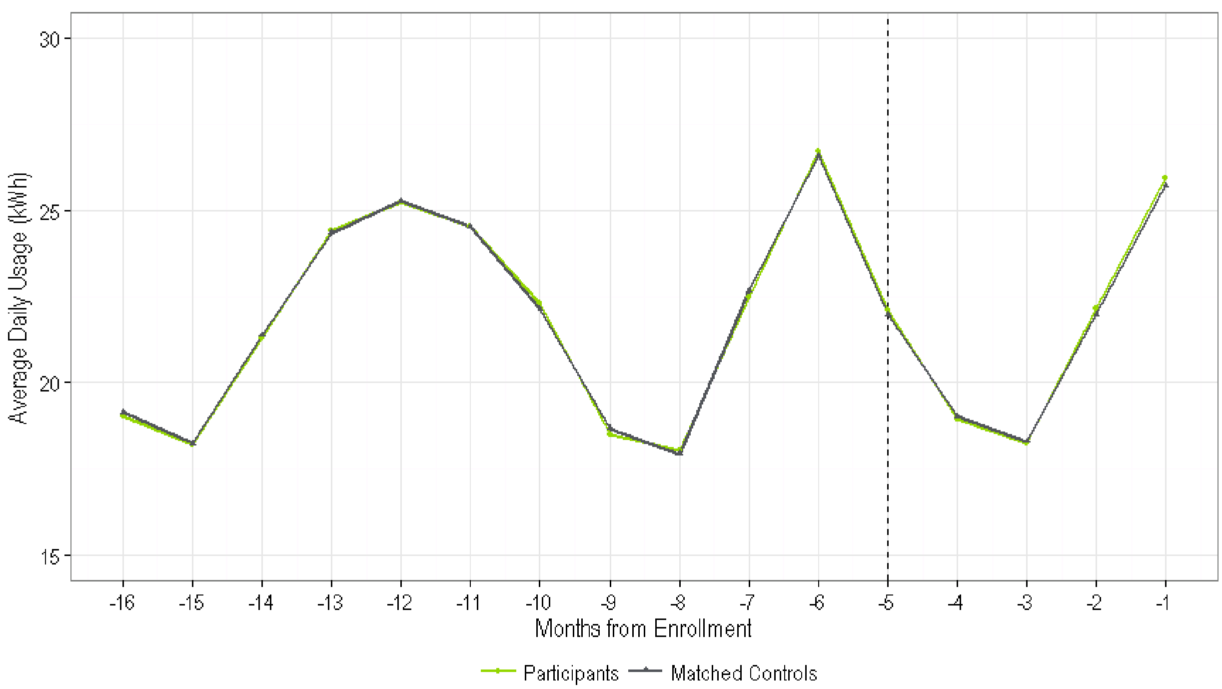
[104] Navigant used households in the following ZIP codes in the pool of non-participants from which to draw matched controls: 01601, 01602, 01603, 01604, 01605, 01606, 01607, 01608, 01609, 01610, 01611, 01501, 01527, 01545, 01505, 01583, 01520, 01612, 01524, 01542, 01537, 01540, 01590, 01519, 01560, 01588, 01534, 01568, 01532, 01581, 01522, 01507, and 01562.

and reduce potential model specification bias by assuring that the distribution of X is the same for treatment and control observations.

In this evaluation, the outcome variable is daily post-program period energy use, and the available exogenous covariate with by far the greatest correlation with this outcome variable is average daily use in the same month of the pre-program period, $PrekWh_{k,t}$, where k indexes the customer and t indexes the month. After drawing matches, the evaluation team ran the regression analysis to further control for any remaining imbalance in the matching on this variable. If, for instance, after matching the participants use slightly more energy on average in the pre-program period than their matches—i.e., they are higher baseline energy users—then including $PrekWh_{k,t}$ as an explanatory variable in a regression model predicting daily energy use during the post-program period prevents this remaining slight difference in baseline energy use from being attributed to the program.

Matches were draw on a 12-month period from September 2012 to August 2013; this left a 4-month test period from September 2013 to December 2013 to see how the matches performed outside of the matching period but before the program started. The expectation is that the participants and their matched controls should have similar usage both during the matching period and during the test period. To ensure that the quality of the matches selected using this method was high, Navigant examined the average usage of the participants and their selected matches in both the matching and test periods as shown in Figure A-2.

Figure A-2. Usage by Participants and Matching Controls in the Matching and Test Periods



Source: Navigant analysis

The development of a matched comparison group is viewed as a useful pre-processing step in a regression analysis to assure that the distributions of the covariates (i.e., the explanatory variables on which the output variable depends) for the treatment group are the same as those for the comparison group that provides the baseline measure of the output variable. This minimizes the possibility of model specification bias.

After matches were drawn, energy impacts were estimated for each year and technology/price group using regression analysis of monthly billing data as shown in Equation A-2. For 2014, energy impacts were estimated for the full year. For 2015 and 2016, savings were estimated separately in each month by interacting the participant variable in Equation A-2 with the monthly dummies.

Equation A-2. Post-Program Regression Model to Estimate Energy Savings

$$y_{k,t} = \beta_1 Participant_k + \sum_i \beta_{2i} Month_{i,t} + \sum_i \beta_{3i} Month_{i,t} \cdot PrekWh_{k,t} + \beta_4 cdd_{k,t} + \beta_5 hdd_{k,t} + \varepsilon_{k,t}$$

Where:

$y_{k,t}$	=	The average daily consumption of kWh by household *k* in bill period *t*.
$Participant_k$	=	A dummy variable equal to one if household *k* is a participant in the Pilot, and zero otherwise.
$Month_{i,t}$	=	A dummy variable equal to one when *i* equals *t*, and zero otherwise. In other words this is a monthly fixed effect.
$PrekWh_{k,t}$	=	Household *k*'s average daily consumption of kWh in the same calendar month of the pre-program year (2013) as the calendar month of month *t*.
$cdd_{k,t}$	=	The cooling degree days in bill period t for household *k* – base is 65°F.
$hdd_{k,t}$	=	The heating degree days in bill period t for household *k* – base is 65°F.

In each regression, the coefficient β_1 is the estimate of the reduction in average daily kWh consumption by program participants.

A.4 Bill Savings

CPP Customers

To estimate the monthly bill impacts of the Pilot for CPP customers, Navigant calculated the bill amount using actual usage under the Smart Rewards TOU pricing rates and the counter-factual bill amount using counter-factual usage in the absence of the program under the Basic Rate. Counter-factual usage was estimated using the energy savings estimated in Equation A-2. In cases where the energy savings were not statistically significant at the 90% level, Navigant still used the point estimate of savings to estimate counter-factual usage. In an unbiased regression, the point estimate of savings is a more accurate estimate of savings than zero, even when the point estimate is not statistically significant. Bill savings were calculated by technology level and were split out by income level.[105]

National Grid gave Navigant the actual bill amount paid by each participant in the Pilot; the TOU rates are shown in Table A-1. To estimate the counter-factual bill amount, the evaluation team calculated counter-factual usage in the absence of the program and multiplied it by the Basic Rate shown in Table A-2 to get commodity cost. Navigant then applied the non-commodity charges which were the same for the TOU rate and the Basic Rate. Once the evaluation team knew the bill amount under the program and in the absence of the program, subtraction gave the bill savings. These steps are laid out in Equation A-3.

[105] Low-income customers are given a 25% discount on their entire bill, including both the commodity and non-commodity charges.

Equation A-3. Bill Savings Calculation for CPP Customers

$$Pilot\_Cost = actual\_usage * basic\_rate$$

$$Counter\_Cost = basic\_rate * (actual\_usage * (1 - energy\_savings)) + non\_commodity\_charges$$

$$bill\_savings = Pilot\_Cost - Counter\_Cost$$

Table A-1. Smart Energy Solutions Pricing Rates

Effective for Usage During the Month of:	Residential (R-1, R-2) Rate (cents / kWh) Smart Rewards Pricing			
	Peak Period	Off-Peak Period	Peak Event Period	Conservation Day Rebate
December, 2016	9.369	7.742	45.853	(45.853)
November, 2016	9.369	7.742	45.853	(45.853)
October, 2016	7.744	6.421	37.416	(37.416)
September, 2016	7.702	6.379	37.374	(37.374)
August, 2016	7.702	6.379	37.374	(37.374)
July, 2016	7.702	6.379	37.374	(37.374)
June, 2016	7.702	6.379	37.374	(37.374)
May, 2016	7.702	6.379	37.374	(37.374)
April, 2016	12.463	10.226	62.636	(62.636)
March, 2016	12.463	10.226	62.636	(62.636)
February, 2016	12.463	10.226	62.636	(62.636)
January, 2016	12.463	10.226	62.636	(62.636)
December, 2015	12.463	10.226	62.636	(62.636)
November, 2015	12.463	10.226	62.636	(62.636)
October, 2015	8.859	7.313	43.544	(43.544)
September, 2015	8.859	7.313	43.544	(43.544)
August, 2015	8.859	7.313	43.544	(43.544)
July, 2015	8.859	7.313	43.544	(43.544)
June, 2015	8.859	7.313	43.544	(43.544)
May, 2015	8.859	7.313	43.544	(43.544)
April, 2015	15.537	12.675	79.730	(79.730)
March, 2015	15.537	12.675	79.730	(79.730)
February, 2015	15.537	12.675	79.730	(79.730)
January, 2015	15.537	12.675	79.730	(79.730)

Source: National Grid

Table A-2. Basic Rate

Fixed Price Options	
Effective During the Period of:	Rate (cents / kWh)
11/1/16 – 12/31/16	9.787
10/1/16-10/31/16	8.084
5/1/16 – 9/30/16	8.042
11/1/15 – 4/30/16	13.038
5/1/15 – 10/31/15	9.257
11/1/14 – 4/30/15	16.273

Source: National Grid

PTR Customers
For PTR customers, the bill savings were due to the rebates paid by National Grid during Peak Events since these customers were not on the TOU rate. This report shows the rebate paid out by the Company for usage reduction during Peak Events. National Grid calculated reduced usage as the difference between metered usage during the Peak Event and “normal” usage, defined as average usage during the ten prior non-holiday, non-Conservation Day weekdays after accounting for a day-of adjustment to capture weather differences, time of event, pre-cooling, etc. The reduction was multiplied by the per-kWh cost of the rebate (see Table A-1) to determine the total rebate due to the customer.[106]

A.5 Load Shifting

In addition to capturing demand savings during a Peak Event, Equation A-1 was also set up to capture snapback after an event, peak savings during times outside of a Peak Event, and evidence of load shifting to weekends.

The coefficient on $qh_{i,t} \cdot s_{s,r,t}$ which is the quarter-hour (or hour in 2016) dummy interacted with the snapback dummy captures whether participants increased usage after the Peak Event relative to what they would have used in the absence of the event. Such snapback would reduce the total demand reduction attributable to the Pilot. A positive coefficient indicates that snapback occurred.

The coefficient on $peakhour\_evtyr_t$ captures the demand reduction during peak hours (8 a.m. to 8 p.m.) in the event year (2015 or 2016) that are not also during Peak Events. A negative coefficient indicates a reduction in usage due to the program. This captures whether the Pilot reduced peak usage when a Peak Event was not called.

The coefficient on $weekend\_evtyr_{d,t}$ captures the change in usage on weekends in the event year (2015 or 2016). This indicates whether participants shifted usage from weekdays which have TOU pricing to weekends which have a flat rate. A positive coefficient indicates that load shifting to the weekend occurred.

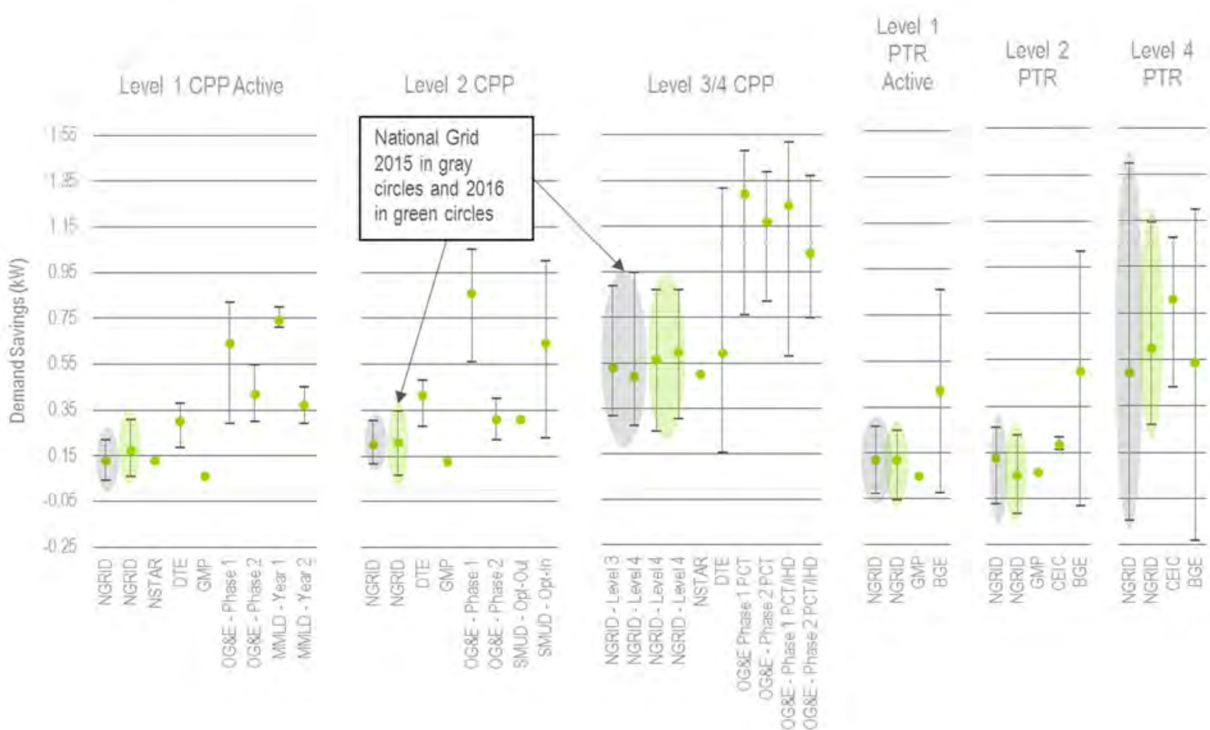
[106] Details can be found in: D.P.U. No. 1237, Tariff for Basic Service, September 3, 2014.

APPENDIX B. ADDITIONAL IMPACT ASSESSMENT RESULTS

B.1 Peak Event and Load Shifting Impacts

Figure B-1 shows comparisons of the Pilot to other utility programs for the absolute impacts during Peak Event hours. The Pilot had slightly lower absolute impacts than the comparison programs for most of the technology/price groups. Combined with the percentage comparisons, this suggests that National Grid has slightly lower baseline usage than most of the comparison utilities. Lower baseline usage among National Grid customers could cause National Grid's total savings to be slightly lower than those for comparable programs even though the percentage savings were the same.

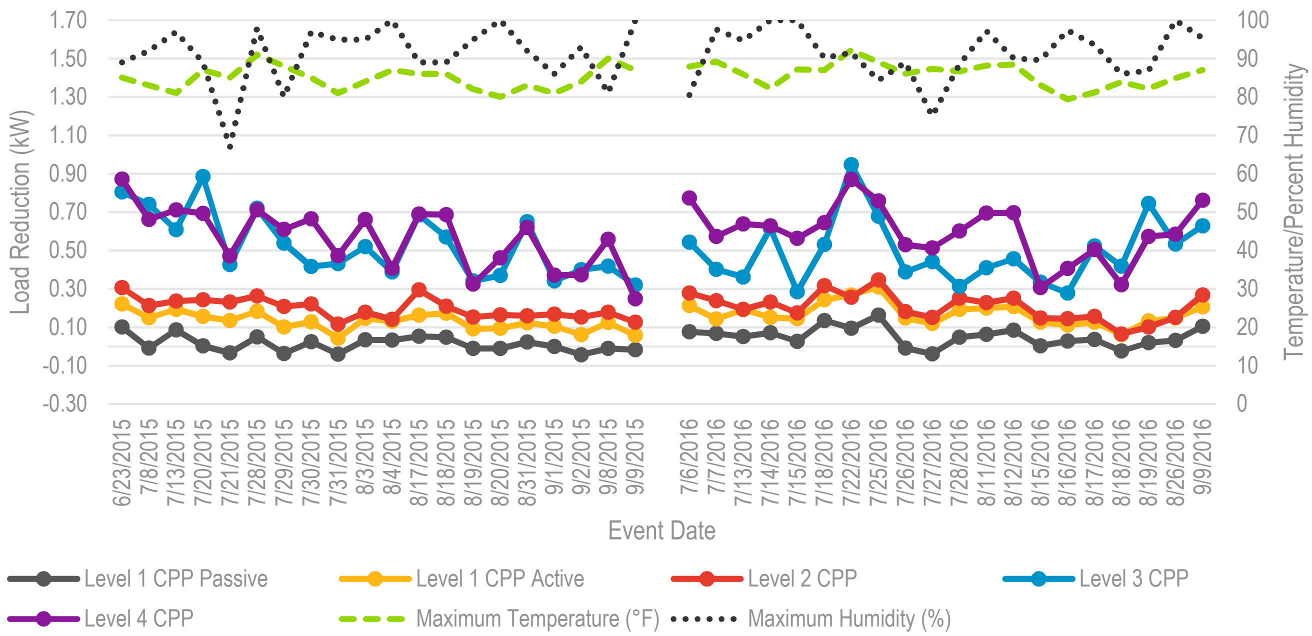
Figure B-1. Peak Event Impacts Absolute Comparison to Other Utilities



Source: Navigant analysis and the Smart Grid Investment Grant program

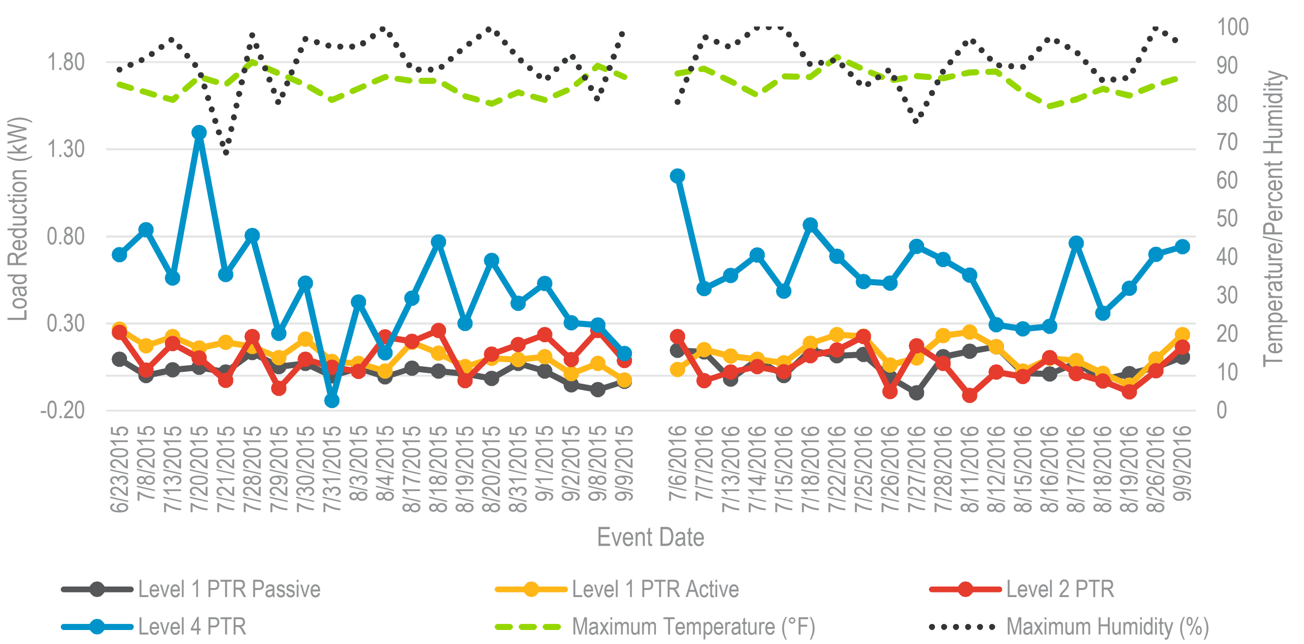
Figure B-2 shows the average absolute impact for each event for the five CPP customer groups, and Figure B-3 shows the average absolute impact for each event for the four PTR groups. The absolute savings followed the same patterns as the percentage savings, with steady impacts for Levels 1 and 2 in both years and decreasing impacts throughout the summer for Levels 3 and 4 in 2015 and steady impacts in 2016. Absolute impacts for passive customers in Level 1 increased from 2015 to 2016.

Figure B-2. Absolute Savings for CPP Customers



Source: Navigant analysis

Figure B-3. Absolute Savings for PTR Customers



Source: Navigant analysis
Note: Level 3 PTR is left out as this group only had one customer in 2015 and two in 2016.

Absolute and percentage impacts by technology/price group for each Peak Event in the two summers of the Pilot are shown in Table B-1 through Table B-4. Positive values indicate savings, or a decrease in electricity usage, and negative values indicate dissavings, or an increase in electricity usage.

Table B-1. Percentage Demand Impact for each Peak Event by Technology/Price Group (2015)

Event Date	Level 1 CPP Passive	Level 1 CPP Active	Level 1 PTR Passive	Level 1 PTR Active	Level 2 CPP	Level 2 PTR	Level 3 CPP	Level 4 CPP	Level 4 PTR
June 23rd	9% *	21% *	9% *	23% *	27% *	20%	50% *	48% *	31% *
July 8th	-1%	15% *	0%	15%	21% *	3%	49% *	38% *	40% *
July 13th	8% *	19% *	3%	20% *	23% *	16%	40% *	40% *	29% *
July 20th	0%	13% *	4%	11%	20% *	8%	45% *	34% *	49% *
July 21st	-3% *	12% *	2%	16% *	21% *	-2%	26% *	26% *	27% *
July 28th	4% *	16% *	12% *	14%	22% *	16%	35% *	35% *	33% *
July 29th	-3% *	9% *	5%	9%	18% *	-6%	29% *	28% *	10%
July 30th	2% *	12% *	6%	16% *	19% *	8%	26% *	34% *	26% *
July 31st	-4% *	5%	0%	8%	12% *	5%	32% *	29% *	-9%
August 3rd	3% *	14% *	4%	6%	16% *	2%	33% *	33% *	21%
August 4th	3% *	13% *	-1%	3%	14% *	18%	28%	25% *	8%
August 17th	4% *	14% *	4%	14% *	23% *	15%	33% *	31% *	20%
August 18th	4% *	14% *	2%	10%	16% *	17%	29% *	30% *	30% *
August 19th	-1%	8% *	1%	4%	13% *	-2%	20%	17% *	14%
August 20th	-1%	9% *	-2%	8%	15% *	10%	23%	27% *	32% *
August 31st	2% *	11% *	6%	7%	14% *	14%	37% *	31% *	22%
September 1st	0%	11% *	3%	11%	17% *	17%	25%	23% *	28% *
September 2nd	-4% *	6% *	-5%	1%	14% *	7%	25% *	20% *	14%
September 8th	-1%	10% *	-7%	5%	15% *	17%	21% *	25% *	13%
September 9th	-1%	5% *	-3%	-2%	10% *	6%	16%	12% *	6%
Average	**1%**	**12%** *	**2%**	**10%**	**17%** *	**9%**	**31%** *	**29%** *	**22%**

Source: Navigant analysis

Note: An asterisk (*) indicates that the majority of the event hours were statistically significant at the 90% confidence level for the indicated group.

Table B-2. Percentage Demand Impact for each Peak Event by Technology/Price Group (2016)

Event Date	Level 1 CPP Passive	Level 1 CPP Active	Level 1 PTR Passive	Level 1 PTR Active	Level 2 CPP	Level 2 PTR	Level 3 CPP	Level 4 CPP	Level 4 PTR
July 6th	6% *	17% *	11% *	3%	23% *	15%	25% *	33% *	46% *
July 7th	6% *	14% *	12% *	13%	23% *	-2%	26% *	34% *	28% *
July 13th	5% *	18% *	-2%	10%	19% *	2%	21% *	34% *	29% *
July 14th	7% *	15% *	8% *	8%	21% *	4%	40% *	37% *	38% *
July 15th	2% *	13% *	0%	6%	16% *	2%	15%	28% *	23%
July 18th	10% *	20% *	11% *	14% *	25% *	8%	26% *	30% *	38% *
July 22nd	7% *	20% *	8% *	16% *	20% *	10%	39% *	34% *	26% *
July 25th	11% *	23% *	8% *	15% *	26% *	14%	29% *	31% *	21% *
July 26th	-1%	13% *	-1%	5%	16% *	-6%	20% *	25% *	24% *
July 27th	-3% *	10% *	-8% *	8%	13% *	12%	22% *	24% *	32% *
July 28th	4% *	16% *	8% *	17% *	21% *	5%	15%	27% *	29% *
August 11th	5% *	15% *	10% *	17% *	18% *	-7%	17% *	28% *	22% *
August 12th	6% *	16% *	11% *	11% *	19% *	1%	20% *	29% *	12%
August 15th	0%	12% *	1%	2%	13% *	0%	19% *	16% *	14%
August 16th	3% *	12% *	1%	10%	15% *	9%	20%	27% *	18%
August 17th	3% *	13% *	7%	8%	16% *	1%	35% *	31% *	44% *
August 18th	-2% *	6% *	-2%	1%	7% *	-2%	26% *	18% *	19%
August 19th	2% *	13% *	1%	-5%	10% *	-7%	43% *	31% *	25% *
August 26th	3% *	14% *	4%	8%	14% *	2%	29% *	29% *	33% *
September 9th	9% *	18% *	9% *	19% *	23% *	11%	32% *	36% *	34% *
Average	**4%** *	**15%** *	**5%**	**9%**	**18%** *	**3%**	**26%** *	**29%** *	**28%** *

Source: Navigant analysis

Note: An asterisk (*) indicates that the majority of the event hours were statistically significant at the 90% confidence level for the indicated group.

Table B-3. Absolute Demand Impact (kW) for each Peak Event by Technology/Price Group (2015)

Event Date	Level 1 CPP Passive	Level 1 CPP Active	Level 1 PTR Passive	Level 1 PTR Active	Level 2 CPP	Level 2 PTR	Level 3 CPP	Level 4 CPP	Level 4 PTR
June 23rd	0.101 *	0.222 *	0.267 *	0.095 *	0.307 *	0.250	0.806 *	0.872 *	0.695 *
July 8th	-0.009	0.150 *	0.173	0.002	0.213 *	0.032	0.740 *	0.662 *	0.838 *
July 13th	0.086 *	0.193 *	0.226	0.034 *	0.236 *	0.185	0.609 *	0.712 *	0.561 *
July 20th	0.003	0.157 *	0.159	0.049	0.244 *	0.102	0.886 *	0.694 *	1.396 *
July 21st	-0.034 *	0.135 *	0.193	0.021 *	0.232 *	-0.026	0.426 *	0.472 *	0.581 *
July 28th	0.050 *	0.184 *	0.168 *	0.133	0.264 *	0.225	0.720 *	0.712 *	0.805 *
July 29th	-0.037 *	0.102 *	0.104	0.052	0.208 *	-0.071	0.539 *	0.611 *	0.243
July 30th	0.025 *	0.129 *	0.210	0.072 *	0.222 *	0.095	0.417 *	0.665 *	0.532 *
July 31st	-0.040 *	0.043	0.083	-0.001	0.117 *	0.050	0.432 *	0.474 *	-0.142
August 3rd	0.035 *	0.147 *	0.072	0.044	0.178 *	0.026	0.520 *	0.662 *	0.423
August 4th	0.034 *	0.131 *	0.028	-0.006	0.141 *	0.224	0.388	0.407 *	0.131
August 17th	0.054 *	0.164 *	0.193	0.043 *	0.295 *	0.198	0.686 *	0.691 *	0.445
August 18th	0.049 *	0.173 *	0.130	0.028	0.210 *	0.261	0.571 *	0.687 *	0.769 *
August 19th	-0.010	0.091 *	0.052	0.012	0.153 *	-0.028	0.341	0.325 *	0.300
August 20th	-0.011	0.095 *	0.101	-0.015	0.165 *	0.124	0.370	0.462 *	0.662 *
August 31st	0.023 *	0.124 *	0.093	0.071	0.160 *	0.180	0.650 *	0.621 *	0.416
September 1st	0.000	0.105 *	0.109	0.027	0.169 *	0.237	0.341	0.372 *	0.530 *
September 2nd	-0.043 *	0.061 *	0.012	-0.051	0.153 *	0.093	0.400 *	0.373 *	0.304
September 8th	-0.011	0.125 *	0.072	-0.079	0.178 *	0.261	0.419 *	0.559 *	0.292
September 9th	-0.017	0.058 *	-0.025	-0.031	0.126 *	0.087	0.320	0.249 *	0.129
Average	**0.012**	**0.129** *	**0.121**	**0.025**	**0.199** *	**0.125**	**0.529** *	**0.564** *	**0.496**

Source: Navigant analysis

Note: An asterisk (*) indicates that the majority of the event hours were statistically significant at the 90% confidence level for the indicated group.

Table B-4. Absolute Demand Impact (kW) for each Peak Event by Technology/Price Group (2016)

Event Date	Level 1 CPP Passive	Level 1 CPP Active	Level 1 PTR Passive	Level 1 PTR Active	Level 2 CPP	Level 2 PTR	Level 3 CPP	Level 4 CPP	Level 4 PTR
July 6th	0.076 *	0.213 *	0.146 *	0.036	0.278 *	0.226	0.544 *	0.773 *	1.146 *
July 7th	0.069 *	0.144 *	0.137 *	0.151	0.239 *	-0.028	0.402 *	0.574 *	0.500 *
July 13th	0.052 *	0.191 *	-0.018	0.114	0.194 *	0.022	0.362 *	0.639 *	0.576 *
July 14th	0.071 *	0.151 *	0.093 *	0.095	0.231 *	0.053	0.617 *	0.628 *	0.694 *
July 15th	0.026 *	0.145 *	0.001	0.075	0.175 *	0.024	0.285	0.564 *	0.486
July 18th	0.135 *	0.244 *	0.149 *	0.186 *	0.317 *	0.116	0.531 *	0.646 *	0.865 *
July 22nd	0.095 *	0.269 *	0.116 *	0.236 *	0.257 *	0.149	0.947 *	0.871 *	0.686 *
July 25th	0.163 *	0.310 *	0.123 *	0.227 *	0.347 *	0.225	0.679 *	0.758 *	0.541 *
July 26th	-0.008	0.148 *	-0.009	0.062	0.182 *	-0.090	0.388 *	0.530 *	0.532 *
July 27th	-0.039 *	0.120 *	-0.098 *	0.103	0.152 *	0.172	0.442 *	0.513 *	0.742 *
July 28th	0.049 *	0.193 *	0.109 *	0.230 *	0.252 *	0.072	0.313	0.602 *	0.667 *
August 11th	0.064 *	0.200 *	0.141 *	0.251 *	0.228 *	-0.113	0.410 *	0.696 *	0.577 *
August 12th	0.085 *	0.208 *	0.167 *	0.167 *	0.252 *	0.022	0.457 *	0.697 *	0.293
August 15th	0.003	0.126 *	0.017	0.027	0.148 *	-0.004	0.335 *	0.307 *	0.269
August 16th	0.029 *	0.112 *	0.010	0.101	0.145 *	0.105	0.278	0.406 *	0.284
August 17th	0.036 *	0.127 *	0.074 *	0.088	0.157 *	0.012	0.524 *	0.505 *	0.761 *
August 18th	-0.024 *	0.061 *	-0.022	0.014	0.065 *	-0.030	0.419 *	0.322 *	0.360
August 19th	0.02 *	0.134 *	0.013	-0.054	0.102 *	-0.092	0.745 *	0.574 *	0.502 *
August 26th	0.032 *	0.148 *	0.050 *	0.097	0.152 *	0.029	0.534 *	0.586 *	0.696 *
September 9th	0.105 *	0.206 *	0.107 *	0.236 *	0.269 *	0.164	0.629 *	0.762 *	0.740 *
Average	**0.052** *	**0.173** *	**0.065**	**0.122**	**0.207** *	**0.052**	**0.492** *	**0.598** *	**0.596** *

Source: Navigant analysis

Note: An asterisk (*) indicates that the majority of the event hours were statistically significant at the 90% confidence level for the indicated group.

Absolute snapback impacts by technology/price group for each Peak Event in each summer of the Pilot are shown in Table B-5 and Table B-6. As noted in Section 3.4.1 no snapback was found for Level 2 customers on either rate, thus these groups are left out of the table. Negative values indicate snapback, or an increase in electricity usage subsequent to a Peak Event, and positive values indicate continued lower usage subsequent to a Peak Event.

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Table B-5. Absolute Snapback (kW) for each Peak Event by Technology/Price Group (2015)

Event Date	Level 1 CPP Passive		Level 1 CPP Active		Level 1 PTR Passive		Level 1 PTR Active		Level 3 CPP		Level 4 CPP		Level 4 PTR	
June 23rd	-0.02	*	0.05	*	0.04		0.00		-0.23	*	-0.14	*	0.17	
July 8th	-0.06	*	-0.04	*	0.00		-0.01		-0.42	*	-0.22	*	-0.43	*
July 13th	0.07	*	0.09	*	0.00		0.03		-0.18		0.03		0.03	
July 20th	-0.14	*	0.00		-0.17	*	0.00		-0.42	*	-0.45	*	0.35	
July 21st	-0.09	*	-0.01		0.02		-0.36	*	-0.53	*	-0.36	*	-0.15	
July 28th	0.08	*	0.07	*	0.00		0.00		-0.01		-0.22	*	-0.27	
July 29th	0.00		0.03	*	0.09	*	0.00		-0.55	*	-0.14		-0.12	
July 30th	0.02	*	0.00		0.00		0.00		-0.61	*	-0.18	*	-0.14	
July 31st	-0.04	*	-0.01		-0.08	*	0.00		-0.17		-0.23	*	-0.91	*
August 3rd	0.00		0.07	*	0.00		0.00		-0.43	*	-0.15	*	-0.29	*
August 4th	0.07	*	0.10	*	-0.03	*	0.00		-0.36	*	-0.11	*	-0.16	
August 17th	0.14	*	0.09	*	0.03	*	0.00		0.20		-0.10	*	-0.05	
August 18th	0.05	*	0.04	*	0.05	*	0.00		-0.13		-0.18	*	-0.13	
August 19th	0.00		0.00		0.00		0.00		-0.47	*	-0.30	*	-0.38	*
August 20th	0.01		0.00		0.00		0.00		-0.55	*	-0.22	*	-0.31	
August 31st	0.00		0.00		0.00		0.00		-0.37	*	-0.49	*	-0.50	*
September 1st	-0.02	*	0.00		0.00		0.00		-0.31	*	-0.26	*	0.00	
September 2nd	-0.01		0.00		0.00		0.00		-0.43	*	-0.40	*	-0.61	*
September 8th	0.00		0.02	*	0.00		0.02		-0.15		-0.16	*	-0.69	*
September 9th	0.00		-0.09	*	0.00		0.00		-0.13		-0.34	*	-0.71	*
Average	**0.00**		**0.02**		**0.00**		**-0.02**		**-0.31**	*	**-0.23**	*	**-0.27**	

Source: Navigant analysis

Note: An asterisk (*) indicates that the majority of the event hours were statistically significant at the 90% confidence level for the indicated group.

Table B-6. Absolute Snapback (kW) for each Peak Event by Technology/Price Group (2016)

Event Date	Level 1 CPP Passive		Level 1 CPP Active		Level 1 PTR Passive		Level 1 PTR Active		Level 3 CPP		Level 4 CPP		Level 4 PTR	
July 6th	0.096	*	0.07	*	0.177	*	0		-0.123		-0.149	*	0.175	
July 7th	0.076	*	0.04	*	0.108	*	0		-0.299	*	-0.14	*	-0.122	
July 13th	0.032	*	0.04	*	0		0		-0.352	*	-0.205	*	-0.251	
July 14th	0.037	*	0.03	*	0		0		0.147		-0.104	*	-0.078	
July 15th	0.083	*	0.11	*	0.135	*	0		-0.071		0.012		0.053	
July 18th	0.108	*	0.07	*	0.152	*	0		0.135		-0.096	*	-0.058	
July 22nd	0.221	*	0.22	*	0.093	*	0		0.289		0.255	*	0.114	
July 25th	0.144	*	0.13	*	0.201	*	0		-0.119		-0.063		-0.301	
July 26th	0.006	*	0.02	*	0		-0.227	*	-0.263	*	-0.35	*	-0.537	*
July 27th	-0.034	*	-0.06	*	0		0		-0.481	*	-0.616	*	-0.703	*
July 28th	0.067	*	0.10	*	0		0		0.021		-0.146	*	-0.619	*
August 11th	0.101	*	0.08	*	0.123	*	0		-0.358	*	-0.019		-0.65	*
August 12th	0.043	*	0.00		0.127	*	0		-0.319	*	-0.136	*	-0.196	
August 15th	0.007	*	-0.03		0		-0.308	*	-0.14		-0.39	*	-0.639	*
August 16th	0.033	*	0.02	*	0		0		-0.249	*	-0.192	*	-0.097	
August 17th	0.094	*	0.10	*	0.127	*	0		-0.061		-0.096	*	-0.28	
August 18th	-0.034	*	0.00		0		0		-0.247	*	-0.373	*	-0.416	*
August 19th	0		0.04	*	0		-0.045	*	0.364	*	-0.132	*	-0.034	
August 26th	0		0.02	*	0		-0.285	*	-0.183		-0.242	*	0.22	
September 9th	0.099	*	0.10	*	0.028	*	0		-0.002		-0.084	*	-0.124	
Average	**0.06**		**0.06**		**0.06**		**-0.04**		**-0.12**	*	**-0.16**		**-0.23**	*

Source: Navigant analysis

Note: An asterisk (*) indicates that the majority of the event hours were statistically significant at the 90% confidence level for the indicated group.

B.2 Arrearages Analysis Tables

Table B-7 through Table B-10 show the results of Navigant's review of credit and collections for Pilot participants versus other Worcester customers. This analysis included review of:

- End of Pilot arrears balances and customer counts for 30/60/90+ day periods;

- End of Pilot arrears balances and customer counts for accounts flagged as medical or life support, and therefore not subject to disconnections;
- Disconnection service history before and during the Pilot; and,
- Uncollectible account history before and during the Pilot.

Overall compared to Worcester customers not in the Pilot, a smaller portion of the Pilot participants had disconnections or uncollectible balances. However, this was true in 2014, before the Pilot began, as well as during the Pilot in 2015 and 2016. A similar percentage of customers within and outside of the Pilot had arrears balances. The average dollar amounts per customer with arrears, disconnects, or uncollectible balances were also similar for Pilot and non-Pilot customers. Therefore, the Pilot did not appear to have a large impact on any of these metrics.

Table B-7. Arrears Balances for 30/60/90+ Days

	30 Day Arrears	60 Day Arrears	90 and Plus Day Arrears	Total Arrears
Worcester Non-Pilot Customers	$3,595,793	$1,911,086	$11,390,436	$16,897,315
Pilot Participants	$504,055	$272,787	$1,900,085	$2,676,928
	30 Day Arrears - Customer Counts	**60 Day Arrears - Customer Count**	**90 and Plus Day Arrears - Customer Count**	**Total Arrears - Customer Counts**
Worcester Non-Pilot Customers	19,899	12,846	10,412	20,451
Pilot Participants	3,289	1,913	1,507	3,363
	30 Day Arrears -Average Per Customer	**60 Day Arrears - Average Per Customer**	**90 and Plus Day Arrears - Average Per Customer**	**Total Arrears - Average Per Customer**
Worcester Non-Pilot Customers	$181	$149	$1,094	$826
Pilot Participants	$153	$143	$1,261	$796
	30 Day Arrears - Customer Counts as % of Customer Base	**60 Day Arrears - Customer Counts as % of Customer Base**	**90 and Plus Day Arrears - Customer Counts as % of Customer Base**	**Total Arrears - Customer Counts as % of Customer Base**
Worcester Non-Pilot Customers	28%	18%	15%	29%
Pilot Participants	32%	18%	15%	32%

Source: Navigant analysis

Table B-8. Arrears Balances for Medical and Life Support Accounts

	Total Medical & Life Support Accounts	Accounts with Arrears Balance	Share of Medical & Life Support Accounts with Arrears Balances	Average Arrears Per Account
Worcester Non-Pilot Customers	1,245	885	71%	$4,129
Pilot Participants	155	121	78%	$5,031

Source: Navigant analysis

Table B-9. Disconnection Service History

Year	Worcester Non-Pilot Customers			Pilot Participants		
	Total Number of Customers			Total Number of Customers		
2014	69,029			11,184		
2015	70,090			10,555		
2016	69,915			10,361		
	Number of Disconnected Customers	Total $ Amount in Arrears	Average $ Amount Per Disconnected Customer	Number of Disconnected Customers	Total $ Amount in Arrears	Average $ Amount Per Disconnected Customer
2014	2,536	$3,305,180	$1,303	282	$332,185	$1,178
2015	4,140	$5,327,681	$1,287	314	$372,751	$1,187
2016	4,348	$4,881,481	$1,123	598	$777,486	$1,300
	Percentage of Total Customers Disconnected			Percentage of Total Customers Disconnected		
2014	3.7%			2.5%		
2015	5.9%			3.0%		
2016	6.2%			5.8%		

Source: Navigant analysis

Table B-10. Uncollectible Account History

Year	Worcester Non-Pilot Customers			Pilot Participants		
	Total Number of Customers			Total Number of Customers		
2014	69,029			11,184		
2015	70,090			10,555		
2016	69,915			10,361		
	Number of Uncollectible Customers	Total $ Amount in Arrears	Average $ Amount Per Uncollectible Customer	Number of Uncollectible Customers	Total $ Amount in Arrears	Average $ Amount Per Uncollectible Customer
2014	4,044	$4,636,522	$1,147	272	$349,719	$1,286
2015	4,411	$5,666,770	$1,285	434	$556,184	$1,282
2016	4,998	$5,810,217	$1,163	617	$788,534	$1,278
	Percentage of Total Customers with Uncollectibles			Percentage of Total Customers with Uncollectibles		
2014	5.9%			2.4%		
2015	6.3%			4.1%		
2016	7.1%			6.0%		

Source: Navigant analysis

APPENDIX C. DETAILED SURVEY, INTERVIEW, AND FOCUS GROUP RESULTS

Throughout every stage of the Pilot, National Grid sought customer feedback in order to understand customer awareness and experiences with the rates, technologies, and operation of Peak Events. Navigant completed several surveys, interviews, and focus groups, which are summarized in the body of this report. This appendix details customer responses to the following data collection activities:

1. Meter Decline Survey, November 2013
2. Pre-Pilot Survey, February 2014
3. Pre-Pilot Commercial Interviews, April-May 2014
4. Post Installation Survey, April 2014-March 2015
5. Post Event Surveys, June-July 2015 & July-August 2016; End of Summer Survey, September 2015; and End of Pilot Survey, October 2016
6. End of Summer Low-Income Focus Groups, September 2015 & September 2016
7. End of Summer Commercial Interviews, October 2015
8. Opt Out & Drop Out Survey, November 2015 & October 2016

C.1 Meter Decline Survey, November 2013

The rate at which National Grid customers declined to have a smart meter installed (4%) was within the range of full-scale deployments by other utilities, some of which did not initially offer the option to opt out of meter installation (Table C-1). Seventy customers who had actively declined a meter were interviewed by phone in order to understand why they opted out of the meter installation. Customers who did not have an installation completed due to technical problems were not addressed in this survey.

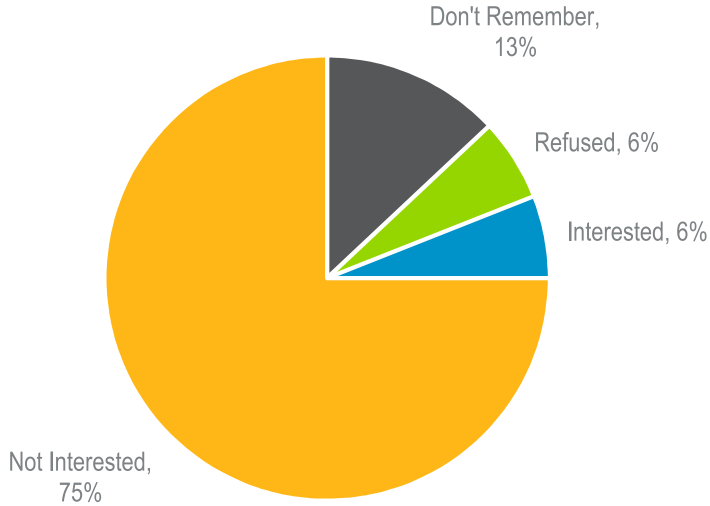
Table C-1. Comparison of Meter Decline Rate to Other Meter Installations

Utility	Total Residential Customers (#)	Opt Out (#)	Percentage Opt Out	Notes on Opt Out
BC Hydro	2,000,000	60,000	3%	Full system deployment
SCE	4,283,836	23,100	1%	Full system deployment
PG&E	5,500,000	42,905	1%	Full system deployment
Central Maine Power	620,000	8,000	1%	Full system deployment
SDG&E	1,249,104	2,227	<1%	Full system deployment

Source: Navigant analysis of the meter decline survey and other utility meter deployments

Customers who declined a meter tended to not have knowledge about the Pilot; as shown in Figure C-1, 75% were not interested in participating in the Pilot at all.

Figure C-1. Desire of Customers who Declined Meter to Participate in Pilot



Source: Navigant analysis of the meter decline survey (N=70)

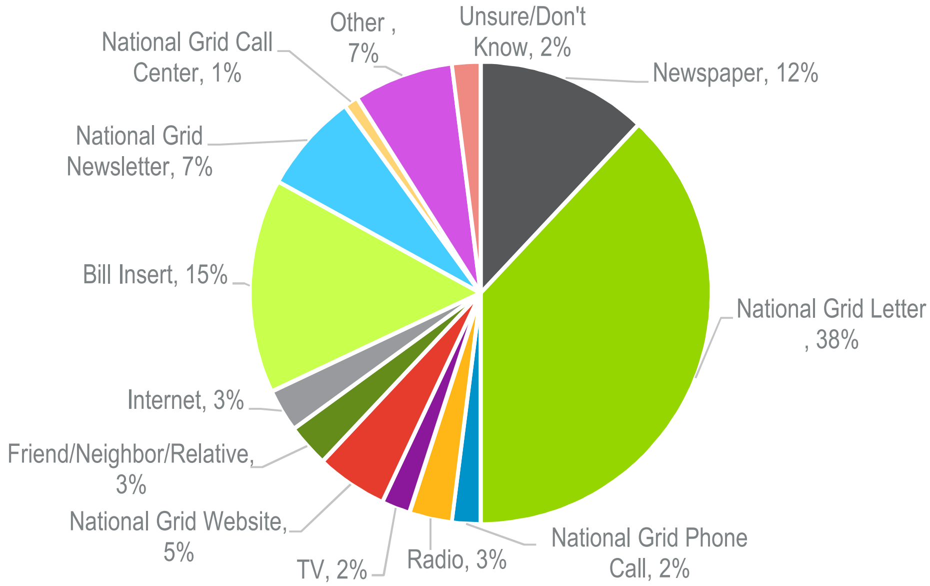
When asked why they declined to have a meter installed, 61% of customers cited only one reason for declining, 31% cited two reasons, and 7% cited three reasons. The single most often cited reason was "I won't benefit from this," followed by health and safety concerns.

C.2 Pre-Pilot Survey, February 2014

The Smart Energy Solutions pre-pilot survey was fielded to potential Pilot participants from January 9, 2014 to February 12, 2014. The survey was available to a total population of 12,823 residential customers through an online survey and in-bound and out-bound phone calls. A total of 1,470 residential customers completed the survey, or approximately 11.5% of the eligible population. The survey contained questions about a wide range of topics including demographic information, Pilot awareness and attitude, end-use appliance information, and energy usage habits. The survey was built upon the pre-pilot survey developed as part of the *Common Evaluation Framework* produced by the Massachusetts Smart Grid Collaborative Technical Subcommittee. With National Grid and DPU approval, some modifications were made to the survey to accommodate the Smart Energy Solutions Pilot.

At the time of the survey, almost 50% of customers surveyed had read, seen, or heard information about Smart Energy Solutions within the previous three months. The most common way that customers had heard about the Pilot was from a National Grid communication (letter or bill insert) (see Figure C-2).

Figure C-2. How Customers Heard of the Pilot

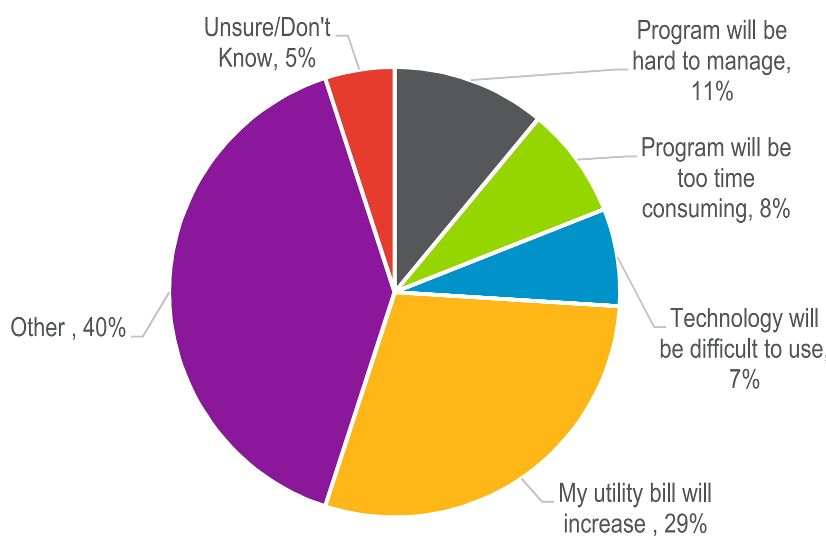


Source: Navigant analysis of pre-pilot survey (N=706)

Within the respondents' verbatim responses, many requested more information about the Pilot. Many respondents across all demographic segments also expressed interest in participating in the Pilot if it could provide them a better way to manage their energy usage and decrease their monthly energy bill.

The majority (53%) of customers did not have any concerns about participating in the Pilot. Of those that did have concerns, the most common was with their bill increasing, as shown in Figure C-3. Verbatim responses showed a similar pattern and are represented in the "Other" category.

Figure C-3. Reasons for Concern with Pilot Participation



Source: Navigant analysis of pre-pilot survey (N=323)

C.3 Pre-Pilot Commercial Interviews, April-May 2014

Navigant contacted 99 commercial customers in the Pilot area to establish a focus group to discuss their understanding of the Pilot before it began. After five attempts and having only recruited four customers, Navigant decided to interview the customers individually rather than convene a focus group. The interviews provided insight into how much each customer knew about Smart Energy Solutions, how they believed it would affect them, and how much they knew about the Sustainability Hub. The customers represented a variety of services: commercial landlord, construction and real estate development, automotive services, and operations for the City of Worcester. There were no retail sales businesses among the sample.

The evaluation team found that customers appeared to be unaware of the products and services available to them, including technology packages and the Sustainability Hub. Overall, the customers' feedback emphasized their communication desires, including the following:

- **Desire for personal National Grid contact.** Customers said that they would appreciate more personal interactions with National Grid in order to learn about the program. They wanted to receive emails about the program directly from a contact at National Grid and know that they could easily call or email a National Grid employee with questions.
- **Preference for web-based information presentment.** Besides emails, these customers would like to access information about the Pilot online rather than via a smartphone app or IHD.

Although National Grid had not released any information about the program rate before the interviews took place, customers understood the program rates when the evaluation team explained them. Two of the interviewees raised concerns that they could not shift their electricity usage because their business model depends on their using energy-intensive heavy equipment during weekday business hours. The participants' responses suggested that it would be important for National Grid to emphasize how the rate plans may affect commercial as well as residential customers during the Pilot.

C.4 Post Installation Survey, April 2014-March 2015

Navigant completed 241 surveys out of a population of 743 National Grid residential customers who had technologies installed between April 2014 and February 2015. Customers reported strong satisfaction with installation:

- 98% of participants reported that installers appeared at the scheduled day and time
- 90% of participants received the equipment they expected
- 99% of participants received training
- 91% of participants received hands-on demonstrations
- 67% of participants found explanations of how equipment worked "very clear" and 27% found explanations "somewhat clear"
- Verbatim responses indicated some participants were not able to access expected usage/cost data or thought it insufficient for their needs

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C.5 Post Event Survey, June-July 2015 & July-August 2016; End of Summer Survey, September 2015; and End of Pilot Survey, October 2016

Navigant achieved 2,974 completes across four post event surveys and two end of season surveys (Table C-2). The majority of respondents were Level 1 customers, which was not surprising considering most participants have Level 1 technology.

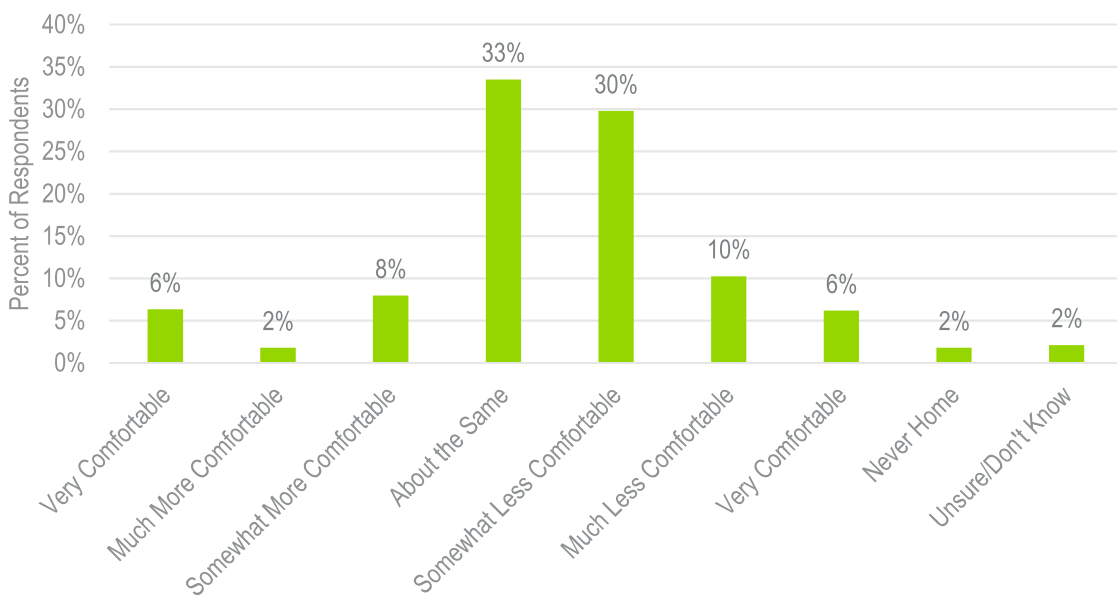
Table C-2. Number of Respondents per Post Event, 2015 End of Summer, and 2016 End of Pilot Survey by Technology Package

Survey	Level 1	Level 2	Level 3	Level 4	Totals
Post Event #1 - June 2015	307	154	10	54	**525**
Post Event #2 - July 2015	167	68	5	30	**270**
End of Summer - September 2015	315	118	7	66	**506**
Post Event #3 - July 2016	377	130	6	50	**563**
Post Event #4 - July 2016	325	112	4	54	**495**
End of Pilot - October 2016	381	144	11	79	**615**

Source: Navigant analysis of post event, 2015 end of summer, and 2016 end of pilot surveys

In comparison to a typical afternoon, participants in the Pilot reported that they were generally equally or less comfortable in their home during the Peak Events, as shown in Figure C-4.

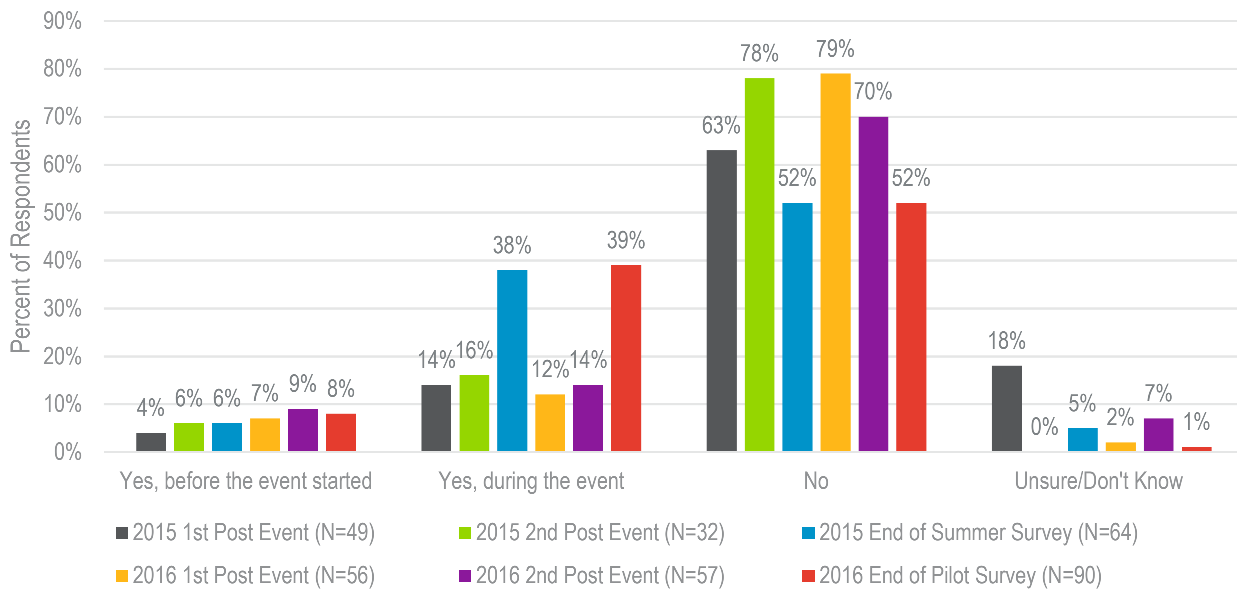
Figure C-4. Comfort during Peak Events Compared to a Typical Afternoon with Similar Temperatures



Source: Navigant analysis of 2016 end of pilot survey (N=615)

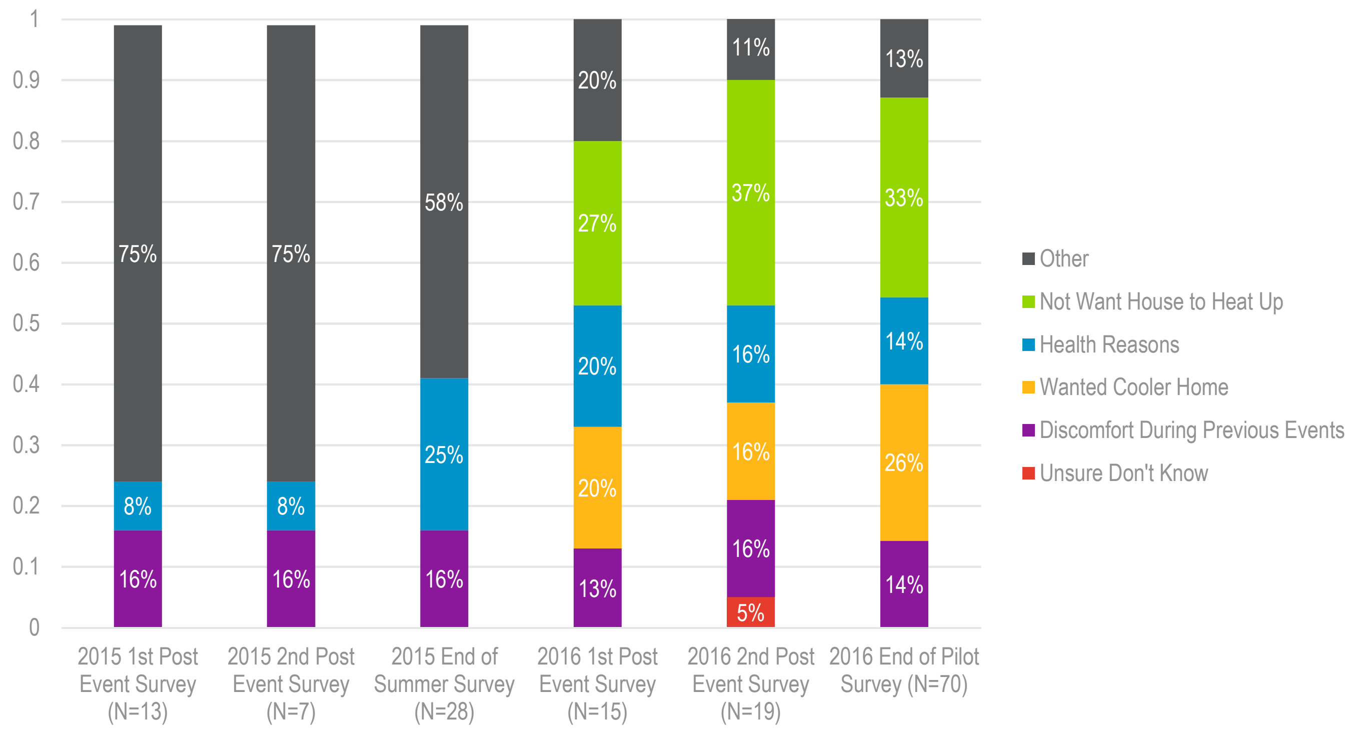
The end of pilot survey asked respondents with a thermostat a series of questions about how they used their thermostat during Peak Events throughout the two summers. In each year as the summer progressed, respondents reported using the override button on their thermostat more frequently (see Figure C-5). In each summer, a little under 40% of customers indicated overriding their thermostat at least once during a Peak Event. As shown in Figure C-6, when asked in the post event and end of season surveys, customers cited comfort and health as reasons for overriding the thermostat adjustment ("Other" responses were primarily about comfort or confirming that there were no other reasons for the override). Nearly two-thirds of thermostat respondents were satisfied with their smart thermostat; few participants (7%) were dissatisfied with the smart thermostat.

Figure C-5. Occurrence of Smart Thermostat Overrides



Source: Navigant analysis of post event (N=49, N=32, N=56, N=57), 2015 end of summer (N=64), and 2016 end of pilot (N=90) surveys

Figure C-6. Reasons for Smart Thermostat Overrides



Source: Navigant analysis of post event (N=13, N=7, N=15, N=19), 2015 end of summer (N=28), and 2016 end of pilot surveys (N=70)

Half of respondents that had a smart plug reported using it during Peak Events in 2015 and 30% reported doing so in 2016. In 2015, those who used their smart plug plugged it into small appliances and electronics (26%), lamps or other light fixtures (8%), refrigerator or freezer (4%)—although National Grid told customers not to use the smart plug for these appliances—room air conditioner or dehumidifier (4%), or other uses (8%). In 2016, those who did not use their smart plug reported that they had forgotten about the Smart Plug (20%), did not understand its purpose (16%), or did not know how to use it (9%). Most customers were satisfied or very satisfied with the smart plug.

C.6 Low-Income Focus Groups

Purpose and Recruitment

To gain a nuanced understanding of how low-income participants perceived and adjusted to the Pilot, Navigant hosted three low-income focus groups: two in 2015 and one in 2016. Using a script developed by Navigant and approved by National Grid and low-income stakeholders, recruiters offered a $150 incentive for participation in a 90-minute discussion with a Navigant moderator. Almost all of the participants in the three groups had technology Level 1, and all but two participants were on the CPP program rate.

In 2015, 22 Pilot participants whose self-reported income was less than or equal to 60% of Massachusetts median income, accounting for household size, took part in the two focus groups.

In 2016, to reach customers at even lower income levels, Navigant recruited participants whose self-declared income was at or below 200% of federal poverty levels. Although 13 customers agreed to participate, only 6 appeared for the group.[107]

Participants varied in their household composition, including single parents (male and female), single elders, elders with grandchildren, families with one or more people with health problems such as asthma, families with seriously ill members, and one college student.

Focus Group Discussion Topics and Responses

Focus group topics included:

- Energy affordability and options and practices for reducing electricity use;
- Presence of very young, elderly, ill, and disabled household members, or pets during Peak Events;
- Participant awareness of events and responses to them;
- Awareness of program technology and reasons for not signing up;
- Internet access, familiarity, and usage; and,
- Awareness of program rates, bill protection, and ability to initially choose and later switch rates.

Through these three focus groups, low-income customers reported several concerns about participating in the Pilot including:

- Keeping the home cool for homebound parents, members in poor health, babies, and/or pets;
- Electricity expenses and affordability;
- Options for reducing their electricity usage; and
- Desire for more information and transparency about their particular electric usage and bill savings opportunities.

Unsurprisingly, participants expressed considerable concern about electricity cost and affordability. They were positive about the Pilot, engaged, and felt they were able to manage their electricity use; however, in more detailed discussion some said they had few options for making real reductions. They were highly aware of events and most preferred text and email event notifications. However, some expressed the opinion that if they missed a notification or a family member kept the air conditioning running they were being penalized for not cutting back during the event. The two participants on the PTR rate were aware of rebates for conserving electricity but did not understand how the rebates were calculated, even when an explanation was provided.

Participants were not aware of a number of factors that might affect their participation in the Pilot, including rate choices, technology options, and bill protection. All of the groups strongly expressed a

[107] This occurred despite reminder phone calls made the day before the focus group to those who had agreed to participate.

desire for more information and more explanation, such as what sort of rate would provide the lowest cost given their particular circumstances. Despite this, focus group participants were positive about the Pilot overall and showed a willingness to learn and to do as much as they could to take actions that would lower their electric bills.

In all three groups, participants reported taking the maximum measures they could think of to reduce electricity usage during events, even if those actions affected their comfort or feeling of wellbeing. These actions included conversations with family members to impress the importance of taking actions such as playing video games on battery operated handheld devices rather than online or on the television with a video game console. Participants reduced or completely turned off all lighting, clothes and dishwashers, and air conditioning during events, including households who had elderly or sick members. One person reported closing every circuit breaker in the house except for the 20-year-old refrigerator. Many recipients left the home, going to libraries, museums, stores, or any publicly open place that had air conditioning, but for the longer Peak Events that strategy was not always practical, especially around mealtimes. In 2016, which had several back-to-back events, participants expressed weariness by the second or third day and some said they gave up trying at some point. From these actions participants felt they used considerably less electricity but they did not see bill reductions in line with their actions. There was no awareness of bill protection or the net effect of truing up bills on an annual basis. This lack of bill protection awareness was not limited to low-income participants, as demonstrated in surveys.

Participants were very aware of the rewards platform and were positive about it. However, they had little or no awareness of National Grid's energy efficiency programs or programs offered through community groups like Worcester Community Action, although one person was having an old refrigerator replaced, apparently through the Low-Income Retrofit initiative.

Participants had little or no awareness of rate choices at the outset of the Pilot or their ability to switch to the PTR rate. One participant with a chronically ill household member found out about the PTR pricing plan through a call to National Grid customer service and found that the switch made a substantial difference in their bill because they could not do without air conditioning.

Most Level 2 focus group participants were positive in their views about the IHD's, however the great majority of focus group participants were unaware of the technology choices. When participants had an opportunity to see the IHDs in person during the focus groups they were very positive about the technology offerings as tools in managing electricity usage.

C.7 End of Summer Commercial Interviews, October 2015

As there were too few commercial customers in the Pilot area to survey, Navigant interviewed four commercial participants in order to obtain qualitative input about their 2015 summer season experience. National Grid and Navigant identified approximately 275 commercial participants on general service (G1) rates, but the majority were property owner accounts and almost all were on the Critical Peak Pricing (CPP) rate with Level 1 technology. Navigant sought a variety of participants, aiming to talk to customers with Level 2 or higher technology as well as a PTR customer, focusing on retail and office customers. Customers received a $200 honorarium or charity donation for a 30-minute interview. The four interviewed customers were all on the CPP rate with Level 1 technology.

The evaluation team found that the commercial customers interviewed were continuing business as usual and with one exception were not aware of their rate choice within the Pilot. The participants knew about the CPP pricing plan but not the PTR pricing plan and knew about the events but were unable to adjust their usage during them.

Given the very low response rates and the amount of effort exerted to recruit just five customers for interviews in 2015, as well as the small number of commercial participants in the Pilot, Navigant did not conduct commercial interviews in 2016.

C.8 Opt Out & Drop Out Surveys, November 2015 & October 2016

Customers could change rates or leave the Pilot at any time. Navigant surveyed these customers on a rolling basis to understand their reasons for "opting out" (*i.e.*, switching from CPP to PTR) or dropping out of the program, based on whether enough customers had dropped out or opted out to have a statistically significant customer pool to survey. Enough customers had dropped out of the program, or switched to the PTR rate by November 2015 to field a survey. Due to the very low rate of opting out and dropping out, a second survey was not fielded until the end of the Pilot in October 2016.

Across both surveys Navigant completed surveys with 42 customers (Table C-3). Six of the PTR respondents dropped out before the Pilot rates-go-live date of January 1, 2015, and the rest dropped out during the Pilot.

Table C-3. Opt Out & Drop Out Customers Surveyed by Technology Package

Technology Package	2015		2016	
	Opt Out	Drop Out	Opt Out	Drop Out
Level 1	5	14	2	6
Level 2	1	6	0	3
Level 3	1	1	0	0
Level 4	1	0	0	2
Total	**8**	**21**	**2**	**11**

Source: Navigant analysis of the opt out and drop out surveys

Survey responses indicated that customers that dropped out of the program felt:

- More information was needed on the Pilot;
- Peak Event hours were inconvenient;
- The Pilot intruded on privacy and personal decision-making;
- The Pilot increased their bills;
- Savings didn't justify the effort; and,
- They could not change electric usage due to equipment they needed to use.

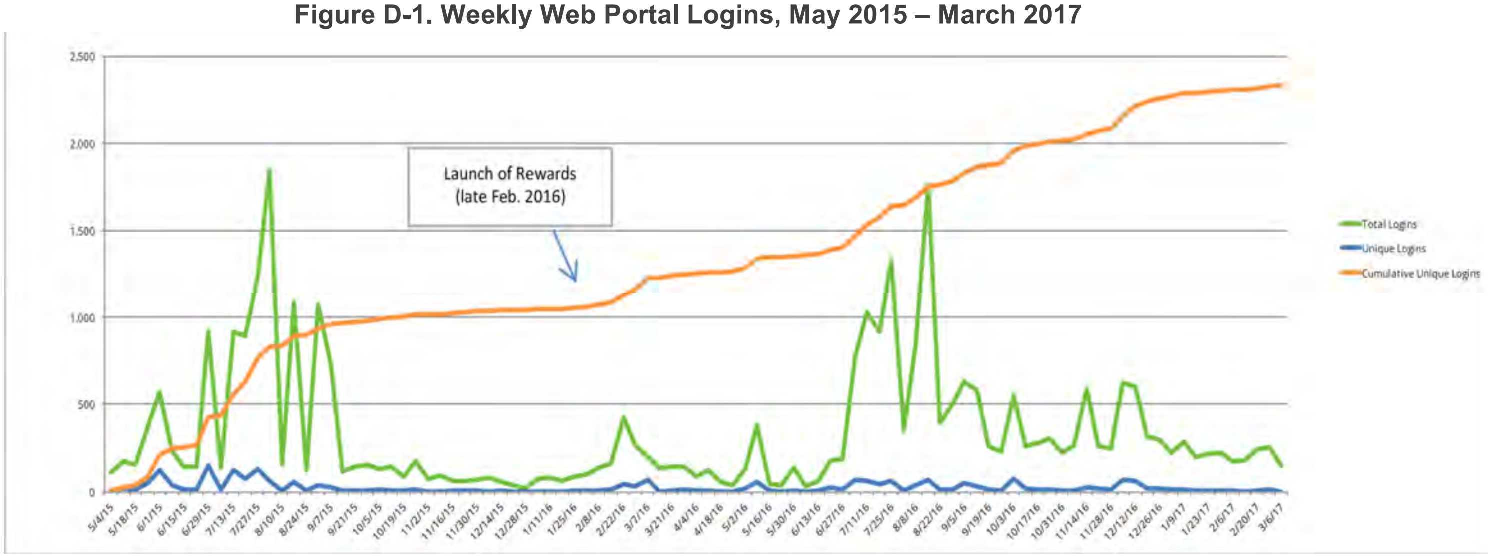
APPENDIX D. REWARDS PLATFORM EFFECTIVENESS

The rewards platform on the WorcesterSmart web portal was launched in February 2016. As of March 2017, over 2,200 rewards had been redeemed by Pilot participants. The following results came from National Grid's internal assessment of the platform's effectiveness.

Web Portal Logins

Since launching the rewards platform, there has been a considerable increase in the total logins to the web portal (Figure D-1). After the launch of the rewards platform, the average weekly login count jumped from 323 (from 5/4/15 to 2/21/16) to 360 (from 2/22/16 to 3/6/17) – an 11.5% increase. While logins spiked after the initial program launch in 2014 and again during the first Peak Event season in 2015, they plateaued following the Pilot's first Peak Event season – until the February 2016 addition of rewards reinvigorated customer interest.

Figure D-1. Weekly Web Portal Logins, May 2015 – March 2017



Source: National Grid
*The "cumulative logins" are cumulative as of this chart's start date (i.e. they exclude unique logins prior to 5/04/2015).

Communication Click-to-Open Rates

Table D-1 details the click-to-open rates (the key measurement for conversion) for Peak Event-related communications in 2015 and 2016. These rates generally improved from 2015 to 2016. For emails sent to customers the day before Peak Events click-to-open rates increased by 18.4%, and for emails sent the day of Peak Events click-to-open rates increased by 9.2%.

Table D-1. Click-to-Open Rates for Peak Event Emails in 2015 and 2016

	Click-to-Open Rates	
Peak Event Emails Sent	2015	2016
Day Before	5.91%	7.0%
Day Of	8.7%	9.5%
Day After	31.0%	22.6%

Source: National Grid

Program Satisfaction

National Grid also found that the rewards platform positively impacted customer satisfaction. In a survey conducted by National Grid in January and February 2017, 83% of customers rated the value of the rewards feature as a 4 or 5 on a 5-point scale. Ranked among other web portal site and program features (such as Peak Event content, energy-saving tips, and energy insights), the rewards feature received the highest customer satisfaction score. Furthermore, 68% of customers reported that email content relating to rewards and contests helped them to save energy and money in their homes. These survey results suggest that rewards are a significant motivator and driver of site traffic, engagement, and energy savings.

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APPENDIX E. MEDIA COVERAGE OF SMART ENERGY SOLUTIONS

Various media sources have covered Smart Energy Solutions from different points of view. National Grid's "listen, test, learn" approach lends itself to reviewing criticism and praise, and adjusting the Pilot or providing additional information to customers.

The following summarizes a selection of these stories:

Title: A Controversy Erupts in Worcester: All Eyes on Smart Grid Plan

Date: January 30, 2014

Link: http://worcestermag.com/2014/01/30/controversy-erupts-worcester-eyes-smart-grid-plan/20499

Summary: This article, written early in the Pilot—after meter installation was completed and just as technologies and rates were offered, provides coverage of National Grid's cooperation with neighbors to build a communications tower. It details concerns that some customers have about smart meter radio frequency, as well as information National Grid provided about smart meter radio frequency strength in order to educate people about the low health risk posed by smart meters.

Title: National Grid Smart Grid Program Launches Technology Phase

Date: April 1, 2014

Link: http://www.golocalworcester.com/news/national-grid-smart-grid-program-launches-technology-phase

Summary: Released during National Grid's customer technology launch, this article discusses the customer-facing and grid-facing investments covered in the Pilot. It provides detail on the distribution and communication infrastructure investment.

Title: National Grid's Sustainability Hub Gathers Customers and Community

Date: December 16, 2014

Link: http://www.intelligentutility.com/article/14/12/national-grid-s-sustainability-hub-gathers-customers-and-community

Summary: This op-ed by National Grid's VP of Customer Strategy and Engagement, Ed White, summarizes the Sustainability Hub's first year as an educational tool and community space. It highlights events held at the Sustainability Hub, individuals and groups who visit the Hub to learn about the Pilot and sustainability, as well as community groups that use the Hub as a meeting space.

Title: Worcester Smart Grid Up and Running as National Grid Launches Pilot Program

Date: January 15, 2015

Link: http://www.masslive.com/news/worcester/index.ssf/2015/01/worcester_smart_grid_up_and_r.html

Summary: Written shortly after the Pilot rates went live, this article summarizes rate offerings and describes meters, anticipated customer savings, as well as National Grid's smart grid distribution system investments. It also cites Worcester's diversity as the driver to have the Pilot in Worcester.

Title: National Grid's Smart Energy Solutions Program Adds Interactive Energy Savings Features

Date: April 30, 2015

Link: http://3blmedia.com/News/National-Grids-Smart-Energy-Solutions-Program-Adds-Interactive-Energy-Savings-Features

Summary: Written in the first quarter that Pilot rates went live, this article summarizes the customer portal, IHD, and app, as well as how the Pilot's smart grid investments have reduced outage restoration times.

Title: A year in, Smart Energy program bright idea for most

Date: September 12, 2015

Link: http://www.telegram.com/article/20150912/NEWS/150919656/101448

Summary: This front-page article in the Sunday Worcester Telegram & Gazette documents the positive program experience of multiple customers, as well as presenting results from the first summer of Conservation Days. The article also introduces the natural link between Smart Energy Solutions and National Grid's Grid Modernization Plan that was filed with the DPU in 2015.

Title: CEIVA Energy Technology Powers 20% Additional Savings for National Grid's Smart Energy Solutions Customers

Date: October 12, 2015

Link: http://www.businesswire.com/news/home/20151012005202/en/CEIVA-Energy-Technology-Powers-20-Additional-Savings

Summary: This article, published after customers' first summer on the Pilot rates, summarizes the technologies offered. It highlights customer bill savings and other technologies offered to customers.

Title: Carlos Nouel and Nick Corsetti on Jordan Levy Show

Date: July 15th, 2015

Summary: Carlos Nouel and Nick Corsetti on Jordan Levy radio show to discuss Smart Energy Solutions.

Title: Marcy Reed on Jordan Levy Show

Date: October 15th, 2015

Summary: Marcy Reed on Jordan Levy radio show, mentions Smart Energy Solutions.

Title: Worcester Habitat for Humanity chapter to dedicate first Veterans Build home today

Date: February 12, 2016

Link: http://www.telegram.com/article/20160212/NEWS/160219927

Summary: This article discusses National Grid's partnership with Habitat for Humanity to provide an energy efficient home to a veteran and his family. As part of Smart Energy Solutions, this home features in-home technology tools and energy efficient washer, dryer, and heating systems.

Title: Worcester smart grid pilot reports $1.25M savings

Date: February 25, 2016

Link: http://www.telegram.com/article/20160225/NEWS/160229460

Summary: This article, written after the first year of the pilot, describes the details of National Grid releasing the results of the first year of the program. The results revealed customers participating in the Pilot saved $1.25 million on their electricity bills, which is equivalent to powering a local library for almost a year. The first year results also highlighted the program's retention customer satisfaction rates. This report tremendously helped National Grid to make improvements for the second year, such as better communication with customers before and during Conservation Days and providing more information on saving energy through the online portal.

Title: National Grid touts success in first-year of Worcester Smart Grid program

Date: March 1st, 2016

Link: http://www.masslive.com/news/worcester/index.ssf/2016/03/national_grid_touts_success_of.html

Summary: This article gives a short explanation of what Smart Energy Solutions is and summarizes the successes of the first year of the program. The successes mentioned include $1.25 million in customer savings, 2,300 Megawatt-hours saved, a 98 percent retention rate, and a 72 percent customer satisfaction rate.

Title: Ed White on Jordan Levy Show

Date: March 14th, 2016

Summary: Ed White on Jordan Levy radio show mentions Smart Energy Solutions.

Title: Smart Grid pilot at $55M and counting

Date: May 23rd, 2016

Link: http://www.wbjournal.com/article/20160523/PRINTEDITION/305209985/smart-grid-pilot-at-55m-and-counting

Summary: This article explains some of the challenges regarding National Grid's budget for the Smart Grid pilot. Planned financial contributions and unexpected cost overruns have resulted in National Grid exceeding the program's initial budget ($45.5M). Consequently, the Massachusetts Attorney General's Office has flagged the pilot with concerns of excess spending and called for an investigation at the end of the pilot. The overrun includes $20 million for investments in distribution systems and $35 million for all program costs, technologies, outreach, and solutions. Costs were unexpectedly high because the original budget assumed community donations that it didn't receive. However, the benefits of the Sustainability Hub and Smart Energy Solutions program have exceeded initial expectations.

Title: Chronicle/Problem Solvers: A House Full of Energy Saving Tips-National Grid's Sustainability Hub in Worcester

Date: June 10th, 2016

Link: http://www.wcvb.com/article/chronicleproblem-solvers-a-house-full-of-energy-saving-tips/8103467

Summary: The local news show "The Chronicle" visited the Sustainability Hub in the summer of 2016 to show how the Sustainability Hub is a resource for energy efficiency and "smart" appliance information. Interviews with staff and interns give tips on how to be more energy efficient, what energy efficient products and appliances are available, and other energy saving ideas and information available at the Hub.

Title: Connected controversies: The NTP cell phone study and wireless electric meters

Date: June 23rd, 2016

Link: https://worcestermag.com/2016/06/23/connected-controversies-ntp-cell-phone-study-wireless-electric-meters/43751

Summary: This article describes the preliminary results of U.S. Department of Health and Human Services' National Toxicology Program's study testing links between cancer and chronic exposure to radiation emitted from wireless devices, including National Grid's smart meters. The results revealed strong evidence that such exposure is associated with certain cancer formation (testing on rodents). Major controversy surrounds the assumption that weak exposures (sub-thermal) are assumed to be safe. Some Worcester residents are in opposition to National Grid's wireless meter pilot because of health risks, privacy, and circulation of the community's energy dollars. The article also highlights how other countries have taken precautions surrounding low intensity, high-frequency electromagnetic fields.

Title: National Grid taps Itron for Massachusetts smart metering plan in grid modernization effort

Date: July 27th, 2016

Link: http://www.utilitydive.com/news/national-grid-taps-itron-for-massachusetts-smart-metering-plan-in-grid-mode/423337/

Summary: This article, appearing in July 2016, discusses National Grid's (NG) decision to use the tech and services company Itron to supply the platform for the Advanced Metering Functionality for its grid modernization plan. It highlights National Grid's four proposals, of varying scale, to the Department of Public Utilities (DPU) to meet grid modernization requirements set by state regulators. The decision to use Itron for this next phase of modernization is dependent on DPU approval, and the two companies agreeing to a contract.

Title: National Grid Pursues Smart Energy Solutions Extension

Date: September 1st, 2016

Link:http://www.electricenergyonline.com/detail_news.php?ID=594760&titre=National+Grid+Pursues+Smart+Energy+Solutions+Extension

Summary: This article, written in September 2016, discusses National Grid's plans to extend the Smart Energy Solutions pilot program in Worcester for an additional two years. National Grid recently filed a request to the Department of Public Utilities (DPU) to expand on infrastructure investments, customer engagement and improvements to electric services. The program has also helped inform National Grid's grid modernization in Massachusetts, later filed to the DPU.

Title: Monfredo: How Safe are the Electromagnetic Fields Emitted by Wireless Technology?

Date: September 3rd, 2016

Link: http://www.golocalworcester.com/news/monfredo-how-safe-is-the-electromagnetic-fields-emitted-by-wireless-technol

Summary: This article, posted on the Go Local Worcester website, presents information, research, and opinions that are concerned about the use of technology, specifically Wi-Fi-enabled technology, and its health effects on students and children who are consistently exposed to it. The National Grid pilot program smart meters are briefly mentioned as one of the expanded uses of such technology. The author, who expresses concern about the possible health-risk associated with these technologies, presents scientists, organizations, and countries who have either expressed concern, or taken action, on limiting exposure to Wi-Fi technology and lists suggestions for possible equipment that limits exposure. In the end, the author advocates its readers to do more research on the subject to become better informed.

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENERGY RESOURCES

Customer and third-party access to usage data

Proposal for Topic 3 Meeting Agendas

AMI Stakeholder Working Group

Draft Deliberative

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Massachusetts Department of Energy Resources

Outline

1. Topics to discuss from DPU Order on Data Access
2. Proposed schedule

Proposed order	Focus area	Project implications	Explanation	Timing
1	Billing of TVR offered by competitive suppliers	High	To preserve AMI timeline, CIS and MDMS replacement/modernization projects are [illegible]; TVR business requirements should be determined before functional designs are locked	March-May 2023
2	AMI deployment strategies that may expedite the ability for competitive suppliers to offer TVR products	Medium	Deployment strategies may impact network design, regional timelines and the duration of the deployment, which are critical inputs into the SOWs for the AMI equipment vendor and installation sourcing strategy. Target date for completion of those SOWs is Q3 2023	June-Aug. 2023
3	Customer and third-party access to usage data	Low	Customer and permissible third-party access will be accommodated; the delivery mechanisms, format and consent requirements are not critical core system business requirements; customer engagement platform SOW tentatively targeted for late 2023, with business requirements to be defined in 2024	Sept.-Nov. 2023
4	Customer education and engagement	Low	No core system implications; customer engagement platform SOW tentatively targeted for late 2023, with business requirements to be defined in 2024	Jan.-March 2024
			Solicit input on draft final report	April-May 2024
			Submit final report	June-July 2024

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Massachusetts Department of Energy Resources

ATTACHMENT C

Discussion Areas on Data Access (From DPU Order)

1. **Customer data access and voluntary sharing with third parties**
   - Effective and efficient ways for customers to access their hourly usage data and share data with competitive suppliers (Track 2 Order at 328)
   - Many customers likely to access their metering data through a mobile phone application. Accordingly, and to ensure that all customers can readily access data, consider user accessibility and technological compatibility (Track 2 Order at 210)

2. **Third-party stakeholder access to aggregated customer data**
   - Assess the need for and value of providing aggregated hourly usage data to stakeholders (Track 2 Order at 328)
   - Identify how data access benefits customers (Track 2 Order at 209)

3. **Data security & customer privacy**
   - How to efficiently provide such data in a way that protects customer privacy (Track 2 Order at 209, 328)

4. **AMI functionality**
   - Home Area Network (HAN) functionality

     HAN functionality refers to the ability of AMI meters to communicate with HANs, which can provide customers and third parties with near real-time access to meter data and be used to communicate with other customer devices such as smart inverters or EV charging equipment (Track 2 Order at 207)

   - Distributed Intelligence (DI) functionality and platform

     DI functionality, also referred to as grid-edge computing, refers to the capability of grid-edge devices such as AMI meters to perform computing, analytics, and decision making at a localized level, instead of at a central. Enabling DI in AMI meters can result in reduced network strain, faster and more efficient computation, and increased capabilities and potential use cases. (Track 2 Order at 207)

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Massachusetts Department of Energy Resources

ATTACHMENT C

Proposed Meeting Schedules for Data Access Topic

September: 9/26, 1-3 PM

- Review discussion areas for data access (previous slide)
- Overview from EDCs
    - Current avenues for data access: customers and third-parties
    - Data access in GMPs
    - Data access in ESMPs
    - Update on EDC meter procurement process/timeline
- **Area 1:** Customer data access and voluntary sharing with third parties
    - Stakeholder presentations
        - Unitil current AMI customer access
    - Invited external presenters
    - Discussion

October: 10/31, 1-3 PM

- Area 1: Summary of key points - Opportunity for continued discussion
- **Area 2:** Third-party stakeholder access to customer data
    - Stakeholder presentations
    - External presenters on data access platform examples:
        - New Hampshire data access proposal (Unitil)
        - NY Integrated Energy Data Resource (National Grid and/or NYSERDA)
    - Discussion

November: 11/28, 1-3 PM

- Area 2: Summary of key points - Opportunity for continued discussion
- **Area 3:** Data security and customer privacy
    - Stakeholder presentations
    - Invited external presenters
    - Discussion
- **Area 4:** AMI Functionalities (HAN & DI)
    - Stakeholder presentations
    - Invited external presenters
    - Discussion

Draft Deliberative

Attachment D: October 3 Meeting Agenda, Minutes & Presentation

AMI Stakeholder Group
Meeting Agenda

October 3, 2023
1:00 – 3:00 PM EST

1. Roll Call/Administrative Items (5 min)
   - review/update meeting minutes from the August 29th meeting (see attached)
2. Introduction of ERM facilitation services (10 min)
3. Follow up from August meeting (10 min)
   - TVR: EDC response to L. Chretien's request for edits to the report ("if possible it would be sooner"; "within six months")
   - TVR: Eversource follow up on the NH pilot program (EV meters)
   - Discussion on whether TVR will be revisited again prior to the August 2024 Final Report. The assumption would be that a lot will happen for the EDCs between now and next spring/summer so the EDCs might have updates/new information on the topics being discussed for TVR.
4. Review discussion areas for data access (5 min)
5. Overview from EDCs – Agenda items approved at the August meeting (20 min)
   - Data access in GMPs
   - Data access in ESMPs
   - Update on meter procurement process and timeline
6. Area 1: Customer data access and voluntary sharing with third parties
   - Stakeholder presentations
     - Until – current customer access (10 min)
   - Invited external presentrs
     - UtilityAPI (10 min)
     - Landis + Gyr (10 min)
     - Oracle (10 min)
7. Discussion (30 min)
8. Planning for Next Meeting – October 31, 2023 1:00 – 3:00 pm

October 3 Meeting Minutes

AMI Stakeholder Group Meeting Minutes
October 3, 2023 1:00-3:00 pm

Attendees:

ERM Representatives:

Renee Hoyos	Madison Weaver	Kristi Moore
Liz Valsamidis	Emma Jablonski	

Participants:

Marguerite Behringer, Landis + Gyr	Danielle Winter, Eversource	Dee Martir, UtilityAPI
Don Boecke, Office of the Attorney General	Aurora Edington, DOER	Elisa Grammer, Green Energy Consumers Alliance
Riley Hastings, Eversource	John Holtz, NRG Energy	Jerrylyn Huckabee, DOER
Jeremy Haynes, Unitil	Jessica Ralston, Eversource	John Howat, National Consumer Law Center
John Spring, National Grid	Josh Keeling, UtilityAPI	Kevin Sprague, Unitil
Kristine O'Shaughnessy, National Grid	Kyle Murray, Arcadia Center	Larry Chretien, Green Energy Consumers Alliance
Jared Lawrence, Eversource	Lisa Morgera, National Grid	Mariel Marchand, Cape Light Compact
Melissa Liazos, National Grid	Michael Murray, Mission Data	Nathan Holmy, National Grid
Pat Taylor, Unitil	Penny Navarro, Actual Energy	Luis Pizano, Eversource
Mary Quan, Eversource	Renee Addario, National Grid	Lou Sahlu, DOER
Samantha Caputo, Oracle	Sara Simkovitz, Actual Energy	John Schatz, VistraCorp/TXU
Tanya Moniz-Witten, National Grid	Tony Cusati III, IGS Energy	Michael Vecchi, Landis + Gyr
Wendy Lohkamp, Oracle		
Seb (UtilityAPI) – unknown participant	T (Guest) – unknown participant	603-545-1045 – unknown participant

Meeting Minutes

- **Roll Call/Administrative Items**
    - Renee Hoyos completed roll call.
- **Introduction of ERM facilitation services**
    - Renee Hoyos introduced herself and the ERM team (Liz Valsamidis, Madison Weaver & Emma Jablonski)
    - Ground Rules & Communication Process
        - Meetings:
            1. Agenda items due 7 days prior to meeting
            2. Agenda sent 3 days prior to meeting
            3. Meeting summary available 7 days after meeting

4. All materials related to meetings will be put on the Keegan-Werlin Sharepoint Drive.

- Reports
  1. Process for receiving and incorporating feedback
- Communication
  1. Email management process for ERMAMIStakeholdergroup@erm.com. Aim to respond within 48 hours.

Follow up from the August 5th meeting

TVR: EDC response to L. Chretien's request for edits to the report

- J. Lawrence: In the last meeting, Larry Chretien expressed a desire to include aspirational language regarding the timeline for TVR, which is targeted for 12 months after the first meters are installed, assuming achieved systems and mesh stability. Eversource is not comfortable putting into writing an expectation that it might be able to deliver that sooner because of the significant number of dependencies that we see in our project plan to be able to deliver this functionality. Other EDCs were invited to speak their opinion, but nobody spoke.

TVR: Eversource follow up on the NH pilot program (EV meters)

- J. Lawrence: The position that the EDCs are taking due to technical limitations on the need to install a separate meter for any EV-specific time varying rates and so the question was whether there were any insights or lessons learned from Eversource's New Hampshire pilot that could be applied here. Eversource has three offers.
  - There was a time-of-use rate that was filed with the intention of targeting residential customers that would have included a separate requirement for a separate meter to be used and that was rejected by the Commission.
  - There is currently no EV pilot in New Hampshire being run by a resource that targets residential customers.
  - There is an EV use rate targeting residential customers, but no enrollment in that. EV coincident peak product, metered for charging stations. No precedent in NH other than separately metering EV customers who want to pursue TOU rates.

Discussion on whether TVR will be revisited again prior to the August 2024 Final Report

- J. Lawrence: Looking at Eversource's project timeline, our blueprinting teams are actively working right now, but their primary focus is on the functionality at the initial go-live, which won't include the TVR. Aside from the framework published for this group, there may not be anything substantial to share at that time. We can't be sure if there's anything to share differently.
- M. Marchand: If there is an update to cost to supplies to offer TOU rates, that is something we are curious and concerned about. If you have a better sense of timing for phase 2 in a few months, that would be appreciated.
- J. Lawrence: Reasonable asks, and we will do our best to provide what we have next year.
- A. Edington: Clarification question. Not sure if folks on the call can answer. In the National Grid Electric Sector modernization plan, there are TOU plans alongside AMI meter rollout. Curious if folks on the call can speak to that and TVR pilot programs.
- K. O'Shaughnessy: TVR pilot programs, we don't have any in the field or planned at this point. We had mentioned the idea of running one, but the notion of starting less than one year before meters have rolled out is still in consideration. A pilot would be a better idea than going out fresh. Idea is circulating, but nothing firm.
- A. Edington: Thank you.
- J. Lawrence: Luis Pizano is here to speak on meter procurement activities.
- L. Pizano: We are deep into the IT and process requirements and planning workshops to set us up for development. Targeting to go live for system development at the end of Q1 of 2025. Field network infrastructure ahead of meter development in mid-2024. Negotiating

with key vendors. No changes from high level timeline presented previously. Development testing next year and rolling out in 2025.

- J. Lawrence: Any questions on the timeline? Kristine?
- K. O'Shaughnessy: No change here as well to National Grid's meter deployment timeline. New York is in the midst of deployment. We've had MA kickoff which means we're further along in the mobilization and setup process. MA fan deployment is still on track and scheduled to start in 2024: 5-15 employee customers and 2025 and beyond will be skill deployment. Starting in the City of Worster and deploying from there. Other update is on vendors. Customer research is important as we go into MA deployment, we want to hear from customers so we can educate property. Have a survey to go out to customers in beginning of 2024. Seeking a vendor for that, likely going with one we work with in NY.
- A. Edington: Thanks for the update. Questions for all of you. Trying to understand the meter procurement process. Is that something you're in the midst of, is it wrapped up? Could you speak to more specific meter procurement? Glad to hear the rest of the timeline is on track.
- L. Pizano: We are in the middle of contract negotiations with the AMI vendor, which cover both the network infrastructure and the meters. We wouldn't have anything executed until the end of the calendar year and start placing orders for delivery towards the end of 2024. Not sure if you're looking for additional details but it's dependent on contracts and we're still working through that.
- K O'Shaughnessy: From National Grid perspective, we're working with LNG, our vendor in NY. No firm updates on when we'll have the meters preferred. We're in the midst of updating the contract to add Massachusetts so no procurement of actual meters at this point. Still in contract negotiations.

Overview from EDCs: Data access in GMPs & ESMPs and meter procurement process and timeline update

- J. Lawrence: Aurora and I have exchanged emails in response to her question. In the ESMP Eversource filed, there are high-level data access and sharing plans, but not the level we're doing here. Being concurrently worked out in blueprinting session with vetting of the stakeholder group. Aurora, if you're referring differently to something else let me know, but I don't think we've publicly shared that information yet. We intend to vet with this group, but wanted to be responsive to the request.
- A. Edington: We didn't have ESMPs for this agenda, the meat and details are with the grid mod plan.
- J. Lawrence: Thank you for reminding.
- A. Edington: I was intending, based on the last discussion for the utilities, to discuss where they are with planning for data access from AMI meters. Not sure if EDCs have anything prepared on that.
- J. Lawrence: So expanding on the high-level comment I made previously, we have blueprinting teams actively working on AMI functionality. We will turn to data access which falls nicely on the backend of work from this group. We have a proposal with other EDCs to share with the stakeholder group, and then when we have consensus, the blueprinting team will run with those. From a grid mod planning perspective, we have not ironed out details but we have high-level proposals to share with group.
- K. O'Shaughnessy: Same for National Grid.
- A. Edington: Great to hear, look forward to seeing those.
- J. Keeling: I want to clarify the timeline for the data access plan being shared. Is that for the next meeting?
- J. Lawrence: I believe that's for the next meeting, or Renee shared a draft of it. I'm checking to see if it was sent. It was not sent. I guess we will share it for the next one.
- A. Edington: If we have time, seems like we're running early. I would be very interested to have the utilities present that plan instead of waiting until next time. Are there rules that say we can't talk about it if it's not on the agenda?

- J. Lawrence: Kristine, if you're okay with it, I would walk through it if we have time at the end.
- K. O'Shaughnessy: At the end at the high level, maybe. I don't want to do it quickly and not effectively since it was not on the agenda.

Area 1: Customer data access and voluntary sharing with third parties

- **Stakeholder presentations**
    - **Unitil – current customer access**

- J. Haynes: I'm Jeremy Jaynes, director of enterprise IT systems at Unitil. I've been with Unitil for just over 10 years, close to 25 years of experience total. Like most utilities on this call, in addition to our standard bill offerings and PDFs, we offer electronic data-sharing systems that are designed to allow customers to both view and download their energy usage and interval data. I'm showing a few we offer today and offer up a quick look at our future plans. Customer adoption of these services is relatively low. Less than 1% of customers access their data. We'll start with our customer-facing options. First and foremost is our green button download for electric customers only, accessed through our Unitil portal. From here, they can download rolling 13 months of usage data. Green button is a standardized format developed by NAESB that allows customers to share data with third parties for future analysis. We also have a tool called the My Energy Use tool, available for electrical customers only. Allows customers to compare historical points in time, and tabular view of just their daily usage. For gas and electric customers, we have a Consumption History tool. Tabular and bar chart view of rolling 13 months of consumption history that can be downloaded to Excel. Larger view of bar charts offered. For net metering customers, we offer the option to view metering history in tabular and excel format. Via data integration and Oracle, we offer home energy reports in electronic pdf or printed version that show usage comparison compared to neighbors. Customers can offer CEPS to access monthly data. We use EDI to transmit data to CEPS. See the table for what EDI transactions we use. This is an example of an approval form for data sharing.

M. Murchand raised her hand.

- M. Murchand: Could you go back to the form? I have not seen it and I think that goes to the crux of how do customers actually authorize? Does it require a signature from both the customer and supplier? How does the customer download this form from your website and send it to the supplier?
- J. Haynes: Yes, that's correct. We can circulate.
- M. Murchand: So this is not check a box online? They have to fill out a form and send it to the supplier and it's not like a check a box kind of thing online.
- J. Haynes: That's correct. This is all manual at this time. The Green Button Connect My Data initiative would be a more automated version.

A. Edington raised her hand.

- A. Edington: I saw you had an interval of daily, monthly, and interval. What is the interval time period?
- J. Haynes: I'd refer to another member to speak to what is available in Massachusetts today or we can take that back.
- K. Sprague: We'll take that back.
- J. Haynes: I want to touch on one of the more niche offerings, a tariff-based service based on interval data. Very few customers, less than 5, but it is an offering. We also service data requests through on-demand inquiries. Generally handled by IT group on an ad hoc basis. Delivered via secure email or FTP. An example is community aggregated data to towns. Regarding future plans, there have been some questions about the authorization process

for downloading and sharing data. We are preparing to roll out an implementation of Green Button Connect My Data in early 2024. This follows many of the same tenets of the Green Button Download My Data with a standardized file format. This bypasses much of the manual overhead of filling out paper forms, and attempts to automate workflow electronically. Will serve as backbone for NH data sharing program for 2024. All participating utilities can share usage data from one centralized hub. Unitil has been involved in that initiative. This work with our portal will help us contribute to NH data sharing platform.

- D. Martir: For green button, is that a certified green button?
- J. Haynes: Yes, NH data sharing is a central platform. Unitil does not have plans to certify our own platform, but the central hub will be.
- A. Edington: Wanted to ask, could the facilitator confirm that slides will be shared more broadly? Second, I'd love to hear more from Unitil and Eversource on the third-party data platform. Would like to hear about that process, where it's at, and what's included.
- J. Haynes: Unitil is already committed to doing a presentation on some of those next steps. I'm sure we'd be happy to do that.
- R. Hoyos: All slides will be shared and on SharePoint. If you need access to project SharePoint, let me know.
- E. Grammar: I'm intrigued with the NH community aggregation reference. Included specific customer data. What data would be involved, and what is the process? Does the customer or community aggregator go through a community process?
- J. Haynes: Pat, can you speak to NH community aggregation and the genesis of that process and what's involved with towns requesting data? High-level overview?
- E. Grammer: What data is shared, how is it requested, how do you get it?
- Pat: Can't speak with a lot of specificity. There are rules that have been passed in NH that obligate companies to share data on a one-time basis. Not sure if there's specific data you're interested in. I can point you to the rules that govern it.
- E. Grammer: In past TVR discussions, utilities may not be ready to do all of the billing. One option would be for municipal aggregators to develop their own rates and do their own billing. How does that affect data available on a disaggregated basis to communities or municipal aggregators?
- Pat: We don't have the right SMEs online for these. There is currently a docket pending where there are certain billing requests that are being made by aggregators that the companies aren't able to do at this time. From my perspective, it's something in flux but if you have granular questions, that's something our folks in the billing group can answer. Need other personnel to answer.
- J. Keeling: Jeremy, you mentioned green button from Unitil will not be certified?
- J. Haynes: Correct, it will not be certified.
- J. Keeling: Is there a reason for not doing this? Have you shared implementation plans? In house or partner?
- J. Haynes: We have not shared implementation plans, reviewing currently. Will be public sooner than later I expect. As far as certification, there's a cost to it. Not part of our plan.

Invited external presenters

- **UtilityAPI**
- **Landis + Gyr**
- **Oracle**

UtilityAPI presentation

- J. Keeling: As an introduction I'm new to this group. Lead regulatory team as well as product team, making sure that we're aligned in terms of the strategic direction of the company. I previously held some roles in virtual powerplants as well as customer energy solutions distribution resource planning. Preface for utility API does: we are involved in the data access space for a long time and helped develop standards. Connect data between different solution providers looking to integrate and create data. Work closely in developing platforms for utilities at the state level. Core to this conversation is having a secure, consent-driven platform that connects different parties and conveys trust between actors. This is a general slide, we wanted to cover streamlining the data access process between actors and utilities. Key to accelerating participation. I've been on this side of the utilities, and we have cumbersome processes and people don't adopt them. There is pent up demand for data, and simplified platforms show large updates. As we look to electrification, there are new use cases that aren't being tapped. Security is fundamental to this. Operating this space between utilities and third parties, it's important to have transparency on the utility side. A successful green button connect platform is porting. Data visibility. Platform to track in centralized place is helpful for utilities. You would be shocked at how many players are involved in this space. In this broad ecosystem of data access, there is a growing and diverse ecosystem interested in data for a variety of reasons – energy management, resource adoption, ESG reporting, carbon accounting, bill management. There is an increasing need for data. Green button certified process. We have seen a wide degree of success in implementation. Certification helps reduce costs in the long run. The upfront investment seems large, but utilities can go through years of improvements trying to fast-track and avoid op-ex issues down the line. Green button connect allows utilities to have a standard exchange. Allows a central process at the processing level, but allows a process by which utilities register third parties and how third parties access data. More engaged role for utilities. That visibility can be invaluable. Having a standardized format allows utility to share and have common understanding across own organization. A common platform is helpful. For example, coordinating across key accounts. Allows for reducing manual processes. Example of how O-auth process works. I've included customer journey and back end flow in appendix. Happy if folks want to follow up. As a customer is given opportunities to authorize data, the customer can authorize any time for any party, as well as what data is shared. What's powerful about this approach is the customer has a streamlined process. I only want to provide historical data, but not in perpetuity. Data privacy and marketing can be managed. Customers can choose not to provide certain information. Federal funding programs call out data access. HOMES program include modeled or measured program that relies on data access. That provides a great opportunity for utilities that they're already making as part of AMI deployments and provide value back to their state energy offices to show where there could be a leverage investment. We see strong demand in MA. Utility API provides access in green button, and web portal integrations. We see there is strong interest in data in MA with a suboptimal process without AMI. We see 11,000 data requests from different sectors, dominated by solar with EVs growing. This is a great opportunity for utility to proactively engage communities to ensure they're going in the right areas. Any questions?

- R. Hoyos: Want to see appendices attached?
- J. Keeling: To be mindful of time, if folks have questions or want to go deeper, happy to have conversations one-on-one.
- R. Hoyos: No other questions, we will move onto the next speaker.

Landis + Gyr presentation

- M. Behringer: I serve as the Director of Regulatory Policy and Industry Relations for Landis and Gyr. Joined by Michael Vecchi. Here to give you a primer on the intersection of regulatory issues and technologies. Thank you, Josh, for that primer on why data is needed in MA. If you're not familiar with Landis and Gyr, we are one of the global leaders in smart metering. We have a century of experience in managing energy better – key areas are smart metering, managing infrastructure, grid edge intelligence, looking at customer homes and finding granular evidence via waveform collection to provide action and control of assets on the grid and more processing at the edge. Smart infrastructure, looking at everything from street lights to electric vehicle chargers. Using data to help utility partners see what's happening and maintain reliability, quality, and the like. To highlight, we have the tech but do we know what we're talking about with data? 1 in 3 in the US is processed on our meters. We're thinking about how to interact with agencies and others who work on these processes, as well as utility systems. Providing a primer on where data exists today. These terms are gathered through review of 15 states with data access investigations. All those PUCs are in different places. This is a menu of topics that this working group could go on. Ownership. Who owns data? Who is the utility what is their role? Custodians of data. They are the ones processing and cleaning, maintaining cyber security. We help manage the backside, and others can manage interchange with third parties. Permission – how is it released to third parties? How are third parties receiving what kind of customer data? What kind of language is given contractually? Cyber security certifications? How are the barriers for entry? Creating an ecosystem that is secure and reliable. Non-disclosure agreements. Aggregations screens and metering in general. Customer experience. Making sure customers have access to data and can make decisions. This report is a little dated but show requests can vary. With data requests, we have to think about time intervals. Monthly, to 15-minute intervals to real time. Who is receiving it? A lot of policies around researchers and universities reporting on efficiency. Intended use. Marking is the most contentious but contains a lot of potential. The author has highlighted that real-time data generates most concern and discussion. We have a lot of background on how data measurements has changed in the last decade. There are shifts because the way we collect data is changing. All of MA will use grid edge computing, data will be super granular. Customers can see and act on device level data – washer dryer, etc. This comes when MA is looking to transform the grid. Thinking about real-time data, what data can be shared? Using NY as an example, customer data and distribution level data. This tends to be available on the wholesale market, etc.

- M. Vecchi: We spent some time on how data is transferred from the back office, but we know there's more interest from customers to have near real-time experience. What does the future hold and how is data shared? The back-end system is data collection today coming off meters through green button connect. What if I wanted more real-time experience? With the meter, you can run disaggregation and take advantage of the sample rate. With the vendor, information is shared with the cloud directly to the end user. End user allows meter to connect to service, and they could act upon the info. Putting that info into the hands of consumers to take action. Feedback is almost real-time. If the utility contacts you about demand response office, can you commit to certain loads in you home? Previously unable to, but tomorrow we can look at what is running in the house. Can I drop load? Can I manage the load? Feedback for engagement purposes. Doesn't come without risks and principles. We have data principles. AMI2.0 is Wi-Fi connected, and all meters deployed in MA will have Wi-Fi connection Wi-Fi certificate should be included – just like any other Wi-Fi connect device for home. Customers should be able to send data directly to the service provider. Important that all consumers have an equitable experience. Flexibility is needed. Structures need to allow innovation and learning in real-time. Further discussions are needed. This is a great example of a working group for how it can be connected.
- R. Hoyos: Any questions? No questions.

Oracle presentation

- W. Lohkamp: I work on data access and data sharing strategies for Oracle. Energy and water. We are our global business unit within Oracle, focusing on operational applications for utilities like customer care and billing work and asset management, network management, energy efficiency and consumer engagement. Here to share our experience with utilities across country that use tools to educate consumers and drive them to take action. Why and how utilities should turn data into insights. Customer ecosystem to energy efficiency is more complex. App for everything, but all apps give different answers and disjointed experiences. Not all customers have the same experience or interest. Most effective to put what they're seeing in a broader access. Utilize our best steward. Critical information that differentiates utilities from third parties. Before AMI, bills were the primary interaction. All information was after-the-fact. Neither the customer nor utility could see usage prior to bill. The frequent collection of interval data allows for new analysis like disaggregation forecasting and customer segmentation, which can be used to empower and enable customers. Knowing how much energy your garage opener uses is interesting, but the question is what's normal. Data needs context to learn and act. Customers may not know about rates to know when energy costs are highest. Utilities can target customers to let them know about rates and savings. Another application is forecasting. AMI is used fairly, so future can be forecasted for high bill alerts and enough time to make corrections. AMI can create load shapes for each customer. A customer that uses most energy during the afternoon may receive information that is personalized and targeted to resonate with the customer and take action. There are three main ways to reach customers. Alerts, outbound communications, and web or mobile. Customers can opt in or out. Alerts reach customers for important information. Customers may say they're not interested in opting in, but want to hear if something is going wrong. Utilities can always give the option to opt out after first alert. With outbound comms, utilities can educate customers about education, tools, and dive deeper into many costs. AMI can support building benchmarking or solar sizing. The utility may want to embed applications into their sites and make the customer experience seamless. There are different ways to use AMI data: interval data, aggregated usage patterns, and disaggregation. As customers get more familiar with energy use, explain rate and usage. And customers who choose to take steps towards electrification, their energy use is complex. Show how much energy is used for different actions. For those who don't use self-service, they can be made available to CSRs for support. Happy to provide more at a later date. There is lots to do with AMI in the future and I'm excited for the result of MA. Questions?

- K. O'Shaughnessy: AMI education reports, I don't want to go too far into the weeds, or we can go offline. What does that look like? Specific topics around AMI and data or more general?
- W. Lohkamp: It starts with rollout – let them know about what will be available. Is it aggregation, web tools, green button connect? Promote what you would like to tie in. As you shift away, you can show the customer their own data and start to personalize the report. Get customers engaged, and they ask for more.
- R. Hoyos: Other questions? No questions.

Discussion & Planning for Next Meeting (October 31, 2023 1:00 – 3:00 pm)

- R. Hoyos: We can move to discussion. We have 20 minutes for general discussion and next steps.
- J. Lawrence: Topic of framework, we will distribute it prior to the next meeting and make an item on the agenda.
- A. Edington: Sounds great. Looking forward to it. Can you give a high-level overview? Is that similar to TVR?
- J. Lawrence: It's a dense document. Laid out like a matrix, data principles, timeline for enabling individual customer data and aggregated data, proposal for third party vetting, extensive parameters around consent. Detailed document.

- M. Murray: Mission data coalition. It'd be great to delve into the principles. We need to go beyond the principles, some of the specifics about the eligibility of third parties, I would encourage the group to not be afraid of delving into technical details. Other programs, from data sharing POV, ended up with failures due to details. A critical issue is what data is included and what is not. Platforms that aren't used waste time and effort. Conversations are important, my recommendation would be to not stop at the principal level. It's not satisfactory for users or investments for facilitating data sharing.
- A. Edington: Appreciate the comment. I am mindful of the nitty-gritty details of setting up AMI systems, and setting up the backend, it's a lot of work the utilities are doing. In a similar vein as Michael, I'm interested in discussing with the group where we are going with data access. Standardizing across states, what use cases should we be thinking about with data access, thinking about the future of what we can do. There's a lot of work in other states and it's important to explore that. The NY integrated energy folks agreed to present at the next meeting if that's of interest to the group. Setting up to maximize benefits to everyone in MA.
- M. Murray: One area where we've been spending time is around the homes rebate program. MA is getting 73 million to provide energy efficiency rebates for low-income households. It's hard to understate the challenge of administering the program. We saw interesting things, but for MA to spend the money from the IRA, it's on the table, but the state and the contractors need access to electric and gas information for at least twelve months. It's going to be impossible to give those rebates to customers without this information. Paper forms won't work. If you're spending 5000 per home, but we're talking about thousands of homes, it has to scale, be standardized and consistent. Consistency is important for the state and limiting overhead costs. They don't need anything fancy, they just need the data to administer rebates.
- D. Martin: I wanted to pick up on how important it is for data access to these standards for these contractors. Scalability is so important from a standard way of contractors being able to access the same types of data across utilities.
- J. Haynes: That's how we're trying to solve the problem in NH, by having a single multi-utility hub and also having the utilities that are participating to agree to a standard logical data model. It's the same thing at Eversource, Liberty. We need to have these discussions for MA.
- A. Edington: To MA utilities, you have work on the table, I'm curious about this point on standardization on term definitions, on data formatting and access. Are you all coordinating on that, as well? I don't know what blueprinting is, Jared, but you mentioned it and I suspect this is kind of part of the blueprinting process. Are you guys having your blueprinting teams work together across utilities so that, from a state perspective, we do have that consistency?
- J. Lawrence: I think you'll be happy with the matrix because it's focused on standardization for that very topic. Blueprinting is not working on technical specifications until 2024. The intention is to create as much technical standardization as possible while still accommodating unique deployment.
- A. Edington: To the greatest extent you can include technical details in the table, getting those out in front of stakeholders is important.
- J. Lawrence: Excellent point. We'll share the document and look for input.
- M. Murray: One last point on the technical detail front. We have a logical data model, we have a detailed list and wireframe of consent process, a lot of these issues that range from consumer protection to data definitions, a lot of that work has been done already. Hope there is time to go over that at the next meeting rather than reinventing the wheel. Good time to react to that, same with IDR in NY.
- R. Hastings: Michael, hope you'll be surprised because our proposal on the EDC side leverages work in NH to create standardization in both states.

- M. Murray: That's great. I didn't know that. Thank you.
- R. Hoyos: Any more discussion? None. I want to draw your attention to the next meeting, which is October 31st from 1:00 to 3:00. We will get all the materials out to you 3 days prior. We'll have the meeting summary and all of the presentations from today's meeting to you in a week.
- A. Edington: I wanted to confirm what we're thinking for the agenda. EDC proposal, maybe a few follow-ups. To the extent we can have ten minutes for NY EDR folks would help inform. Want to see if anyone else in the working group has ideas on the agenda. Anyone else have agenda items for next meeting?
- M. Murray: Customer experience, and what they need to do to execute data sharing. What exactly do they need to do and how is that being processed? We have a state with a lot of utilities, and what the customer sees and goes through, if they can do it on a mobile device, all those details are important. Language presented to customers before they say I agree, thinking about those details is important.
- R. Hoyos: Any other items to discuss at the next meeting? No response. Thank you all so much for getting on the call today and for your patience with the technical difficulties. We will see you on the 31st.

Next meeting: October 31, 2023
Time: 1:00 – 3:00 pm

Meeting Chat Log

1:02 PM: K. O'Shaughnessy: Love the new intro already, ERM!!

AMI Stakeholder Group Meeting

October 3, 2023

Photo by Jon Moore

The business of sustainability

ERM

Meeting agenda

1. Roll Call/Administrative Items (5 min)
2. Introduction of ERM facilitation services (5 min)
3. Follow up from August meeting – TVR response to comments, update on NH pilot project, and will this be revisited prior to the August report? (5 min)
4. Review discussion areas for data access (5 min)
5. Overview from EDCs – Data access in GMPs, ESMPs, and update on meter procurement and timeline (20 min)
6. Area 1: Customer data access and voluntary sharing with third parties – stakeholder and external presenters (40 min each)
7. Discussion (25 min)
8. Next Meeting – October 31, 2023, 1:00 – 3:00

Facilitator introduction

Environmental Resources Management (ERM)

ERM is a leading global provider of environmental, health, safety, risk, social consulting services and sustainability-related services. ERM's practitioners have been developing and leading stakeholder engagement processes for decades. Experience includes facilitating processes to support transparent and productive conversations related to energy, renewables, transportation and many other sectors.

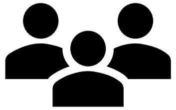
ERM builds trust through proactive, sustained outreach that informs stakeholders while soliciting input and promoting two-way communication. This approach will provide an opportunity for all stakeholders to share their perspectives openly in a well-managed forum.

- Lead Facilitator: Renee Hoyos
- Senior Advisor: Liz Valsamidis
- Supporting Consultants: Madison Weaver and Emma Jablonski

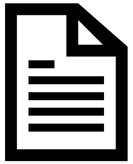
Contact us: ERMAMIstakeholdergroup@erm.com

Ground rules and communication process

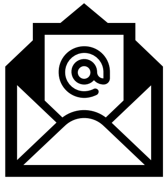
- Meetings
  - Agenda items due 7 days prior to meeting
  - Agenda sent 3 days prior to meeting
  - Meeting summary available 7 days after meeting



- Reports
  - Process for receiving and incorporating feedback



- Communication
  - Email management process for ERMAMIStakeholdergroup@erm.com



Follow-up from August meeting

1. TVR response to comments
2. Update on NH pilot project

Overview from EDCs

1. Data access in GMPs, ESMPs
2. Update on meter procurement and timeline

Stakeholder and third-party presenters

Discussion and next steps

- Next Meeting – October 31, 2023, 1:00 – 3:00

Thank you

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ERM

Attachment E: October 31 Meeting Agenda, Minutes & Presentation

AMI Stakeholder Group
Meeting Agenda

October 31, 2023
1:00 – 3:00 PM EST

1. Roll Call/Administrative items (5 min)

2. Follow up on Unitil presentation (Jamie G., Kevin Sprague, 5 min)
   a. Concerning the History Consumption Tool, there were daily, monthly, and interval time periods. What is the time period interval available in MA?
   b. New Hampshire Data Access Platform (Unitil to answer follow up questions)

3. Preliminary discussion on EDC plan to provide data to support "bill-ready" TVR designs in which the non-EDC "supplier calculates bill line items based on interval data provided by EDCs at end of billing cycle" (per Attachment C of AMI Stakeholder Group Quarterly Report) (requested by Elisa Grammer) (Elisa, 20 min)

4. Preliminary discussion on eligibility criteria of third parties (requested by Michael Murray) (Michael Murray, 15 min)

5. EDC Presentation on Data Access Framework (TBD, 20 min)

6. Cape Light Compact: Roles and benefits of AMI data (Mariel Marchand, 10 min)

7. NY Integrated Energy Data Resource Program: Overview of the program and process to date, use case framework, and best practices/findings (Lea Springstead, 10 minutes)

8. Discussion (25 minutes)
   a. Preliminary discussion of Data Access Plan – stakeholder thoughts and positions

9. Planning for next meeting and Third Quarterly Report timeline (10 min)
   a. November 8 – report out to Stakeholders
   b. November 13 – edits due from Stakeholders
   c. November 15 – report submitted

October 31 Minutes

AMI Stakeholder Group Meeting Minutes
October 31, 2023   1:00-3:00 pm

<u>Attendees:</u>

ERM Representatives:

Liz Valsamidis	Madison Weaver	Sarah Barreca

Participants:

Aurora Edington, DOER	Brian Beote, Action Inc	Carlos Nouel, National Grid
Chris Dube, Unitil	Chris Modlish, AGO	David J. Creer, Constellation
Danielle Winter, Eversource	Dee Martir, UtilityAPI	Don Boecke, Office of the Attorney General
Elisa Grammer, Green Energy Consumers Alliance	Jaden Crawford, David Energy	Jamie Goudreaul…*(name and affiliation cut off in Teams)*
Jared Lawrence, Eversource	Jeff Wamboldt, Landis + Gyr	Jeremy Haynes, Unitil
Jerrylyn Huckabee, DOER	Jessica Ralston, Eversource	John Howat, National Consumer Law Center
John Spring, National Grid	Kevin Sprague, Unitil	Kristina Montgomery, Vistra Corp
Kristine O’Shaughnessy, National Grid	Kyle Murray, Arcadia Center	Kyle P. Monsees, NYSERDA
Lea Springstead, NYSERDA	Lisa Morgera, National Grid	Lou Sahlu, DOER
Luis Pizano, Eversource	Marguerite Behringer, Landis + Gyr	Mark Cappadona, Colonial Power Group
Mariel Marchand, Cape Light Compact	Michael Murray, Mission Data	Michael Vecchi, Landis + Gyr
Nathan Holmy, National Grid	Pat Taylor, Unitil	Patrick Roche, Good Energy
Renee Addario, National Grid	Riley Hastings, Eversource	Samantha Caputo, Oracle
Sara Simkovitz, Actual Energy	Seb, UtilityAPI	Steve Bright, WeaveGrid
Stuart Ormsbee, Colonial Power Group	T (Guest) – unknown participant	

Agenda

1. Roll Call/Administrative items (5 min)
2. Follow up on Unitil presentation (Kevin Sprague, 5 min)
    1. Concerning the History Consumption Tool, there were daily, monthly, and interval time periods. What is the time period interval available in MA?
    2. New Hampshire Data Access Platform (Unitil to answer follow up questions)
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5. EDC Presentation on Data Access Framework (TBD, 20 min)
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7. NY Integrated Energy Data Resource Program: Overview of the program and process to date, use case framework, and best practices/findings (Lea Springstead, 10 minutes)
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    1. Preliminary discussion of Data Access Plan – stakeholder thoughts and positions
9. Planning for next meeting and Third Quarterly Report timeline (10 min)
    1. November 8 – report out to Stakeholders
    2. November 13 – edits due from Stakeholders
    3. November 15 – report submitted

Meeting Minutes

Roll Call/Administrative items (5 min)

- Liz Valsamidis welcomed attendees to the meeting, reviewed the agenda, completed roll call, and reviewed the ground rules and communications processes for the meeting.

Follow up on Unitil presentation (Jeremy Hayes, 5 min)

- J. Hayes: The answer to the first question on the slide (Concerning the History Consumption Tool, there were daily, monthly, and interval time periods. What is the time period interval available in MA?) is 15-minute intervals in Massachusetts.
- A. Edington: How long until that is available?
- J. Hayes: 24 hours, the next day.
- L. Morgera: Working through customer and energy efficiency organizations, responding to ad hoc requests and talked about different things that had been done. New Hampshire community aggregation effort, data generated by Unitil for participating towns. Could there be some elaboration on how you create on demand requests? More info would be helpful.
- P. Taylor: Not to get in Jeremy's way, the question that is being asked with respect to community aggregation in New Hampshire is different from what we're discussing. Data access program is not up and running. With respect to aggregation, rules in New Hampshire require utilities to provide data at different stages. There is discussion right now on how certain info is provided. There is an EDI working group to develop standards for information. That process is separate from the development of the data platform docket. I want to make sure we're talking about the right thing for what's available for community aggregators now and what might be available for the platform in the future.
- A. Edington: I was expecting a presentation from Unitil on data access process and what your experience has been, best practices, and expected timeline. That was my intention. If you could speak at minimum to that, or provide a presentation next time, that would be informative.
- P. Taylor: We did provide a presentation at the last meeting. There was a bullet point provided today and we weren't sure what that entailed. The data development platform has been very complex. To reduce it to just a couple slides would be very difficult. At this point the company is still developing it. Working with stakeholders.
- E. Grammer: Thanks for the answer, the slide that I referenced had some examples. Can you tell us what information was provided and what form/aggregations? What was the information and what the mechanism, EDI or green button, to provide that?
- J. Hayes: For the format, everything we're providing is specified in New Hampshire law. Data sets are .csv format with exception of EDI where there is still discussion on EDI customer information sharing.
- P. Taylor: I'm going to confess that I don't have the rule committed to memory, so I can't name everything provided in the rule. I can provide a link to the rule which would show everything we're required to provide.

- E. Grammer: It it's ad hoc, is it pursuant to the rule?
- J. Hayes: We may be conflating two points. Above and beyond that, there are unrelated ad hoc requests for a variety of data from different departments.
- E. Grammer: So on-demand request with community aggregations are pursuant to a regulation. And you're going to put that regulation in the chat.
- P. Taylor: This is the AMI working group. We're the only one that has AMI in New Hampshire, but this is not necessarily an AMI issue in New Hampshire. There are companies in New Hampshire that do not have AMI but are subject to the same community aggregation rules.
- A. Edington: My comment is more of a comment than question. I think the confusion is the presentation from Unitil in early October was current access to AMI data. Unitil shared a lot of great slides and info. The next step here was to get more information about the ongoing process in New Hampshire. NYSERDA has slides on their data access platform and process. To have a parallel example from Unitil would be great. Anything from high level process to how the group is thinking about developing. High level information on how it is related to AMI data and making it more accessible in the state. That's my intention in requesting this in the agenda. Happy to connect offline if helpful.

Preliminary discussion on EDC plan to provide data to support "bill-ready" TVR designs in which the non-EDC "supplier calculates bill line items based on interval data provided by EDCs at end of billing cycle" (per Attachment C of AMI Stakeholder Group Quarterly Report) (requested by Elisa Grammer) (Elisa, 20 min)

- E. Grammer: Simple question, what do the utilities have in mind in terms of providing data? The prior TVR discussion indicated that this is the way it would be done if the third party supplier wanted to have TVR earlier than the utilities were ready to do it or different from the rate ready design. When would the data be available, in what format, would it be granular enough to develop bills with? In proposing the bill ready concept, I'm sure the utilities had an idea. That's my question.
- J. Lawrence: I can speak on Eversource high level plan. Our plan, a couple of years off, is intended to be available when we enable TVR rates. Roughly a year after the first meters are installed. Tentative plan to use EDI meter data format modeled after other states where interval data is transmitted to suppliers on billing day 1 and suppliers have until the end of billing day 3 to return billing line items. There's a lot of technical details to work out. The idea is to model some well proven models in other states. Happy to answer specific questions.
- E. Grammer: Thanks, I was also wondering if special permissions will be required to make data available regarding customers of municipal aggregation. Does the customer need to provide an additional event of permission for the municipal aggregator to receive customer data, because its AMI data compared to other data usually exchanged?
- J. Lawrence: We'll talk about consent for data sharing later. This is for customers registered. In the process of customer or municipal aggregating entering with a supplier, we may need to look into some [inaudible].
- C. Nouel: Our intent is to start offering TVR on bill-ready side, starting with rate-ready then adding bill-ready to our capabilities. Timeline is similar to Eversource. On your question to sharing data question, I think we will talk about that later on.
- E. Grammer: You mentioned stakeholder interaction on this. That sounds like a good idea. What kind of procedures are happening on this? Seems like it would benefit from cooperative approach.
- J. Lawrence: From an Eversource perspective, it's being modeled after practices in other states. Our proposal would be to share those conventions that we're seeing work elsewhere and confirm they're working for stakeholders before we design our systems.

- M. Marchand: When do you propose to have those kinds of conversations with stakeholders? During this process or another process?
- J. Lawrence: I can't give exact timeline. With go-live in 2026, expectation would be maybe late 2024.
- M. Marchand: This is not my area of expertise. Could you explain the billing day 1 and billing day 3 again?
- J. Hayes: The way that billing works is data is obtained from meters, then goes through a process. If being billed internally, we would bill the second day after the meter read is obtained. Because this is a third party that sends them back before billing window closing, there is an extra 1-2 days in that process because of the two way transfer of data. End of day three would allow us to produce the bill on day four.

Preliminary discussion on eligibility criteria of third parties (requested by Michael Murray) (Michael Murray, 15 min)

- M. Murray: The need for eligibility criteria has come through experience. To define third party, that's any entity that is not customer or utility. These range from for-profit to nonprofit to licensed retail suppliers, unregulated utility affiliates. A third party is not a utility vendor. As a technical matter, third party recipient needs to register with the utility and agree to some terms and conditions. Since utilities have a monopoly on energy usage data, typical contract bargaining doesn't really work. There is no alternative to access that info, this is where public utility regulation comes into play. Problems we've seen, which is why it's important to take about eligibility criteria, include:
    - Utilities unilaterally change terms and conditions, just take it or leave it, Utility said if you don't agree by Jan. 1st, then you have stop accessing the data. No opportunity for comment. Creates business interruption.
    - Discriminatory conditions where utility allies get a fast line and utility opponents get a slow lane, there are different entities on a changing basis welcomed into the fold of access info while other are kicked out.
    - Required 3rd parties to disclose proprietary or sensitive business information so the utility could copy or emulate. There are problematic outcomes and market failures. When we talk about criteria, we're talking about enforcement and how enforcement plays out. Is there DPU jurisdiction over properties?
- C. Nouel: Wanted to go back and ask a couple questions. Can you talk about what you mean by utility allies get fast lane? In reality we don't complete, so what do you mean by that?
- M. Murray: There's competition around the edges. We've seen cases where those people would receive more scrutiny whereas those that are harmless to utility interests may be treated well.
- C. Nouel: we need to be careful, speaking for National Grid, there are regulatory mechanisms in place that encourage utilities to think of NWAs instead of wire solution, delivering solutions to customers at a higher cost. We need to be careful when we say utilities have allies and opponents. Our role is to serve customers. Utilities may change terms. For any company that shares data, terms and updates are changed all the time for different business needs. As utilities are responsible for ensuring security and privacy of customers. Need to be careful not to go to extremes.
- M. Murray: – If utilities want changes they can go to the regulator. Abrupt changes enter anticompetitive territory. Every state has different public utility law around this. There are cases in both circumstances. This is not a stumbling block but wanted to highlight. New York and California have greater authority. In California, you need to provide info to be an eligible third party, provide info and not be banned by Public Utilities Commission. Colorado is simple. New York and New Hampshire are probably more complex because they involve

some cyber security requirements. There's a wide range of thought on this topic. To end on New Hampshire, Eversource and Unitil are involved in this case, and my nonprofit is a party to this settlement agreement. There's a lot of merits to the New Hampshire approach. Third party applies not to every utility but to a centralized authority. You only have to register as a third party once across the state. That's really valuable in a state like Massachusetts where there's multiple different utilities you may need to interact with. It's a good idea to have a central registration process. Within 30 days utilities accept or deny based on objective criteria. If denied, third party can go to the Commission or New Hampshire council. This is a cyber security questionnaire or point system [inaudible]. I put settlement agreement in the chat. I wanted to highlight these risk-based groups because it's sensible to have a risk based. The lowest tier is anonymized or aggregated, second tier is permission access with fewer than 100, third is 100 to 1000, and fourth is greater than 1000 customer records. This is a somewhat arbitrary risk threshold, but better than blanket.

- A. Edington: Thanks for presentation, a question like what I posed to Unitil earlier. I know it's a tough question, are there lessons learned from the New Hampshire process? Anything that stands out as it might apply to MA as we think about this framework?
- M. Murray: I'm a big fan of what's happened in New Hampshire. It's been difficult and taken a lot of coordination statewide. Multiparty collaboration. Multiple points come to mind. One is centralized registration, one stop shopping. New York IEDR is moving in this direction, so is Smart Meter Texas. As IEDRs grow and move across the state, standardization is name of the game. That's lesson one. Number 2 is there's a common data model in New Hampshire. This is the relationship between customers and accounts and addresses and where meters fit in. Data models can vary widely. With standardization, a third party recipient is going to get information in the same format with the same understanding of the relationship. This is with multisite customers in particular. As part of that, we also agreed on a data set. It's more than just electric usage data. Those of us who are excited about advanced metering, you forget there are other basic account information that is necessary to enrolling a customer in different programs. On certain TOU rates, you may not be able to use[inaudible]. The last thing is a very well thought out consent process. There's a mockup of the consent screen in the settlement agreement. We had a number of sessions to arrive at standard template to ensure third parties don't need wildly different educational materials on how to send customers through the process.

EDC Presentation on Data Access Framework (TBD, 20 min)

- J. Lawrence: I'll give you a high level orientation and then hit the highlights.
- C. Nouel: From an EDC perspective, our goal is that customers have access to information to help them make better decisions. We want to make sure we have right mechanisms to do that in a safe and secure. Simple enough process for this to be executable in reasonable amount of time.
- J. Lawrence: To hit the highlights, and if you see any points of interest raise your hand. On guiding principle side, we really want to limit data sharing to data that is required. We also want to make sure that all participants adhere to the principle of destroying or deleting data. There are distinct strategies for individual customer data, building level data, community aggregated data.
- A. Edington: On each of these, are there specific state laws you have in mind as related to data access or data sharing, destroying data when it's no longer useful. Maybe there's limits on hosting certain quantities of data. What does that bullet point mean? What data shouldn't be destroyed or deleted? Customers should be able to share their data with whoever they want. Those are my initial thoughts.
- J. Lawrence: The second bullet and subbullets are direct from our cyber security experts. Limit only to data that is absolutely needed. A third party who enters into an agreement

assert that they're only maintaining the data and long as they engaged. When they are no longer doing so, they would be obligated to destroy data to minimize risk.

- C. Nouel: We do that today as part of normal course of business. Every time we cease to have meeting with that vendor, we require data to be destroyed. I would prefer my data gets deleted if it's no longer used. Doesn't mean the customer can't re-up it, but as a general principle not to have unnecessary data.
- M. Murray: Principle is fine, but destroying is not just blanket if the customer does not want it to be deleted. Sometimes, as part of a contractual bargain, the third party is allowed to use that information on ongoing basis. Lookbacks, etc. There may be legitimate reasons to retain that information for a long time. If it's consistent with transactions and what was agreed to, then we shouldn't have mandatory deletion if customer did not agree.
- C. Nouel: Not mandatory deletion. I'll give a radical but possible example. I shared data with company X and they shared with another company without my consent. That would not be an appropriate use from that third party. That purpose might be a long purpose, or a short period. The point remains, when it's no longer need, the vendor should not retain it.
- J. Lawrence: Customers will click on term and conditions without reading. But there is an assumption that there are certain protections in place. Don't want to keep data beyond strong cyber security process. Data sharing model, for the purpose of cyber security and speed to market, we advocate a third party vendor hosted solution. Not proactive uploading of all data to this vendor. A better solution is API based with green button connect with data residing with utilities.
- C. Nouel: It would be the same protocol given that we're a multistate utilities, we would use same protocol on utilities and vendors not have to collate multiple ways of sharing data.
- J. Lawrence: Data available next day for individual customers, aggregated data on next month. We propose that a third party that is the conduit be considered as possible administrator of third party and vetting process. Various consent requirements here, based on industry best practices. One thing we want to make sure customers understand is that their data will be communicated outside of the utility.
- E. Grammer: This seems to aimed at business interests. Does this apply to DOER, which may want information from AMI as it works on climate conditions, or research interests. Do all of these proposals apply to those kinds of examples?
- J. Lawrence: May need inputs from others. Let's set DOER aside. Researchers, assume they'd look at primarily aggregated data. All requirements would apply to them. Just because it's research rather than for profit or nonprofit does not mean they don't need requirements.
- M. Murray: Home efficiency retrofits – DOER will need to receive energy usage data. My organization is working on a model utility data access plan. We've been thinking through with companies and partners, one of the cleanest ways is to share on the consent screen a program implementor, but that implementor needs a separate sheet of paper to give to the customer outside of the utility, and that's when the customer consents. I give consent to DOER as well as US DOE. Otherwise it lists a lot of different entities and requires some technical issues, you share it with one person once, and a separate process goes to DOER.
- C. Nouel: That is something that already exists, that is probably a feasible thing we can do. Similar principle.
- M. Murray: It's DOER that have the money, not a utility program. I'm a big fan of electronic exchange of information but [inaudible].
- E. Grammer: Looking at screen where it says consent data security acknowledgement. Are there multiple places where consent needs to be. New Jersey wants one click customer consent that's standardized. Are you thinking of that, or something else?
- J. Lawrence: Speaking for Eversource, conceptually we think there is an 'accept all' or al a carte option.

- C. Nouel: The idea would be to have a standardized process. From a National Grid perspective, we need simplicity and transparency. We're always transparent on who the data is shared with, simplicity, the reality is that in a lot of cases, customers will default back to the utility.
- A. Edington: I appreciate the framework. I'd be interested to go row by row in next meeting. Something for the group to consider is what it looks like to work on this data beyond working group. There are many stakeholders who are interested in developing what it looks like. Massachusetts is in interesting spot where utilities are straddling multiple states, so there's a lot different ideas we would leverage and standardize. In Massachusetts, we should standardize as much as possible. Once this working group concludes, what does it look like to further this stakeholder engagement?
- C. Nouel: This is going to be a journey. As technology advances, this information is going to become more sophisticated. We need to recognize that this is going to evolve and we need to start with something that is secure and transparent without doing everything on day one. Last point is that having specific questions for next meeting that can be helpful for us. We don't have all the answers by any stretch of the imagination.
- M. Marchand: Wondering from the user aggregated perspective, would we register as a third party? We can request data monthy from the utility, is that something we wouldn't have access to interval data unless the customer clicked this box to allow it?
- J. Lawrence: I might need to go back to my colleagues and ask how that would be factored into current enrollment process.
- C. Nouel: Same, need to talk to some folks.
- M. Marchand: That would be great to discuss next time.

Cape Light Compact: Roles and benefits of AMI data (Mariel Marchand, 10 min)

- M. Marchand: Cape Light Compact represents 21 towns on Cape Cod and Martha's Vineyard and Dukes County. The Compact is a municipal aggregator and the only non-utility program administrator in Massachusetts operating an energy efficiency program. Serve 145,000 through power supply program and 208,000 through energy efficiency program. As a municipal aggregator, hopefully capturing the needs of other aggregators. If the utilities are not doing the billing, to be able to verify those numbers on their end. In addition, the load needs to be settled based on actual usage of the customer as opposed to an average use profile so we can take advantage of capacity savings by shifting load away from the peak. The municipal aggregator should be able to access that data to design TVR based on data and educate and respond to customers. We get questions about high bills, and it would be great to see customer data to help them understand what's going on with their bill. It allows us more detail to help the customer. In terms of energy efficiency, in order to effectively administer the energy efficiency program, the Compact is hoping to access interval usage data by customer account. Background as to why this data would be useful: in the current three-year plan, Compact does require interval level data for the commercial battery program. In order to calculate customer baseline for insurance cap, that is data we currently need and would love to access. Our Cape and Vineyard electrification offering requires interval level data on import and export. To get the interval level data in import and export, we can't use a monthly net. Interval level data will be useful to calculate savings. Having access to interval level data would make that more exact and a lot simpler.
- M. Murray: How would you envision getting that interval data? For program participants, it's not a big problem to get their consent. Were you envisioning some arrangement where there wasn't consent from the customer?
- M. Marchand: I am not sure. I assume if they are signing up for DR program consent could be a part of the process. Having access to data from all customers would be beneficial for time varying rates, but that's not really answering your question.

- M. Murray: You need a control group a lot of times, so it's painful to sign up customers and then tell half they can't receive any benefits because they're part of the control group.
- M. Marchand: I can try to get back to you on that.
- J Hayes: Do you have anticipate a need for contemporaneous data? How much historical data is valuable?
- M. Marchand: At least a year historical data is useful.

NY Integrated Energy Data Resource Program: Overview of the program and process to date, use case framework, and best practices/findings (Lea Springstead, 10 minutes) - *Lea Springstead was replaced by presenter, Kyle Monsees.*

- K. Monsees: This is a high level overview of goals in New York state. These goals are driven by climate act. Biggest goals for 2030 are 70% of electricity from renewable energy and 1 million electric and electrification-ready homes. These are aggressive goals. To flash the IEDR vision statement, recognize a key part of achieving those goals is streamlined data access for achieving those goals and allowing all of our partners for achieving those goals. A bit of background on how IEDR was initiated. Pilot program on limited set of use cases. Developers need to query different datasets. There was a working group report that highlighted DER industry needs for different datasets to meet goals. Whitepaper from the Department of Public Services and how they are handling data process. Their proposed solution for tackling all of that. Our Public Service Commission in 2021 had goal of establishing a single state platform for all utilities across New York State, as well as public and private data sources. Well if that seems broad and wide sweeping, it is. As part of that order, NYSERDA was established as program sponsor. I wanted to give history on precursor items. Responsible for building out team. Brought out on program manager with Deloitte, advisor/SME Pecan Street and how to source data, brought on development team and subcontractors for designing, building and implementing IEDR program. Ensure transparency and unambiguous performance standards and milestones. Finally, want to ensure IEDR is stakeholder driven and has stakeholder driven use cases. Three bodies to guide – IEDR Steering committee, Utility Coordination group, and Advisory Group with broad range of stakeholders from developers. Broad set of voices for data, use cases and features. From broad sessions to directionally steer IEDR to small sessions on specific features to user interfaces to provide an experience that is useful. I want to mention there was a sister order to IEDR on adopting data access framework for aggregating data and making accessible, and how data should be accessed and what requirements are. IEDR development is two phases. Right now we're approaching the end of the first phase which is focused on creating the foundation. Back in Q1 of this year we released the initial public version of IEDR with three use cases. We wanted to get a version out early so there was a tangible version for stakeholders to react to. Anticipating the second phase if approved by commission. Comment period just closed on proposal for Phase 2, the goal is to focus on iterating IEDR for additional forty use cases by mid-2026. Prioritizing use cases, stakeholder driven, stakeholder access can mean a lot of things to a lot of people. Consistently and objectively prioritize use cases. How a use case can enable the achievement of climate goals. Feasibility based on how quickly we could get use cases out the door. What were we going to need to add as time down the road. With that prioritization exercise, our initial release consolidated hosting maps from across the state. From our interconnection, consolidating resources in one place for a more comprehensive view of the grid. We've been adding additional features for IEDR siting such as layers and filters, a more comprehensive view for initial IEDR siting. In our next release, storage capacity maps. Working on making rate plan information accessible in machine readable format, folks will be able to see what available rates are and have that available on continuous basis. Standard process across the state for customer to share data with third party.

Wanted to zero-in on what we're doing with customer data. New order regarding IEDR which made it clear for utilities to share data. The order confirmed IEDR is data custodian, be responsible for obtaining customer consent before releasing personal information. As well as all the responsibilities that come along with protecting that information. We'll also be housing monthly data as well. Customer choice on data sharing. Working through cyber security and privacy. Seeking to create a more secure practice than some existing practices out there. Want to make sure that this is a consistent and safe practice. Built cyber security into contacts with developers. At no point plan on pulling in highly sensitive data will never be hosted on IEDR and thinking about how data is either housed or not housed.

- A. Edington: Thanks for presentation. I appreciate the slide on AMI data access and the recent order. How recent was the order? Any other thoughts you might share on what you've learned or see in that order that you might recommend as a best practice for us to consider?
- K. Monsees: Released on 13th of this month (October). From that order, very explicit to make sure regulatory requirements are unambiguous. Making sure that some of that is sorted out front. Considering liability structure for who is responsible when there is a data breach. Feedback on what happens if there is a data breach on IEDR. If there is a data breach on a third party, guidance on what that looks like for us. IEDR has been helpful for us to make sure we're continuously engaging with stakeholders.
- M. Murray: To respond to Aurora about lessons learned, I would emphasize limits on liability that Kyle mentioned. It seemed obvious to anyone who read the orders that utilities were required [inaudible] and wanted to be sure they would be held harmless in case of another entity having a data breach. I think some level of explicit immunity is going to be important. Certainly, was important in NY. I am completely familiar with MA law, but it may be the same sort of situation.

Discussion (25 minutes)

- No further questions from the group.

Planning for next meeting and Third Quarterly Report timeline (10 min)

- Liz Valsamidis reviewed the next meeting steps and review process for the upcoming quarterly report. Next meeting is November 28, 2023 from 1:00 to 3:00 pm.
  - Third Quarterly Report Timeline:
  - November 8 – report out to Stakeholders
  - November 13 – edits due from Stakeholders
  - November 15 – report submitted

Meeting Chat Log

[1:20 PM] Michael Murray (Guest)

FYI - the New Hampshire data platform settlement agreement, which provides a comprehensive overview for the system under design: https://www.puc.New Hamphire.gov/Regulatory/Docketbk/2019/19-197/LETTERS-MEMOS-TARIFFS/19-197_2021-04-28_EVERSOURCE_JT_SETTLEMENT_AGREEMENT.PDF

[1:25 PM] Pat Taylor (Unitil) (Guest)

Thanks Michael. Here are the Community Aggregation rules: https://www.puc.New Hamphire.gov/Regulatory/Rules/PUC2200.pdf

[1:26 PM] Pat Taylor (Unitil) (Guest)

ATTACHMENT E

Puc 2203.02, Puc 2204.02, Puc 2204.03 are the relevant rules

[2:48 PM] Springstead, Lea (NYSERDA)

Navigate to the IEDR Platform: https://iedr.nyserda.ny.gov/

Contact the IEDR Program Team at: iedr@nyserda.ny.gov

[2:51 PM] Michael Murray (Guest)

Recent NY PSC order on IEDR:
https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={D0102A8B-0000-CE1E-95DD-1F79716C9AA8}

ERM

AMI Stakeholder Group Meeting

OCTOBER 31, 2023

PHOTO BY JON MOORE

Sustainability is our business

Meeting agenda

1. **Roll Call/Administrative items** (5 min)
2. **Follow up on Unitil presentation** (Kevin Sprague, 5 min)
    1. Concerning the History Consumption Tool, there were daily, monthly, and interval time periods. What is the time period interval available in MA?
    2. New Hampshire Data Access Platform (Unitil to answer follow up questions)
3. **Preliminary discussion on EDC plan to provide data to support "bill-ready" TVR designs** in which the non-EDC "supplier calculates bill line items based on interval data provided by EDCs at end of billing cycle" (per Attachment C of Quarterly Report) (requested by Elisa Grammer) (Elisa Grammer, 20 min)
4. **Preliminary discussion on eligibility criteria of third parties** (requested by Michael Murray) (Michael Murray, 15 min)
5. **EDC Presentation on Data Access Framework** (TBD, 20 min)
6. **Cape Light Compact: Roles and benefits of AMI data** (Mariel Marchand, 10 min)
7. **NY Integrated Energy Data Resource Program**: Overview of the program and process to date, use case framework, and best practices/findings (Lea Springstead, 20 minutes)
8. **Discussion** (25 minutes)
    1. Preliminary discussion of Data Access Plan – stakeholder thoughts and positions
9. **Planning for next meeting and Third Quarterly Report timeline** (10 min)
    1. November 8 – report out to Stakeholders
    2. November 13 – edits due from Stakeholders
    3. November 15 – report submitted

Roll Call

- Eversource
- National Grid
- Unitil
- Cape Light Compact
- IGS Energy
- Vistra Corp. / TXU
- Actual Energy
- NRG Energy
- Green Energy Alliance Consumers
- Office of the Attorney General
- Peregrine Group
- Department of Energy Resources (DOER)
- Colonial Power Group
- WeaveGrid
- City of Boston
- CleanChoice Energy
- Low-Income Weatherization and Fuel Assistance Program Network
- Just Energy
- Constellation
- Acadia Center
- Mission Data
- UtilityAPI
- National Consumer Law Center
- Landis + Gyr
- Good Choice Energy
- Oracle

Ground rules and communication process

Meetings

- Agenda items due 7 days prior to meeting
- Agenda sent 3 days prior to meeting
- Meeting summary available 7 days after meeting

Reports

- Process for receiving and incorporating feedback

Communication

- Email management process for ERMAMIStakeholdergroup@erm.com

Follow up on Unitil presentation

Kevin Sprague., 5 min

- Concerning the History Consumption Tool, there were daily, monthly, and interval time periods. What is the time period interval available in MA?

- New Hampshire Data Access Platform (Unitil to answer follow up questions)

Preliminary discussion on EDC plan to provide data to support “bill-ready” TVR designs

Elisa Grammer, 20 minutes

1. Preliminary discussion on EDC plan to provide data to support “bill-ready” TVR designs in which the non-EDC “supplier calculates bill line items based on interval data provided by EDCs at end of billing cycle” (per Attachment C of AMI Stakeholder Group Quarterly Report)

Preliminary discussion on eligibility criteria of third parties

Michael Murray, 15 minutes

EDC Presentation on Data Access Framework

20 minutes

Proposed Customer AMI Data- sharing Guidelines for MA AMI Stakeholder Group

Data guiding principles	• First priority is compliance with state laws
	• Data security best-practices:
	    • Only data that is required should be shared
	    • Data must be destroyed/deleted when no longer needed
	• Three distinct strategies:
	    1. Individual customer data
	    2. Building-level data
	    3. Aggregated data

Data sharing method	• Explore single statewide solution based on an API architecture and Green Button Connect • Individual and aggregated data sets included • EPA Portfolio Manager compatibility for multi-property owners • Common data model shared by EDCs • Explore a vendor host solution

Data to be shared	• Detailed logic model to be developed
	• General categories to be made available:
	    • Usage data – billing period
	    • Usage data -- 15-minute intervals
	    • Peak demand
	    • Billed amount (future functionality)
	    • Customer account, address, meter (not for aggregated or building-level)
	    • Supplier info

When are data available	• Individual customer data will be available next-day • Aggregated and building-level data will be available next-month (to verify consent thresholds)
Timeline	• Individual customer data • Good-faith effort to accommodate data access for AMI customers 6 months after each EDC's commencement of AMI deployment, or when statewide administrative processes are in place, whichever is later

	• Aggregated data
	    • Ensure functionality is ready when AMI deployment is substantially complete
	    • Good-faith effort for deliver functionality before full deployment, recognizing incomplete deployment may create confusion

	• Building-level data
	    • Ensure functionality is ready when AMI deployment is substantially complete
	    • Good-faith effort for deliver functionality before full deployment, recognizing incomplete deployment may create confusion

Vetting of third-parties	• Recommend that the data platform vendor hosts vet third-parties based on criteria established by EDCs with stakeholder input
	• Vetting to include third-parties' cybersecurity and privacy protections, and business need
	    • Privacy: third-parties accessing data must be signatory to Dataguard; annual attestation required
	    • Security: progressive security requirements based on number of customers accessed (e.g. highest standards apply to third-party accessing >1000 customers' data)
	• Foreign controlling interest must be disclosed

Consent	• Individual customers:
	    • Consent required
	    • Customer acknowledgement that breaches of shared data are outside of EDC control and EDCs bear no responsibility
	    • Web-based consent process
	    • Ongoing data feeds: annual customer option to revoke consent
	    • Options for customers to provide consent for each third-party, or blanket consent for all vetted third-parties
	    • Anonymization does not override consent requirement
	    • See consent data security acknowledgement

	• Building-level data:
	    • Municipal statutes may supersede these guidelines
	    • Consent not required if a building has more than four tenants and no single tenant's usage exceeds 50% of the building's total usage
	    • Consent required from all tenants if four or fewer tenants
	    • Consent required from any tenant whose usage exceeds 50% of the building's total usage
	    • Web-based consent process
	    • Ongoing data feeds: annual customer option to revoke consent (where consent is required)
	    • Anonymization does not override consent requirement
	    • Acknowledgement by third-party that attempts to identify customers using building-level data are prohibited

	• Aggregated data:
	    • Municipal statutes may supersede these guidelines
	    • Aggregation basis must be an existing datum in EDC CIS
	    • Consent not required if number of unaffiliated customers in aggregation exceeds 100
	    • Consent not required if an aggregation has more than four customers and no single customer's usage exceeds 50% of the total usage in the aggregation
	    • Consent required from all customers if four or fewer customers
	    • Consent required from any customer whose usage exceeds 50% of the aggregation's total usage
	    • Web-based consent process
	    • Ongoing data feeds: annual customer option to revoke consent (where consent is required)
	    • Anonymized data only
	    • Acknowledgement by third-party that attempts to identify customers using aggregate data are prohibited

Consent data security acknowledgement

I understand that, by agreeing to share my usage and account data, my information will be transmitted to an organization that is independent of my electric utility, and that the security of my information is outside of my utility's control.

Click Here to Acknowledge and Proceed

Cape Light Compact: Roles and benefits of AMI data

Mariel Marchand, 10 minutes

Cape Light Compact

Your Trusted, Local Energy Resource

Cape Light Compact: Data Access Needs

AMI Stakeholder Meeting
October 31, 2023

Mariel Marchand
Power Supply Planner

Who is Cape Light Compact?

- The Compact (CLC) is a Joint Powers Entity (JPE) comprised of the 21 towns on Cape Cod and Martha's Vineyard, and Dukes County
- The Compact is a municipal aggregator and is the only non-utility program administrator in Massachusetts operating an energy efficiency program
- Serve approximately 145,000 customers through our power supply program
- Serve approximately 208,000 customers through our energy efficiency program

Power Supply Data Access

- In order to be able to offer TVR, CLC's supplier will require:
  - o Access to interval level usage data by customer account in near real time at reasonable costs
  - o Ability for supplier to access/download data daily from a portal
- Load needs to be settled based on actual usage as opposed to being settled based on an average usage profile
- In order to design TVR and educate/respond to customer questions, CLC should have the ability to access customer data

Energy Efficiency Data Access

- To effectively administer its EE programs, CLC will require:
  - o Access to interval level usage data by customer account
  - o Ability to download data from a portal and/or have SFTP site to share
- Having access to interval level data would be beneficial for current and potential future programs
  - o Currently, CLC needs to request interval data from Eversource to calculate the performance cap for commercial battery program
  - o Cape and Vineyard Electrification Offering (CVEO) requires reporting to DPU on system import and export (as opposed to monthly net)
  - o Interval data would also be useful to calculate savings from behavioral and peak reduction programs and would improve evaluation of programs

NY Integrated Energy Data Resource Program

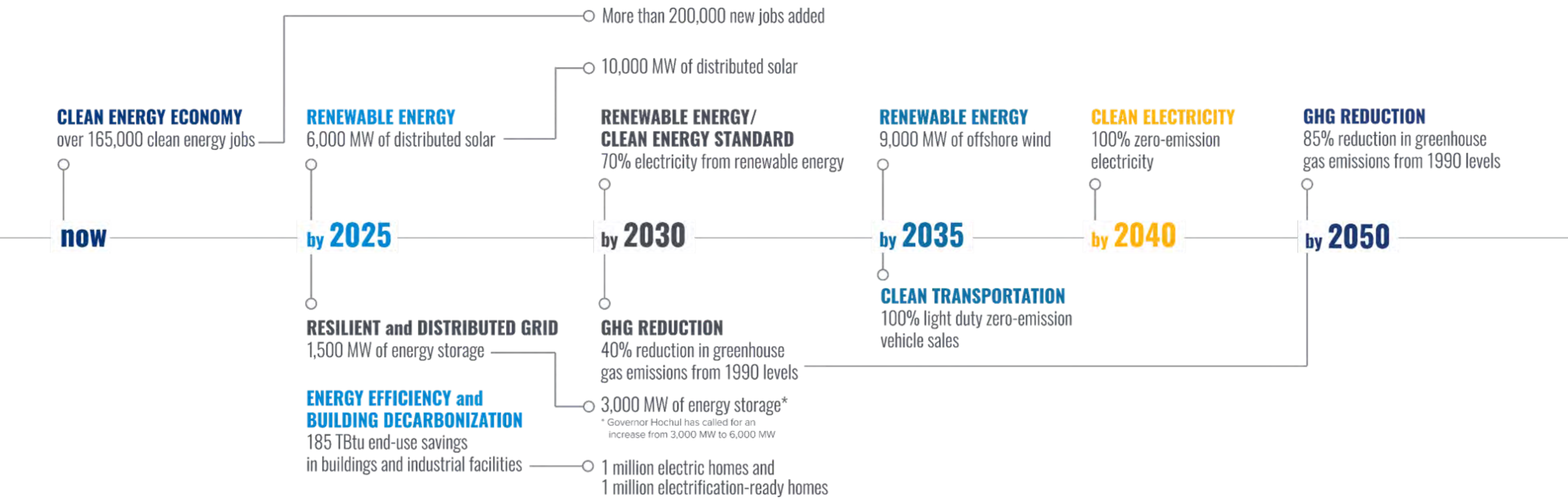
Lea Springstead, 20 minutes

- Overview of the program and process to date
- Use case framework
- Best practices/findings

Integrated Energy Data Resource (IEDR)

NEW YORK STATE | NYSERDA

NYS Climate Act Goals



IEDR Vision Statement

New York is transforming its energy system into one that is ***cleaner, more resilient, and more affordable***.

Effective access to ***useful energy data*** will play a critical role in this transformation to inform ***investment decisions***, identify operational inefficiencies, monitor the effectiveness of ***policy objectives***, promote ***innovation***, and ***encourage new business models.***

IEDR Background and Goals

Commission-directed Pilot Data Platform (Storage Deployment Order)

DER Industry Data Initiative | DER Industry Group Report

Department of Public Service (DPS) whitepaper

↓

New York Public Service Commission (PSC) Order Implementing an Integrated Energy Data Resource (IEDR) (2/11/21)

↓

"A single statewide platform to securely collect, integrate, analyze, and make accessible a large and diverse set of energy-related data and information from New York's electric, gas, and steam utilities – and other sources"

Program value delivery commitments that guide our process

Individuals and organizations that possess the expertise and experience in the development, implementation, and operation of a data platform of similar scale and scope

NEW YORK STATE | NYSERDA
E Source
PECAN STREET
Deloitte.

1

Unambiguous performance requirements and firm schedules and milestones established by the Program Charter and Program Sponsor Implementation Plan

2

- Conducting effective and extensive collaboration with and among targeted stakeholders, to identify use cases of value to them

- Three bodies guide IEDR program's activities: The IEDR Steering Committee, Utility Coordination Group, and Advisory Group

3

Data Access Framework

- Order Adopting a Data Access Framework and Establishing Further Process- 4/15/21
- Adopts a statewide 4/50 aggregated data privacy screen
- The Data Access Framework Matrix maps the existing Commission authorized cybersecurity and privacy requirements to combinations of purpose, access mechanism, and data type

IEDR development is broken into 2 phases, that are centered around use case development

Use cases are functional tools within the IEDR that are designed to serve user needs

In Phase 1 (Q3 2021 – Q4 2023) we:

- Released the "Initial Public Version" of the IEDR, in Q1 2023, which included 3 primary use cases
- Are on track to release the "Minimum Viable Product" version of the IEDR, in Q4 2023, which will include additional use cases

In Phase 2 (Q1 2024 – Q4 2026) we will:

- Continue to iterate on IEDR functionality and release new features of the IEDR
- Release an additional 40 use cases

Use Case Framework

Extensive Stakeholder Outreach

Ensured that all Program activities were driven by stakeholder input, helping to craft a platform ultimately born from the ideas of potential end users and shaped by subject-matter experts.

Use Case Refinement

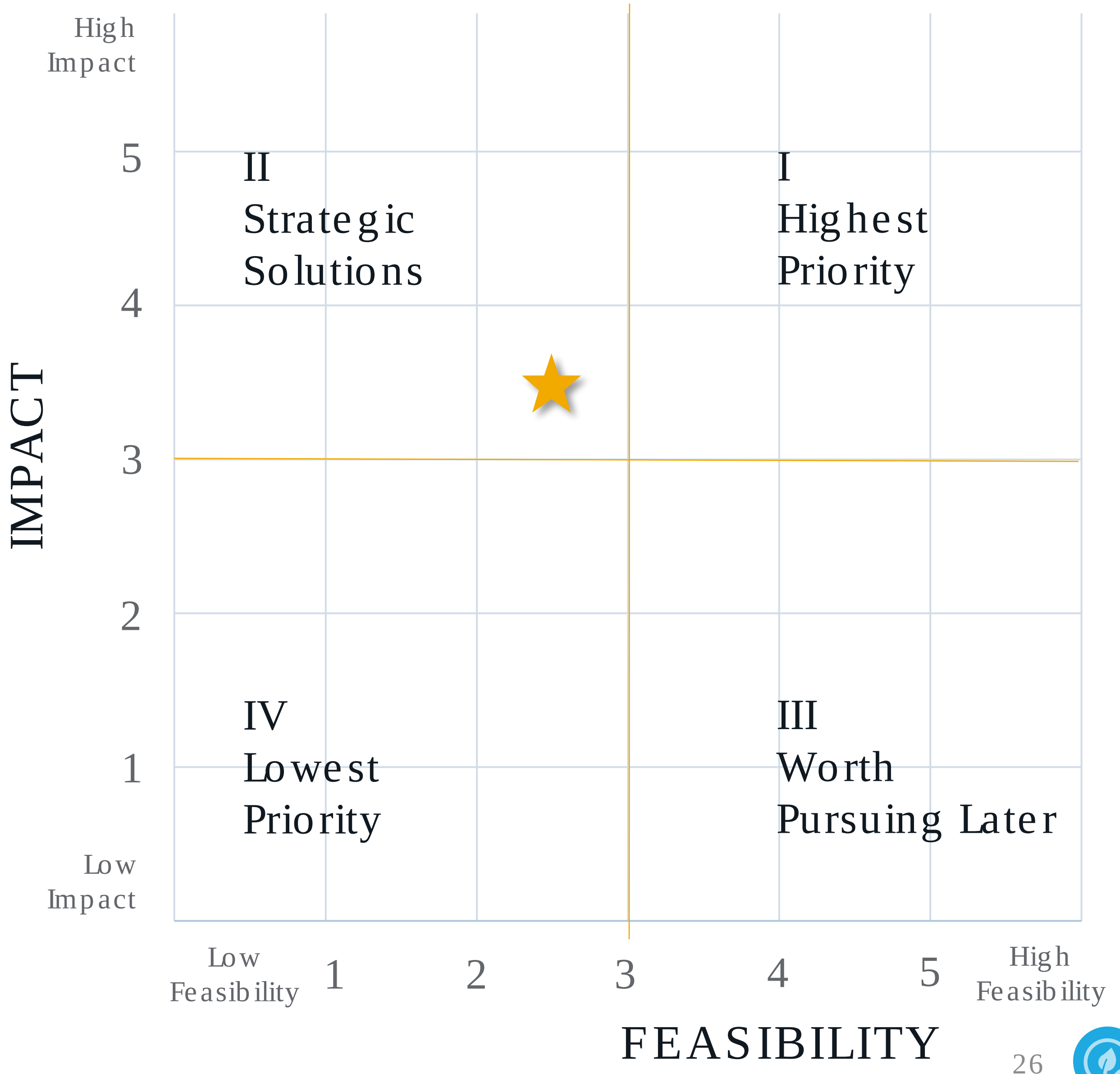
The Program Team conducted one-on-one interviews with a diverse set of non-utility stakeholders, explaining the vision of the program, the use case development and prioritization process, and incorporating feedback received into user stories.

Stakeholders also attended deep dive workshops to help develop a shared understanding of processes, needs, and the steps necessary for enabling use cases and discussing any challenges and data needs associated with development.

Use Case Development Prioritization

Our use case prioritization framework assessed use cases based on an impact (the extent to which a use case enabled Climate Act goals) and feasibility (the degree to which a use case can be easily implemented, with a focus on cost and time requirements) matrix.

Prioritization results were divided into quadrants correlating to priority level.

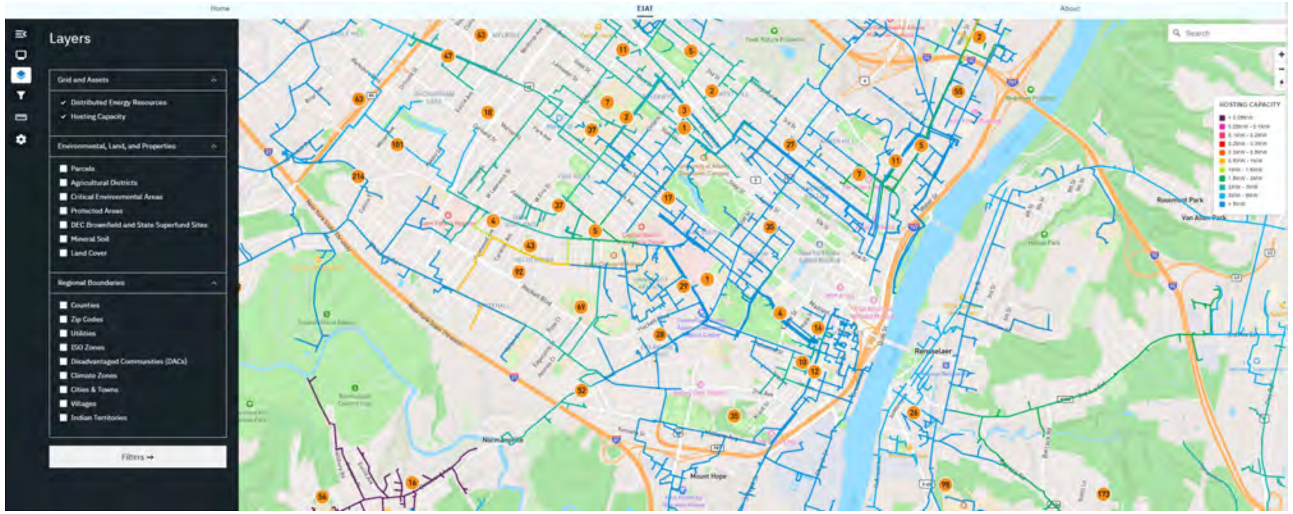


IEDR Phase 1 Use Case Development At A Glance

IPV Released - Q1 2023

Use Cases Deployed:

- Large Installed DERs
- Large Planned DERs (Interconnection Queue)
- Consolidated Hosting Capacity Maps



MVP to be Released - Q4 2023

Use Cases to be Deployed :

- DER Siting – Environmental, Community, Terrain, Land, and Property Assessment
- EIAT (Electronic Infrastructure Assessment Tool) Hosting Capacity & DER Map Enhancements
- Find and Filter Rate Options Across NYS IOU Utilities
- Access to Basic Rate Data and Tariff Book for Individual Rate
- Efficient and Effective Access to Existing Customer Billing Data (Sandbox Environment)

Customer Data Sets

- Order Addressing Integrated Energy Data Resource Matters
  - Directs NYS utilities to share unanonymized, unaggregated customer data sets with the IEDR for a range of use cases
  - Confirms IEDR as a "Data Custodian"
- Mix of AMI and Monthly data
- IEDR utilizing the Green Button Connect Standard
  - Provides streamlined customer consent mechanism to increase customer choice and likelihood of program participation
  - Standardizes customer data format
- Cybersecurity and Privacy
  - Seeking to improve on existing practices (sharing passwords, web scrapping, etc.)
  - No highly sensitive data
    - Credit Card Number, Social Security Number, and other highly sensitive customer data will never be housed on the IEDR
    - Privacy considerations regarding any data that may identify customer income or public data that may be used to re-identify a customer

Engagement Opportunities

We'd love to hear from you!

IEDR IPV is LIVE! – https://iedr.nyserda.ny.gov

Provide Feedback	You can access the Ideas Portal and provide feedback at any time. Ideas are regularly reviewed by our development team.
System Testing	Reach out to the IEDR inbox at IEDR@nyserda.ny.gov if you are interested in testing early releases of the platform or participating in Advisory Group panels.
Stay Up-To-Date	Please join the IEDR mailing list and visit the IEDR public dashboard for up-to-date information and upcoming events

Discussion

25 minutes

1. Preliminary discussion of Data Access Plan – stakeholder thoughts and positions

Planning for next meeting and Third Quarterly Report timeline

10 minutes

- Next Meeting: November 28, 1:00 to 3:00 pm

- Third Quarterly Report Timeline
  - November 8 – report out to Stakeholders
  - November 13 – edits due from Stakeholders
  - November 15 – report submitted

Thank you

If further information is required, please contact:

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