Guidehouse

Massachusetts Grid Modernization Program Year 2022 Evaluation Report: Advanced Distribution Management System (ADMS)

Massachusetts Electric Distribution Companies

Submitted by:

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Introduction

As part of the Grid Modernization Plan (GMP), the Massachusetts Electric Distribution Companies (EDCs) have been investing in advanced distribution management systems (ADMS) and advanced load flow (ALF). ADMS/ALF is a software platform investment fundamental to a modernized grid. ADMS consists of supervisory control and data acquisition (SCADA), outage management systems (OMSs), distribution management systems (DMSs), and advanced applications such as operational power flow, conservation voltage reduction (CVR), Volt/VAR optimization (VVO), fault location isolation and service restoration (FLISR), and distributed energy resource management systems (DERMS). ALF investments are tightly coupled with ADMS investments at Eversource, the only Electric Distribution Company (EDC) with a separate investment plan for ALF. Eversource completed deployment of ALF in PY 2021.

An ADMS's capabilities are key to delivering on the Massachusetts Department of Public Utilities' (DPU's) grid modernization objectives. These objectives include the ability to control devices for system optimization, provide support for advanced distribution automation (ADA) and VVO, and serve as an enabling platform to support a high penetration of distributed energy resources (DER). This evaluation focuses on the progress and effectiveness of the Massachusetts DPU preauthorized ADMS investments for each EDC toward meeting the DPU's grid modernization objectives for Program Year (PY) 2022.

Evaluation Process

The DPU requires a formal evaluation process, including an evaluation plan and evaluation studies, for the EDCs' preauthorized grid modernization plan investments. Guidehouse is completing the evaluation to establish a uniform statewide approach and to facilitate coordination and comparability. The evaluation is to measure and assess progress toward achieving the DPU's grid modernization objectives. The evaluation uses the DPU-established Infrastructure Metrics and Performance Metrics along with a set of Case Studies to understand if the GMP investments are meeting the DPU's objectives.

The original Evaluation Plan developed by Guidehouse[1] was submitted to the DPU by the EDCs in a petition for approval on May 1, 2019. Modifications to this original Evaluation Plan were required to enable evaluation of PY 2022. These modifications included an 1) extension of the evaluation window from the four year term spanning 2018 – 2021[2] (hereon referred to as Term 1) to incorporate the new four year term spanning 2022 – 2025 (hereon referred to as Term 2), and 2) revisions required to reflect the new Term 2 investment activity. Modifications to the original Evaluation Plan were submitted to the EDCs for approval on March 1, 2023. The

[1] Guidehouse had previously filed as "Navigant Consulting" and did so during the initial evaluation plan filing.

[2] On May 10, 2018, the Massachusetts DPU issued its Order regarding the individual GMPs filed by the three Massachusetts EDCs. In the Order, the DPU preauthorized grid-facing investments over 3 years (2018-2020) for each EDC and adopted a 3-year (2018-2020) regulatory review construct for preauthorization of grid modernization investments. On May 12, 2020, the DPU issued an Order extending the 3-year grid modernization plan investment term to a 4-year term, which introduced a 2021 program year. In addition, on July 1, 2020, Eversource filed a request for an extension of the budget authorization associated with grid modernization investments. The 2018-2021 GMP term results provided for Eversource reflect these changes.

modified Evaluation Plan has been used to develop the analysis and evaluation provided below in this document.

Table 1 illustrates the key Infrastructure Metrics, Performance Metrics, and Case Studies (shown as Other metrics in the table) relevant for the ADMS evaluation by EDC.

Table 1. ADMS Evaluation Metrics

Type	ADMS Evaluation Metrics	ES	NG	UTL
IM-5	Cost for Deployment	✓	✓	✓
IM-6	Deviation between Actual and Planned Deployment for the Plan Year	✓	✓	✓
IM-7	Projected Deployment for the Remainder of the GMP Term			
PM-8	Increase in Circuits and Substations with DMS Power Flow and Control Capabilities	✓	✓	✓
PM-9	Control Functions Implemented by Circuit and Substation	✓	✓	✓
PM-ES-1	ALF – Percent of Milestone Completion	✓		

IM = Infrastructure Metric, PM = Performance Metric, ES = Eversource, NG = National Grid, UTL = Unitil

* The EDCs are responsible for these metric calculations and the calculations are not addressed in this evaluation

Source: Stamp Approved Performance Metrics, July 25, 2019

Data Management

Guidehouse worked with the EDCs to collect data to complete the ADMS evaluation for the assessment of Infrastructure Metrics, Performance Metrics and Case Studies. A consistent methodology was used across Investment Areas and EDCs for evaluating and illustrating EDC progress toward the GMP metrics.

Table 2 summarizes data sources used throughout the ADMS evaluation for PY 2022. Section 3.1.1 details each of the data sources.

Table 2. ADMS Data Sources

Data Source	Description
2021 Grid Modernization Plan Term Report[3,4,5]	Planned device deployment and cost information from each EDC's appendix to the *2021 GMP Term Report* (filed April 1, 2022). Data was used as the reference to track progress against the GMP targets and are referred to as the GMP Plan in summary tables and figures throughout the report.

[3] Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid, Grid Modernization Plan Annual Report 2020. Submitted to Massachusetts DPU on April 1, 2021 as part of DPU 21-30.

[4] NSTAR Electric Company d/b/a Eversource Energy, Grid Modernization Plan Annual Report 2020. Submitted to Massachusetts DPU on April 1, 2021 as part of DPU 21-30. Note that Eversource Energy filed an updated Appendix 1 filing in December of 2021; however that update did not affect any of the data or results in the evaluation.

[5] Fitchburg Gas and Electric Light Company d/b/a Unitil, Grid Modernization Plan Annual Report 2020. Submitted to Massachusetts DPU on April 1, 2021 as part of DPU 21-30.

Data Source	Description
2022 Grid Modernization Plan Annual Report[6,7,8]	All PM-related data are from these 2022 GMP Annual Report Appendices. In addition, data collected as part of EDC Data Template (below) was compared to the data submitted by the EDCs to the DPU in the 2021 Grid Modernization Plan Term Reports and associated Appendix 1 filings. The evaluation team confirmed the consistency of the data from the various sources and reconciled any differences
EDC Device Deployment Data Template	Captures planned and actual device deployment and spend data. Actual device deployment and cumulative spend information were provided by work order ID and specified at the feeder- or substation-level as appropriate. Device deployment information and estimated spend for 2022 were provided as well.
ADMS/ALF Supplemental Data Template	Collects ADMS-specific data from the EDCs at the feeder- and substation-level, including information on the feeders and substations with ADMS power flow and control capabilities, and information on feeders and substations with control functions implemented.
Eversource's 2021 DPU-Filed Plan[9]	Eversource's GMP extension request was approved by the DPU on February 4, 2021. It includes budgets for PY 2021 deployment at the Investment Area level. This data source is included in the EDC Plan for Eversource planned spend at the Investment Area level.
2022-2025 Grid Modernization Plan Track 1 Order[10]	The GMP Track 1 Order was filed by the DPU on October 7, 2022. It includes budgets for PY 2022-PY 2025 deployment at the Investment Area level. This data source is included in the EDC Plan for each EDC's planned spend at the Investment Area level.
EDC DOER Response Appendix[11]	Planned device deployment and cost information from each EDC's Appendix 1 filing was provided in response to DOER requests for information. Data was used as the reference to track progress against the GMP targets and are referred to as the GMP Plan in summary tables and figures throughout the report.

Source: Guidehouse analysis

Findings and Recommendations

Table 3 summarizes the Term 1 Infrastructure Metrics results for Eversource's ADMS Investment Area through PY 2022. Although Infrastructure Metrics are the same across all

[6] Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid, Grid Modernization Annual Report for Calendar Year 2022. Submitted to Massachusetts DPU on April 24, 2023, as part of DPU 23-30.
[7] NSTAR Electric Company d/b/a Eversource Energy, Grid Modernization Annual Report for Calendar Year 2022. Submitted to Massachusetts DPU on April 24, 2023, as part of DPU 23-30.
[8] Fitchburg Gas and Electric Light Company d/b/a Unitil, 2022 Grid Modernization Plan Annual Report. Submitted to Massachusetts DPU on April 24, 2023, as part of DPU 23-30.
[9] Grid Modernization Program Extension and Funding Report. Submitted to Massachusetts DPU on July 1, 2020 as part of DPU 15-122.
[10] Massachusetts DPU 21-80/DPU 21-81/DPU 21-82 Order on Previously Deployed Technologies issued October 7, 2022.
[11] Plan data is sourced from EDC responses to the first set of information requests issued by the Department of Energy Resources (DOER). These responses were filed on October 4th, December 2nd, and October 5th, 2021, for Eversource, National Grid, and Unitil under DPU dockets 21-80, 21-81, and 21-82.

Investment Areas, ADMS investments are not tracked by device. Instead, ADMS investments are tracked by technology or software implementation.[12]

Table 3. Term 1 ADMS Infrastructure Metrics Summary

Infrastructure Metrics			Eversource
GMP Plan Total, PY-2018-2022*		# Devices	0
		Spend, $M	$25.57
IM-4	Number of devices or other technologies deployed thru PY 2018-2022*	# Devices Deployed***	0
		% Devices Deployed	N/A
IM-5	Cost for Deployment thru PY 2018 – 2022*	Total Spend, $M	$25.16
		% Spend	98%
IM-6	Deviation Between Actual and Planned Deployment for PY 2022	% On Track (Devices)	N/A
		% On Track (Spend)	96%
IM-7	Projected Deployment for the remainder of the GMP Term (i.e., Term 1)**	# Devices Remaining	0
		Spend Remaining, $M	$0.00

*The metric names have been slightly changed here to clarify the time span used in analysis.

**This metric has been interpreted here (i.e., within the context of the 2022 Program Year Evaluation) as the units and spending that the EDC plans to complete their most recent 4-year Term 1 plans. Additional Grid Modernization units and dollars incurred in 2022 are attributed to Term 2, as appropriate, and all units and dollars spent during 2023 through 2025 will be considered as part of Term 2 GMPs.

***Note that "Deployed" here refers to commissioned devices. For full definitions of deployment stages, see Docket 20-46 Response to Information Request DPU-AR-4-11, September 3, 2020.

Source: Guidehouse analysis of 2021 GMP Term Reports and 2022 EDC Data

Table 4 summarizes the Term 2 Infrastructure Metrics results for each EDC's ADMS Investment Area through PY 2022.

Table 4. Term 2 ADMS Infrastructure Metrics Summary

Infrastructure Metrics			Eversource	National Grid**	Unitil
GMP Plan Total, 2022-2025		# Devices Planned	0	0	0
		Spend, $M	$16.69	$61.02	$0.95
EDC Data Total, 2022-2025		# Devices Planned	0	0	0
		Spend, $M	$15.73	$61.02	$0.61
IM-4	Number of devices or other technologies deployed thru. PY 2022*	# Devices Deployed	0	0	0
		% Devices Deployed	N/A	N/A	N/A
IM-5	Cost for Deployment thru. PY 2022*	Total Spend, $M	$0.00	$20.60	$0.06
		% Spend	0%	34%	6%
IM-6	Deviation Between Actual and Planned Deployment for PY 2022	% On Track (Devices)	N/A	N/A	N/A
		% On Track (Spend)	0%	91%	15%
IM-7		# Devices Remaining	0	0	0

[12] Throughout this report, the term *technology* or *software implementation* is used instead of device deployment.

Infrastructure Metrics		Eversource	National Grid**	Unitil
Projected Deployment for the Remainder of the GMP Term*	Spend Remaining, $M	$15.73	$40.42	$0.55

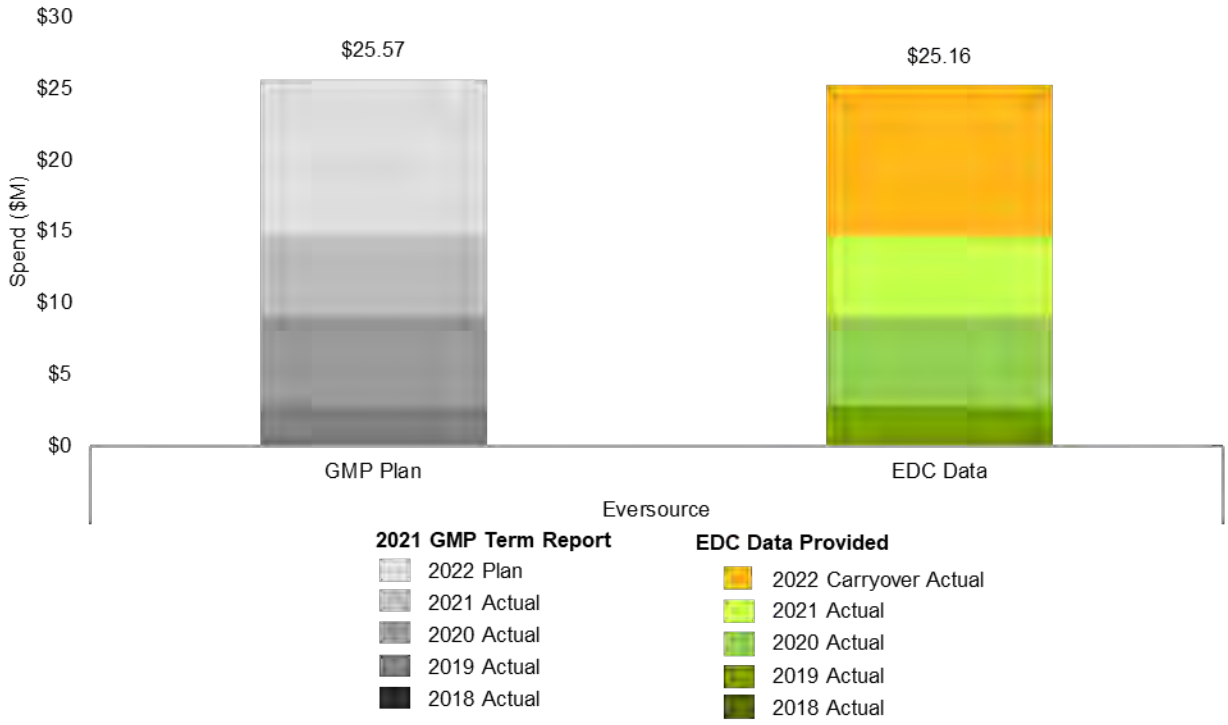
*Note that "Deployed" here refers to commissioned devices. For full definitions of deployment stages, see Docket 20-46 Response to Information Request DPU-AR-4-11, September 3, 2020.

** To more closely align spend projections with DPU pre-authorized budgets, National Grid operations and maintenance (O&M) spend is included in actual and planned spend presented here. O&M spend is provided in aggregate for each investment area and is therefore excluded from device-specific summaries of spend.

Source: Guidehouse analysis of 2021 DOER Responses and 2022 EDC Data

Figure 1 compares the Term 1 GMP Plans and EDC Data totals and year-over-year spending for each EDC.

Figure 1. ADMS Term 1 Spend Comparison (2018-2022, $M)

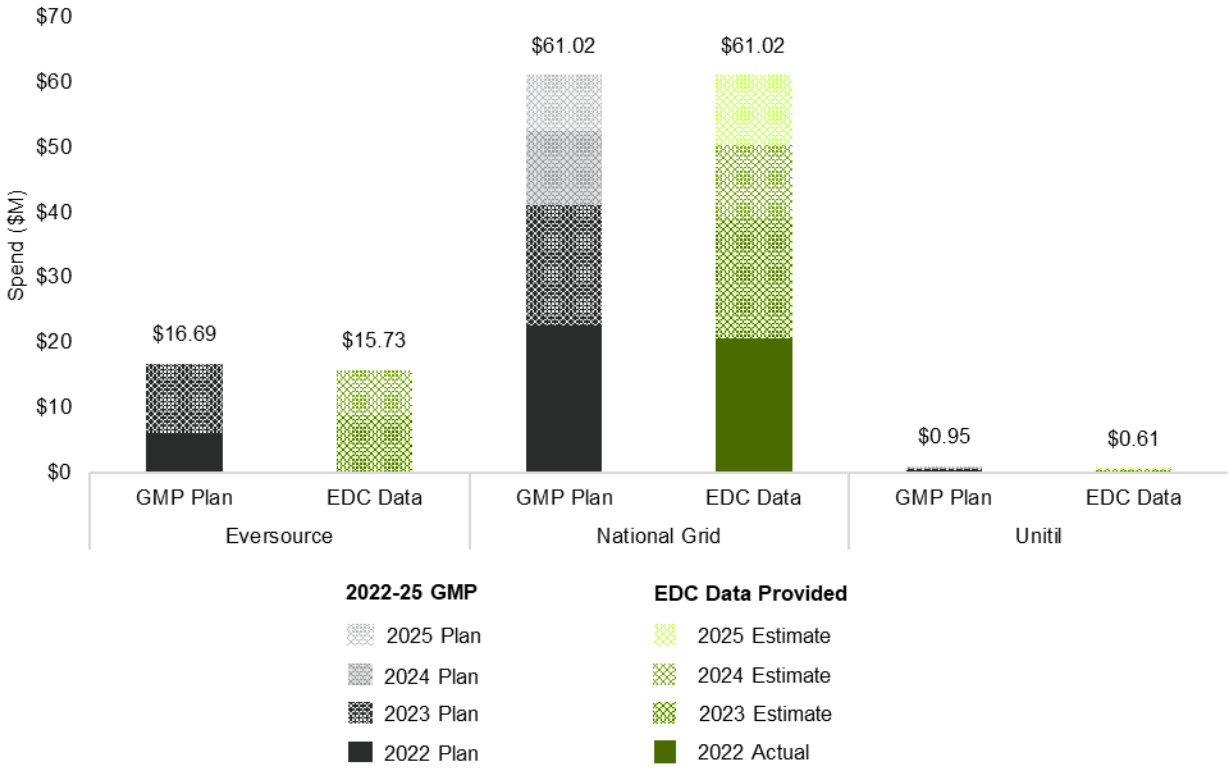


Note: Includes the Eversource planned spend on activity from 2021 that was transferred to 2022, set forth in Eversource's 2021 GMP Term Report, filed on April 1, 2022.

Source: Guidehouse analysis of 2021 GMP Term Report, "GMP Extension and Funding Report," and 2022 EDC Data

Figure 2 compares the Term 2 GMP Plans and EDC Data totals and year-over-year spending for each EDC.

Figure 2. ADMS Term 2 Spend Comparison (2022-2025, $M)



Note: To more closely align spend projections with DPU pre-authorized budgets, National Grid operations and maintenance (O&M) spend is included in actual and planned spend presented here. O&M spend is provided in aggregate for each investment area and is therefore excluded from device-specific summaries of spend.

Source: Guidehouse analysis of DPU Order (October 7, 2022) and 2022 EDC Data

Table 5 summarizes key findings related Guidehouse's ADMS evaluation for each EDC.

Table 5. Summary of Infrastructure Metrics Findings for ADMS Investment Area

EDC	Summary of Findings
Eversource	• Eversource's Term 1 ALF completion has been evaluated as 100% since PY 2021, as Eversource has implemented all planned enhanced semi-automatic ALF analysis. • Eversource's ADMS activity planned for Term 2 was on hold within PY 2022. Efforts to standardize and consolidate its two legacy GIS systems, expected to be complete in July 2023, must be completed before ADMS activity can continue.
National Grid	• National Grid's capital spend ($20.6M) for ADMS investment in PY 2022 was slightly below its latest plan filed in its 2021 DOER Responses ($22.5M). • ADMS spend ratios across device type for National Grid differed from its *DOER Responses*, with spend exceeding plans for DMS, and showing lower relative spend for all other technology categories. Plan spend has been adjusted across all technology types for PY 2023 - PY 2025 in order to align with initial plan targets.

EDC	Summary of Findings
Unitil	• Unitil's actual spend for ADMS was significantly under plan ($0.06M v. $0.40M); however, Unitil projects that ADMS deployment will be complete by the end of 2024. • Despite spend coming in under plans during PY 2022, spend plans for the remainder of GMP Term 2 (2023-2025) are unchanged.

Source: Guidehouse analysis of 2021 GMP Term Reports and EDC Data

Table 6 summarizes key findings related to Guidehouse's ADMS Performance Metrics evaluation for each EDC.

Table 6. Summary of Performance Metrics Findings for ADMS Investment Area

Performance Metrics		Eversource		National Grid		Unitil	
		Circuits	Sub-stations	Circuits	Sub-stations	Circuits	Sub-stations
PM-8	Increase in Circuits and Substations with DMS Power Flow and Control Capabilities	*ADMS Paused*	*ADMS Paused*	282	110	25	9
PM-9	Control Functions Implemented by Circuit and Substation	*ADMS Paused*	*ADMS Paused*	0	0	0	0
PM-ES-1	ALF – Percent of Milestone Completion	100%	100%	N/A	N/A	N/A	N/A
Other	Distributed Generation (DG) Interconnection Queue Wait Time	N/A	N/A	N/A	N/A	N/A	N/A

Source: Guidehouse Analysis

Guidehouse submits the following recommendations for EDC consideration in PY 2022:

- Despite Unitil's ADMS spend coming in under plans during PY 2022, spend plans for 2023 through 2025 are unchanged since submission of updated 2022 - 2025 GMP plans in response to 2021 DOER information requests.[13] Guidehouse encourages Unitil to reassess whether additional activity, and therefore spend, not conducted in PY 2022 requires additional spend to be projected for 2023 through 2025. This is especially important, as ADMS spend and deployment are closely tied to the M&C and VVO investment areas, which faced delays in deployment in recent years.

[13] Fitchburg Gas and Electric Light Company d/b/a Unitil, Company's response to the First Set of Information Requests issued by the Department of energy Resources. Submitted to Massachusetts DPU on October 5, 2021 as part of DPU 21-48

1. Introduction to Massachusetts Grid Modernization

This section provides a brief background to the grid modernization evaluation process along with an overview of the Advanced Distribution Management System (ADMS) and Advanced Load Flow (ALF) Investment Area and specific ADMS/ALF evaluation objectives. These are provided for context when reviewing the subsequent sections that address the specific evaluation process and findings.

1.1 Massachusetts Grid Modernization Plan Background

The following subsections summarize the progression of Massachusetts Grid Modernization Plans (GMPs) filed by the three Massachusetts Electric Distribution Companies (EDCs): Eversource, National Grid, and Unitil.

1.1.1 Grid Modernization Term 1 (2018-2021)

On May 10, 2018, the Massachusetts DPU issued its Order[14] regarding the individual Grid Modernization Plans (GMPs) filed by the three Massachusetts EDCs.[15,16] In the Order, the DPU preauthorized grid-facing investments over 3 years (2018-2020) for each EDC and adopted a 3-year (2018-2020) regulatory review construct for preauthorization of grid modernization investments. On May 12, 2020, the DPU issued an Order[17] extending the 3-year grid modernization plan investment term to a 4-year term, which introduced a 2021 program year.

During the GMP term spanning 2018-2021 (hereon referred to as Term 1) the grid modernization investments were organized into six Investment Areas to facilitate understanding, consistency across EDCs, and analysis.

- Monitoring and Control (M&C)
- Advanced Distribution Automation (ADA)
- Volt/VAR Optimization (VVO)
- Advanced Distribution Management Systems/Advanced Load Flow (ADMS and ALF)
- Communications/IoT (Comms)
- Workforce Management (WFM)

A certain level of spending for each of these GMP Investment Areas was preauthorized by the DPU, with the expectation they would advance the achievement of DPU's grid modernization objectives:

[14] Massachusetts DPU 15-120/DPU 15-121/DPU 15-122 (Grid Modernization) Order issued May 10, 2018 (DPU Order).

[15] On August 19, 2015, National Grid, Unitil, and Eversource each filed a grid modernization plan with the DPU. The DPU docketed these plans as DPU 15-120, DPU 15-121, and DPU 15-122, respectively.

[16] On June16, 2016, Eversource and National Grid each filed updates to their respective grid modernization plans

[17] Massachusetts DPU 15-120; DPU 15-121; DPU 15-122 (Grid Modernization) Order (1) Extending Current Three-Year Grid Modernization Plan Investment Term; and (2) Establishing Revised Filing Date for Subsequent Grid Modernization Plans (issued May 12, 2020).

- Optimize system performance by attaining optimal levels of grid visibility command and control, and self-healing
- Optimize system demand by facilitating consumer price responsiveness
- Interconnect and integrate distributed energy resources (DER)

For Term 1, the Massachusetts DPU's preauthorized budget for grid modernization varied by Investment Area and EDC. Eversource originally had the largest preauthorized budget at $133 million, with ADA and M&C representing the largest share ($44 million and $41 million, respectively). National Grid's preauthorized budget was $82.2 million, with ADMS representing over 50% ($48.4 million). Unitil's preauthorized budget was $4.4 million and VVO makes up 50% ($2.2 million).

On July 1, 2020, Eversource filed a request for an extension of the budget authorization associated with grid modernization investments.[18] The budget extension, approved by the DPU on February 4, 2021,[19] included $14 million for ADA, $16 million for ADMS/ALF, $5 million for Communications, $15 million for M&C, and $5 million for VVO.[20] These values are included in the Eversource total budget by Investment Area in Table 7.

Table 7. Term 1 (2018-2021) Preauthorized Budget, $M

Investment Areas	Eversource	National Grid	Unitil	Total
ADA	$58.00	$13.40	N/A	**$71.40**
ADMS/ALF	$33.00	$48.40	$0.70	**$79.10**
Comms	$23.00	$1.80	$0.84	**$25.60**
M&C	$56.00	$8.00	$0.35	**$64.75**
VVO	$18.00	$10.60	$2.22	**$30.80**
WFM	--	--	$0.30	**$1.00**
2018-2021 Total	**$188.00**	**$82.20**	**$4.41**	**$272.65**

Source: DPU Order, May 10, 2018, and Eversource filing "GMP Extension and Funding Report," July 1, 2020

1.1.2 Grid Modernization Term 2 (2022-2025)

On July 2, 2020, the Massachusetts DPU issued an Order[21] that triggered further investigation into modernization of the electric grid. In the order, the DPU required that the EDCs file a grid modernization plan on or before July 1, 2021. In accordance with this order, the Massachusetts EDCs filed grid modernization plans for a 4-year period spanning 2022-2025 (hereby referred to as Term 2).[22] In these plans, the EDCs outlined continued investment in the areas that received

[18] Grid Modernization Program Extension and Funding Report. Submitted to Massachusetts DPU on July 1, 2020 as part of DPU 15-122

[19] Massachusetts DPU 20-74 Order issued on February 4, 2021.

[20] The DPU allowed flexibility to these budgets to accommodate changing technologies and circumstances. For example, EDCs can shift funds across the different preauthorized investments if a reasonable explanation for these shifts is supplied.

[21] Massachusetts DPU 20-69: Investigation by the Department of Public Utilities on its own Motion into the Modernization of the Electric Grid – Phase Two (issued July 2, 2020).

[22] On July 1, 2021, Eversource, National Grid, and Unitil each filed a grid modernization plan with the DPU for the period spanning 2022-2025. The DPU docketed these plans as DPU 21-80, 21-81, and 21-82, respectively.

investment during Term 1 (referred to as Track 1 Investment Areas), and investment in new Investment Areas (Track 2 Investment Areas). The Track 2 grid modernization investments were organized into the following additional Investment Areas to facilitate understanding, consistency across EDCs, and analysis.

- Interconnection Automation
- Probabilistic Power Flow Modeling
- Distributed Energy Resource Mitigation (DER Mitigation)
- Distributed Energy Resource Management System (DERMS)
- Demonstration Projects

1.1.3 Investment Areas

Table 8 and Table 9 and summarize the DPU pre-authorized GMP investments.

Table 8. Overview of Term 2, Track 1 Investment Areas

Investment Areas	Description	Objective
Monitoring and Control (M&C)	Remote monitoring and control of devices in the substation for feeder monitoring or online devices for enhanced visibility outside the substation	Enhancing grid visibility and control capabilities, reliability increase
Advanced Distribution Automation (ADA)	National Grid-only investment for Term 2. ADA allows for isolation of outage events with automated restoration of unaffected circuit segments	Reduces the impact of outages
Volt/VAR Optimization (VVO)	Control of line and substation equipment to optimize voltage, reduce energy consumption, and increase hosting capacity	Optimization of distribution voltage to reduce energy consumption and demand
Advanced Distribution Management Systems	New capabilities in real-time system control with investments in developing accurate system models and enhancing Supervisory control and data acquisition (SCADA) and outage management systems to control devices for system optimization and provide support for distribution automation and VVO with high penetration of DER	Enables high penetration of DER by supporting the ability to control devices for system optimization, ADA, and VVO
Communications/IoT	Fiber middle mile and field area communications systems	Enables the full benefits of grid modernization devices to be realized
Workforce Management (WFM)	Unitil-only investment for Term 2 to improve workforce and asset utilization related to outage management and storm response	Improves the ability to identify damage after storms

Source: Grid Mod RFP – SOW (Final 8-8-18).pdf; Guidehouse

Table 9. Overview of Term 2, Track 2 Investment Areas

Investment Areas	Description	Objective
Interconnection Automation	Eversource plans to integrate, into a single software, both their existing Distributed Generation (DG) tools and customer interconnection portal.	Improve the DG interconnection process with reductions in time & resources for a growing number of applications
Probabilistic Power Flow Modeling	Eversource plans to use a simulation of locational load and generation based on variables such as customer behavior and energy market prices.	Leverage GMP term 1 ALF investments into an automated approach to system modelling.
DER Mitigation	Unitil plans to install ground-fault overvoltage protection as well as upgrade either voltage regulators or load tap changers for three substations with reverse power flow issues	Address reverse power flow issues caused by DER saturation at three specific substations.
DERMS	Software that forms the hub of DER management functions and integrates with other applications such as a Demand Response Management System ("DRMS") and ADMS, to create the DERMS Platform.	Cost-effectively optimize system performance and integrate DERS with more granularity
Demonstration Projects	Two demonstration projects proposed by National Grid to test new tools. Includes Active Resource Integration (ARI) and Local Export Power Control	Facilitates the interconnection of DG in certain areas of the EDC's distribution system that are approaching saturation
Project Management and Third-Party Evaluation	Investment into evaluation and project management. Evaluation includes third party evaluator budget, where the evaluator will conduct studies on appropriate topics related to the deployment of preauthorized investments. Project management includes portfolio management and reporting.	Assess and report on GMP deployment progress and performance of grid modernizing investments.

Source: Massachusetts DPU 21-80/DPU 21-81/DPU 21-82 Order on New Technologies and Advanced Metering Infrastructure Proposals issued November 30, 2022.

The Massachusetts DPU preauthorized budget for Track 1 investments and Track 2 investments on October 7, 2022[23] and November 30, 2022, [24] respectively. The preauthorized budget for grid modernization varies by Investment Area and EDC. National Grid has the largest preauthorized track one budget at $300.8 million, with Communications and VVO representing the largest share ($103 million and $76 million, respectively). Eversource's preauthorized Track 1 budget is $176.6 million, with M&C representing about 50% ($76.3 million). Unitil's preauthorized track one budget is $9.1 million with VVO making up more than 50% ($5.4 million).

[23] Massachusetts DPU 21-80/DPU 21-81/DPU 21-82 Order on Previously Deployed Technologies issued October 7, 2022.

[24] Massachusetts DPU 21-80/DPU 21-81/DPU 21-82 Order on New Technologies and Advanced Metering Infrastructure Proposals issued November 30, 2022.

Table 10. Term 2 (2022-2025) Preauthorized Budget, $M

Investment Areas	Eversource	National Grid	Unitil	Total
ADA	--	$37.70	--	**$37.70**
ADMS*	$21.90	$61.00	$1.50	**$84.40**
Comms**	$38.00	$102.80	$0.82	**$141.62**
M&C	$76.30	$4.10	$1.10	**$81.50**
VVO	$40.40	$76.40	$5.40	**$122.20**
WFM	--	--	$0.25	**$0.25**
IT/OT	--	$18.80	--	**$18.80**
Track 1 Total	***$176.60***	***$300.80***	***$9.07***	***$486.47***
Interconnection Automation	$2.77	--	--	**$2.77**
Probabilistic Power Flow	$2.07	--	--	**$2.07**
DER Mitigation	--	--	$1.04	
DERMS	$16.00	$24.60	$0.16	**$41.80**
Demonstration Projects	--	$6.40	--	**$6.40**
Project Management and Third-Party Evaluation	$8.00	$4.40	$0.30	**$12.70**
Track 2 Total	***$29.00***	***$35.40***	***$1.50***	***$65.90***
2022-2025 Total	**$205.60*****	**$336.20**	**$10.57**	**$552.37**

* Given as $1.66M minus DERMS cost from DPU Order, Oct. 7, 2022, and calculated from DPU Order, Nov. 30, 2022.

** Includes Communications Modernization for Eversource, with added budget taken from DPU Order, Nov. 30, 2022.

*** Budget includes $16.3 million in funds remaining from the supplemental budget approved in D.P.U. 20-74 for DMS, substation automation, and VVO investments that Eversource sought to expend in calendar year 2022.

Source: DPU Order on Previously Deployed Technologies, October 7, 2022, and DPU Order on New Technologies, November 30, 2022 under docket 21-80, 21-81, and 21-82.

1.1.4 Evaluation Goals and Objectives

The DPU requires a formal evaluation process (including an evaluation plan and evaluation studies) for the EDCs' preauthorized GMP investments. Guidehouse is completing the evaluation to enable a uniform statewide approach and to facilitate coordination and comparability. The evaluation measures the progress made toward the achievement of DPU's grid modernization objectives. It uses the DPU-established Infrastructure Metrics and Performance Metrics, as well as Case Studies that illustrate the performance of specific technology deployments, to help determine if the investments are meeting the DPU's GMP objectives.

As previously noted, the Massachusetts DPU order on Track 2 technologies was released on November 30, 2022. The EDCs waited for DPU ruling on these technologies prior to commencing with significant investment, and thus were not able to complete deployment of

Track 2 technologies within the remaining 2022 calendar year.[25] Guidehouse has, therefore, not included evaluation findings for Track 2 technologies in this PY 2022 evaluation report, but instead will report GMP Track 2 evaluation findings for PY 2023 through PY 2025 in future program year reports.

1.1.5 Metrics for Evaluation

The DPU-required evaluation involves Infrastructure Metrics and Performance Metrics for each Investment Area. In addition, selected case studies have been added for some Investment Areas (e.g., ADMS) as part of the evaluation to help facilitate understanding of how the technology performs in specific instances (e.g., in remediating the effects of a line outage).

1.1.5.1 Infrastructure Metrics

The Infrastructure Metrics assess the deployment of the GMP investments Table 11 summarizes the Infrastructure Metrics.

Table 11. Infrastructure Metrics Overview

Metric		Description	Applicable IAs	Metric Responsibility*
IM-1	**Grid Connected Distribution Generation Facilities**	Tracks the number and type of distributed generation facilities in service and connected to the distribution system	ADMS/ALF	EDC
IM-2	**System Automation Saturation**	Measures the quantity of customers served by fully or partially automated devices.	M&C, ADA	EDC
IM-3	**Number and Percent of Circuits with Installed Sensors**	Measures the total number of circuits with installed sensors which will provide information useful for proactive planning and intervention.	M&C	EDC
IM-4	**Number of Devices or Other Technologies Deployed**	Measures how the EDC is progressing with its GMP from an equipment or device standpoint.	All IAs	Evaluator
IM-5	**Cost for Deployment**	Measures the associated costs for the number of devices or technologies installed; designed to measure how the EDC is progressing under its GMP.	All IAs	Evaluator
IM-6	**Deviation Between Actual and Planned Deployment for the Plan Year**	Measures how the EDC is progressing relative to its GMP on a year-by-year basis.	All IAs	Evaluator

[25] Within PY 2022, there was limited spend for Track 2 technologies for both Unitil and Eversource. Unitil reported approximately $20k collectively across DER mitigation, workforce management, and Program Management and EM&V, while Eversource reported approximately $6k for DERMS.

Metric		Description	Applicable IAs	Metric Responsibility*
IM-7	**Projected Deployment for the Remainder of the GMP Term**	Compares the revised projected deployment with the original target deployment as the EDC implements its GMP.	All IAs	Evaluator

PM = Performance Metric, IA = Investment Area, ES = Eversource, NG = National Grid, UTL = Unitil

* Column indicates which EDC is responsible for calculating each metric, for statewide metrics, all EDCs are responsible

Source: Guidehouse Review of DPU Order, May 10, 2018[26]

1.1.5.2 Performance Metrics

The Performance Metrics assess the performance of all the GMP investments. Table 12 summarizes the Performance Metrics used for the various Investment Areas. This report discusses Performance Metrics that pertain specifically to the M&C Investment Area.

Table 12. Performance Metrics Overview

Metric		Description	Applicable IAs	Metric Responsibility*
PM-1	**VVO Baseline**	Establishes a baseline impact factor for each VVO-enabled circuit which will be used to quantify the peak load, energy savings, and greenhouse gas (GHG) impact measures.	VVO	All
PM-2	**VVO Energy Savings**	Quantifies the energy savings achieved by VVO using the baseline established for the circuit against the annual circuit load with the intent of optimizing system performance.	VVO	All
PM-3	**VVO Peak Load Impact**	Quantifies the peak demand impact VVO/CVR has on the system with the intent of optimizing system demand.	VVO	All
PM-4	**VVO Distribution Losses without Advanced Metering Functionality (AMF) (Baseline)**	Presents the difference between circuit load measured at the substation via the SCADA system and the metered load measured through advanced metering infrastructure.	VVO	All
PM-5	**VVO Power Factor**	Quantifies the improvement that VVO/CVR is providing toward maintaining circuit power factors near unity.	VVO	All

[26] Massachusetts DPU 15-120/DPU 15-121/DPU 15-122 (Grid Modernization) Order issued May 10, 2018 (DPU Order), pg. 198-201.

Metric		Description	Applicable IAs	Metric Responsibility*
PM-6	**VVO – GHG Emissions**	Quantifies the overall GHG impact VVO/CVR has on the system.	VVO	All
PM-7	**Voltage Complaints**	Quantifies the prevalence of voltage-related complaints before and after deployment of VVO investments to assess customer experience, voltage stability under VVO.	VVO	All
PM-8	**Increase in Substations with DMS Power Flow and Control Capabilities**	Examines the deployment and data cleanup associated with deployment of ADMS, primarily by counting and tracking the number of circuits and substations per year.	ADMS/ ALF	All
PM-9	**Control Functions Implemented by Circuit**	Examines the control functions of DMS power flow and control capabilities, focused on the control capabilities including VVO-CVR and FLISR.	ADMS/ ALF	All
PM-10	**Numbers of Customers that benefit from GMP funded Distribution Automation Devices**	Shows the progress of ADA investments by tracking the number of customers that have benefitted from the installation of ADA devices.	ADA	ES, NG
PM-11	**Grid Modernization investments' effect on outage durations**	Provides insight into how ADA and M&C investments can reduce outage durations (CKAIDI). Compares the experience of customers on GMP M&C-enabled circuits as compared to the previous 3-year average for the same circuit.	M&C, ADA	All
PM-12	**Grid Modernization investments' effect on outage frequency**	Provides insight into how ADA and M&C investments can reduce outage frequencies (CKAIFI). Compares the experience of customers on M&C-enabled circuits as compared to the prior 3-year average for the same circuit.	M&C, ADA	All
PM-ES-1	**Advanced Load Flow – Percent Milestone Completion**	Examines the fully developed ALF capability across Eversource's circuit population.	ADMS/ ALF	ES
PM-ES-2	**Protective Zone: Average Zone Size per Circuit**	Measures Eversource's progress in sectionalizing circuits into protective zones designed to limit outages to customers located within the zone.	ADA	ES

Metric		Description	Applicable IAs	Metric Responsibility*
PM-UTL1	**Customer Minutes of Outage Saved per Circuit**	Tracks time savings from faster AMI outage notification than customer outage call, leading to faster outage response and reduced customer minutes of interruption.	M&C	UTL
PM-NG-1	**Main Line Customer Minutes of Interruption Saved**	Measures the impact of ADA investments on the customer minutes of interruption (CMI) for main line interruptions. Compares the CMI of GMP ADA-enabled circuits to the previous 3-year average for the same circuit.	ADA	NG

PM = Performance Metric, IA = Investment Area, ES = Eversource, NG = National Grid, UTL = Unitil

* Column indicates which EDC is responsible for calculating each metric, for statewide metrics, all EDCs are responsible

Source: Stamp Approved Performance Metrics, July 25, 2019.[27]

1.2 ADMS/ALF Investment Area Overview

ADMS/ALF is a software platform investment fundamental to a modernized grid. ADMS consists of a combination of SCADA, outage management systems (OMS), distribution management systems (DMS), and advanced applications such as operational power flow, VVO, and FLISR. The capabilities of ADMS are key to delivering on all three of the DPU's grid modernization objectives. These objectives include the ability to control devices for system optimization, provide support for ADA and VVO, and serve as an enabling platform to support a high penetration of DER.

Table 13 summarizes preauthorized budget for ADMS for Eversource, National Grid, and Unitil.

Table 13. GMP Preauthorized Budget for ADMS/ALF

Period	Eversource	National Grid	Unitil	Total
Term 1 (2018 – 2021)	$22.00	$48.40	$0.70	**$71.10**
Term 2 (2022 – 2025)	$21.90	$61.00	$1.50	**$84.40**

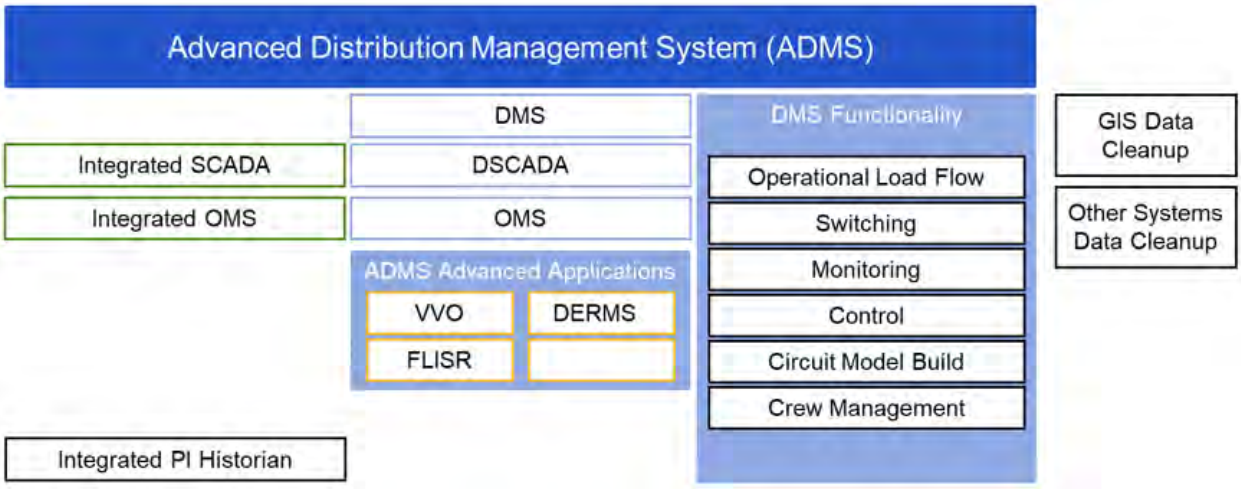
Source: Term 1 preauthorized budgets were populated using DPU Order, May 10, 2018, and Eversource filing "GMP Extension and Funding Report," July 1, 2020. Term 2 preauthorized budgets were populated using DPU Order, October 7, 2022, and DPU Order, November 30, 2022 under docket 21-80, 21-81, and 21-82.

Figure 3 shows the typical components of an ADMS. This diagram shows the intrinsic and integrated components of an ADMS and a functionality stack related to the DMS component of the ADMS. The components and functionality are foundational to the industry status of ADMS and serve as the consistent picture for evaluating ADMS at the EDC. Each of the EDCs are

[27] Massachusetts Department of Public Utilities, Grid Modernization Plan Performance Metrics. Submitted on July 25, 2019, as part of DPU 12-120,15-121, & 15-122

implementing solution components, integration, and functionality and are supporting data cleanup with different plans and timeframes in response to the Investment Area and their needs.

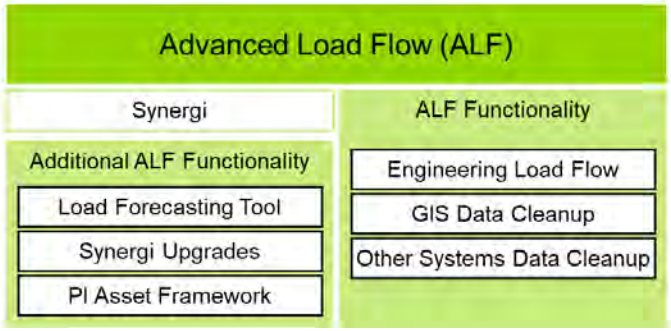
Figure 3. ADMS Evaluation Components and Functionality



Source: Guidehouse

The ALF context is shown in Figure 4. This diagram shows Synergi and a functionality stack related to the data cleanup component of ALF. The components and functionality shown in the figure are foundational to the industry definition of ALF and serve as the consistent picture for ALF at Eversource.

Figure 4. ALF Evaluation Components and Functionality



Source: Guidehouse

Eversource completed its Term 1 investment in ALF in PY 2021. As such, aside from summary information provided for Term 1 in Section 1.1.1 and here, Guidehouse will not assess any Infrastructure Metrics or Performance Metrics in this evaluation. In Term 2, Eversource will continue investment in ALF, and to do so plans to deploy Interconnection Automation and Probabilistic Power Flow Modeling. Guidehouse will be evaluating investment activity for these investments from PY 2023 onwards, as a late 2022 DPU ruling pre-authorizing these investments hampered activity for these investments in 2022.

1.3 ADMS Evaluation Objectives

This evaluation focuses on the progress and effectiveness of the DPU preauthorized ADMS and ALF investments for each EDC toward meeting the DPU's grid modernization objectives.[28] Table 14 illustrates the key Infrastructure Metrics and Performance Metrics relevant for the M&C evaluation.

Table 14. ADMS Evaluation Metrics

Metric Type	ADMS Evaluation Metrics	ES	NG	UTL
IM	Deviation between actual and planned deployment for the plan year	✓	✓	✓
IM	Projected deployment for the remainder of the 4-year term	✓	✓	✓
PM	Increase in circuits and substations with DMS power flow and control capabilities	✓	✓	✓
PM	Control functions implemented by circuit and substation	✓	✓	✓
Other*	DMS implementation (planning, procurement, development, deployment, go-live)	✓	✓	✓
Other	Distribution SCADA (DSCADA) implementation or integration (planning, procurement, development, deployment, go-live)	✓	✓	✓
Other	OMS implementation or integration (planning, procurement, development, deployment, go-live)	✓	✓	✓
Other	Cleanup of geographic information system (GIS) data by circuit, substation, and region		✓	
Other	Cleanup of other data by circuit, substation, and region		✓	

IM = Infrastructure Metric, PM = Performance Metric, ES = Eversource, NG = National Grid, UTL = Unitil

* Denotes that generating the metric is EDC responsibility

** Note that the original 3-year term was extended to a 4-year term by the DPU in 2020

*** The "Other" metric type applies to metrics not specifically outlined by the DPU but that will be measured to understand aspects of ADMS for a comprehensive evaluation. See Guidehouse Stage 3 Evaluation Plan submitted March 1, 2023.

Source: Guidehouse Stage 3 Evaluation Plan filed March 1, 2023; Stamp Approved Performance Metrics, July 25, 2019

The EDCs provided the data supporting the Infrastructure Metrics and Performance Metrics to the evaluation team. Section 3 through Section 4 present the results from the analysis of Infrastructure Metrics and Performance Metrics. The Infrastructure Metrics analysis measures whether the investments are taking place on the projected schedule and budget. The Performance Metrics are based on statistical analyses performed by the evaluation team using data provided by each EDC. The results from the analysis of Infrastructure Metrics and Performance Metrics are included in Sections 3.2 and 4.2, respectively.

Table 15 presents the research questions associated with the ADMS evaluation objectives. The scope of the ADMS evaluation includes tracking the ADMS software implementation against plan, data cleanup progress, and cost.

[28] DPU Order, May 10, 2018, p.106.

Table 15. ADMS Evaluation Objectives and Associated Research Questions

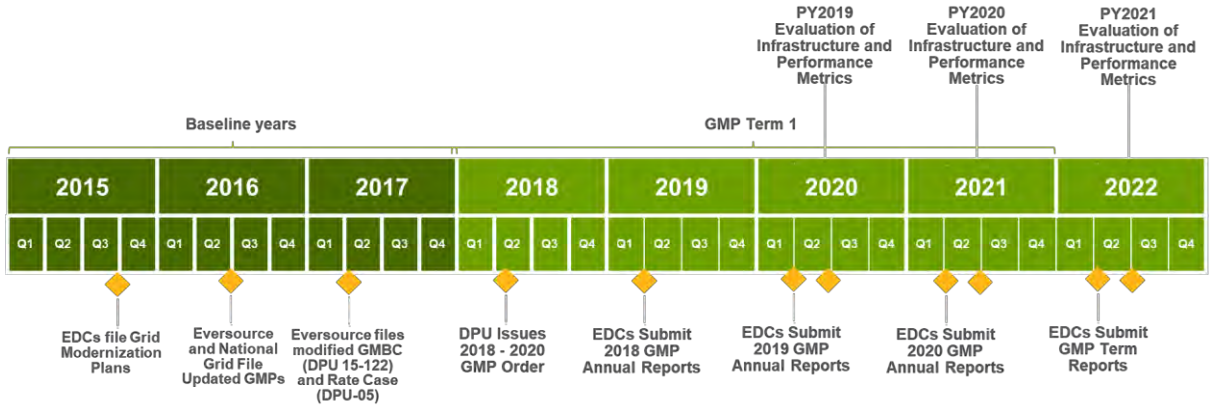
ADMS Evaluation Objective	Associated Research Questions
Software Implementation	• How do the ADMS and ALF investments align with optimizing system performance, optimizing system demand, and enabling interconnection and integration of DER? • What is each EDC's specific investment plan strategy for ADMS and ALF implementation (components and timeframes) during the preauthorized investment periods, 2018-2021 (Term 1) & 2022-2025 (Term 2)? • What does each EDC plan to leverage as a baseline ADMS and ALF application/component stack (GIS, PI Historian, DSCADA, OMS, Synergi, other systems, or other)? • What does each EDC plan to do related to ADMS functionality, including operational load flow, VVO, FLISR, and DERMS? • What does each EDC plan to do related to ALF functionality, including static analysis, semiautomated analysis, and fully automatic analysis? • What is the specific timing of ADMS implementation, integration with supporting systems, and data cleanup in GIS and other systems?
Data Cleanup	• What is the specific timing of ALF investment components including GIS data cleanup, other system data cleanup, and Synergi implementation?

Source: Guidehouse

2. ADMS Evaluation Process

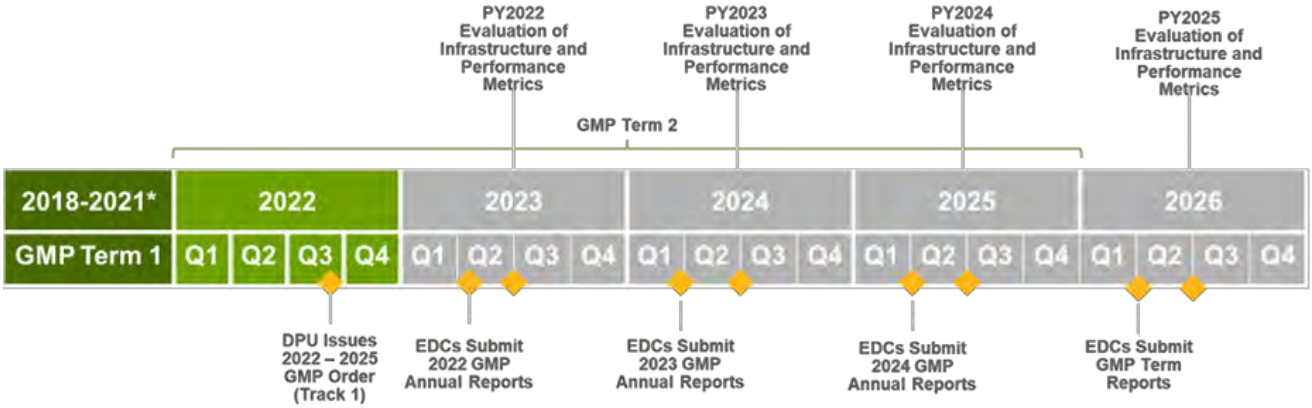
This section presents a high-level overview of the Guidehouse methodologies for the evaluation of Infrastructure and Performance Metrics. Figure 5 highlights the Term 1 filing background and timeline of the GMP Order and the evaluation process, and Figure 6 indicates the expected timeline for Term 2.

Figure 5. GMP Term 1 ADMS/ALF Evaluation Timeline



Source: Guidehouse

Figure 6. GMP Term 2 ADMS Evaluation Timeline



Source: Guidehouse

As a note, spend and deployment was conducted in PY 2022 to account for any spend and deployment from Term 1 (2018-2021 plan) as well as new spend to be included in Term 2 (2022 – 2025). Term 1 spend and deployment will be denoted separately within the analysis for Eversource, as Eversource provided data to support a comparison of Term 1 and Term 2 planned versus actual activity.

2.1 Infrastructure Metrics Analysis

Guidehouse annually assesses the progress of each of the EDCs toward enabling ADMS on their feeders and substations. Table 16 and Table 17 highlight the Infrastructure Metrics that were evaluated. Although Infrastructure Metrics are the same across all Investment Areas,

ADMS investments are not tracked by device. Instead, ADMS investments are tracked by technology or software implementation. Throughout this report, the term technology or software implementation is used instead of device deployment, which is more pertinent to some of the other Investment Areas.

Table 16. GMP Term 1 Infrastructure Metrics Overview – Eversource Only

Infrastructure Metrics			Calculation
IM-4	Number of devices or other technologies deployed thru. PY 2022	# Devices Deployed	$\sum_{PY=2018}^{2021}(Devices\ Commissioned)_{PY} + Devices\ Commissioned_{CY2022(T1)}$
		% Devices Deployed	$\frac{\sum_{PY=2018}^{2021}(Devices\ Commissioned)_{PY} + Devices\ Commissioned_{CY202}}{\sum_{PY=2018}^{2021}(Devices\ Commissioned)_{PY} + (Planned\ Devices)_{CY2022(T}}$
IM-5	Cost through PY 2022	Total Spend, $M	$\sum_{PY=2018}^{2021}(Actual\ Spend)_{PY} + Actual\ Spend_{CY2022(T1)}$
		% Spend	$\frac{\sum_{PY=2018}^{2021}(Actual\ Spend)_{PY} + Actual\ Spend_{CY2022(T1)}}{\sum_{PY=2018}^{2021}(Actual\ Spend)_{PY} + Planned\ Spend_{CY2022(T1)}}$
IM-6	Deviation Between Actual and Planned Deployment for PY 2022	% On Track (Devices)	$\frac{(Devices\ Commissioned)_{CY2022(T1)}}{(Planned\ Devices)_{CY2022(T1)}}$
		% On Track (Spend)	$\frac{(Actual\ Spend)_{CY2022(T1)}}{(Planned\ Spend)_{CY2022(T1)}}$
IM-7*	Projected Deployment for the remainder of the GMP Term (i.e., Term 1)*	# Devices Remaining	N/A*
		Spend Remaining, $M	N/A*

Note: This table pertains to Infrastructure Metrics for Eversource only. Planned devices and pend are based on the 2021 GMP Term Report filing (filed on April 1, 2022 under DPU docket 21-80). All CY2022 spend and deployment data given above, to be calculated, includes only units/dollars dedicated to work intended for Term 1, and excludes any deployment and spend apportioned for Term 2.

* This metric has been interpreted here (i.e., within the context of the 2022 Program Year Evaluation) as the units and spending that the EDC plans to complete their most recent 4-year Term 1 plans. Additional Grid Modernization units and dollars incurred in 2022 are attributed to Term 2, as appropriate, and all units and dollars spent during 2023 through 2025 will be considered as part of Term 2 GMPs.

Source: Guidehouse

Table 17. GMP Term 2 Infrastructure Metrics Overview – All EDCs

Infrastructure Metrics			Calculation
IM-4	Number of devices or other technologies deployed thru. PY 2022	# Devices Planned	$(Devices\ Commissioned)_{PY2022}$
		% Devices Deployed	$\frac{(Devices\ Comissioned)_{PY2022}}{(Devices\ Comissioned)_{PY2022} + \sum_{PY=2023}^{2025}(Planned\ Devices)_{PY}}$
IM-5	Cost through PY 2022	Total Spend, $M	$(Actual\ Spend)_{PY2022}$
		% Spend	$\frac{(Actual\ Spend)_{PY2022}}{\sum_{PY=2022}^{2025}(Planned\ Spend)_{PY}}$

Infrastructure Metrics			Calculation
IM-6	Deviation Between Actual and Planned Deployment for PY 2022	% On Track (Devices)	$\frac{(Devices\ Commissioned)_{PY2022}}{(Planned\ Devices)_{PY2022}}$
		% On Track (Spend)	$\frac{(Actual\ Spend)_{PY2022}}{(Planned\ Spend)_{PY2022}}$
IM-7*	Projected Deployment for the remainder of the GMP Term*	# Devices Remaining	$\sum_{PY=2022}^{2025}(Planned\ Devices)_{PY} - (Devices\ Comissioned)_{PY2022}$
		Spend Remaining, $M	$\sum_{PY=2022}^{2025}(Planned\ Spend)_{PY} - (Actual\ Spend)_{PY2022}$

Note: CY2022 spend and deployment data given above includes only units/dollars within Term 2 plans, and excludes any deployment and spend apportioned for Term 1 (carryover).

These most recent plan totals were included in each EDC's *DOER Responses*, which listed the planned units and spending to be completed in Term 2.

Source: Guidehouse

Section 3 provides the results from the evaluation of Infrastructure Metrics. To evaluate Infrastructure Metrics, Guidehouse:

- Reviewed the EDC data provided to ensure the information provided accurately reflected progress through PY 2022 (see Section 3.1.2).
- Interviewed representatives from each EDC to understand the status of the ADMS investments, including:
  - Updates to their planned ADMS investments.
  - Reasons for deviation between actual and planned deployment and spend.

2.2 Performance Metrics Analysis

Performance Metrics were evaluated for each of the three EDCs. The EDCs have proposed to score and then count the number of substations with fully implemented and successful ADMS power flow analysis and the number of circuits with the specified control functions implemented. For ALF, Eversource proposed a metric designed to demonstrate progress toward the final completion of a fully automated modeling tool. Table 18 describes the Performance Metrics evaluated for PY 2022.

Table 18. Performance Metrics Overview

PM	Performance Metrics	Description
PM-8	**Increase in Circuits and Substations with DMS Power Flow and Control Capabilities**	• Increase in circuits and substations with DMS power flow and control capabilities. • Primary Performance Metric to examine the deployment and data cleanup associated with ADMS deployment (situational awareness, basic power flow, switching, restoration capabilities). • The assumption is that data must be ready and fully clean prior to ADMS deployment, allowing converging power flow on specific circuits and substations. Counting and tracking the number of circuits and substations per year is the primary component of this Performance Metric.

PM	Performance Metrics	Description
PM-9	**Control Functions Implemented by Circuit and Substation**	• Control functions implemented by circuit and substation. • Secondary Performance Metric to examine implementation of advanced applications (e.g., automated capabilities, VVO, CVR, FLISR)
PM-ES-1	**Advanced Load Flow – Percent Milestone Completion**	• Percent milestone completion of circuits (100% of planned circuits) with ALF capabilities. • Addresses Eversource narrowly and examines the fully developed ALF capability across its circuit population. This includes components of the hosting capacity maps that Eversource is now addressing.
PM-Other	**DG Interconnection Queue Wait Time**	• DG Interconnection Queue Wait Time is a proposed PM to be evaluated in the future when there is sufficient data to evaluate. • Comparison of reduction in average DG interconnection queue wait time between ALF-enabled vs. non-ALF-enabled feeders.* Reduction in average timing of DG interconnection requests for all EDCs across Massachusetts. • The work done on ALF and Synergi upgrades during the PY 2018-2021 term is not expected to have any measurable impact on the interconnection study process.

PM = Performance Metric

Note: Potential metrics in the future would be to assess the implementation and functionality of ADMS-based advanced applications such as ADMS-based VVO and ADMS-based FLISR.

*Depending on availability of appropriate data.

Source: Stamp Approved Performance Metrics, July 25, 2019

3. ADMS Infrastructure Metrics

3.1 Data Management

Guidehouse worked with the EDCs to collect data to complete the ADMS evaluation for the assessment of Infrastructure Metrics and Performance Metrics. The following sections highlight the evaluation team's data sources and data quality assurance/quality control (QA/QC) processes used to evaluate the Infrastructure Metrics.

3.1.1 Data Sources

Guidehouse used a consistent methodology (across Investment Areas and EDCs) to evaluate the data and illustrate EDC progress toward the GMP metrics. The data sources are summarized as follows.

3.1.1.1 Term 1 Planned Deployment and Spend for PY 2022

To assess progress against planned carryover deployment and spend for Eversource, Guidehouse used the planned device deployment and cost information from each its *2021 GMP Term Report*[29,30,31], which were filed on April 1, 2022. These filings served as the sources for planning data in this report and are referred collectively as the *GMP Term 1 Plan* each EDC in summary tables and figures throughout this report.

Table 19 lists the sources for the planned and actual quantities reviewed, and it specifies the color/shade used to represent these quantities in graphics throughout the rest of the report.

Table 19. GMP Term 1 Deployment Categories Used for the EDC Plan

Representative Color	Data	Description
	2022 Plan	Projected 2022 unit deployment and spend
	2021 Actual	Actual 2021 unit deployment and spend
	2020 Actual	Actual 2020 unit deployment and spend
	2019 Actual	Actual reported unit deployment and spend in 2018
	2018 Actual	Actual reported unit deployment and spend in 2018

Source: Plan and actual data is sourced from the EDCs' 2021 GMP Term Report Appendix 1 filed April 1, 2022.

[29] Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid, Grid Modernization Plan Annual Report 2020. Submitted to Massachusetts DPU on April 1, 2021 as part of DPU 21-30.
[30] NSTAR Electric Company d/b/a Eversource Energy, Grid Modernization Plan Annual Report 2020. Submitted to Massachusetts DPU on April 1, 2021 as part of DPU 21-30. Note that Eversource Energy filed an updated Appendix 1 filing in December of 2021; however that update did not affect any of the data or results in the evaluation.
[31] Fitchburg Gas and Electric Light Company d/b/a Unitil, Grid Modernization Plan Annual Report 2020. Submitted to Massachusetts DPU on April 1, 2021 as part of DPU 21-30.

3.1.1.2 Term 2 Planned Deployment and Spend for PY 2022

Guidehouse used the planned device deployment and cost information from each EDCs' filed responses to the first set of information requests issued by the Department of Energy Resources (DOER).[32,33,34] These responses were filed on October 4th, October 5th, and December 2nd, 2021, for Eversource, Unitil, and National Grid respectively. These filings served as the sources for planning data in this report and are referred collectively as the *DOER Responses* for each EDC in summary tables and figures throughout this report.

Table 20 lists the sources for the planned and actual quantities reviewed, and it specifies the color/shade used to represent these quantities in graphics throughout the rest of the report.

Table 20. GMP Term 2 Deployment Categories Used for the EDC Plan

Representative Color	Data	Description
	2025 Plan	Projected 2025 unit deployment and spend
	2024 Plan	Projected 2024 unit deployment and spend
	2023 Plan	Projected 2023 unit deployment and spend
	2022 Plan	Projected 2022 unit deployment and spend

Source: Plan data is sourced from EDC responses to the first set of information requests issued by the Department of Energy Resources, filed October 4, October 5, and December 2, 2021 under DPU dockets 21-80, 21-82, and 21-81 for Eversource, Unitil, and National Grid, respectively.

3.1.1.3 PY 2022 Actual Deployment and Spend, Planned Deployment and Spend for the Remainder of Term 2, and PY 2022 ADMS Activity

Guidehouse collected device deployment data and ADMS implementation at the feeder- and substation-level using standardized data collection templates. Guidehouse developed these templates for all EDCs: the *GMP All Device Deployment data* and *ADMS_ALF_Supplemental* workbooks, respectively. These data sources are referred to as *EDC Data* in summary tables and figures throughout the report. Table 21 summarizes the file versions used for the evaluation. The collected data was compared to the data submitted by the EDCs to the DPU in

[32] NSTAR Electric Company d/b/a Eversource Energy, Company's response to the First Set of Information Requests issued by the Department of energy Resources. Submitted to Massachusetts DPU on October 4, 2021 as part of DPU 21-80

[33]Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid, Company's supplemental responses to certain information requests in this proceeding, including: (1) Information DOER-NG-1-1 Supplemental; (2) Information Request DPU-1-2-Third Supplemental; and (3) Information Request DPU-11-2-Supplemental, which includes as an attachment Exhibit NG-GMP-2-Revised. Submitted to Massachusetts DPU on December 2, 2021 as part of DPU 21-81

[34] Fitchburg Gas and Electric Light Company d/b/a Unitil, Company's response to the First Set of Information Requests issued by the Department of energy Resources. Submitted to Massachusetts DPU on October 5, 2021 as part of DPU 21-48

the 2021 EDCs responses to DOER,[35,36,37] as well as the 2022 Grid Modernization Plan Annual Reports and associated Appendix 1 filings.[38,39,40] The evaluation team confirmed the consistency of the data from the various sources and reconciled any differences.

Table 21. All Device Deployment and Supplemental Data Files Versions for Analysis

Company	File Version Used for Analysis[41]	
	All Device Deployment	ADMS Supplemental
Eversource	Received 3/20/2023	Received 2/14/2023
National Grid	Received 3/29/2023	Received 2/10/2023
Unitil	Received 3/30/2023	Received 2/14/2023

Source: Guidehouse

The EDC device deployment data (collected in the *All Device Deployment* workbook) captured planned and actual device deployment and spend data. Actual device deployment and cumulative spend information were provided by work order ID and specified at the feeder- or substation-level, as appropriate.

The implementation stage of the work order (commissioned, in service, construction, or design/engineering), the commissioned date (if applicable), and all cumulative costs associated with the work order were also collected. Planned device deployment information and estimated spend for PY 2022 was provided by the EDCs at the most granular level (circuit or substation) available. Table 22 summarizes the categories used for the revised planned and actual deployment and spend and specifies the color and pattern used in bar graphs to represent each in the remainder of the report.

[35] NSTAR Electric Company d/b/a Eversource Energy, Company's response to the First Set of Information Requests issued by the Department of energy Resources. Submitted to Massachusetts DPU on October 4, 2021 as part of DPU 21-80

[36] Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid, Company's supplemental responses to certain information requests in this proceeding, including: (1) Information DOER-NG-1-1 Supplemental; (2) Information Request DPU-1-2-Third Supplemental; and (3) Information Request DPU-11-2-Supplemental, which includes as an attachment Exhibit NG-GMP-2-Revised. Submitted to Massachusetts DPU on December 2, 2021 as part of DPU 21-81

[37] Fitchburg Gas and Electric Light Company d/b/a Unitil, Company's response to the First Set of Information Requests issued by the Department of energy Resources. Submitted to Massachusetts DPU on October 5, 2021 as part of DPU 21-48

[38] Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid, Grid Modernization Annual Report for Calendar Year 2022. Submitted to Massachusetts DPU on April 24, 2023, as part of DPU 23-30.

[39] NSTAR Electric Company d/b/a Eversource Energy, Grid Modernization Annual Report for Calendar Year 2022. Submitted to Massachusetts DPU on April 24, 2023, as part of DPU 23-30.

[40] Fitchburg Gas and Electric Light Company d/b/a Unitil, 2022 Grid Modernization Plan Annual Report. Submitted to Massachusetts DPU on April 24, 2023, as part of DPU 23-30.

[41] Some minor additional updates to specific work orders were addressed after these dates via email.

Table 22. EDC Spending Data Legend

Representative Color	Data	Description
GMP Term 1 – Eversource Only		
	2022 Actual	Actual 2022 spend (from All Device Deployment workbook)
	2021 Actual	Actual 2021 spend ($) (provided in 2022 Appendix 1 filings)
	2020 Actual	Actual 2020 spend ($) (provided in 2021 Appendix 1 filings)
	2019 Actual	Actual 2019 spend ($) (provided in 2020 Appendix 1 filings)
	2018 Actual	Actual 2018 spend ($) (provided in 2019 Appendix 1 filings)
GMP Term 2 (from All Device Deployment Workbook)		
	2025 Estimate	Planned 2025 spend (from All Device Deployment workbook)
	2024 Estimate	Planned 2024 spend (from All Device Deployment workbook)
	2023 Estimate	Planned 2023 spend (from All Device Deployment workbook)
	2022 Actual	Actual 2022 spend (from All Device Deployment workbook)

Source: Guidehouse

3.1.2 Data QA/QC Process

To enable accuracy, Guidehouse conducted a high-level QA/QC of all device deployment data received. This review involved following up with the EDCs for explanations regarding the following:

- Potential errors in how the forms were filled out (e.g., circuit information provided in the wrong field)
- Missing or incomplete information
- Large variation in the unit cost of commissioned devices
- Variance between the aggregated totals by device/technology and work order-level data
- Variance between the actual unit costs and planned unit costs

3.2 Deployment Progress and Findings

Guidehouse presents findings from the Infrastructure Metrics analysis for the ADMS Investment Area in the following subsections.

3.2.1 Statewide Comparison

This section discusses statewide ADMS investment progress through PY 2022, as well as projected progress for the remainder of Term 2.

3.2.1.1 GMP Term 1 Statewide Comparison

Table 23 presents the Infrastructure Metric results through PY 2022 for Eversource. Additional detail surrounding findings for each Infrastructure Metric are provided in the subsections below. Although several Infrastructure Metrics track progress by device for the various Investment Areas, ADMS investments are not tracked by device. Instead, ADMS investments are tracked

by technology or software implementation. Throughout the remainder of the report, the term technology or software implementation is used instead of device deployment.

Table 23. 2022 Infrastructure Metrics for ADMS – Term 1

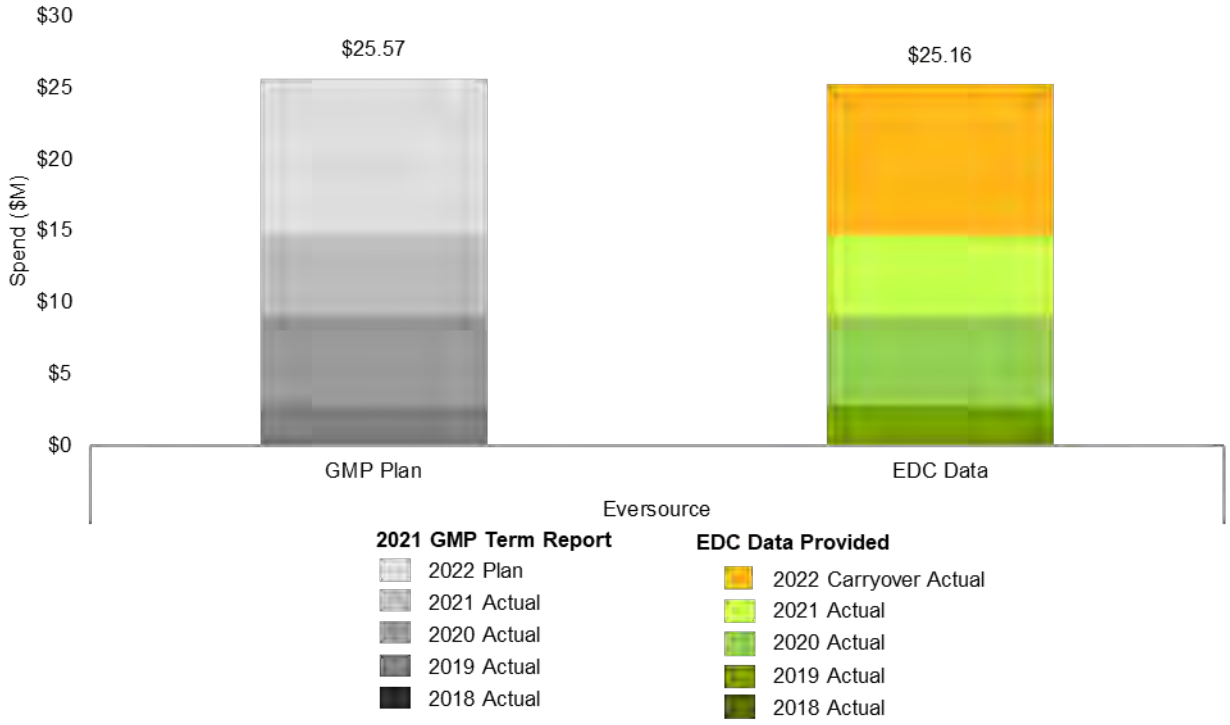
Infrastructure Metrics			Eversource
GMP Plan Total, PY-2018-2022*		# Devices	0
		Spend, $M	$25.57
IM-4	Number of devices or other technologies deployed thru PY 2018-2022*	# Devices Deployed***	0
		% Devices Deployed	N/A
IM-5	Cost for Deployment thru PY 2018 – 2022*	Total Spend, $M	$25.16
		% Spend	98%
IM-6	Deviation Between Actual and Planned Deployment for PY 2022	% On Track (Devices)	N/A
		% On Track (Spend)	96%
IM-7	Projected Deployment for the remainder of the GMP Term (i.e., Term 1)**	# Devices Remaining	0
		Spend Remaining, $M	$0.00

*The metric names have been slightly changed here to clarify the time span used in analysis.
** This metric has been interpreted here (i.e., within the context of the 2022 Program Year Evaluation) as the units and spending that the EDC plans to complete their most recent 4-year Term 1 plans. Additional Grid Modernization units and dollars incurred in 2022 are attributed to Term 2, as appropriate, and all units and dollars spent during 2023 through 2025 will be considered as part of Term 2 GMPs.
***Note that "Deployed" here refers to commissioned devices. For full definitions of deployment stages, see Docket 20-46 Response to Information Request DPU-AR-4-11, September 3, 2020.

Source: Guidehouse analysis of 2021 GMP Term Reports and 2022 EDC Data

Figure 7 compares the GMP plans and EDC data totals and year-over-year spending for each EDC.

Figure 7. Term 1 ADMS Spend Comparison (2018-2022, $M)



Source: Guidehouse analysis of 2021 GMP Term Reports, "GMP Extension and Funding Report," and 2022 EDC Data

For Eversource, O&M spending toward the GIS Survey[42] investment is included in the tables and figures. Eversource incurred no O&M costs toward the ADMS Investment Area in PY 2022.

3.2.1.2 GMP Term 1 Key Findings

Term 1 Infrastructure Metric findings for PY 2022 show that Eversource is approximately in line with their ADMS deployment and only slightly behind in spending relative to where they anticipated in their 2021 GMP Term Report. Eversource devoted the majority of PY 2022 to DMS, the remainder going to Load Forecasting and PI Asset Historian. Eversource plans to continue investment in ADMS into Term 2. Further detail on Eversource progress on completing Term 1 investments may be found in Section 3.2.2.2 through 3.2.2.4.

3.2.1.3 GMP Term 2 Statewide Comparison

This section includes Infrastructure Metrics results through PY 2022 for all EDCs. For Eversource, results compare actual PY 2022 spend and deployment that was not considered Term 1 to planned PY 2022 spend and deployment outlined in its 2022-2025 GMP. For National Grid and Unitil, results compare all actual PY 2022 spend and deployment, independent of Term

[42] For Eversource, GIS Survey is also referred to as GIS Verification.

status, to planned PY 2022 spend and deployment outlined in their respective 2022-2025 GMPs.[43] The following EDC-specific subsections provide further detail.

Table 24 presents the Infrastructure Metric results through PY 2022 for all EDCs. Additional detail surrounding findings for each Infrastructure Metric are provided in the other subsections below. Although several Infrastructure Metrics track progress by device for the various Investment Areas, ADMS investments are not tracked by device. Instead, ADMS investments are tracked by technology or software implementation. Throughout the remainder of the report, the term technology or software implementation is used instead of device deployment.

Table 24. Term 2 2022 Infrastructure Metrics for ADMS

Infrastructure Metrics			Eversource	National Grid**	Unitil
GMP Plan Total, 2022-2025		# Devices Planned	0	0	0
		Spend, $M	$16.69	$61.02	$0.95
EDC Data Total, 2022-2025		# Devices Planned	0	0	0
		Spend, $M	$15.73	$61.02	$0.61
IM-4	Number of devices or other technologies deployed thru. PY 2022*	# Devices Deployed	0	0	0
		% Devices Deployed	N/A	N/A	N/A
IM-5	Cost for Deployment thru. PY 2022*	Total Spend, $M	$0.00	$20.60	$0.06
		% Spend	0%	34%	6%
IM-6	Deviation Between Actual and Planned Deployment for PY 2022	% On Track (Devices)	N/A	N/A	N/A
		% On Track (Spend)	0%	91%	15%
IM-7	Projected Deployment for the Remainder of the GMP Term*	# Devices Remaining	0	0	0
		Spend Remaining, $M	$15.73	$40.42	$0.55

Note: For ADMS, '0 devices' means there is no hardware deployment.
*The metric names have been slightly changed here to clarify the time span used in analysis.
** To more closely align spend projections with DPU pre-authorized budgets, National Grid operations and maintenance (O&M) spend is included in actual and planned spend presented here. O&M spend is provided in aggregate for each investment area and is therefore excluded from device-specific summaries of spend.
Source: Guidehouse analysis of 2021 DOER Responses and 2022 EDC Data

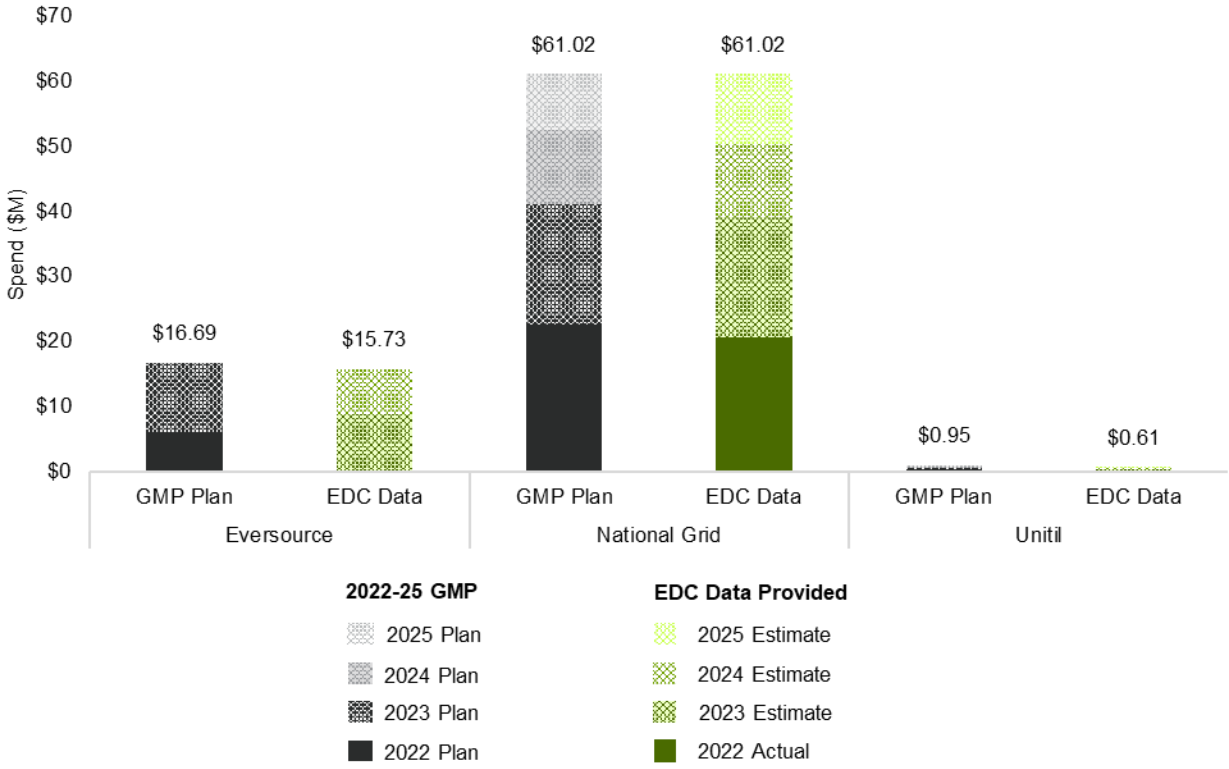
All three EDCs have operating territories that include Massachusetts and surrounding states. The ADMS programs include investments in Massachusetts as evaluated in this report. Regions that contain feeders with planned ADMS investments include the following within the evaluation period:

- **Eversource:** All Massachusetts operating territory
- **National Grid:** All Massachusetts operating territory
- **Unitil:** Cities/towns of Fitchburg, Townsend, and Lunenburg

[43] On July 1, 2021, Eversource, National Grid, and Unitil each filed a grid modernization plan with the DPU for the period spanning 2022-2025. The DPU docketed these plans as DPU 21-80, 21-81, and 21-82, respectively.

Figure 8 compares the GMP plans and EDC data totals and year-over-year spending for each EDC.

Figure 8. Term 2 ADMS Spend Comparison (2022-2025, $M)



Note: To more closely align spend projections with DPU pre-authorized budgets, National Grid operations and maintenance (O&M) spend is included in actual and planned spend presented here. O&M spend is provided in aggregate for each investment area and is therefore excluded from device-specific summaries of spend.

Source: Guidehouse analysis of 2021 DOER Responses and 2022 EDC Data

Eversource reported no O&M spend towards the ADMS investment area in PY 2022. National Grid incurred approximately $2.89 million in O&M costs toward the ADMS Investment Area in PY 2022. Unitil incurred approximately $60,706 in O&M costs toward the ADMS Investment Area in PY 2022.

3.2.1.4 GMP Term 2 Key Findings

Infrastructure Metric findings for PY 2022 show that the EDCs are progressing their ADMS deployment but are behind in spending relative to where they anticipated in their *2021 DOER Responses*

- Eversource attributed all PY 2022 ADMS spend to Term 1 and has placed ADMS on hold until receipt of a GIS deliverable planned for July 2023. Eversource has decided to standardize and consolidate two legacy systems into a singular GIS. This effort, currently ongoing, has paused ADMS progress. Eversource projects that ADMS will be fully deployed by the end of PY 2024.

- National Grid ADMS spend is on track relative to *2021 DOER Responses*, although spend is unbalanced across technologies. National Grid's DMS has expended 73% of its expected spend within the whole of GMP term 2, while of the remaining technologies, none exceeded 13%. National Grid's forecasts account for this disparity and have be refitted to meet the goals stated in their *DOER Responses*.
- Unitil is continuing its ADMS implementation with a reduced Term 2 spend projection compared to *2021 DOER Responses*. Much of Unitil's planned spend for ADMS is projected to fall within 2023 and 2024. Unitil expects that ADMS deployment will be complete by the end of 2024, with some remaining spend slated for 2025.

3.2.2 Eversource

This section discusses Eversource's ADMS investment progress through PY 2022 in two dimensions:

- Term 1 Progress: a comparison of progress Eversource made in 2022 against its plans detailed in its *2021 GMP Term Report*. These results consider only the deployment and spending that were planned in 2021 to be carried over into 2022. Note that because Eversource completed the deployment of ALF in PY 2021, actual spend data for 2018 through 2021 will include costs associated with ALF.

- Term 2 Progress: a comparison of progress Eversource made towards its 2022 plans outlined in its *2022-2025 GMP Plan.* These results do not consider deployment or spending that were planned in 2021 to be carried over into 2022. Further, because Eversource completed deployment of ALF in PY 2021, this section will not provide any information regarding ALF activity.

3.2.2.1 Overview of GMP Deployment Plan

Table 25 presents the GMP objectives that Eversource aims to achieve with its ADMS implementation. Eversource's ADMS Investment Area goals and objectives for Term 2 are implementing ADMS throughout the region to increase visibility, enhance the grid for DER customers, and increase DER hosting capacity.

Table 25. Eversource ADMS GMP Objective Summary

Software Type	Software Implementation	Term
ADMS	• The ADMS project is currently on hold and is expected to resume in July 2023 with GIS data deliverable. Eversource has decided to standardize and consolidate two legacy systems into a singular GIS. This effort, currently ongoing, has paused ADMS progress. • Remainder of planned spend is slated for 2023 and 2024. DMS is to be complete by the end of 2024.	1 2
ALF*	• Implemented enhanced semi-automatic ALF analysis on all planned circuits. • Deployed ALF on 2,242 circuits across 246 substations. • Synergi Upgrades completed in 2021 and enabled full ALF automation build. • Term 2 investments include Interconnection Automation and Probabilistic Power Flow Modeling. Evaluation of these investments will begin with the PY 2023 evaluation report, as no deployment had occurred in PY 2022.	1 2
Load Forecasting Tool	• Improve capability for long-term load forecasting. • Add new capability for long-term DER forecasting.	1
Synergi Upgrades	• Evolution and refinement of the ALF tool capability to build upon what has been implemented. • Initial step in producing a precise hosting capacity value on the Massachusetts distribution network.	1
PI Asset Framework	• Data analytics tool to provide insight into the impact of DER on system operations and establish a more uniform data model for historical data.	1

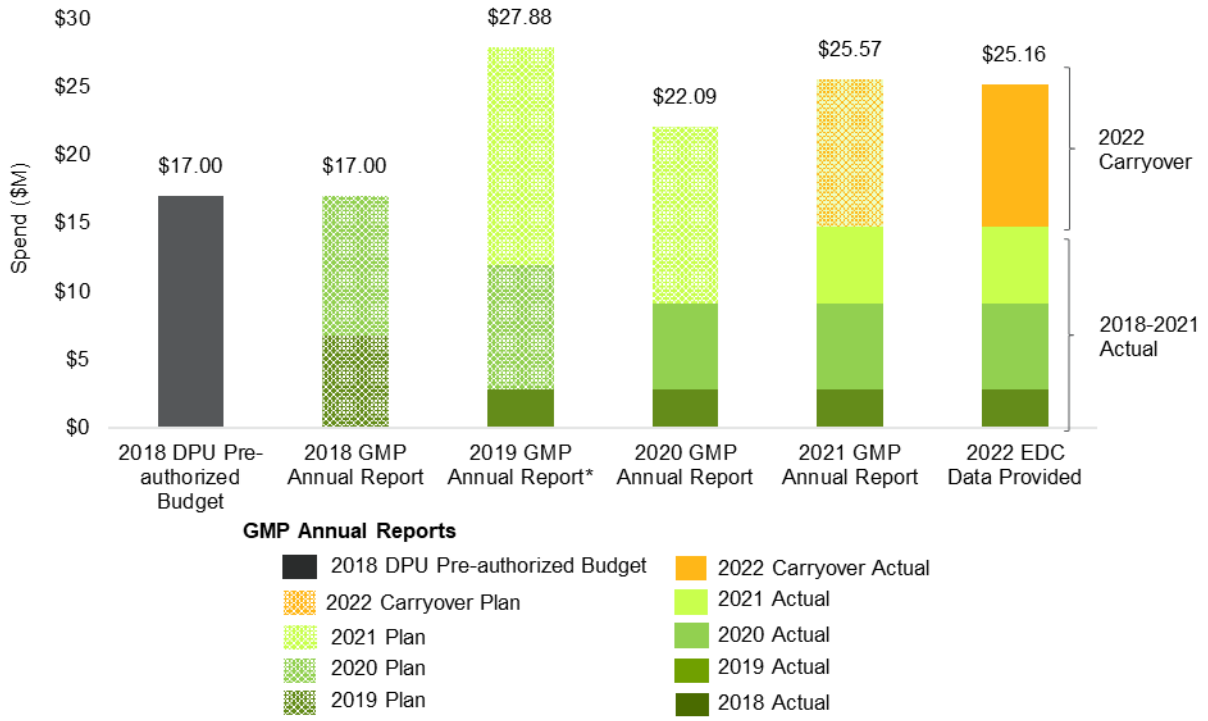
*Eversource completed deployment of ALF in PY 2021. Guidehouse includes information regarding ALF progress by the end of its implementation in this table for transparency. Two device types (Interconnection Automation and Probabilistic Power Flow Modeling) are included under the ALF investment category for Term 2

Source: Guidehouse analysis of 2021 GMP Term Reports, 2022-2025 GMPs, and 2022 EDC Data

3.2.2.2 GMP Term 1 ADMS Deployment Plan Progression

Figure 9 shows the progression of Eversource's M&C deployment plans from DPU-approval in 2018 through PY 2022.

Figure 9. Term 1 Eversource ADMS/ALF Planned vs. Actual Spend Progression, $M



Notes: GIS survey is O&M spending but is included in this figure as it makes up a significant portion of the total spending. Chart includes the Eversource plan for 2021, set forth in the *GMP Extension and Budget* filing on July 1, 2020.

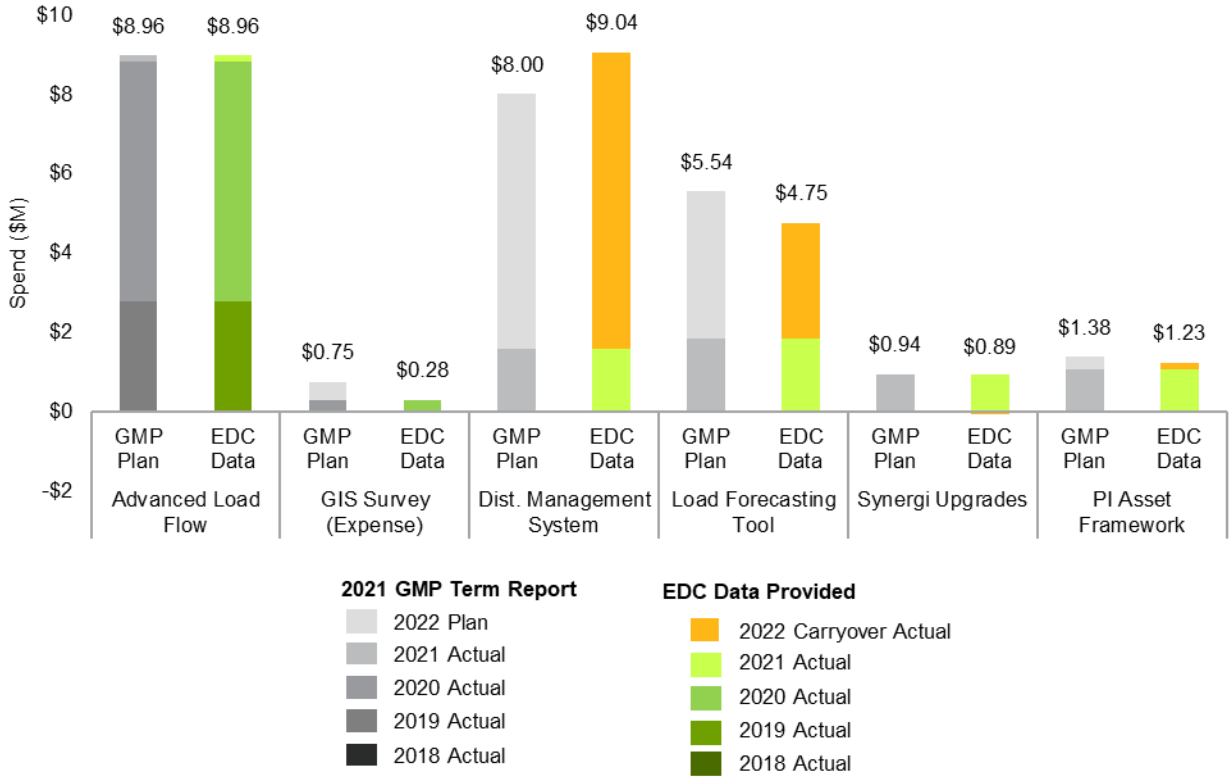
Source: Guidehouse analysis of DPU Order (May 10, 2018), 2018-2021 GMP Term Reports, GMP Extension and Funding Report filed on July 1, 2020, and *2022 EDC Data*

Eversource was approximately on-track with Term 1 spend plans in 2022, spending approximately $10.5M. Much of this spend occurred on the Distribution Management System ($7.4M) and the Forecasting Tool ($2.9M). No spend occurred on ALF, as ALF was completed in 2021. By the end of 2022, Eversource's Term 1 activity brought the total spending on ADMS/ALF deployment ($25.16M) close to its final plan for Term 1 outlined in the 2021 GMP Term Report ($25.57M).

3.2.2.3 GMP Term 1 ADMS/ALF Progress through PY 2022

Figure 10 shows Eversource's corresponding planned versus actual spend over the 2018-2022 Term period, broken out by each of these six areas.

Figure 10. Term 1 Eversource ADMS/ALF Spend Comparison (2018-2022, $M)



Notes: GIS survey is O&M spending but is included in this figure as it makes up a significant portion of the total spending.

Source: Guidehouse analysis of 2021 GMP Term Report and 2022 EDC Data

The EDC Data presented in Figure 10 is also shown in Table 26 to provide the specific dollar spend in each category.

Table 26. Term 1 Eversource ADMS/ALF Plan and Actual Spend (2018-2022, $M)

	Advanced Load Flow	GIS Survey (Expense)	Dist. Management System	Load Forecasting Tool	Synergi Upgrades	PI Asset Framework
2018-2022 Total	**$8.96**	**$0.28**	**$9.04**	**$4.75**	**$0.89**	**$1.23**
PY 2022 Actual	$0.00	$0.00	$7.45	$2.91	-$0.05	$0.16
PY 2021 Actual	$0.15	$0.00	$1.60	$1.84	$0.94	$1.08
PY 2020 Actual	$6.03	$0.28	$0.00	$0.00	$0.00	$0.00
PY 2019 Actual	$2.78	$0.00	$0.00	$0.00	$0.00	$0.00
PY 2018 Actual	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

Source: Guidehouse analysis of 2021 GMP Term Report and 2022 EDC Data

In PY 2021, Eversource spend was below plans due to a delayed Interim Continuation Order for continuing Term 1 spending, which was finalized in February 2021. As such, Eversource identified roughly $11M in spend was needed in 2022 to complete work that it had intended to complete in 2021. Eversource's ADMS/ALF investment through the end of 2022 ($25.16M) was

roughly on track with plans ($25.57M) with some variation at the technology level. Below, Guidehouse provides a summary of spending on each ADMS/ALF technology.

- **ALF.** Eversource's Advanced Load Flow implementation was completed in PY 2021. No spend occurred in this area in PY 2022.
- **GIS.** Although GIS survey spending is categorized as O&M spending, it is included as part of the ADMS/ALF Investment Area for Eversource because it makes up a significant portion of the ADMS/ALF budget. No expenses were incurred in this area in 2022. Term 1 spend on GIS through the end of 2022 ($0.28M) was below plans ($0.75M).
- **ADMS.** In 2022, spend on DMS ($7.4M) made up the preponderance of ADMS Term 1 spend in PY 2022 ($10.5M). Spend on DMS through the end of 2022 ($9.04M) exceeded plans ($8.0M), however final spend through 2022 was under plans for other technologies. Given this, total spend for ADMS/ALF technologies was still below plans by the end of 2022.
- **Load Forecasting.** Eversource had around $2.9M Term 1 spend on Load Forecasting in PY 2022, around 76% of planned spend. Final Term 1 spend on Load Forecasting ($4.75M) was below plans ($5.54M).
- **Synergi Upgrades.** Synergi Upgrades were completed in 2021 and enabled full ALF automation build. Some expenses occurred in 2022 as a function of the workorder closeout process. Eversource reported approximately $53,000 in negative spend in PY 2022 associated with Synergi Upgrades during the workorder closeout process.
- **PI Asset Framework.** Limited Term 1 spend ($0.16M) was made on the PI Asset Framework in 2022 and was roughly 52% of planned spend for 2022. Final Term 1 spend on the PI Asset Framework was $1.23M relative to plans of $1.38M.

3.2.2.4 GMP Term 1 Infrastructure Metrics Results and Key Findings

Table 27 presents the Infrastructure Metrics results through PY 2022 for Eversource.

Table 27. Term 1 Eversource ADMS/ALF: Infrastructure Metrics Summary

Infrastructure Metrics			Advanced Load Flow	GIS Survey (Expense)	Dist. Management System	Load Forecasting Tool	Synergi Upgrades	PI Asset Framework
GMP Plan Total, PY 2018-2022*		Devices	0	0	0	0	0	0
		Spend, $M	$8.96	$0.75	$8.00	$5.54	$0.94	$1.38
IM-4	Number of devices or other technologies deployed through PY 2018-2022*	# Devices Deployed	0	0	0	0	0	0
		% Devices Deployed	N/A	N/A	N/A	N/A	N/A	N/A
IM-5	Cost for Deployment	Total Spend, $M	$8.96	$0.28	$9.04	$4.75	$0.89	$1.23

Infrastructure Metrics			Advanced Load Flow	GIS Survey (Expense)	Dist. Management System	Load Forecasting Tool	Synergi Upgrades	PI Asset Framework
	through PY 2018-2022*	% Spend	100%	38%	113%	86%	94%	90%
IM-6	Deviation Between Actual and Planned Deployment for PY 2022	% On Track (Devices)	N/A	N/A	N/A	N/A	N/A	N/A
		% On Track (Spend)	N/A	0%	116%	79%	N/A	52%
IM-7	Projected Deployment for the remainder of the GMP Term (i.e., Term 1)*	# Devices Remaining	0	0	0	0	0	0
		Spend Remaining, $M	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

Note: For ADMS/ALF, '0 devices' means there is no hardware deployment. For Eversource, IM-6 denotes 'N/A' because there was no 2022 Plan Spend for ALF and Synergi Upgrades.
*The metric names have been slightly changed here to clarify the time span used in analysis.
** This metric has been interpreted here (i.e., within the context of the 2022 Program Year Evaluation) as the units and spending that the EDC plans to complete their most recent 4-year Term 1 plans. Additional Grid Modernization units and dollars incurred in 2022 are attributed to Term 2, as appropriate, and all units and dollars spent during 2023 through 2025 will be considered as part of Term 2 GMPs.
Source: Guidehouse analysis of 2021 GMP Term Reports and 2022 EDC Data

Key findings related to Eversource's progress include the following:

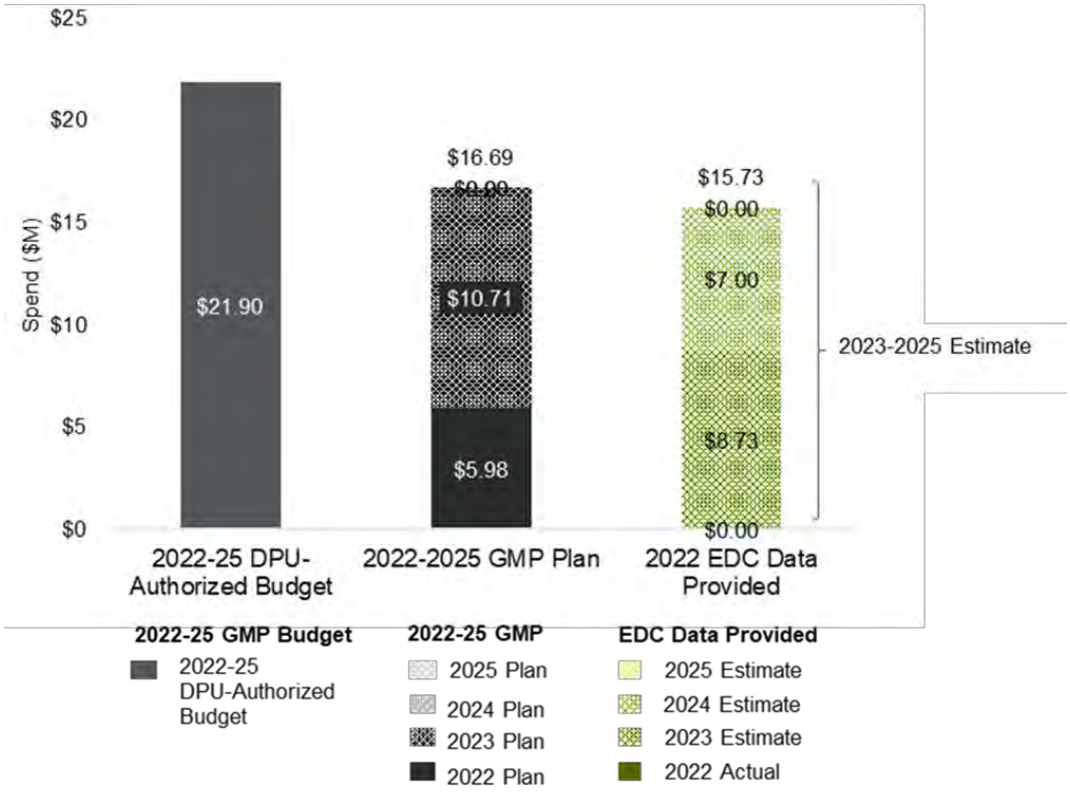
- Eversource was approximately on-track with Term 1 spend plans for 2022, spending approximately $10.5M. Much of this spend occurred on the Distribution Management System ($7.4M) and the Forecasting Tool ($2.9M). No spend occurred on ALF, as ALF was fully deployed in 2021.

- By the end of 2022, Eversource's Term 1 activity brought the total spending on ADMS/ALF deployment ($25.16M) close to its final plan for Term 1 outlined in the 2021 GMP Term Report ($25.57M). Final Term 1 spend was slightly above plans for DMS, while spend on PI Asset Framework and Load Forecasting Tool was below plans.

3.2.2.5 GMP Term 2 ADMS Deployment Plan Progression

Figure 11 presents the costs, planned and actual, for Eversource's ADMS investment over Term 2 spanning 2022 through 2025. Costs for Eversource's ADMS investment over this 4-year Term are reflected in the figure.

Figure 11. Term 2 Eversource ADMS/ALF Planned and Actual Spend Progression, (2022-2025, $M)



Source: Guidehouse analysis of DPU Order (October 7, 2022), 2021 DOER Responses, and *2022 EDC Data*

In the DPU Order on Track 1 and Track 2 technologies (filed October 7, 2022 and November 30, 2022, respectively), Eversource received preauthorization for $21.90M in spend on ADMS. Following DOER information requests filed in late 2021, Eversource subsequently reduced its spend plans for ADMS to $16.69M. Planned spend received in 2022 EDC data was further reduced to $15.73M.

Throughout PY 2022, Eversource allocated ADMS activity to completing work identified in its 2021 GMP Term Report. Meanwhile, Eversource's ADMS activity that was initially planned for Term 2 was on hold throughout PY 2022. Eversource has decided to standardize and consolidate its two legacy GIS systems into a singular GIS. This effort, which is slated to be completed in July 2023, will need to be completed before ADMS activity can continue for Term 2. Following completion of a singular GIS, Eversource expects for deployment of DMS to be complete by the end of 2024. As such, Eversource projects all remaining spend on DMS to occur in 2023 ($6.7M) and 2024 ($7.0M).

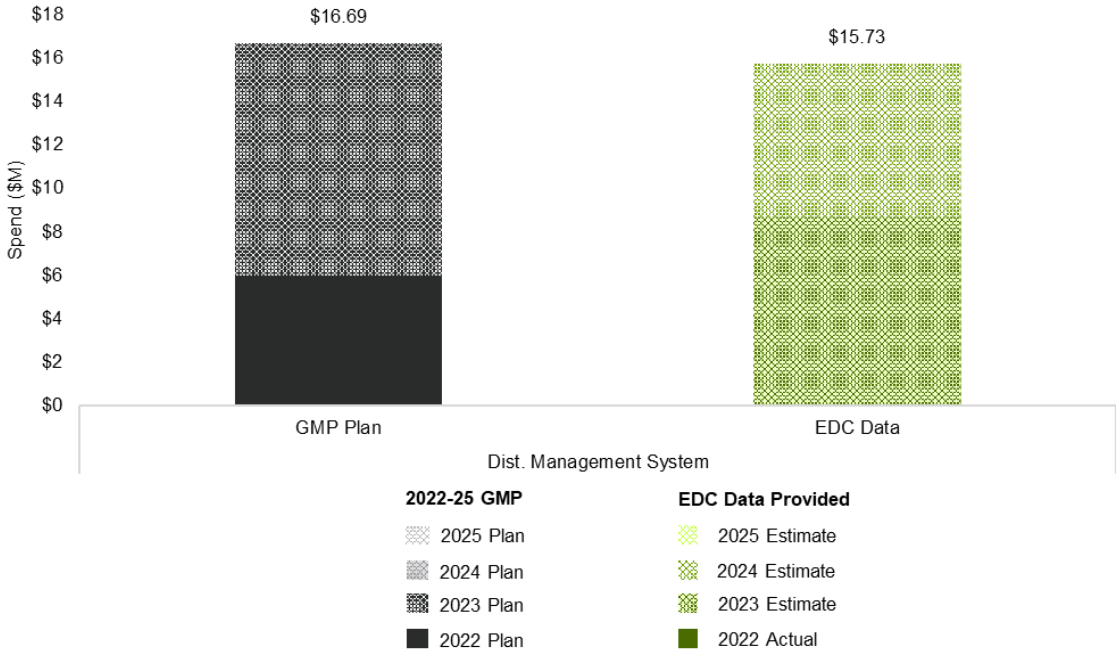
Within Eversource's ADMS spend plans, there were several Track 2 investments that were proposed for preauthorization, including Analytics Platform, Interconnection Automation, and Probabilistic Power Flow Modeling capabilities. Of these, Interconnection Automation and Probabilistic Power Flow Modeling were preauthorized in the November 30, 2022 DPU Order on Track 2 technologies. The analytics platform investment was not ultimately preauthorized with the DPU Order and has thus been removed from Term 2 spend plans. In addition, due to the late DPU Order in 2022, Eversource did not conduct spending on Interconnection Automation

and Probabilistic Power Flow Modeling. Planned spend for these Track 2 investments have therefore been omitted for this evaluation. Guidehouse will begin providing findings regarding deployment of these technologies beginning with its PY 2023 Grid Modernization evaluation.

3.2.2.6 GMP Term 2 ADMS/ALF Progress through PY 2022

Figure 12 shows Eversource's corresponding planned versus actual spend for PY 2022, as well as planned investment for PY 2023 through PY 2025, broken out by device type.

Figure 12. Term 2 Eversource ADMS/ALF Spend Comparison (2022-2025, $M)



Source: Guidehouse analysis of 2021 DOER Responses and 2022 EDC Data

The EDC Data presented in Figure 12 is also shown in Table 28 to provide the specific dollar spend in each category.

Table 28. Term 2 Eversource ADMS/ALF Plan and Actual Spend (2022-2025, $M)

	Distribution Management System
2022-2025 Total	**$15.73**
PY 2025 Planned	$0.00
PY 2024 Planned	$7.00
PY 2023 Planned	$8.73
PY 2022 Actual	$0.00

Source: Guidehouse analysis of 2021 DOER Responses and 2022 EDC Data

Eversource's ADMS/ALF investment plan has been revised to account for a PY 2022 pause in Term 2 ADMS deployment. Its revised plan has a slight budget underrun of ADMS implementation against the *2022-2025 GMP*. Eversource tracks ADMS costs in one area, DMS.

Eversource's ADMS project is currently on hold and estimated to resume in July 2023. After resuming deployment with a GIS deliverable, DMS is estimated by Eversource to be complete by the end of 2024.

3.2.2.7 GMP Term 2 Infrastructure Metrics Results and Key Findings

Table 29 presents the Infrastructure Metrics results through PY 2022 for Eversource.

Table 29. Term 2 Eversource ADMS/ALF: Infrastructure Metrics Summary

Infrastructure Metrics			Dist. Management System
GMP Plan Total, PY 2022-2025		# Devices Planned	0
		Spend, $M	$16.69
EDC Data Total, PY 2022-2025		# Devices Planned	0
		Spend, $M	$15.73
IM-4	Number of devices or other technologies deployed thru. PY 2022*	# Devices Deployed	0
		% Devices Deployed	N/A
IM-5	Cost for Deployment thru. PY 2022*	Total Spend, $M	$0.00
		% Spend	0%
IM-6	Deviation Between Actual and Planned Deployment for PY 2022	% On Track (Devices)	N/A
		% On Track (Spend)	N/A
IM-7	Projected Deployment for the Remainder of the GMP Term	# Devices Remaining	0
		Spend Remaining, $M	$15.73

Note: For ADMS/ALF, '0 devices' means there is no hardware deployment.

Source: Guidehouse analysis of 2021 DOER Responses and 2022 EDC Data
*The metric names have been slightly changed here to clarify the time span used in analysis.

Key findings related to Eversource's progress include the following:

- Eversource has paused ADMS deployment until it can complete consolidation of two legacy GIS systems into a singular system. Eversource expects that GIS activity will be completed in July 2023. Following completion of GIS activity, Eversource will resume deployment of ADMS. Eversource projects that DMS will be fully deployed by the end of 2024. As such, Eversource has allocated the remainder of planned spend between 2023 and 2024. but an increase in planned spend across PY 2023 and PY 2024 to complete deployment by 2024 year-end.

3.2.3 National Grid

This section discusses National Grid's planned and actual ADMS investment progress through PY 2022, as well as projected Term 2 2023-2025 progress .

3.2.3.1 Overview of GMP Deployment Plan

Table 30 presents the GMP objectives that National Grid aims to achieve with its ADMS implementation overall. In 2022, the ADMS investment moved forward with an OMS build, and expanding load flow solutions

Table 30. National Grid ADMS Summary

Company	GMP Objective	Software Implementation
National Grid	Using ADMS to optimize: • Performance • Demand • DER integration ADMS also helps reach the overall reliability and customer experience objectives.	ADMS • Three-phase implementation approach: – Monitor and inform – Manage and control – Implement active management

Source: Guidehouse analysis of 2022 EDC Data

National Grid follows a multistep process for ADMS data cleanup. This process is designed to align with go-live activities within ADMS and is commonly used in the industry for ADMS implementation. Process steps for ADMS data cleanup continue to be the following:

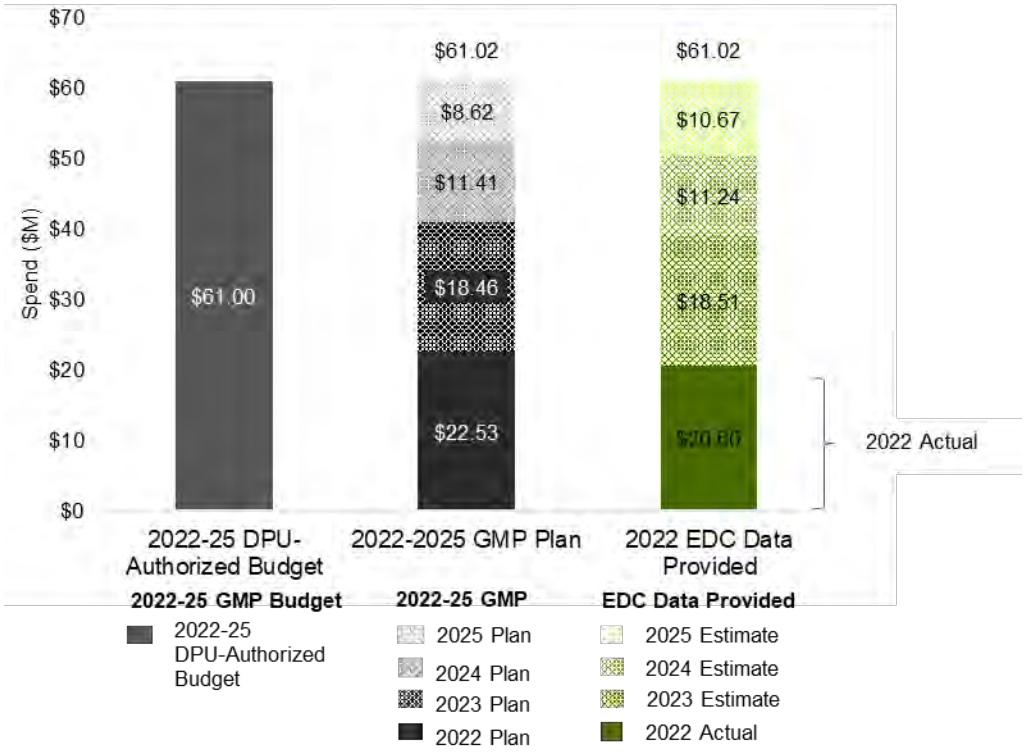
- Circuit retirement/renaming
- Initial data prep for circuits for base ADMS
- Final data prep for circuits for base ADMS
- Go-live of ADMS with circuits
- Additional circuit cleanup (post go-live)

This process reflects practical realities of ADMS implementation.

3.2.3.2 Term 2 ADMS Deployment Plan Progression

Figure 13 presents the costs, planned and actual, for National Grid's ADMS investment over the GMP evaluation period.

Figure 13. Term 2 National Grid ADMS Planned vs. Actual Spend, (2022-2025, $M)



Note: To more closely align spend projections with DPU pre-authorized budgets, National Grid operations and maintenance (O&M) spend is included in actual and planned spend presented here. O&M spend is provided in aggregate for each investment area and is therefore excluded from device-specific summaries of spend.

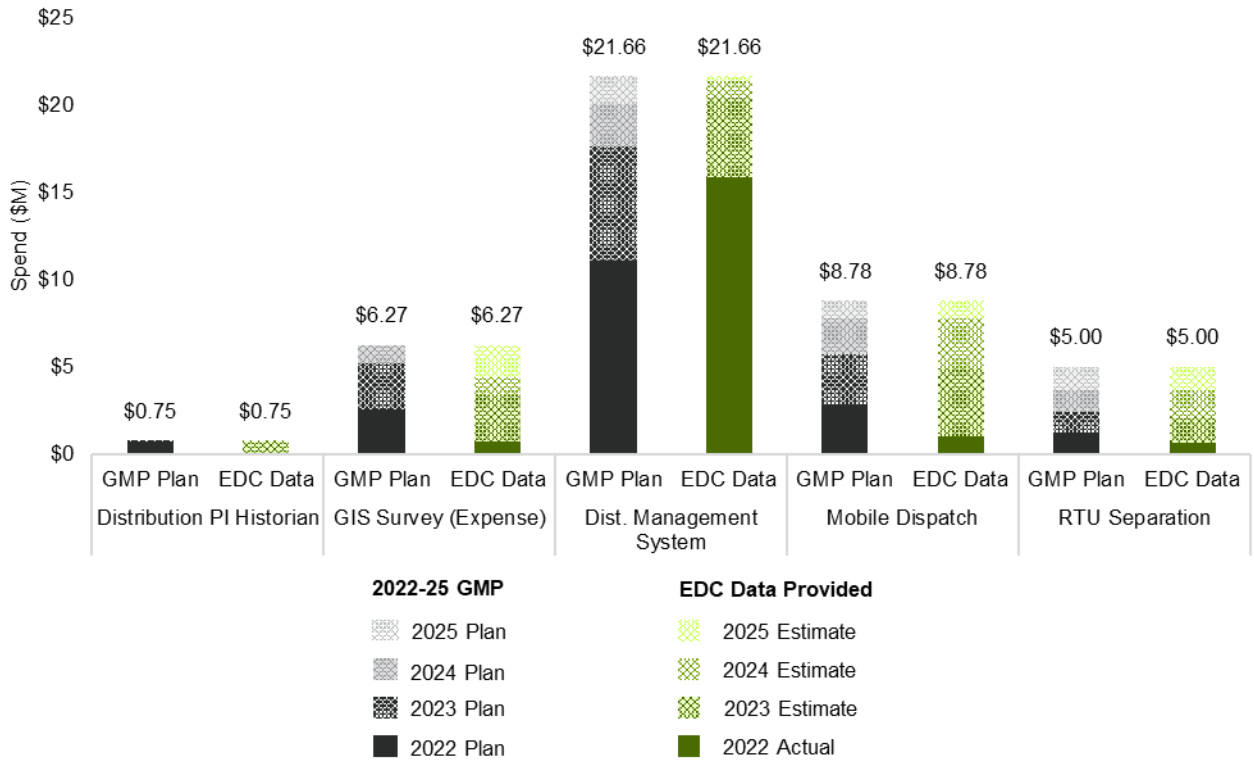
Source: Guidehouse analysis of DPU Order (October 7, 2022), 2021 DOER Responses, and *2022 EDC Data*

Guidehouse's review of National Grid's ADMS progress confirmed that National Grid has moved forward with the ADMS investment in PY 2022 and actual spend ($20.6M) is below its latest plan filed in its 2021 DOER Responses ($22.5M). During PY 2022, National Grid completed data cleanup activities and deployed ADMS across 282 feeders at 110 substations.

3.2.3.3 Term 2 ADMS Progress through PY 2022

Figure 14 shows National Grid's planned versus actual spend for PY 2022, as well as planned investment for PY 2023 through PY 2025. The EDC Data presented in Figure 14 is also shown in Table 31.

Figure 14. Term 2 National Grid ADMS Spend Comparison (2022-2025, $M)



Note: GIS survey is O&M spending but is included in this figure as it makes up a significant portion of the total spending. O&M spend is provided in aggregate for each investment area and is therefore excluded from device-specific summaries of spend.

Source: Guidehouse analysis of 2021 DOER Responses and 2022 EDC Data

Table 31. Term 2 National Grid ADMS Plan and Actual Spend (2022-2025, $M)

	Dist. PI Historian	GIS Survey (Expense)	Dist. Management System	Mobile Dispatch	RTU Separation
2022-2025 Planned Spend	**$0.75**	**$6.27**	**$21.66**	**$8.78**	**$5.00**
PY 2025 Planned	$0.00	$1.86	$0.29	$1.03	$1.30
PY 2024 Planned	$0.05	$1.03	$0.91	$2.81	$1.55
PY 2023 Planned	$0.70	$2.65	$4.57	$3.92	$1.48
PY 2022 Actual	$0.00	$0.73	$15.88	$1.03	$0.67

Note: O&M spend is provided in aggregate for each investment area and is therefore excluded from device-specific summaries of spend.

Source: Guidehouse analysis of 2021 DOER Responses and 2022 EDC Data

National Grid has moved forward with the ADMS investment in PY 2022, with actual spend ($20.6M) below its latest plan filed in its 2021 DOER Responses ($22.5M). National Grid progress in PY 2022 included deploying ADMS across 282 feeders connected to 110

substations. National Grid's control rooms are now actively using ADMS software, with the feeder readiness for ADMS having doubled to approximately 558 feeders ready.

Due to the disproportionately large PY 2022 spend on DMS as compared to their *DOER Responses*, National Grid's Term 2 plan spend has been adjusted in order to meet aggregate and technology specific estimates. Spend for DMS over 2023-2025 has been planned lower than *DOER Responses*, while the remaining technologies have increased their plan spend, making all technology spend plans align with *DOER Responses*.

3.2.3.4 Term 2 Infrastructure Metrics Results and Key Findings

Table 32 presents the Infrastructure Metrics results through PY 2022 for National Grid.

Table 32. Term 2 National Grid ADMS: Infrastructure Metrics Summary

Infrastructure Metrics			Dist. PI Historian	GIS Survey (Expense)	Dist. Management System	Mobile Dispatch	RTU Separation
GMP Plan Total, 2022-2025		# Devices Planned	0	0	0	0	0
		Spend, $M	$0.75	$6.27	$21.66	$8.78	$5.00
EDC Data Total, 2022-2025		# Devices Planned	0	0	0	0	0
		Spend, $M	$0.75	$6.27	$21.66	$8.78	$5.00
IM-4	Number of devices or other technologies deployed thru. PY 2022	# Devices Deployed	0	0	0	0	0
		% Devices Deployed	N/A	N/A	N/A	N/A	N/A
IM-5	Cost for Deployment thru. PY 2022	Total Spend, $M	$0.00	$0.73	$15.88	$1.03	$0.67
		% Spend	0%	12%	73%	12%	13%
IM-6	Deviation Between Actual and Planned Deployment for PY 2022	% On Track (Devices)	N/A	N/A	N/A	N/A	N/A
		% On Track (Spend)	N/A	28%	143%	36%	55%
IM-7	Projected Deployment for the Remainder of the GMP Term*	# Devices Remaining	0	0	0	0	0
		Spend Remaining, $M	$0.75	$5.54	$5.77	$7.76	$4.33

Note: For ADMS/ALF, '0 devices' means there is no hardware deployment. O&M spend is provided in aggregate for each investment area and is therefore excluded from device-specific summaries of spend.
*The metric names have been slightly changed here to clarify the time span used in analysis
Source: Guidehouse analysis of 2021 DOER Responses and 2022 EDC Data

Key findings related to National Grid's progress on ADMS deployment include the following:

- National Grid had progressed the ADMS investment in PY 2022, with actual spend ($20.6M) below its latest plan filed in its 2021 DOER Responses ($22.5M).

- ADMS spend data for National Grid was unbalanced relative to *DOER Responses*, with spend exceeding plans for DMS, and showing lower relative spend for all other technology categories. Total spend for DMS exceed planned PY 2022 spend by 43% or $4.79M; however, total ADMS capital spend is slightly below total ADMS planned with a shortfall of $110k. Spending plans have been adjusted across all technology types for PY 2023 - PY 2025 in order to align with initial plan targets.
- DERMS is planned by National Grid to be integrated with ADMS during Term 2. Guidehouse will investigate DERMS deployment further in subsequent DERMS evaluations.

3.2.4 Unitil

This section discusses Unitil's ADMS investment progress through PY 2022 and plans for the remainder of Term 2 as compared to the prior plan presented in the *2021 DOER Responses.*

3.2.4.1 Overview of GMP Deployment Plan

Table 33 presents the GMP objectives that Unitil aims to achieve with its ADMS implementation.

Table 33. Unitil ADMS Summary

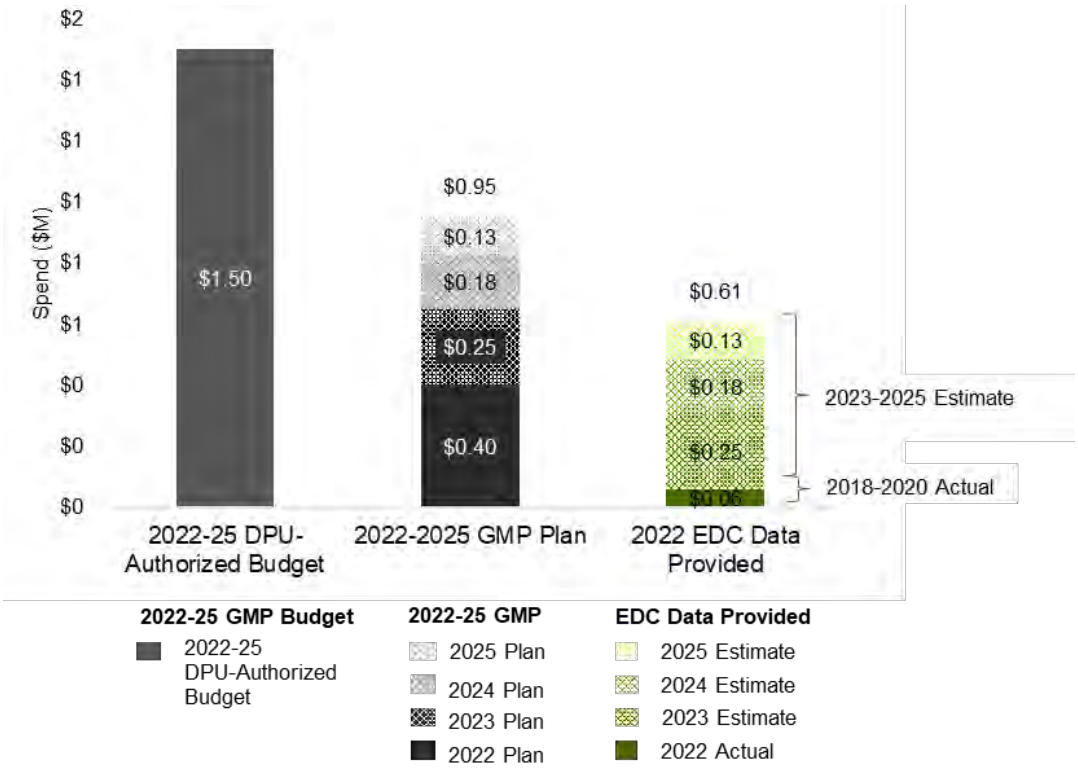
Company	GMP Objective	Software Implementation
Unitil	• Improve reliability • Use current SCADA system more effectively • Use ADMS as the platform for VVO • *Future application*: DERMS, increasing M&C of DER on the system	ADMS • Accelerating the ADMS project to go hand in hand with other investments – Original plan was to have no ADMS spending in first 3 years of Term 1 – As VVO investment developed, ADMS was chosen as platform for VVO. Term 2 deployment of ADMS will be progressing alongside deployment of VVO.

Source: Guidehouse analysis of 2020 GMP Annual Reports and EDC Data

3.2.4.2 Term 2 ADMS Deployment Plan Progression

Figure 15 presents the total cost, planned and actual, for Unitil's ADMS investment in PY 2022, as well as for the remainder of the Term (2023 through 2025).

Figure 15. Term 2 Unitil ADMS Planned vs. Actual Spend (2022-2025, $M)



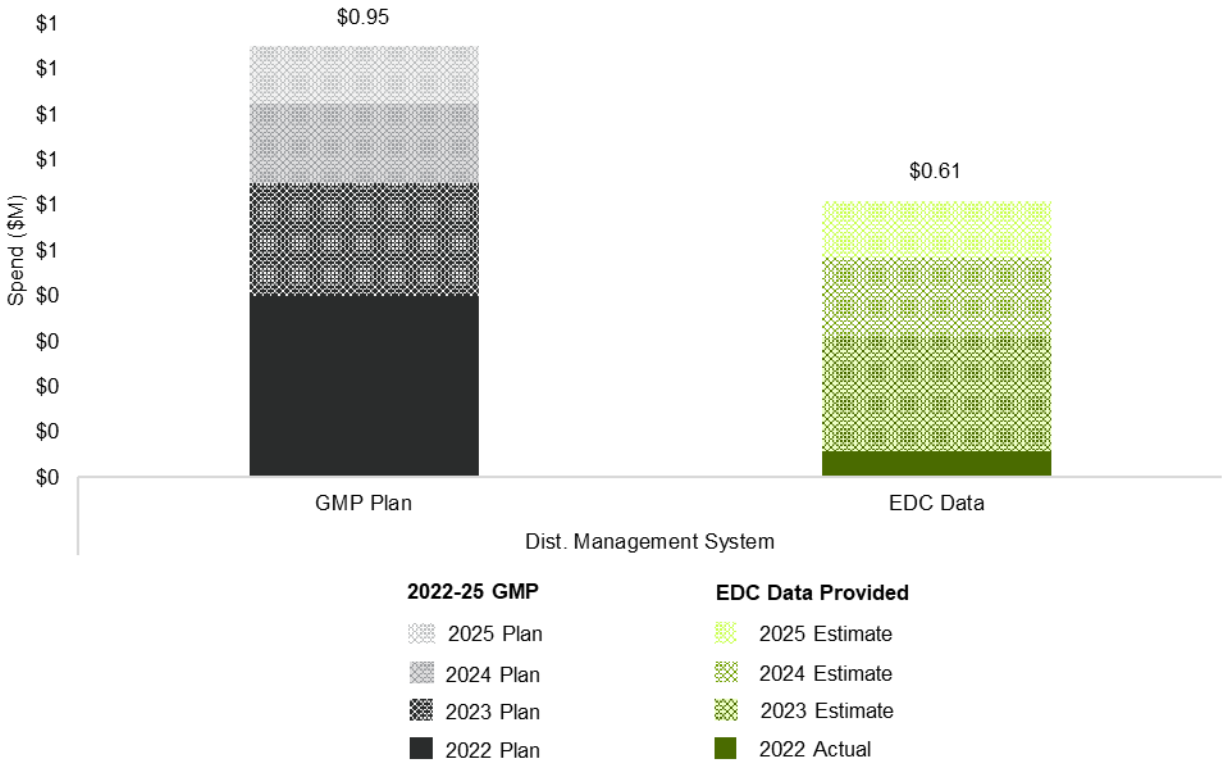
Source: Guidehouse analysis of DPU Order (October 7, 2022), 2021 DOER Responses, and *2022 EDC Data*

During PY 2022, the first year of Term 2, Unitil spent $0.12M on ADMS deployment activity, or around 14% of its initial plans for PY 2022. less than what was initially planned. This spend resulted in completion of ADMS deployment across 25 feeders connected to 9 substations.

3.2.4.3 Term 2 ADMS Progress through PY 2022

Figure 16 shows Unitil's planned versus actual spend for PY 2022, as well as planned investment for PY 2023 through PY 2025. The EDC Data presented in Figure 16 is also shown in Table 34.

Figure 16. Term 2 Unitil ADMS Spend Comparison (2022-2025, $M)



Source: Guidehouse analysis of 2021 DOER Responses and 2022 EDC Data

Table 34. Term 2 Unitil ADMS Plan and Actual Spend (2022-2025, $M)

	Dist. Management System
2022-2025 Planned Spend	**$0.61**
PY 2025 Planned	$0.13
PY 2024 Planned	$0.18
PY 2023 Planned	$0.25
PY 2022 Actual	$0.06
2022-2025 Planned Spend	**$0.61**

Source: Guidehouse analysis of 2021 DOER Responses and 2022 EDC Data

Actual spending on ADMS was significantly under plans laid out for PY 2022, as Unitil spent approximately $0.06M as compared to its plan of $0.40M. This spend resulted in completion of ADMS deployment across 25 feeders connected to 9 substations. Since ADMS implementation is tied closely with M&C and VVO rollout, variances in M&C and VVO deployment will be reflected in spend and deployment of ADMS. This is seen in PY 2022 spend data, as there was lower deployment than plans for several M&C and VVO technologies.

Unitil projects that ADMS deployment will be complete by the end of 2024. As such, the majority of remaining spend is planned for 2023 ($0.25M) and 2024 ($0.18M), with minimal spend

planned for 2025. Notably, despite spend coming in under plans during PY 2022, spend plans for 2023 through 2025 are unchanged since submission of updated 2022-2025 GMP plans in response to 2021 DOER information requests. Given this, total spend projections ($0.61M) indicate that Unitil spend on ADMS will wind up below plans outlined in its original 2022-2025 GMP plans ($1.34M) and revised plans submitted in response to 2021 DOER information requests ($0.95M). Guidehouse encourages Unitil to reassess whether additional activity, and therefore spend, not conducted in PY 2022 requires additional spend to be projected for 2023 through 2025.

After deployment of ADMS is complete in PY 2024, Unitil expects to integrate DERMS with ADMS. This effort, which is projected to begin in PY 2024 and conclude in PY2025, will be reflected as a part of the DERMS investment area. Guidehouse will evaluate spend and deployment for the DERMS investment area for its PY 2023 evaluation report, as this was a Track 2 investment area that did not see activity in 2022.

3.2.4.4 Term 2 Infrastructure Metrics Results and Key Findings

Table 35 presents the Infrastructure Metrics results through PY 2022 for Unitil.

Table 35. Unitil ADMS: Infrastructure Metrics Summary

Infrastructure Metrics			Dist. Management System
GMP Plan Total, 2022-2025		# Devices Planned	0
		Spend, $M	$0.95
EDC Data Total, 2022-2025		# Devices Planned	0
		Spend, $M	$0.61
IM-4	Number of devices or other technologies deployed thru. PY 2022*	# Devices Deployed	0
		% Devices Deployed	N/A
IM-5	Cost for Deployment thru. PY 2022*	Total Spend, $M	$0.06
		% Spend	6%
IM-6	Deviation Between Actual and Planned Deployment for PY 2022	% On Track (Devices)	N/A
		% On Track (Spend)	14%
IM-7	Projected Deployment for the Remainder of the GMP Term	# Devices Remaining	0
		Spend Remaining, $M	$0.55

Note: For ADMS/ALF, '0 devices' means there is no hardware deployment.
*The metric names have been slightly changed here to clarify the time span used in analysis.
Source: Guidehouse analysis of 2021 DOER Responses and 2022 EDC Data

Key findings related to Unitil's progress include the following:

- Actual spending on ADMS was significantly under plans laid out for PY 2022, as Unitil spent approximately $0.06M as compared to its plan of $0.40M. This spend resulted in completion of ADMS deployment across 25 feeders connected to 9 substations. Lower-than-planned spend was, in part, attributed to lower deployment than plans for several M&C and VVO technologies.
- Unitil projects that ADMS deployment will be complete by the end of 2024. As such, the majority of remaining spend is planned for 2023 ($0.25M) and 2024 ($0.18M), with minimal spend planned for 2025.

- Despite spend coming in under plans during PY 2022, spend plans for 2023 through 2025 are unchanged since submission of updated 2022-2025 GMP plans in response to 2021 DOER information requests. Guidehouse encourages Unitil to reassess whether additional activity, and therefore spend, not conducted in PY 2022 requires additional spend to be projected for 2023 through 2025.

- DERMS is expected to be integrated with ADMS, with the process beginning in PY 2024 and concluding in PY2025. Spend on DERMS integration will be within the DERMS investment area.

4. ADMS Performance Metrics

4.1 Data Management

Guidehouse worked with the EDCs to collect data to complete the ADMS evaluation for the assessment of Infrastructure Metrics and Performance Metrics. The following sections highlight Guidehouse's data sources and data QA/QC processes to evaluate the Performance Metrics.

4.1.1 Data Sources

Guidehouse used a consistent methodology (across Investment Areas and EDCs) to evaluate the data and illustrate EDC progress toward the GMP metrics. The data sources used for the Performance Metrics are summarized in the subsections below.

4.1.1.1 EDC PY 2022 Device Deployment Data Template

Guidehouse collected ADMS-specific data at the feeder- and substation-level using standardized data collection templates—the *ADMS Supplemental Data Template*-- for all EDCs. This data source is referred to as *EDC Data* in summary tables and figures throughout the report. Table 36 summarizes the file versions used for the evaluation.

Table 36. EDC ADMS/ALF-Specific Data Received for Analysis

Company	ADMS/ALF Supplemental Data Template
Eversource	Received 2/14/2023
National Grid	Received 2/10/2023
Unitil	Received 2/14/2023

Source: Guidehouse

4.1.1.2 DG Interconnection Data

The PM is being explored to help understand any reduction in average DG interconnection time for EDCs across Massachusetts can be attributed to GMP investments. This prospective PM[44] is the comparison of reduction in average DG interconnection queue wait time between ALF-enabled vs. non-ALF-enabled feeders.

Guidehouse utilized a public data set of DG interconnection queue information[45] to determine the availability of data to compute this metric. However, on the current public data set, there are gaps in interconnection step start/end dates that may make establishing a baseline difficult once the EDCs do begin to see mature performance on ADMS/ALF.

Eversource does not expect its currently completed ALF/Synergi upgrades to have a measurable impact on DG interconnection queue times, but notes that its updated hosting

[44] *This potential Performance Metric was added as an evaluation metric to help better understand the investment's ability to meet one of the Department's three grid modernization objectives: "Interconnect and integrate distributed energy resources (DER)." However, it is not one of the Stamped Approved Metrics and is not required by the Department.
[45] MassDGIC: Interconnection in Massachusetts, https://sites.google.com/site/massdgic/home/interconnection.

capacity maps allow applicants to better identify areas of available capacity and thus reduce the number of applications to locations without capacity.

4.1.2 Data QA/QC Process

To ensure accuracy, Guidehouse conducted high level QA/QC of all Performance Metric data received to confirm each of the required data inputs could be incorporated in the Performance Metrics analysis. This review involved following up with the EDCs for explanations regarding the following:

- Potential errors in how the forms were filled out (e.g., circuit information provided in the wrong field)
- Missing or incomplete information

4.2 Performance Metrics Analysis and Findings

4.2.1 Statewide Comparison

This section discusses statewide ADMS/ALF investment progress through PY 2022. Table 37 presents the progress of the three Performance Metrics across the state's three EDCs.

Table 37. ADMS/ALF Performance Metrics Progress

Performance Metrics		Eversource		National Grid		Unitil	
		Circuits	Substations	Circuits	Substations	Circuits	Substations
PM-8	Increase in Circuits and Substations with DMS Power Flow and Control Capabilities	*ADMS Paused*	*ADMS Paused*	282	110	25	9
PM-9	Control Functions Implemented by Circuit and Substation	*ADMS Paused*	*ADMS Paused*	0	0	0	0
PM-ES-1	ALF – Percent of Milestone Completion	100%	100%	N/A	N/A	N/A	N/A

PM = Performance Metric, N/A = Not Applicable (i.e., not sufficient data yet for evaluation)

Source: EDC data

Additional explanation for the Performance Metrics progress is provided in the subsections below for each EDC.

4.2.2 Eversource

Throughout PY 2022, Eversource allocated ADMS activity to completing work identified in its 2021 GMP Term Report. Otherwise, as summarized previously, Eversource's ADMS activity that was initially planned for Term 2 was on hold throughout PY 2022. Eversource has decided to standardize and consolidate its two legacy GIS systems into a singular GIS. This effort, which

is slated to be completed in July 2023, will need to be completed before ADMS activity can continue for Term 2. Due to this pause, Guidehouse has evaluated PM-8 (increase in circuits and substations with DMS power flow and control capabilities) as 0 for circuits and substations. In addition, PM-9 (control functions implemented by circuit and substation) is 0 and 0 for the same reason.

Eversource implemented enhanced semi-automatic ALF analysis on all planned circuits and substations in PY 2021. Synergi Upgrades were also completed in PY 2021 and enabled full ALF automation build. As a result, percent milestone completion for ALF (reflected in PM-ES-1) is evaluated as 100%.

Eversource does not expect its currently completed ALF/Synergi upgrades to have a measurable impact on DG interconnection queue times, but notes that its updated hosting capacity maps allow applicants to better identify areas of available capacity and thus reduce the number of applications to locations without capacity. As such, DG Interconnection Queue Wait Time is a future PM for when there is sufficient data to evaluate and may be a part of future evaluations of DERMS deployment.

4.2.3 National Grid

In PY 2022, National Grid has completed adequate data prep for analysis on 282 out of 1,042 potential feeders, 27%, across all regions. National Grid's plan is to make 320 feeders ADMS ready. PM-8 (increase in circuits and substations with DMS power flow and control capabilities) is 282 for circuits and 110 for substations for National Grid. In addition, PM-9 (control functions implemented by circuit and substation) is 0 and 0.

National Grid does not have an ALF investment, so PM-3 is not applicable (N/A).

DG Interconnection Queue Wait Time is a future prospective PM for when there is sufficient data to evaluate and may be a part of future evaluations of DERMS deployment. This PM has been added as a proposed evaluation metric to help better understand the investment's ability to meet one of the 3 DPU grid modernization objectives: "Interconnect and integrate distributed energy resources (DER);" however, it is not one of the DPU Stamped Approved Metrics.

4.2.4 Unitil

Unitil has implemented VVO control function, and therefore ADMS, on 25 additional circuits in PY 2022. PM-8 (increase in circuits and substations with DMS power flow and control capabilities) is 25 and 9 for circuits and substations. In addition, PM-9 (control functions implemented by circuit and substation) is 0 and 0, as data provided indicate no additional circuits have control functions since PY 2021.

Unitil does not have an ALF investment, so PM-3 is N/A.

DG Interconnection Queue Wait Time is a future prospective PM for when there is sufficient data to evaluate and may be a part of future evaluations of DERMS deployment.

5. Conclusions and Recommendations

Guidehouse's conclusions and recommendations are listed as follows.

Conclusions:

PY 2022's evaluation results show that the EDCs are at varying stages in ADMS deployment. Details pertaining to deployment progress are shown below for each EDC:

- Eversource has paused ADMS deployment until it can complete consolidation of two legacy GIS systems into a singular system. As such, no additional circuits or substations had control capabilities introduced in 2022. Eversource expects that GIS activity will be completed in July 2023. Following completion of GIS activity, Eversource will resume deployment of ADMS. Eversource projects that DMS will be fully deployed by the end of 2024. As such, Eversource has allocated the remainder of planned spend between 2023 and 2024. but an increase in planned spend across PY 2023 and PY 2024 to complete deployment by 2024 year-end.
- National Grid conducted spend on ADMS, with spend slightly below plans laid out for PY 2022, spending $20.6M of its $22.5M planned for 2022. Of this $20.6M, the majority ($15.9M) was on DMS and exceeded planned spend for DMS by 43%. PY 2022 spend resulted in completion of ADMS preparation across 282 feeders connected to 110 substations, although no additional control functions were added in 2022. National Grid's control rooms are actively using ADMS software. Lastly, DERMS is planned by National Grid to be integrated with ADMS. Guidehouse will investigate DERMS deployment further in subsequent DERMS evaluations.
- Unitil spending on ADMS was significantly under plans laid out for PY 2022, as Unitil spent approximately $0.06M as compared to its plan of $0.40M. This spend resulted in completion of ADMS preparation across 25 feeders connected to 9 substations, although no additional control functions were added in 2022. Lower-than-planned spend was, in part, attributed to lower deployment than plans for M&C and VVO. Unitil projects that ADMS deployment will be complete by the end of 2024. In addition, DERMS is expected to be integrated with ADMS, with the process beginning in PY 2024 and concluding in PY2025. Guidehouse will investigate DERMS deployment further in subsequent DERMS evaluations.

Recommendations:

- Despite Unitil's ADMS spend coming in under plans during PY 2022, spend plans for 2023 through 2025 are unchanged since submission of updated 2022 - 2025 GMP plans in response to 2021 DOER information requests.[46] Guidehouse encourages Unitil to reassess whether additional activity, and therefore spend, not conducted in PY 2022 requires additional spend to be projected for 2023 through 2025. This is especially important, as ADMS spend and deployment are closely tied to the M&C and VVO investment areas, which faced delays in deployment in recent years.

[46] Plan data is sourced from EDC responses to the first set of information requests issued by the Department of Energy Resources (DOER). These responses were filed on October 4th, December 2nd, and October 5th, 2021, for Eversource, National Grid, and Unitil under DPU dockets 21-80, 21-81, and 21-82.