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Rhode Island Energy™
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January 31, 2023

VIA ELECTRONIC MAIL

Luly E. Massaro, Commission Clerk
Rhode Island Public Utilities Commission
89 Jefferson Boulevard
Warwick, RI 02888

RE: Docket No. 22-53-EL - Rhode Island Energy's Proposed FY 2024 Electric Infrastructure, Safety, and Reliability Plan
Supplemental Response to Division 1-36

Dear Ms. Massaro:

On behalf of The Narragansett Electric Company d/b/a Rhode Island Energy (the "Company"), enclosed please see the Company's supplemental response to Data Request Division 1-36 issued by the Division of Public Utilities and Carriers on November 4, 2022 ("DIV 1-36") for filing in the above referenced docket.

Please be advised that the Company's supplemental response to DIV 1-36 contains the Grid Modernization Plan ("GMP") Benefit-Cost Analysis ("BCA") Spreadsheet that is referenced as Attachment I of the GMP and referenced as Attachment DIV 1-36-6 in the supplemental response to DIV 1-36. The GMP BCA Spreadsheet was submitted in Docket No. 22-56-EL (the GMP docket) with a request for confidential treatment, which is currently pending before the Public Utilities Commission ("PUC"). The Company is reiterating the same request in this Docket No. 22-53-EL (the Electric ISR docket). Please see enclosed Motion for Protective Treatment. In accordance with 810-RICR-00-00-1.3(H)(2), the Company also respectfully requests that the PUC make a preliminary finding that the GMP BCA Spreadsheet is exempt from the mandatory public disclosure requirements of the Rhode Island Access to Public Records Act ("APRA").

Thank you for your attention to this transmittal. If you have any questions or concerns, please do not hesitate to contact me at 401-784-4263.

Sincerely,

Andrew S. Marcaccio

Enclosures
cc: Docket No. 22-53-EL Service List
John Bell, Division
Greg Booth, Division
Christy Hetherington, Esq.
Al Contente, Division

STATE OF RHODE ISLAND
PUBLIC UTILITIES COMMISSION

In re: The Narragansett Electric Company d/b/a Rhode Island Energy's FY 2024 Electric Infrastructure, Safety and Reliability Plan	)	Docket No. 22-53-EL

MOTION OF THE NARRAGANSETT ELECTRIC COMPANY D/B/A RHODE ISLAND ENERGY FOR PROTECTIVE TREATMENT OF CONFIDENTIAL INFORMATION

The Narragansett Electric Company d/b/a Rhode Island Energy ("Rhode Island Energy" or the "Company") respectfully requests that the Rhode Island Public Utilities Commission ("PUC") provide confidential treatment and grant protection from public disclosure of certain confidential, competitively sensitive, and proprietary information submitted in this proceeding, as permitted by Rule 1.3(H)(3) of the PUC Rules of Practice and Procedure, 810-RICR-00-00-1-1.3(H)(3) ("Rule 1.3(H)"), and R.I. Gen. Laws § 38-2-2(4)(B). The Company also requests that, pending entry of that ruling, the PUC preliminarily grant the Company's request for confidential treatment pursuant to Rule 1.3(H)(2).

I. BACKGROUND

On December 30, 2022, Rhode Island Energy submitted its Grid Modernization Plan ("GMP") in Docket No. 22-56-EL (the GMP docket). In that filing, the Company submitted its GMP Benefit-Cost Analysis ("BCA") Spreadsheet in Excel format as Attachment I to the GMP (the "BCA Model"). On January 31, 2023, the Company submitted a supplemental response to Data Request 1-36 issued by the Division of Public Utilities and Carriers on November 4, 2022 ("DIV 1-36") in the above referenced docket (the Electric Infrastructure, Safety, and Reliability Plan docket). The Company's supplemental response to DIV 1-36 contains the BCA Model that

is referenced as Attachment I of the GMP and referenced as Attachment DIV 1-36-6 in the supplemental response to DIV 1-36. The Company is making the same request for confidentiality of the BCA Model in both dockets. The BCA Model contains confidential and proprietary commercial and financial information that the Company ordinarily would not share with the public. Therefore, the Company requests that, pursuant to Rule 1.3(H), the PUC afford confidential treatment to the BCA Model.

II. LEGAL STANDARD

Rule 1.3(H) provides that access to public records shall be granted in accordance with the Access to Public Records Act ("APRA"), R.I. Gen. Laws § 38-2-1, *et seq.* APRA establishes the balance between "public access to public records" and protection "from disclosure [of] information about particular individuals maintained in the files of public bodies when disclosure would constitute an unwarranted invasion of personal privacy." Gen. Laws § 38-2-1. Per APRA, "all records maintained or kept on file by any public body" are "public records" to which the public has a right of inspection unless a statutory exception applies. *Id.* § 38-2-3. The definition of "public record" under APRA, however, specifically excludes "trade secrets and commercial or financial information obtained from a person, firm, or corporation that is of a privileged or confidential nature." *Id.* § 38-2-2(4)(B). The statute provides that such records "shall not be deemed public." *Id.*

The Rhode Island Supreme Court has held that when documents fall within a specific APRA exemption, they "are not considered to be public records," and "the act does not apply to them." *Providence Journal Co. v. Kane*, 577 A.2d 661, 663 (R.I. 1990). Further, the court has held that "financial or commercial information" under APRA includes information "whose disclosure would be likely either (1) to impair the Government's ability to obtain necessary

information in the future, or (2) to cause substantial harm to the competitive position of the person from whom the information was obtained." *Providence Journal Co. v. Convention Ctr. Auth.*, 774 A.2d 40, 47 (R.I. 2001) (internal quotation marks omitted). The first prong of the test is satisfied when information is provided voluntarily to the governmental agency, and that information is of a kind that would not customarily be released to the public by the person from whom it was obtained. *Id.* at 47.

III. BASIS FOR CONFIDENTIALITY

The BCA Model constitutes "commercial or financial information" to which the APRA public disclosure requirements do not apply. *See* Gen. Laws § 38-2-2(4)(B); *Kane*, 577 A.2d at 663. It contains confidential and proprietary commercial and financial information relating to the Company's business operations. The Company ordinarily does not make this information available to the public. The Company has provided it on a voluntary basis to assist the PUC with its decision-making in this proceeding and the GMP proceedings. Therefore, this information satisfies the APRA exception found in Gen. Laws § 38-2-2(4)(B).

Accordingly, Rhode Island Energy respectfully requests that the PUC grant protective treatment to the BCA Model and take the following actions to preserve its confidentiality: (1) maintain the BCA Model as confidential indefinitely; (2) not place the BCA Model on the public docket; and (3) disclose the BCA Model only to the PUC, its attorneys, and staff as necessary to review this docket.

IV. CONCLUSION

For the foregoing reasons, Rhode Island Energy respectfully requests that the PUC grant its Motion for Protective Treatment of Confidential Information.

Respectfully submitted,

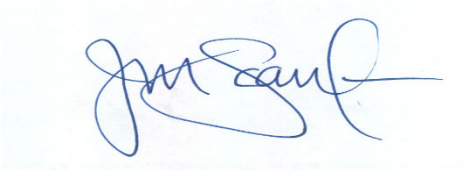
The Narragansett Electric Company
By its attorney,

Andrew S. Marcaccio (#8168)
Rhode Island Energy
280 Melrose Street
Providence, RI 02907
(401) 784-4263

Dated: January 31, 2023

CERTIFICATE OF SERVICE

I hereby certify that on January 31, 2023, I delivered a true copy of the foregoing Motion via electronic mail to the parties on the Service List for Docket No. 22-53-EL.



Joanne Scanlon

Division 1-36 (Supplemental)

Request:

Provide the RIE Grid Modernization Plan. Provide all assessment data, evaluations, justification documents, assumptions, workpapers, studies, and any information relied upon to develop the GMP and associated budget in the FY24 ISR Plan. Provide data in executable format.

Initial Response:

Rhode Island Energy's Grid Modernization Plan ("GMP") is being finalized and will be provided when it is complete. The Company currently plans to file the GMP with the Public Utilities Commission by the end of December 2022. As discussed with the AMF/GMP Subcommittee of the Power Sector Transformation ("PST") Advisory Group on November 9, 2022, the Company is using well-established Benefit-Cost Analysis ("BCA") methodologies and input assumptions. The BCA that will be used in the GMP will justify the Fiscal Year ("FY") 2024 Electric Infrastructure, Safety, and Reliability ("ISR") Plan foundational investments and is consistent with the Public Utilities Commission's Docket 4600 Framework. The GMP will include the study assumptions, projections, and analysis to support the conclusions that the GMP foundational investments included in the FY 2024 Electric ISR Plan are justified and urgently needed.

The presentations provided by the Company to the PST Advisory Group are included as Attachment DIV 1-36-1 through Attachment DIV 1-36-4. These presentations provide preliminary insight into the GMP studies, evaluations, and justifications in advance of the formal GMP filing.

Attachment DIV 1-36-1, presented July 2022, includes details on the GMP study approach and forecast inputs (slides 24-33).

Attachment DIV 1-36-2, presented August 2022, includes preliminary study results, reference feeder details, and software functionality (slides 31-66).

Attachment DIV 1-36-3, presented October 2022, was a demonstration on the CYME analysis used for the GMP effort.

Attachment DIV 1-36-4, presented November 2022, includes an update on study results, functionality roadmaps, and initial benefit-cost analysis results.

Division 1-36 (Supplemental), page 2

Supplemental Response:

This supplemental response to Division 1-36 includes the Grid Modernization Plan ("GMP") which was filed by The Narragansett Electric Company d/b/a Rhode Island Energy (the "Company") on December 30, 2022 in Docket No. 22-56-EL. The GMP that the Company filed in Docket No. 22-56-EL is provided as Attachment DIV 1-36-5, and the GMP Benefit-Cost Analysis Spreadsheet, which is referenced as Attachment I of the GMP, is attached as Confidential Attachment DIV 1-36-6.

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Advanced Meter Functionality and Grid Modernization Plan Overview and Stakeholder Outreach

Power Sector Transformation – July 14, 2022

Agenda

- 9:30 – 9:45 Introductions, Objectives and Background
- 9:45 – 10:00 The Current State and PPL Insights
- 10:00 – 10:10 Potential Solutions and Enabled Functionalities
- 10:10 – 10:25 AMF Technology and Project Overview
- 10:25 – 10:35 Functionalities Roadmap
- 10:40 – 10:50 Implementation Plan
- 10:50 – 11:00 AMF Costs Review
- 11:00 – 11:15 Break
- 11:15 – 11:30 GMP Study Scope and Approach
- 11:30 – 11:45 DER Forecast
- 11:45 – 12:00 Next Steps

Objectives

- AMF Business Plan
  - Introduce the RIE AMF Business Plan
  - Highlight advantages from PPL background and experience
  - Describe why full-scale AMF system
  - Review AMF implementation and functionality
  - Review AMF costs

- GMP Business Plan
  - Introduce the GMP study scope and approach
  - Review and agree upon the DER forecast

Ground Rules:

- Ask questions and provide feedback as we go
- Raise hand and state name when asking questions
- One conversation at a time
- Timekeeper to monitor discussion and align to agenda
- Topics and questions scheduled for future discussion will be saved in the Parking Lot

Background

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- PPL Corporation acquired The Narragansett Electric Company on May 25, 2022 and rebranded the utility as Rhode Island Energy (RIE).
- Converging drivers are creating the need to act:
  1. **Operational**: Approximately 60% of meters are at the end of their design life
  2. **Modernized System:** Increased visibility/control (planning, integration, management)
  3. **Clean Energy:** Net-zero greenhouse gas emissions by 2050,100% renewables by 2033
  4. **Customer Expectations:** Manage energy usage, improved reliability and superior customer experience
- Plan to file an advanced metering functionality (AMF) business case in September 2022 and a GMP business case by the end of 2022
- Seeking Power Sector Transformation (PST) Advisory feedback in anticipation of making the AMF and GMP filings

RI PST Advisory Collaboration

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AMF – Advanced Metering Functionality
GMP – Grid Modernization Plan
BCA – Benefit-Cost Analysis

Initial alignment meeting with RI Division and OER

PST Advisory Sub-Committee Meeting AMF

PST Advisory Sub-Committee Meeting GMP

September 2022
AMF Targeted Filing Date

December 2022
GMP Targeted Filing Date

PST Advisory AMF & GMP Subcommittee Meetings and Preliminary Agendas

Stakeholder Collaboration (i.e., Subcommittee meetings and discussions)

Obtain Feedback and Seek Alignment on Proposals and Approaches

Review Initial, Refined and Final Proposals

Jun 21, 2022

- **RI Division and OER Meeting**
- Introductions
- Proposed timeline
- Preliminary agenda for PST meetings
- AMF Introduction and overview of key areas
- GMP Introduction and coordination

July 14, 2022

- **PST Advisory Meeting**
- Introductions
- PPL Background and Experience
- Full Scale Enabling Platform
- Detailed Deployment Plan
- Functionality Timing
- ASA coverage
- AMF cost review
- GMP study scope and approach
- GMP forecast analysis

Aug 2, 2022

- **PST Advisory Meeting**
- Prior meeting will drive agenda
- AMF Customer Engagement Plan
- AMF Opt-out
- AMF Customer value streams
- AMF Auto-notification
- AMF Benefits

Aug 16, 2022

- **PST Advisory Meeting**
- Prior meeting will drive agenda
- AMF Data access, privacy, governance
- AMF Cyber Security
- AMF Cost and Benefit Recap
- Cost Recovery and Revenue Requirements
- GMP scenario analysis
- GMP solution development
- GMP ISR Coordination plans

September 2022

- **File AMF**
- AMF Includes Business Case, Testimonies and BCA
- Coordinate with GMP execution plan and BCA

w/o Oct 20, 2022

- **PST Advisory Meeting**
- Prior meeting will drive agenda
- GMP Alternative recommendation
- GMP BCA review

December 2022

- **File GMP**
- GMP Includes Business Case, Testimonies and BCA
- Coordinate with ISR and AMF details

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Advanced Meter Functionality (AMF) Business Plan

AMF Overview

- Replace ~525,000 electric AMR meters with AMF meters over a 3 ½ year deployment
- Design and build a fixed, secure IP-based radio frequency (RF) mesh network
- Back-office IT systems are developed that harmonize with TSA developments providing functionality to achieve objectives of customers, the utility, and clean energy
- Anticipated outcomes:
  1. Additional customer capabilities to manage their energy usage
  2. A technologically-advanced, state-of-the-art metering infrastructure
  3. The requisite tools and technology required to achieve clean energy goals
  4. An enabling platform to position for future grid modernization and gas AMF
- Strong Benefit/Cost ratio: ~3, 4 and 5 for Utility, Customer and Societal respectively

Current State of RIE Electric Meters

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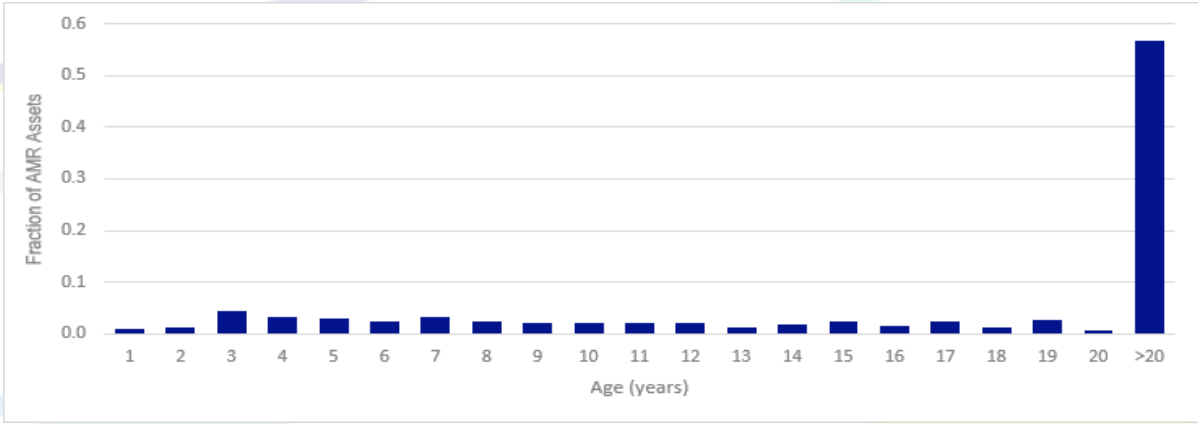
- 528,848 electric meters
- Two types of AMR meters with modules
- Read with drive-by technology
- Collects one billing read per month
- ~60% are at end of design life

Electro-mechanical Meter

Solid State Meter

Age of Meter Assets



Technology is old, does not provide required functionality and needs to be replaced

GMP and AMF for Operational Impacts of Clean Energy

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Context

- DER forecasted penetration is needed for Clean Energy requirements
- Society is increasingly dependent on a reliable electric supply

Operational Impact (lack of visibility hides existing issues)

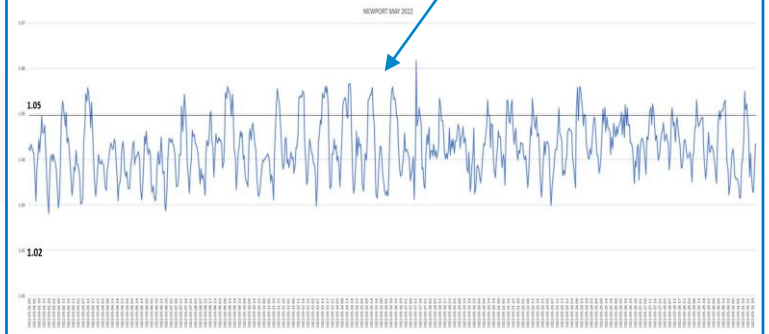
- Reliability is trending worse. Reliability and safety risk is building due to lack of situational awareness and challenges to manage the grid
- Increased variability of load and voltage, creating violations
- Increasing system complexity and multi-directional power flow
- Greater operational uncertainty
- Greater dependency on local generation to balance with load
- Increased system load due to beneficial electrification
- Emerging markets and rate designs will require new functionality

Investment Needed

- AMF and GMP needed to provide visibility, awareness and added system monitoring and control for reliable and safe operations with increasing DERs that are contributing towards Act on Climate

RIE Operational Challenge

Voltage repeatedly exceeds 1.05 per unit operating target



Solar DER nominal voltage output in RIE Newport Region - May 2022

*Required to maintain ±5% of nominal voltage ie 0.95 to 1.05 per unit voltage.

Our AMF Approach

- Presents the need to replace the AMR system with a proposal having costs and benefits over 20-years
- Utilized National Grid Updated Business Case (Docket 5113) as a basis
  - Interviewed National Grid contributors
  - Modified NG BCA
  - Addresses Amended Settlement Agreement (ASA) items
- Factored in PPL AMF deployment experience, costs, business impacts, processes and systems
- Incorporated updated pricing from suppliers
- Updated BCA assumptions with current information
- Created a detailed deployment plan and system release schedule harmonized with TSA developments

RIE Considered Amended Settlement Agreement

1	A refined and updated AMF business plan, benefit-cost analysis (BCA), and a detailed customer engagement plan
2	An updated AMF deployment schedule with a BCA (using Societal Cost Test) for different meter deployment periods
3	Revenue Requirement for AMF deployment
4	Deployment proposals, a proposal for cost recovery of AMF, and any activities associated with implementation of AMF
5	A proposal to allocate AMF costs among rate classifications
6	Assumptions upon which a proposal for Time-Varying rates will be based
7	A Data Governance Plan regarding customer, NPP, and third-party access to system and customer data in place with access to quality customer and billing data, along with appropriate privacy and security protections
8	Updated costs for AMF deployment based on information gained from procurement efforts
9	Transparent, updated benefit cost analysis that fully incorporates the Docket 4600 framework
10	Investigation of alternative business models and ownership models
11	Analysis of data latency
12	Deployment details
13	Role of non-regulated power producers, including articles to share customer information and customer engagement
14	Ownership model for assets and telecom
15	Detailed AMF functionalities, how RI will achieve these functionalities, and a timeline for when those functionalities are available
16	Identification of the most cost-effective way to achieve the functionalities, and how the functionalities align to policy objectives
17	Explanation of whether the realization of those functionalities align to policy objectives will require additional future work and costs over 20 years
18	Identification of what functionalities the AMF will achieve that are part of the grid modernization plan and which are in addition to the Grid Modernization Plan
19	Identification of which functionalities are dependent on full-scale roll out instead of a targeted roll out
20	Business case based on both a RI-only scenario and RI/New York scenario
21	A business case based on the length (duration) of meter deployment
22	Identification of the critically linked parts of grid modernization and AMF
23	Identification of whether the AMF solution would allow for proper net metering according to the tariff

RIE Benefits from PPL AMF Insights

PPL Full-Scale Automated Meter Reading Experience includes several million meters over the last two decades:

- PPL First Generation in PA: 2002 – 2004
- PPL Second Generation in PA: 2015 – 2020
- LG&E KU Full Scale Launch in KY: Oct. 20221 - 2026

PPL Offers Many Insights:

- AMF Meter Implementation
- Back-Office Systems Deployment and Integration
- Communication Network Design/Implementation
- People, Process, and Tools
- DER Management and Monitoring
- Integration with grid modernization

RIE Benefits:

- Implementation Cost Efficiencies
- Functionality Efficiencies
- Lessons Learned and Best Practices
- Vendor Relations and Purchasing Power
- Operational Efficiencies
- Shared Network Services
- Analytics

Functionality Assessment of Metering Solutions

National Grid developed for their Updated Business Plan

Recommend **Full-Scale** AMF Solution:

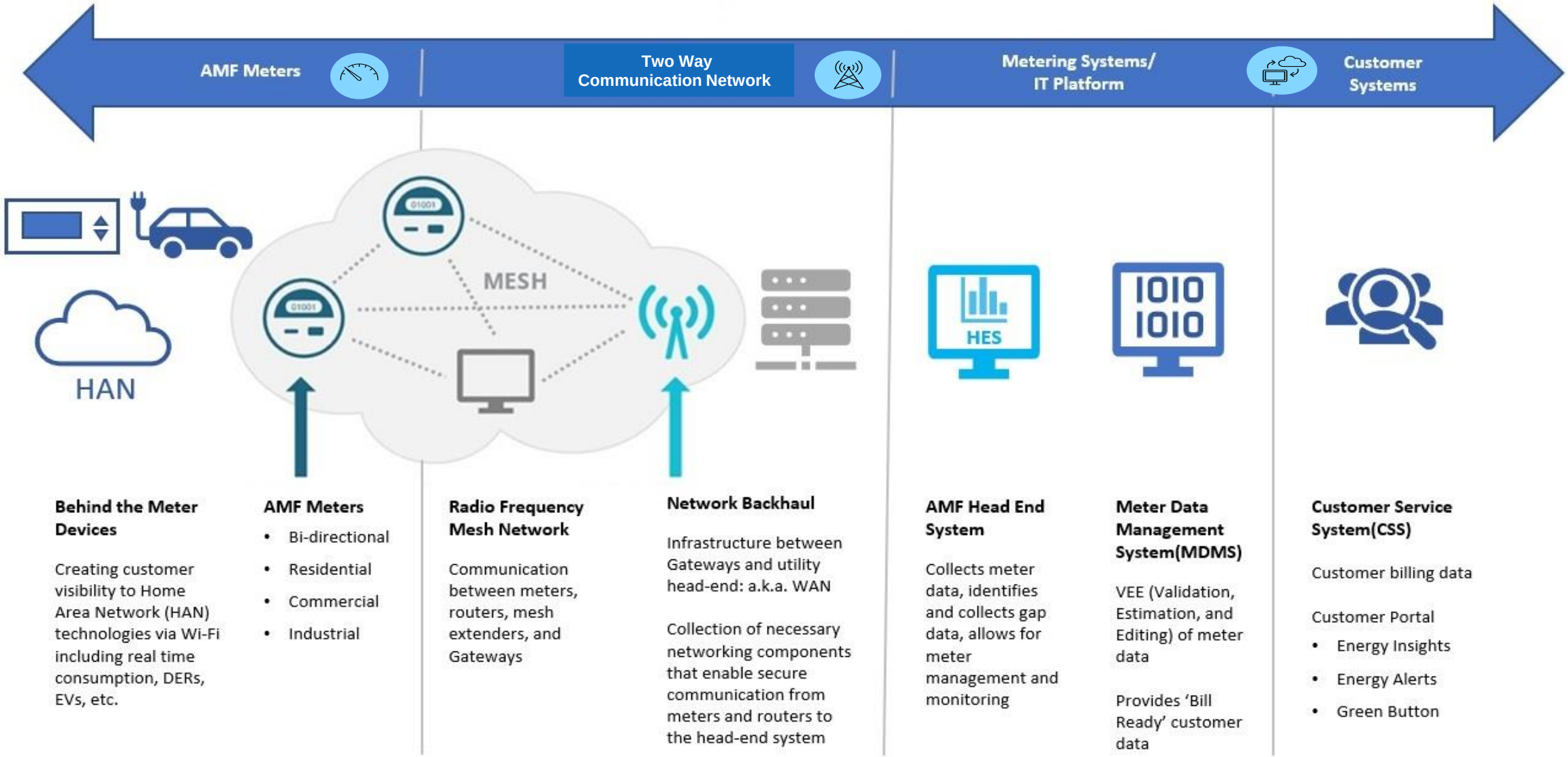
- ✓ The only fit-for purpose solution
- ✓ Supports all enhanced functionalities
- ✓ Provides capability to meet multi-pronged objectives

	AMF Functionality / Use Case	Current AMR	Targeted Enhanced AMR (Opt In)	Targeted AMF*	Full-Scale AMF	End User Solutions**	Transformer level Sensors	Pole Top Sensors
		Complete Metering Solutions				Complementary Customer and Grid Technologies		
Customer-Facing	CP – Near Real Time Customer Data Access	○	○	●	●	●	○	○
	CP – Customer Energy Insights	◐	◐	●	●	◐	○	◐
	CP – Bill Alerts	○	○	●	●	◐	○	◐
	CP – Load Disaggregation	○	○	●	●	●	○	○
	CP – Green Button Connect	○	○	●	●	○	○	◔
	Integrates with In-Home Technologies	○	○	●	●	●	○	○
	Time Varying Rates, Customer and DER	○	◔	●	●	○	○	○
	Remote Interval Meter Reading	○	○	●	●	○	○	○
	Remote Meter Configuration	○	○	●	●	○	○	○
	Remote Meter Investigation	○	○	●	●	○	○	○
	Remote Electric Connect and Disconnect	○	○	●	●	○	○	○
	Theft Detection	◔	◔	◔	●	○	○	◔
Grid-Facing	Voltage Measurement – VVO / CVR	○	○	◔	●	○	◐	○
	Outage Detection and Notification	○	○	◔	●	○	◐	◔
	Time Varying Rates – Load Shift	○	○	◔	●	○	○	◔
	Load & Voltage Data – Situational Awareness	○	○	◔	●	○	◐	◔

** Included combination of high-resolution home sensors with in-home technology packages and no CP integration, *** Assumes integration with utility platforms services (e.g. billing)

Potential Solutions and Enabled Functionalities

Full Scale AMF Technology Elements



Behind the Meter Devices

Creating customer visibility to Home Area Network (HAN) technologies via Wi-Fi including real time consumption, DERs, EVs, etc.

AMF Meters

- Bi-directional
- Residential
- Commercial
- Industrial

Radio Frequency Mesh Network

Communication between meters, routers, mesh extenders, and Gateways

Network Backhaul

Infrastructure between Gateways and utility head-end: a.k.a. WAN

Collection of necessary networking components that enable secure communication from meters and routers to the head-end system

AMF Head End System

Collects meter data, identifies and collects gap data, allows for meter management and monitoring

Meter Data Management System(MDMS)

VEE (Validation, Estimation, and Editing) of meter data

Provides 'Bill Ready' customer data

Customer Service System(CSS)

Customer billing data

Customer Portal

- Energy Insights
- Energy Alerts
- Green Button

AMF Meters

- Most critical component for enabling the benefits
- Reads customer data at 15-minute intervals
- Can support TOU/TVR leading to stronger customer engagement, better energy management
- Two-way communication provides new customer and grid-facing functionality for remote operations
- Enables new and needed customer-facing and grid-facing functionality
- Hardware features:
  - Remote connect/disconnect
  - Multiple registers (kWh (real), KVAR (reactive), voltage)
  - Integrated Wi-Fi
  - Temperature Sensor
  - Arc Sensor
  - Accelerometer
  - Cover Removal Switch
  - Precision Network Timing

Two-Way Communication Network

RF Mesh Communication Network

- Provides state-of-the-art two-way communications with the meters
- Solution includes a communication network that is IP-based
- Applies radio (RF) using peer-to-peer communications to create a mesh
- Analysis performed to minimized number of ‘hops’ each endpoint needs to get data back to the HES
- Security is inherent in the design to safely transmit data
- Network is self-healing, featuring dynamic routing messages that automatically adjust for changes
- Design accounts for scalability and forecasted end-points

Backhaul

- Will utilize a cellular network as backhaul unless RIE fiber is available, in which case it will be used.
- Data will be encrypted at transit at the networking layers on the devices

Substation Network Equipment

Pole-Mounted Network Equipment

Router

Network Gateway

Systems

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Head End System (HES)

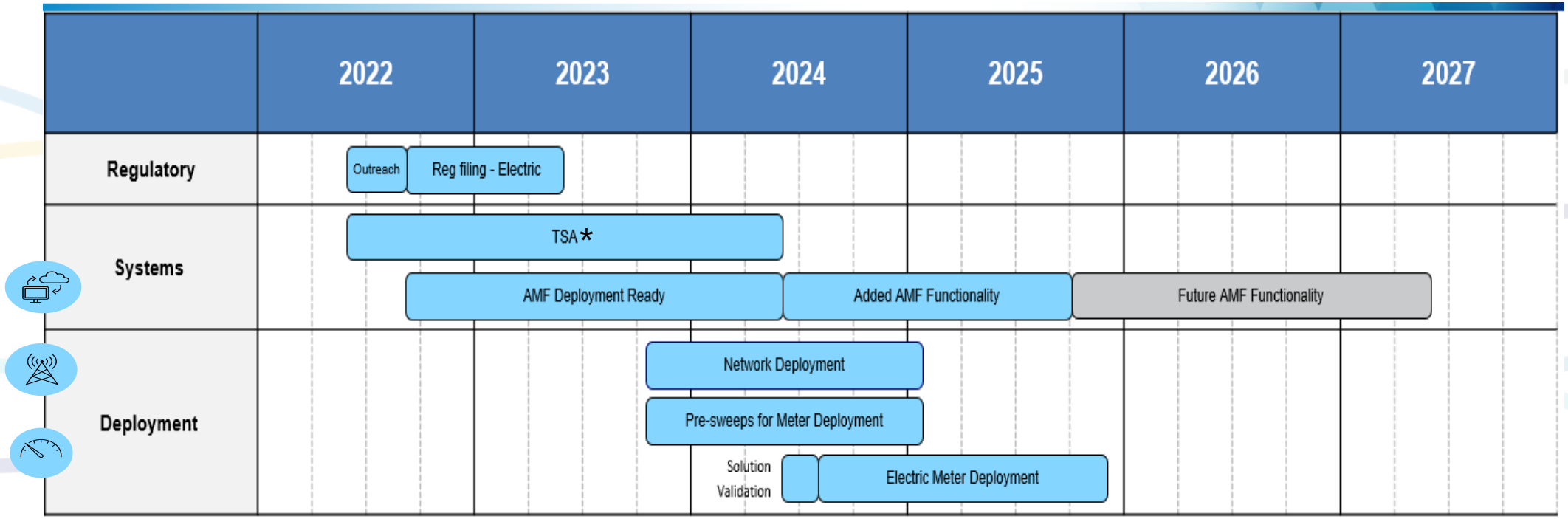
- HES is the centralized data collection solution for all meter information coming from the Network Gateways through the Backhaul
- Provides the tools to manage and monitor the advanced capabilities of the AMF meters
- HES can send commands such as remote connects/disconnects, and over-the-air (OTA) updates
- Ability to communicate through the HES to the meter to provide utility visibility and enables functionality

Meter Data Management System (MDMS)

- HES delivers data to MDMS for data validation and pre-billing
- Will be sourced for various customer enablement programs such as the Customer Portal, the Supplier Portal, and providing Green Button Connect data.
- Will populate many distribution operations systems to enable better near real-time visibility of the system and to enable more efficient management of the grid

AMF Deployment

AMF Deployment Schedule (3 ½ Years)



* TSA is the "Transition Service Agreement" where National Grid operates and maintains its back-office systems for RIE customers for up to two years after PPL closed on the transaction to acquire Narragansett Electric Company.

AMF Functionality Roadmap

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"AMF Deploy Ready"		"AMF Enhancements from Meter Deployment Start"			Future
GROUP 1 & 2 (TSA Exit)		GROUP 3 (w/in 6 months)	GROUP 4 (w/in 12 months)	GROUP 5 (w/in 18 months)	GROUP 6 (future)
Remote (AMF) Meter Reading & Billing	Proactive Outage Mgmt. (Last Gasp / Power Up)	CP: Green Button Connect	ADMS: Voltage Conservation (Volt-Var Optimization)	ADMS-DER: Monitor & Mgmt Foundational	Load Disaggregation & Waveform Analytics
Remote Meter Configuration & Investigation	Remote Electric Connect & Disconnect	CP: Bill Alerts	ADMS: Voltage Automated Notification (Sag/Swell)	TVR Foundational – need Reg approval	Grid Edge Computing (writing applications to the meter)
Deployment Exchange Management Solution	CP: Customer Portal	CP: Customer Mobile App (Native Mobile App)	ADMS: On Demand Voltage Measurement (to ADMS)	CP: Distributed Generation "DG" Portal	CP: Streamlined Energy Efficiency & Demand Response Program Signup
AMO Data Driven Operations (routine measurement from devices including meters, routers, collectors, voltage)	Customer Outage Alerts	CP: Near Real-Time Customer Data Access	Network Model Analytics	CP: Carbon Footprint Calculator	
Alerts & Alarms: High Temp		CP: In-Home Device Support	Theft Detection Analytics	CP: C&I and Multi-Family Portfolio View	Enable TVR – post Reg approval

LEGEND

- STANDARD FUNCTION
- ADVANCED FUNCTION, FURTHER REVIEW NEEDED
- CSS DRIVEN
- CUSTOMER ENGAGEMENT DRIVEN
- OPS (ADMS/OMS) DRIVEN

Network Staging and Deployment Process

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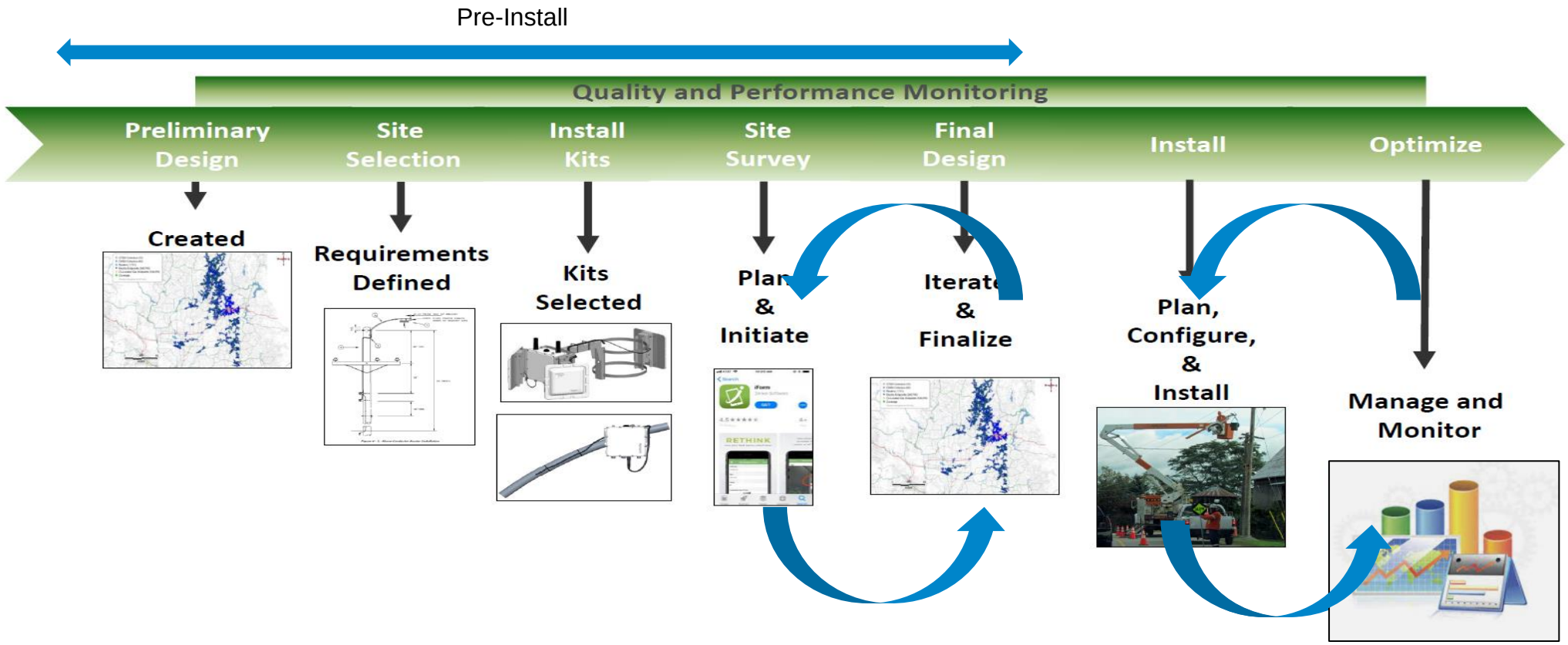
Two-Way Communication Network Staging and Deployment

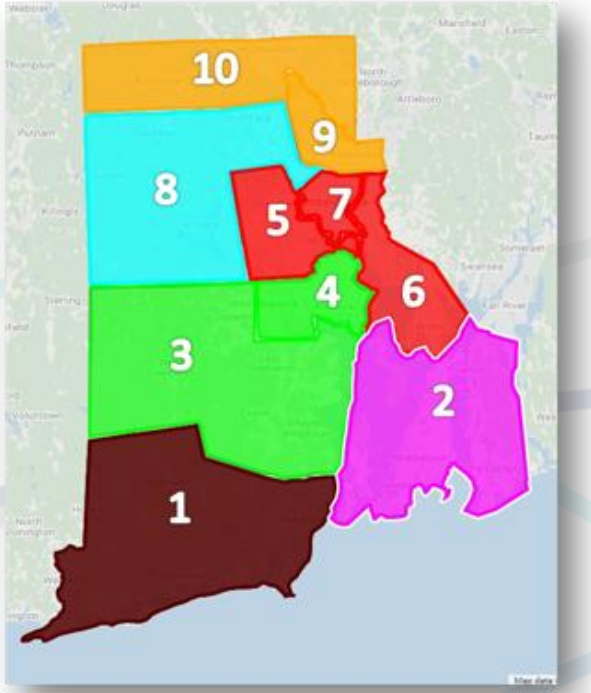


Deployment by Sector

Considerations for Deployment Sector Rollout:

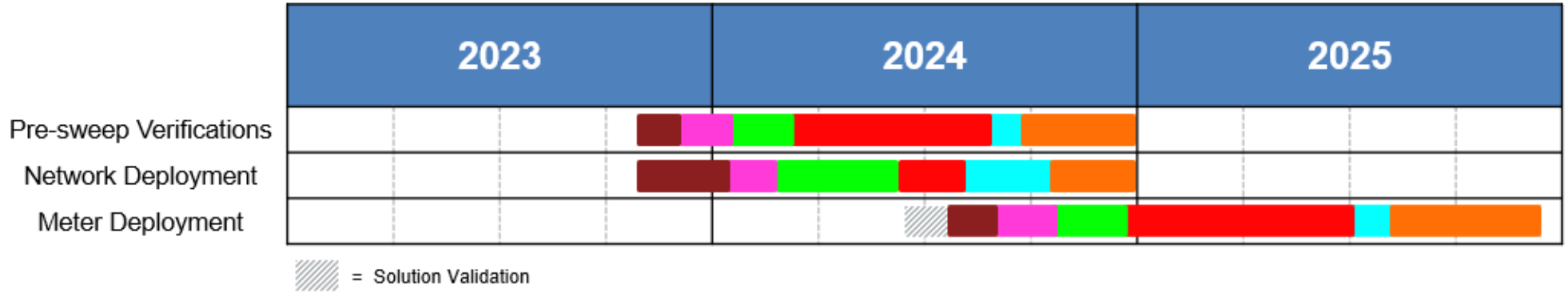
- Avoids coastal areas in the summer
- Allows time to address hard-to-access indoor meter situations
- Homogenous mix of service and meter types at the start of the project
- Avoids heavily populated areas in the initial stages to reduce complexity
- Prioritizes higher density DER areas

Deployment Sectors



Sequence No.	Sector
1	Westerly
2	Middletown
3	North Kingstown - W
4	North Kingstown - E
5	Providence -W
6	Providence - E
7	Providence
8	Chopmist
9	Lincoln - E
10	Lincoln - W

Deployment Sector Schedule



AMF Cost Review - DRAFT

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Overview

Meter

- Hardware
- Installs
- Pre-Sweeps
- Program Management
- Repairs

Network

- Hardware
- Installs
- Program Management
- Steady State Operations

Systems

- ADMS & OMS
- Analytics
- CSS
- Customer Engagement
- CyberSecurity
- Deployment Exchange Mgt.
- Grid Edge & Load Dissag.
- Headend
- MDMS
- Middleware
- Program Management
- Steady State Operations

Program

- Change Management
- Program Management

AMF 20-Year Nominal Cost
$288.46M*

AMF 20-Year NPV
$189.99M*

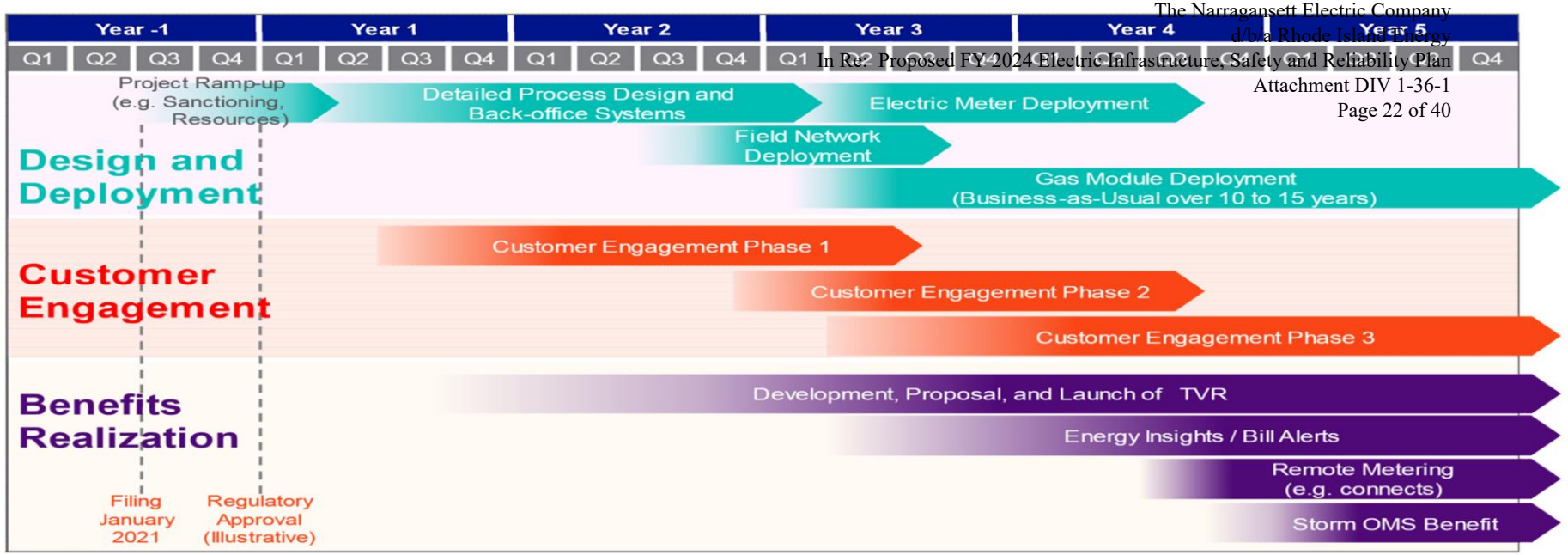
Meter Network Systems Program

* Compared to NG of $289.35 nominal and 192.60 NPV

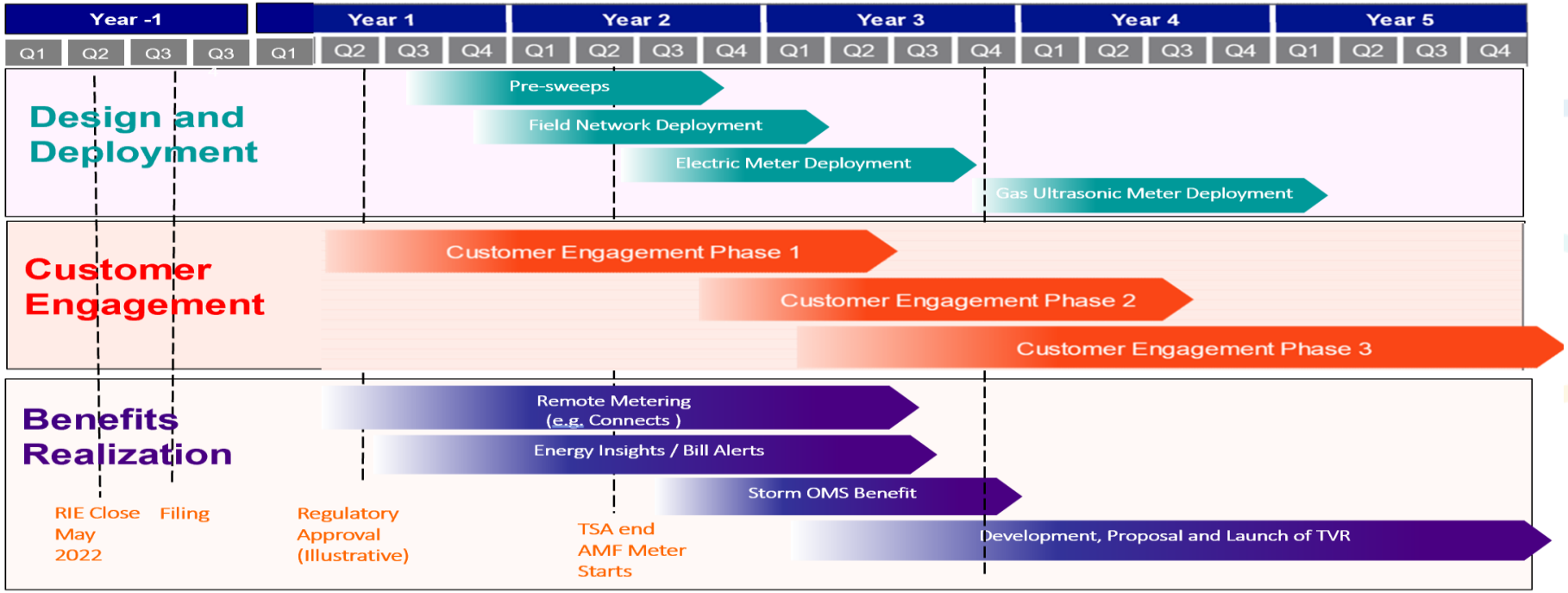
AMF Deployment Comparison

National Grid and Rhode Island Energy

National Grid



Rhode Island Energy



AMF Comparison: RIE and National Grid

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Similarities

- Deployment period of 3 ½ years
- Fixed IP-based RF mesh communication system
- Full-scale technical solution
- Opt-out assumption 1%
- Alternative business analysis
- Used the NG BCA framework applying Docket 4600 requirements
- Customer Engagement Plan
- Data latency assumptions
- Assumptions designed to meet clean energy goals
- TVR assumed in a separate filing

Differences

- Broader interpretation of AMF as enabling platform
- More robust, future-proofed communication system
- Cellular communications is not needed for meters
- Meter unit costs are slightly higher than the NG filing
- More functionality, sooner, leveraging prior PPL integration and experience
- Added pre-sweeps as a deployment activity
- Update meter bases where needed
- More operational savings with PPL business impacts
- Outsource assumptions
- Quantification of reduced time for outage notification and customer savings from energy insight
- Used AESC 2021 report rather than 2018 report

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Grid Modernization Plan (GMP) Business Plan

Grid Modernization Plan

- AMF and GMP, which includes Advanced Distribution Management Software (ADMS), are foundational for an electric grid that Rhode Island Energy customers deserve – safe, reliable, affordable, and clean

- An overall Grid Modernization Plan (GMP) is being developed that will allow RIE to operate safely and reliably while supporting clean energy requirements.

- PPL has extensive experience implementing technology and automating the grid in other jurisdictions which will be leveraged to define and accelerate RIE grid modernization
  - SAIFI and customer satisfaction have significantly improved with PA deployment
  - The PPL GMP playbook and business impacts will be considered in the RIE GMP

- ADMS, provided with the PPL transaction, advances business value and will improve the BCA

GMP Approach

- RI Energy will propose the most optimal deployment plan that will provide safe, reliable operations over the study period while anticipating clean energy.
- Benefit acceleration will be possible given the availability of ADMS from the PPL Transaction
- Study will conduct a Statewide 8760 analysis inclusive of the DER forecast and recently completed area study plans
- Company forecasts will be used as a base and refined to align with Act on Climate
- Duration of the study period will extend to 2050
  - Analysis to be performed for 2030, 2040, 2050
  - Timing may be refine based on analysis results that reveal changing of system characteristics
- Aligns with AMF Filing assumptions:
  - EV Forecasts and Time Varying Rate capability
  - Alignment of interdependent functionality such as proactive outage management and VVO benefits
- IIJA and Transition Agreement linkage

GMP Analysis and Solution Development

- Analysis and Solution Development will consider a “with” & “without” GMP
- Case and Solution set to be considered:
  1. Base Forecast:
     – Traditional utility solutions no GMP
     – Refined utility solutions with GMP
  2. Low Forecast:
     – Refined traditional utility solutions with GMP
  3. High Forecast:
     – Refined traditional utility solutions with GMP
- Traditional Utility solutions will include Distribution, Sub-Transmission, Transmission Line and Substation upgrades and expansion alternatives
- GMP Solutions will include Smart Devices, ADMS, DERMS, Batteries, TVR and more

Study Process

Stakeholder Outreach and Consultation

Scope

State-wide analysis

- ~400 feeders
- Sub-transmission modeling and testing
- Includes area study recommendations
- System-wide transmission analysis
- 8760 hour per year

Years – 2030, 2040, 2050

Cases

- No Grid Modernization – build for extremes
- Grid Modernization – manage away extremes
- Sensitivities: Low, Base, High DER forecasts With and without transmission consideration

Analysis

Issue Identification

- Determine load and voltage issues across hours of the year
- Determine areas with degrading reliability
- Determine resiliency needs

Case Evaluation

- No GMP
- GMP

Leverage PPL proven technology

Estimation

Leverage PPL experience

- Technology costs
- Installation assumptions
- Standards

Benefit Cost Analysis

Comply with Docket 4600

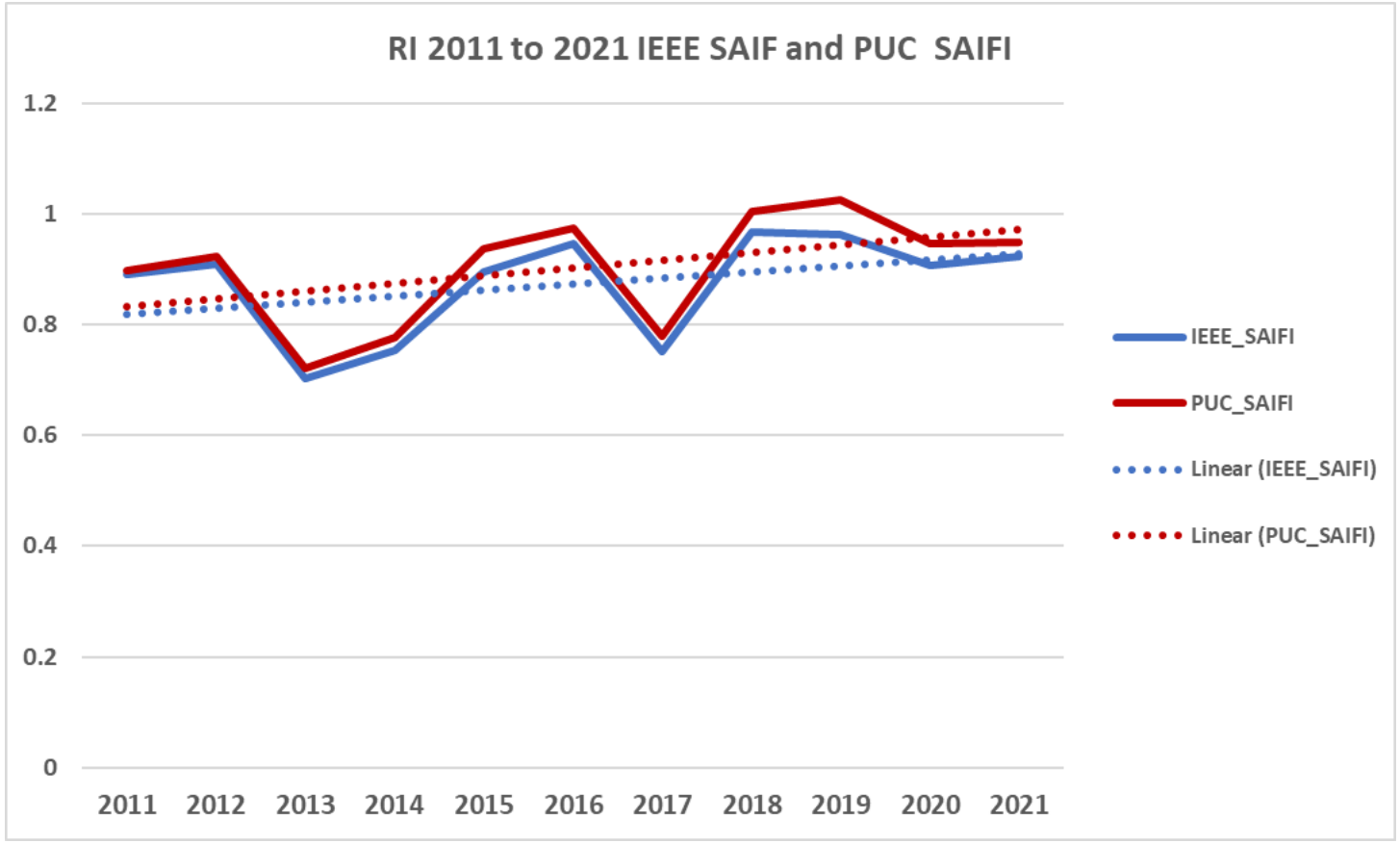
Update with PPL experience, Study and Reliability findings

2024 ISR Coordination

ADMS ‘Basic’ came with the acquisition

Reliability Study

- RIE's SAIFI (interruption frequency index is increasing
- Robust data-driven approach for optimal device placement
  - outage history
  - vegetation mapping
  - construction configurations
- Leverages PPL expertise and proven value

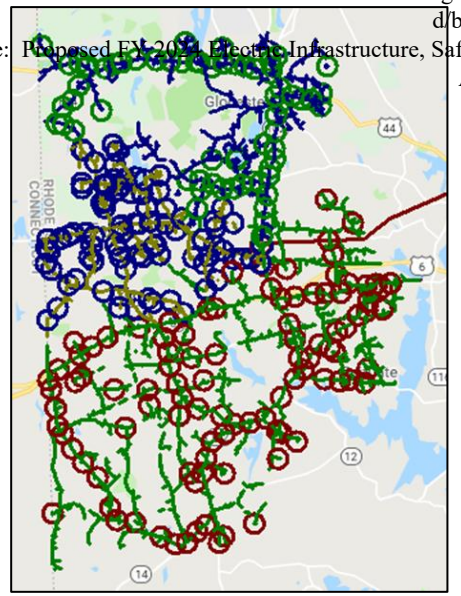


RIE reliability (SAIFI) is trending worse. Define optimal investments for improvement.

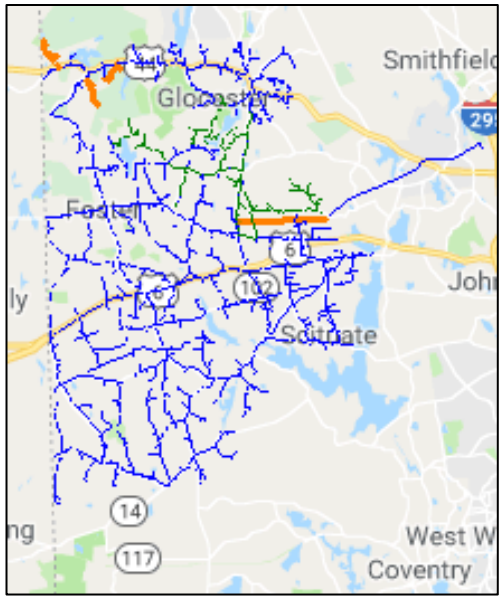
GMP Study Scope and Approach

CYME Analysis

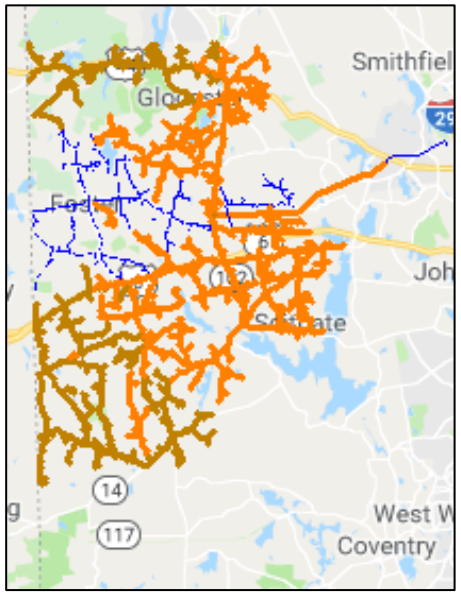
- Python script tools developed to distribute PV, EV, and EHP
  - Scattered approach, no propensity modeling
- Time Range Analysis is data intensive and time consuming
  - Time range analysis used to find key dates/times
  - Single time analysis done on key date/time



- Example: Voltage Violation – 5/25 at 12:00 pm
  - Peak load – minimal voltage issues
  - Light load - high voltage with DG – shown in **ORANGE, BROWN**



Summer Peak Load



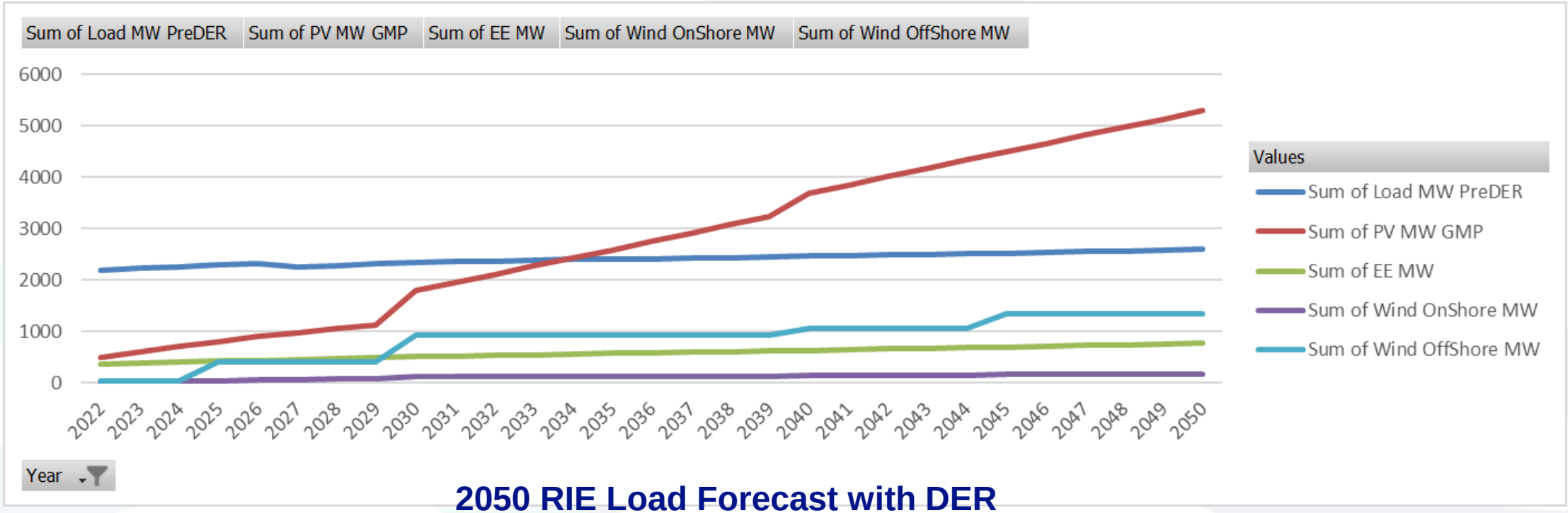
Summer Light Load

Rhode Island's "2021 Act on Climate Bill"

- "…economy-wide enforceable targets for greenhouse gas emissions reductions as follows:
  - 10% below 1990 levels by 2020
  - 45% below 1990 levels by 2030
  - 80% below 1990 levels by 2040
  - Net-zero emissions by 2050."
  - http://webserver.rilin.state.ri.us/Statutes/TITLE42/42-6.2/42-6.2-9.htm
- Revision of 2014 bill with several key changes:
  - Increased target reductions
  - Targets are mandatory and enforceable
  - Focus on equity of climate change impacts
  - More focus on workers and jobs

2050 Load Forecast with DER

- Used National Grid 2022 forecast that was issued in November 2021 as a basis
- Extended to 2050 considering ISO-NE forecast and milestone years
- Aligned with other planning and engineering efforts
- Considers Rhode Island Act on Climate Bill



2050 RIE Load Forecast with DER

DER Forecast / Impact to Peak Demand

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Key DER Metrics for Milestone Study Years

	GMP DER Forecast Analysis -- Impact to Peak Demand					
	2030		2040		2050	
	Summer	Winter	Summer	Winter	Summer	Winter
Heat Pumps, MW	0	200	5	1310	5	2825
# Heat Pumps	54,000	54,000	325,000	325,000	400,000	400,000
Solar PV, MW	0	0	0	0	0	0
Solar PV, nameplate MW	1500	1500	3400	3400	5000	5000
EV Charging, MW	70	80	805	910	1010	238
# Electric Vehicles	87,300	87,300	675,000	675,000	840,000	840,000
RIE Peak Demand, MW	1940	1415	2590	3280	2785	3855

Thoughtful DER forecast developed with sound reasoning applies to AMF and GMP

Next Steps: RIE Stakeholder Collaboration

Upcoming Dates for PST Briefings

- Tuesday August 2nd 9:30 to noon
- Tuesday, August 16th 9:30 to noon

Appendix

Functionality Available at TSA Exit

AMR or AMF Functionality	Working Definition
Remote (AMF) Meter Reading & Billing	Reading and billing interval energy usage at standard latency using AMI meters.
Remote Meter Configuration & Investigation	Remote "over-the-air" firmware and software updates & investigation of meter malfunctions. Proactively enabled energy data analytics and reactively enabled by alerts and alarming
Deployment Exchange Management Solution	The Meter Deployment Vendor solution (TBD) to status and update the accounts that have been exchanged as part of the AMF deployment. Traditionally this involves exchanging of a "Population file" and synchronizing with the customer system and other asset systems to reflect the newly installed AMF meter.
AMO Data Driven Operations	Implementation of operational dashboards to manage and facilitate the Smart Grid Network and associated endpoints. For example, population configuration management, population firmware levels, installed endpoint inventory, reading percentages, interval completeness, and overall network health.
Alerts & Alarms: High Temp	Alerting & Alarming - Alerting when configurable internal temperature is reached and sending to work management system for disposition
Proactive Outage Management (Last Gasp / Power-up)	Alerting operations when meter experiences an outage, or power is restored via the OMS system.
Remote Electric Connect & Disconnect	Activation of remote electric meter switch to turn on/off service; meter tamper alerts and usage analytics.
CP: Customer Portal	Customer-facing usage data availability, usage analytics, normative comparisons, and other data-driven customer experience features. Provide omni-channel access and continuous improvement through an agile and iterative development approach that incorporates on-going customer experience updates.
Customer Outage Alerts	Proactive communication of outages identified in the OMS system to customers.

Enhanced Functionality During Meter Deployment

AMR or AMF Functionality	Working Definition
CP: Green Button Connect	Enables customers to provide for the automated transfer of customer energy usage data at standard latency to authorized third parties.
CP - Bill Alerts	Alerts for variety of customer needs. Examples include projected high-bill (consumption and/or costs), prediction of peak demand or usage, and customizable threshold alert at various points during a billing period.
CP: Customer Mobile App (Native Mobile App, IHD)	Extension of the customer portal to a native Android/iOS mobile application.
CP: Near Real-Time Customer Data Access	Availability of near real-time raw usage data through the customer portal. This allows 15-minute electrical raw usage data, available within 45 minutes, updated with bill quality data within 24 hours.
CP: In-Home Device Support	Enable communications between a customer owned In Home Device and the AMF meter
ADMS: Voltage Conservation (Volt-Var Optimization)	Providing interval meter voltage and reactive power data to the ADMS to support conservation voltage reduction (CVR) and Volt-Var Optimization (VVO). This also includes new ADMS functionality to implement CVR and VVO.
ADMS: Voltage Automated Notification (Sag/Swell)	Configurable real-time alert for momentary under or over voltage on a meter, integrated to ADMS for immediate action.
ADMS: On Demand Voltage Measurement (to ADMS)	ADMS function to ping networked electric devices and meters for voltage measurements.
ADMS-DER: Monitor & Management	Monitor & management of distributed energy resource (DER) inverter-based infrastructure (i.e. battery banks, solar PV, net-meters).

Enhanced Functionality During Meter Deployment – Cont'd

AMR or AMF Functionality	Working Definition
Network Model Analytics	MDMS functionality to support analysis of the network, identifying outlier issues for investigation (i.e. circuits missing a meter, mis-associated meters).
Theft Detection Analytics	MDMS functionality to identify outlier patterns and settlement issues that indicate potential energy theft.
CP: Distributed Generation "DG" Portal	Customer portal functionality that creates an integrated marketplace for customer research of solar PV adoption, A customer completes an online survey/audit and numerous estimates are provided for customer's review and subsequent selection of options from qualified thirdparty service providers/installers.
CP: Carbon Footprint Calculator	Customer portal functionality that creates an ability for customers to calculate carbon footprint based on usage data and actions to better manage usage.
CP: C&I and Multi-Family Portfolio View	Customer portal functionality that enables (1) a portfolio view of C&I facilities as well as properties for multifamily unit owners and managers, (2) search/sort, aggregate data and insights, assist with evaluation, measurement, and verification ("EM&V"), and (3) usage normalization on variables such as production, sq. ft., occupancy, weather.

Future Functionality

AMR or AMF Functionality	Working Definition
CP: Streamlined Energy Efficiency & Demand Response Program Signup	Reduce program marketing spend by targeting customers who are eligible, have a higher probability of participating, and represent the highest potential load shed or shift based on specific consumption. Outreach and communications costs can be reduced by utilizing personalized channels, rather than mass marketing efforts.
Time Varying Rates (TVR) Foundational	Interval meter data with VEE integrated to billing systems and billing system functionality to support Time Variable Rate billing.
Load Disaggregation & Waveform Analytics	Provide a breakdown of electricity consumption by appliance or end-use for educational purposes and/or recommended actions to save, available through the customer portal. Meter waveform data from a representative sample of bellwether meters for general analytics use.
Grid Edge Computing (writing applications to the meter)	Metering platform for customer- and grid-facing software applications at the meter.
Enabled Time Varying Rates ("TVR")	Customer engagement and approved regulatory framework to support Time Variable Rate billing options to customers.

Acronyms

- ADMS = Advanced Distribution Management System
- AESC = Avoided Energy Supply Cost
- AMF = Advanced Meter Functionality
- AMI = Advanced Meter Infrastructure
- AMR = Automatic Meter Reading
- ASA = Amended Settlement Agreement
- ASHP = Air Source Heat Pump
- BAU = Business as Usual
- BCA = Benefit Cost Analysis
- C&I = Commercial and Industrial
- CEP = Customer Engagement Plan
- CGR = Connected Grid Router
- CO2 = Carbon Dioxide
- CP = Customer Portal
- CPP = Critical Peak Pricing
- D = Distribution
- DCFC = Direct Current Fast Charging
- DER = Distributed Energy Resource
- DERMS = Distributed Energy Resource Management System
- DG = Distributed Generation
- DLM = Dynamic Load Management
- DPAM = Distribution Planning & Asset Management
- DPL = Dayton Power and Light
- DR = Demand Response
- DRIPE = Demand Reduction Induced Price Effect
- DSCADA = Distributed Supervisory Control and Data Acquisition
- EC4 = Executive Climate Change Coordinating Council
- EE = Energy Efficiency
- EDI = Electronic Data Interchange
- EHP = Electric Heat Pump
- EIA = Energy Information Administration
- EPO = Energy Profiler Online
- ESB = Enterprise Service Bus
- EV = Electric Vehicle
- FAN = Field Area Network
- FLISR = Fault Location Isolation and Service Restoration
- GBC = Green Button Connect
- GBD = Green Button Download my data
- GHG = Greenhouse Gas
- GIS = Geographical Information Systems
- GMP = Grid Modernization Plan
- HAN = Home Area Network
- HCA = Hosting Capacity Analysis
- HES = Head End System
- HVAC = Heating, Ventilation, and Air Conditioning
- ICAP = Installed Capacity
- ICE = Interruption Cost Estimate
- IoT = Internet of Things
- IP = Internet Protocol
- ISA = Interconnection Service Agreement
- ISO NE = Independent System Operator New England
- IT = Information Technology
- KY = Kentucky
- LDV = Light Duty Vehicle
- LVA = Locational Value Analysis
- MA = Massachusetts
- MDM = Meter Data Management
- MV/LV = Medium Voltage/Low Voltage
- NEM = Net Energy Metering
- NMPC = Niagara Mohawk Power Corporation
- NPP = Non-Regulated Power Producer
- NY = New York
- NWA = Non-Wires Alternative
- OER = RI Office of Energy Resources
- OMS = Outage Management Systems
- PA = Pennsylvania
- PBR = Performance-Based Regulation
- PI Historian = Plant Information Historian
- PIM = Performance Incentive Mechanism
- PLC = Power-Line Communication
- PPL = Pennsylvania Power and Light
- PSE&G = Public Service Electric & Gas
- PSR = Platform Service Revenue
- PST = Power Sector Transformation
- PUC = Public Utilities Commission
- PV = Photovoltaic
- REC = Renewable Energy Credit
- REV = Reforming the Energy Vision
- RF = Radio Frequency
- RGGI = Regional Greenhouse Gas Initiative
- RI = Rhode Island
- RIE = Rhode Island Energy
- RMD = Residential Methane Detector
- RTP = Real Time Pricing
- RTU = Remote Terminal Unit
- SaaS = Software as a System
- SCT = Societal Cost Test
- SME = Subject Matter Expert
- ToC = Table of Contents
- TOU = Time Of Use
- TSA = Transition Service Agreement
- TVR = Time Varying Rate
- VDER = Value of Distributed Energy Resources
- VMT = Vehicle Miles Traveled
- VPP = Variable Peak Pricing
- VVO/CVR = Volt-Var Optimization/Conservation Voltage Reduction
- WACC = Weighted Average Cost of Capital

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Advanced Meter Functionality Plan
Stakeholder Outreach: Customer Engagement and Benefits

Power Sector Transformation – August 16, 2022

Agenda – PST August 16, 2022

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- 9:30 – 9:40 Objectives, Recap and Feedback
- 9:40 – 9:50 PST Meeting Reflection and Follow-Up
- 9:50 – 10:50 AMF Data Governance, Cyber Security, Privacy
  AMF Benefit Cost Analysis Recap, Sensitivities, TVR
  AMF Cost Recovery and Revenue Requirements
  Reporting and Metrics
  AMF Next Steps
- 10:50 – 11:00 Break
- 11:00 – 12:00 GMP Scenario Analysis
  GMP Study Forecast Results: Northwest Region (Preliminary)
  GMP Solution Development
  GMP Software Functionality Timeline (Preliminary)
  GMP ISR Coordination and Next Steps

Objectives

- Recap results from 8-2-2022 meeting
- Discuss and solicit feedback
- Review remaining aspects for AMF Business Plan to solicit input before filing
- Begin reviewing GMP preliminary findings and solutions
- Align on ISR Coordination for GMP
- Next Steps

Ground Rules:

- Ask questions and provide feedback as we go
- Raise hand and state name when asking questions
- One conversation at a time
- Timekeeper to monitor discussion and align to agenda
- Topics and questions scheduled for future discussion will be saved in the Parking Lot

Rhode Island PST Advisory Collaboration

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PST Advisory AMF & GMP Subcommittee Meetings and Preliminary Agendas

Stakeholder Collaboration (i.e., Subcommittee meetings and discussions)

Obtain Feedback and Seek Alignment on Proposals and Approaches

Review Initial, Refined and Final Proposals

Jun 21, 2022

- **RI Division and OER Meeting**
- Introductions
- Proposed timeline
- Preliminary agenda for PST meetings
- AMF Introduction and overview of key areas
- GMP Introduction and coordination

July 14, 2022

- **PST Advisory Meeting**
- Introductions
- PPL Background and Experience
- Full Scale Enabling Platform
- Detailed Deployment Plan
- Functionality Timing
- ASA coverage
- AMF cost review
- GMP study scope and approach
- GMP forecast analysis

Aug 2, 2022

- **PST Advisory Meeting**
- Prior meeting will drive agenda
- AMF Customer Engagement Plan
- AMF Opt-out
- AMF Customer value streams
- AMF Auto-notification
- AMF Benefits

Aug 16, 2022

- **PST Advisory Meeting**
- Prior meeting will drive agenda
- AMF Data access, privacy, governance
- AMF Cyber Security
- AMF Cost and Benefit Recap
- Cost Recovery and Revenue Requirements
- GMP scenario analysis
- GMP solution development
- GMP ISR Coordination plans

Sept 1, 2022

- **PUC Technical Session**

September 2022

- **File AMF**
- AMF Includes Business Case, Testimonies and BCA
- Coordinate with GMP execution plan and BCA

w/o Oct 20, 2022

- **PST Advisory Meeting**
- Prior meeting will drive agenda
- GMP Alternative recommendation
- GMP BCA review

December 2022

- **File GMP**
- GMP Includes Business Case, Testimonies and BCA
- Coordinate with ISR and AMF details

AMF – Advanced Metering Functionality
GMP – Grid Modernization Plan
BCA – Benefit-Cost Analysis

September 2022
AMF Targeted Filing Date

December 2022
GMP Targeted Filing Date

- Initial alignment meeting with RI Division and OER
- PST Advisory Sub-Committee Meeting AMF
- PST Advisory Sub-Committee Meeting GMP
- PUC Technical Session

Introductions, Objectives and Background

AMF Business Case Overview

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AMF is foundational to RIE achieving a vision of enabling clean, fair, and affordable energy future.

Need:

- Operational: Approximately 60% of the AMR meters are at the end of their design life.
- Environmental: Achieve clean energy mandate of Net-zero carbon emissions in Rhode Island
- Customer Expectations: Manage energy usage; superior customer experience.
- Modernized System: Increased visibility/control (planning, integration, management).

Value:

- BCA developed and refined consistent with the Docket 4600 Framework.
- Net benefits: $ 734.6 million NPV (opt-in)
- Net costs: $189.6 million NPV
- BCA Ratios: 3.9 (opt-in)

Accountability:

- Upfront adjustment to the revenue requirement.
- Semi-annual reporting of AMF metrics.

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PST Meeting Reflection and Follow-up

PST Advisory Group 8/2 Customer Engagement Follow-Ups

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- **How will you handle the exchange of meters for the 900 large C&I customers?**
  - Majority of C&I customers will be included in the Sector Deployment Plan
  - 900 C&I customers have unique metering that are currently out of scope in the Business Plan
- **What is your strategy to engage renting and non-English speaking customers?**
  - The deployment vendor will get a daily refresh of a customer file from the CIS system containing customer information such as billing and premise address, landlord/tenant information
  - Whoever resides at the premise and is impacted by the meter exchange will be contacted
  - Materials will be published in English as well as Spanish and Portuguese where appropriate.
  - Follow up meeting scheduled to get more feedback for the CEP
- **What will the customer portal look like with TVR?**
  - The TVR portion of the customer portal has not been designed.
  - The vision is to include pricing information along with the interval information of the Customer Portal
  - Specifics can not be provided before the TVR is defined

PST Advisory Group 8/2 BCA Follow-Ups

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- **Research on customer behavior that led to the 1.5% energy reduction number used in the benefits?**
  - "Got Data? The Value of Energy Data Access to Consumers" Jan 2016
    - "Since 2010 **12 other studies that indicate energy savings potential of 6% - 18% when customers have easy access to meter data.**"
  - Energy Watch (June 2019) : "Smart meters reduce average electricity consumption by 10% per customer."
  - "New guidance on conducting energy consumption analysis" Dec 2020:
    - "BEIS estimates that the smart meter roll-out will reduce household electricity and gas consumption by 3% and 2.2% respectively."
  - "Leveraging Advanced Metering Infrastructure to Save Energy" Jan 2020:
    - "Studies on customer feedback suggest different degrees of impact. Buchanan, Russo, and Anderson (2015) conclude that there is limited evidence that feedback alone is effective in getting customers to reduce energy use. Karlin, Zinger, and Ford (2015), however, conclude that feedback is a promising strategy to promote energy conservation, but that this depends on how information is conveyed to customers (e.g., via social norms, anchoring, and other behavioral tools) to motivate them to take actions that affect their energy use. Sussman and Chikumbo (2016) find that most real-time feedback programs using opt-in designs report net electricity savings in the 5–8% range."
- **What are your projected EV numbers in order to achieve 40% GHG reductions?**
  - The EV projections range from ~7,000 EVs projected in 2022 to ~750,000 EVs projected in 2041

AMF: Whole House & Electric Vehicle TVR Opt-In & Opt-Out Comparison - NPV ($M)

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As of August 10, 2022		
Business Case Component	**Opt-In Case**	**Opt-Out Case**
A. Costs (20-Year NPV)	**$189.64**	**$189.64**
B. Benefits (20-Year NPV)		
Utility - Opt-In/Opt-Out	$113.13	$471.66
Utility - All Other	$238.60	$238.60
Direct Customer - Opt-In/Opt-Out	$0.00	$0.00
Direct Customer - All Other	$225.46	$225.46
Societal - Opt-In/Opt-Out	$2.51	$5.88
Societal - All Other	$154.90	$154.90
C. Total Benefits (20-Year NPV)	**$734.60**	**$1,096.51**
Benefits Less Costs	$544.96	$906.87
Benefit/Cost Ratio	3.9	5.8

- Base assumption of Opt-In results in Benefit/Cost ratio of 3.9
- Using Opt-Out approach results in Benefit/Cost ratio of 5.8
- Some Utility and some Societal benefits change while Direct Customer benefits do not change

Assumptions:

- EV forecast meets 2040 goal of 80% GHG reduction
- Assumed TOU/CPP & TVR Opt-In = 20% participation; Assumed TOU/CPP & TVR Opt-Out = 85% participation
- Used AESC 2021 avoided costs
- Assumed peak savings of 20% for Whole House and range of 28% to 60% for EVs over 20 years

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AMF Data Governance and Data Security

People, Process, Technology, and Purpose are Key

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- People – The requirement for greater security and faster delivery cycles requires changes in team make up and requires regular training. Security is integrated through the business for security/compliance requirements.

  Company maintains a cybersecurity organization comprised of individuals who are trained, certified and experienced in information and cybersecurity. Investment in, and ongoing assessment of our cyber skills is vital to the success of our cybersecurity function.

- Processes – Software and components need to be tracked as they change and as well as the vulnerabilities affecting them. A systematic process is needed since manual processes for tracking vulnerabilities as they are disclosed are unreliable.

  Company has a Data Governance Council that is made up of a cross-functional body of departments to ensure the governance initiatives are coordinated in the most functional manner with ongoing efforts across PPL. Company leverages internal security policies derived from best practices designed to look for novel and effective ways to protect the company's assets from current and emerging threats.

- Technology – Signature-based solutions providing ground truth based on output and continuous monitoring of newly disclosed vulnerabilities and compromises mapped to production software and associated systems

  AMF system will be evaluated for compliance with cybersecurity requirements derived from the Company's Enterprise Security Standards and appropriate industry security standards and frameworks. This evaluation process will continue throughout the development lifecycle

- Purpose – Evaluate the risk and possible repercussions

  Company considers not only the potential impact to the flow of power to customers, but also the intended flow of data through the company's System(s).

PPL Data Governance Plan

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- Defines pertinent policies addressing data privacy, data governance, information classification, and Cybersecurity and enterprise security standards
- Supports critical infrastructure and vital business functions including AMF
- Framework includes a comprehensive set of principles and standards:

✓ Data Governance Policy
✓ PPL Standards of Integrity
✓ PPL Responsible Behavior Program
✓ Information Security
✓ Information Classification and Handling
✓ Electronic Information Security
✓ Records Management
✓ PPL Cybersecurity Policy
✓ PPL FERC Standards of Conduct
✓ PPL Enterprise Information Security Policy
✓ Data Security Standard

- Designed to ensure the data generated by the Company and through its AMF:
  - Collected, managed, stored, transferred, and protected in a way that preserves customer privacy
  - Practices are consistent with cybersecurity requirements
  - Facilitates access to further operational requirements
  - Enables grid modernization and clean energy objectives

PPL Data Governance Policy

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Data Governance Policy (Governance Team/Roles & Responsibilities)

- Define the roles and responsibilities for different data creation and usage types, and clear lines of accountability.
- Develop best practices for effective data management and protection.
- Protects data against internal and external threats
- Ensure that data consumers complies with applicable laws, regulations, exchange, and standards
- Ensure that a data trail is effectively documented

AMF Data Privacy Review (Framework to communicate with customers and third parties)

- Data Access Principles
  - Utilizes widely recognized data privacy frameworks for AMF
  - Supported by NIST as long-established and best practices that are readily available and straightforward concepts to consistently utilize when building privacy controls into processes
- Data Privacy Review
  - Compares the NIST Guidelines to the Company's existing privacy policies, procedures and the AMF implementation plan to identify where best practice is in place or further alignment is needed

AMF Data Privacy Review

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- AMF Data Privacy
  - Evolving AMF technologies brings new types of information that can involve privacy
  - Need to review existing policies to confirm adequate coverage
  - Standard practices are required to safeguard information
  - Consumers need notification of privacy exposures
- Using NIST Interagency Report 7628 volume 2 on Privacy and the Smart Grid as a basis for a review
- Applies to AMF and to GMP

DRAFT - Data Privacy Review Categories

1 Management and Accountability
2 Notice and Purpose
3 Choice and Consent
4 Collection and Scope
5 Use and Retention
6 Individual Access
7 Disclosure and Limiting Use
8 Safety and Safeguards
9 Accuracy and Quality
10 Openness, Monitoring, and Challenging Compliance
11 Personal Information in the Smart Grid
12 Wireless Access to Smart Meters and Secondary Devices
13 Commisioning, Registration, and Enrollment for Smart Devices
14 Smart Grid Data Acess by Third Parties
15 Plug-in Electric Vehicles Privacy Concerns
16 Awareness and Training
17 Mitigating Privacy Concerns within the Smart Grid
18 Emerging Smart Grid Privacy Risks

Cyber Security: Technology and Process

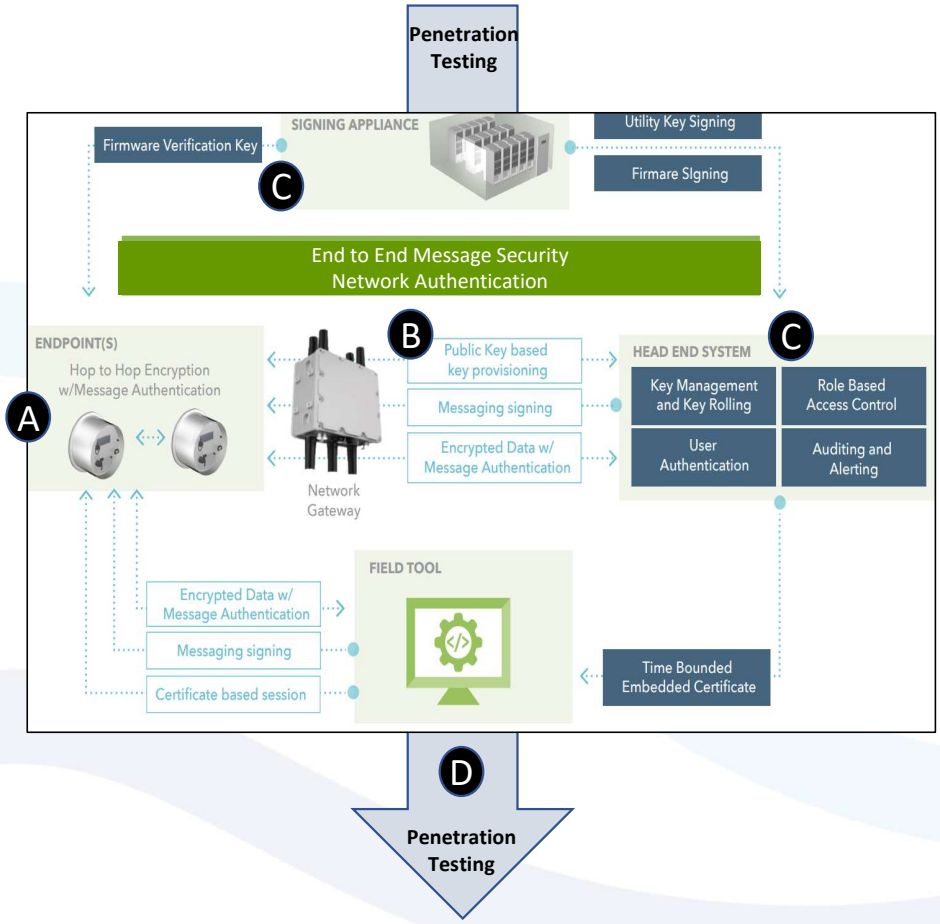
A. Data encryption capability for transit at the networking layers on the devices
   - Uses advanced encryption protocol standard to protect the transfer of data online

B. RF network provides a uniquely keyed application layer messaging encryption to ensure privacy between an endpoint and the associated head end system
   - Uses 3-layered approach provides best in class cryptography and privacy controls

C. Resistance and local security tamper resistance protects devices from being modified and allows for monitoring

D. Penetration testing will also be required by a third-party focusing on the network and software layers

E. Ongoing testing coupled with design characteristics, which includes A+B+C+D, ensures the entire system is secure



Green Button for Customers, Third Parties/NPPs

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- RIE can generate Green Button data from AMF meters
- Green Button Connect will be available through the Customer Portal designed to provide customers with secure access to energy usage in a consumer-friendly and computer-friendly format.
- Provides customers with the ability to take advantage of a growing array of services to help manage energy use and save on their bills.
- Enables and incentivizes entrepreneurs to build innovative applications, products and services which will help consumers manage energy use
- Benefits utilities that receive numerous requests for information
- Customers can authorize the sharing of their data with third-parties.

Performance Metrics and Reporting

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- Suite of metrics designed to provide a transparent assessment progress of AMF implementation in key areas
- Focus is on providing metrics for three key areas:
  - Implementation
  - Customer
  - Operations
- AMF Program Report to be provided at the end of the year with mid-year project status update meeting

DRAFT Performance Metrics

Benefit Category	Benefit Metric
Program Implementation	**Major Project Release progress** Progress of AMF Program Functionality Releases
	Meter Pre-Sweep Completions Counts of Completed Pre-Sweeps
	Network Deployment Counts of Completed Device Installs
	Meter Deployment Counts of Completed Exchanges
	Meter Base Repairs Counts of Meter Bases requiring repairs prior to meter exchange
	Sector Completion Sector Acceptance Status
	Program Spend Costs Breakdown Summary for key categories of the AMF Program
Customer	**Customer Interactions** Counts and reasons for customer contacts to the AMF Program
	Customer Portal Enrollments Counts of customers signing up for Customer Portal access
	Customer Surveys / Customer Satisfaction Breakdown of Customer Satisfaction survey results of AMF communication, access to information & FAQs, and issue resolution
	Customers Accessing Green Button Connect Data Counts of customers who have exported their Green Button Connect data
	Customers who Opt out of AMF meter Count of customers who have elected to Opt Out from receiving an AMF meter
Operations	**Billing Read Rate** Register meter reads expected vs. delivered
	Interval Read Rate Interval meter reads expected vs. delivered
	MDMS estimates sent to Billing Percentage of meters requiring estimates for billing
	Remote Switch Performance Percentage success rates of remote switches
	Last Gasp Alerting Percentage of Last Gasp alerts successfully delivered to the OMS (Outage Management System)
	VVO metric Number of feeders with AMF deployed that have implemented Volt Var Optimization

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AMF Cost-Benefit Recap & Sensitivities

Benefits & Costs: Comparison to National Grid – Opt-In

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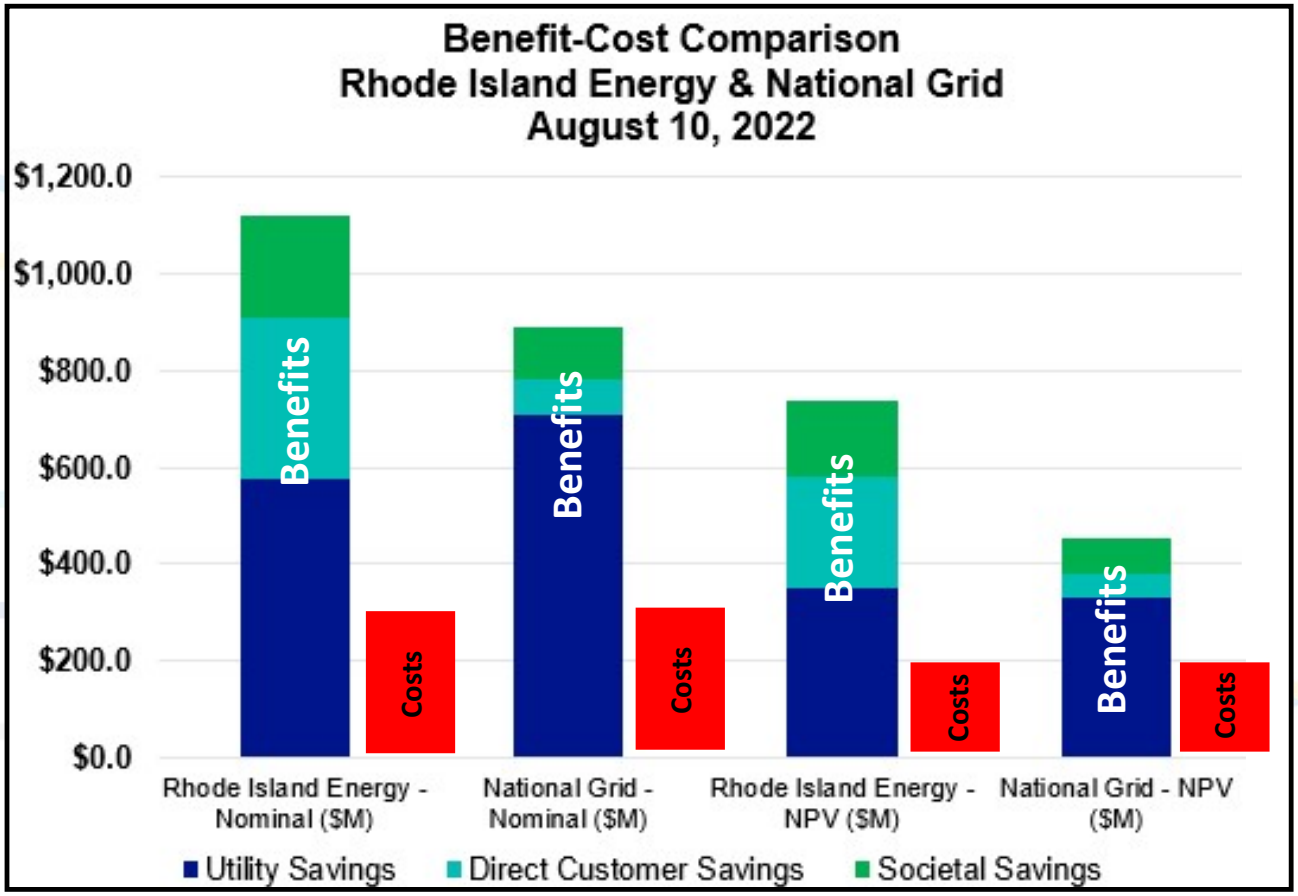
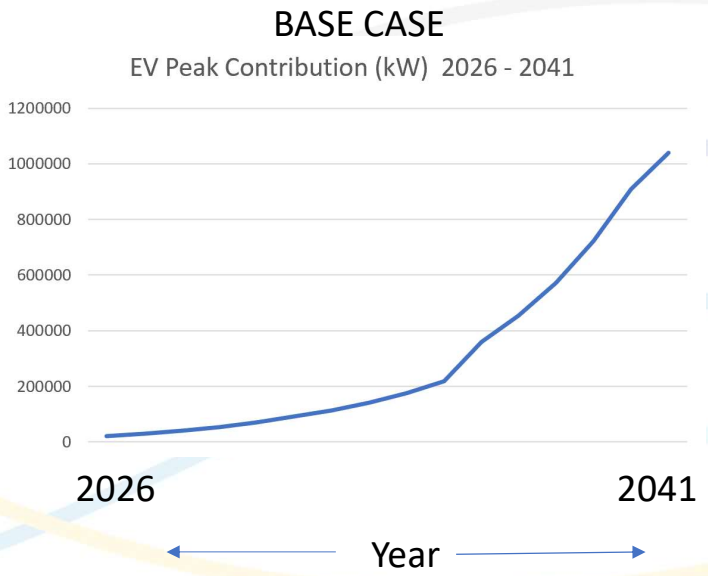


Nominal ($M)	RIE	NG
Utility Savings	$ 574.8	$ 708.89
Direct Customer Savings	$ 331.9	$ 70.77
Societal Savings	$ 210.4	$ 109.73
Total Savings	$ 1,117.1	$ 889.4
AMF Costs	$ 288.7	$ 289.4
Benefit/ Cost Ratio	3.9	3.1

NPV ($M)	RIE	NG
Utility Savings	$ 352.4	$ 333.50
Direct Customer Savings	$ 225.5	$ 48.46
Societal Savings	$ 156.7	$ 72.90
Total Savings	$ 734.6	$ 454.9
AMF Costs	$ 189.6	$ 192.6
Benefit/ Cost Ratio	3.9	2.4

Assumptions for EV Time Varying Rates

- EV Time Varying Rates assumptions included in the Base Case BCA
  - Opt-In Participation & achievement of peak savings where both phased-in
  - Analysis includes years 2026 – 2041 where number of EVs grow to 29.5k to 750k over the period
  - Opt-In participation increases from 5% - 20% by 2029 and remains at 20% through the period (conservative)
  - Peak contribution per EV increases from .69 – 1.38 KW / EV through the period
  - Peak savings increased from 42% - 60%
  - Total kW for EVs range from 20,193 kW to 1,039,481 kW through the period 2026 – 2041 as shown in chart
  - Avoided Capacity is $38.47 – 57.14
- Additional sensitivities for Opt-In participation of 10% - 90% and peak reduction for 2026 = 21 – 55% and for 2041 = 30 – 78% resulting in BCA of 3.7 – 4.4



Significantly positive B/C ratios for all ranges of sensitives that were applied: base case is conservative

Assumptions Whole House TOU/CPP Time Varying Rates

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- Whole house TOU/CPP included in the Base Case BCA
  - Opt-In Participation and achievement was phased-in
  - Residential peak held steady at 94 MW (conservative)
  - Analysis includes years 2026 – 2041
  - Opt-In participation increases from 5% - 20% by 2029 and remains at 20% through the period
  - Opt-In achievement increases from 33% , 66% and 100% in years 2026, 2027 and 2028 and then remaining throughout
  - Peak savings increases from 1.6 – 18.8 MW by 2029 and then remains throughout the period
  - Avoided Capacity is $38.47 – 57.14
- Additional sensitivities performed for Opt-In participation of 10% - 90% and peak reduction of 10 – 20% resulting in BCA Ratio results of 3.6 – 5.0

Significantly positive B/C ratios for all ranges of sensitives that were applied: base case is conservative

Sensitivities: Electric Vehicle TVR & Whole House TOU/CPP

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- Varied Participation Rates and Peak Reduction percentages for both Electric Vehicles and Whole House rate programs
- Combined whole house and EV B/C ratios are significant at lower participation and peak reduction percentages (3.5)
- Base case for AMF Business Plan is conservative and positive

As of August 10, 2022		
EV TVR & Whole House TOU/CPP Sensitivities		
	Electric Vehicles	Whole House
Participation Rate (%)	10%-90%	10%-90%
Peak Reduction (%)	2026: 21%-55% 2041: 30%-78%	10%-20%
B/C Ratio Results	3.7-4.4	3.6-4.5
Combined B/C Ratios	3.5-5.0	

Combined Benefit / Cost ratios for TVR are significantly positive for the full range of sensitivities

Sensitivities: Benefits & Costs

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Benefits

- Developed sensitivities for five of the largest and/or most uncertain benefits
- Varied each of the benefits by +/-20%
- B/C range from 3.7-4.0 for individual sensitivities
- Combined B/C ratio is 3.2 for -20% and 4.5 for +20%

Costs

- Varied total costs +/-10%
- Varied System Costs +/-25%
- B/C range from 3.5-4.3 for individual sensitivities
- Combined B/C ratio is 3.3 for +10%/+25% (unfavorable)
- Combined B/C ratio is 4.6 for +10%/-25%

Benefits Sensitivities		
Benefit	B/C Ratio Unfavorable: -20%	B/C Ratio Favorable: +20%
Faster Outage Notification	3.7	4.0
Reduced Personnel	3.8	3.9
Energy Insights Savings	3.7	4.0
VVO/CVR Benefits (Energy Only)	3.8	4.0
Non-Embedded CO2 Benefits	3.7	4.0
Total Sensitivities	3.2	4.5

Cost Sensitivities		
	B/C Ratio Unfavorable: +10% & +25%	B/C Ratio Favorable: -10% & -25%
Total Costs: +/-10%	3.5	4.3
Systems Costs: +/-25%	3.5	4.3
Combination Total and Systems	3.3	4.6

Benefit / Cost ratios are significantly positive for the full range of BCA sensitivities that were applied

Benefits Realized by Customers as Savings

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Customers are credited with 80% of projected AMF-driven operational costs:

- Reduced AMR Meter Readers
- Reduced AMR Meter Reader Vehicle Costs
- Reduced Meter Investigations
- Remote Metering Capabilities
- FCS Costs
- Interval Meter Reading Costs

Customer savings in Nominal and NPV ($M)

	Nominal	NPV
Reduced AMR Meter Readers	$11.83	$5.22
Reduced AMR Meter Reader Vehicle Costs	$2.78	$1.24
Reduced Meter Investigations	$23.32	$10.29
Remote Metering Capabilities	$82.78	$36.51
FCS Costs	$0.67	$0.29
Interval Meter Reading Costs	$0.64	$0.30

Benefits that will result in customer savings total $122.0 million Nominal and $53.9 million NPV

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AMF Cost Recovery and Revenue Requirements

Revenue Requirements

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- Total revenue requirement for 20 years is approximately $320m*
  - Comprised of incremental AMF related capital in-service and O&M costs
  - Reduced for costs already recovered in base rates
  - Reduced to credit customers with 80% of projected AMF-driven operational cost savings until reflected in the next base rate case (similar to NG proposal)
- Modeled over 20 years, peak year of revenue requirement is expected to be year 4 of cost recovery, declines after that
- Customer allocation consistent with methodology approved in last distribution base rate case (Docket No. 4770)

* Based on preliminary numbers

Pricing and Customer Considerations

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Pricing Considerations:

- Amended Settlement Agreement (Docket No. 4770) does permit reopening for AMF cost recovery
- Distribution base rate case was expected to be filed in Fall 2021
- Proposal to establish a separate AMF factor (per-kWh volumetric)
- Price based on revenue requirement using historical costs (actual dollars spent)
- Change price every ~6 months
- Roll then current rate base into next distribution base rate case

Customer Considerations:

- Pays only for what the company has already spent or placed in-service
- Given a longer time before a distribution base rate case, customers could receive the operational cost savings timely through pricing mechanism if savings realized quicker or more than forecast
- As spend decreases, customer will see a decrease in the factor
- Smaller (though more frequent) price changes for customers

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Next Steps

Amended Settlement Agreement Compliance

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	Amended Settlement Agreements
1	A refined and updated AMF business plan, benefit-cost analysis (BCA), and a detailed customer engagement plan
2	An updated AMF deployment schedule with a BCA (using Societal Cost Test) for different meter deployment periods
3	Revenue Requirement for AMF deployment
4	Deployment proposals, a proposal for cost recovery of AMF, and any activities associated with implementation of AMF
5	A proposal to allocate AMF costs among rate classifications
6	Assumptions upon which a proposal for Time-Varying rates will be based
7	A Data Governance Plan regarding customer, NPP, and third-party access to system and customer data in place with access to quality customer and billing data, along with appropriate privacy and security protections
8	Updated costs for AMF deployment based on information gained from procurement efforts
9	Transparent, updated benefit cost analysis that fully incorporates the Docket 4600 framework
10	Investigation of alternative business models and ownership models
11	Analysis of data latency
12	Deployment details
13	Role of non-regulated power producers, including articles to share customer information and customer engagement
14	Ownership model for assets and telecom
15	Detailed AMF functionalities, how RI will achieve these functionalities, and a timeline for when those functionalities are available
16	Identification of the most cost-effective way to achieve the functionalities, and how the functionalities align to policy objectives
17	Explanation of whether the realization of those functionalities align to policy objectives will require additional future work and costs over 20 years
18	Identification of what functionalities the AMF will achieve that are part of the grid modernization plan and which are in addition to the Grid Modernization Plan
19	Identification of which functionalities are dependent on full-scale roll out instead of a targeted roll out
20	Business case based on both a RI-only scenario and RI/New York scenario
21	A business case based on the length (duration) of meter deployment
22	Identification of the critically linked parts of grid modernization and AMF
23	Identification of whether the AMF solution would allow for proper net metering according to the tariff

AMF Business Case addressed the Amended Settlement Agreements

Incorporate Feedback into the AMF Business Case and File

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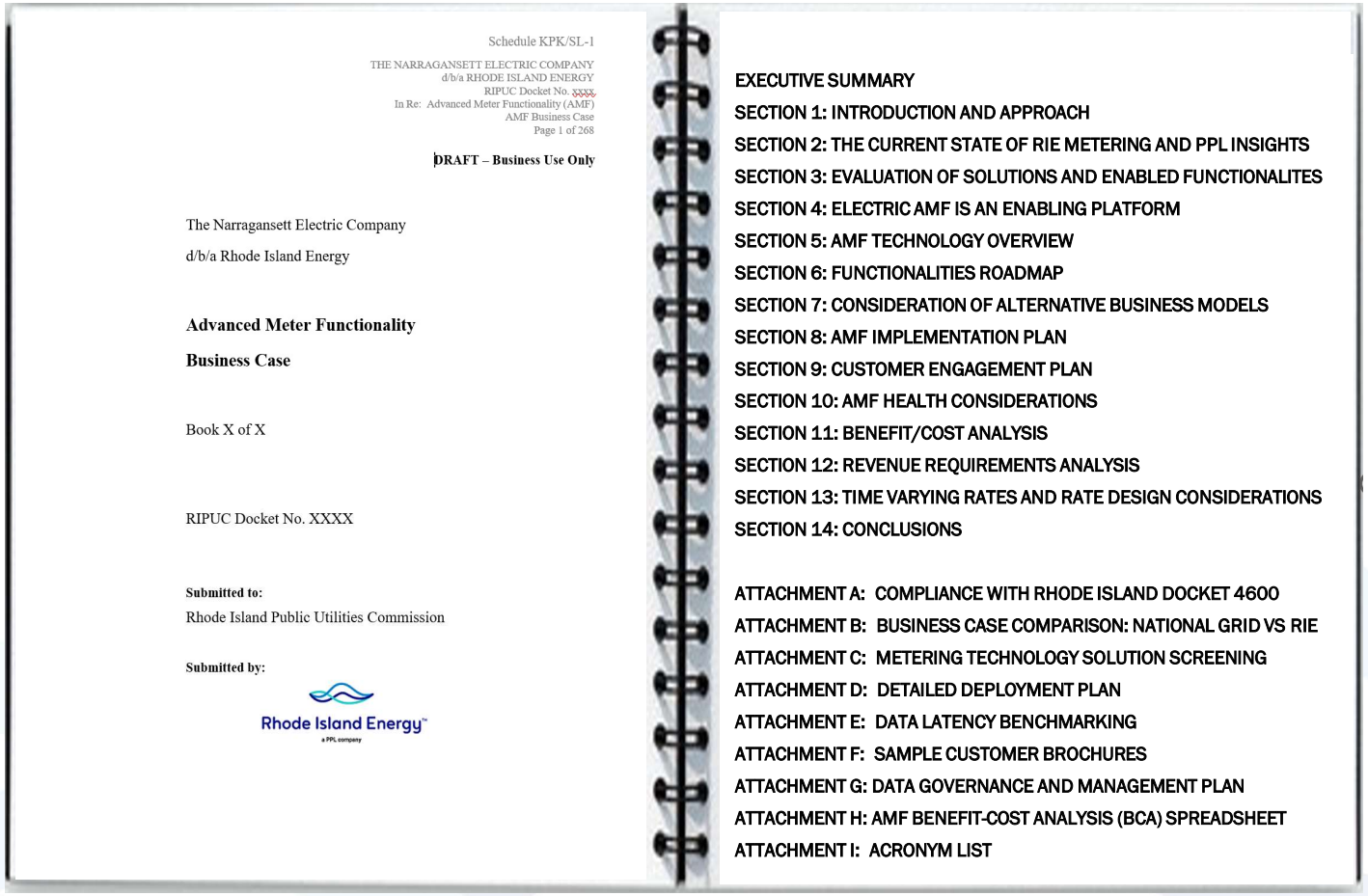

Schedule KPK/SL-1

THE NARRAGANSETT ELECTRIC COMPANY
d/b/a RHODE ISLAND ENERGY
RIPUC Docket No. XXXX
In Re: Advanced Meter Functionality (AMF)
AMF Business Case
Page 1 of 268

DRAFT – Business Use Only

The Narragansett Electric Company

d/b/a Rhode Island Energy

Advanced Meter Functionality

Business Case

Book X of X

RIPUC Docket No. XXXX

Submitted to:
Rhode Island Public Utilities Commission

Submitted by:

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a PPL company

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Grid Modernization Plan
Stakeholder Outreach: Scenario Analysis, Solution Development and ISR Coordination

Power Sector Transformation – August 16, 2022

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GMP Follow-up, Forecast and Approach in Review

PST Advisory Group Follow-Ups for GMP

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PST questions from 7/14/2022 have been incorporated in this presentation:

- Will the messaging incorporate the need for infrastructure build out?
- How will offshore wind that is connected to the transmission system effect distribution?
- What is your strategy regarding storage (battery, vehicle to grid, etc.)?

Forecast / Impact to Peak Demand: A Review

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Key DER Metrics for Milestone Study Years

	GMP DER Forecast Analysis -- Impact to Peak Demand					
	2030		2040		2050	
	Summer	Winter	Summer	Winter	Summer	Winter
Heat Pumps, MW	0	200	5	1310	5	2825
# Heat Pumps	54,000	54,000	325,000	325,000	400,000	400,000
Solar PV, MW	0	0	0	0	0	0
Solar PV, nameplate MW	1500	1500	3400	3400	5000	5000
EV Charging, MW	70	80	805	910	1010	238
# Electric Vehicles	87,300	87,300	675,000	675,000	840,000	840,000
RIE Peak Demand, MW	1940	1415	2590	3280	2785	3855

Off-shore wind is considered in the Transmission model; it is not in the Distribution models.

Approach to Distribution System Analysis

- State-wide analysis to determine the most efficient plan to meet the state's energy policy, growing resiliency and reliability needs, and customer's expectations.
- Scope
  - State-wide distribution analysis
    - ~400 feeders
    - Sub-transmission modeling and testing
    - Traditional area study recommendations included in models
  - System-wide transmission analysis
  - Analysis years – 2030, 2040, 2050 to align with Act on Climate target years
    - Testing may occur in intermediate years for special cases – i.e. when winter peak exceeds summer peak.
  - Cases
    - No Grid Modernization – build for extremes
    - Grid Modernization – manage away extremes
    - Sensitivties
      - Low, Base, High DER forecasts
      - With and without transmission consideration
  - 8760-Hour per year analysis
- Analysis
  - Issue Identification
    - Determine load and voltage issues across hours of the year
    - Determine areas with degrading reliability
    - Determine resiliency needs
  - Case Evaluation
    - No GMP – Base DER Forecast - How would traditional utilities alternatives solve the issues?
    - GMP – Base DER Forecast - How would GMP-type alternatives solve the issues?
      - Sensing, data, communications, dispatch
      - Sensitivities for low and high DER forecasts
      - Sensitivities for with and without transmission
      - Leverage PPL proven technology
- Estimation
  - Leverage PPL subject-matter-expertise
- Benefit Cost Analysis
  - Aligned with Docket 4600
- PST Stakeholder Consultation Throughout

Guide to Analysis Slides

- Each test year will be shown with loading and voltages analysis
  - Cool colors are shaded and have no issues
  - Warm colors are issues

Loading Color Legend

Color Coding - Loading level color(%)

	Greater than (%)	Lower than or equal to (%)	Line width	Color
1	0.0	80.0	1	
2	80.0	90.0	2	
3	90.0	95.0	3	
4	95.0	100.0	4	
5	100.0	105.0	5	
6	105.0	150.0	5	
7	150.0	999999.0	5	

Caution

Violation

Voltage Color Legend

Color Coding - Voltage level color(%)

	Greater than (%)	Lower than or equal to (%)	Line width	Color
1	0.0	85.0	5	
2	85.0	90.0	4	
3	90.0	95.0	4	
4	95.0	97.5	2	
5	97.5	102.5	1	
6	102.5	105.0	1	
7	105.0	107.5	4	
8	107.5	110.0	5	
9	110.0	99999999.0	5	

Violation

Violation

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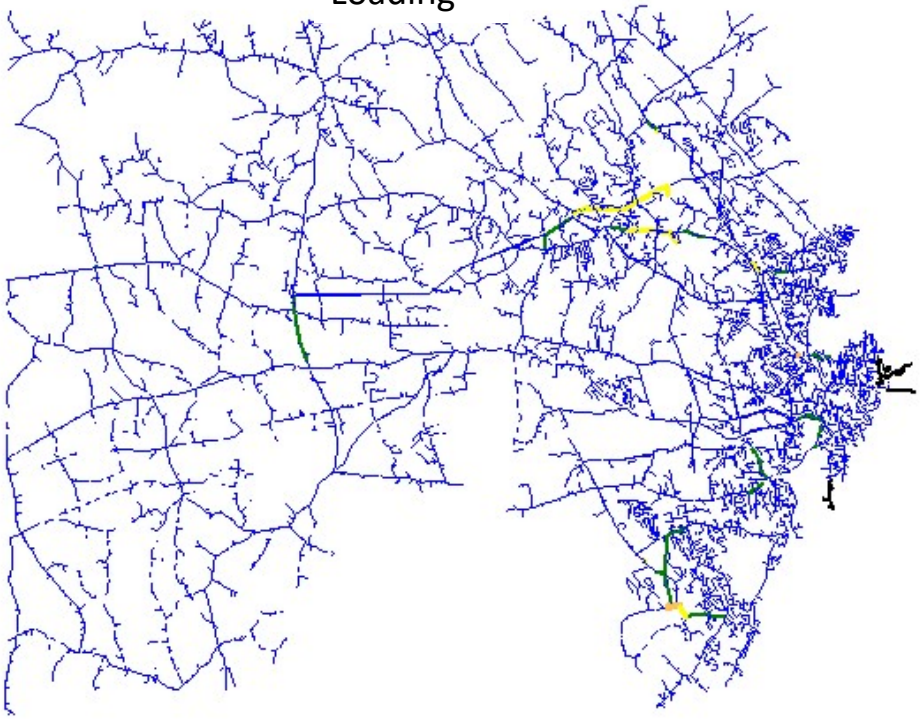
GMP Study Forecast – Northwest Findings (Preliminary)

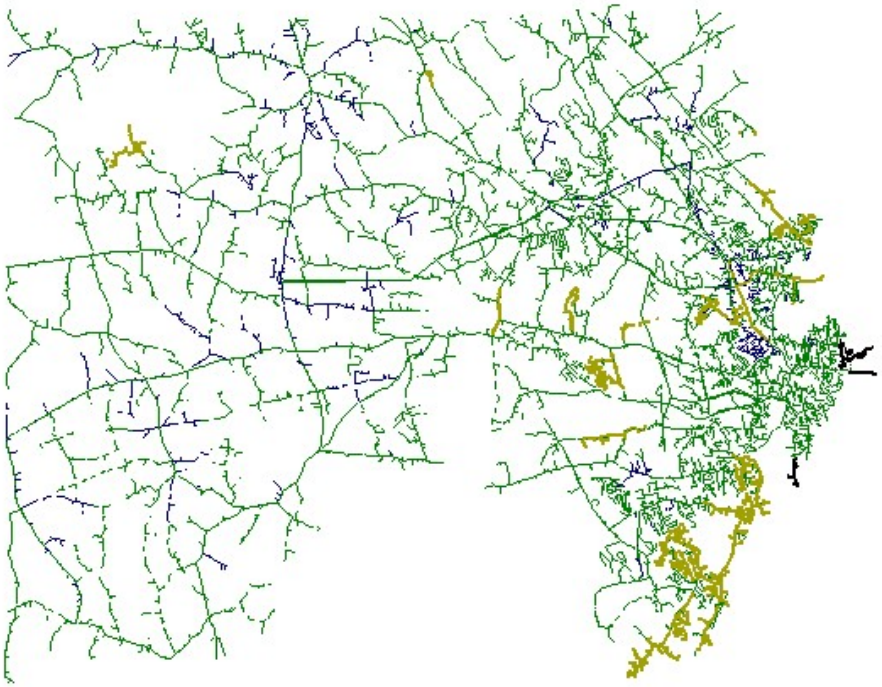
Starting Model – Example Area – NW Rhode Island

- Base Case is the foundational case that includes all area study recommendations - no existing issues
  - No DER added yet
  - 9 substations, 33 distributions circuits, 4 subtransmission circuits

Loading



Voltage



Peak Load Flow Case - 7/22/30 6PM

- 2030 case includes DER allocation of EV, EHP, and DG (solar and on-shore wind)
  - 8760 hour analysis conducted – targeted critical date/time shown

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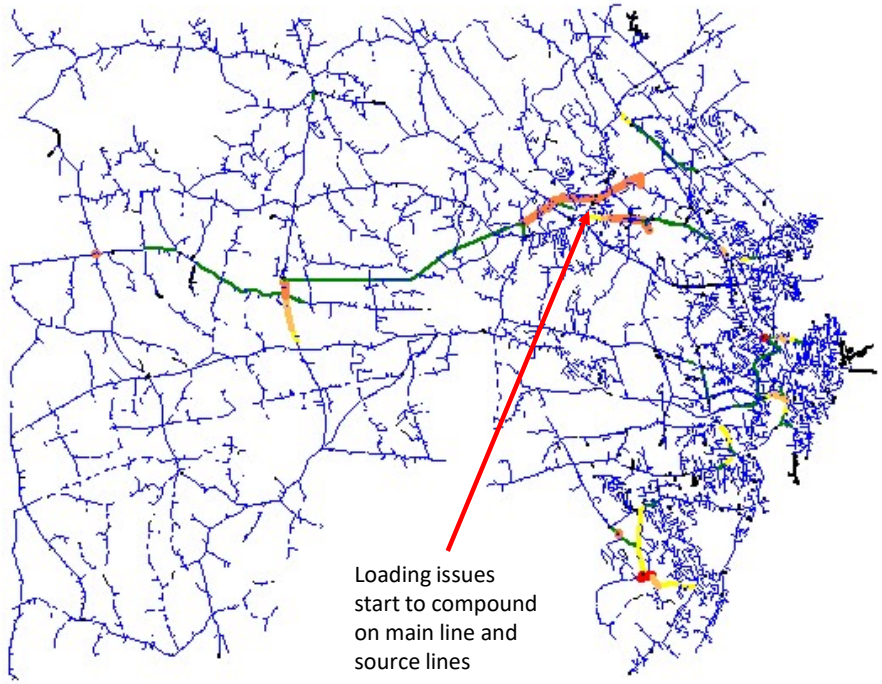

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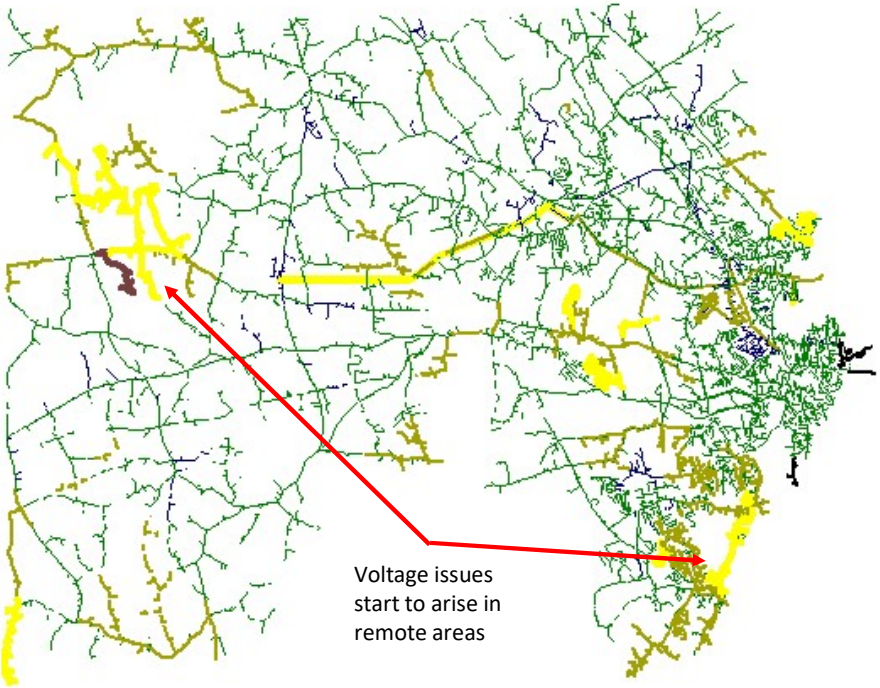

High Generation Load Flow Case - 4/16/30 12PM

- 2030 case includes DER allocation of EV, EHP, and DG (solar and on-shore wind)
  - 8760 hour analysis conducted – targeted critical date/time shown

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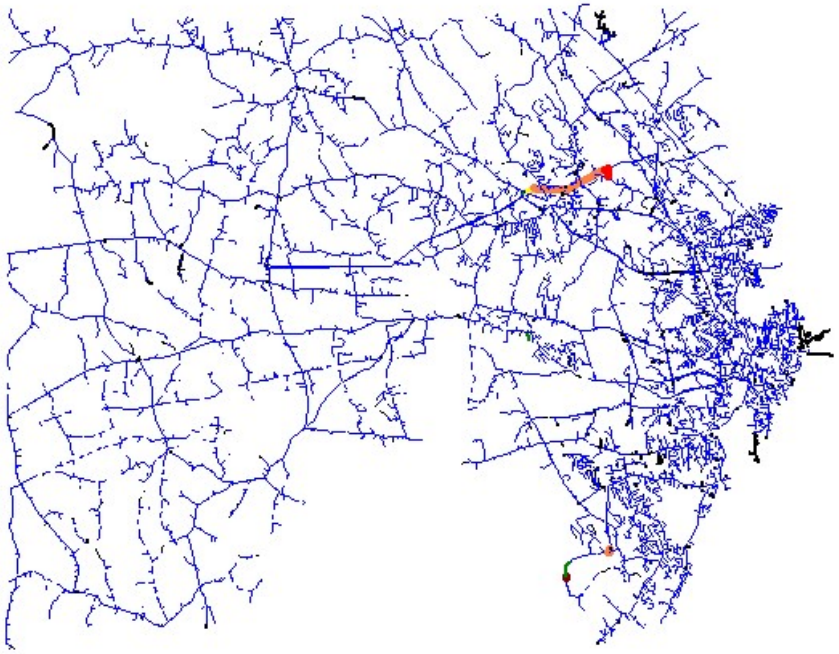

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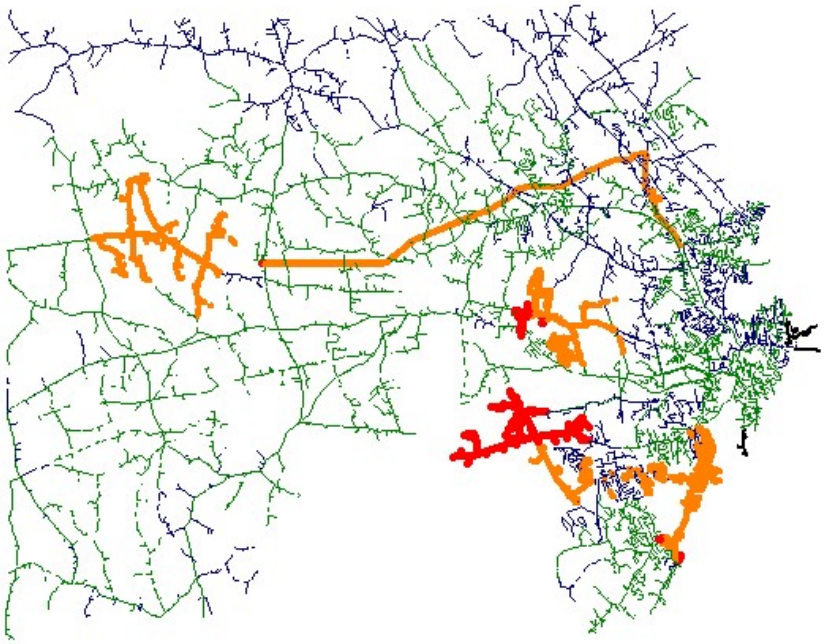

2/29/40 3AM Peak Load Flow Voltage

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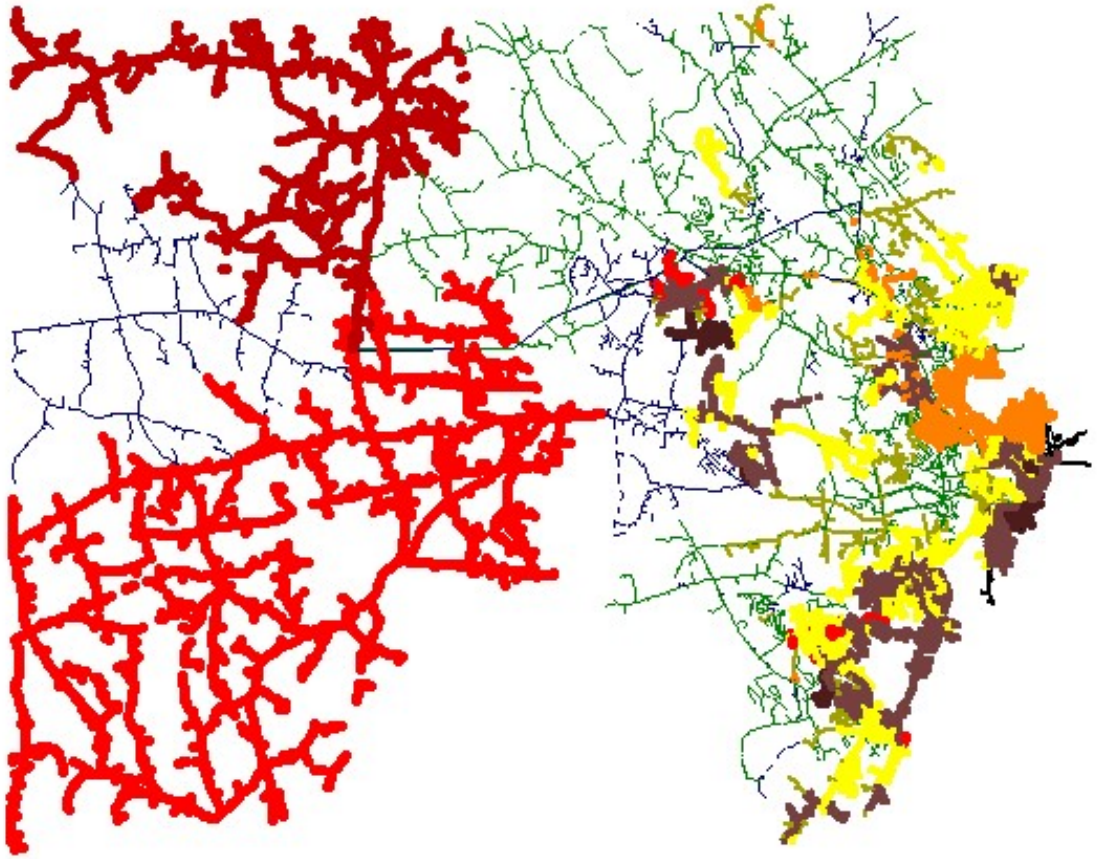

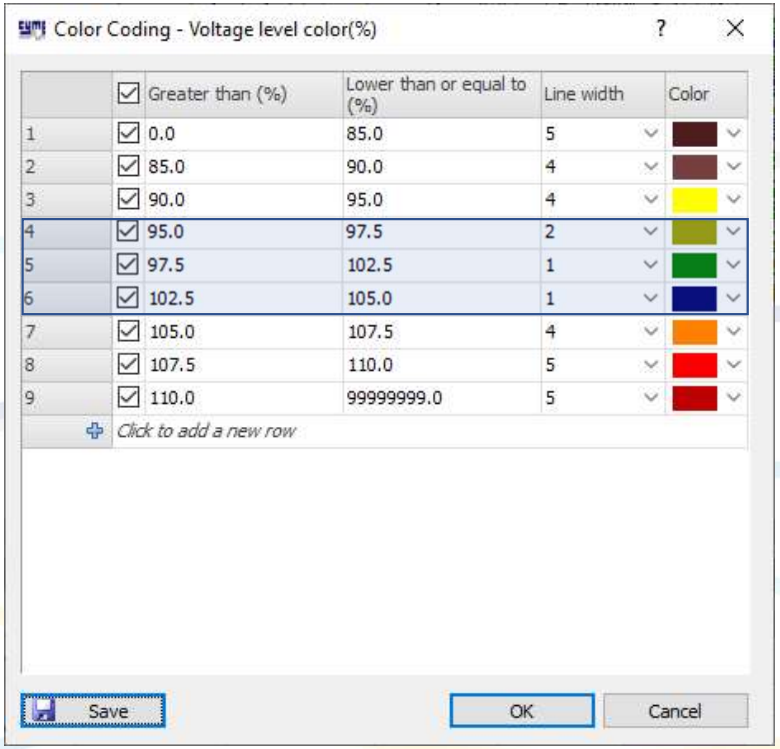

2/29/40 3AM Peak Load Flow Loading

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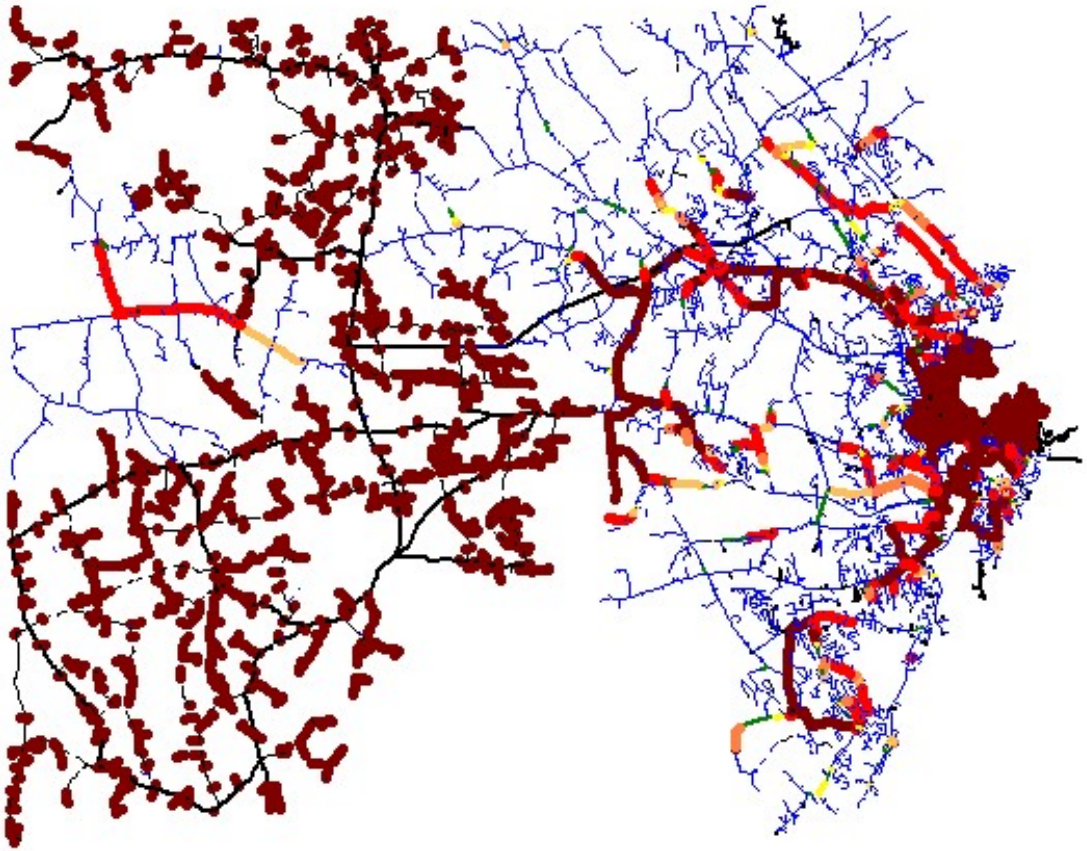

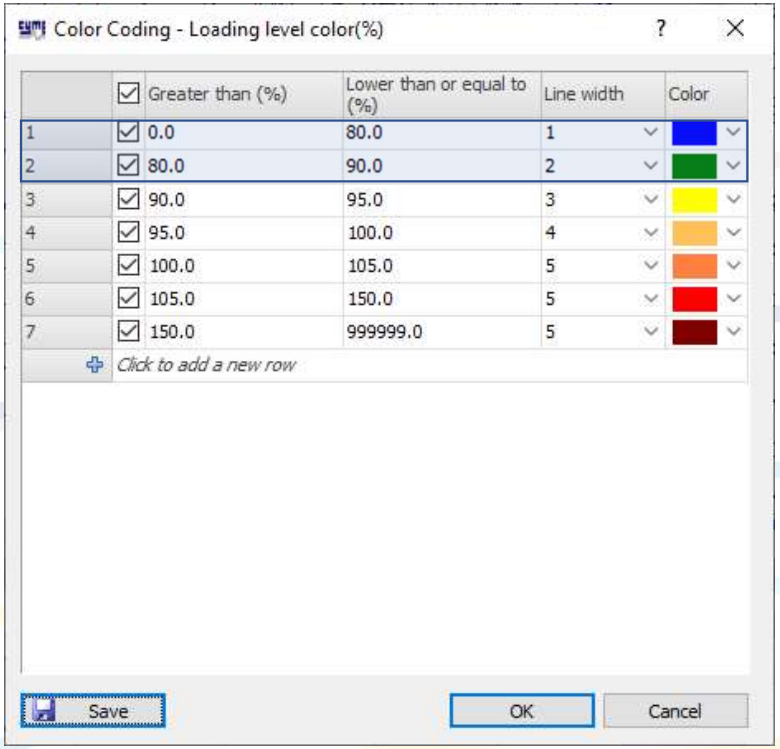

2/21/40 3AM Peak Load Flow Voltage

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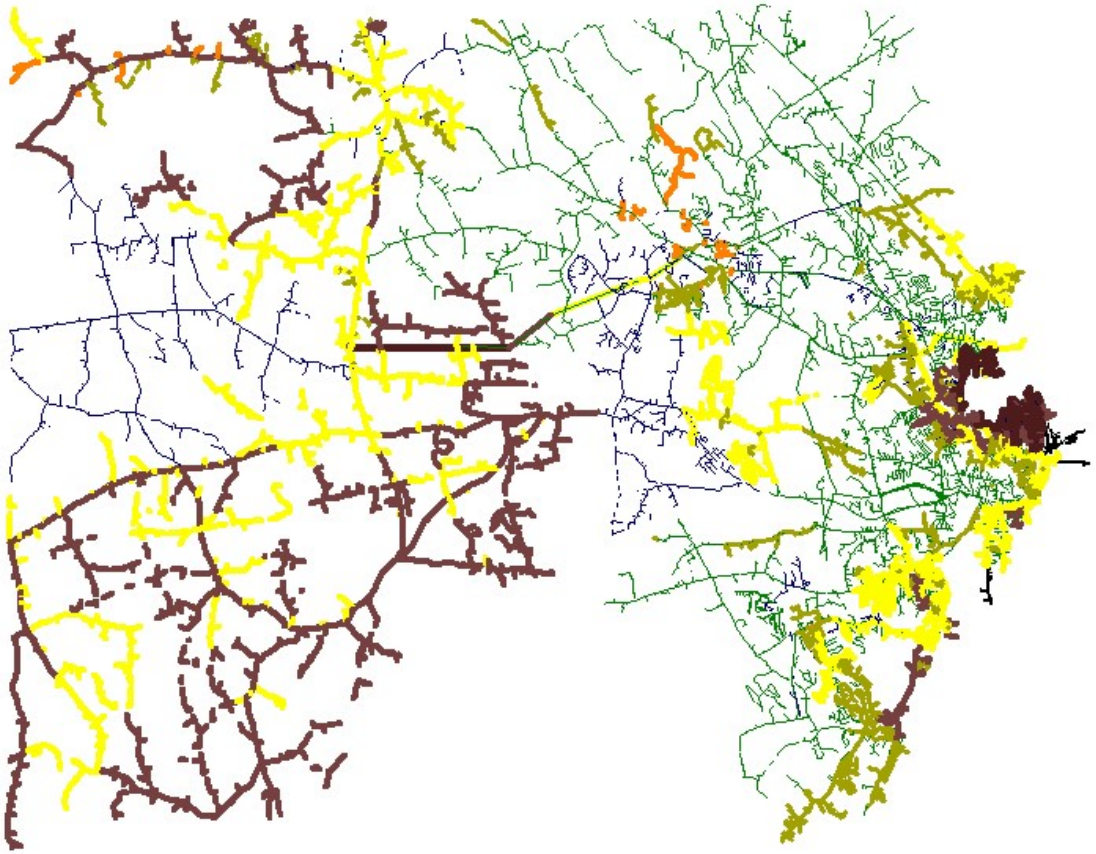

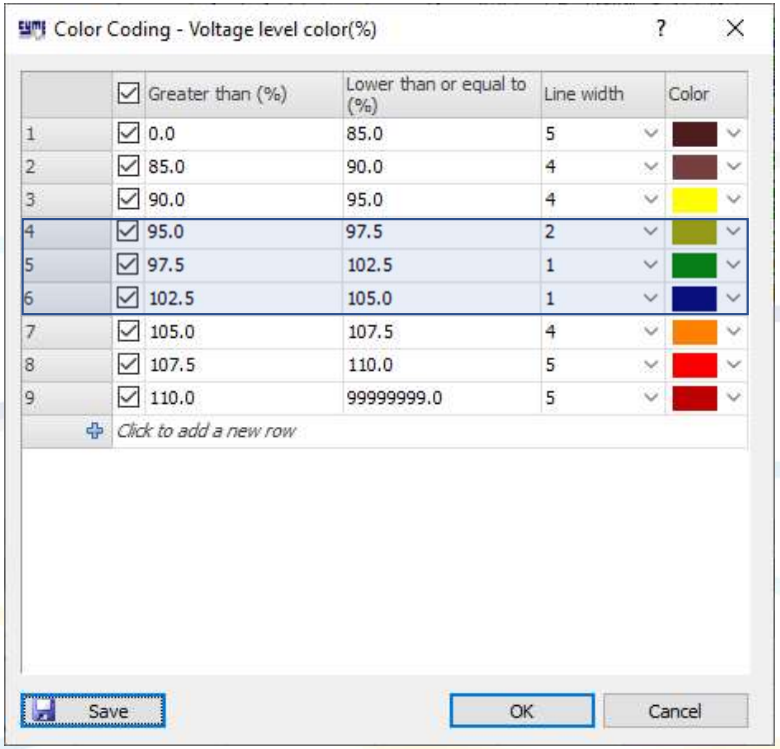

2/21/40 3AM Peak Load Flow Loading

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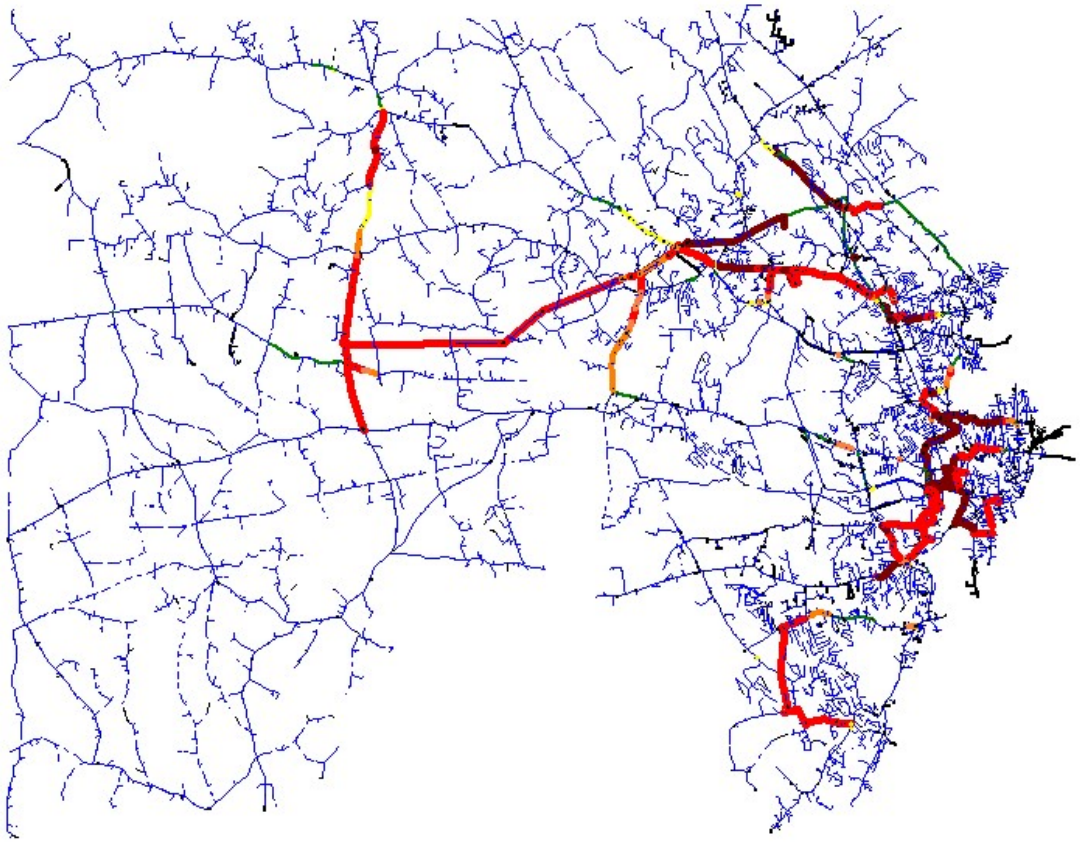

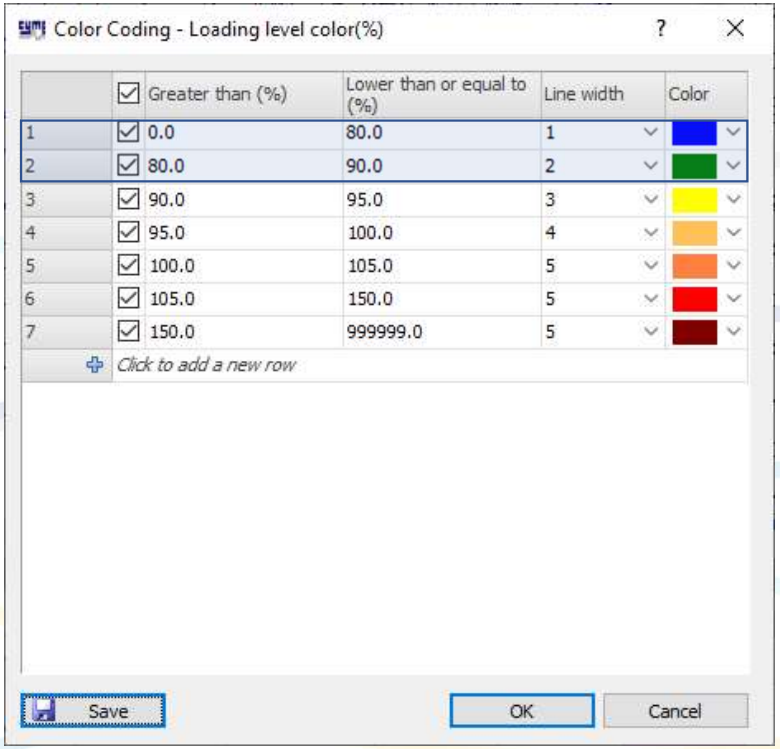

4/16/40 12PM Reverse Peak Load Flow Voltage

Rhode Island Energy™
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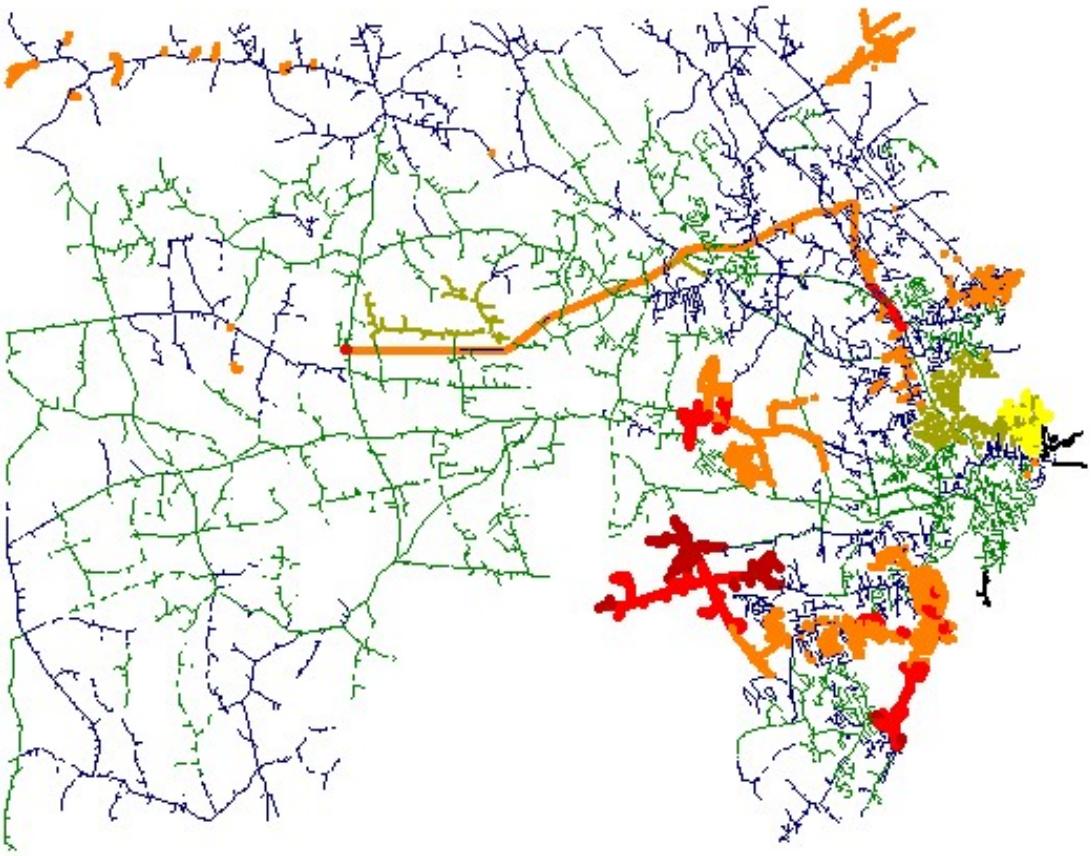
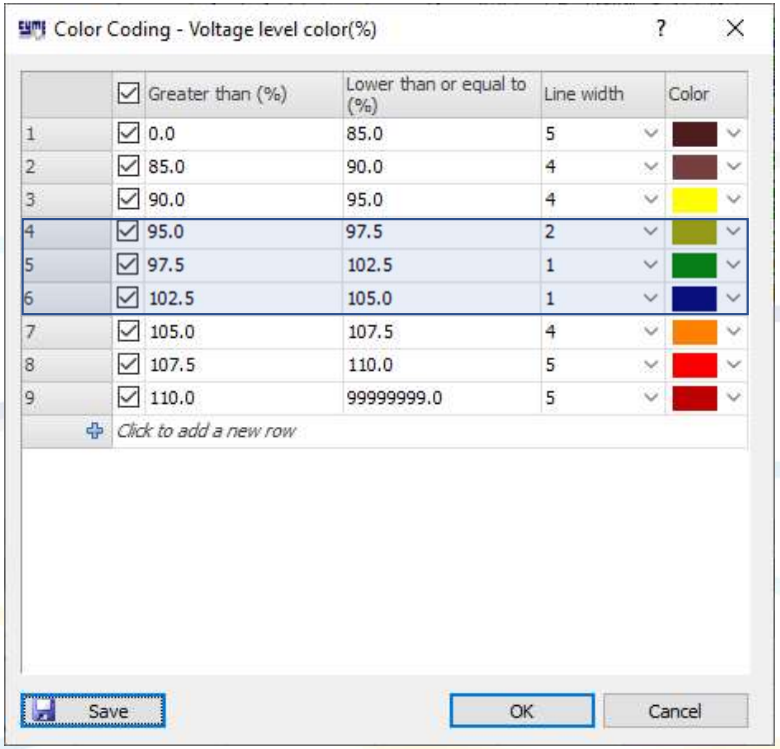
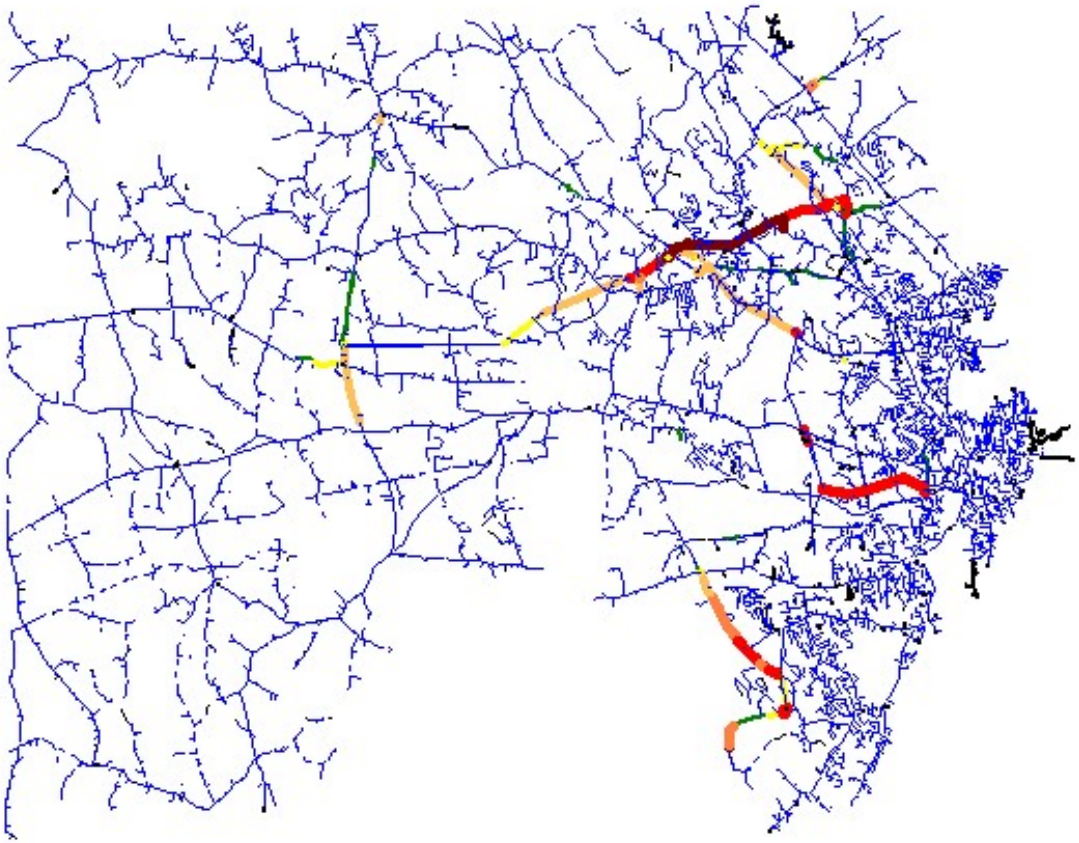
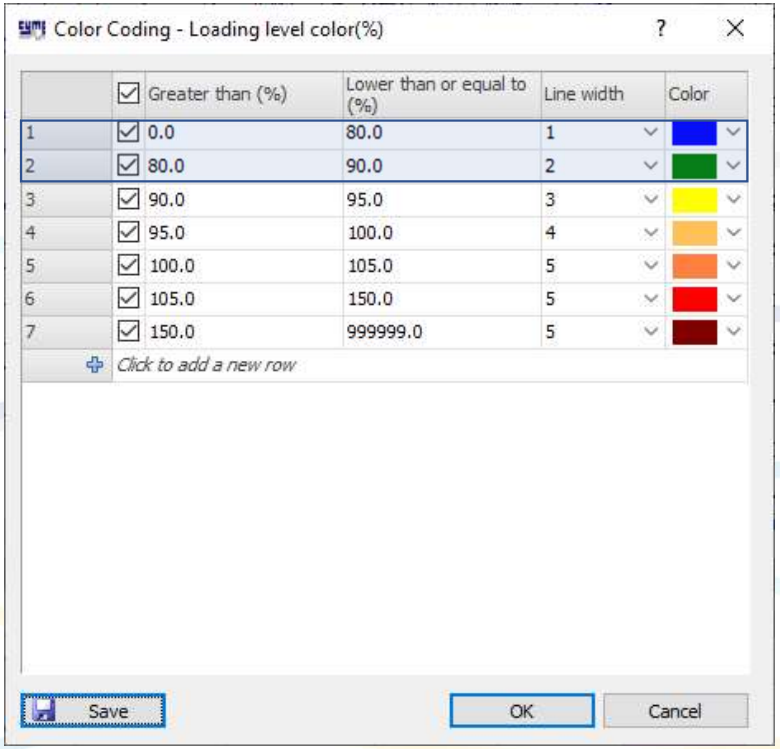




4/16/40 12PM Reverse Peak Load Flow Loading

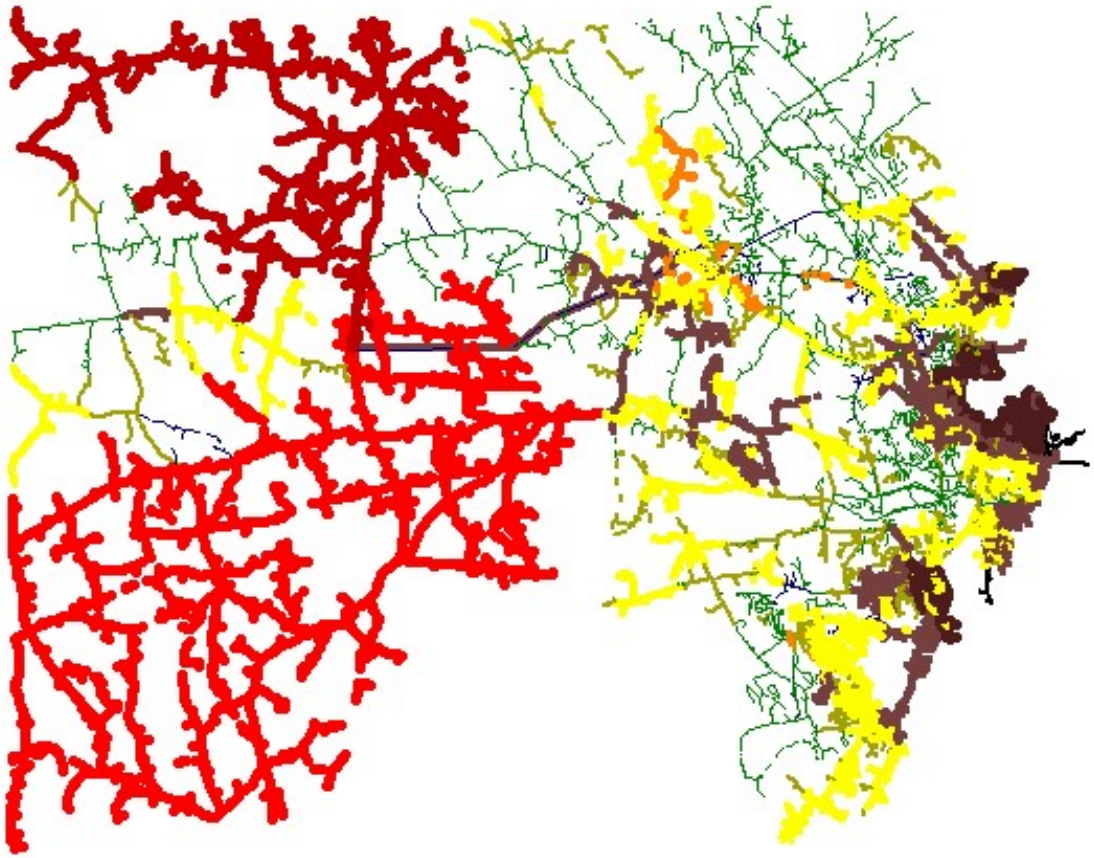
Rhode Island Energy™
a PPL company

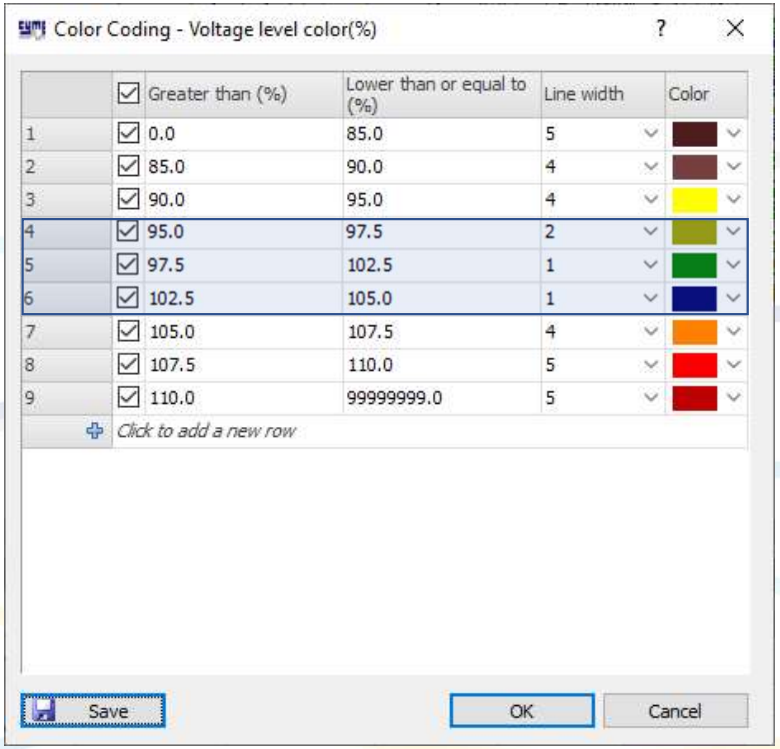




2/24/50 6AM Peak Load Flow Voltage

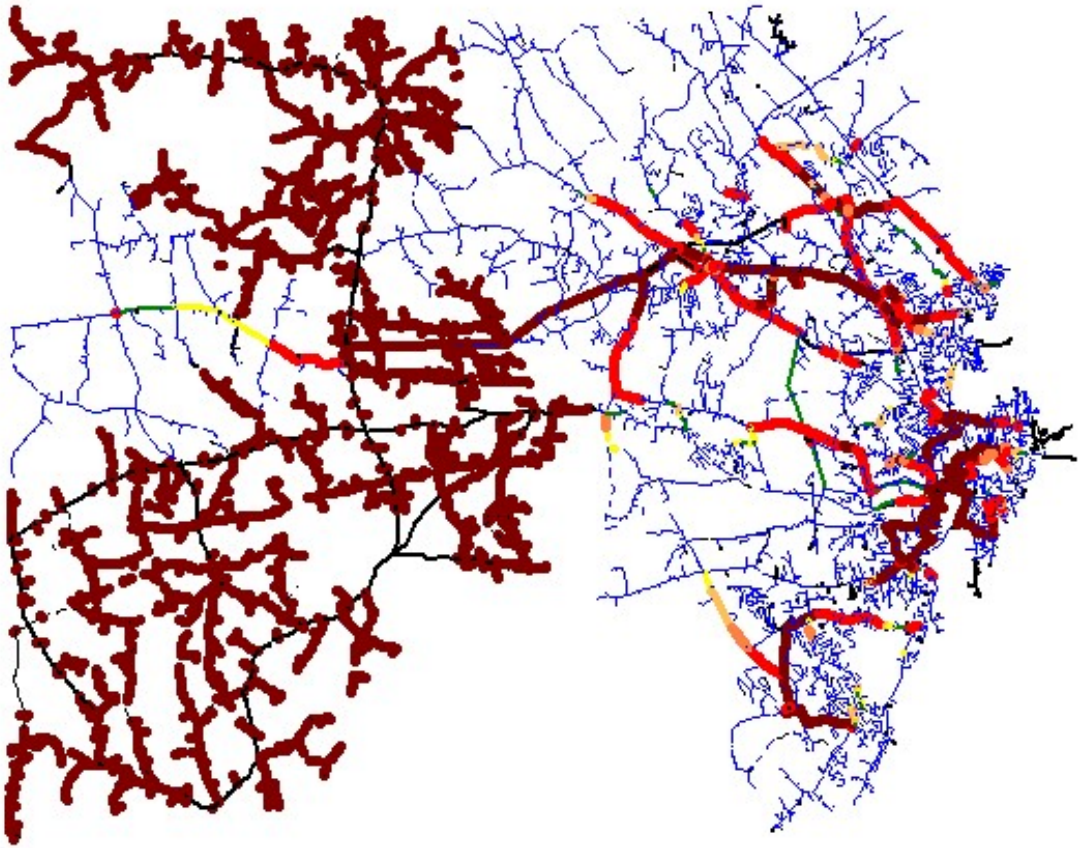
Rhode Island Energy™
a PPL company

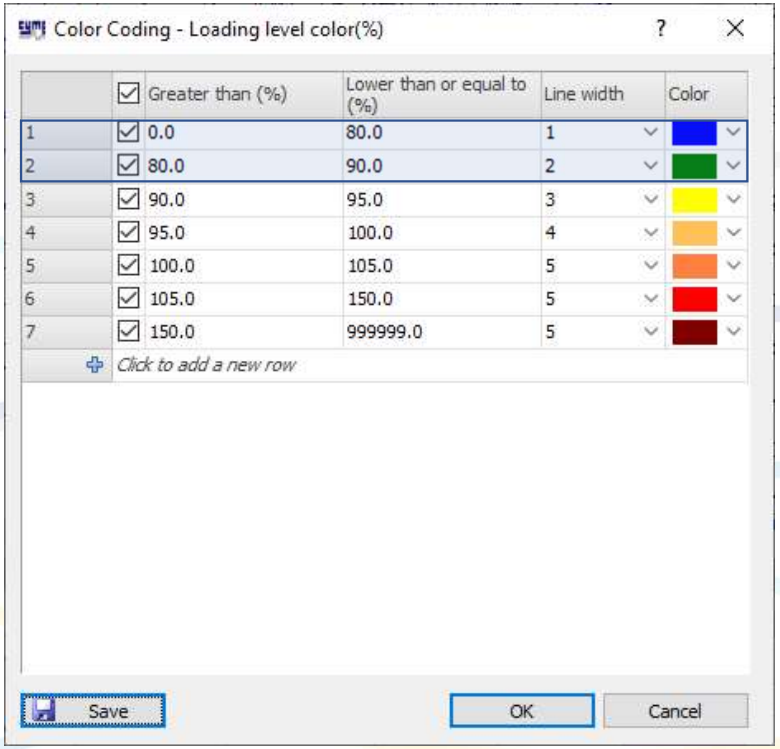




2/24/50 6AM Peak Load Flow Loading

Rhode Island Energy™
a PPL company





1/29/50 6AM Peak Load Flow Voltage

Rhode Island Energy™
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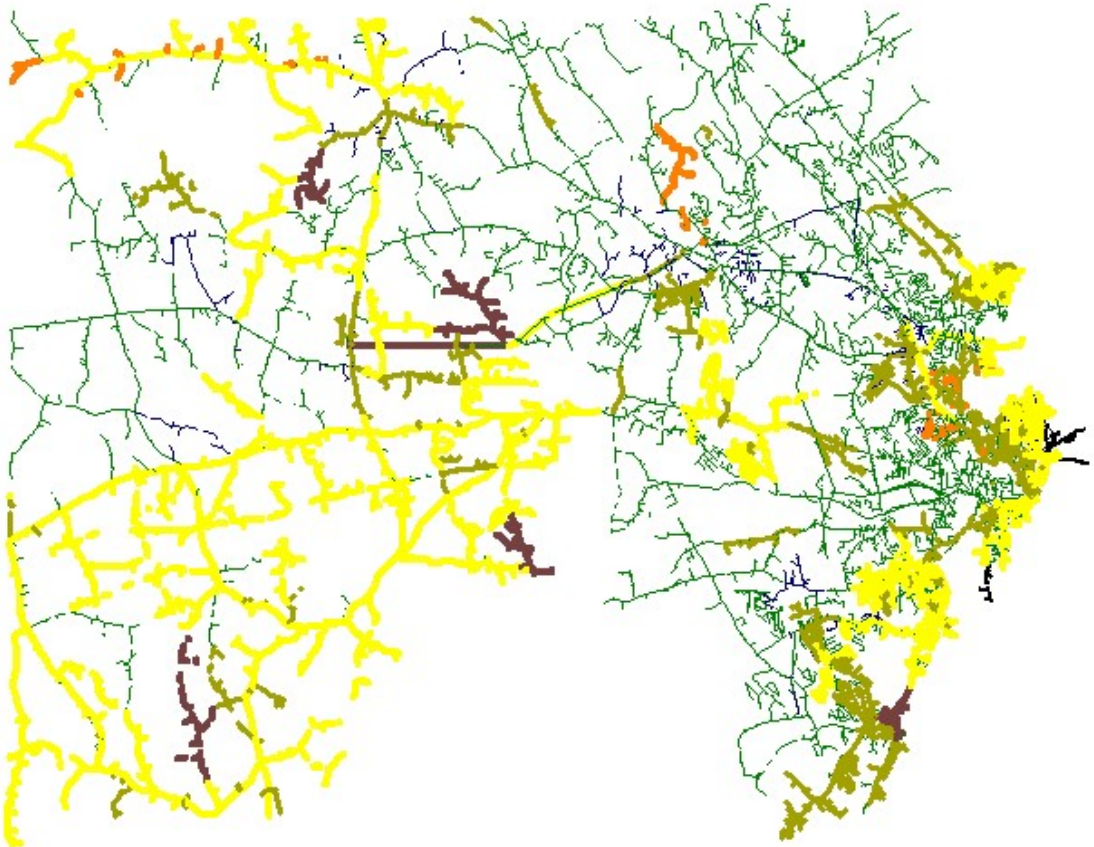
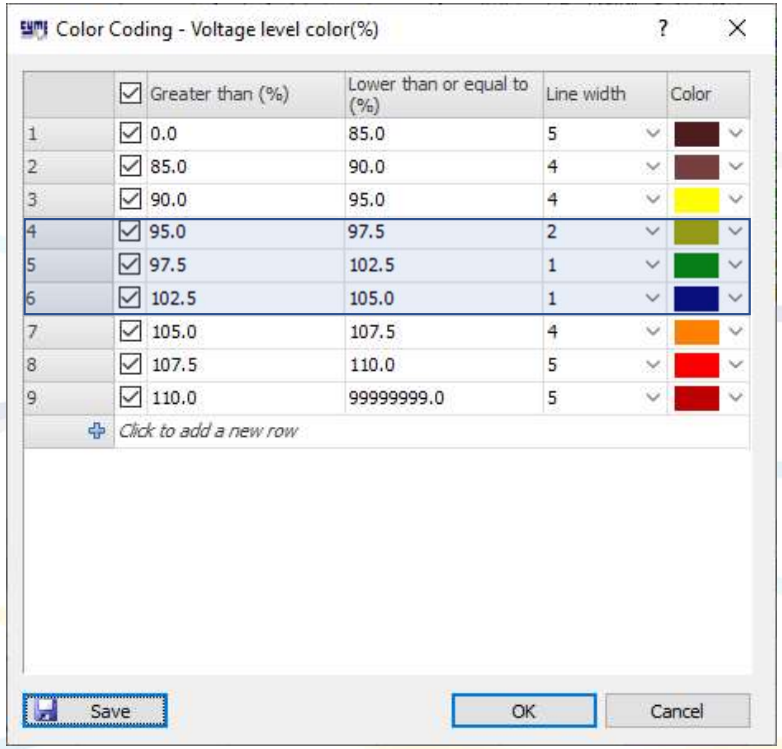
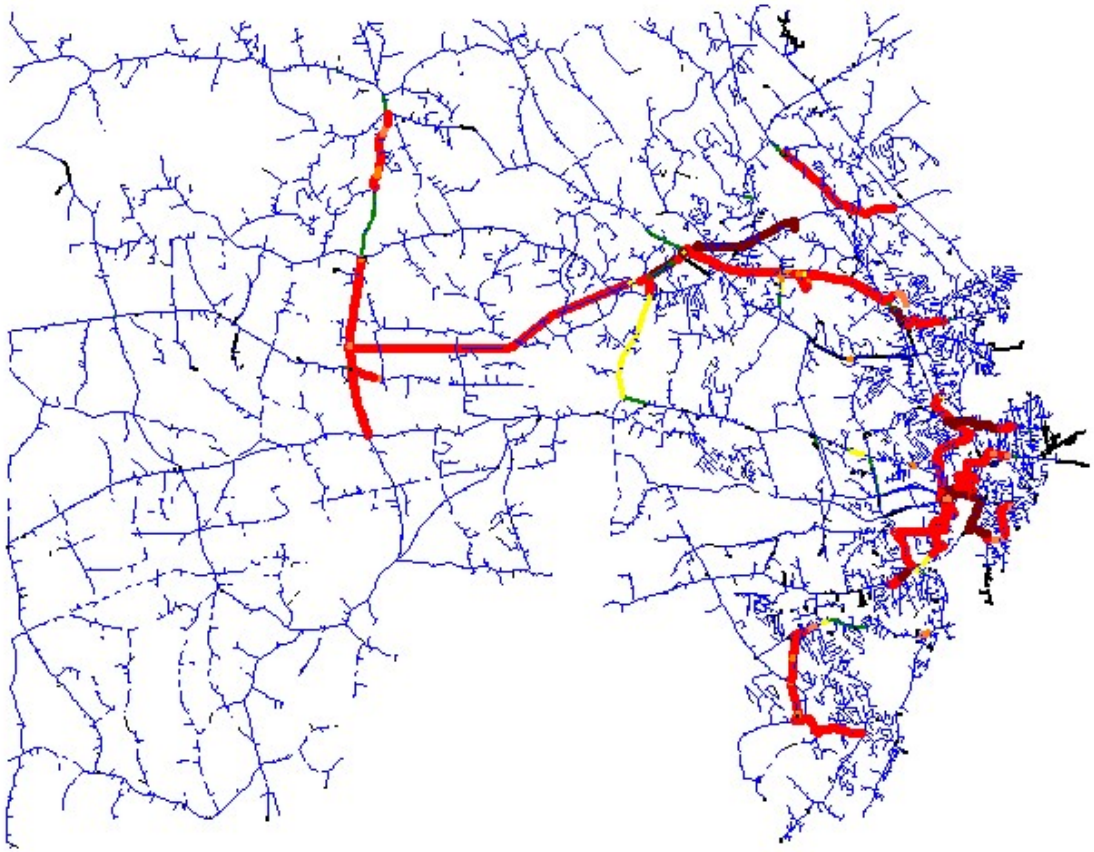
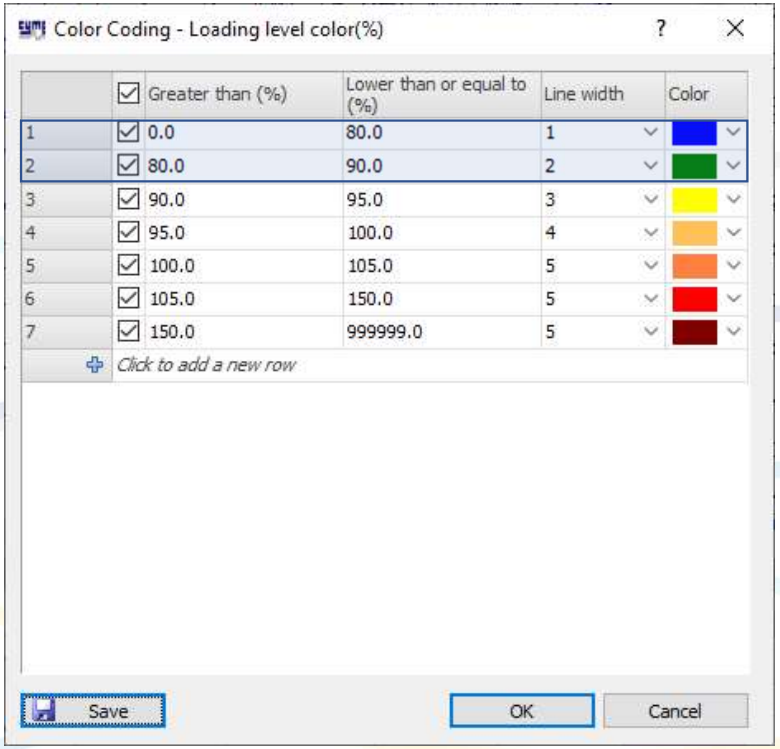




2/24/50 6AM Peak Load Flow Loading

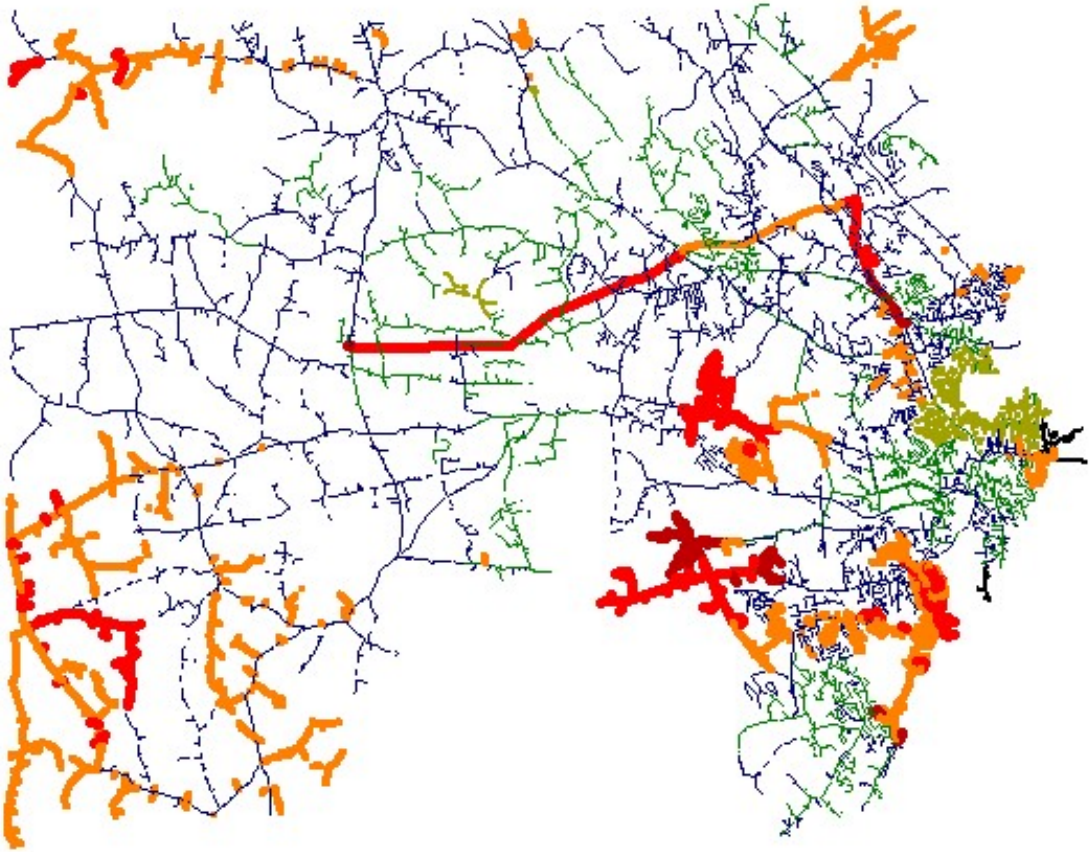
Rhode Island Energy™
a PPL company

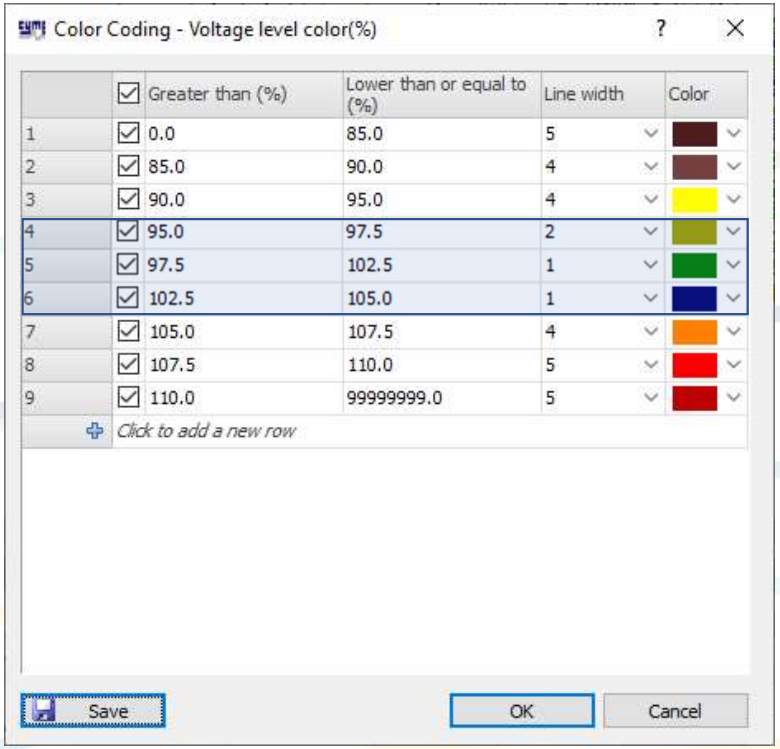




4/16/50 12PM Reverse Peak Load Flow Voltage

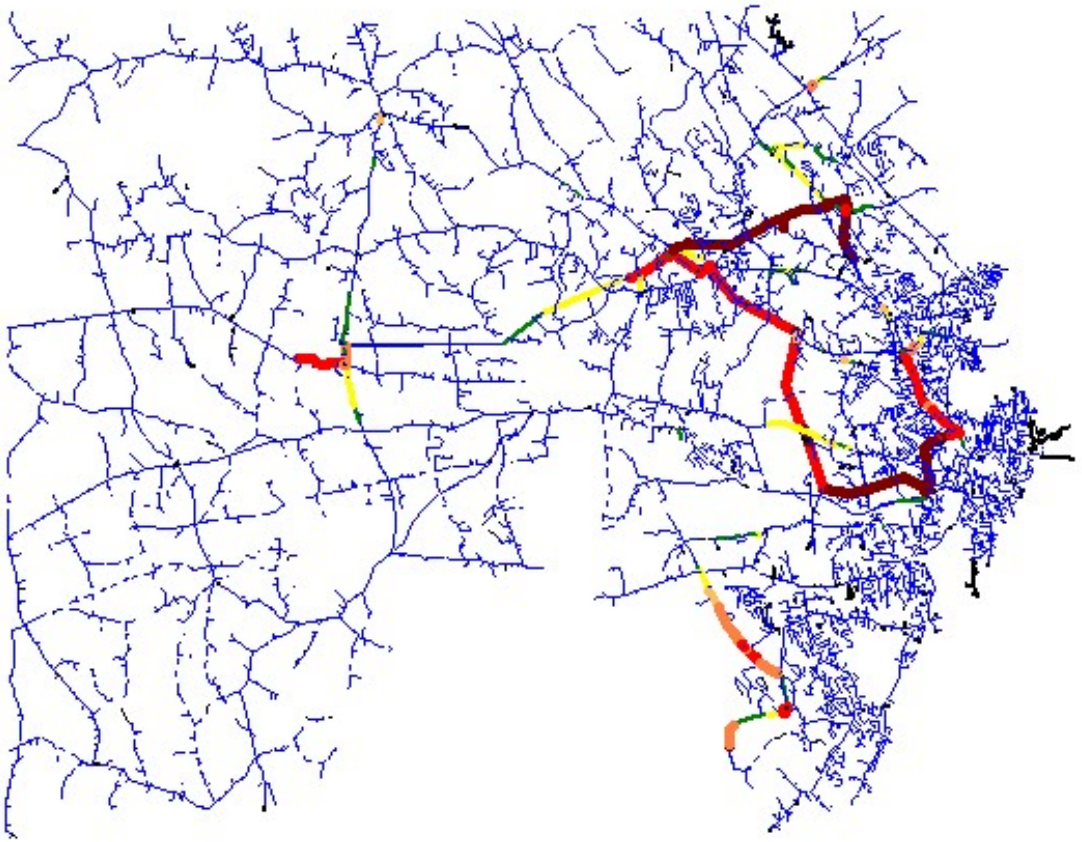
Rhode Island Energy™
a PPL company

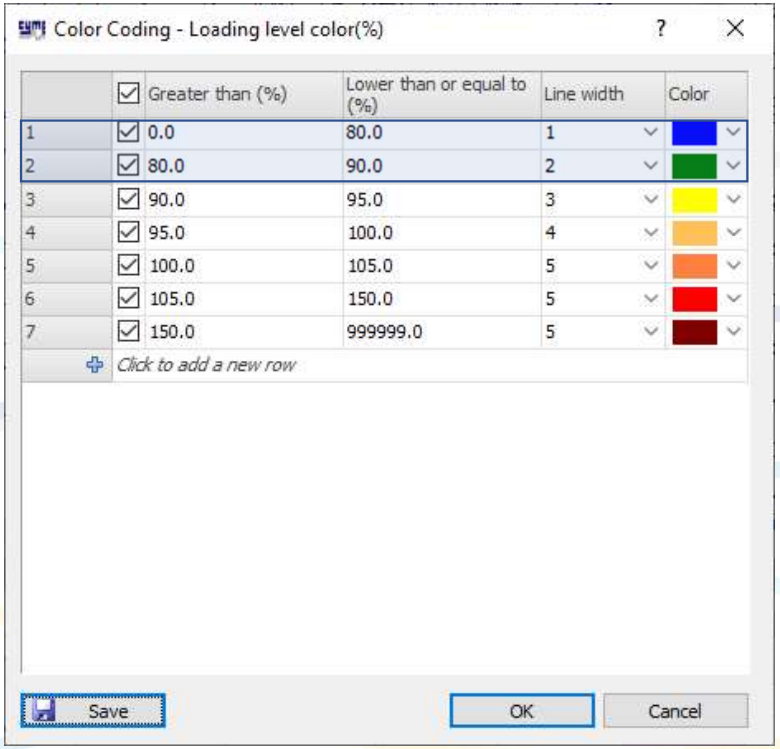




4/16/50 12PM Reverse Peak Load Flow Loading

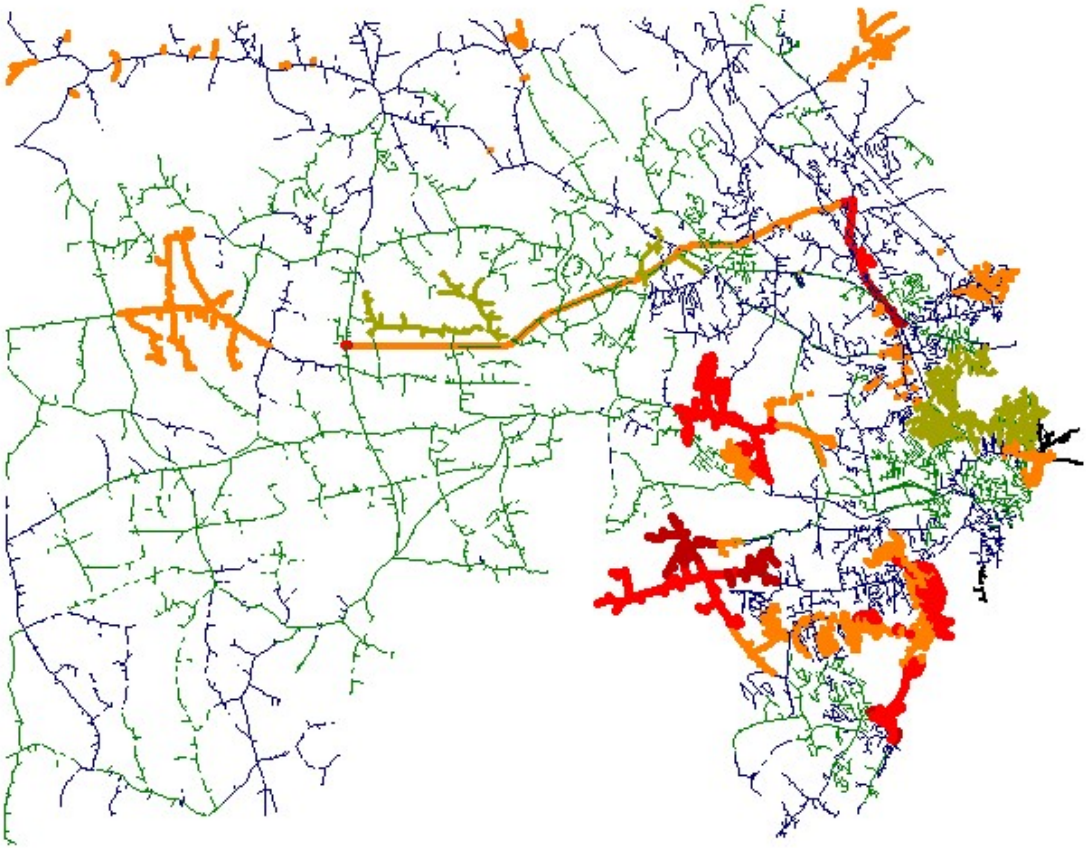
Rhode Island Energy™
a PPL company





4/6/50 12PM Reverse Peak Load Flow Voltage

Rhode Island Energy™
a PPL company



Color Coding - Voltage level color(%)

	Greater than (%)	Lower than or equal to (%)	Line width	Color
1	0.0	85.0	5	
2	85.0	90.0	4	
3	90.0	95.0	4	
4	95.0	97.5	2	
5	97.5	102.5	1	
6	102.5	105.0	1	
7	105.0	107.5	4	
8	107.5	110.0	5	
9	110.0	99999999.0	5	
	Click to add a new row			

Save OK Cancel

4/6/50 12PM Reverse Peak Load Flow Loading

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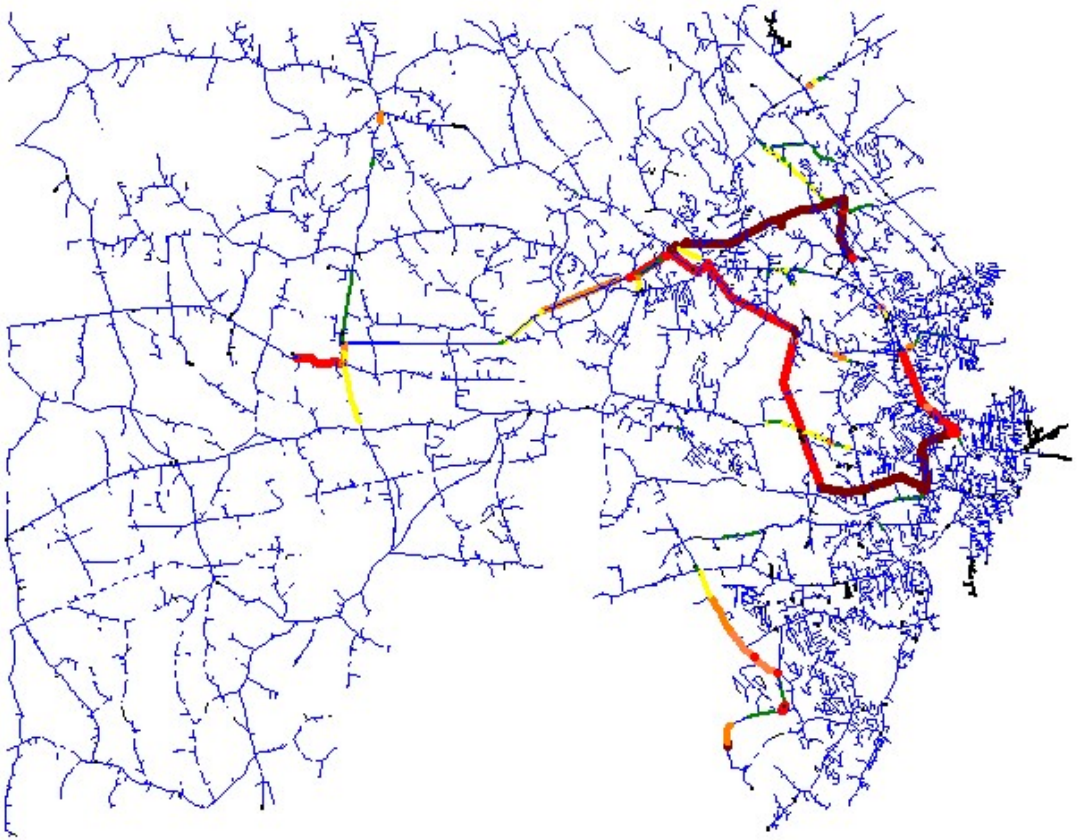

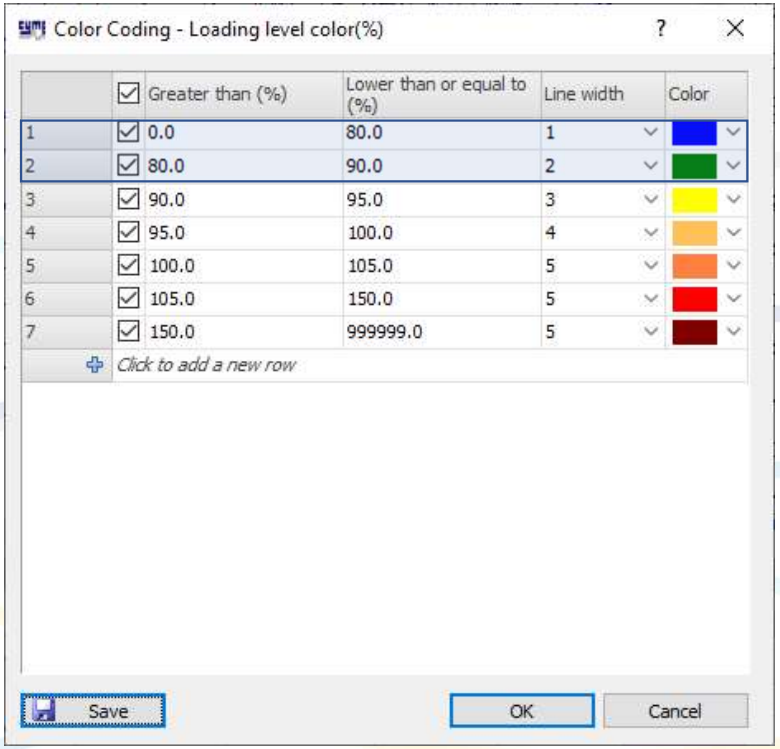

Key NW Study Findings

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- Distribution operating issues (e.g., **high voltage, protection system coordination**) become more systemic at higher DER penetrations.
- Although there will be some coincidence between commercial "workplace" EV charging and the timing of solar DG injections, there is generally **a mismatch between solar DG injections and typical late day and evening residential EV charging**.
- High levels of renewable DG adoption will impact the grid more significantly during light loading (e.g., off-peak) periods than peak periods. **During light loading periods, significant renewable DG curtailment may be required without GMP investments.**
- High penetrations of DER will significantly impact voltage regulation: EV will lead to more low voltage violations during on-peak periods, and renewable DG injections will lead to more high voltage violations during light loading periods. **Advanced voltage control schemes will be required to manage voltage during both on-peak and light loading periods.**
- Significant **swings in loading and the prevalence of two-way power flows** caused by renewable DG will require more adaptive **relay protection schemes to properly match load to DG,** coordinate circuit breakers to ensure worker safety and the reliable operation of the grid.

Need to address these issues for a reliable, safe electrical system

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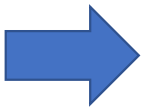
GMP Strategy, Goals, Approach, Reference Standards, Solutions and ISR Coordination

GMP Strategy, Goals and Approach

Strategy

1. Enable the achievement of Rhode Island Clean Energy Mandates
2. Improve customer service:
   - Improve reliability and safety
   - Maintain / optimize voltage
   - Provide reliable DER interconnections
   - Balance DG and load for stability
3. Apply Grid Modernization
   - Predict failures before they occur, respond faster to incidents and use data to improve operations
   - Automatically restore customers where possible
   - Centralize voltage and power quality management with automated capacitor and regulators, and monitoring/managing DERs
   - Gain visibility and control to operate reliably with forecasted DER penetration
   - Dynamically adapt protection settings based on system configuration
   - Improve capability to detect downed conductors



Goals

- Create voltage visibility, operate within tolerance and optimize control
- Implement VVO/CVR functionality
- Design automatically sectionalization considering reliability, DER penetration, contingency capability, resiliency, and load-DG balance
- Achieve PPL EU reliability level with IEEE definition
- Implement DER Monitoring/Management
- Provide reliable, affordable power that meets objectives

Approach

- Use 2024 ISR for foundational investments
- Use RIE Distribution Study Effort (2030/40/50) to develop ultimate plan, drive priorities and sequencing
- Coordinate with ADMS deployment efforts to align software functionality requirements
- Define transmission, sub-transmission, and substation technology needs to achieve overall strategy
- Review system upgrades alternatives including Transmission, NWA, storage etc. to accommodate new load

Reference Feeder

Feeder is planned, designed, and constructed with highest level of resiliency and reliability, optimized maintenance costs, provides real time operating data, and adjusts dynamically for load changes.

Feeder is fed by Substation with:

- Circuit Breaker high side protection (no fuses, 487E Primary and 751 Backup) & SEL Microprocessor Feeder Relays (751 primary and backup/control)
- Transformer(s) w/ LTC (M-2001D)
- BUS Differential Protection with redundant SEL 487B Relays
- IP SCADA & Fiber Communication

Feeder Characteristics:

- Reliability Driven Construction Standards
  - Class 3 or greater standard pole construction
  - Grade B construction with steel poles
  - Hendrix/UG construction through high vegetation line segments
- Condition/Risk –based data models drive:
  - Pole Inspections
  - Tree Trimming
  - Line Inspections
- Leveraging of Non-Wires Alternates
  - Battery energy storage and other NWA are considered for all constraints
  - DLR devices to understand actual system capacity
  - Management of DER's to enable better power quality

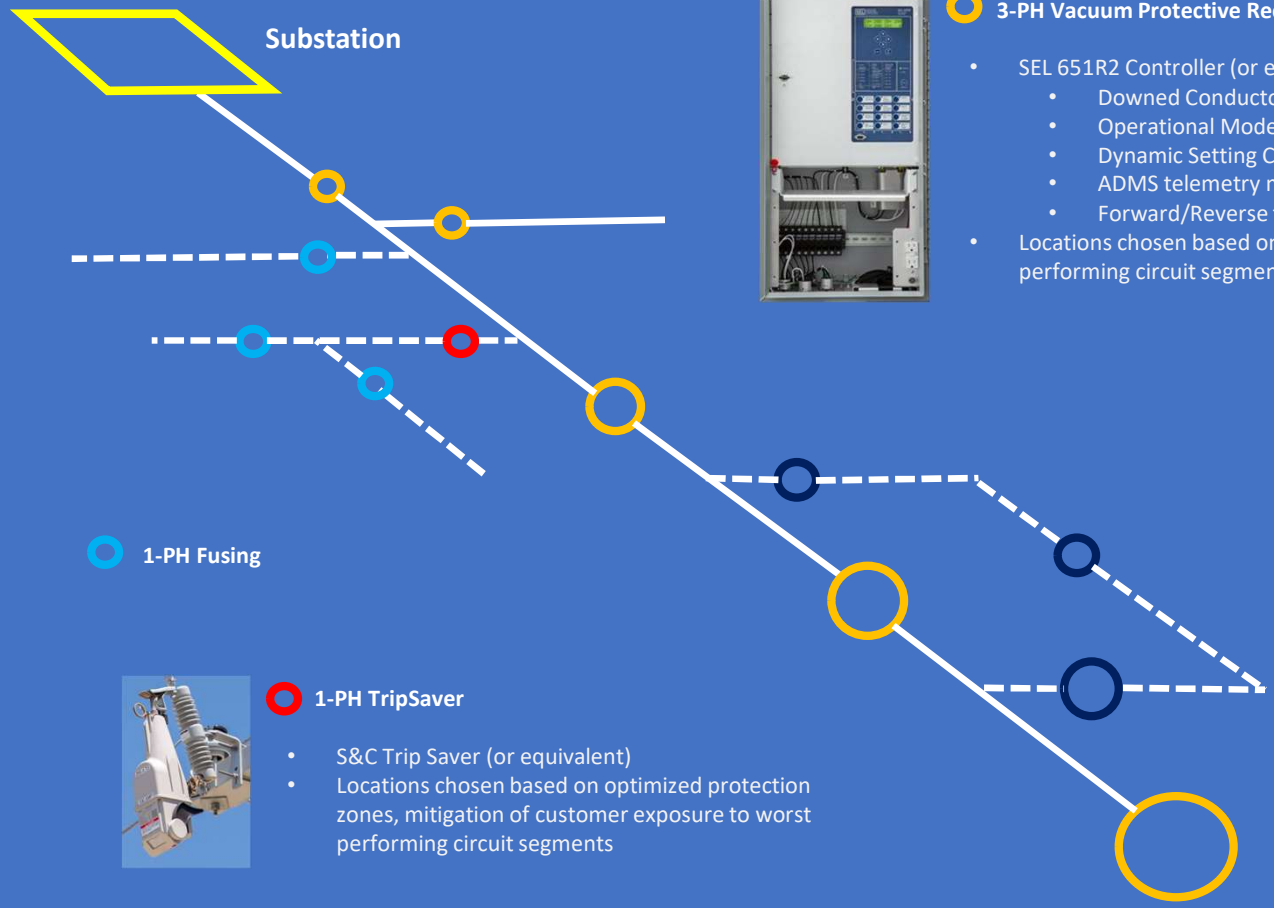
Feeder Characteristics:

- Data driven models driving strategic placement of
  - Telemetered vacuum reclosers w/ SEL relays (651R2) and TripSavers on single and three phase to isolate majority of customers from high-risk segments
  - Telemetered voltage devices to optimize voltage during both peak and light loading (SEL 734B for Cap banks, Beckwith 6200A for Regulators)
  - Feeder ties w/ telemetered reclosers to automatically restore customers (no stranded load)
- Equipped with sensors to locate faults and predict failures
- Downed conductor technology implemented on all smart devices
- Single phase trips to lockout
- Reduced vegetation and vehicle outage exposure due to asset placement
- Eliminated animal exposure
- LTN feeders are equipped with remote switching capability on all network protectors – Standard is Eaton CM-52 with ETI NWP relays

Operational Control:

- Operating system is utilized for
  - Automatic restoration of customers
  - Centralized voltage and power quality management through smart voltage caps and regulators, and behind the meter DERs
  - Dynamically adapt protection settings based on system configuration
  - Control of both single and three phase systems

Reference Feeder – Sectionalizing Equipment



3-PH Vacuum Protective Reclosers

- SEL 651R2 Controller (or equivalent) with:
  - Downed Conductor Detection
  - Operational Mode Flexibility (protective, sectionalizing, switch)
  - Dynamic Setting Capability
  - ADMS telemetry management
  - Forward/Reverse fault detection and measurement
- Locations chosen based on optimized protection zones, mitigation of customer exposure to worst performing circuit segments

1-PH Vacuum Protective Reclosers

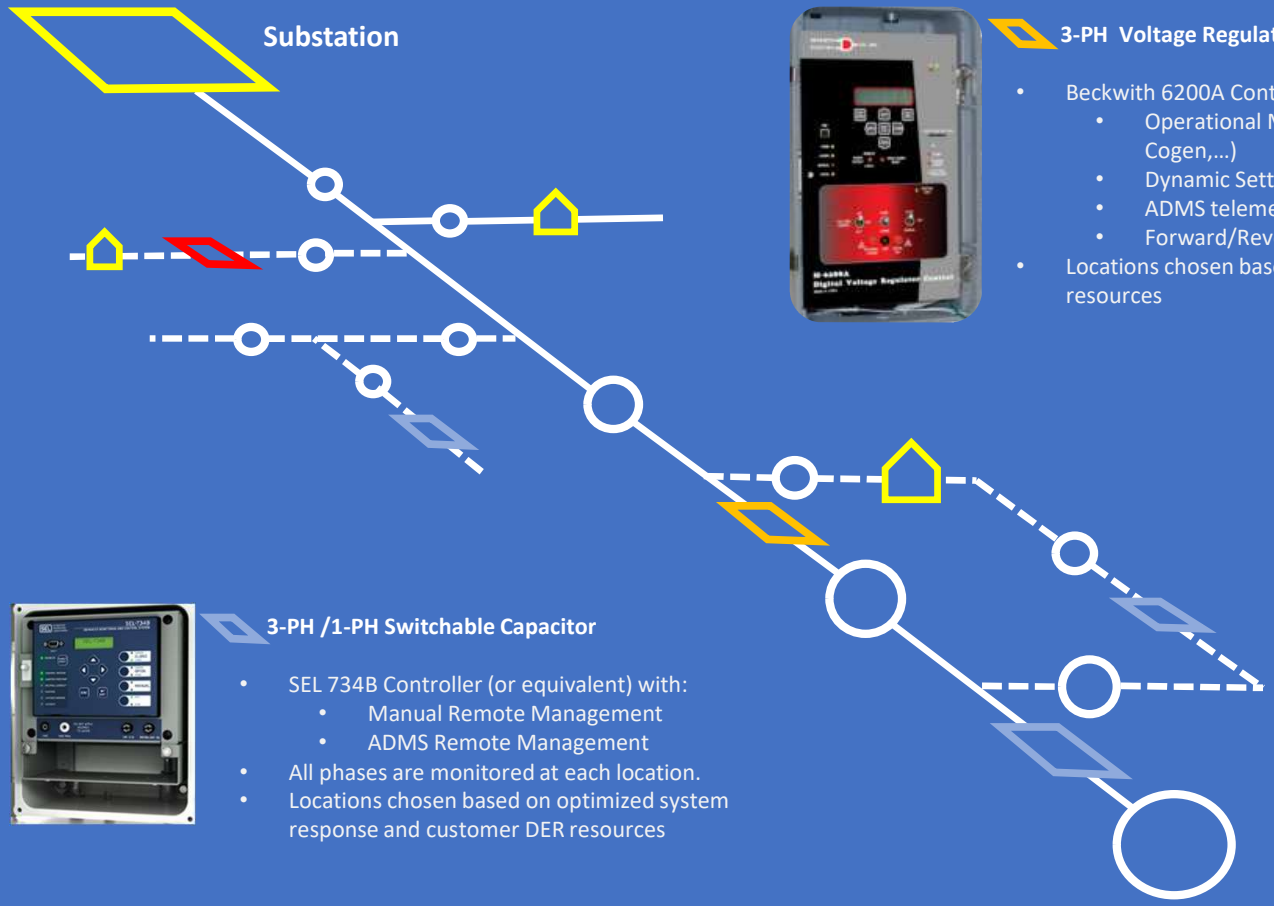
- SEL 651R2 Controller (or equivalent) with:
  - Downed Conductor Detection
  - Operational Mode Flexibility (protective, sectionalizing, switch)
  - Dynamic Setting Capability
  - ADMS telemetry management
  - Forward/Reverse fault detection and measurement
- Locations chosen based on optimized protection zones, mitigation of customer exposure to worst performing circuit segments

1-PH Fusing

1-PH TripSaver

- S&C Trip Saver (or equivalent)
- Locations chosen based on optimized protection zones, mitigation of customer exposure to worst performing circuit segments

Reference Feeder – Volt/VAR Equipment



3-PH Voltage Regulator

- Beckwith 6200A Controller (or equivalent) with:
  - Operational Mode Flexibility (Forward, Reverse, Bi-directional, Cogen,…)
  - Dynamic Setting Capability (remote management)
  - ADMS telemetry management
  - Forward/Reverse fault detection and measurement
- Locations chosen based on optimized system response and customer DER resources

3-PH /1-PH Switchable Capacitor

- SEL 734B Controller (or equivalent) with:
  - Manual Remote Management
  - ADMS Remote Management
- All phases are monitored at each location.
- Locations chosen based on optimized system response and customer DER resources

Residential / Small Commercial DER

- Utility Owned / Managed Connected Controller with:
  - Manual Remote Management of IEEE 1547 Smart Inverter Functions
  - ADMS Remote Management of IEEE 1547 Smart Inverter Functions
- Locations based on either regulatory authority or customer permissions.

Reference T / Sub T Radial Line

- The Reference Sub-T radial line standard calls for future functionality from a variety of monitoring, control and protection devices in substations and on the lines feeding them.
- Examples include:
  - Circuit Breaker monitoring
  - Dynamic line rating monitors
  - Transformer and bushing monitoring
  - Battery monitoring
  - Transmission Cap Bank Primary Relay + Backup and Control Relay
  - Cap Bank String Monitoring
  - Primary line relay
  - Line Protection and Control relay (to optimize protection zones, mitigate customer exposure)
  - Capacitor Voltage Transformer / Potential Transformer monitoring
  - Relay-to-Relay communications (Ring and Direct)
  - EUNet IP based SCADA communication switches and routers

Rhode Island Energy SAIFI Reliability Comparative Analysis

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Reliability Comparative Analysis

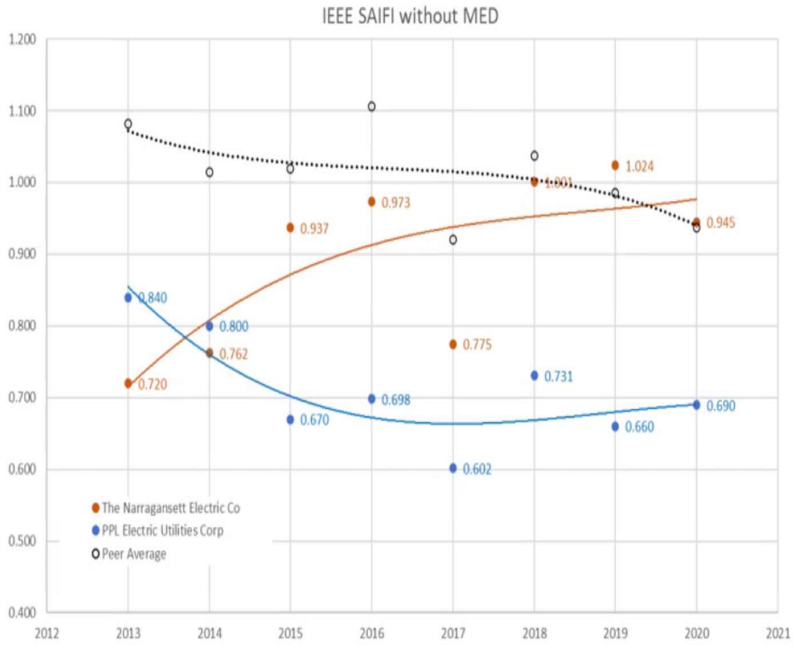
- Compares RIE, PPL EU and Peer Group
- Based upon IEEE Standard
- Included nine peers with >300K electric customers in a similar geography that report 5-minute SAIFI
- Time frame → 2013 – 2020 (2021 data is not available yet)

Conclusion: RIE SAIFI lags when compared to peers and to PPL EU.

- Peers reduced SAIFI by 15%
- PPL EU has reduced SAIFI by 22%
- RIE has increased (worse) SAIFI by 5%

Approach: Plan FLISR deployment in two phases:

- Complete study to plan for ultimate recloser build-out that includes reliability, DG to load needs and reconfiguration.
- Phase 1: Install initial reclosers in the immediate ISR years.
- Phase 2: Build ultimate FLISR scheme



Reliability - Voltage

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Current Situation:

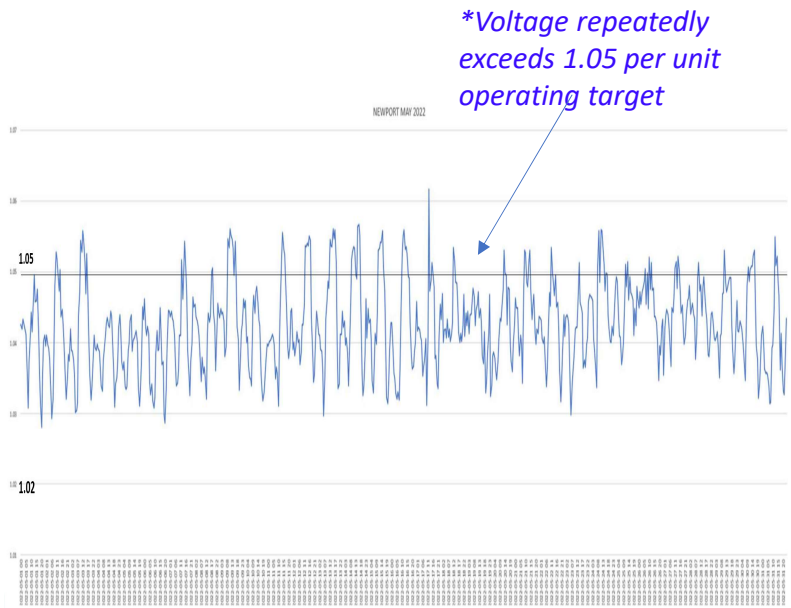
- DERs cause voltage swings and introduce voltage violations during high and low load conditions

Goal:

- See and maintain voltage within +/- 5%
- Successfully operate and manage with increased DER
- Create wherewithal to "fine tune" voltage control through VVO

Approach

- Gain near-time visibility of feeder voltage profile to understand when and where violations are occurring
- Upgrade and install automated capacitors and regulators to better manage voltage
- Coordinate with ADMS Base and development to include VVO and DER Monitor / Manage
- Execute in phases
  - Phase 1: automated capacitors and regulators by end of 2024 per study results
  - Phase 2: Expand capacitors and regulator automation considering studies and Reference Feeder criteria
  - Phase 3: Implement VVO targeting the initial launch in 2026
  - Phase 4: Implement DER Monitor / Manage



3,000 kW Solar DG nominal voltage output in RIE Newport Region - May 2022

**Required to maintain ±5% of nominal voltage ie 0.95 to 1.05 per unit voltage.*

System Enhancements Being Studied

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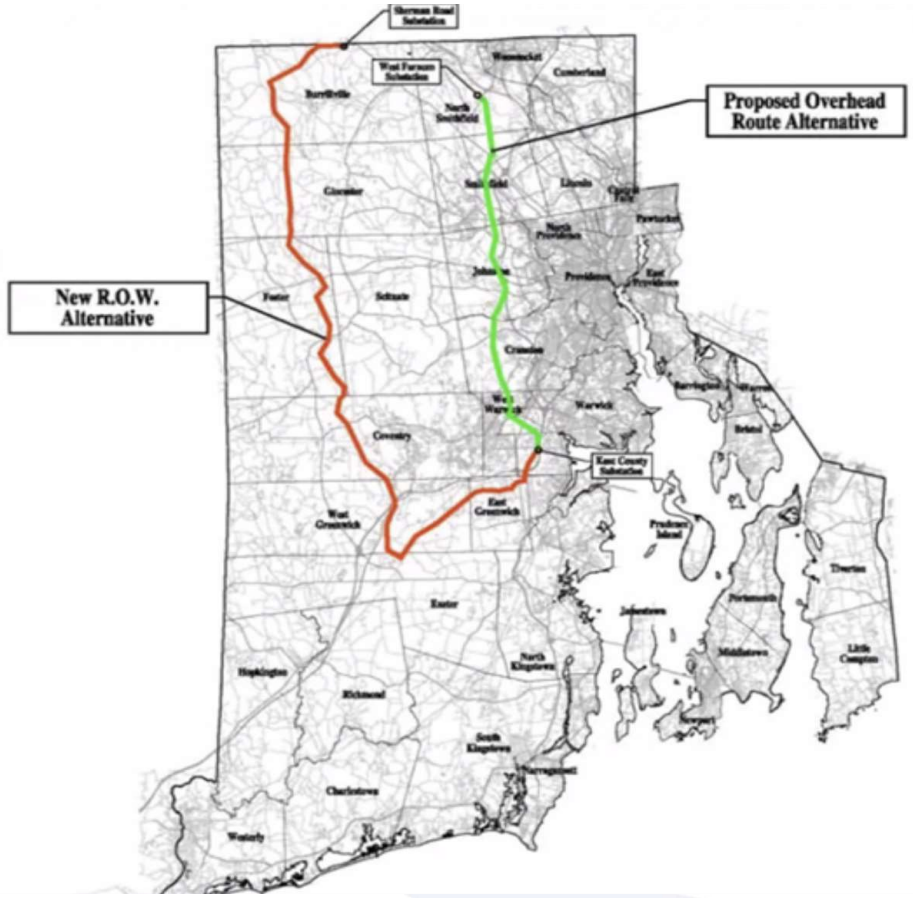
Recognizing there is a significant increase in load over the period and more flexibility is needed…

- Reviewing system alternatives that can accommodate most economically
- Transmission alternatives that are being studied are shown (preliminary)
- Many potential benefits to Rhode Island



GMP Cost Estimates and ISR Coordination

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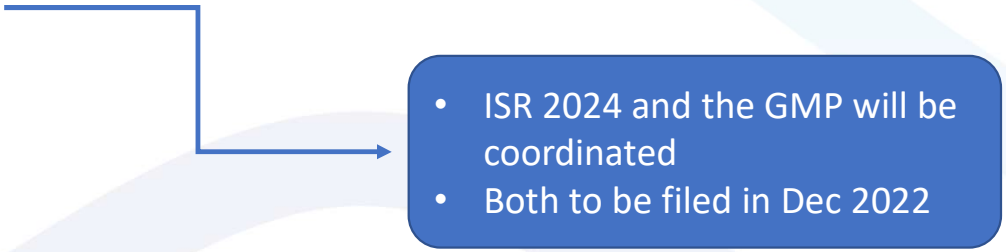
- Five-year cost estimates for each GMP solution will be provided
- High Distributed Energy Resource (DER) and Low DER customer adoption scenarios will be analyzed
- GMP cost estimates include all the costs of deploying the grid modernization solutions
- GMP and AMF will be coordinated where there are interdependencies
- ADMS basic has been included with the PPL acquisition
- Investments in AMF, Advanced Field Devices (i.e., Feeder Monitoring Sensors, Advanced Capacitors & Regulators, Advanced Reclosers & Breakers), and Operational Telecommunications, are the primary cost drivers
- GMP costs would be recovered through the Company's annual ISR filings as adjusted to the PPL calendar year assumed as follows:
  - ISR 2024 = Apr 2023 – Dec 2024
  - ISR 2025 = Jan 2025 – Dec 2025
  - ISR 2026 = Jan 2026 – Dec 2026
  - ISR 2027 = Jan 2027 – Dec 2027
  - ISR 2028 = Jan 2028 – Dec 2028
- Future costs anticipated after ISR 2028 will be discussed and estimated.



Preliminary GMP Software Functionality Chart (ADMS and More)

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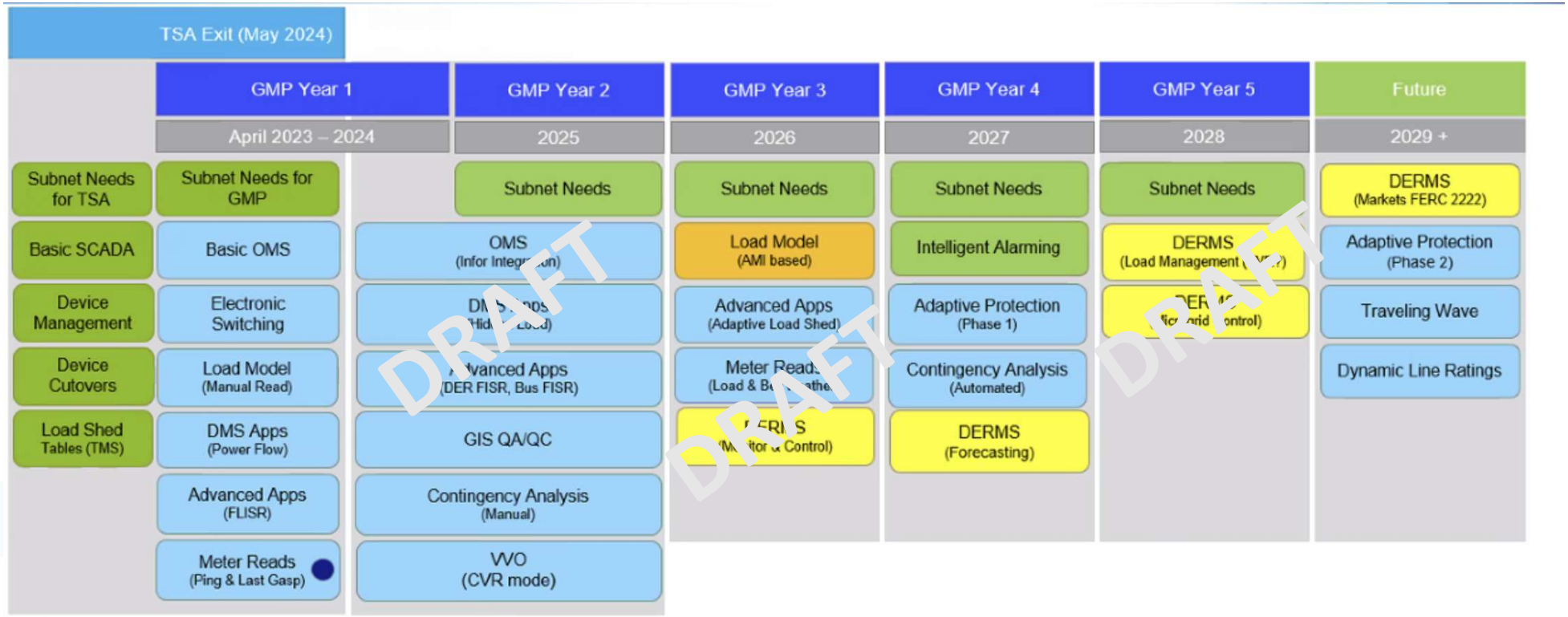

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Appendix

Acronyms

- ADMS = Advanced Distribution Management System
- AESC = Avoided Energy Supply Cost
- AMF = Advanced Meter Functionality
- AMI = Advanced Meter Infrastructure
- AMR = Automatic Meter Reading
- ASA = Amended Settlement Agreement
- ASHP = Air Source Heat Pump
- BAU = Business as Usual
- BCA = Benefit Cost Analysis
- C&I = Commercial and Industrial
- CEP = Customer Engagement Plan
- CGR = Connected Grid Router
- CO2 = Carbon Dioxide
- CP = Customer Portal
- CPP = Critical Peak Pricing
- D = Distribution
- DCFC = Direct Current Fast Charging
- DER = Distributed Energy Resource
- DERMS = Distributed Energy Resource Management System
- DG = Distributed Generation
- DLM = Dynamic Load Management
- DPAM = Distribution Planning & Asset Management
- DPL = Dayton Power and Light
- DR = Demand Response
- DRIPE = Demand Reduction Induced Price Effect
- DSCADA = Distributed Supervisory Control and Data Acquisition
- EC4 = Executive Climate Change Coordinating Council
- EE = Energy Efficiency
- EDI = Electronic Data Interchange
- EHP = Electric Heat Pump
- EIA = Energy Information Administration
- EPO = Energy Profiler Online
- ESB = Enterprise Service Bus
- EV = Electric Vehicle
- FAN = Field Area Network
- FLISR = Fault Location Isolation and Service Restoration
- GBC = Green Button Connect
- GBD = Green Button Download my data
- GHG = Greenhouse Gas
- GIS = Geographical Information Systems
- GMP = Grid Modernization Plan
- HAN = Home Area Network
- HCA = Hosting Capacity Analysis
- HES = Head End System
- HVAC = Heating, Ventilation, and Air Conditioning
- ICAP = Installed Capacity
- ICE = Interruption Cost Estimate
- IoT = Internet of Things
- IP = Internet Protocol
- ISA = Interconnection Service Agreement
- ISO NE = Independent System Operator New England
- IT = Information Technology
- KY = Kentucky
- LDV = Light Duty Vehicle
- LVA = Locational Value Analysis
- MA = Massachusetts
- MDM = Meter Data Management
- MV/LV = Medium Voltage/Low Voltage
- NEM = Net Energy Metering
- NMPC = Niagara Mohawk Power Corporation
- NPP = Non-Regulated Power Producer
- NY = New York
- NWA = Non-Wires Alternative
- OER = RI Office of Energy Resources
- OMS = Outage Management Systems
- PA = Pennsylvania
- PBR = Performance-Based Regulation
- PI Historian = Plant Information Historian
- PIM = Performance Incentive Mechanism
- PLC = Power-Line Communication
- PPL = Pennsylvania Power and Light
- PSE&G = Public Service Electric & Gas
- PSR = Platform Service Revenue
- PST = Power Sector Transformation
- PUC = Public Utilities Commission
- PV = Photovoltaic
- REC = Renewable Energy Credit
- REV = Reforming the Energy Vision
- RF = Radio Frequency
- RGGI = Regional Greenhouse Gas Initiative
- RI = Rhode Island
- RIE = Rhode Island Energy
- RMD = Residential Methane Detector
- RTP = Real Time Pricing
- RTU = Remote Terminal Unit
- SaaS = Software as a System
- SCT = Societal Cost Test
- SME = Subject Matter Expert
- ToC = Table of Contents
- TOU = Time Of Use
- TSA = Transition Service Agreement
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- VVO/CVR = Volt-Var Optimization/Conservation Voltage Reduction
- WACC = Weighted Average Cost of Capital

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Grid Modernization Plan: Model Demonstration

Power Sector Transformation – October 7, 2022

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Agenda

- Schedule Update
- Purpose of Meeting
- Study scope and approach
- Grid Modernization Plan Model Demonstration
- Key Takeaways

PST Ground Rules:

- Ask questions and provide feedback as we go
- Raise hand and state name when asking questions
- One conversation at a time
- Timekeeper to monitor discussion and align to agenda
- Topics and questions scheduled for future discussion will be saved in the Parking Lot

PST Advisory Collaboration: Recap and Schedule Update

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PST Advisory AMF & GMP Subcommittee Meetings and Preliminary Agendas

Stakeholder Collaboration (i.e., Subcommittee meetings and discussions)

Obtain Feedback and Seek Alignment on Proposals and Approaches

Review Initial, Refined and Final Proposals

Jun 21, 2022

- **RI Division and OER Meeting**
- Introductions
- Proposed timeline
- Preliminary agenda for PST meetings
- AMF Introduction and overview of key areas
- GMP Introduction and coordination

July 14, 2022

- **PST Advisory Meeting**
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- PPL Background and Experience
- Full Scale Enabling Platform
- Detailed Deployment Plan
- Functionality Timing
- ASA coverage
- AMF cost review
- GMP study scope and approach
- GMP forecast analysis

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- **PST Advisory Meeting**
- Prior meeting will drive agenda
- AMF Customer Engagement Plan
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Sept 1, 2022

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Oct/Nov 2022

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December 2022

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- Coordinate with ISR and AMF details

AMF – Advanced Metering Functionality

GMP – Grid Modernization Plan

BCA – Benefit-Cost Analysis

September 2022
AMF Targeted Filing Date

December 2022
GMP Targeted Filing Date

- Initial alignment meeting with RI Division and OER
- PST Advisory Sub-Committee Meeting AMF
- PST Advisory Sub-Committee Meeting GMP
- PUC Technical Session

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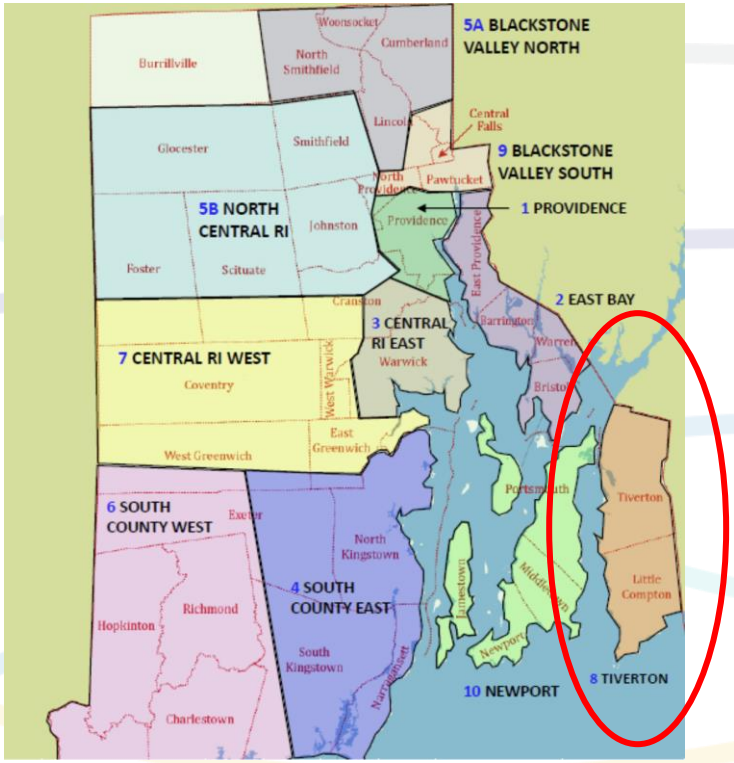
Purpose

- Following up from a PST request to see the GMP model
  - Using one planning area, Tiverton, as an example
  - Applying load and DER forecast through 2050
- Objective
  - Share the study and modeling approach
  - Provide a preview of the system implications resulting from the long-term forecast that define GMP investment requirements and the urgency to make them
  - Address questions, collect feedback

Tiverton Planning Area



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Study Scope

Stakeholder Outreach and Consultation

Scope

State-wide 8760 analysis

- ✓ 400 feeders
- ✓ Includes area study recommendations
- ✓ Sub-transmission modeling and testing (Constable)
- ✓ System-wide transmission analysis (Ali)

Years: 2030, 2040, 2050 – Aligned with Act on Climate

Analysis

Forecast: Base, Low, High DER

Issue Identification:

- ✓ Determine load, voltage and protection issues (Constable)
- ✓ Determine areas with degrading reliability (Eline)
- ✓ Consider resiliency needs

Solutions:

- Optimal Recloser Installation
- No GMP vs With GMP

Sensitivities:

- Transmission

Estimation

Road Map:

- Device Deployment Plan (Constable)
- ✓ Functionality Availability (Menges)

Estimation:

- Equipment Costs
- Installation Costs

Leverage PPL experience

- ✓ Actual Costs
- ✓ Installation Assumptions
- ✓ Standards

Benefit Cost Analysis

BCA:

- Comply with Docket 4600
- Update with PPL experience, Study and Reliability findings

Transition Component:

- ADMS 'Basic' came with the acquisition

Business Plan

- Write Business Case
- Write Testimony

Approach to Distribution System Analysis – Modeling Demo

- State-wide analysis to determine the most efficient plan to meet the state's energy policy, growing resiliency and reliability needs, and customer's expectations.
- Scope
  - State-wide distribution analysis
    - ~400 feeders
    - Sub-transmission modeling and testing
    - Traditional area study recommendations included in models
  - Analysis years – 2030, 2040, 2050 to align with Act on Climate target years
  - Cases
    - No Grid Modernization – build for extremes
    - Grid Modernization – manage away extremes
  - 8760-Hour per year analysis
- Analysis
  - Issue Identification
    - Determine load and voltage issues across hours of the year
  - Case Evaluation
    - No GMP – Base DER Forecast - How would traditional utilities alternatives solve the issues?
    - GMP – Base DER Forecast - How would GMP-type alternatives solve the issues?

Forecast / Impact to Peak Demand: A Review

Key DER Metrics for Milestone Study Years

	GMP DER Forecast Analysis -- Impact to Peak Demand					
	2030		2040		2050	
	Summer	Winter	Summer	Winter	Summer	Winter
Heat Pumps, MW	0	200	5	1310	5	2825
# Heat Pumps	54,000	54,000	325,000	325,000	400,000	400,000
Solar PV, MW	0	0	0	0	0	0
Solar PV, nameplate MW	1500	1500	3400	3400	5000	5000
EV Charging, MW	70	80	805	910	1010	238
# Electric Vehicles	87,300	87,300	675,000	675,000	840,000	840,000
RIE Peak Demand, MW	1940	1415	2590	3280	2785	3855

GMP Model Demonstration – Model Setup

- Base Model – as used with typical planning studies
  - Existing distributed generation confirmed
- Forecasted load, generation, electric vehicles, heating (heat pumps) added
  - Load forecast with energy efficiency incorporated into load profiles
  - Generation added to the model explicitly
    - General distribution PVs added as 100kW sites
    - Specific PV and Wind sites added to subtransmission
    - Generation load cycles are based on PVWatts and actual data
  - Electric vehicles and heat pumps added as customer load types to existing load sites
    - Electric vehicle load cycle based on EVI-Pro-Lite
    - Heating pump load based on industry research and 2015 weather year

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GMP Model Demonstration – Tiverton Example

- Area Study recommendations added
- Forecast details show in table below
  - Generation allocated by load
  - Electric vehicles and heat pumps allocated by customers

Substation Name	Feeder Number	MW DG 2030	MW DG 2040	MW DG 2050	2040 Manual DG Allocation	2050 Manual DG Allocation	Existing Onshore Wind	Onshore Wind 2030	Onshore Wind 2040	Onshore Wind 2050	EVs 2030	EVs 2040	EVs 2050	EV MWs 2030	EV MWs 2040	EV MWs 2050	EHPs 2030	EHPs 2040	EHPs 2050	EHP MWs 2030	EHP MWs 2040	EHP MWs 2050
TIVERTON	33F1	7.72	14.84	14.84							465	3594	4488	0	5	6	272	1718	2148	2	12	15
TIVERTON	33F2	7.00	14.63	14.63							491	3799	4745	0	5	6	288	1816	2271	2	13	16
TIVERTON	33F3	3.53	10.40	10.40							516	3993	4987	0	5	7	302	1909	2387	2	13	17
TIVERTON	33F4	5.55	12.87	12.87							542	4192	5235	0	6	7	317	2004	2506	2	14	18

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Guide to Analysis Slides

- Each test year will be shown with loading and voltages analysis
  - Cool colors are shaded and have no issues
  - Warm colors are issues

Loading Color Legend

Color Coding - Loading level color(%)

		Greater than (%)	Lower than or equal to (%)	Line width	Color
1	☑	0.0	80.0	1	
2	☑	80.0	90.0	2	
3	☑	90.0	95.0	3	
4	☑	95.0	100.0	4	
5	☑	100.0	105.0	5	
6	☑	105.0	150.0	5	
7	☑	150.0	999999.0	5	

Caution

Violation

Voltage Color Legend

Color Coding - Voltage level color(%)

		Greater than (%)	Lower than or equal to (%)	Line width	Color
1	☑	0.0	85.0	5	
2	☑	85.0	90.0	4	
3	☑	90.0	95.0	4	
4	☑	95.0	97.5	2	
5	☑	97.5	102.5	1	
6	☑	102.5	105.0	1	
7	☑	105.0	107.5	4	
8	☑	107.5	110.0	5	
9	☑	110.0	99999999.0	5	

Violation

Violation

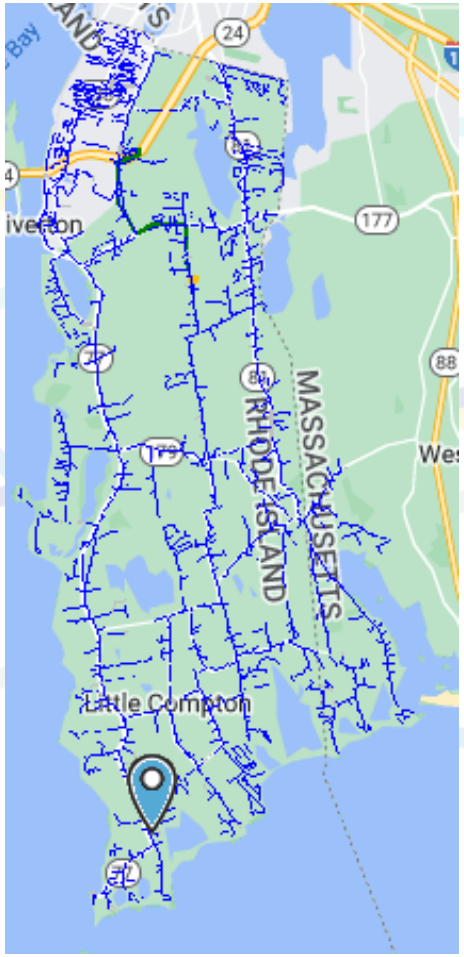
Post Study Area Recommendations - Tiverton

- After study recommendations – new feeder

Loading

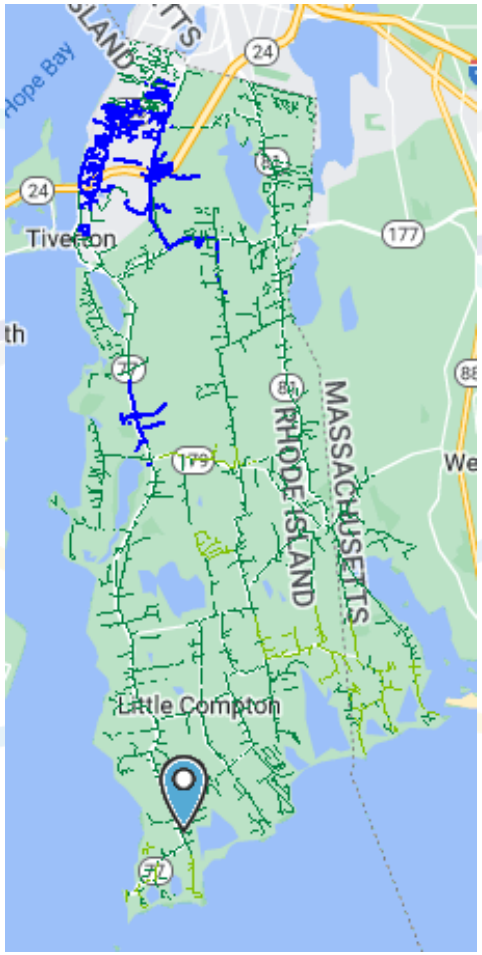
7/22/2025 6PM

4/16/2025 11AM

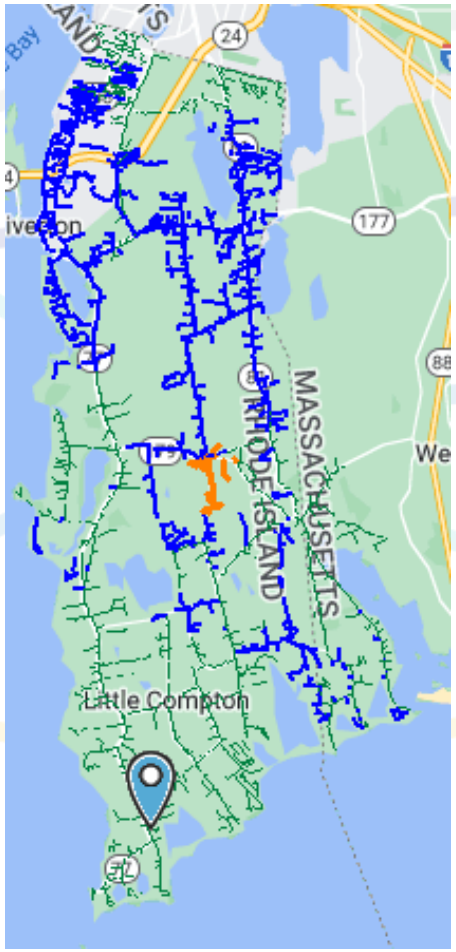


Voltage

7/22/2025 6PM



4/16/2025 11AM



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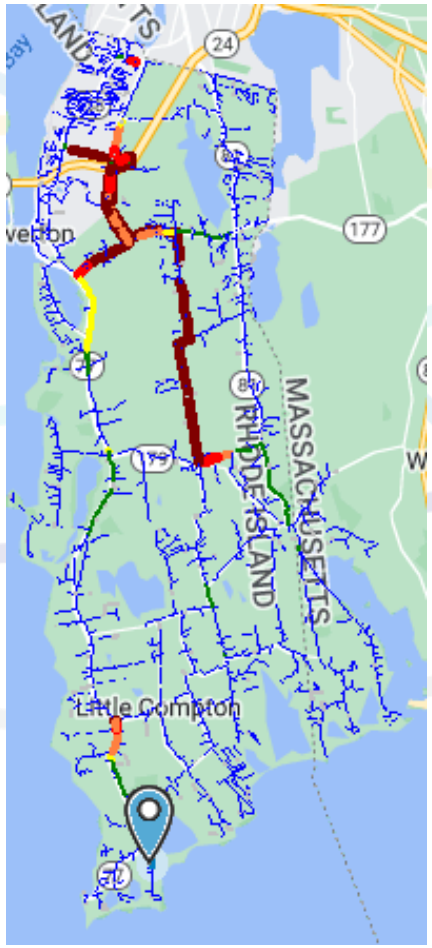
2040 GMP - Tiverton

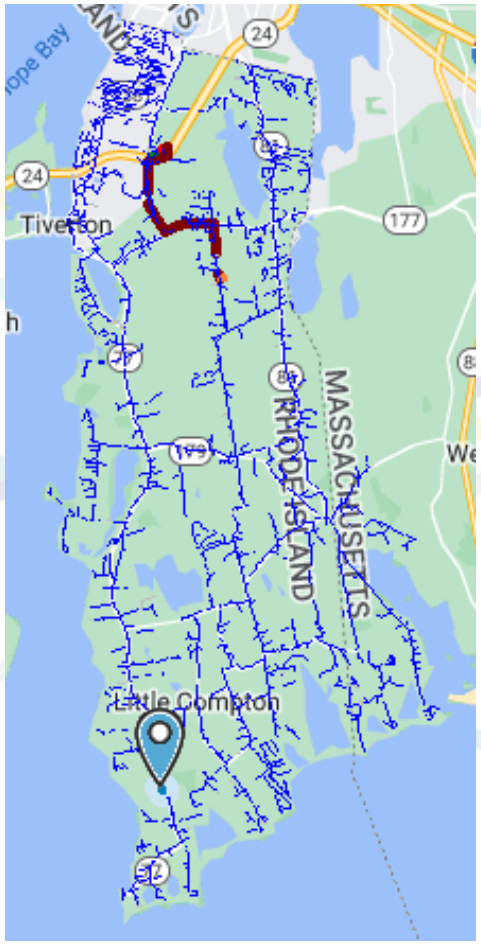
- 2040 load, DG, EV, EHP levels, Winter Peaking

Loading

2/13/2040 6PM

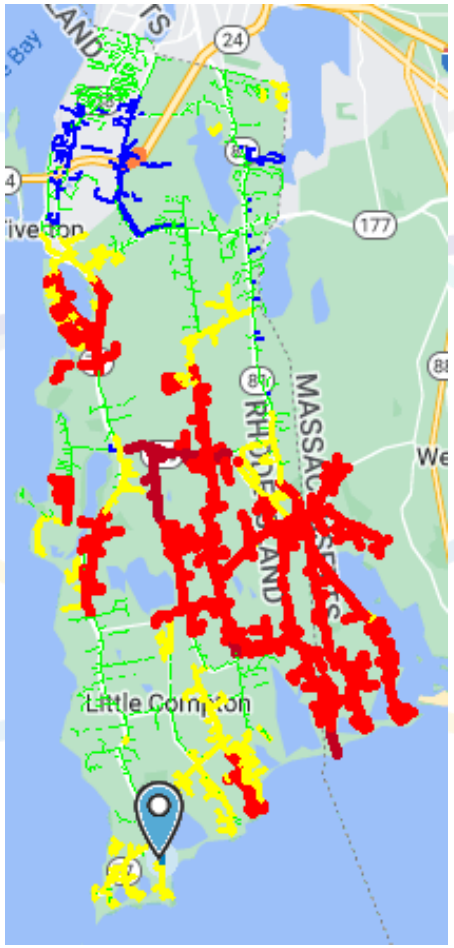


4/16/2040 11AM

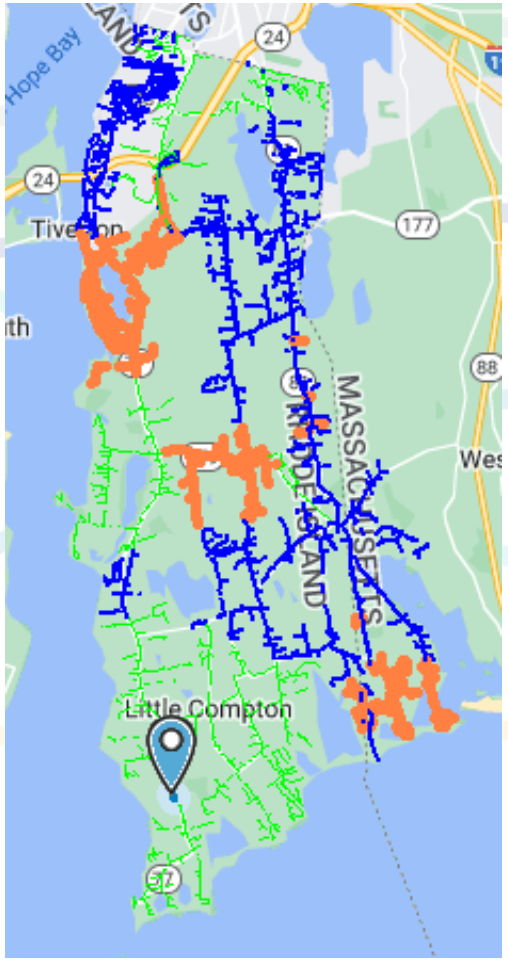


Voltage

2/13/2040 6PM



4/16/2040 11AM



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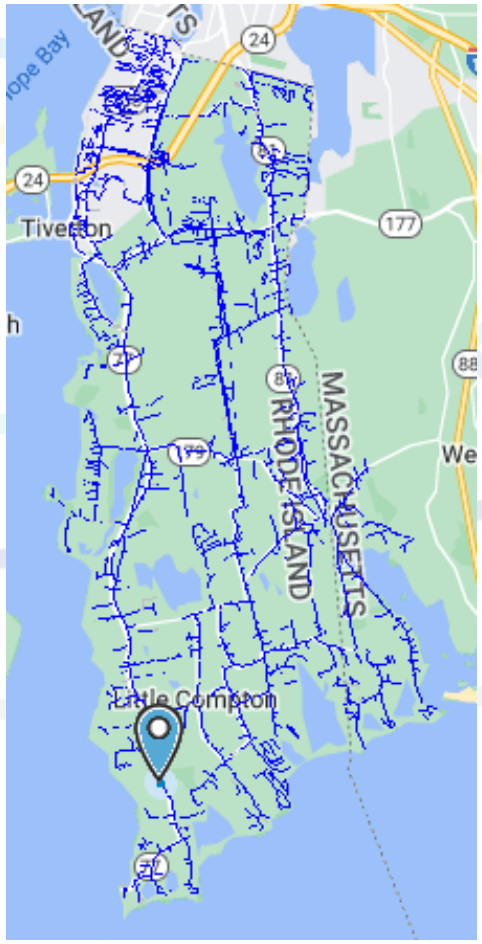
2040 GMP – Tiverton – Non GMP Fixes

- 3 new feeders added to existing station, second substation with 2 new feeders added

Loading

2/13/2040 6PM



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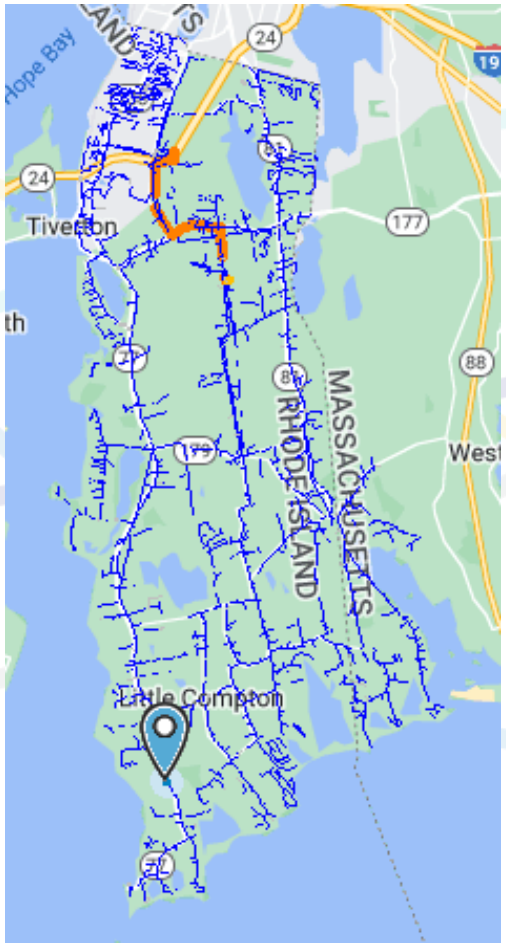
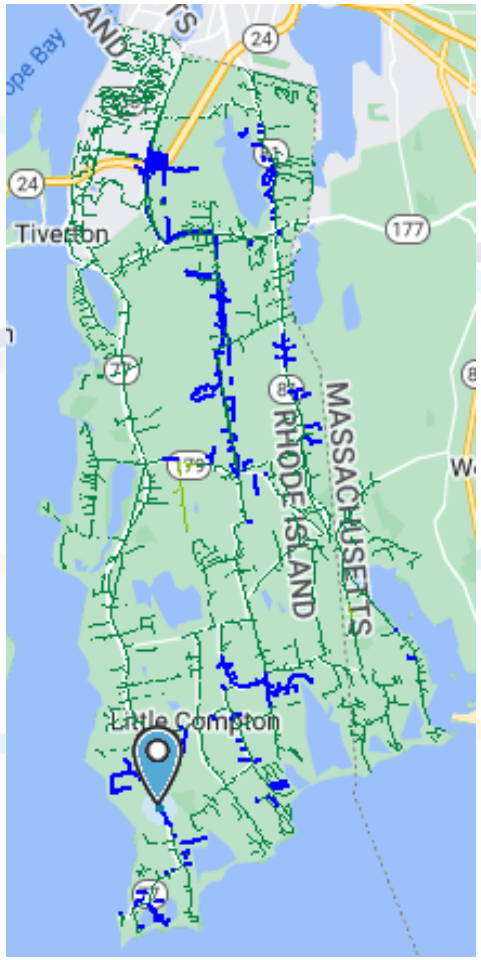


Voltage

2/13/2040 6PM



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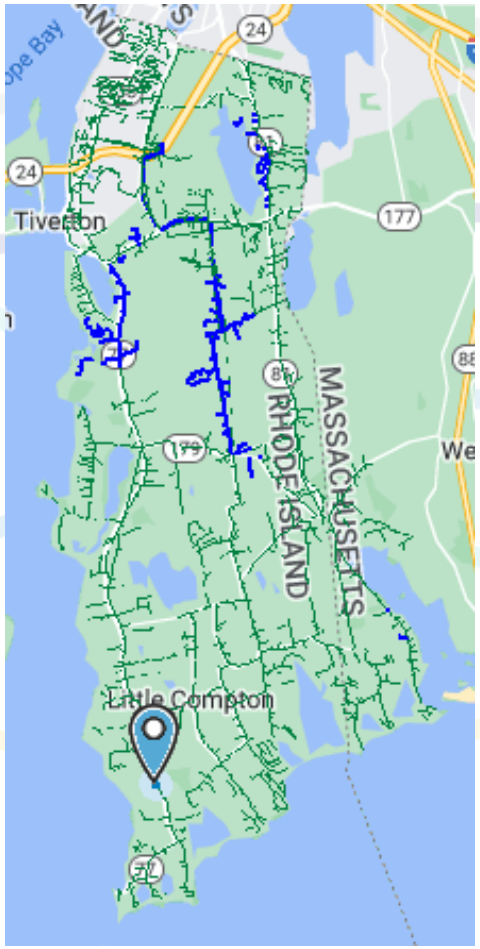

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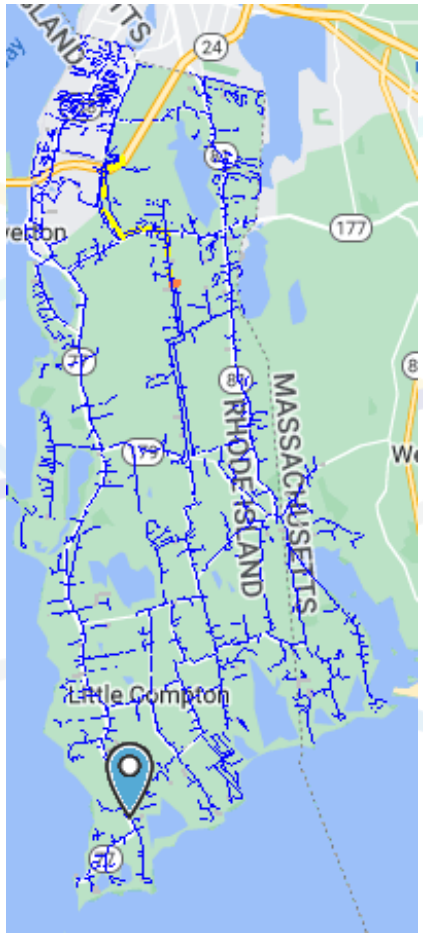
2040 GMP – Tiverton – GMP Fixes

- Load and generation shifts, 2 new feeders, 4 BESS sites

Loading

2/13/2040 6PM

4/16/2040 11AM



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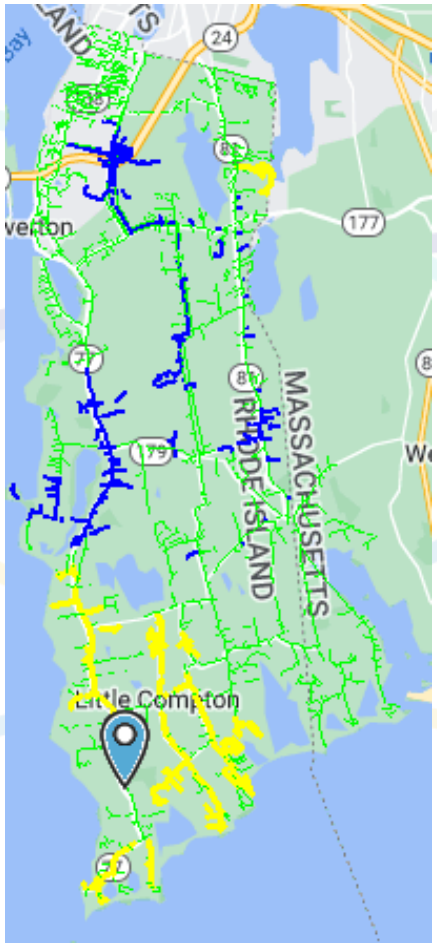

4/16/2040 11AM

GMP Model Demonstration – Key Takeaways

- Need is now
  - System must be setup with proper sensing and data handling and processing now.
    - Each interconnection that occurs without consideration of DERMS (Distributed Energy Resource Management System) is a lost opportunity
    - Each energy storage resource that is interconnected without consideration of distribution system needs is a lost opportunity
    - Each electric vehicle or heating system that is installed without considerations of load shifting capabilities linked to the distribution system is a lost opportunity
    - Without grid modernization foundational investments, RIE has to pursue non-GMP type investments. Over time the savings that can be achieved from the GMP will be eroded
  - Study was conducted using a conservative dispersed DER allocation
    - Actual interconnections can cause localized acute issues in the immediate future
  - RIE customers are getting the ADMS Platform at no cost to enable automation of the system to maintain/improve safety and reliability; off-set T/D and System Capacity Cost; reduce energy usage, and reduce curtailment of renewable energy resources among other benefits
  - The greatest Grid Modernization benefits are achieved when linked to an AMF deployment. The combined smart devices provide comprehensive situational awareness and control required – e.g. FLISR, VVO, DER Monitor/Manage, Advanced Reclosers, Smart Capacitors and Regulators, Relay Upgrades
  - Deployment of these resources will take time and many other utilities across the country are addressing the same issues. Supply chain issues dictate that RIE deploy GMP on an accelerated basis.

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Appendix

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Acronyms

- ADMS = Advanced Distribution Management System
- AESC = Avoided Energy Supply Cost
- AMF = Advanced Meter Functionality
- AMI = Advanced Meter Infrastructure
- AMR = Automatic Meter Reading
- ASA = Amended Settlement Agreement
- ASHP = Air Source Heat Pump
- BAU = Business as Usual
- BCA = Benefit Cost Analysis
- C&I = Commercial and Industrial
- CEP = Customer Engagement Plan
- CGR = Connected Grid Router
- CO2 = Carbon Dioxide
- CP = Customer Portal
- CPP = Critical Peak Pricing
- D = Distribution
- DCFC = Direct Current Fast Charging
- DER = Distributed Energy Resource
- DERMS = Distributed Energy Resource Management System
- DG = Distributed Generation
- DLM = Dynamic Load Management
- DPAM = Distribution Planning & Asset Management
- DPL = Dayton Power and Light
- DR = Demand Response
- DRIPE = Demand Reduction Induced Price Effect
- DSCADA = Distributed Supervisory Control and Data Acquisition
- EC4 = Executive Climate Change Coordinating Council
- EE = Energy Efficiency
- EDI = Electronic Data Interchange
- EHP = Electric Heat Pump
- EIA = Energy Information Administration
- EPO = Energy Profiler Online
- ESB = Enterprise Service Bus
- EV = Electric Vehicle
- FAN = Field Area Network
- FLISR = Fault Location Isolation and Service Restoration
- GBC = Green Button Connect
- GBD = Green Button Download my data
- GHG = Greenhouse Gas
- GIS = Geographical Information Systems
- GMP = Grid Modernization Plan
- HAN = Home Area Network
- HCA = Hosting Capacity Analysis
- HES = Head End System
- HVAC = Heating, Ventilation, and Air Conditioning
- ICAP = Installed Capacity
- ICE = Interruption Cost Estimate
- IoT = Internet of Things
- IP = Internet Protocol
- ISA = Interconnection Service Agreement
- ISO NE = Independent System Operator New England
- IT = Information Technology
- KY = Kentucky
- LDV = Light Duty Vehicle
- LVA = Locational Value Analysis
- MA = Massachusetts
- MDM = Meter Data Management
- MV/LV = Medium Voltage/Low Voltage
- NEM = Net Energy Metering
- NMPC = Niagara Mohawk Power Corporation
- NPP = Non-Regulated Power Producer
- NY = New York
- NWA = Non-Wires Alternative
- OER = RI Office of Energy Resources
- OMS = Outage Management Systems
- PA = Pennsylvania
- PBR = Performance-Based Regulation
- PI Historian = Plant Information Historian
- PIM = Performance Incentive Mechanism
- PLC = Power-Line Communication
- PPL = Pennsylvania Power and Light
- PSE&G = Public Service Electric & Gas
- PSR = Platform Service Revenue
- PST = Power Sector Transformation
- PUC = Public Utilities Commission
- PV = Photovoltaic
- REC = Renewable Energy Credit
- REV = Reforming the Energy Vision
- RF = Radio Frequency
- RGGI = Regional Greenhouse Gas Initiative
- RI = Rhode Island
- RIE = Rhode Island Energy
- RMD = Residential Methane Detector
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Grid Modernization Plan Update

AMF/GMF Subcommittee

Power Sector Transformation Advisory Group

November 9, 2022

Agenda

- 10:00 – 10:10 Introductions, Objectives, Background
- 10:10 – 10:40 Study Results
- 10:40 – 11:10 GMP Functionality Discussion and Roadmap
- 11:10– 11:40 Preliminary BCA Discussion
- 11:40 – 12:00 AMF Linkage to GMP and Next Steps

Objectives

- Discuss and solicit feedback on remaining aspects of the Grid Modernization Plan
  - ✓ Findings of GMP Analysis
  - ✓ Solutions Analysis
  - ✓ BCA Examples
- Next Steps

Ground Rules:

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Oct 7, 2022

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Oct 18, 2022

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- Prior meeting will drive agenda
- GMP Alternative recommendation
- GMP BCA review

w/o Dec, 2022

- Grid Modernization Plan Final BCA Review

December 2022

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November 2022
AMF Targeted Filing Date

December 2022
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- PST Advisory Sub-Committee Meeting GMP
- PUC Technical Session

AMF – Advanced Metering Functionality GMP – Grid Modernization Plan BCA – Benefit-Cost Analysis

GMP Strategy, Goals and Approach

Objectives

1. Invest in the grid so that it meets 21st century demands and the State's clean energy mandates
2. Improve customer service:
   - Improve reliability and safety
   - Maintain / optimize voltage
   - Provide reliable DER interconnections
   - Balance DG and load for stability

Strategy - Apply Grid Modernization

- Automatically restore customers where possible
- Centralize voltage and power quality management with automated capacitor and regulators, and monitoring/managing DERs
- Gain visibility and control to operate reliably with forecasted DER penetration
- Dynamically adapt protection settings based on system configuration
- Improve capability to detect downed conductors
- Predict failures before they occur, respond faster to incidents and use data to improve operations

Goals

- Create situational awareness, operate voltage within tolerance and optimize control
- Realize VVO/CVR functionality
- Design automatic sectionalization considering reliability, DER penetration, contingency capability, resiliency, and load-DG balance
- Achieve PPL EU reliability level with IEEE definition
- Implement DER Monitoring/Management
- Provide reliable, affordable power that meets objectives

Approach

- Use RIE Distribution Study Effort (2030/40/50) to develop ultimate plan, drive priorities and sequencing
- Coordinate with ADMS deployment efforts to align software functionality requirements
- Define transmission, sub-transmission, and substation technology needs to achieve overall strategy
- Review system upgrades alternatives including Transmission and storage etc. to accommodate new load
- Introduce DER Monitor/ Manage capability
- Request approval for ASA compliance
- Include GMP Foundational Investments in ISR

Grid Modernization DER Forecast – Impact to Peak

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GMP DER Forecast/Impact to Peak						
	2030		2040		2050	
	Summer	Winter	Summer	Winter	Summer	Winter
Heat Pumps (Ea.) Forecast	54,000	54,000	325,000	325,000	400,000	400,000
Heat Pumps (MW) @ Peak	0	200	5	1310	5	2825
Solar PV Nameplate (MW) Forecast	1,500	1,500	3,400	3,400	5,000	5,000
Solar PV Nameplate (MW) @ Peak	0	0	0	0	0	0
Electric Vehicles (Ea.) Forecast	87,300	87,300	675,000	675,000	840,000	840,000
Electric Vehicles (MW) @ Peak	70	80	805	910	1010	238
RIE Peak Demand (MW)	**1,940**	**1,415**	**2,519**	**3,280**	**2,785**	**3,855**

More Distributed Generation than Load

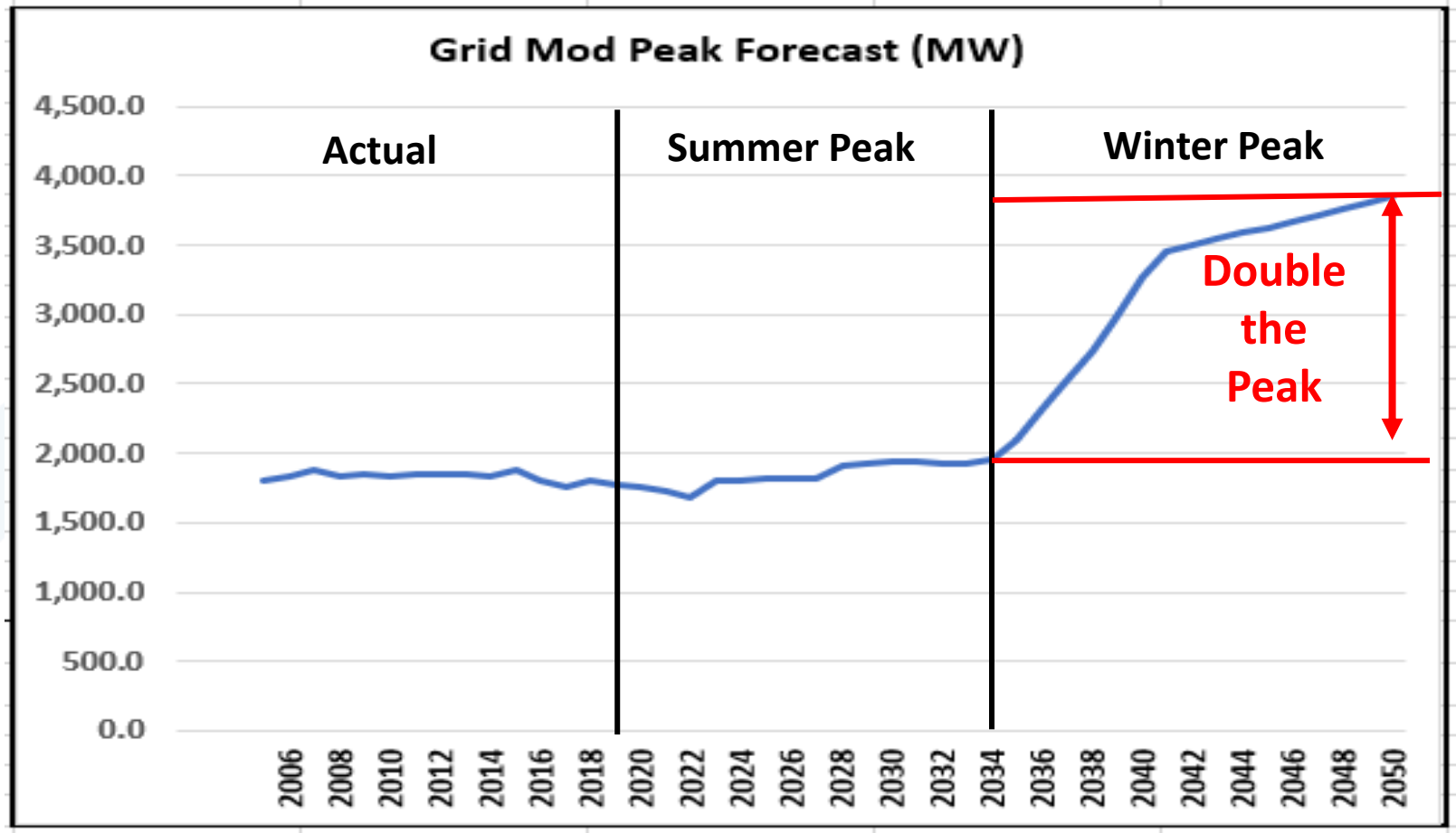
Winter Peak

Peak Demand Doubles

Business Use

Let's Talk About the Peak

- Rhode Island Energy's current peak load is ~1,800-1,900 MW
- By 2050 it is estimated to go to 3,900 with the additional EVs and EHPs added to the system
- Significant penetration of DERs but they have zero impact on Winter Peak and very little impact on the Summer Peak due to SP moving later in the day



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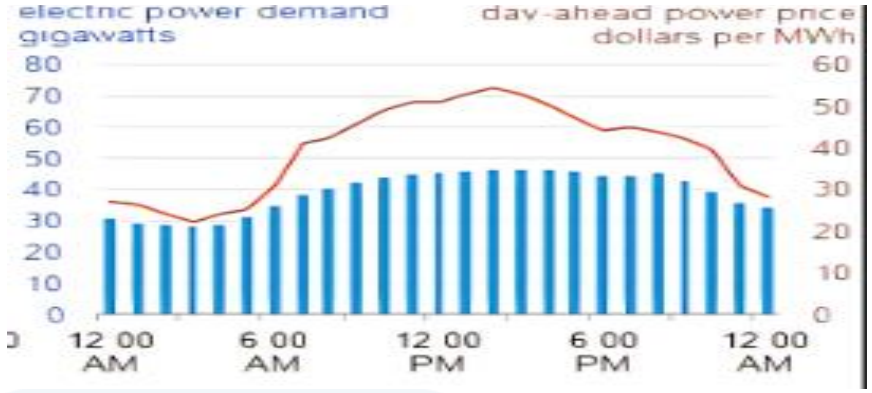
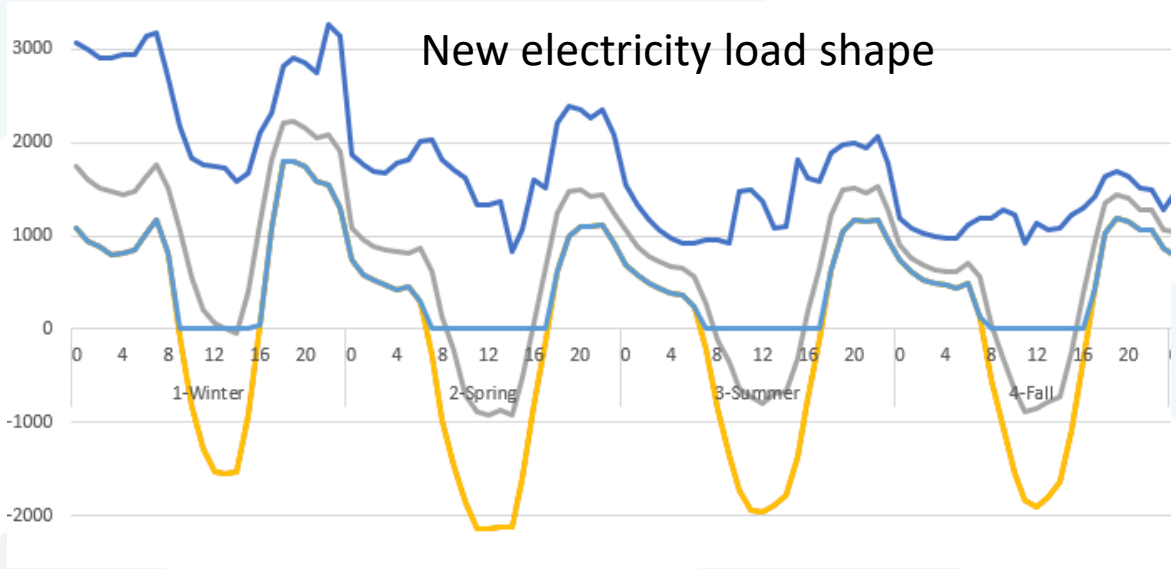
Let's Talk About the Load Shape

- The doubling of the peak creates need for more infrastructure to serve the peak
- Significant penetration of DERs changes the load shape, providing generation when it's not needed and not providing it when it is needed
- The drastically changing load shape creates additional issues due to a need to balance load and generation at every instant of every day

Traditional Electric utility load shape



New electricity load shape



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Study Results

Business Use

GMP Forecast to Meet Climate Mandate

GMP tests Electric System limits to meet Act on Climate Mandate with the following contributing factors:

1. Heating Sector/Commercial and Residential
   - Oil Heat conversions to electric
   - Natural Gas Heat conversions to electric
2. Transportation Sector/Commercial and Residential
   - Gas powered conversions to electric
3. Electric Sector
   - Fossil Fuel (Natural Gas majority in RI) generation conversion to renewable
   - Additional renewable generation to serve increase demand from other sectors

GMP filing proposes foundational investments needed for any level of forecasted adoption: no regrets decision

- Actual adoption in all sectors is uncertain and will vary
- Rates and levels of adoption does not avoid the need for the foundational investments
- Specific adoption may prompt future investments which are not part of the GMP filing.

Heating Sector

- A consideration in the GMP and the Action on Climate Studies
- Natural Gas Heat conversions to electric is the only overlap
- Forecast alignment for Natural Gas Heat conversion to electric is not required for the GMP study

Grid Modernization Study Scope and Status

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Stakeholder Outreach and Consultation

Scope

State-wide 8760 analysis

- ✓ 400 feeders
- ✓ Includes area study recommendations
- ✓ Sub-transmission modeling and testing
- • System-wide transmission analysis

Years: 2030, 2040, 2050 – Aligned with Act on Climate

Analysis

Applied DER forecast to Area Studies:

- ✓ Applied ramped DER forecast to meet Clean Energy Mandate

Issue Identification:

- ✓ Determine load, voltage and protection issues
- ✓ Determine areas with degrading reliability
- ✓ Consider resiliency needs

Solutions:

- ✓ Non-Grid Modernization Solutions – Build for Extremes
  - ✓ Expand Distribution, Sub transmission and Transmission
- ✓ Grid Modernization Solutions – Manage away Extremes
  - ✓ Reduced Expansion of Distribution, Sub transmission and Transmission
  - ✓ System wide Automation & deployment of Sensing, Monitoring, Data Handling and Processing
  - ✓ DER Monitor Manage Energy Shift (TOU)
  - ✓ Battery Energy Storage Systems

Estimation

Estimation:

- ✓ Equipment Costs
- ✓ Installation Costs
- ▪ Final Cost Revisions

Road Map:

- ▪ Device Deployment Plan
- ✓ Functionality Availability

Leverage PPL experience

- ✓ Actual Costs
- ✓ Installation Assumptions
- ✓ Standards

Benefit Cost Analysis

BCA:

- • Comply with Docket 4600
- • Update with PPL experience, Study and Reliability findings

Transition Component:

- • ADMS 'Basic' came with the acquisition

Business Plan

- • Write business plan

✓ Complete
• In Progress

Business Use

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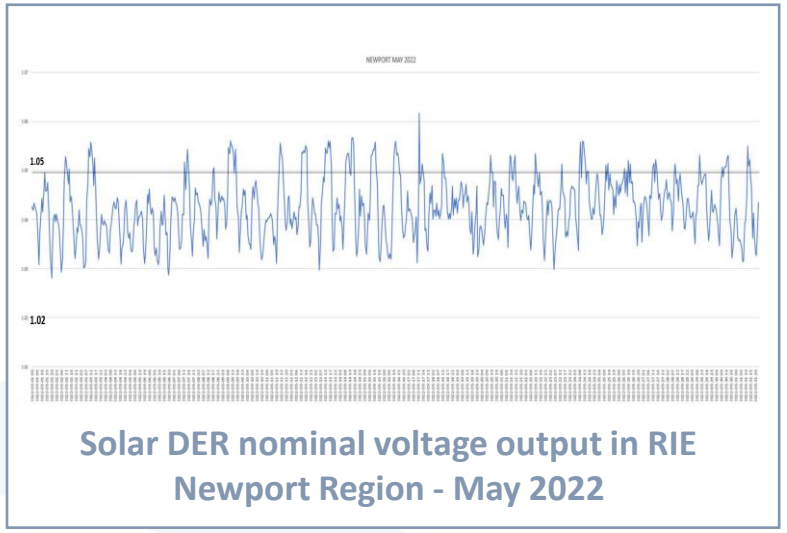
RIE Operational Characteristics Now

- Operational Characteristics:
  - Growing DER adoption and interconnection queue
  - Increased variability of load, voltage, and power flow which increases system complexity
  - Greater operational uncertainty
  - Greater dependency on local generation to balance with load
  - Lacking real time situational awareness

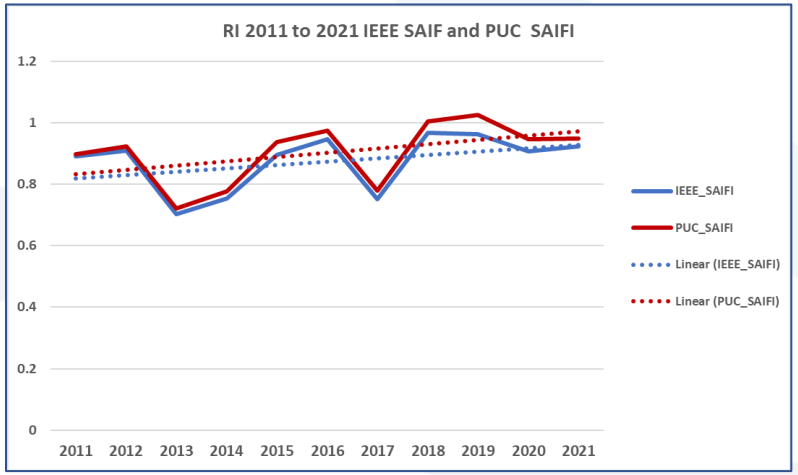
- Consequence:
  - Increasing reliability and safety risk (see trend)
  - DER curtailment and interconnection delays
  - Challenges to recover from major events
  - Recent example at Nasonville



Solar DER nominal voltage output in RIE Newport Region - May 2022

*Required to maintain ±5% of nominal voltage ie 0.95 to 1.05 per unit voltage.

*Voltage repeatedly exceeds 1.05 per unit operating target



SAIFI trending worse (up) in recent years

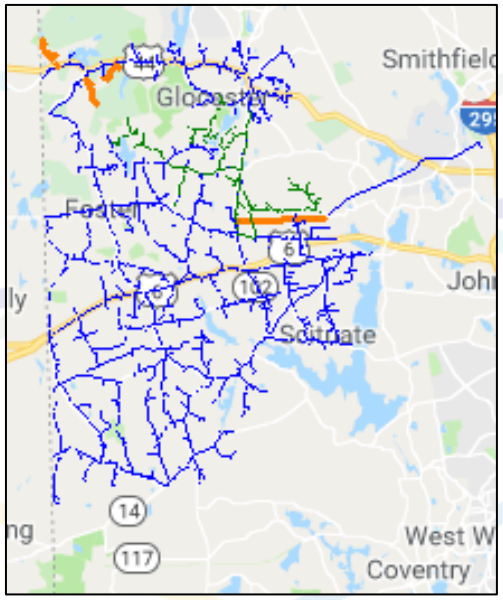
Grid Modernization Area Study Model Inputs

- Base Model – as used with typical planning studies
  - **Area study recommendations**
  - Existing distributed generation confirmed
- Forecasted load, generation, electric vehicles, heating (heat pumps) added
  - Load forecast with energy efficiency incorporated into load profiles
  - Generation added to the model explicitly
    - General distribution PVs added as 100kW sites
    - Specific PV and Wind sites added to sub-transmission
    - Generation load cycles are based on PVWatts and actual data
  - Electric vehicles and heat pumps added as customer load types to existing load sites
    - Electric vehicle load cycle based on EVI-Pro-Lite
    - Heating pump load based on industry research and 2015 weather year

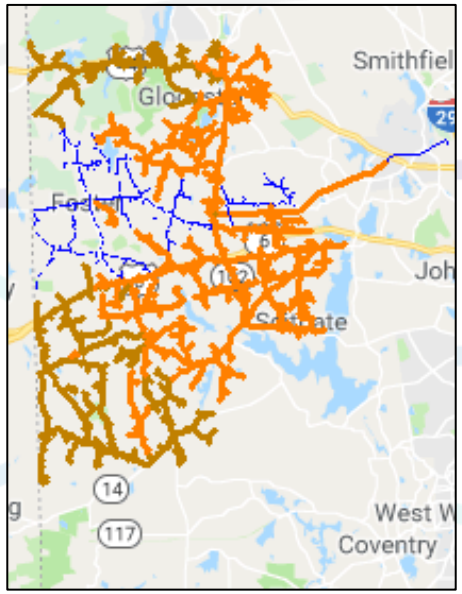
Load Flow and Protection Analysis

- Python script tools developed to distribute PV, EV, and EHP
  - Scattered approach, no propensity modeling
- Time Range Analysis is data intensive and time consuming
  - Time range analysis used to find key dates/times
  - Single time analysis done on key date/time

- Example: Voltage Violation – 5/25 at 12:00 pm
  - Peak load – minimal voltage issues
  - Light load - high voltage with DG – shown in **ORANGE**, **BROWN**



Summer Peak Load



Summer Light Load

Grid Modernization Tiverton Preliminary Area Results 2040

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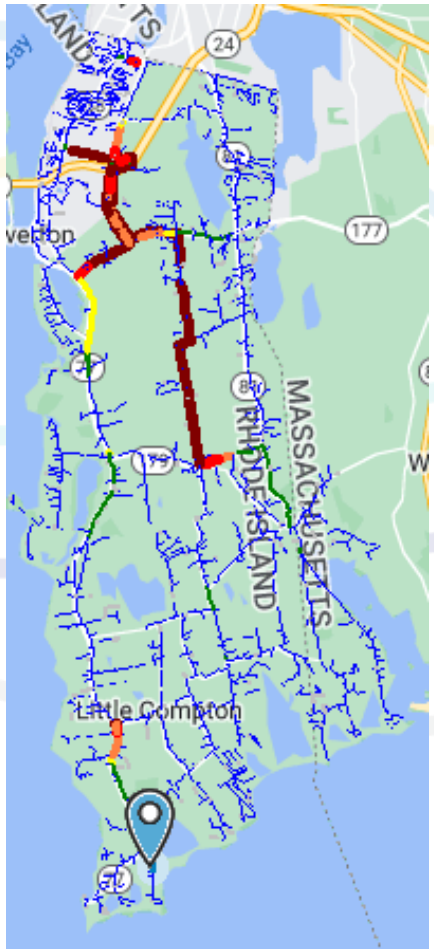
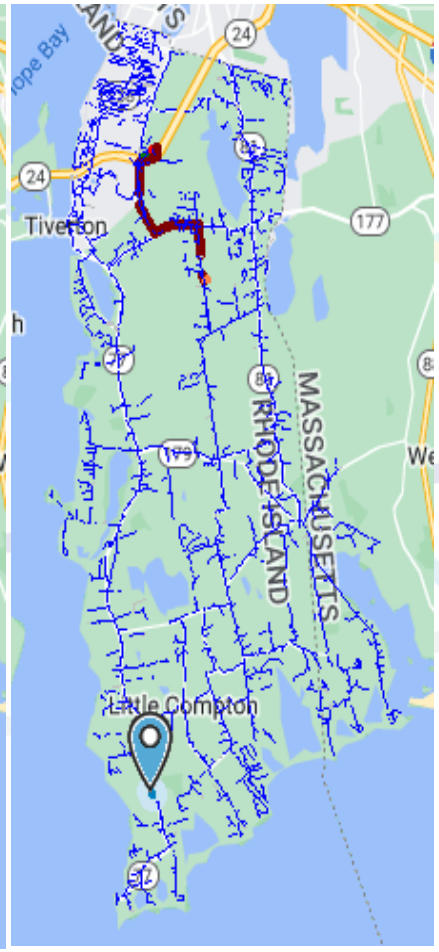
Loading

2/13/2040 6PM

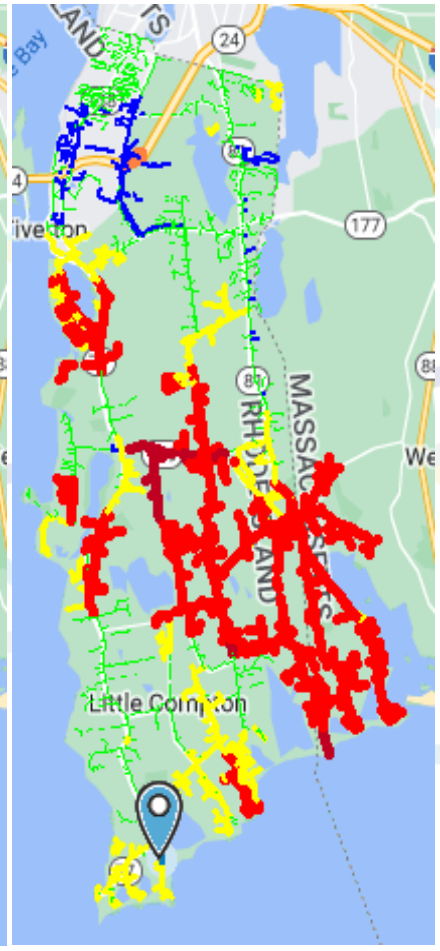


4/16/2040 11AM

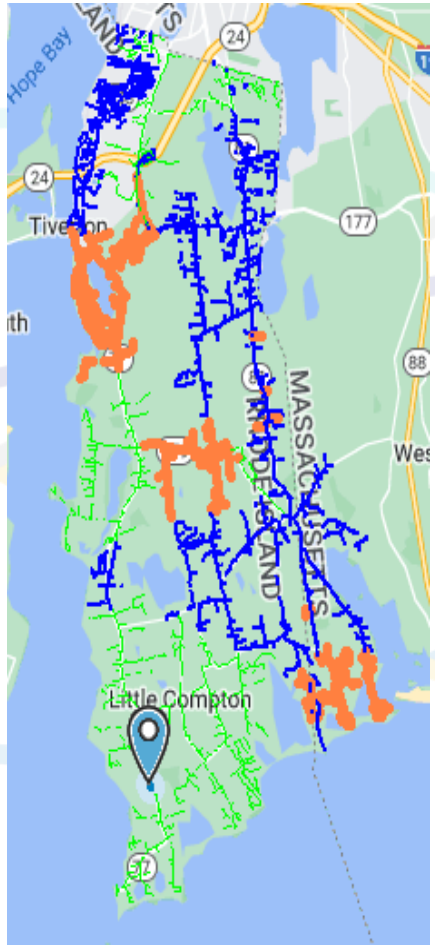


Voltage

2/13/2040 6PM



4/16/2040 11AM



Cool colors are shaded and have no issues

Warm colors are issues

Business Use

Grid Modernization Tiverton Preliminary Area Solutions

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Non-Grid Mod Alternative: Build for extremes by expanding Distribution, Sub-transmission and Transmission

- 3 new feeders added to existing Tiverton Substation
- New area Substation with 2 new feeders added

Grid Mod Alternative: Manage away extremes with system wide automation and deployment of sensing, monitoring, data handling and processing and reducing expansion of distribution, sub-transmission and transmission. Includes, DER Monitor Manage Energy Shift and Battery Energy Storage Systems

- 2 new feeders to existing Tiverton Substation
- 4 BESS Sites - Generation shifts
- Load shifts

- Main Point of the Study is to compare Grid Mod to Non-Grid Mod Alternatives to ensure most prudent option is being recommended

- Results indicate that a Grid Mod Alternative results in 30-50% of deferred capital investments (difference between grid mod and non grid mod alternatives)

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GMP Functionality Discussion and Roadmap

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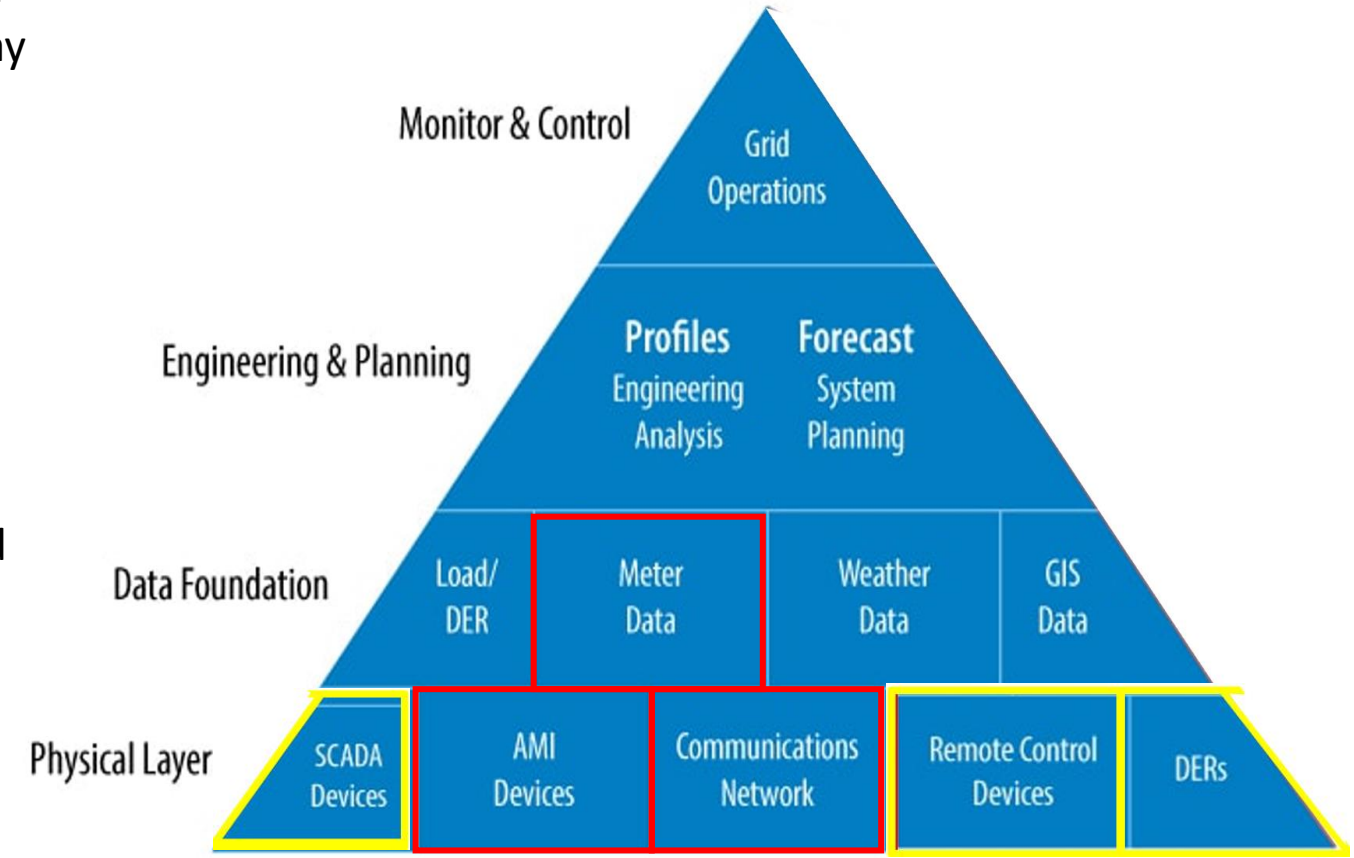
Position for Future Success

- Infrastructure transformation is needed to enable energy policy mandates where traditional one-way power flow is intermittent, multi-directionally, dynamic and unpredictable
- Visibility and enhanced distribution control is necessary for reliable and safe operations
- By applying the grid modernization pyramid, situational awareness and system control can be achieved to successfully operate in the new world
- Approach - recognize evolving needs, identify capability gaps and define ideal characteristics
- Apply technology solutions and leverage data to meet requirements
- Optimize value through intregration



Grid Modernization Pyramid

AMF is foundational and an enabling platform
GMP investments are an operational necessity

The Present – Many Mechanical Devices

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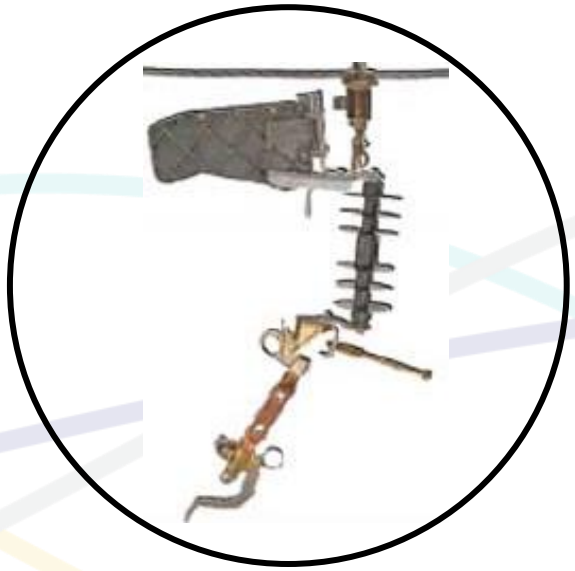
Protective:
Oil-Circuit Recloser

Sectionalizing:
Air-Break Switch



Sectionalizing:
Load-Break Switch

Sectionalizing:
Fused Cutout

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The Proposed – Grid Modernization Components

Protective & Sectionalizing:
Vacuum Circuit Recloser

Switchable Capacitor
Controller

Voltage Regulator
Controller

Recloser Control
with Downed
Conductor
Detection

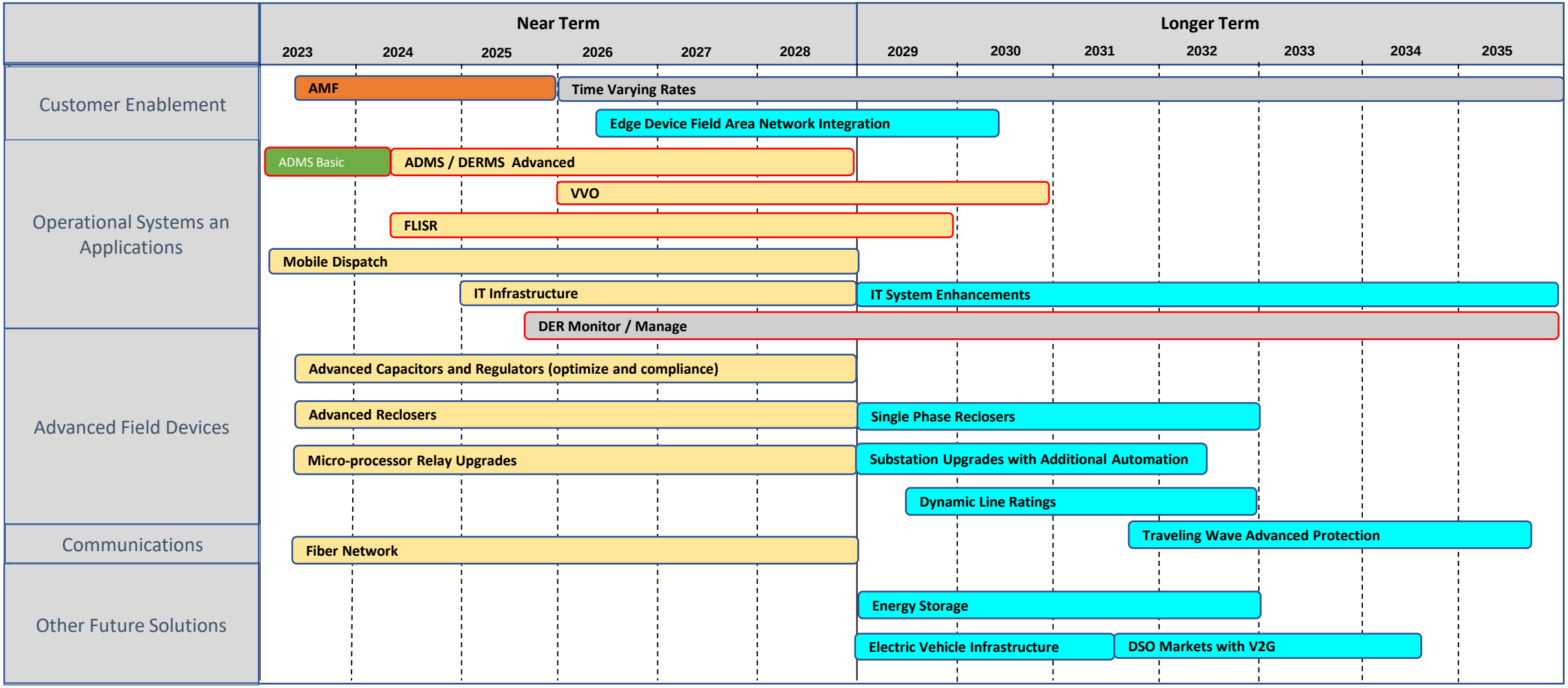
Cellular and Fiber
Communications

ADMS

System Operations:
FLISR and VVO enabled

- Provides operational flexibility, remote settings and operation, ADMS telemetry, forward/reverse fault detection
- Collectively provides comprehensive situational awareness and increased system control
- The greatest benefits when linked to an AMF

Preliminary GMP Roadmap



Operational System Functionality

DERMS related - associated with DER Monitor / Manage*

DMS application ie GIS, power flow, OMS, FLISR, fault location

Basic SCADA functionality: device communication and alarms

Model refined with AMF granular 15-minute data to improve power flow

Software in development

ADMS Basic**

TSA Exit (May 2024)

	GMP Year 1		GMP Year 2	GMP Year 3	GMP Year 4	GMP Year 5	Future
	April 2023 – 2024		2025	2026	2027	2028	2029 +
Subnet Needs for TSA	Subnet Needs for GMP		SCADA Expansion	SCADA Expansion	SCADA Expansion	SCADA Expansion	DERMS (Markets FERC 2222)
Basic SCADA	Basic OMS		OMS (Infor Integration)	Load Model (AMI based)	SCADA App (Intelligent Alarming)	DERMS (Load Management (TVR?)	ADMS Apps (Adaptive Protection) (Phase 2)
Device Management	Electronic Switching		ADMS Apps (Hidden Load)	ADMS Apps (Adaptive Load Shed)	ADMS Apps (Adaptive Protection) (Phase 1)	DERMS (Microgrid Control)	Traveling Wave
Device Cutovers	Load Model (Manual Read)		ADMS Apps (DER FISR, Bus FISR)	Meter Reads (Load & Bell weather)	ADMS Aps (Contingency Analysis - Automated)		Dynamic Line Ratings
Load Shed Tables (TMS)	DMS Apps (Power Flow)		GIS QA/QC		Advanced Apps (Auto Reconfig)		
	DMS Apps (FLISR)		Contingency Analysis (Manual)		DERMS (Forecasting)		
	Meter Reads (Ping & Last Gasp)		VVO (CVR mode)				
			ADMS/DERMS (Monitor and Control)				

* DER Monitor / manage petition dependent
** ADMS Basic provided to RIE at no charge via Acquisition

Volt VAR Optimization (VVO)

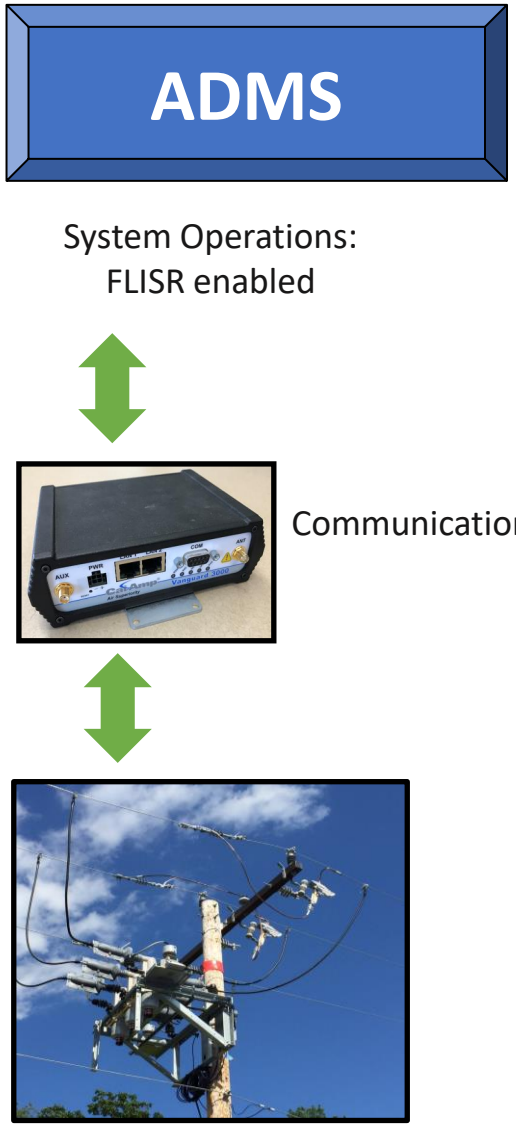
- Requires
  - ADMS: VVO (CVR Mode) enabled
  - Automated Capacitors and Regulators
  - Voltage inputs from AMF and / or sensors

- Assumption
  - Provides 2.5% energy savings: AMF = .5%, GMP = 2%
  - Reduced by 10% to reflect the feeders that have VVO
  - Research shows VVO/CVR savings ranging from 1% to 4.7%
  - RIE's experience on two feeders provided 3.5% savings
  - AMF avoids line sensors and provides granular visibility
  - Benefits ramp up from 2026 - 2031

Fault Location Isolation and Service Restoration (FLISR)

- Requires
  - ADMS: FLISR enabled
  - Automated Reclosers
  - Enhanced with Last Gasp and Power Up AMF Data

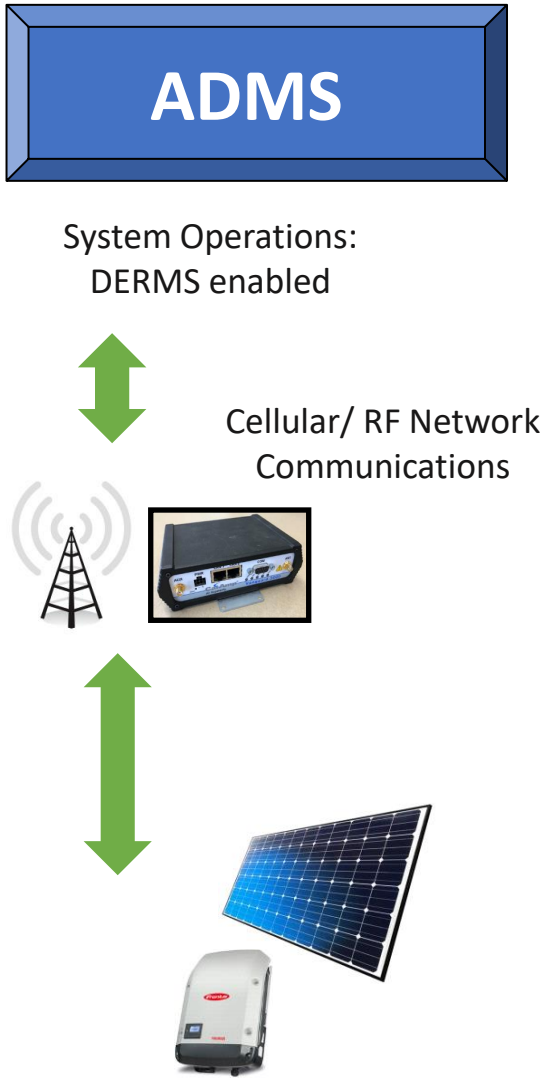
- Assumption
  - Foundational investments include Automated Reclosers
  - Utilizes ADMS Basic provided at no cost from the Acquisition
  - FLISR estimated to provide up to 30% SAIFI improvement
  - Benefits start in 2024 and increase with additional field automation
  - Expected to improve customer satisfaction



DER Monitor / Manage

- Requires
  - ADMS: DERMS enabled
  - IEEE 1547-2018 certified smart inverters
  - DER Monitor / Manage field equipment
  - Communications: RF mesh or cellular

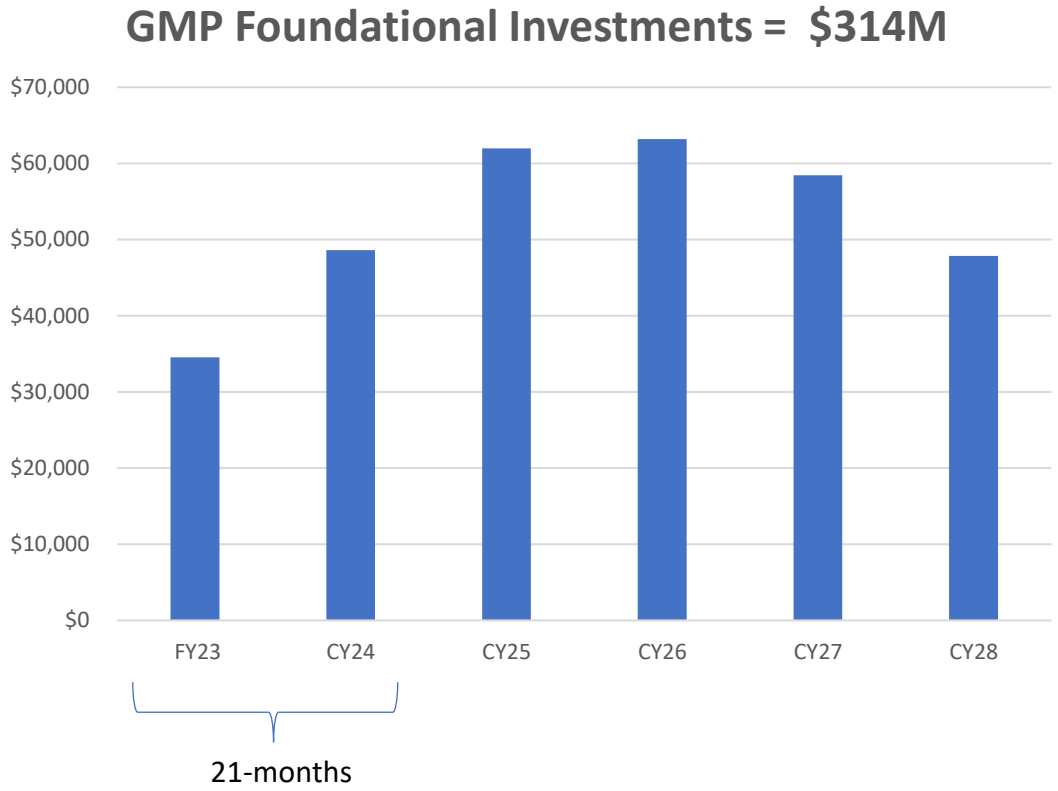
- Assumption
  - Enabled by IEEE 1547-2018 standard
  - Provides second port on smart inverters for distribution utilities
  - Foundational investments includes DER Monitor / Manage
  - Utilizes ADMS DERMS enabled software
  - Provides ability to monitor DERs, change settings, and adjust output (rather than curtailing) for system needs
  - DER Monitor / Manage requires petition approval



GMP Foundational Investments

- Programs
  - ADMS/DERMS Advanced
  - Advanced Capacitors & Regulators
  - Advanced Reclosers
  - DER Monitor/Manage
  - Electro-mechanical Relay Replacements
  - Fiber Network
  - IT Infrastructure
  - Mobile Dispatch

- No Regrets Investment that is needed for any adoption scenario



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Preliminary BCA Results Discussion

Preliminary BCA Solutions to Address GMP Analysis Findings

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Introduction

- Still working on the Benefit/Cost analysis for Grid Modernization
- Have some benefits calculated
- Numbers are VERY preliminary

BCA Basics

Benefits Discussed Today

- Avoided Transmission & Distribution Costs
- VVO/CVR
- Time-Varying Rates
- Reliability – Reduced Frequency of Outages

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Benefit Cost Analysis (BCA) Basics

RI GMP BCA Tool is based on the AMF BCA Tool, so GMP BCA assumptions are kept as close as possible to the AMF BCA Tool

RI GMP BCA Model Assumptions	Values	Notes
NPV Analysis Period	20 year	Consistent with AMF BCA; analysis period specified by PUC
Discount Rate (After-Tax WACC)	6.97%	Consistent with AMF and NWA BCAs
Labor Escalation Rate	3.00%	Consistent with AMF BCA; based on July 1, 2019 base rate cost of service for management employees
Non-Labor Escalation Rate	2.26%	Consistent with AMF BCA; Moody's forecasts of BEA and BLS statistics
Benefit Value Metrics	AESC, EPA, ISO-NE, DOE ICE Tool	Consistent with AMF BCA; generally consistent with the Energy Efficiency Program BCA

Preliminary Benefits Summary

Results thus far: Nominal and $2022 Millions

Total Preliminary GMP Benefits		
As of November 7, 2022		
Category	Nominal ($M)	NPV ($M)
Utility	$ 1,856	$ 1,054
Direct Customer	$ 413	$ 283
Societal	$ 232	$ 174
Total Benefits	$ 2,500	$ 1,510

Preliminary Benefits Summary by Program

Results thus far: Nominal and $2022 Millions

Preliminary GMP Benefits		
As of November 8, 2022	Nominal ($M)	NPV ($M)
Avoided Infrastructure Costs	$ 1,005	$ 439
VVO/CVR Benefits	$ 431	$ 323
EV/TVR Benefits	$ 343	$ 243
Whole House TOU/CPP	$ 307	$ 222
Operational Savings	*TBD*	*TBD*
Reduced Outage Frequency Benefits	$ 413	$ 283
Reduced Outage Duration Benefits	*TBD*	*TBD*
Reduced DER Curtailment	*TBD*	*TBD*
Total Calculated GMP Benefits	$ 2,500	$ 1,510

Benefits – Avoided Infrastructure Costs

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Assumptions

- GMP forecast developed to meet Act on Climate clean energy mandates
- Each of 11 Areas modeled for 8760 hours of the year to identify "new" problem hours
- Base Case: Solved thermal and voltage overloads with traditional wires and support equipment
- GMP Case: Solved thermal and voltage overloads using Grid Modernization equipment and functionalities
- Avoided savings represent the difference between the two cases

Preliminary

Preliminary Avoided GMP Infrastructure Costs		
As of November 8, 2022	Nominal ($M)	NPV ($M)
Tiverton Area - Avoided Infrastructure Costs	$ 53	$ 23
Providence Area - Avoided Infrastructure Costs	$ 116	$ 51
SCW Area - Avoided Infrastructure Costs	$ 31	$ 14
NCRI Area - Avoided Infrastructure Costs	$ 141	$ 61
SCE Area - Avoided Infrastructure Costs	$ 75	$ 33
BVN Area - Avoided Infrastructure Costs	$ 62	$ 27
BVS Area - Avoided Infrastructure Costs	$ 98	$ 43
CRIE Area - Avoided Infrastructure Costs	$ 88	$ 38
CRIW - Avoided Infrastructure Costs	$ 185	$ 81
EB - Avoided Infrastructure Costs	$ 23	$ 10
Newport Area - Avoided Infrastructure Costs	$ 135	$ 59
Total Avoided Infrastructure Costs	$ 1,005	$ 439

Benefits – Volt/Var Optimization/Conservation Voltage Reduction

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Assumptions

- Grid Modernization will allow Rhode Island Energy to save 2% of energy using VVO/CVR
- GMP forecasts of peak and energy include DERs, Electric Vehicles and Electric Heat Pumps
- 10% of feeders already have VVO/CVR
- AESC 2021 values for avoided costs and AESC discount rate
- Capacity lag: 3 years

Preliminary

Preliminary GMP VVO/CVR Benefit		
As of November 8, 2022	Nominal ($M)	NPV ($M)
GMP - Total Non-Embedded CO2 Benefit: VVO/CVR	$ 222	$ 167
Energy Savings: VVO/CVR	$ 138	$ 103
Monetized CO2 Benefit: VVO/CVR	$ 32	$ 24
Trans Capacity Benefit: VVO/CVR	$ 17	$ 12
GMP - System Capacity Benefit: VVO/CVR	$ 12	$ 9
GMP - Total Public Health Benefit: VVO/CVR	$ 9	$ 6
Dist Capacity Benefit: VVO/CVR	$ 1	$ 1
GMP - Total Non-Embedded NOX Benefit: VVO/CVR	$ 1	$ 0
Total VVO/CVR Benefits	$ 431	$ 323

Benefits – Electric Vehicle TVR

Assumptions

- Start with an Opt-In TVR program and transition to an Opt-Out program as more Electric Vehicles come on system
- Program Start Year: 2026
- EVs kWh use:
  - 3,500 kWh in 2022
  - 4,300 kWh in 2041
- EVs' Contribution to Peak:
  - .6 kW in 2022
  - 1.4 kW in 2041
- Peak Savings increase from 29% in 2022 to 60% in 2041
- AESC 2021 values for avoided costs and AESC discount rate

Preliminary

Preliminary EV/TVR Benefit - Mix of Opt-In and Opt-Out		
As of November 8, 2022	Nominal ($M)	NPV ($M)
GMP Total Trans Capacity Benefit: EV TVR	$ 187	$ 132
GMP - Total System Capacity Benefit: EV TVR	$ 138	$ 97
GMP Total Dist Capacity Benefit: EV TVR	$ 12	$ 9
GMP - Total Energy Shift Benefits: EV TVR	$ 6	$ 5
Total EV/TVR Benefits	$ 343	$ 243

Benefits – Whole House Time-of-Use/Critical Peak Pricing

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Assumptions

- Start with an Opt-In TVR program and transition to an Opt-Out program as more Electric Heat Pump
- Program Start Year: 2026
- Peak Savings: TOU
  - 3.7% Opt-In
- Peak Savings: TOU
  - 2.1% Opt-Out
- Peak Savings: CPP – 20%
- AESC 2021 values for avoided costs and AESC discount rate

Preliminary

Preliminary Whole House TOU/CPP - Mix of Opt-In and Opt-Out				
As of November 8, 2022	Nominal ($M)		NPV ($M)	
GMP Total Trans Capacity Benefit: Whole House CPP	$	174	$	126
GMP - Total System Capacity Benefit: Whole House CPP	$	116	$	84
GMP Total Dist Capacity Benefit: Whole House CPP	$	3	$	3
GMP Total Capacity DRIPE Benefit: Whole House CPP	$	4	$	3
GMP - Total System Capacity Savings: Whole House Time-of-Use	$	9	$	7
GMP Total Trans Capacity Benefit: Whole House TOU	$	1	$	1
GMP Total Dist Capacity Benefit: Whole House TOU	$	0	$	0
Total Whole House TOU/CPP	$	307	$	222

Benefits - Reliability

Preliminary

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Preliminary Reduced Outage Frequency Benefits		
As of November 8, 2022	Nominal ($M)	NPV ($M)
Reduced Outage Frequency Benefits	$ 413	$ 283

Assumptions

- System Average Interruption Frequency Index (SAIFI) first quartile performance achievable with proposed advanced reclosers and FLISR, up to a 30% reduction.
- Used DOE's Interruption Cost Estimation (ICE) tool to estimate value of reducing the number of interruptions
- Annual value based on number of customers in Rhode Island Energy's area approximately $27M in $2022
- Inflated at 1.86% (average inflation 2012-2021) and discounted at 3% (Societal discount rate)

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AMF Linkage to GMP and Next Steps

AMF Enables the GMP: Coordinated Business Plans

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AMF enables GMP:

- Granular interval data
- Voltage data
- Remote connect / disconnect
- Automatic notification of outages
- Interaction with customers and in-home technologies
- Remote configuration

GMP Outcomes:

- Fault location, isolation and automatic restoration
- Improved outage restore process
- Safety and operational efficiencies
- Improved power quality
- Volt / Var optimization
- Increased hosting capacity
- Dynamic pricing to incent behaviors
- Demand response
- DER visibility and management
- Greater DER interconnection flexibility

AMF and GMP business plans coordinate benefit and timing assumptions

Wanda

Filing discussion and next steps

AMF and GMP Business Case Linkages

Benefit Quantification

- Volt VAR Optimization / Avoided Sensors
  - AMF .5% energy savings; GMP 2% energy savings
- Outage Management
  - AMF notification automation; GMP dispatch efficiencies and reliability improvements
- Time Varying Rates
  - AMF 20% opt in
  - GMP brings additional participation with locational value proposition

Benefit Timing Considerations

- Software availability
- AMF data availability
- GMP Automation availability

Functionality

- AMF brings foundational and enhancing capability to GMP

Grid Modernization: Why? Why NOW??

- Existing system provides **little distribution operator visibility** and limited automated control
- **Accelerated grid transformation needed** for 21st century to manage increased system complexity. Caused by increased DER penetration and electrification reinforced by State clean energy policy.
- Successful operations requires comprehensive **situational awareness** and more **system control**
- Greatest benefit from **combined AMF and GMP** functionality
- Grid Modernization study tested system limits and identify solutions to meet Act on Climate Mandates resulted in a **no regrets decision for GMP investments** with very positive BCA (preliminary) as the most the most economical alternative
- The **time is NOW:** Reliability trends, Nasonville lessons, renewable interconnection queue, hidden load from switching, high-end DER forecast adoption, clean energy mandates, ADMS Basic availability, increased GMP capability from PPL experience
- **Impacts of a delay:** opportunity cost, customer service, safety, reliability, increased costs, affordability risks, supply chain, delayed benefits, ability to enable clean energy
- **Included in FY24 ISR:** accelerating GMP investments, which are foundational and the path of no-regret
- GMP Business Case: includes long-range studies, **foundational GMP investments**, GMP roadmap and BCA

Next Steps

1. Finalize BCA
2. Align Foundational GMP investments with ISR
3. Finalize Business Case
4. PST Final Meeting December
5. File GMP consistent with ASA requirements

Rhode Island Energy™
a PPL company

Attachments

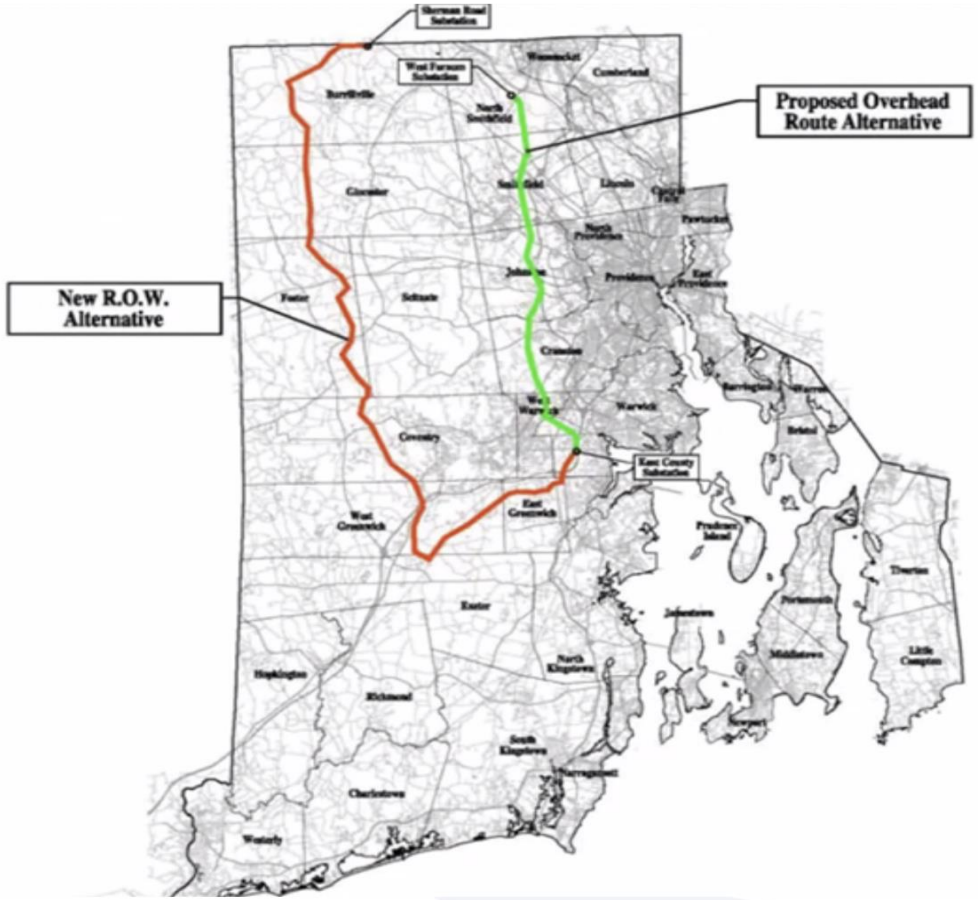
Rhode Island Energy™
a PPL company

Transmission Studies and Sensitivity

System Enhancements Being Studied

Recognizing there is a significant increase in load over the period and more flexibility is needed…

- Reviewing system alternatives that can accommodate most economically
- Transmission alternatives that are being studied are shown (preliminary)
- Many potential benefits to Rhode Island



Combined AMF + GMP advance core objectives

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Advanced Metering Functionality (AMF)		Grid Modernization Plan (GMP)
Existing meters are at end of life and must be replaced; advanced meters result in **lifetime savings for customers**.	$	Advanced meters provide the data backbone to better utilize & operate grid infrastructure, improve service & reliability, & **right-size build-out to reduce long-term costs**.
Near real-time/highly granular data is necessary to operate the grid while **affordably meeting our climate mandates**.	leaf	**Easier and less costly to interconnect** renewable energy, energy storage, electric transportation and heat.
Improved data and greater control are necessary to support **safe, reliable service** now and into the future.	shield	Remote operation and refined control means improved **safety and protection** for workers and infrastructure.
Grid operators will know **exactly when and where outages occur**; customers no longer need to report power is out.	pulse	Software can automatically re-route electricity to reduce outages in our **'self-healing' grid**.
Customers can access **data to manage energy use** and utility bills resulting in greater affordability and superior customer experience.	★★★	Fewer shorter outages and managed more affordable costs are primary **drivers of customer satisfaction**.

The Narragansett Electric Company
d/b/a Rhode Island Energy
RIPUC Docket No. 22-53-EL
In Re: Proposed FY 2024 Electric Infrastructure, Safety and Reliability Plan
Responses to the Division's First Set of Data Requests
Supplemental Response to Division 1-36
Issued on November 4, 2022

Attachment DIV 1-36-5

Grid Modernization and Attachments
Schedule KC/RC/WR-1
Filed on December 30, 2022
Docket No. 22-56-EL

https://ripuc.ri.gov/sites/g/files/xkgbur841/files/2023-01/2256-RIE-Book2-%20GMPlan.pdf

The Company is providing one hard copy of Attachment DIV 1-36-5 referenced above for the Commission's file in this docket.

Prepared by or under the supervision of: Kathy Castro, Ryan Constable, and Wanda Reder

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Confidential

Excel Attachment DIV 1-36-6

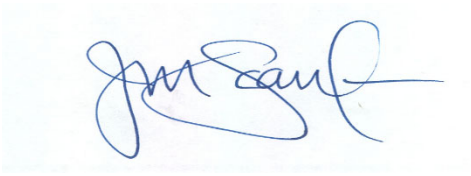
GMP Benefit-Cost Analysis ("BCA") Spreadsheet in Excel format

Prepared by or under the supervision of: Kathy Castro, Ryan Constable, and Wanda Reder

Certificate of Service

I hereby certify that a copy of the cover letter and any materials accompanying this certificate was electronically transmitted to the individuals listed below.

The paper copies of this filing are being hand delivered to the Rhode Island Public Utilities Commission and to the Rhode Island Division of Public Utilities and Carriers.



Joanne M. Scanlon

January 31, 2023
Date

Docket No. 22-53-EL – RI Energy's Electric ISR Plan FY 2024
Service List as of 1/18/2023

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