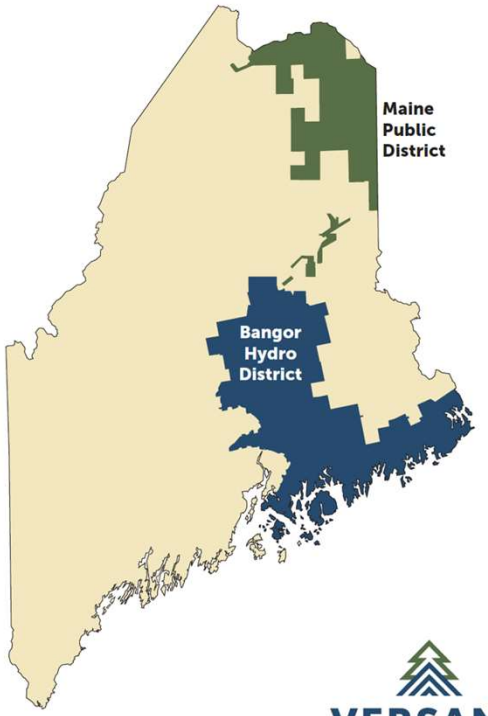
Maine Distribution Systems Roadmap

Prepared for

Agenda

1	Introduction
2	Roadmap Drivers and Development Process
3	Immediate and Short-Term Recommendations
4	Medium-Term Recommendations
5	Long-Term Recommendations
6	Q&A

Utility Territory Maps



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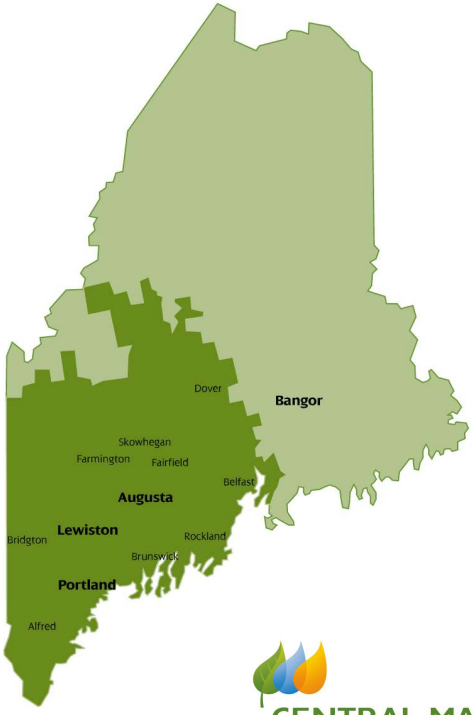

CENTRAL MAINE
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EPE Introduction

About EPE

Electric Power Engineers, LLC (EPE) is a leading consulting engineering firm focused on the energy transition and providing power systems engineering services to a diverse client base including distribution, transmission, generation, and energy market services for utilities, project developers, ISOs, and others.

Vision

To be the leader and innovator in the application of a holistic approach to the design, study, and implementation of infrastructure that enables the integrated grid of the future.

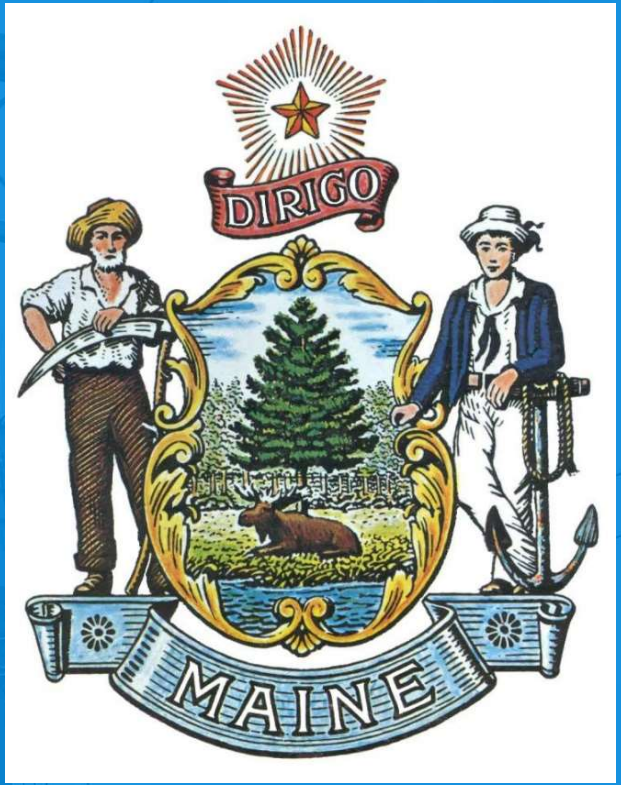
EPE Project Lead: Cody Davis

- Manager, Distribution & Grid Modernization
- Key Team Members: Tamer Rousan, Amin Dindar
- Experience Includes:
  - Distribution Planning
  - DER Interconnection & Smart Inverters
  - Non-Wires Alternatives
  - Value of DER to the Distribution System

Regulatory Drivers

Regulatory

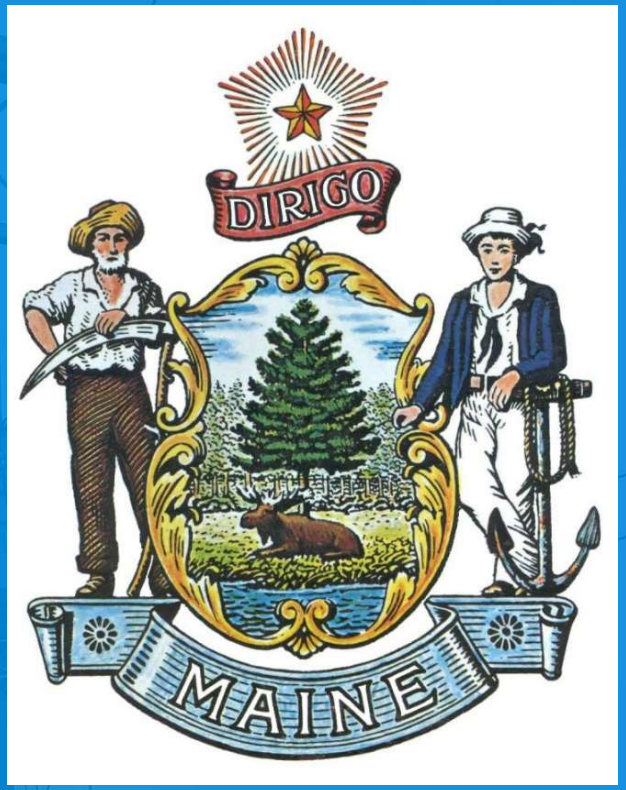
- Public Law No. 1494: Requires electricity providers to include 50% renewables by 2030 and 100% by 2050 in their portfolio
- Public Law No. 1711: Amends and enacts provisions regarding NEB and the Maine Solar Energy Act to support the integration of solar
- Maine Climate Council Goals:
  - To put new 41,000 EVs on the road by 2025 and 219,000 by 2030
  - To develop a statewide EV roadmap by 2022
- Maine Statute Title 35-A, Chapter 97: In 2009, the Efficiency Maine Trust (EMT) was created to administer energy efficiency and alternative energy programs in Maine
- Maine Statute Title 35-A, Chapter 31, Subchapter 2: In 2019, the act resulted in creation of Non-wires Alternatives Coordinator (NWAC) in Maine to oversee capital projects and offer lower cost NWA



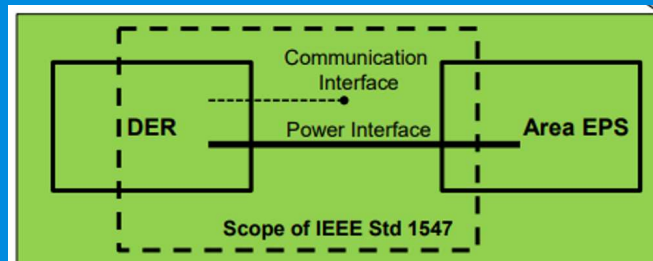
Regulatory Drivers

Regulatory

- EMT Requirements
  - EVSE promotion: Utilities must design rates to encourage EVSE use and file a rate schedule proposal to MPUC
  - By January 1, 2050, reduce overall GHG emissions to 80% below 1990 levels
- Public Law No. 1766: Sets forth the goal to have 100,000 heat pumps installed in Maine by 2025
- MPUC Rule 407 Chapter 320: Provides quality of service standards, voltage requirements, provisions on how and when to report service interruptions, and metering requirements for T&D utilities
- Public Law No. 1181: Establishes how utilities should approach NWA, non-transmission alternatives, behind-the-meter alternatives, and the processes for how projects will be assessed
- Case 2021-00039: Initiate an investigation of the design and operation of Maine's electric distribution system



Technological Drivers



IEEE Std 1547-2018

- Focused on distribution and bulk system aspects.
- Specifications encompass the whole DER.
- Can be used for equipment listing as well as plant-level verification.
- Includes both electrical as well as interoperability/communications requirements.
- *Shall be capable of* ride-through and grid support

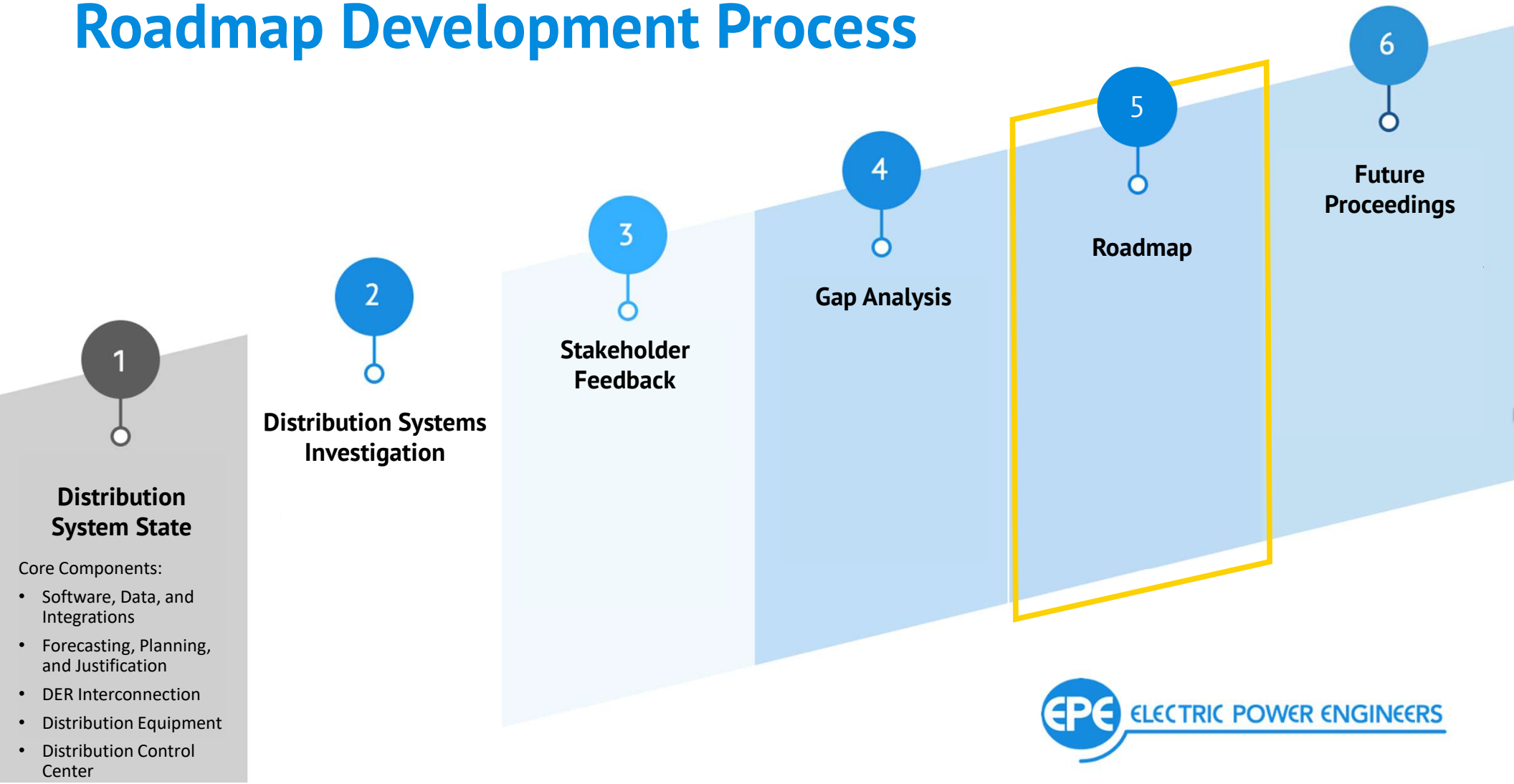
EV Charging and Management

Energy Storage Systems

Solar PV

Heat Pumps for Cooling and Heating

Roadmap Development Process



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Roadmap Introduction

Prescribed Areas of Focus:

- Proliferation of distributed energy resources (DERs)
- Electric vehicles (EVs) and electrification adoption

Other challenges:

- Increasing importance and public expectation of grid reliability and resilience
- Affordability of service
- Increasingly complex distribution system
- Erosion of traditional planning and operating assumptions

Adopting recommendations to ensure:

- Maine's climate goals are supported
- DER integration is as streamlined and efficient as possible
- EVs and electrification loads are integrated to effectively manage system capacity
- System reliability and resilience are improved
- Strike the right balance of investment and affordability
- Increased visibility and operational awareness
- Reduce dependencies on assumptions

Stakeholder Process

Goals:

- Understand key concerns and perspectives of impacted parties
- Provide stakeholders an avenue to influence roadmap focus
- Ground recommendations with public perspectives

Stakeholders Included:

- AARP Maine
- Aroostook Energy Association
- Central Maine Power Company
- City of Portland
- Conservation Law Foundation
- Dynamic Grid
- Eastern Maine Electric Cooperative
- Efficiency Maine Trust
- Governor's Energy Office
- ISO New England
- Symbiotic Strategies
- Maine Renewable Energy Association
- Maine State Representative Nicole Grohoski
- Maine State Representative Seth Berry
- Maine State Senator Trey Stewart
- Northern Maine Independent System Administrator
- Office of the Public Advocate
- Revision Energy
- Versant Power

Stakeholder Feedback Examples

Stakeholder Needs

- Facilitating DER integration and clarifying the process
- Reliability and resilience improvements while keeping energy costs low
- Public investment in efficiency, demand response, and other behind-the-meter initiatives
- Supporting EV and electrification adoption

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Immediate and Short-Term Recommendations

Recommendations for both CMP and Versant

Hosting Capacity: How much DER can be accommodated without "significant modifications"

Expected benefits:

- System information availability to developers and stakeholders
- Directing developers to low-cost areas
- Reduction in number of applicants in areas where cost is expected to be high
  - Reduces overall study costs

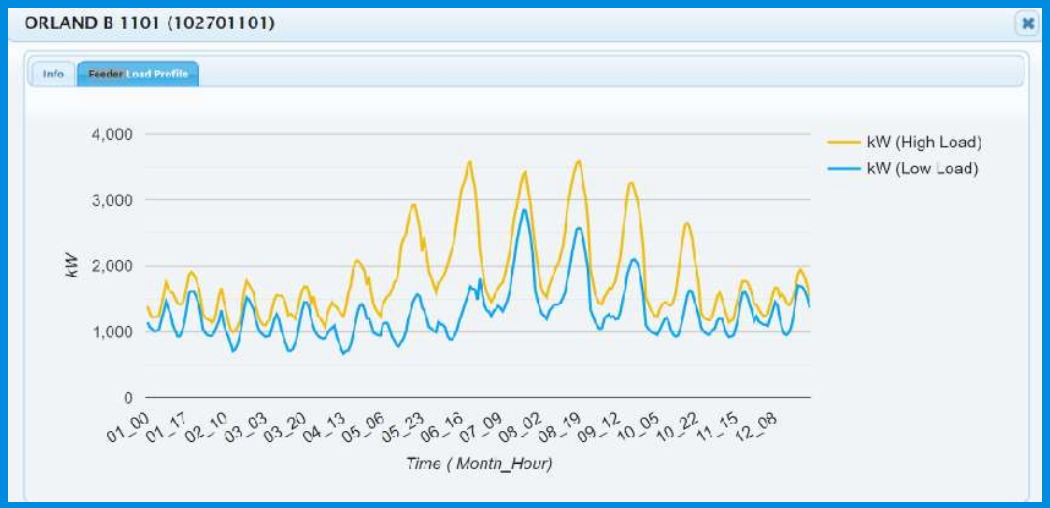
Potential Pitfalls:

- Timeliness of Updates
  - Too infrequent is stale and not useful
  - Too frequent can be costly to implement and oversee
- Specificity of Information
  - Too general is not useful
  - Too specific may be overwhelming or not cost-effective
- Definition and Threshold for "significant upgrades"

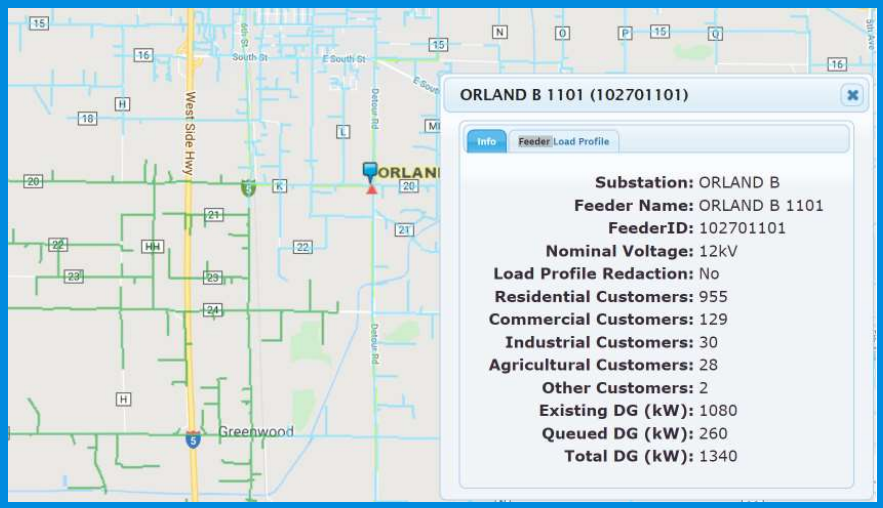
Immediate and Short-Term Recommendations

Recommendations for both CMP and Versant

Hosting Capacity



SCE substation feeder load profile



SCE hosting capacity map

Recommendations for both CMP and Versant

Hosting Capacity

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- CMP plans to expand its hosting capacity pilot to entire distribution system by 2022 for both load and generation
- Costs: Additional manual processing efforts, troubleshooting of the hosting capacity tool, validating and correcting erroneous results, and publishing generated data
- Expected timeline: An ongoing annual effort to update and refine the map after planned roll out in 2022

VERSANT POWER

- Currently, Versant is not publishing hosting capacity maps for load or generation
- Costs: software integration, additional manual processing effort, troubleshooting of the hosting capacity tool, validating and correcting erroneous results, and publishing generated data
- Next steps: Solidify processes and timeline

Recommendations for both CMP and Versant

EV and Electrification Team

There is a need for a dedicated team to coordinate with EMT to encourage EV and electrification adoption in Maine and manage the additional load.

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- CMP is planning to add incremental full-time employees to focus on EV and electrification research and program development

VERSANT POWER

- Versant currently has no plans to form an EV and electrification team

Recommendations for both CMP and Versant

Continuing Reliability Improvement

The need for continued distribution system reliability improvement in Maine was expressed by several stakeholder groups. Both CMP and Versant identified ongoing and expanded programs to improve system reliability.

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- CMP's service territory is heavily wooded which has had an adverse impact on reliability indices
- CMP has comprehensive area study projects, and grid resilience, including system hardening, vegetation management, circuit ties, and automation to improve reliability

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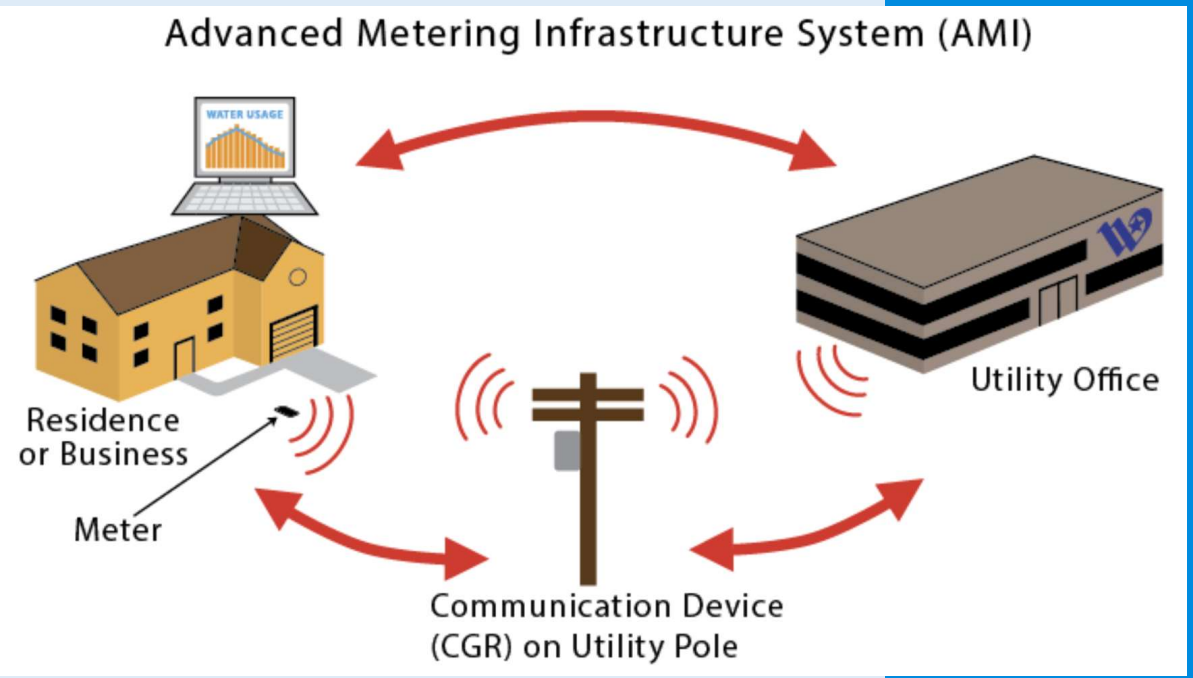
- Main outage cause: Weather including weather-induced tree contact
- Versant has several planned reliability investments that are expected to improve reliability including elements like tree wire, danger tree removal, and installing additional protective devices

Recommendations for both CMP and Versant

Increased Data Utilization in Planning



- There is need for meter data utilization in planning and system studies
- Benefits: Improved model quality and visibility of distribution system, creating a foundation for migration to time-series analysis, and detailed analytics of load data

Recommendations for both CMP and Versant

Increased Data Utilization in Planning

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- All existing AMI can read KW and KWh; over 40% can be pinged for voltage reading; 4,000 meters can read kVAr; all can read temperature
- Currently, CMP uses historical kWh billing data for load allocation
- DERs are included in distribution planning studies using capacity factors
- CMP plans to integrate AMI data into CYME for more accurate power flow results and building load profiles

VERSANT POWER

- In MPD: L&G Turtle AMR systems that only collect KWh; In the BHD: Aclara TWACS, a two-way AMI system that collects kW, kWh, and amps.
- Currently, Versant uses historical kWh billing data for load allocation
- Future plan: In 2022, Versant plans to upgrade to Itron Riva AMI system with an RF mesh network which will be able to read 15 data points including kW, kWh, amps, voltage, kVAr, and temperature.

Recommendations for Versant

VERSANT POWER

DER Application Portal:

- Versant's current system for processing DER applications is manual
- Expected benefits: Facilitating and speeding up DER application processing and tracking

Modifying Equipment Ratings:

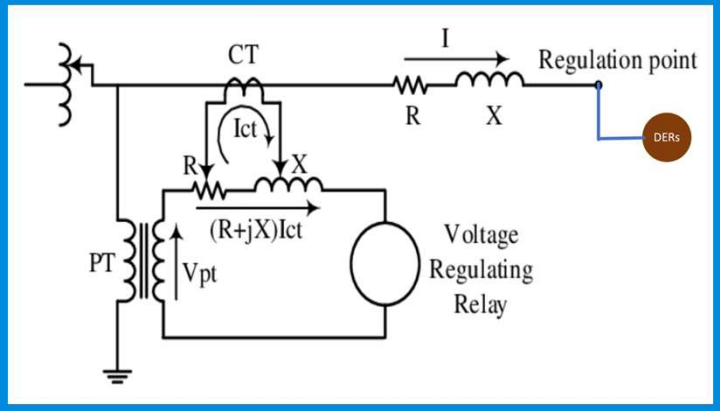
- Utilization of "Summer Normal" ratings is very conservative
- With the expected increase in EV adoption and electrification, using Winter and emergency ratings can increase capacity without significant capital investments
- Example: A transformer with Summer Normal rating of 25 MVA may be rated at 30 MVA in the winter season

Recommendations for Versant

VERSANT POWER

Voltage Regulator Load Drop Compensation (LDC) Modifications:

- Currently, Versant has locations with voltage regulators with LDC (or "R" and "X") settings
- Increase in DERs integration with smart inverter functions like volt/var may cause unintended negative voltage impacts
- Recommended to monitor DER penetrations at locations where voltage regulators with LDC exist



Medium-Term recommendations

Recommendations for both CMP and Versant

Capital Project Evaluation:

- Recommendation: Combine SMEs input with data-driven and analytical methods for capital project evaluation. Example: DOE-Funded Interruption Cost Estimate Calculator (ICE)

CENTRAL MAINE POWER

- CMP began using AVANGRID's planning process in 2021 heavily relying on SMEs' input
- Recommendation: Moving toward more analytically driven methods considering NWAs in collaboration with NWAC in Maine

VERSANT POWER

- Versant currently uses both analytical and SME's input for investment justification
- The analytical part is specific to reliability improvement projects and the criteria are "dollar per avoided outage occurrence" and "dollar per avoided outage duration"
- Recommendation: Moving toward more analytically driven methods considering NWAs in collaboration with NWAC in Maine considering non-reliability related projects

Recommendations for both CMP and Versant

Advanced EV Load Forecasting (in collaboration with EMT)

Accurate EV load forecast leads to having knowledge of energy and capacity impact of EVs on the system.

Factors impacting EV adoption

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- CMP's work: A scenario-based (low, medium, and high) temporal and spatial EV load forecast along with initiating pilot projects for DC fast-charging (DCFC)
- Expectation: Improving the current process to consider the impact of variables such as time-of-use rates, charging station costs, and incentive structures

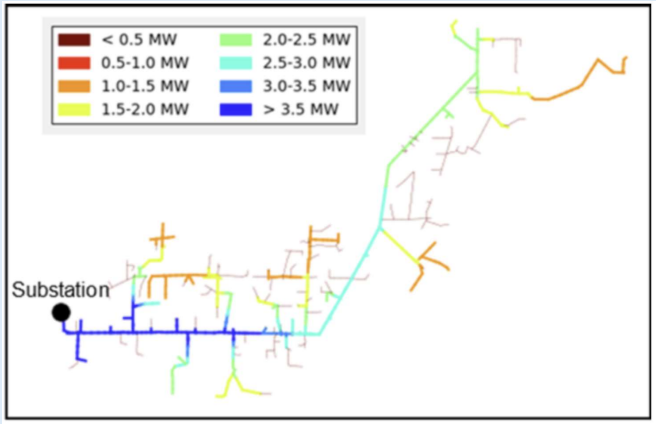
VERSANT POWER

- Versant currently does not forecast EV and electrification loads

Recommendations for both CMP and Versant

Electrification/Load Hosting Capacity Map

- Hosting capacity map for load leads to:
  - Identification of high-capacity areas in the system
  - Locating large charging stations and electrification in optimal areas
  - Capital capacity investments deferral



Example: hosting capacity heat map[1]

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- CMP's plan: To toll out load hosting capacity map along with DER hosting capacity map in 2022.

VERSANT POWER

- Versant currently has no plans for load hosting capacity map development.

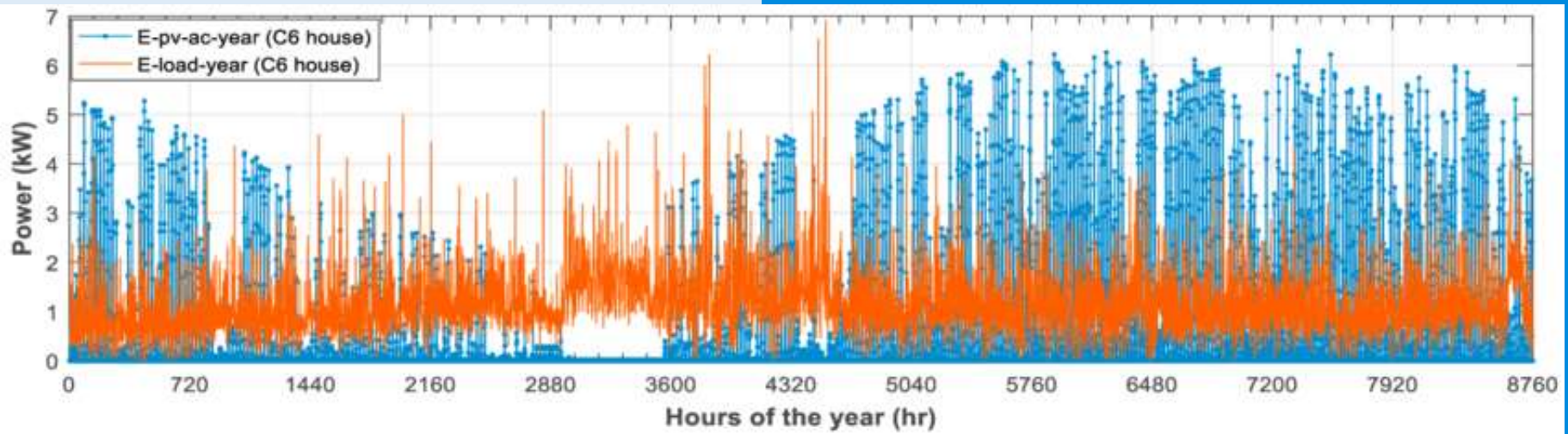
1: https://www.esig.energy/blog-methods-applications-hosting-capacity/

Recommendations for both CMP and Versant

Time Series Profiles and Planning Capabilities

- Migration from snapshot/worst-case analyses to time-series based approaches helps accounting for granular effects of DER outputs, EV and electrification loads, and complex advanced control capabilities
- CYME module for time-series analysis: "Steady State Analysis with Load Profiles"

Time-series load and PV output profiles[1]



1:https://www.researchgate.net/figure/Hourly-PV-and-load-profile-for-full-year-C6-house_fig1_322849772

Recommendations for both CMP and Versant

Time Series Profiles and Planning Capabilities

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- CMP's current practice: Consideration of capacity factors to determine DERs outputs alignment with substation peak load.

VERSANT POWER

- Versant is not currently utilizing time series profiles in system studies.

Recommendations for both CMP and Versant

Expand EV Pilot Projects

- Purpose: Identifying realistic challenges and benefits associated with EV adoption

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- CMP's work: EV Make-Ready program, a suite of EV charging rates

VERSANT POWER

- Collaboration with CMP and using their experience is recommended
- Recommendation: Versant to begin considering various EV pilot projects implementation to realize the impacts and potential for system-wide adoption

Recommendations for Versant

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EV roadmap elements[1]

1. Coordination with Policymakers and the Public
2. Expanding Electric Vehicle Supply Equipment (EVSE) Infrastructure
3. Electric Vehicle Rebates and Other Purchase Incentives
4. Market Engagement and Education
5. Grid Reliability in an Electrified Transportation Future

1: https://drintl.com/wp-content/uploads/2020/04/DR-White-Paper-Utility-Roadmap.pdf

EV and Electrification Roadmap (in collaboration with EMT):

- No incorporation of EV and electrification in Versant's operations and planning maybe due to capacity availability
- Recommendation: Versant to begin considering the expected impacts of increasing EVs and electrification as part of the medium to long-term planning process

Recommendations for CMP

CENTRAL MAINE POWER

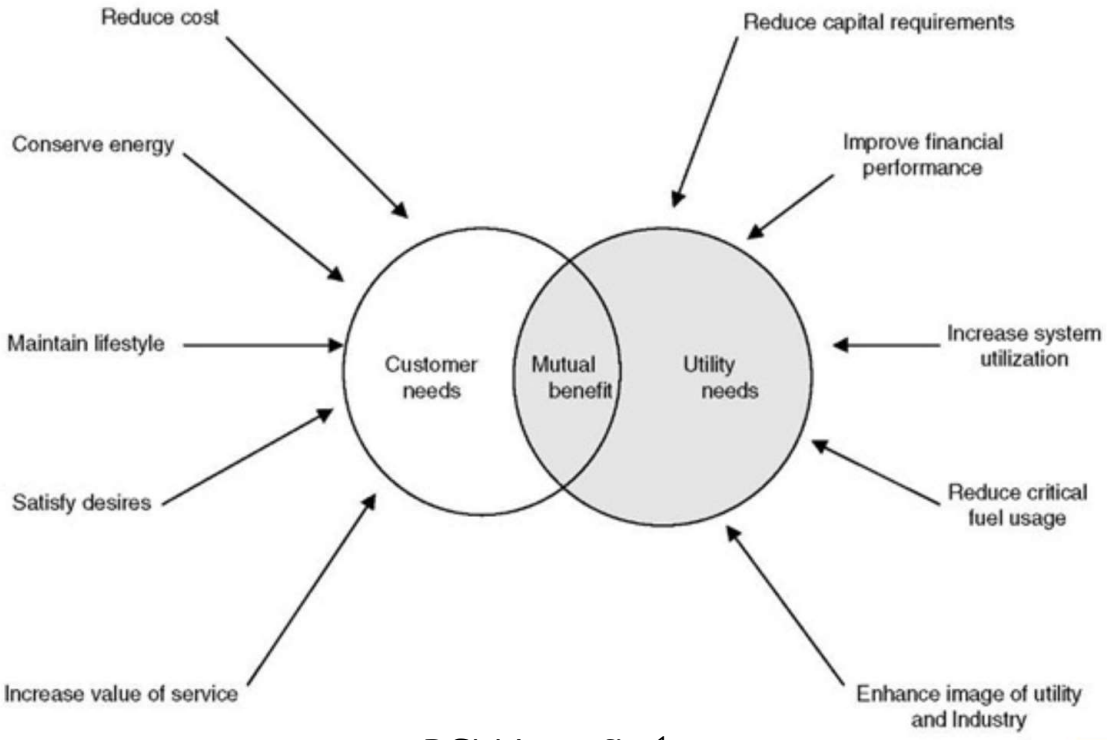
Data and Model Quality

- Current challenge: Data quality especially distribution phase assignment and customer-to-service transformer mapping
- CMP's plan: Grid model enhancement project (GMEP), i.e., a comprehensive distribution system audit

Improved Operational Voltage Control Capabilities

- Critical utility functions: Maintaining power quality and effectively controlling voltage in presence of variable DERs
- CMP's plan: Installing communication devices for remote management of capacitors
- Through deployment of Spectrum ADMS, CMP will be able to implement remote controls over capacitors, regulators, and LTCs to effectively control voltage.

Long-Term Recommendations



DSM benefits[1]

Recommendations for both CMP and Versant

Utilization of Smart Meters for Demand-Side Management (DSM) (in Collaboration with EMT)

1:http://what-when-how.com/energy-engineering/demand-side-management-programs-energy-engineering/

Long-Term Recommendations

Recommendations for both CMP and Versant

Utilization of Smart Meters for Demand-Side Management (DSM) (in Collaboration with EMT):
The implementation of DSM programs depends on the development of future technologies that would mitigate the interoperability challenges identified by existing DSM pilot programs that have limited its scalability.

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- Current AMI utilization by CMP: collecting power consumption, momentary outage detection, remote connect/disconnect, outage detection, billing, voltage optimization (pilot), theft detection, on-demand reads, and power flow (future plan).

VERSANT POWER

- Current AMI utilization by Versant: collecting power consumption, voltage optimization (pilot), remote connect/disconnect, outage detection, theft detection, billing, load flow, and on-demand reads.

Recommendations for Versant

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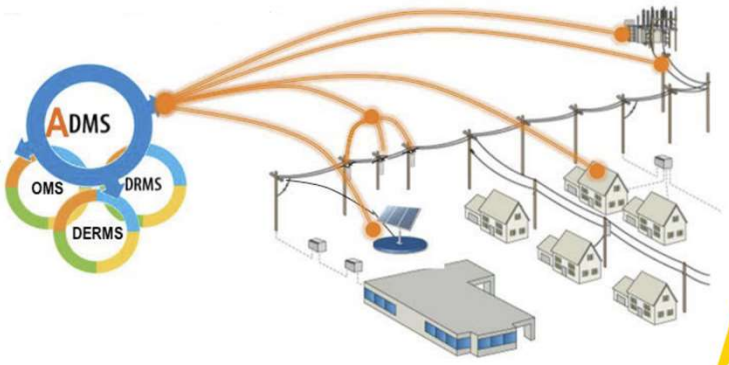
ADMS implementation[1]



1: https://www.nrel.gov/docs/fy20osti/72739.pdf

ADMS Deployment

- Versant does not currently have an ADMS system deployed.
- Benefits
  - Lower operations and maintenance costs
  - Faster service restoration and improved reliability
  - Improved power quality and energy efficiency
  - More efficient crew dispatch during outages
  - Enhanced customer experience and satisfaction
- Potential drawbacks
  - High cost of implementation
  - Engineering trainings to utilize automated functionalities
  - System study complexities


Q&A
EPE