Avangrid A member of the Iberdrola Group

Central Maine Power
An Avangrid company

Integrated Grid Plan

Milestone 2 Stakeholder Meeting: Needs Assessment

August 25, 2025

Agenda

Introductions

Chris Morin, Sr. Director, Integrated System Planning

Jacob Farmer, Manager, Transmission Planning

Marshall Ripley, Sr. Principal Engineer, System Planning

Craig Nale, Sr. Director, Regulatory Affairs

Overview of Integrated Grid Plan Process

Milestone 1

Develop Inputs to Planning Models

- Key components:
  - Forecasts of electric load growth
  - Forecasts of available generation and dispatch
  - Projects and contingencies
- Outcome:
  - Transmission and distribution models for the electric system through 2034

Milestone 2

Needs Assessment

- Key components:
  - System modeling using inputs to simulate future conditions
  - Identification of grid constraints under various scenarios
  - Consideration of asset condition, load growth, and DER integration
- Outcome:
  - A comprehensive understanding of where and when grid upgrades or modifications are needed

Milestone 3

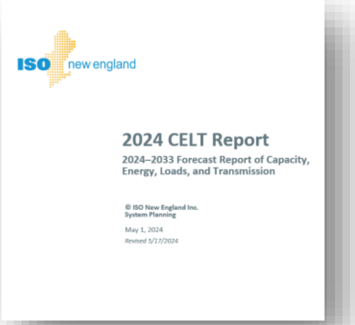
Solutions Development

- Key components:
  - Exploration of wires and non-wires alternatives (storage, DERs, demand response)
  - Evaluation framework
  - Prioritization of investments aligned with state policy goals
- Outcome:
  - Portfolio of potential actionable and cost-effective grid solutions

Review of Milestone 1: Models and Inputs

ISO-NE CELT 2024 Forecast

- 50/50 "baseline" forecast
- 90/10 "high adoption" forecast
- Load and generation growth


ISO new england

2024 CELT Report

2024–2033 Forecast Report of Capacity, Energy, Loads, and Transmission

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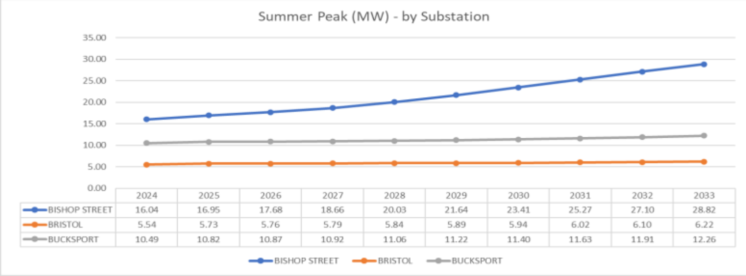
System Planning

May 1, 2024

Revised 5/17/2024

Adjusted for local conditions

- CMP's "bottom-up" forecast accounts for local differences in residential or industrial customers, EV adoption, heat pump adoption, native growth

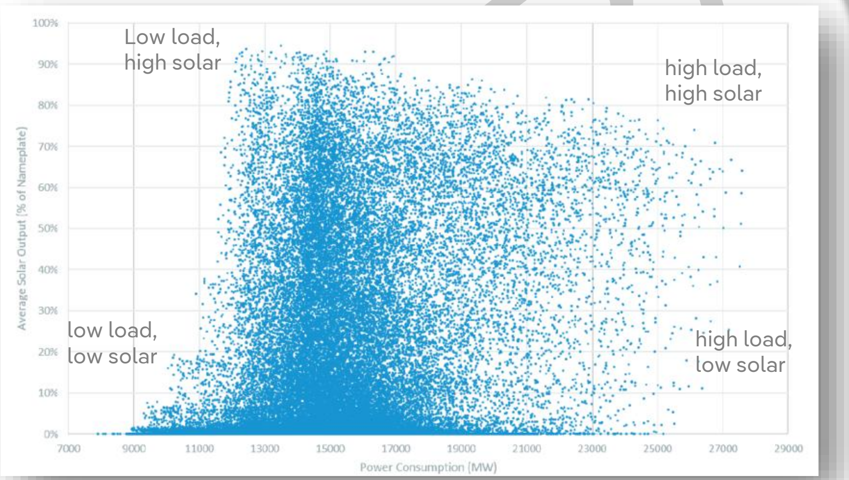


	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
BISHOP STREET	16.04	16.95	17.68	18.66	20.03	21.64	23.41	25.27	27.10	28.82
BRISTOL	5.54	5.73	5.76	5.79	5.84	5.89	5.94	6.02	6.10	6.22
BUCKSPORT	10.49	10.82	10.87	10.92	11.06	11.22	11.40	11.63	11.91	12.26

Example of how "bottom-up" approach shows variations in growth between circuits

Six snapshots represent varying usage at different times of the day and year

- Summer daytime peak
- Winter evening peak
- Summer evening peak
- Spring minimum
- Daytime minimum
- Evening minimum



Snapshots account for daily and annual variations in load and generation, to ensure all scenarios are considered

Key Takeaways from Milestone 1:

- Peak demand growth varies by season and location:
  - Summer: growth ranges from 0% to 150% (higher growth in urban areas)
  - Winter: growth ranges from 3% to 230% (rural areas show higher growth in winter)
- Historically summer peaking, but forecasts show the CMP system is expected to become winter peaking by 2028
  - Solar generation significantly lower in the winter
- Forecasting over 1500 MW of DG/solar on the CMP system by 2033, up from about 940 MW already in service
  - DG generally located in more rural areas can exceed demand

Overview of Milestone 2: Needs Assessment

Assess Current Grid Conditions

- Review how much electricity the system can safely carry (thermal limits)
- Check voltage levels to ensure safe and stable delivery of power
- Evaluate the physical condition of infrastructure (e.g. poles, wires, transformers)

Identify System Stress Points

- Locate areas where equipment is overloaded or nearing capacity
- Detect voltage fluctuations that could affect service quality
- Consider aging or deteriorating assets that may be prone to failure

Consider Reliability and Resilience

- Examine outage history and system performance during extreme weather
- Identify vulnerable areas that may need upgrades to recover faster from disruptions

Forecast Future Needs

- Use load forecasts and electrification trends (e.g. EVs, heat pumps) to predict where demand will grow
- Model different scenarios to understand how the grid will perform under various future conditions

What Needs are Being Assessed: Primary IGP Needs

Thermal Overloads

Definition: Thermal overloads occur when the current flowing through a power line or transformer exceeds its rated capacity, causing it to overheat

Why it matters: Can damage equipment, reduce its lifespan, and increase the risk of outages and fire

Causes:

- High electric demand during peak usage periods, including because of electrification of heating and transportation
- Backfeeding from solar or batteries in areas of the grid not designed for two-way power flow
- Aging infrastructure – older equipment generally has lower ratings

Voltage Violations

Definition: Voltage violations occur when the voltage at a point in the grid falls outside acceptable limits (typically ±5% of nominal voltage)

Why it matters: Can damage customer equipment, reduce power quality, and impair grid stability

Causes:

- Solar PV can cause over-voltage during midday when generation is high and local demand is low
- Long feeder lines – voltage drops occur over distance, especially with high loads at the end of the line
- Lack of voltage control devices (like capacitors or regulators), or existing voltage control devices are unable to adequately respond to changing demand

What Needs are Being Assessed: Additional IGP Needs

Asset Condition and Aging Infrastructure

Definition: The physical state and remaining useful life of grid components such as transformers, poles, wires, and substations

Why it matters: Increased risk of equipment failure, service interruptions, safety hazards, and higher maintenance costs. Limits ability to support modern technologies, clean energy integration, and growing demand

Causes:

- Equipment operating beyond its intended lifespan
- Storm damage, extreme heat, flood damage, corrosion, wood decay
- Lack of monitoring and diagnostic tools

Reliability and Resiliency

Definition: The grid's ability to consistently deliver electricity (reliability) and to withstand and recover from disruptions such as storms, wildfire, and equipment failure (resilience)

Why it matters: Reliable and resilient power is essential for public safety, economic stability, and quality of life — especially during extreme weather or emergencies

Causes:

- Storms, including wind, snow, and ice, and associated vegetation contact
- Flooding – both inland and coastal
- Heat events – both intense heat and persistent high heat
- Lack of redundant power supply and rural, radial circuits with no "circuit tie," or backup supply

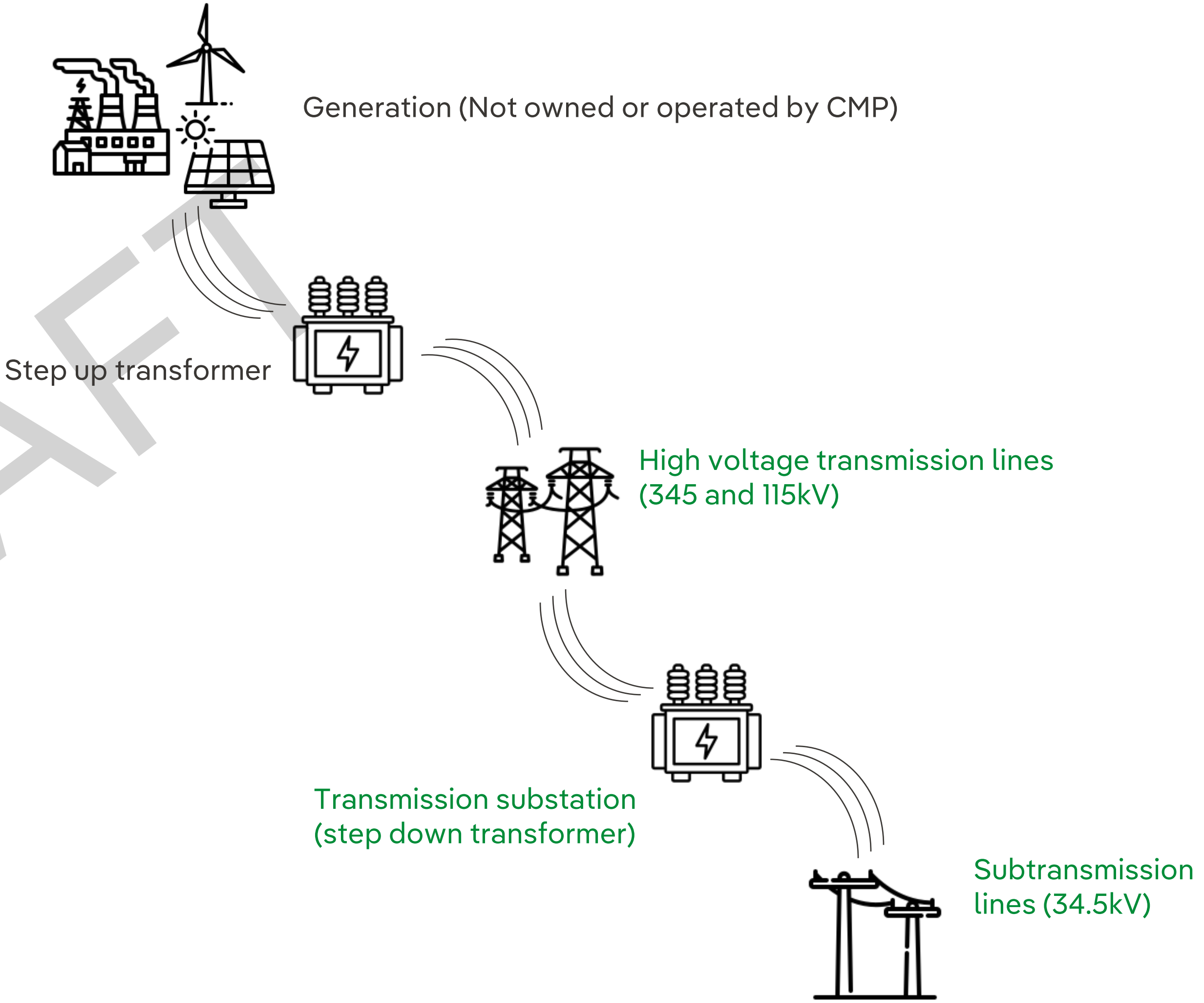
How are Primary Needs Being Assessed?

Transmission System Analysis

- **Model Inputs:** Integrated Milestone 1 modeling assumptions into ISO-NE models.
- **Contingency Analysis:** Conducted N-0, N-1, and N-1-1 contingency analyses on 124 transmission transformers and 314 lines, across 18 scenarios.
- **Reliability Assessment:** Evaluated thermal and voltage performance against local, regional, and national reliability standards.

Identified

- Thermally overloaded transmission transformers and transmission lines
- Substation low/high voltage violations and voltage collapse



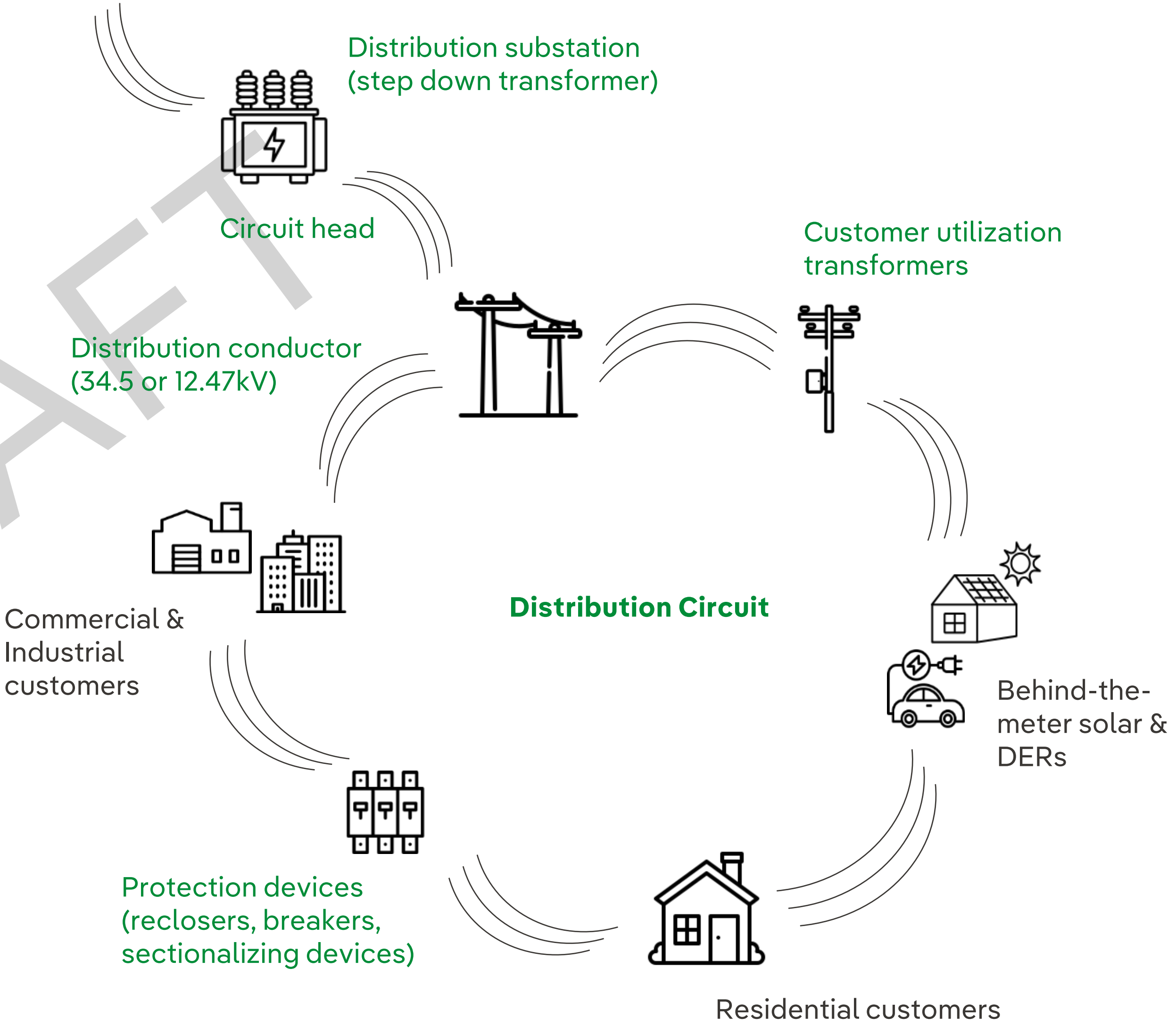
How are Primary Needs Being Assessed?

Distribution System Analysis

- **Transformer Level Analysis:** Modeled all 250 substation transformers across 12 different forecast scenarios.
- **Circuit Level Analysis:** Modeled all 480 distribution circuits at the head-end for thermal overloads, across all 12 scenarios.
    - Likely most significant need/upgrade
- **Sub-Circuit Level Analysis:** Performed detailed analysis on 70 sample circuits – extrapolated sub-circuit level needs to remaining circuits based on similar conditions.

Identified

- Thermally overloaded distribution transformers and circuits
- Downstream voltage violations and thermal overloads along the circuit



Additional Needs Require Consideration of Outage Causes, System Condition, and Topology

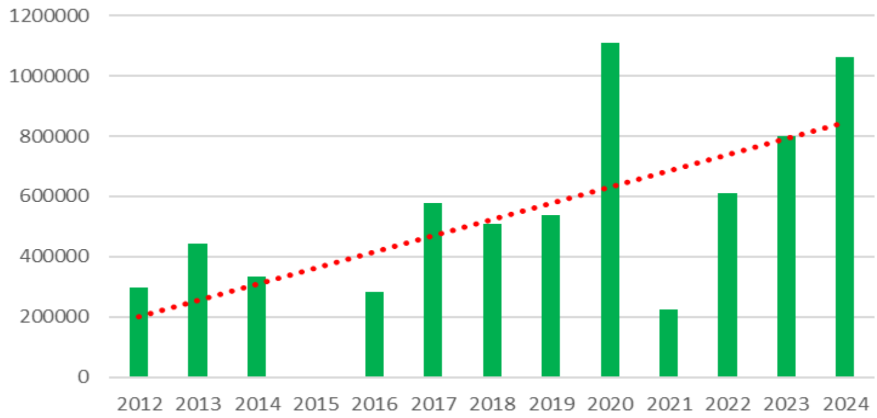
Storms: Approximately **1,300 wooden poles** broken during the Dec. 2023 storms.

Using climate data and projections from the Intergovernmental Panel on Climate Change (IPCC), FEMA, NOAA, and the World Climate Research Program, CMP's Climate Change Vulnerability Study **found high risk to the electric system from:**

- **Severe Storms and Wind**
- **Flooding**
- **Heat Events**
- **Wood Decay**
- **Wildfire**

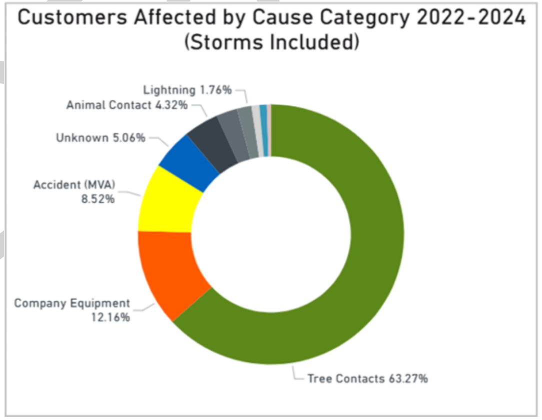


1 Total CMP Customer Interruptions During Major Storms **(2012-2024)**



✓ Customers are experiencing increasing impacts from major storms.

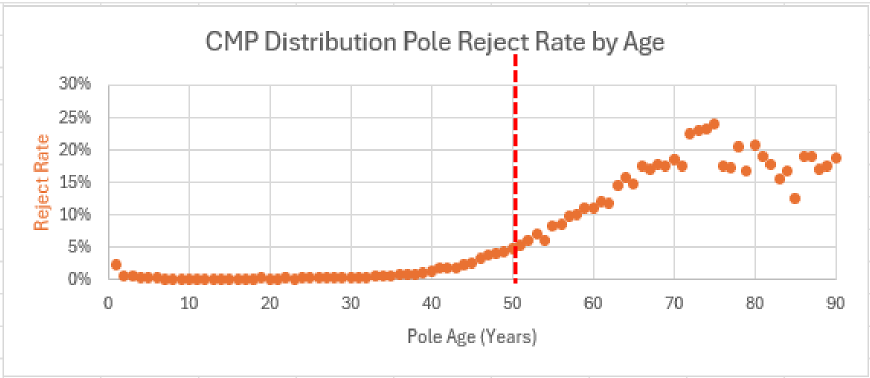
2 Customers Affected by Cause Category – Storms Included **(2022-2024)**



✓ Roughly **60% of outages** caused by **trees** in 2023.

✓ Approximately **90% of CMP distribution lines** are bare wire conductor.

3 Distribution Wood Pole Reject Rates



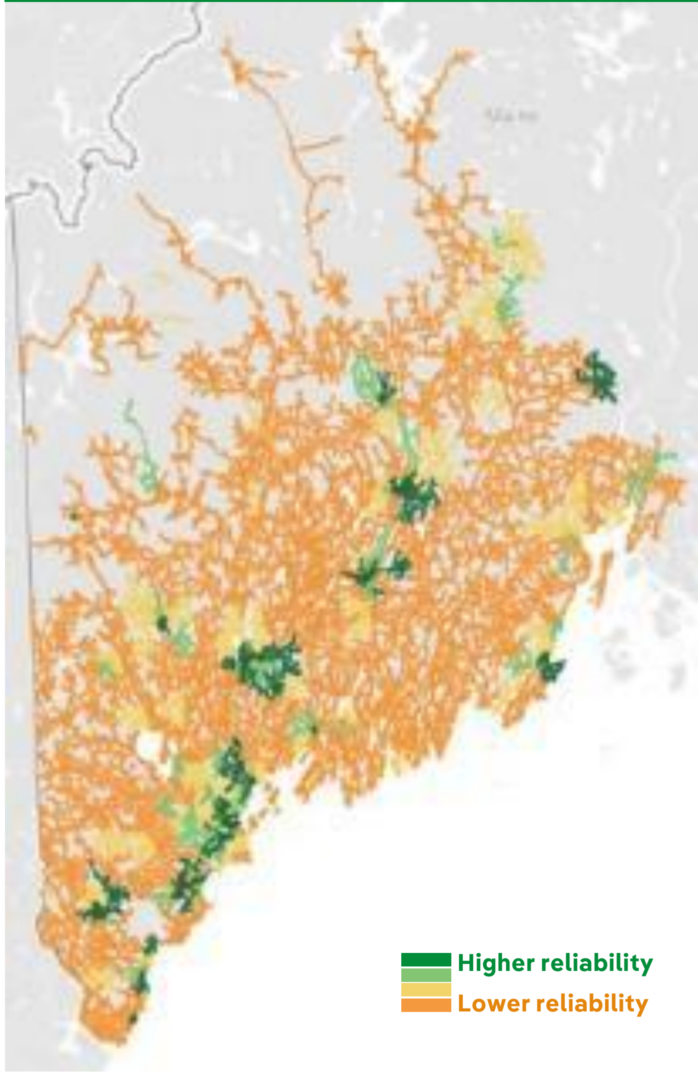
✓ Pole condition drops significantly after **50-year lifespan.**

✓ Over **160,000 poles** are over 50 years old.

*These data and analyses are based on current assumptions, available information, and methodologies that are subject to change.

Additional Needs Require Consideration of Outage Causes, System Condition, and Topology

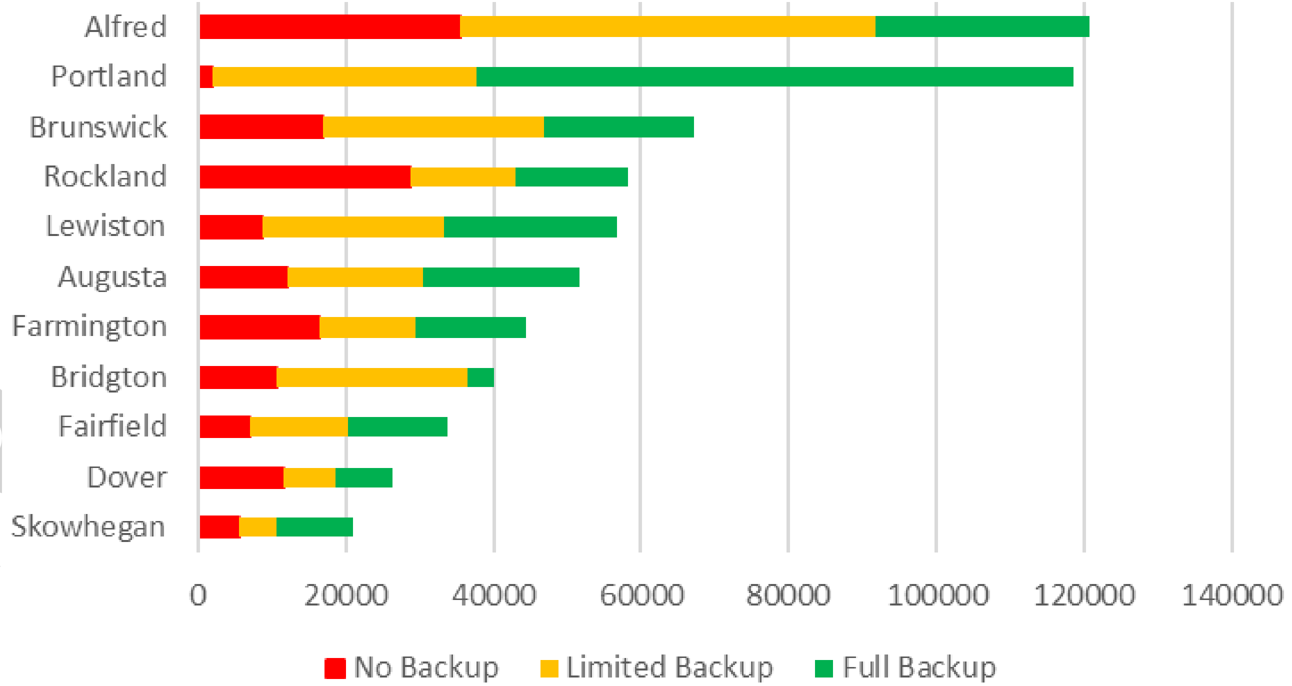
Circuits by Reliability



Circuits with **higher reliability** are generally in **densely populated areas** with more back-up circuit ties and less tree cover.

Fewer than 40% of customers have full back-up circuit tie capability.

Number of Customers with Back-up Circuit Tie Capability By Division



- ✓ No Back-Up Circuit Ties: **156,000** Customers **24%**
- ✓ Limited Back-Up Circuit Ties: **243,000** Customers **38%**
- ✓ Full Back-Up Circuit Ties: **240,000** Customers **38%**

Urban areas have the greatest number of customers with 100% back-up capability

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IGP Needs Findings Summary

Transmission and Distribution (T&D) Needs Summary

Thermal Overloads	2034 (Winter)		2034 (Summer)		2034 (Day Min load)	
	Violations	Total	Violations	Total	Violations	Total
Distribution Substation Transformer	103	41 %	81	32 %	31	12 %
Distribution Circuit	107	330 mi.	109	105 mi.	39	40 mi
Transmission Transformer	13	11 %	18	15 %	4	3 %
Transmission Line	25	97 mi.	35	121 mi.	10	40 mi.

Voltage Violations	Violations	Violations	Violations
Distribution	145 circuits	121 circuits	27 circuits
Transmission	290 instances	157 instances	280 instances

DRAFT

Key Takeaways

Significant **thermal overloads** observed regardless of season (e.g. distribution transformers, **41%** in winter and **32%** summer).

Winter heat pump use expected to overload more transformers.

Majority of system needs are during peak load conditions in **southern Maine** (heavily populated areas).

System needs in more rural areas occur during lighter loads, mainly due to **DER** (Distributed Energy Resources).

Possible Solution Examples

Thermal Overloads

- ✓ Load Shift & Circuit Tie
- ✓ Peak Shaving
- ✓ New Transformer
- ✓ GETs (Grid-Enhancing Technologies)
- ✓ New Circuit
- ✓ Upgraded Conductor
- ✓ Load Management

Voltage Violations

- ✓ Voltage Regulator
- ✓ STATCOM
- ✓ Capacitor Bank
- ✓ Load Shift

Reliability/Resiliency

- ✓ Automation
- ✓ Circuit-Tie
- ✓ Hardening
- ✓ Microgrid

Asset Condition

- ✓ New or Upgraded Infrastructure

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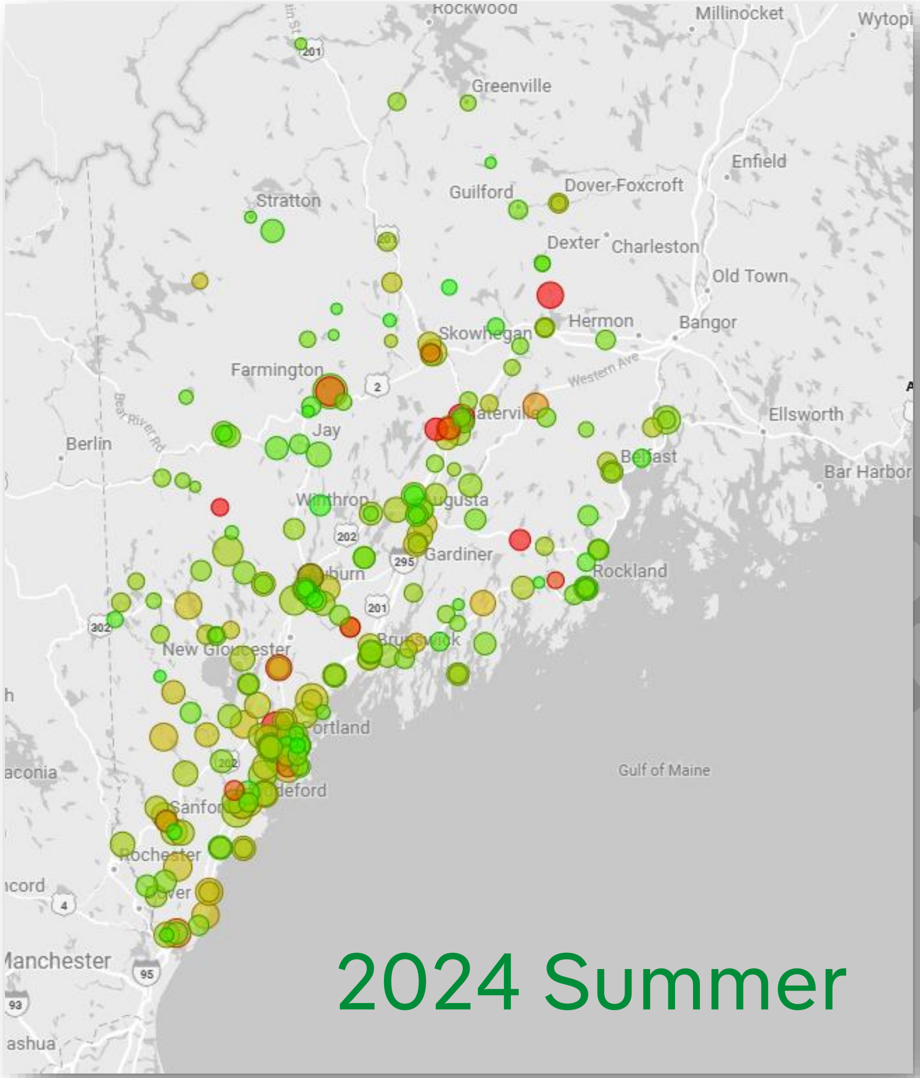
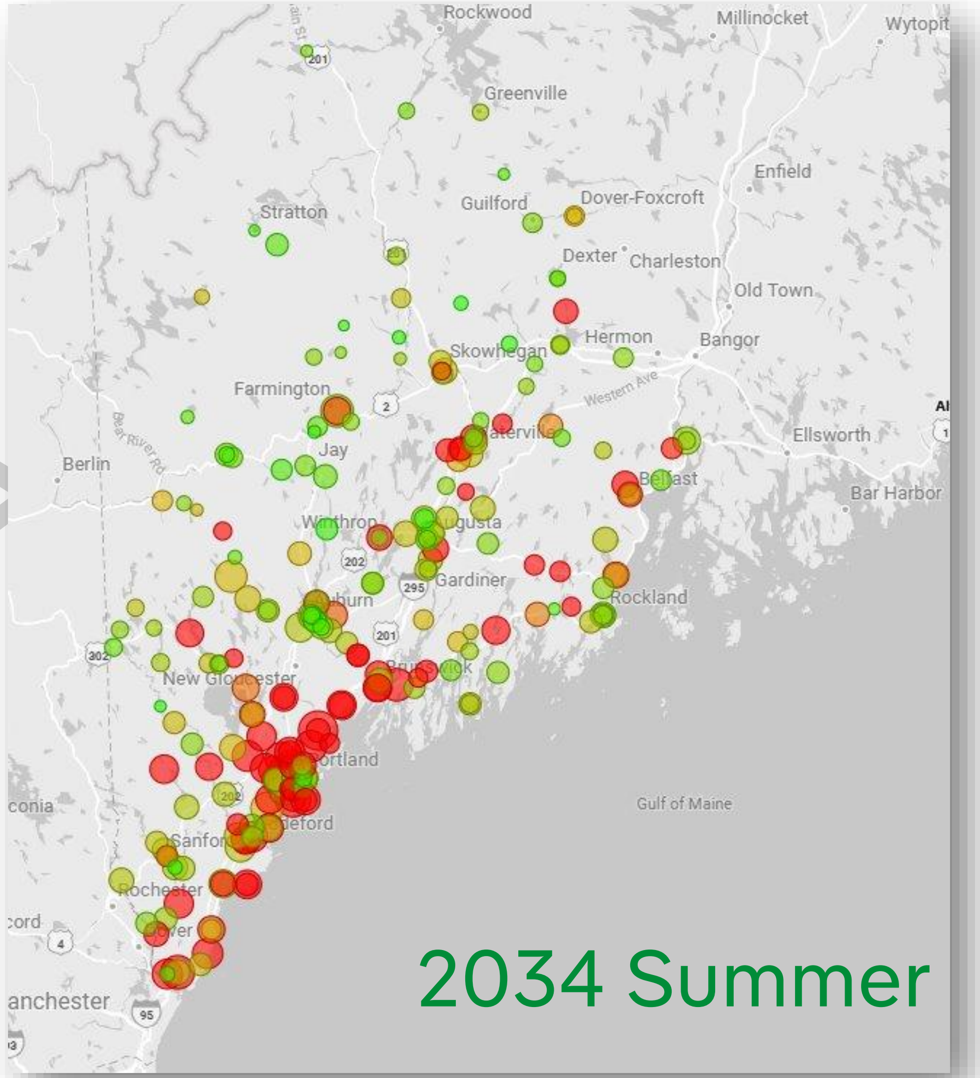
Distribution Transformer Overload Comparison (Summer)





<90% Loaded | 90-100% Loaded | >100% Loaded

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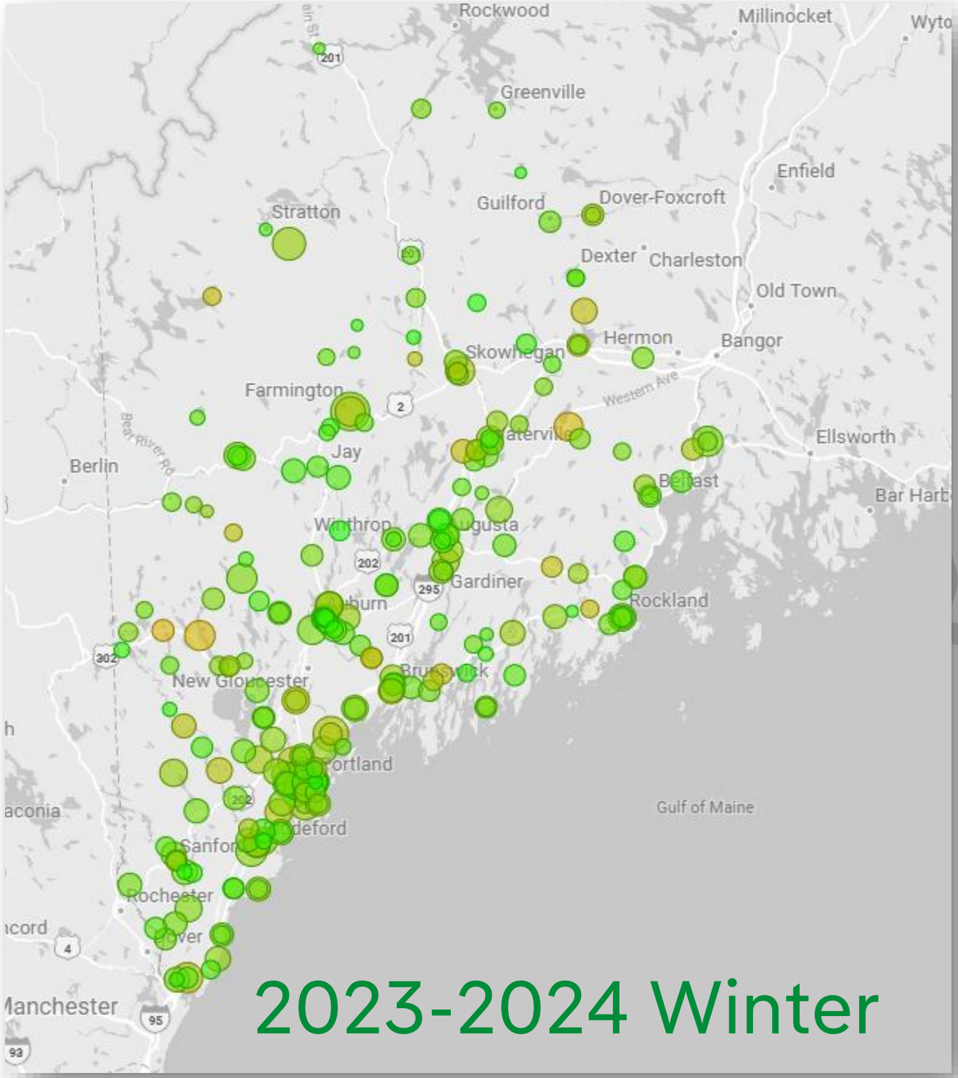
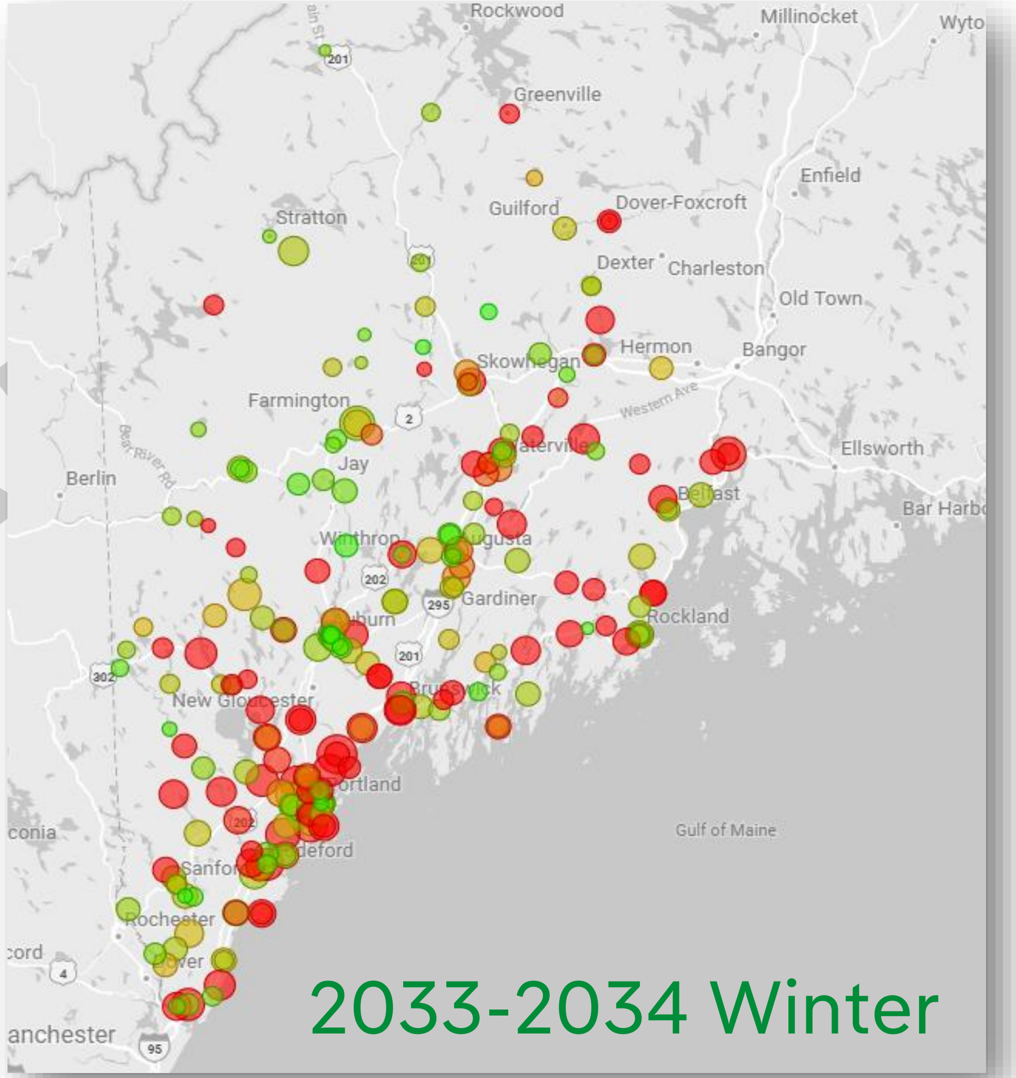
Distribution Transformer Overload Comparison (Winter)





<90% Loaded | 90-100% Loaded | >100% Loaded

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IGP Needs Findings – Detailed Example #1 (High Load, Low DG)

Circuit 688D1 Summary

- ✓ Serves the towns of **Kittery** and **York.**
- ✓ Densely populated area in Southern Maine, **123% forecasted electric growth.**
- ✓ **Low DG** (Distributed Generation) penetration (0.24MW forecasted by 2034).

Needs Summary:

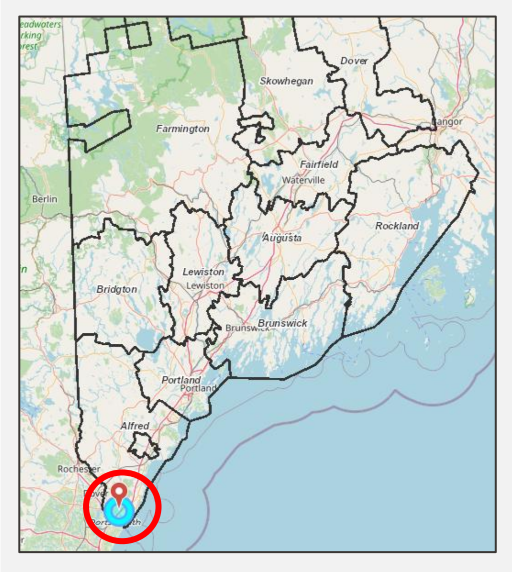
- ✓ Significant **overloads** on circuit and substation transformer in both **summer and winter peak** conditions.
- ✓ High loading causes numerous **low voltage violations** on the circuit.

Snapshot Comparison

Snapshot Scenarios – Driving Needs/Upgrades

Need Type	Summer Daytime Peak	Summer Evening Peak	Winter Evening Peak	Spring Minimum	Daytime Minimum	Evening Minimum
		50/50				
Thermal Overloads	40	29	29	1	1	0
Voltage Violations	1,482	1,306	1,450	267	0	0
		90/10				
Thermal Overloads	53	33	44	1	1	1
Voltage Violations	1,523	1,467	1,489	334	0	0

Circuit Diagram/Location



Key Takeaways

High customer density in **Southern Maine** means high load growth potential from **heat pumps** and **EV**.

There is little un-developed land for large scale **distributed generation** projects.

Significant # of needs observed even at lighter load level (**50/50**)

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IGP Needs Findings – Detailed Example #2 (Low Load, High DG)

Circuit 870D2 Summary

- ✓ Serves the town of **Winslow Maine**.
- ✓ **Rural population**, 68% forecasted electric growth.
- ✓ **High DG** (Distributed Generation) penetration (13MW forecasted by 2034).

Needs Summary:

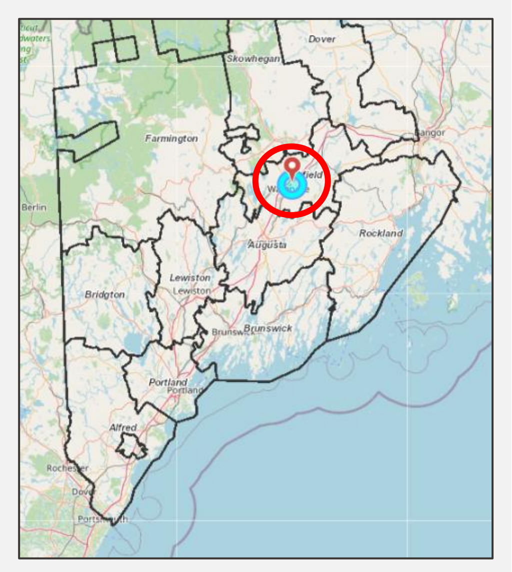
- ✓ Circuit **overloaded in reverse direction** due to DG, under minimum load conditions.
- ✓ Downstream **high voltage violations**, due to forecasted DG.

Snapshot Comparison

Snapshot Scenarios – Driving Needs/Upgrades

Need Type	Summer Daytime Peak	Summer Evening Peak	Winter Evening Peak	Spring Minimum	Daytime Minimum	Evening Minimum
50/50						
Thermal Overloads	0	0	0	1	9	0
Voltage Violations	0	0	0	58	156	0
90/10						
Thermal Overloads	0	0	0	0	9	0
Voltage Violations	0	0	0	56	68	0

Circuit Diagram/Location



Key Takeaways

There are fewer loading concerns in more rural areas of the state, however, undeveloped land is more prevalent and viable for large scale distributed generation projects. This results in **violations in the reverse direction**.

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Preview of Milestone 3: Solutions Development

Milestone 1

Develop Inputs to Planning Models

- Key components:
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- Outcome:
  - Portfolio of potential actionable and cost-effective grid solutions
  - *Hardening, higher-rated assets, automation, potential DER solutions and microgrid feasibility assessment*

Next Steps

We want your feedback!

Email us at: gridandclimateplanning@cmpco.com

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Questions, Comments, Discussion