Central Maine Power
An Avangrid company

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Integrated Grid Plan

Milestone 1 Stakeholder Meeting: Inputs to the Planning Models

January 27, 2025

Agenda

01 Introductions

02 Background: Grid Planning Requirements; Priorities; Stakeholder Input

03 Milestone 1 Overview

04 Inputs to the Models

05 Next Steps

06 Questions, Comments, Discussion

Introductions

Chris Morin, Sr. Director, Integrated System Planning

Meg Sullivan, Sr. Manager, Strategic Programs

Mike Purtell, Director, Advanced Load Forecasting & Analysis

Ed Roedel, Sr. Principal Engineer, Integrated System Planning

Craig Nale, Director, Regulatory Affairs

Background: Grid Planning Requirements; Priorities; Stakeholder Input

Grid Planning Requirements: LD 1959

"'Grid plan' means a 10-year integrated grid plan developed in accordance with this section designed to improve system reliability and resiliency and enable the cost-effective achievement of the greenhouse gas reduction obligations and climate policies pursuant to Title 38, section 576-A and section 577, subsection 1." *35-A MRSA § 3147.*

IGP Components:

- Assessment of electric system and relationship to the regional grid
- Reference to Efficiency Maine's triennial plan
- Two planning scenarios (baseline, high penetration)
- Baseline energy supply data and assessments
- Analysis of hosting capacity
- Analysis of available and emerging technologies to enable load management and flexibility
- Assessment of EEEJ impacts of grid plans
- Identification of cost-effective near-term investments and operations

Background: Grid Planning Requirements; Priorities; Stakeholder Input

Grid Planning Requirements: Components Required by the Public Utilities Commission in its July 12, 2024 Order

Docket No. 2022-00322.

- Vision for the evolving grid
- System overview
- Forecasting and scenario development
- System modeling and needs identification
- Solutions identification and evaluation
- Technology, integration, systems investments, and pilot projects
- Energy, equity, and environmental justice (EEEJ) outreach and impacts assessment
- Solutions assessment

Key IGP Process Milestones

Nov. 1, 2022	Beginning November 1, 2022, then every 5 years thereafter, the commission shall initiate a proceeding
Jan. 2023 – Jan. 2024	• MPUC held 13 meetings and workshops with stakeholders to determine grid plan contents and priorities
July 12, 2024	• MPUC Order initiating formal 18-month grid planning process
Grid Planning	• Milestone meetings (inputs, needs, solutions) • Stakeholder input
Jan, 12 2026	• Grid plan filings due

Background: Grid Planning Requirements; Priorities; Stakeholder Input

Grid Planning Priorities (identified in PUC Order)

1. Reliability and resilience improvements while keeping costs affordable & facilitate achievement of State's climate action reduction policies	Make investments that cost-effectively maintain or improve reliability;
	Reduce barriers to promote cost-effective non-wires alternatives (NWA) solutions and identify any process improvements/efficiencies; and
	Build climate adaptation into the investment solution mix.
2. Improve data quality and integrity to maximize its use in distribution system planning	Leverage investments in Advanced Metering Infrastructure (AMI);
	Improve mapping of the distribution system and develop a governance policy or protocols for maintaining the integrity of the data on an ongoing basis;
	Develop initial roadmap for advancing time-series planning models; and
	Enhance hosting capacity maps to benefit stakeholder decision making by standardizing them across utilities.
3. Promote flexible management of consumers' resources and energy consumption	Improve forecasting electric vehicle (EV) load, distributed energy resources (DER) adoption, and climate parameters;
	Support integration and utilization of DERs to enable load flexibility and resilience;
	Technologies or programs to shift load from system peak to reduce Maine's share of the Regional Network Service (RNS) charge.

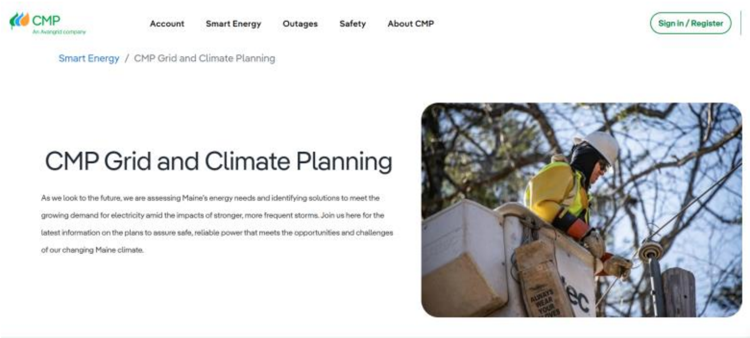
Background: Grid Planning Requirements; Priorities; Stakeholder Input

Stakeholder Engagement and Input

- ✓ Hold at least three stakeholder meetings at three distinct milestones to obtain input:
  - ➡ When utilities have the inputs to run the models
  - When the needs assessment is complete
  - When potential solutions have been identified
- ✓ Document feedback received; document whether feedback was incorporated into the grid plan, and if not, why not
- ✓ Solicit and document tribal and EEEJ input
- ✓ Include in the grid plan a proposal of how to evaluate and measure EEEJ impacts in the near and longer term

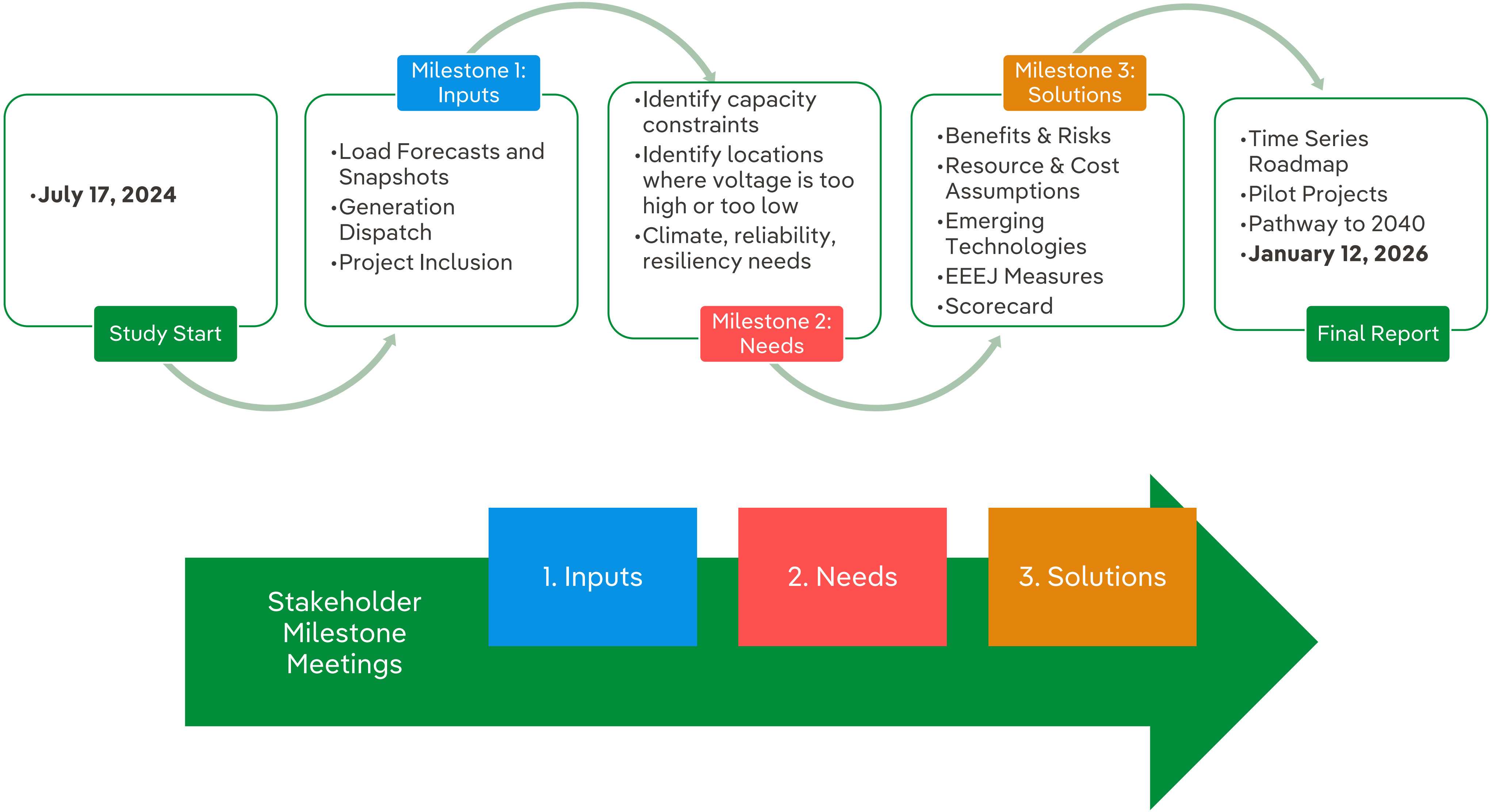
Visit our grid and climate planning webpage:

www.cmpco.com/smartenergy/cmp-grid-and-climate-planning



- ✓ Meeting dates
- ✓ Meeting recordings
- ✓ Grid and climate planning materials
- ✓ Provide feedback
- ✓ Email updates

Background: Overview of the Integrated Grid Planning Process



Milestone 1 Overview: Developing Inputs to Planning Models

What is a planning model?

- A **planning model** estimates load growth, capacity constraints, and potential vulnerabilities of the electric system
- Identifying needs and proposing appropriate solutions depends upon building a good model

What are the inputs to the planning models?

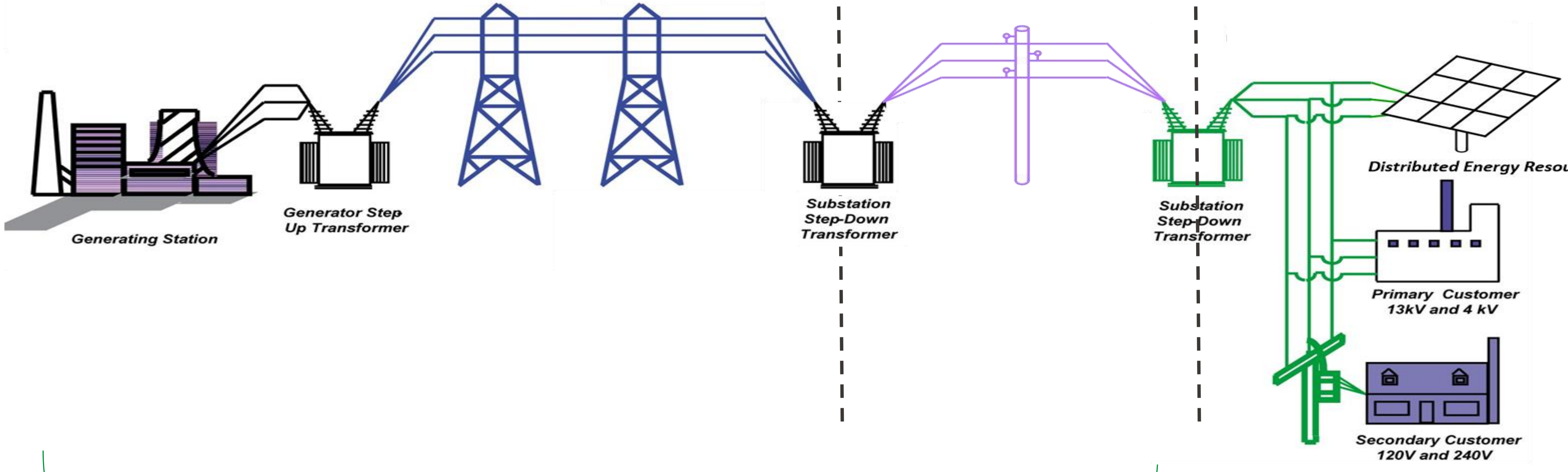
- **Inputs** are the foundation for our estimates about what the future grid will look like:
  - ***Load***: *How much energy will we use? How will EV adoption, heat pumps, and usage from generalized growth and electrification affect overall demand?*
  - ***Generation***: *What generation sources will be available, when will they be available, and how much of each type of generation will be available?*
  - ***Infrastructure***: *What grid infrastructure should we assume will be in place?*

Milestone 1 Overview:
Planning for the Transmission and Distribution Systems

Bulk Electric System
(345 and 115 kV)

Local Transmission System
(115 and 34.5 kV)

Distribution System
(34.5 kV and below)



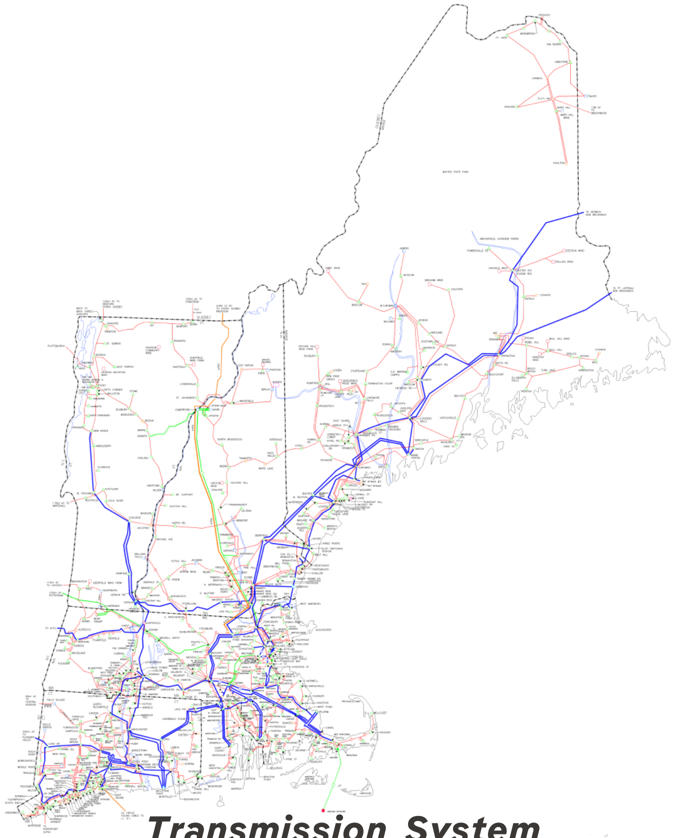
Transmission System

Planning done by ISO-NE and utilities

Distribution System

Planning done by utilities

Milestone 1 Overview: Planning for the Transmission and Distribution Systems



Transmission System

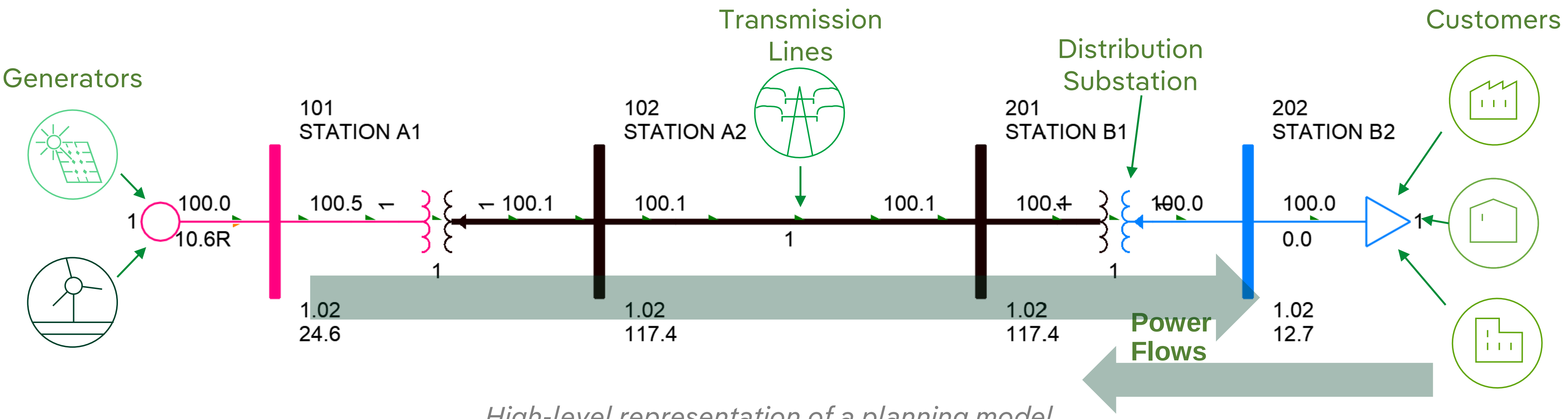
- The "grid" that allows electricity to be delivered regionally across North America
- The "local" transmission system in Maine is typically operated at 34.5 kV and is used to transport power from the Bulk system into communities
- Must satisfy national (NERC) , regional (ISO-NE), and state reliability/performance standards

Distribution System

- Serves customer loads over shorter distances, at lower voltages
- Radial system, but with circuit ties and distributed generation
- Must be operated within loading limits and within an acceptable range of voltages

Milestone 1 Overview: System Planning Concepts & Example Model

- The core goal of system planning is to ensure that the electric system remains reliable and adequate for customer needs in both the short-term and in the long-term
- System planners use detailed models of the electric system, like the one below, to simulate system performance

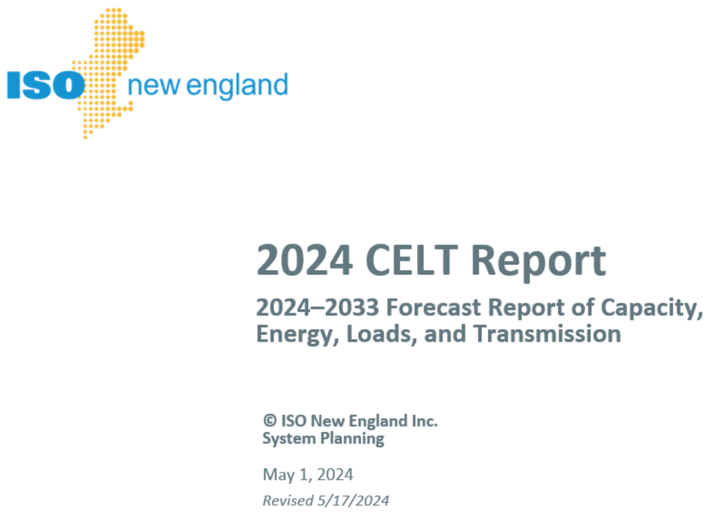


High-level representation of a planning model

Inputs to the Models: Load; CELT Forecasts

The Commission's July 12 Order directs utilities to:

> "use two use two different forecasts, each derived from the most recent CELT (i.e., the 2024 CELT released May 1, 2024), the 50/50 weather year and the 90/10 weather year and consider six different seasonal load snapshots of each forecast."


ISO new england

2024 CELT Report

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

© ISO New England Inc.
System Planning

May 1, 2024
Revised 5/17/2024

What are the 50/50 and 90/10 weather years?

50/50 Weather Year (1-in-2 year weather scenario)

- A weather event (i.e. daily high temp/high humidity) that has a 50% probability of occurring during any summer
- Considered a normal summer peak day weather condition
- A proxy for a "baseline" forecast

90/10 Weather Year (1-in-10 year weather scenario)

- A weather event (i.e. daily high temp/high humidity) that has a 10% probability of occurring during any summer
- Considered an extreme summer peak day weather condition
- A proxy for a "high DER penetration and electrification forecast"
- *New utility projects across New England are identified based on studies that use 90/10 load forecasts*

The CELT is a forecast report of Capacity, Energy, Loads, and Transmission.

It is an objective forecast produced by ISO-NE and relied upon across New England.

Inputs to the Models: Load; Snapshots

The Commission's July 12 Order directs utilities to:

> "consider **six different seasonal load snapshots** of each forecast as described in the Outline . . . . This will ensure that a broad range of load levels and seasonal conditions are considered."

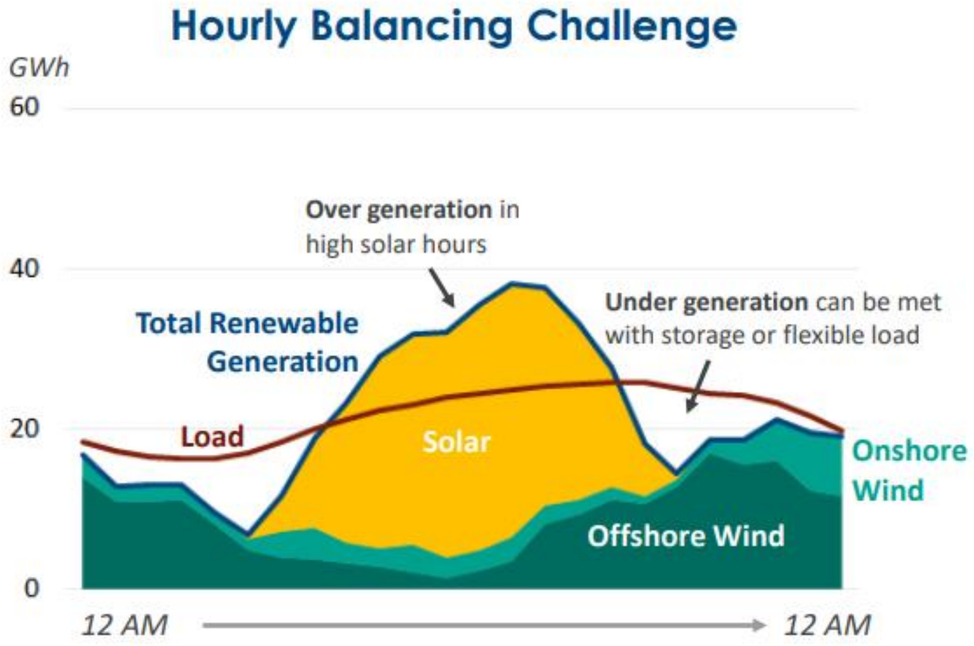
The six seasonal load snapshots are:

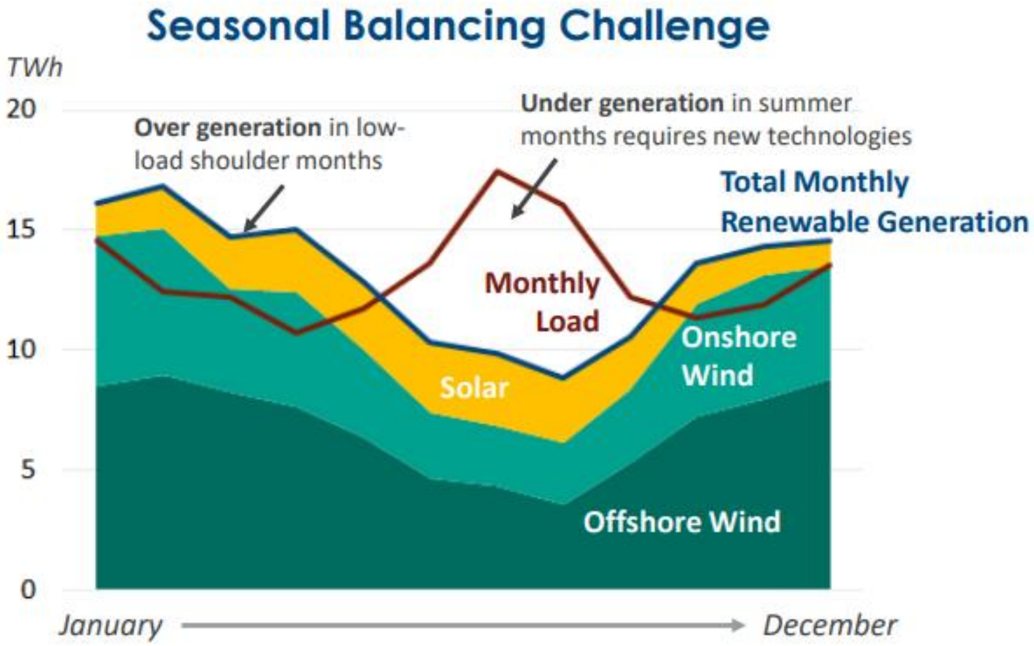
- Summer Daytime Peak Load
- Summer Evening Peak Load
- Winter Evening Peak Load
- Daytime Minimum Load
- Evening Minimum Load
- Spring Minimum Load

Inputs to the Models: Load; Snapshots

Why do we need different snapshots?

As the generation and load profiles evolve, assessments like the Integrated Grid Plan can identify reliability challenges before they become system constraints





Source: *The Brattle Group, New York Electric Grid Evolution Study, 2020*

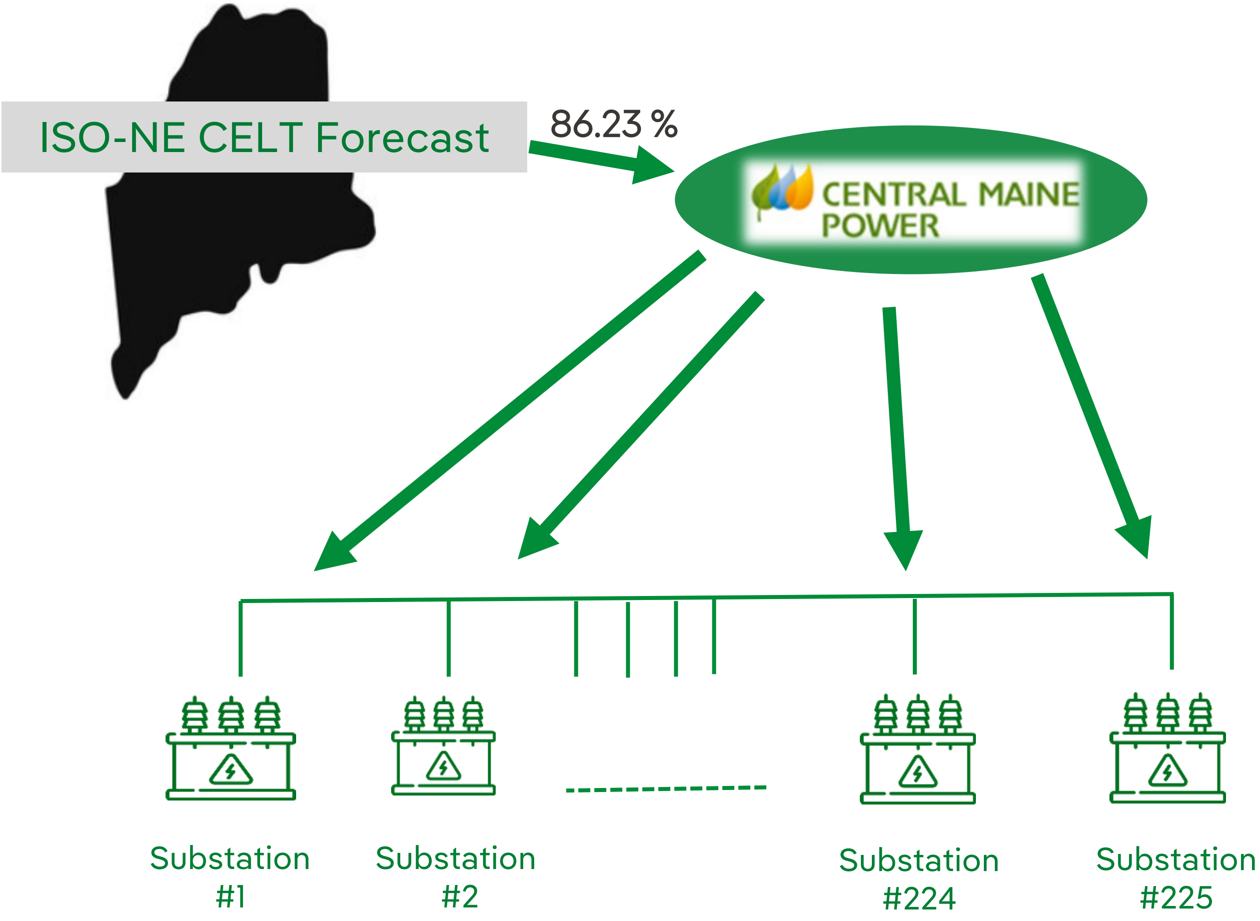
Inputs to the Models: Load; Disaggregation

The Commission's July 12 Order provides:

"Because the CELT is a transmission-level forecast, the utilities preparing their grid plans must develop a method to disaggregate the CELT forecast to the level of the distribution system."

Disaggregation step 1:

Determine CMP's share of ISO-NE and Maine load



Inputs to the Models: Load; Disaggregation

First: Determine Maine's share of the ISO-NE 50/50 and 90/10 CELT forecasts:

State	Forecast	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
ME	50/50 Gross Model Output	2,131	2,147	2,164	2,181	2,198	2,213	2,229	2,244	2,260	2,276
	Heating Electrification Forecas	0	1	1	2	3	4	5	7	9	12
	Transportation Electrification F	4	14	31	51	77	108	144	184	227	271
	50/50 Gross Load Forecast	2,136	2,162	2,197	2,234	2,277	2,325	2,378	2,436	2,496	2,559
	PV Forecast	81	87	90	92	93	93	94	94	95	95
	EE Forecast	100	106	112	117	110	102	94	85	76	67
	50/50 Net Load Forecast	1,954	1,968	1,995	2,025	2,075	2,130	2,190	2,256	2,326	2,398
		1,692	5								
			0								
	90/10 Gross Load Forecast	2,261	2,290	2,327	2,367	2,414	2,466	2,523	2,585	2,650	2,717
	PV Forecast	81	87	90	92	93	93	94	94	95	95
	EE Forecast	100	106	112	117	110	102	94	85	76	67
	90/10 NET Load Forecast	2,080	2,097	2,125	2,158	2,211	2,271	2,335	2,406	2,479	2,555

Next: Determine CMP's share of total Maine load:

State Pe	State	Company	BHE	ME	SME
0.0459	CT	CMEEC	0.0000	0.0000	0.0000
0.7587	CT	CLP	0.0000	0.0000	0.0000
0.1954	CT	UI	0.0000	0.0000	0.0000
0.1377	ME	EM	1.0000	0.0000	0.0000
0.8623	ME	CMP	0.0090	0.5247	0.4430
0.1166	MA	COMEL	0.0000	0.0000	0.0000
0.2790	MA	BECO	0.0000	0.0000	0.0000

Finally: Apply CMP's share of total Maine load forecast to determine CMP's load CELT load forecasts:

Forecast	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
50/50 Gross Model Output	1,838	1,851	1,866	1,881	1,895	1,908	1,922	1,935	1,949	1,963
Heating Electrification Forecast	0	1	1	2	3	3	4	6	8	10
Transportation Electrification Forecast	3	12	27	44	66	93	124	159	196	234
50/50 Gross Load Forecast	1,842	1,864	1,894	1,926	1,963	2,005	2,051	2,101	2,152	2,207
PV Forecast	70	75	78	79	80	80	81	81	82	82
EE Forecast	86	91	97	101	95	88	81	73	66	58
50/50 Net Load Forecast	1,685	1697	1720	1746	1789	1837	1888	1945	2006	2068
	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
90/10 Gross Load Forecast	1,950	1,975	2,007	2,041	2,082	2,126	2,176	2,229	2,285	2,343
PV Forecast	70	75	78	79	80	80	81	81	82	82
EE Forecast	86	91	97	101	95	88	81	73	66	58
90/10 NET Load Forecast	1,794	1808	1832	1861	1907	1958	2013	2075	2138	2203

Inputs to the Models: Load; Disaggregation

Disaggregation step 2:

Determine CMP load at each of the six snapshots

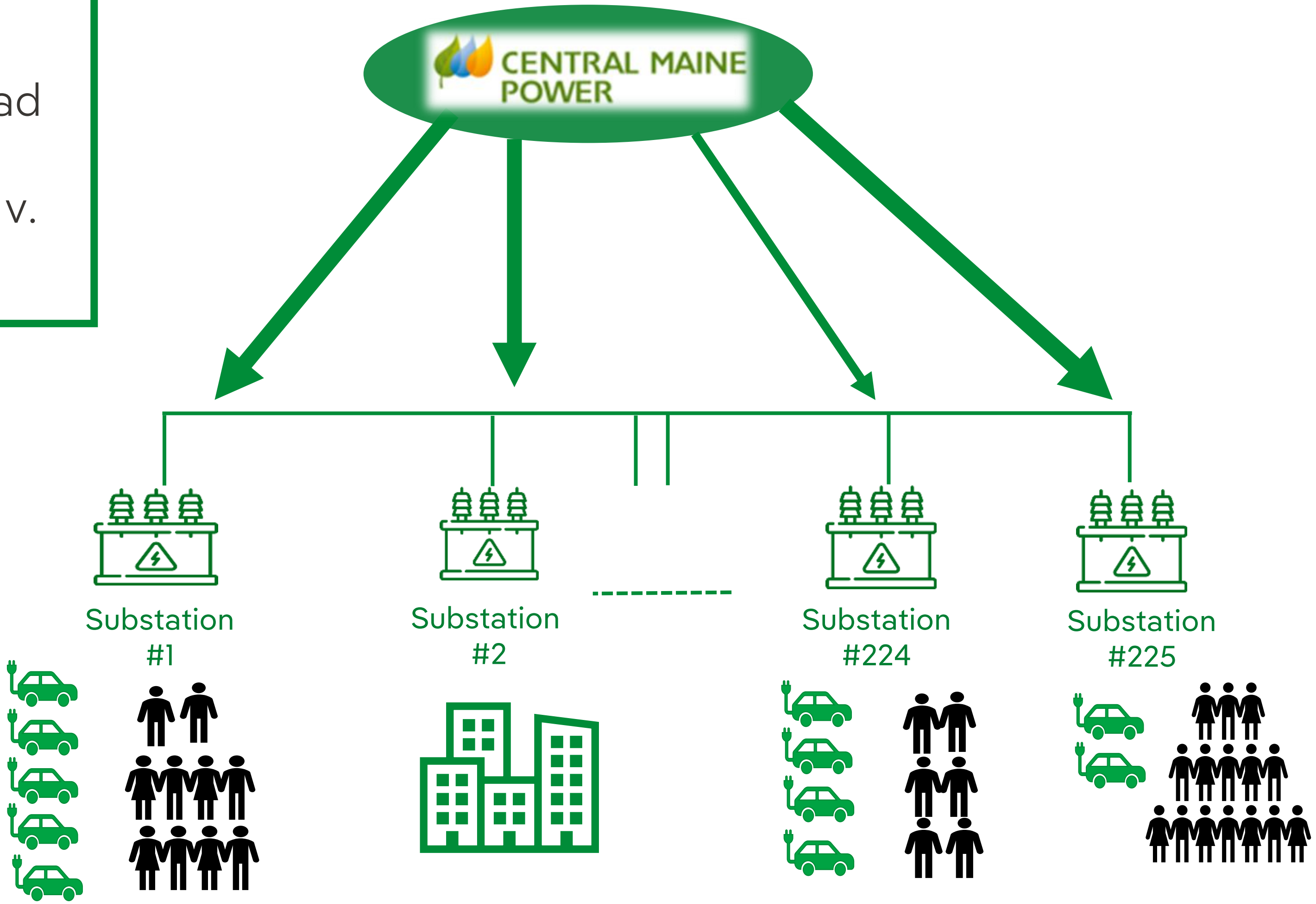
Case/Snapshot	CELT Forecast (Defines Load Level)	ISO-NE Load (MW)	ME Load (MW)	CMP Load (MW)
Summer Daytime Peak	100% of Summer Peak 50/50	31,246	2,563	2,163
	100% of Summer Peak 90/10	33,171	2,721	2,296
Winter Evening Peak	100% of Winter Peak 50/50	30,609	3,166	2,670
	100% of Winter Peak 90/10	32,225	3,508	2,958
Summer Evening Peak	92% of Summer Peak 50/50	28,746	2,358	1,990
	92% of Summer Peak 90/10	30,517	2,503	2,112
Spring Minimum	57% of Summer Peak 50/50	17,636	1,466	1,239
	57% of Summer Peak 90/10	18,907	1,551	1,309
Daytime Minimum	39% of Summer Peak 50/50	12,136	1,009	854
	39% of Summer Peak 90/10	12,937	1,061	895
Evening Minimum	28% of Summer Peak 50/50	8,500	706	599
	28% of Summer Peak 90/10	9,288	762	643

*2034 numbers

Inputs to the Models: Load; Disaggregation

Disaggregation step 3:

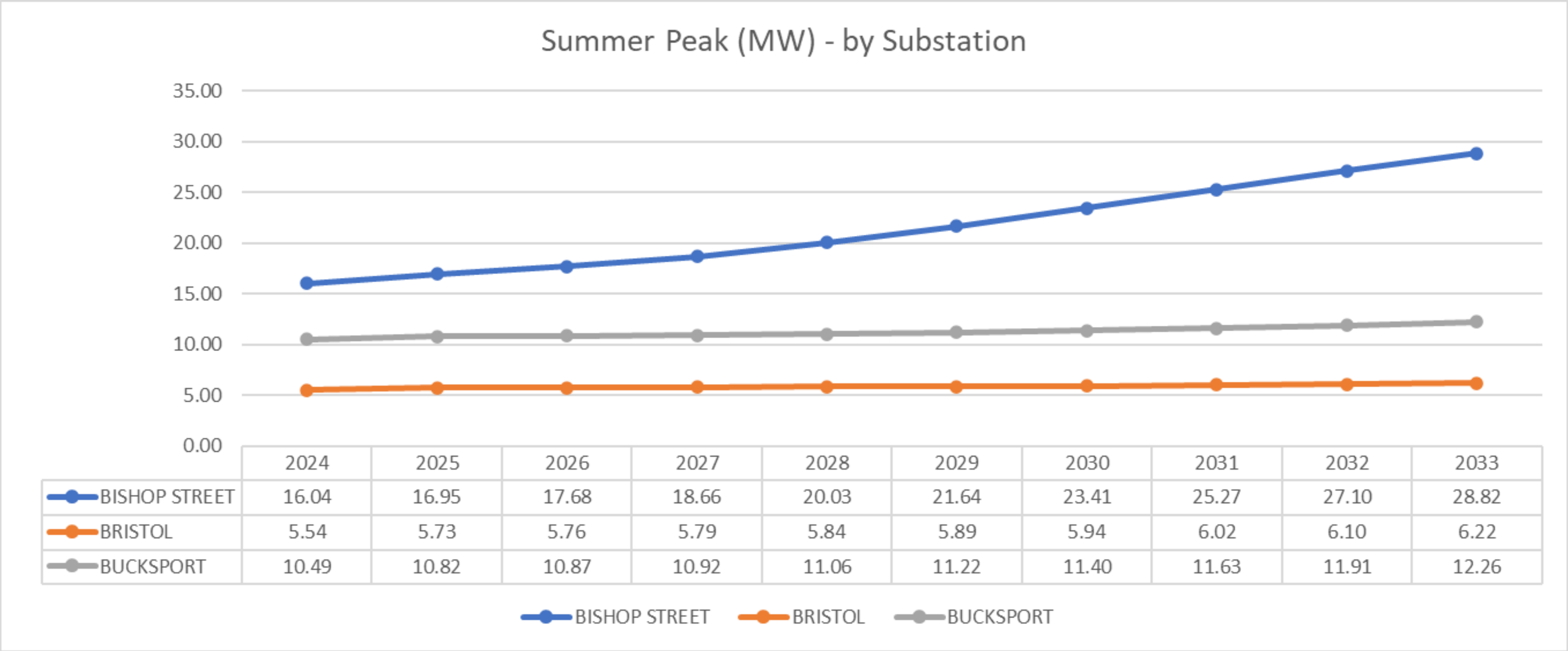
Account for local differences in load growth (EV adoption, heat pump adoption, native growth, industrial v. residential characteristics)



Inputs to the Models: Load; Disaggregation

How does CMP's "bottom-up" approach to accounting for local differences in load growth across substations show up in the models?

The examples below show higher growth areas compared to lower growth areas:



	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

Inputs to the Models: Load; Disaggregation

CMP will run studies on select substations that accurately reflect the range of potential overload magnitude and voltage class.

- CMP will compare the forecasted load with the distribution substation and circuit rating for each distribution substation and circuit, respectively
- For the distribution substation and circuits that do not have enough headroom to accommodate the forecasted load growth without mitigation, the substations and circuits will be grouped based on the expected overload magnitude (e.g., 0 to 5%, 5% to 20%, 20% to 50%) and the voltage class (12.47 kV or 34.5 kV)
- For the distribution substation and circuits that do not have enough headroom to accommodate the forecasted DER integration without mitigation, the substations and circuits will be similarly grouped
- Circuits with enough headroom to accommodate the forecasted load will not be studied, similar to how other integrated grid plans have been executed. *See*, Hawaiian Electric 2023 Integrated Grid Plan; and Salt River Project 2023 Integrated System Plan.
- CMP will select the representative subset of distribution substations to be specifically studied.
- Needs (thermal overload, under/over voltage) from each group will be applied to remaining substations and circuits within that group to obtain system-wide conclusions.

Inputs to the Models: Generation

Generation inputs to the models estimate:

- How much generation will be available;
- From what sources it will be available; and
- When that generation will be available over the course of the day and the course of the year

Case / Snapshot	Solar (%)	Battery Energy Storage Systems (BESS)	Run-of-River (ROR) Hydro	Wind (%)
Summer Evening Peak	0	Discharging MWh/6	Safe Harbor summer peak	10
Summer Daytime Peak	40	Offline	Safe Harbor summer peak	10
Winter Evening Peak	0	Discharging MWh/6	Safe Harbor winter peak	20
Daytime Minimum	90	Charging	Safe Harbor off-peak	20
Evening Minimum	0	Offline	Safe Harbor off-peak	20
Spring Minimum	90	Discharging MWh/6	Safe Harbor off-peak	20

How are CMP's generation inputs determined?

- Solar: ISO-NE Transmission Planning Technical Guide (https://www.iso-ne.com/static-assets/documents/100009/2024_03_21_pac_tptg_rev8.2.pdf)
- BESS: ISO-NE Transmission Planning Technical Guide (https://www.iso-ne.com/static-assets/documents/100009/2024_03_21_pac_tptg_rev8.2.pdf)
- ROR hydro: varying "Safe harbor" criteria based on season, recalculated for each facility every 5 years (amounts determined in MPUC Docket No. 2011-00494, updated 2020) ;
- Wind: percentages shown are "safe harbor" amounts (determined in MPUC Docket No. 2011-00494, updated 2020)

Inputs to the Models: Infrastructure

What infrastructure will be included in the electrical representation of the system?

- Projects with ISO New England and Maine PUC approval, if required

  Example: CMP's rebuild of the Highland Substation and new synchronous condenser

- Generation projects in the ISO New England and CMP interconnection queues (includes utility-scale and DG projects)

  See: ISO-NE Public Queue [link to queue]

  See: CMP's Level 2 & 4 Public Queues

  [Link to Level 2 queue] [Link to Level 4 queue]

Inputs to the Models: State Policies Scenarios

In addition to the scenarios covering six snapshots for each of the 90/10 and 50/50 CELT forecasts, the Commission's July 12 Order provides:

> "While the first grid plans will not reach 2040, the Commission also directs the utilities to include a narrative explanation in the grid plans of how they intend to support the achievement of the State's climate goals in subsequent planning periods."

- **To meet this requirement, CMP will use the ISO-NE 2040 cases from the ISO's 2050 transmission study.**

  For example, a constraint identified in the grid plan may have multiple mitigation alternatives, which will be applied to the "state policies" cases (at right) to inform the efficacy, reliability & resiliency impact, existing infrastructure optimization, and advancement of state policy goals components of the solutions scorecard.

Case/ Snapshot	Forecast	Solar Output (%)	ISONE Load Level (MW)	ME Load Level (MW)	CMP Load Level (MW)	2040 vs 2034 (%)
Summer Evening Peak	95% of Summer Peak 90/10	10%	32,650	2,929	2,526	
Winter Evening Peak	95% of Winter Peak 90/10	10%	43,996	4,570	3,940	

ISO-NE 2050 Transmission Study, 2040 Load Level

https://www.iso-ne.com/system-planning/transmission-planning/longer-term-transmission-studies

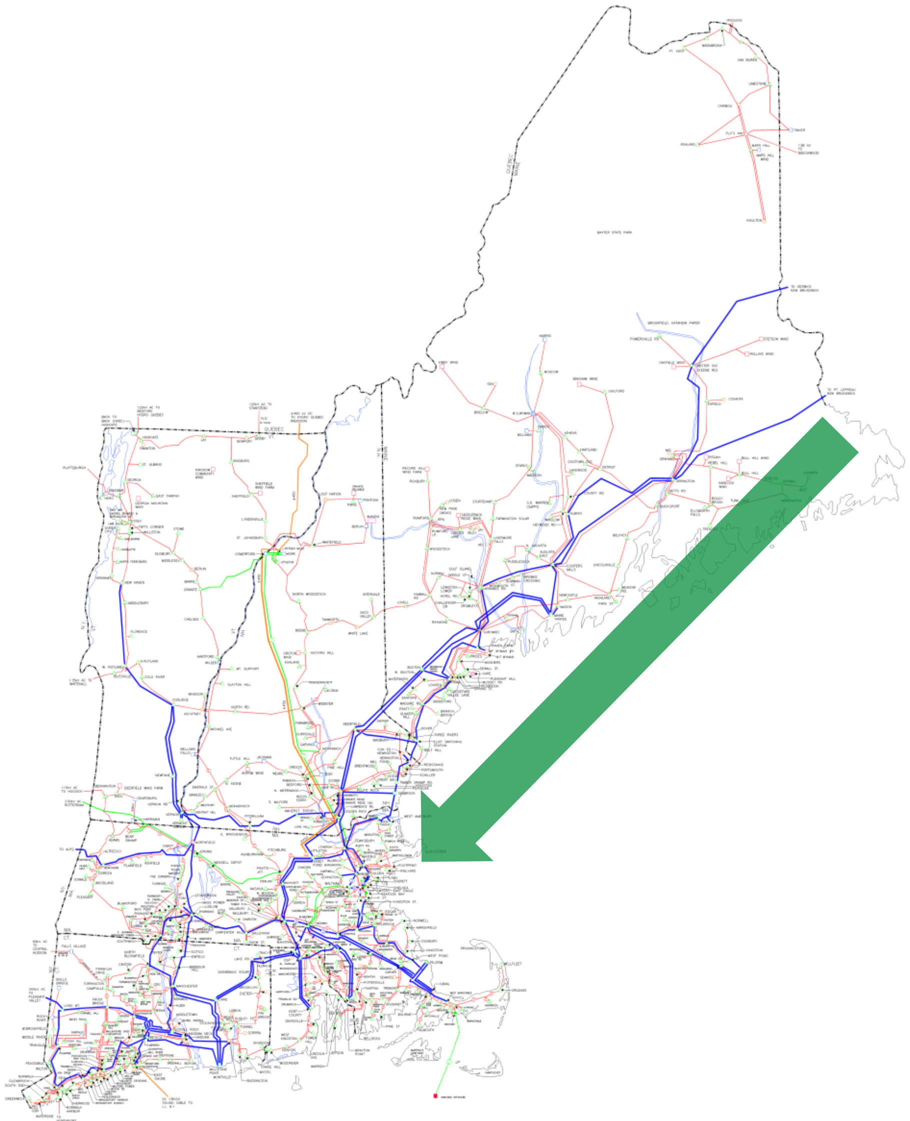
Inputs to the Models: Transmission Inputs

CMP will consider additional inputs for transmission:

- Transmission models will incorporate the same load, generation, and infrastructure inputs at the regional level
- Transmission models will also consider transfer levels into and out of the state at its borders, which are based on load and generation in- and outside of Maine

CMP will model two transmission transfer levels:

- Dispatch Scenario 1 (high north to south transfers)
  - *High Surowiec–South flow with Buxton STATCOMs in-service*
  - *High New Brunswick—New England flow*
  - *High Maine—New Hampshire Export*
- Dispatch Scenario 2 *(low north to south transfers):*
  - *Low New Brunswick—New England flow*
  - *High Maine—New Hampshire import*

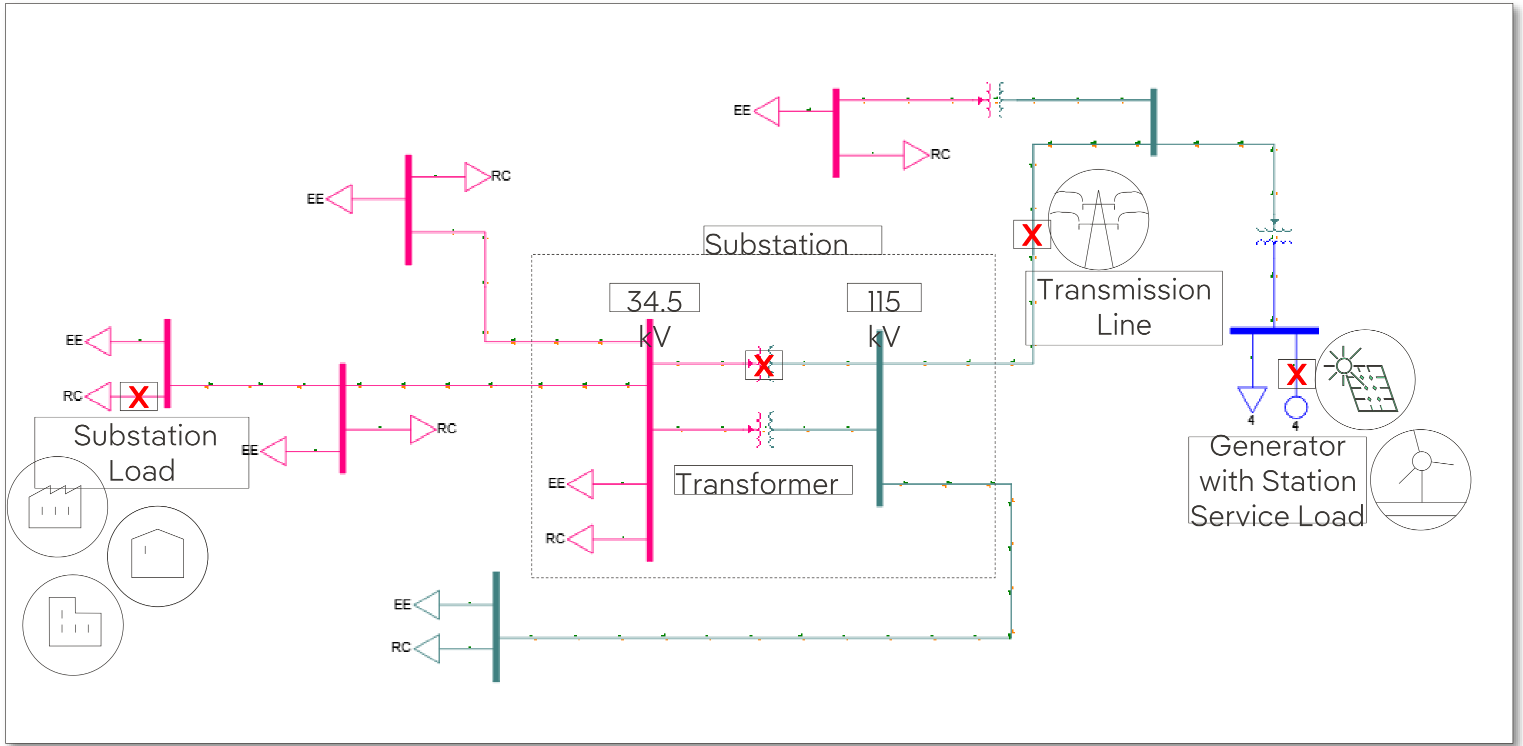


- During light load conditions, no/reduced transfers are required from Canada; local generation can serve the load

Inputs to the Models: Contingencies

A *contingency* is the loss or failure of a part of the power system (e.g. a transmission line), or the loss/failure of individual equipment such as a generator or transformer. This is also called an unplanned outage.

Each X in the planning model below shows a contingency, or the loss/failure of that component of the transmission or distribution system:



Why do we test contingencies?

- System studies analyze system contingencies to ensure that the electrical system is capable of remaining within specified voltage, thermal, short circuit and stability criterion for various conditions.
- Criteria is based on regional and local requirements including, but not limited to NERC Reliability Planning Standards.

Next Steps

We want your feedback!

Email us at: gridandclimateplanning@cmpco.com

Sign up for email updates at:

cmpco.com/smartenergy/cmp-grid-and-climate-planning

Attend future meetings

Receive meeting info and registration links at our webpage and by signing up for email updates

Integrated Grid Planning meetings:

- Milestone 2 meeting: Needs assessment (Q2 2025)
- Milestone 3 meeting: Potential solutions (Q3-Q4 2025)

Climate Change Protection Plan meetings:

- Vulnerability assessment meeting (Q1-Q2 2025)
- Resiliency planning meetings (Q2-Q4 2025)

Questions, Comments, Discussion