Avangrid A member of the Iberdrola Group

Central Maine Power
An Avangrid company

Integrated Grid Plan

Milestone 3 Stakeholder Meeting: Solutions

Nov. 25, 2025

Agenda

01 Introductions

02 Overview of Integrated Grid Plan Process and Review Milestones 1 & 2

03 Milestone 3 Overview

04 Solutions Methodology

05 Solutions Findings

06 Next Steps

07 Questions, Comments, Discussion

Introductions

Chris Morin, Sr. Director, Integrated System Planning

Craig Nale, Sr. Director, Regulatory Affairs

Jacob Farmer, Manager, Transmission Planning

Marshall Ripley, Sr. Principal Engineer, System Planning

James Yu, Sr. Manager, Strategic Planning

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

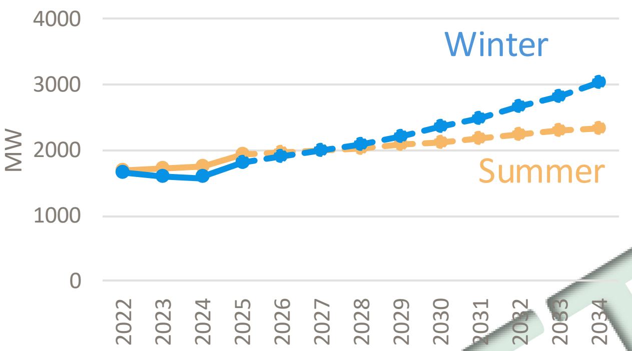
- **Key components:**
  - **Exploration of wires and non-wires alternatives (storage, DERs, demand response)**
  - **Evaluation framework**
  - **Prioritization of investments aligned with state policy goals**
- **Outcome:**
  - **Portfolio of potential actionable and cost-effective grid solutions**
  - **Hardening, higher-rated assets, automation, potential DER solutions and microgrid feasibility assessment**

Review of Milestone 1: Forecast and Inputs

Milestone 1

ISO-NE CELT 2024 Forecast

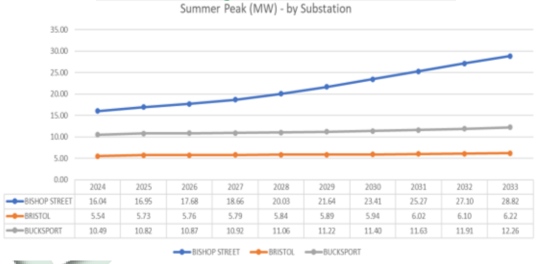
- ✓ 50/50 "baseline" forecast
- ✓ 90/10 "high adoption" forecast
- ✓ Load and generation growth



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

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

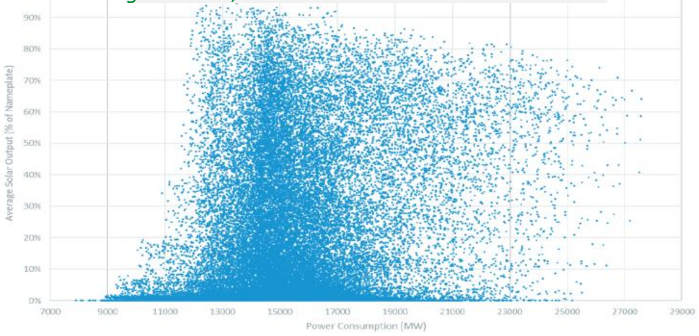


	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
BISHOP STREET	16.04	16.95	17.68	18.66	20.03	21.64	23.41	25.27	27.10	28.82
BRISTOL	5.54	5.73	5.76	5.79	5.84	5.89	5.94	6.02	6.10	6.22
BUCKSPORT	10.49	10.82	10.87	10.92	11.06	11.22	11.40	11.63	11.91	12.26

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

- CMP's peak demand is forecasted to grow by ~1 GW over current demand
- 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 370% (rural areas show higher growth in winter)
- Historically summer peaking, forecasts show the CMP system is expected to become **winter peaking at the end of this decade**
  - ➢ **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

Review of Milestone 2: Needs Assessment

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

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)

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

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

Review of Milestone 2: Needs Assessment

Transmission and Distribution (T&D) Needs Summary

Thermal / Voltage	2034 Violations	2034 Total
Distribution Substation Transformer	115	46%
Distribution Circuit	123	25%
Transmission Transformer	34	28%
Transmission Line	107	31%
Transmission Voltage	76	15%

DER Interconnection Driven	Violations
Distribution	39
Transmission	221
Total Capacity-Driven Needs	**715**

Also Consider Asset Condition and Reliability and Resilience

- ✓ Evaluate the physical condition of infrastructure (e.g. poles, wires, transformers)
- ✓ Examine outage history and system performance during extreme weather
- ✓ Identify vulnerable areas that may need upgrades to recover faster from disruptions

Key Takeaways from Milestone 2

- ✓ Significant **thermal overloads** observed in both summer and winter, projected to drive constraints at 46% of substation transformers
- ✓ **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).
- ✓ Storm hardening, reliability impact and asset condition needs are strong considerations during the IGP.

Solutions Identification and Evaluation Process

Identify System Needs

Distribution
Modeled 12 forecast scenarios on:
- ✓ 250 substation transformers
- ✓ 480 distribution circuits at the head-end*

Transmission
Modeled 18 forecast scenarios on:
- ✓ 124 transmission transformers
- ✓ 314 transmission lines

Identified 715 needs

Categorize Needs

Detailed assessment not possible for all 715 needs

Driver
- Load-driven
- DER-driven

Expected time of need
- Near-term (0-5 years)
- Long-term (6-10 years)

Severity
- 90-110% overload
- 110-150% overload
- >150% overload

Separated 715 needs into 16 categories by driver, timing and severity

Identify Solutions

Determined solution alternatives for each category of needs, including traditional and non-traditional upgrades

Determined 3-4 viable solution alternatives for each category of needs

Solution Alternative Comparison

Compare and assess solution alternatives for example from each needs category

Scorecard Categories
- Cost
- Technical Performance
- Environmental Justice
- Policy Alignment

Determined what types of solutions are best suited to meet each needs category (qualitative + quantitative*)

Apply Across all Needs

Near-Term (next 5 years)
- ✓ "No-regrets" solutions needed in the next 5 years
- ✓ Lay the foundation to enable new technologies and overcome barriers

Long-Term (6-10 years)
- ✓ Identify good candidates for technology pilots

Prioritized portfolio of solutions for near and long-term

10 Year Roadmap

*Detailed Circuit Level Analysis on 70 sample circuits from end to end

Solution Methodology: Categorization of Needs

Why Categorization Matters

- *Not all needs should be treated the same*
- *But many needs exhibit strong similarities, enabling us to establish a framework for thinking about categories of needs*

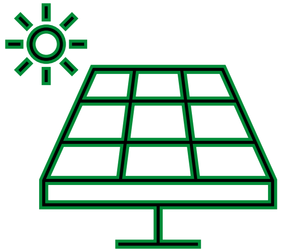
Near Term or Long Term?	Lower Severity	Medium Severity	Highest Severity
Near term • Need is immediate or within 5 years • Higher certainty • Within planning horizon for ordering equipment, real estate, regulatory approval process • Solutions enable greater long-term flexibility **Long term** • Less certainty around load forecast, less certainty about available technologies, beyond any planning horizon with actionable next steps • Increased flexibility in considering solutions with lower certainty of serving needs • Opportunity to build upon near-term solutions	• A violation is occurring, but reduced likelihood of frequent, widespread disruptions in service • Greater opportunity for non-wires or low-investment solutions	• Higher likelihood of frequent, widespread disruptions in service • Reduced opportunities for non-wires solutions • Appropriate solutions more likely to be infrastructure investments	• Very likely to cause significant adverse effects on service • Appropriate solutions are likely significant infrastructure investments

Solution Methodology: Categorization of Needs

Additional Categorization Considerations

DER v. Non-DER Driven

- ***DER-related violations are accounted for*** *in the analysis*
- *DER-driven needs are currently mostly addressed with customer-funded solutions*



Type of Violation

- ***Thermal overloads and voltage drops share the same root cause****: excessive current and reactive power imbalance.* ***Fixing the thermal overload*** *usually restores reactive power margins, which improves voltage*

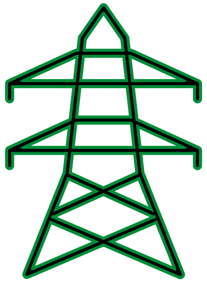
On the transmission system:

- *Considered both thermal and voltage needs, because* ***larger geographic coverage of transmission system reduces likelihood that thermal solutions will also solve voltage issues***

Equipment Studied

On the distribution system:

- ***Transformer-level analysis helps understand larger needs****, on critical infrastructure serving thousands of customers*
- ***Circuit-level analysis provides more granular insights*** *for potential needs not appearing at the transformer level*



Solution Methodology: Categorization of Needs

					# of Needs
Needs	Distribution	Near term Thermal Violations	Circuit	Low severity	10
				Medium severity	43
				High severity	28
			Transformer	Low severity	10
				High severity	75
		Long term Thermal Violations	Circuit	Low severity	41
				High severity	1
			Transformer	Low severity	27
				High severity	3
		DER-driven Violations*			39
	Transmission	Thermal Violations	Transmission line	Low severity	29
				Medium severity	43
				High severity	35
			Transformer*		34
		Voltage Violations*			76
		DER-driven Violations*			221

- ➢ **Sixteen total categories of "needs"**
- ➢ **Solutions analysis for each category**

**Not further categorized because: DER-driven violations are customer-specific; transmission voltage violations are inherently specific; or need is attenuated.*

Solution Methodology: Identification of Solutions

		Pros / When Suitable	Cons / When Not Suitable
Customer-controlled Solutions	Demand Response	✓ Reduces peak demand, potentially delaying or eliminating need for upgrades	x Relies on customer participation x Limited impact if load flexibility is low
	DERs	✓ Offsets load ✓ Local generation source could provide some resiliency benefits	x Intermittent output may not serve load unless paired with battery storage x Will not always align with peak demand periods
Solutions for Lower-severity Needs	Hardening and Automation	✓ Reduces outages and improves resilience ✓ Enables remote monitoring and control	x Do not address thermal or voltage overloads
	Shift System Load	✓ Mitigates overloads when adjacent circuits have available capacity	x Requires appropriate adjacent circuit conditions x Limited as a long-term solution
	Cooling Retrofit	✓ Extends life of equipment under thermal stress ✓ Cost effective compared to full replacement	x Doesn't increase capacity x Maintenance intensive; limited impact in extreme heat
	Circuit Upgrade	✓ Increases capacity and reliability for long-term growth; addresses thermal and voltage overloads	x Requires infrastructure investment; potential ROW limitations
	Capacitor Banks or Voltage Regulators	✓ Improves voltage stability	x Ineffective for thermal overloads x Limited benefit for fast-changing loads or DER variability
Solutions for Higher-severity Needs	Circuit Tie	✓ Improves flexibility for load transfer, and alternate feed during outages	x Requires compatible voltage and protection schemes x Limited benefit when adjacent circuits are constrained
	New Circuit	✓ Adds redundancy, capacity, reliability, load balancing	x Requires infrastructure investment; potential ROW limitations
	Transformer Upgrade or Parallel Transformer	✓ Increases capacity; improves reliability	x Limited benefit if upstream circuit is constrained x May not solve voltage issues if feeder is long
	Substation Upgrade or New Substation	✓ Adds capacity; improves reliability ✓ Reduces line loading ✓ Supports future DER integration	x Long lead time x Higher investment
	STATCOM or Synchronous Condenser	✓ Improves voltage stability and power quality; effective for DER integration	x Does not address thermal overloads x Higher investment

Solution Methodology: Identification of Solutions

Further Solutions: *That Build Upon Near-term Systems or Grid Enhancements*

Enabling Technology and Initiatives	**Grid Model Enhancement Project (GMEP)**	• Ensures accuracy in planning tools by aligning field assets with internal models	
	Automation; SCADA; Fault Location/Isolation/ Restoration (FLISR)	• Equipment necessary to establish visibility and control over the full distribution system	• Allows reconfigurations of the system to isolate outages
	Centralized Control and Visibility	• With field equipment providing visibility and control, allows grid operators to manage the grid effectively and efficiently	
	Advanced Load Forecasting	• Enables time-series planning • Allows processing of real-time and historical grid data more accurately	• Enhances predictive analysis for electrification and DER integration
Systems and Technologies to be Enabled	**Battery Energy Storage**	• Can serve peak shaving and reliability needs • Can mitigate variability of intermittent generation	• High upfront costs and 5-15 year lifespan • Potential safety and environmental concerns • Regulatory uncertainty
	Advanced Distribution Management System (ADMS)	• Integrates outage management, SCADA, and distribution management into a single system • IT/OT integration	• Depends upon enabling technology and control/visibility infrastructure to obtain proper data
	Distributed Energy Resources Management System (DERMS)	• Dovetails with ADMS: ADMS focuses on grid operation, while DERMS focuses on DER orchestration • Can adjust DER dispatch within prescribed constraints • Can facilitate integration of DERs	• Potential complexity with secure and reliable communication between grid operator and third-party owned DER • Potential regulatory uncertainty around interconnection and operating envelopes
	Microgrid	• If capable of islanding, can provide reliability • Could be implemented with advanced communications scheme to coordinate with the full grid, with appropriate protection systems to protect the microgrid and the full grid, and with microgrid control system like ADMS and DERMS	• High upfront costs; complex design and operation • Potential regulatory barriers/uncertainty • Benefits are localized • Full scope of generation, voltage/thermal support, and distribution infrastructure needed within the microgrid
	Dynamic Line Ratings (a GET)	• With real-time line capacity data, operators could optimize power flows on transmission lines depending upon the weather	
	Flexible Interconnections	• Could allow interconnecting load and generation customers to interconnect within prescribed operating envelopes to reduce interconnection costs, enable DER integration	

Scorecards Approach

Description of System Need:		*[1-3 sentences summarizing need]*			
	Evaluation Category	**Comparative Assessment Scorecard**			
		Alternative A	Alternative B	Alternative C	Alternative D
Cost	Capital costs	*[low, medium, or high impact]*			
	Operations & maintenance costs				
	Avoided costs				
Technical Performance	Efficacy				
	Execution and schedule risk				
	Existing infrastructure optimization				
	Reliability & resiliency impact				
	Flexible management of customers' load and generation				
EJ	Equity				
	Emissions impact				
	Local environmental impact				
Policy Alignment	Peak load reduction				
	Electrification readiness				
	DER and renewables integration				
	Advances state energy and climate goals				
	Overall prioritization ranking	*[1st, 2nd, 3rd, 4th]*			
Scorecard Narrative:		*[longer text describing scoring process & results, with any necessary supporting data]*			

CMP's Scorecard Approach:

- An illustrative assessment tool for stakeholders to get a high-level sense of how solution alternatives compare across key categories;
- Scorecard with color coding with a narrative explanation of the scorecard contents.

Sixteen scorecards, one for each category:

Distribution

Near Term	Category I – Circuit: 90% – 110%
	Category II – Circuit: 110% – 150%
	Category III - Circuit: > 150%
	Category IV - Transformer: 90% – 110%
	Category V - Transformer: > 110%
Long Term	Category VI – Circuit: 90% – 110%
	Category VII – Circuit: 110% – 150%
	Category VIII - Transformer: 90% – 110%
	Category IX - Transformer: > 110%
DER-Driven	Category X – DER Driven: Thermal & Voltage

Transmission

[Transmission needs were evaluated over the full 10-year period, because transmission projects are generally larger scale and longer in duration]	Category I – Line: 100% – 110%
	Category II – Line: 110% – 150%
	Category III - Line: > 150%
	Category IV - Transformer: > 100%
	Category V – Substation: < 95%
DER-Driven	Category VI – DER Driven: Thermal & Voltage

Scorecard- Cost

Costs				
Evaluation Category	Definition	Comparative Assessment Scorecard		
		Most Preferred	Middle	Least Preferred
Capital costs	What is the **overall cost** to implement the solution?	**Low** Minimal utility investment	**Medium** Moderate utility investment	**High** Major capital investment required
Operations & maintenance costs	What level of ongoing **O&M effort** is expected?	**Low** Minimal maintenance needs	**Medium** Some recurring maintenance	**High** Regular and resource-intensive maintenance
Avoided costs	What is the potential for future **cost avoidance**?	**High** Significant deferral of major investments	**Medium** Some deferral or efficiency gains	**Low** Limited or no meaningful cost avoidance

The cost comparison presented in this report **is not based** on unit costs or absolute financial values. **CMP adopts a comparative approach** to highlight the differences among viable mitigation alternatives—such as NWA, reconductoring/upgrading and new circuit construction.

This "**sliding scale**" approach allows for relative comparison across options without implying a definitive ranking, recognizing that actual costs and benefits are highly project-specific and **influenced by factors such as location, inflation, supply chain and implementation timelines**. A more detailed and quantitative comparison would require real-time costing and project-specific data.

Scorecard- Technical Performance

Technical Performance				
Evaluation Category	**Definition**	**Comparative Assessment Scorecard**		
		Most Preferred	**Middle**	**Least Preferred**
Efficacy	Does the solution support operation within **thermal and voltage limits**?	**High** Fully resolves the system need over multiple years	**Medium** Partially resolves needs over time	**Low** Limited ability to consistently resolve needs
Execution and schedule risk	What level of **execution or timeline risk** is expected?	**Low** Mature tech, simple build, short lead times	**Medium** Moderate complexity, some permitting/procurement risk	**High** High uncertainty, long lead times, complex dependences
Existing infrastructure optimization	Can existing infrastructure be **effectively leveraged**?	**High** Maximizes use of current assets	**Medium** Some reuse or efficiency gains	**Low** Replaces existing assets without improving utilization
Reliability & resiliency impact	Does the solution improve **reliability and resiliency**?	**High** Significantly reduces outage risk	**Medium** Some reliability improvement	**Low** Minimal or no impact on outage risk
Flexible management of customers' load and generation	Can customer load/generation be **flexibly managed**?	**High** Actively enables dynamic management/control	**Medium** Some interaction with flexible resources	**Low** No or limited enablement of customer-side flexibility

Scorecard- Environmental Justice

Environmental Justice				
Evaluation Category	Definition	Comparative Assessment Scorecard		
		Most Preferred	Middle	Least Preferred
Equity	Does affected grid infrastructure serve **disadvantaged community**?	**High** >=66% in DAC	**Medium** [33%, 66%] in DAC	**Low** <33% in DAC
Emissions impact	Does the solution **increase or decrease emissions**?	**High** Direct reduction of emissions	**Medium** Indirect reduction of emissions	**Low** Directly increases emissions
Local environmental impact	Does the solution require **development of new land**?	**Low** No new land use or reduces land use	**Medium** Moderate increase in land use	**High** Increases land use

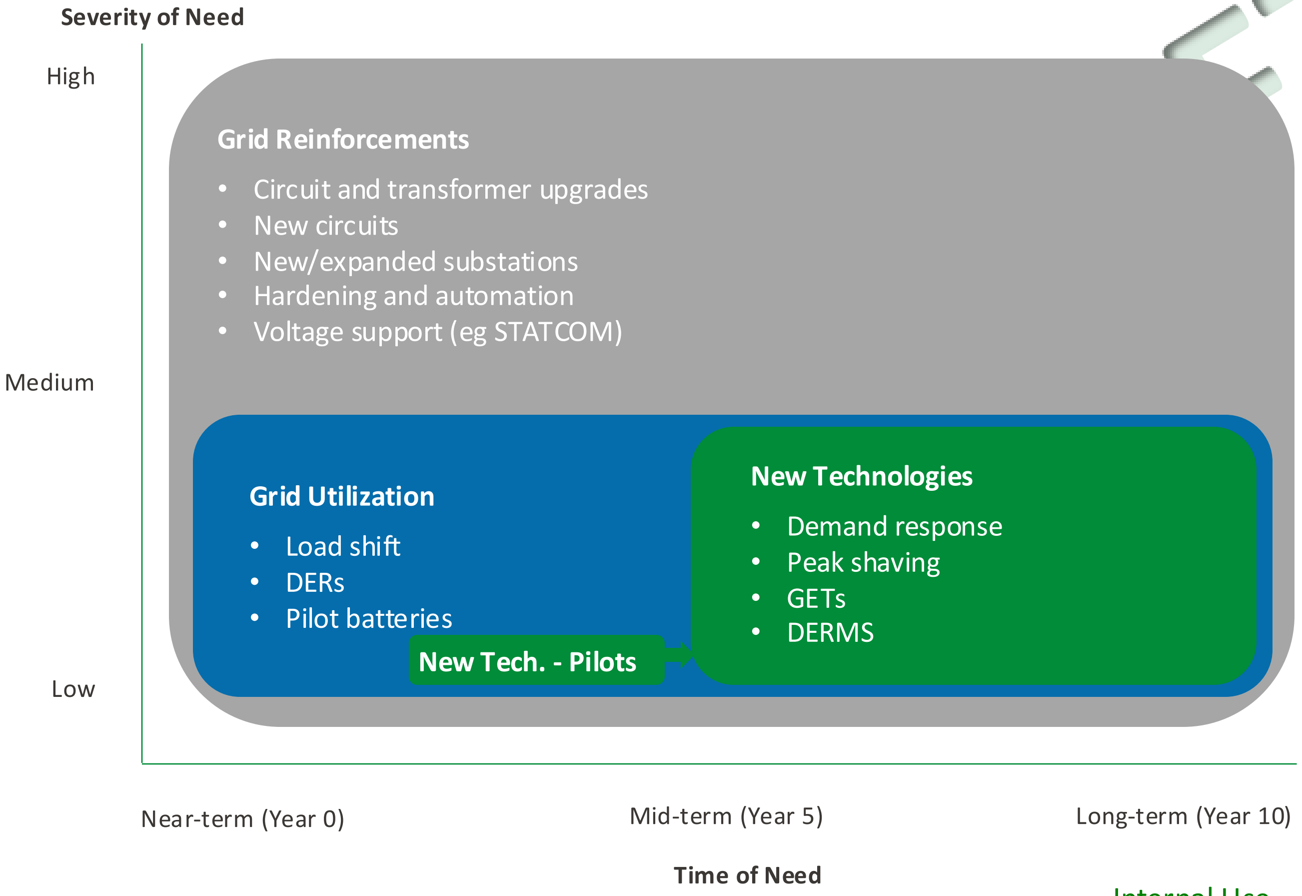
Scorecard- Policy Alignment

Policy Alignment				
Evaluation Category	Definition	Comparative Assessment Scorecard		
		Most Preferred	Middle	Least Preferred
Peak load reduction	Does the solution **reduce peak load**?	**High** Significant peak reduction over multiple years	**Medium** Moderate, temporary, localized peak reduction	**Low** Negligible impact on system peak
Electrification readiness	Does the solution allow for **future load growth**?	**High** Substantially expands or future-proofs grid capacity	**Medium** Moderate additional grid capacity	**Low** Marginal or no improvement in grid capacity
DER and renewables integration	Does the solution enable **DER and renewable integration**?	**High** Directly promotes DER adoption or installs DER	**Medium** Enables moderate additional capacity for DER	**Low** Marginal or limits DER hosting capacity
Advances state energy and climate goals	Does the solution help **advance state goals**?	**High** Directly advances Maine's clean-energy and climate mandates	**Medium** Indirectly supports state goals	**Low** Neutral or misaligned with state goals

Foundational + Enabled Technology and Systems

Solutions aligned with severity and timing of system needs

- Grid reinforcements are essential to address higher severity needs
- Increased utilization of existing grid assets can avoid/defer grid upgrades for lower severity needs
- New technologies can also avoid/defer grid upgrades; need to pilot to confirm suitability



Grid Reinforcements

- Established technology
- Address all system needs, regardless of timing and severity
- Can provide maximum capacity headroom
- Can be high-cost

Grid Utilization

- Manage system usage to maximize use of existing infrastructure and resources
- Low severity needs more commonly eligible
- Provides limited capacity headroom
- Lower cost

New Technology

- Generally less established technology
- Suited to address low severity needs, mid- to long-term
- Provides limited capacity headroom
- Variable in cost
- Pilot new technology, before BAU

Solution Results: Alternative Comparison – Example Circuit 217D2

Distribution Circuit: Thermal Overload

(Bucket #1: 90%-110%)

(Near-Term: 0-5 yrs)

Alternative	Assessment Detailed Circuit Modeling		Scorecard Prioritization Ranking	
1 Load Shift *(<$50K)*	√	17% Capacity Margin	1	Recommended Solution
2 Upgraded Circuit *($1.5M)*	√	7% Capacity Margin	2	
3 New Circuit *($5.5M)*	√	37% Capacity Increase	3	

Distribution Need

- Thermal Overload on Circuit 217D2 at the Cooks Corner Substation
- Capacity limit = 7 MVA
- Peak Loading = 8.8 MVA (2034 - 125% thermal overload)

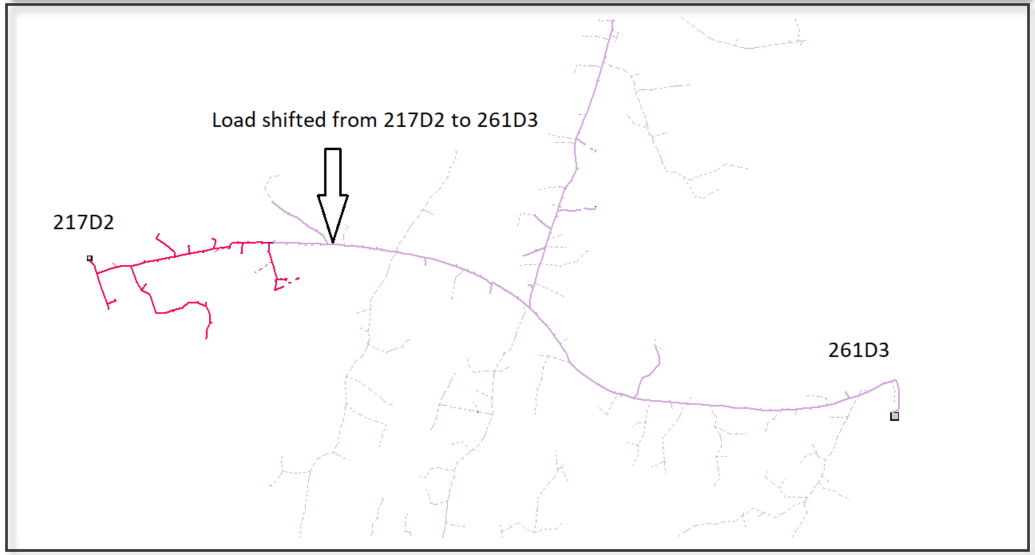
Recommended Solution – *Utilize Existing Circuit-Tie*

- Shift 3 MVA of load from circuit 217D2 to nearby circuit 261D3 out of the Bath 34.5 kV Substation.
- Reduces loading to 5.8 MVA (providing additional 21% capacity margin)

Comments

- Minimal/no cost load shift can defer major upgrade for 10+ years
- Upgrading circuit/regulator does not provide adequate headroom
- New circuit provides most headroom but high cost, can be differed

CYME Load Flow (Circuit 217D2): 3-Phase Thermal Overload



Solution Results: Alternative Comparison – Example Circuit 624D1

Distribution Circuit: Thermal Overload (Bucket #1: 90%-110%) (Near-Term: 0-5 yrs)	Assessment Detailed Circuit Modeling		Scorecard Prioritization Ranking	
1 Load Shift *(<$50K)*	X	No Viable Load Shifts	3	
2 Upgraded Circuit *($2.5M)*	√	20% Capacity Increase	1	Recommended Solution
3 New Circuit *($6.5M)*	√	50% Capacity Increase	2	

Distribution Need (2.5-mile)

- Thermal Overload on Circuit 624D1 out of the Fort Hill Substation
- Capacity limit = 9.5 MVA (336 kcmil conductor)
- Peak Loading = 9.5 MVA (2034 - 105% thermal overload)

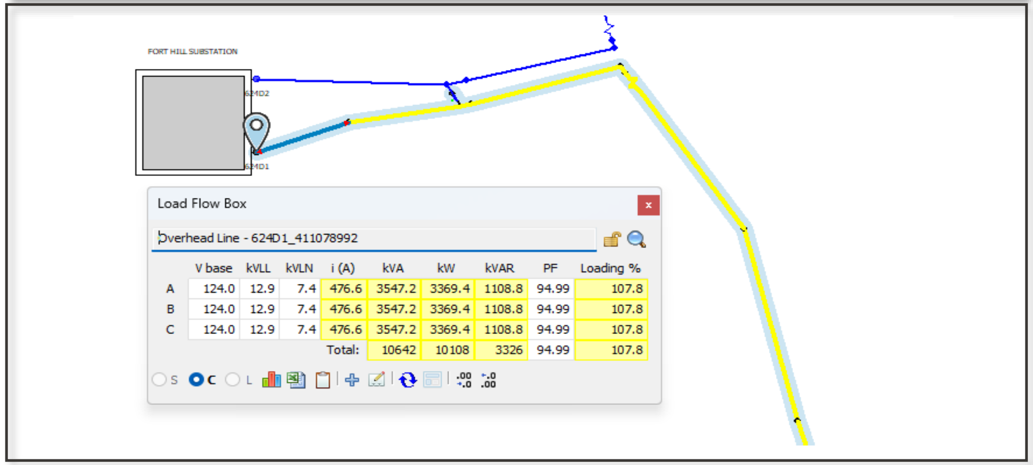
Recommended Solution

- Upgrade 2.3 miles of 336 kcmil to 477 kcmil conductor

Comments

- Current circuit-ties at Fort Hill are unable to accommodate a load shift
- Upgrading conductor is cost-effective, establishes headroom for 10+ years
- New circuit provides most headroom but high cost, can be deferred

CYME Load Flow (Circuit 624D1): 3-Phase Thermal Overload



	V base	kVLL	kVLN	i (A)	kVA	kW	kVAR	PF	Loading %
A	124.0	12.9	7.4	476.6	3547.2	3369.4	1108.8	94.99	107.8
B	124.0	12.9	7.4	476.6	3547.2	3369.4	1108.8	94.99	107.8
C	124.0	12.9	7.4	476.6	3547.2	3369.4	1108.8	94.99	107.8
				Total:	10642	10108	3326	94.99	107.8

Solution Results: Alternative Comparison – Example Transformer Gray 416T1

Distribution Transformer: Thermal Overload

(Bucket #8: >110%)

(Near-Term: 0-5 yrs)

Alternative		Assessment Transformer Modeling	Scorecard Prioritization Ranking	
1 Load Shift (<$50K)	X	No Viable Load Shifts	4	
2 Upgraded Transformer ($7.2M)	√	40% Capacity Increase	1	Recommended Solution
3 Additional New Transformer ($20M)	√	100% Capacity Increase	2	
4 Peak Shaving (BESS)	X	Not Viable Solution	3	

Distribution Need (Transformer Overloading)

- Thermal Overload on Transformer 416T1, Gray
- Capacity limit = 10.5MVA

Recommended Solution

- An upgraded transformer sized at 22.4 MVA

Comments

- There is no adjacent circuit to shift the demand – **Alternative 1 dismissed**
- Medium cost to upgrade the 10.5 MVA transformer to a 22.4 MVA unit – **Alternative 2 recommended**
- Major substation work needed to host additional transformer – **Alternative 3 dismissed**
- Overload too severe for viable BESS solution – **Alternative 4 dismissed**

Solution Results: Alternative Comparison – Example Transformer 855T1

Distribution Transformer: Thermal Overload

(Bucket #8: 90%-110%)

(Long-Term: 6-10 yrs)

Alternative	Assessment (Detailed Circuit Modeling)		Scorecard (Prioritization Ranking)
1 Load Shift (<$50K)	X	No Viable Load Shifts	4
2 Upgraded Transformer ($7.2M)	√	40% Capacity Increase	2
3 Additional New Transformer ($20M)	√	100% Capacity Increase	3
4 Peak Shaving (BESS) ($5M)	√	25% Capacity Increase	1 (Recommended Solution)

Distribution Need (Transformer Overloading)
- Thermal Overload on Transformer 855T1, South Waterville
- Capacity limit = 10MVA

Recommended Solution
- A battery sized at 2.5-3MW

Comments
- There is no adjacent circuit to shift the demand – **Alternative 1 dismissed**
- Medium cost to upgrade the 10MVA transformer to a 14MVA unit – **Alternative 2 dismissed**
- New transformer is not cost-effective to address marginal thermal overload – **Alternative 3 dismissed**
- Peak shaving BESS is most cost-effective as a deferral alternative – **Alternative 4 recommended**
  - Loading levels will need to be closely monitored, re-evaluate alternatives once loading re-exceeds 90%

Summary of Distribution Capacity Results

Potential Solutions	Near-Term: Thermal Overloads *(0-5 years)* — Circuit			Near-Term: Thermal Overloads *(0-5 years)* — *Transformer*	
	90-110% ***(10 Needs)***	**110-150%** ***(43 Needs)***	**>150%** ***(28 Needs)***	**90-110%** ***(10 Needs)***	**>110%** ***(75 Needs)***
Load Shift (incl. adding circuit tie)	1	9	6	6	20
Circuit or Transformer upgrade	4	11	4	2	47
Regulator Upgrade	1	15	13	-	-
New Circuit	2	4	2	-	4
Substation Expansion	1	4	3	1	4
Peak Shaving Battery Storage Candidate	-	-	-	1	-
Load Management Candidate	1	-	-	-	-
Total Needs Addressed	**10**	**43**	**28**	**10**	**75**
	$575M - $950M *(unit-based estimate)*				

Long-Term: Thermal Overloads
(6-10 years)

Circuit & Transformer ***(72 Needs)***

Long-Term Solutions informed by near-term solution mix and scorecard summary results:

68 Low severity needs

- Most viable for Grid Utilization or New Technology solutions
- Likely opportunities to address needs & reduce cost with New Technology (*pilots are required to confirm viability)*

4 Mid & High severity needs

- Likely addressed by Grid Reinforcements (informed by near-term results and scorecards)

$215M - $350M *(unit-based estimate)*

Solution Results: Building in Climate Resilience

CMP's Climate Change Protection Plan

1. High Exposure Climate Hazards:	*2. Identify Key Vulnerabilities to those Climate Hazards:*
Storm Events and Wind	Highest vulnerabilities to **overhead conductors** and **line structures**, as well as other **elevated assets**, from impacts of wind and downed trees; **distribution, transmission, and substation systems all include assets with high vulnerability**
Flooding (Inland and Coastal)	Highest vulnerabilities to **ground-mounted assets**, such as substations, and any **underground assets** such as buried conductor and structure foundations
Heat Events	Higher vulnerability for **most distribution, transmission, and substation assets** such as transformers and circuit breakers
Wood Decay	High expected vulnerability of **transmission and distribution wooden poles**, as well as on overhead assets and ground-mounted **assets exposed to falling vegetation**
Wildfire (low change from current exposure, but high impact)	Periods of high, very-high, or extreme Fire Weather Index pose a **significant threat to utility assets**, which are generally not designed to be exposed to fire

3. Implement Key Resilience Measures:

- *Spacer cable/Hendrix construction*
- *Tree wire*
- *Stronger wood poles*
- *Steel poles*
- *Targeted undergrounding*
- *Fiberglass crossarms*
- *Ambient adjusted ratings*
- *Circuit ties*
- *Substation hardening*
- *Advanced management systems, incl. automation*
- *ADMS and DERMS*
- *Battery energy storage*
- *Relocation/elevation of vulnerable assets*
- *Dynamic line ratings*
- *Equipment ratings*

+ Asset Condition and Reliability

Assess Current Asset Health

Perform condition-based monitoring and inspections to determine remaining useful life.

Use predictive analytics to identify failure risks and prioritize replacements.

Evaluate Operational Performance

Review historical reliability, maintenance costs, and outage impacts.

Identify assets that no longer meet current performance standards.

Consider Future Grid Requirements

Account for anticipated load growth, electrification trends, and DER penetration.

Ensure compatibility with advanced technologies (e.g., sensors, automation, communications)

Solutions Roadmap

IGP Priorities	Near-term (2026-2030)	Long-term (2031-2035)
Reliability and Resilience	• **Alleviate 166 network capacity constraints identified in the IGP evaluation and prepare for an additional ~500 MW of electricity demand** • **Harden substations and circuits to address asset condition** • **Increase backup circuit-ties to reduce the impact of outages** • Continue deploying **Distribution Automation** (**SCADA devices**) **to improve visibility and remote-control capabilities** • Complete rollout of **Distribution Automation to achieve visibility and remote-control capabilities across 100% of circuits by 2031** • **Pilot battery storage for reliability and contingency backup use cases**	• **Alleviate 72 network capacity constraints and prepare for an additional ~600 MW of electricity demand** • **Create sufficient network hosting capacity to enable the connection of up to 1.6 GW of low-carbon generation by 2035** • **Continue to harden substations and circuits to address asset condition** • **Continue to increase backup circuit-ties to reduce the impact of outages** • Explore opportunities for **battery storage deployments in cost effective use cases**
Improve Data Quality, Integrity	• **Integrate AMI and SCADA data** into forecasting and system planning • Implement advanced forecasting and system planning tools to **enable time series analysis** • **Improve mapping of the distribution system** (Grid Model Enhancement Project) • **Enhance hosting capacity** maps	• **Enhanced system modeling** capabilities using **time series analysis** enables more automated and efficient evaluation of solutions • Enable real-time data, improved interoperability and enhanced capabilities in analytics, DER management and control
Promote flexible management of consumers' resources	• Deploy ADMS features to **lay the foundation for integration and utilization of DERs**, enabling load flexibility • Coordinate with EMT on impacts of **customer flexibility programs**	• **Flexible load management and DER optimization** play a role in proactively mitigating peak demand, enabled by DERMS • **Enhanced DERMS** features enable new solutions and use cases • Scale deployment of smart grid technologies, such as GETs

Time Series Modeling

CMP's Time Series Roadmap Summary

Short-Term (<2 years)
Infrastructure, Coverage, & Deployment

Mid-Term (2-5 years)
Improved Data Availability & Quality

Long-Term (>5 years)
Enhanced Modelling & Network Operation

Typical Modeling & Time Series Analysis Comparison

Aspect	Typical (Snapshot) Modeling	Time-Series Modeling
Basic Idea	Simulates grid conditions at defining static points in time	Simulates grid conditions and changes on an hourly basis
What It Shows	Performance under fixed conditions (e.g., peak load, % DG output, etc.).	Behavior as load and generation fluctuate throughout the day.
Pros	• Faster to prepare and simulate	• Captures hourly system variability
	• Works with currently available data	• Reveals how long needs occur for
	• Good for determining needs and comparing solutions	• Enables flexible interconnection
Cons	• Unable to identify hourly duration of need	• Needs detailed data that's not currently available
	• Limited capability to evaluate load management	• More setup and computing time
	• Doesn't support flexible interconnection	• Limited value for longer duration needs
Typical Use Cases	• All Grid Planning Studies	• High-DER feeders
	• Low-DER feeders during summer conditions	• Hosting capacity and determining operating envelopes
	• Establishing	• Non-wires alternatives (e.g. sizing BESS)

Agenda

01 Introductions

02 Overview of Integrated Grid Plan Process and Review Milestones 1 & 2

03 Milestone 3 Overview

04 Solutions Methodology

05 Solutions Findings

06 Next Steps

07 Questions, Comments, Discussion

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

Questions, Comments, Discussion