MAINE DEPARTMENT OF
Energy Resources

Transmission Planning Stakeholder Group Meeting #4

Pursuant to Resolve 2025, ch. 57

May 5, 2026

Resolve 2025, ch. 57

To Direct the Governor's Energy Office (now DOER) to Conduct a Study Regarding the Future of Electric Transmission Infrastructure in the State

DOER will **coordinate with state agencies** involved in the siting, permitting and regulation of electric transmission infrastructure and **solicit information from a stakeholder group** to assist in conducting the study under section 1.

DOER must submit a report with an overview of the study and any recommendations **to the Legislature by September 1, 2026**.

DOER will **include any comments provided by the stakeholder group as an appendix** to the report of the study.

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Maine Transmission Infrastructure Study

Pursuant to the legislation, the study must include a review of:

1. Existing processes for the siting and permitting of new and upgraded electric transmission infrastructure in the State;

2. Best practices related to electric transmission planning, siting, permitting and community engagement from other states or regions;

3. Existing analyses of future electric transmission needs in the State necessary to integrate new renewable resources as well as to ensure reliability, improve market efficiency or support the achievement of the State's policy goals;

4. Types of existing rights-of-way and opportunities for potential use of those rights of-way for siting of electric transmission infrastructure in the State; and

5. Existing and emerging technology and construction methods

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Next Steps for Engagement

- DOER will conduct 2 more stakeholder group meetings prior to the submission of the report.
- The meetings will continue to follow the content outlined in Section 1 of the Resolve.
  - **June 2, 2026, 12pm-2pm:** Overview of the types of existing rights-of-way and opportunities for potential use of those rights-of-way for siting of electric transmission infrastructure in the State; explore strategic undergrounding and a cost-benefit analysis of various undergrounding options
  - **August 5, 2026, 12pm-2pm:** Overview of the draft Maine Instructure Study and how its content evolved based on stakeholder input
- The study will be completed and submitted to the Legislature by September 1, 2026.

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Today's Goals

- **Delve into existing analyses of future electric transmission needs** in the State; **explore existing and emerging technology and construction methods**, such as grid-enhancing technologies and advanced conductors
- Discuss these analyses and methods, generating **feedback and input** for the Maine Transmission Infrastructure Study.
- Provide a reminder of **future meeting topics and schedule** for the remainder of the engagement.

Today's Agenda

- **Brief re-introductions and opening exercise**
- **Presentation by E3 with opportunity for discussion**
  - Overview of existing analyses of future electric transmission needs in the State, as well as existing and emerging technology and construction methods, such as grid-enhancing technologies and advanced conductors.
- **Facilitated Q&A and time for public input**
- **Next steps for engagement**

Maine Transmission Infrastructure Study

Stakeholder Engagement Meeting #4

5/5/26

Energy+Environmental Economics

Existing Analyses of Future Electric Transmission Needs

Energy+Environmental Economics

Existing Studies Overview

+ **The goal of this presentation section—as directed by the Resolve—is to clearly summarize future electric transmission needs in the state that have been identified via recent existing studies**
  - Transmission infrastructure is built to serve customer needs, and therefore the planning landscape is an evolving one, shaped by factors including electricity demand, reliability standards, economic development, and resource needs.
    - As such future studies are bound to identify additional needs
    - Additionally, the needs discussed here reflect the best information at the time of the studies, and based on study goals and scenarios. Consequently they vary in terms of timing and likelihood of development, and some may evolve as load conditions and resource availability continues to shift

Section Agenda

Context Setting
- Drivers of transmission needs: load growth, aging transmission assets, and changing energy mix

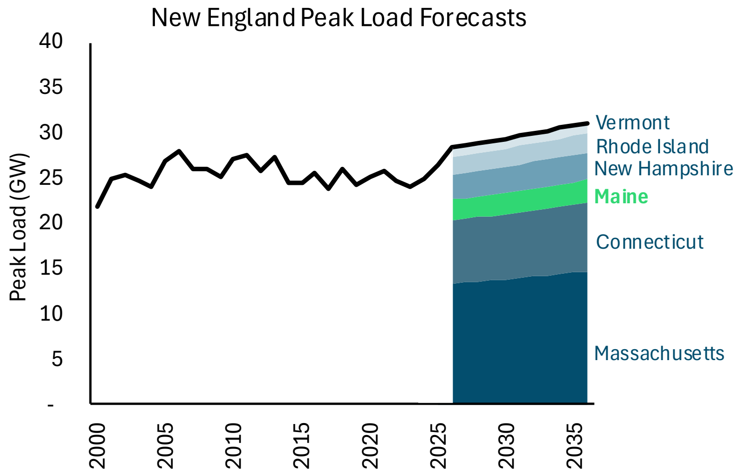
Review of Targeted Existing Studies
- Local and State-led studies
- Regional studies
- National studies

Discussion of Transmission Needs
- Specific transmission needs identified by existing studies

Appendix of Additional Existing Studies
- Numerous additional studies are summarized in the appendix, and will be to be included in the final report
- These include local system plans, studies of neighboring systems, studies of interregional needs, and more

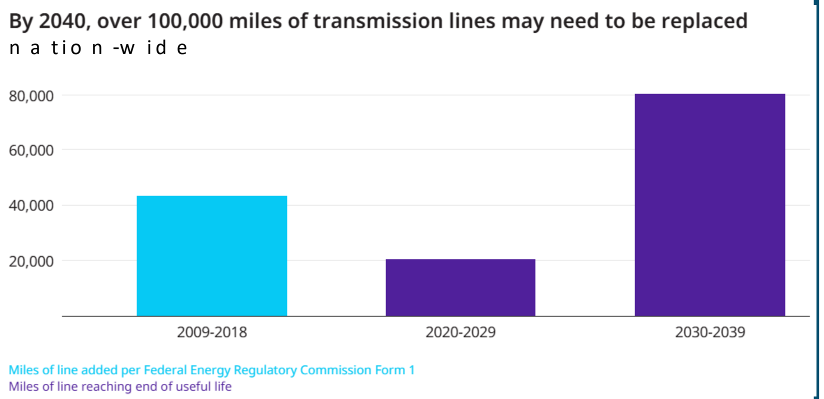
Key Factors Driving Need for Transmission in Maine

Increasing Expectations for Load Growth



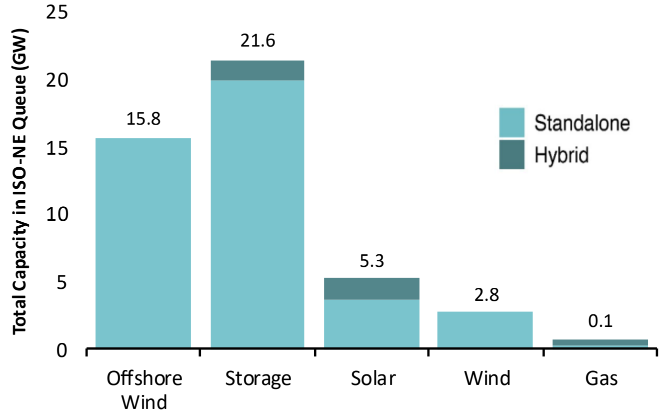
- **ISO-NE's base case forecasts region-wide increase by 9% in the next decade (from 28 GW in 2026 to 31 GW by 2036)***
  - CELT forecasts have lowered the rate of load growth from prior years, but large loads and electrification is still expected to increase load over the next decade
- **Maine's Peak Load is forecasted to increase 11% by 2036, from 2.2 GW in 2026 to 2.5 GW in 2036**

Aging Transmission



- **Large investments will be needed over the next decade to replace and upgrade aging transmission infrastructure**
- **Over $5B in asset condition projects across New England through 2033, $443M of which is in Maine**

Changing Energy Mix



- **The ISO-NE interconnection queue reflects a predominant commercial focus on new renewables and storage for near-term interconnection**
  - This indicates both economic trends and regional policy priorities, but regardless reflects an evolution in the distribution of grid resources that will require transmission to deliver to loads

Range of Reviewed Studies

State-Level Focus
Specific Needs Identified

National Scope
Broad Needs Identified

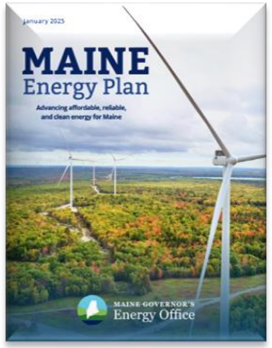
ME Utility Local System Plans

CENTRAL MAINE POWER

VERSANT POWER

Identifying local transmission system (34.5kV-115kV) needs

Maine Energy Plan

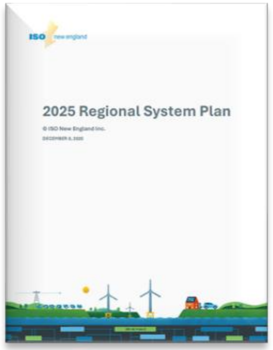


Maine's long-term, strategic plan guiding economic, workforce, and infrastructure actions to advance clean energy

NMISA 7-Year Outlook

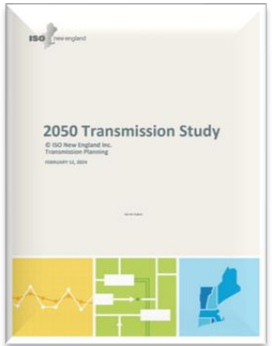
Resource planning, resource adequacy analysis, and transmission planning

ISO-NE Regional System Plan



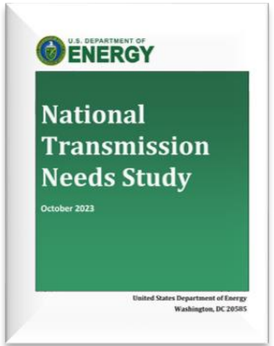
Comprehensive planning report on system needs, G&T facilities required to maintain reliability over 10-year period

ISO-NE 2050 Tx Study



Identifies long-term system needs, serves as the baseline for ISONE's LTTP and competitive procurements

DOE National Tx Needs Study



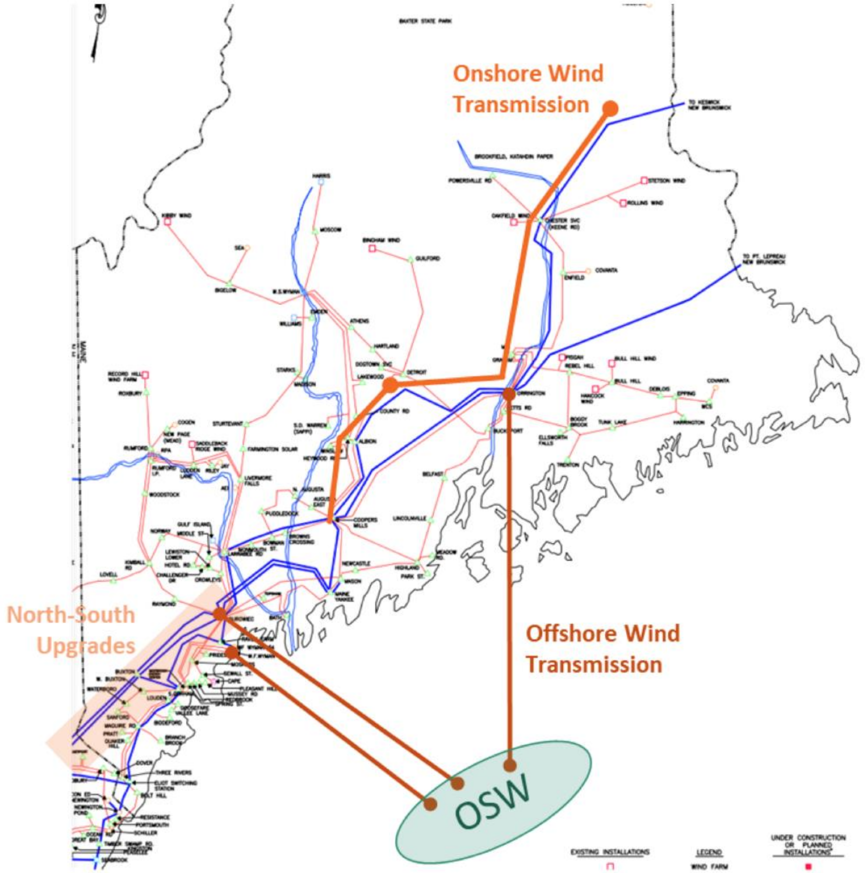
Compilation of findings from a range of transmission needs studies across the country

Note: Numerous additional studies are profiled in the appendix

Maine Energy Plan

- **Strategic plan to advance affordable, reliable, and clean energy for Maine's people and economy**
  - Accompanying technical report, Maine Pathways to 2040, identifies infrastructure needs within this energy planning future
- **Identifies several transmission priorities:**
  1. Building new transmission to connect **new generation resources**
     - E.g., 1.2 GW for Northern Maine Renewable Energy Development Program, although up to 2.4 GW may be required
  2. Upgrading **transmission between Maine and New England** to serve demand in both regions with diverse and cost-effective clean resources
     - E.g., "North-South/Boston Import" upgrades identified in ISO-NE LTTP process
  3. Upgrading **local transmission** to meet rising peak load due to electrification
  4. Consideration of expanding transmission ties to **Canadian provinces**

Map of Key Transmission Needs



Northern Maine Independent System Administrator 7-Year Outlook

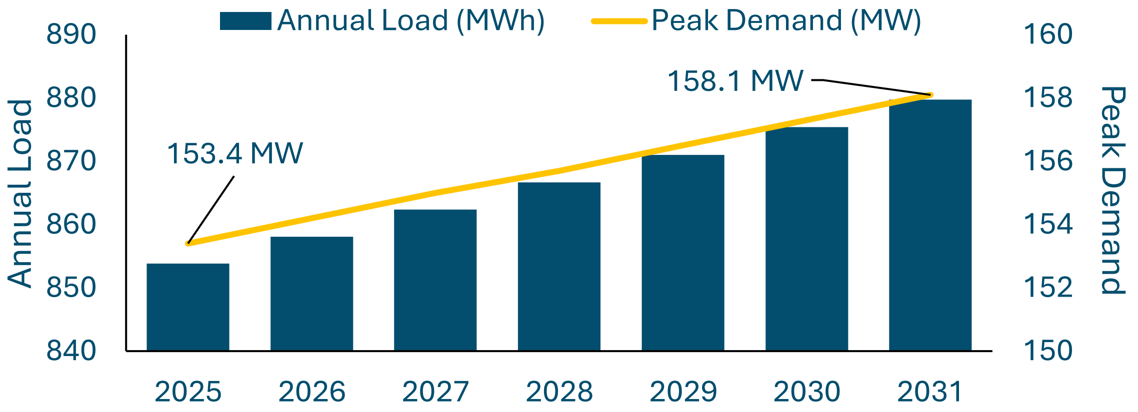
- **NMISA conducts 7-Year Outlook each year for planned development in Northern Maine Transmission System (NMTS)**
  - Study includes a load forecast, review of generation resources and retirements, resource adequacy, and transmission planning to identify system needs; overview of system impact studies performed by Transmission Owners (TOs)
- **2025 Outlook shows >37% reserve margin for 2025-2031 vs. PRM requirement of 20%**
  - Annual capital maintenance projects by Versant Power MPD will increase system reliability and decrease O&M expenses, but not expected to increase Total Transfer Capacity (TTC) of MPD system
- **NMTS consists of MPD (Aroostook) and EMEC (Washington and Penobscot), which are interconnected by NBP transmission system**

MPD is connected to NBP via 3 Tx lines

- Two 100 MVA and one 56 MVA with a total TTC of 134 MW and TRM of 24 MW

EMEC is connected to NBP via 1 Tx line

- A 40-mile, 69 kV Tx line with a TTC of 32 MW and TRM of 11 MW



Current NMISA Generation Resources

32 MW Hydro	42 MW Wind	20 MW Biomass	105 MW Distributed Generation

Maine Utilities' Local System Plans (LSPs)

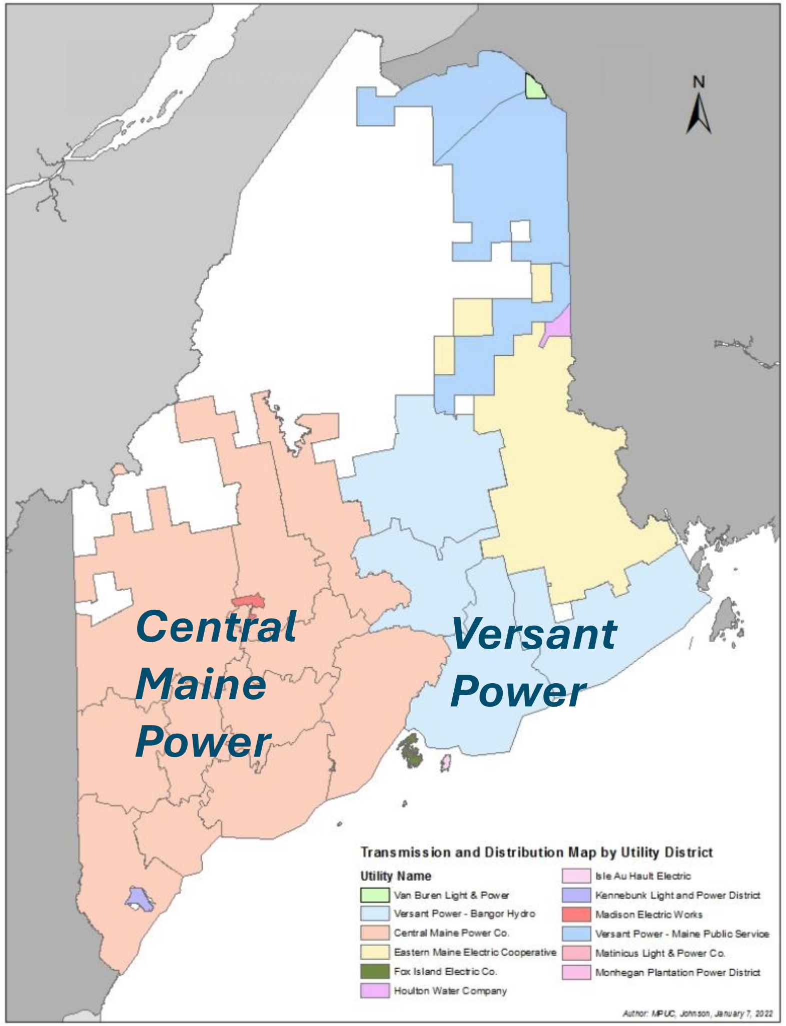
- **LSPs are conducted by utilities within ISO-NE and are focused on the local transmission needs within their own operating footprints**
- **Needs focus on asset condition, load growth, reliability, and generator or customer interconnection**
- **LSPs are required from Central Maine Power (CMP) and Versant Power's Bangor Hydro District (BHD)**
  - The Greater Portland Phase 1 project originated from a CMP LSP

Projects identified by Maine Utility LSPs

Project Status	CMP	Versant BHD
Concept	6	14
Planned	33	19
Proposed	8	7
Under Construction	3	8
Total	**50**	**48**

**Project voltages range from 34.5kV-115kV*

Map of Utility Service Territories



ISO-NE Regional System Plan

+ Reliability Transmission Upgrades (RTUs)

- Designed solely to address reliability concerns
- For June 2025 through end of 2028, estimated cost of RTUs expected to be ~$0.45B across New England
- 20 project components currently proposed, planned, or under construction

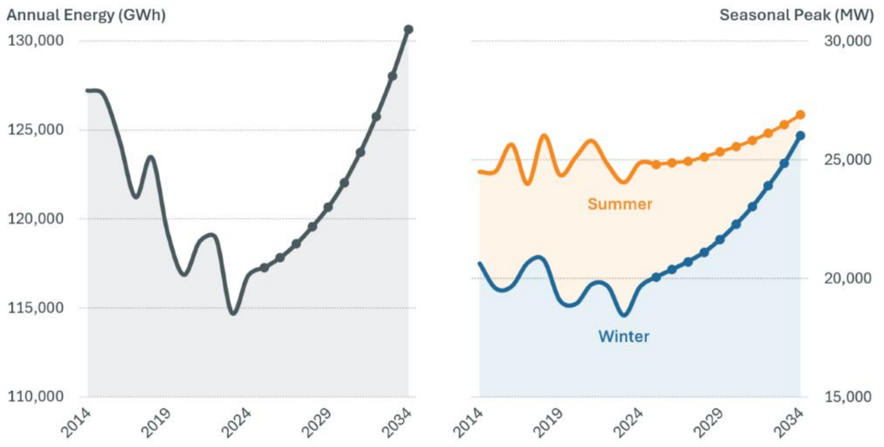
+ System Efficiency Transmission Upgrades (SETUs)

- Designed to reduce congestion or lower overall production costs
- No solutions identified to date due to RTU-driven benefits and merchant development of economic resources in response to wholesale markets

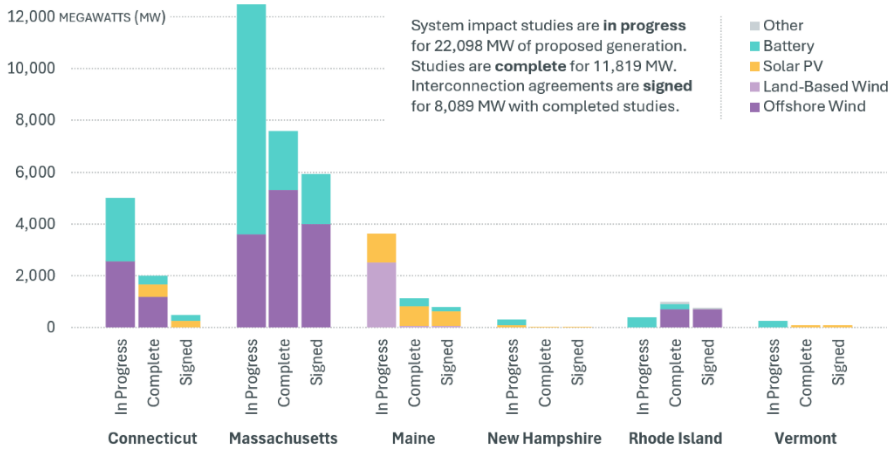
+ Asset Condition Projects

- Consists of transmission upgrades or replacements driven by aging infrastructure or equipment failure
- Estimated $5.8B in spending across New England through 2032, far outstripping RTUs/SETUs

Forecast of Annual Net Energy and Peak Demand



Active Interconnection Queue as of July 1, 2025

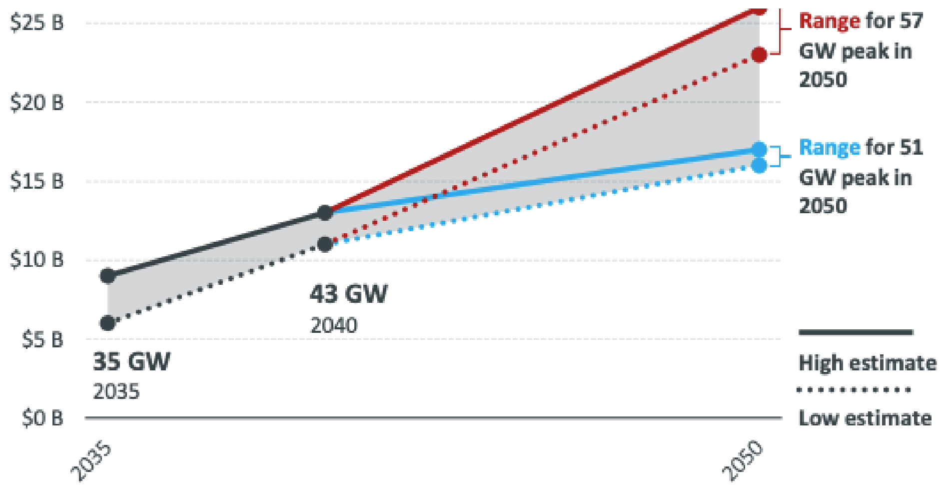


Source: ISO-NE Regional System Plan

ISO-NE 2050 Transmission Study

- Initiated by a request from NESCOE to identify long-term system reliability and other needs
- Serves as the baseline for solutions for ISONE's LTTP Phase 2 and resulting competitive procurements
- Outlines many *potential roadmaps* of Tx solutions including upgrades to the North-South and Boston import interfaces that address system needs that appear across modeled scenarios

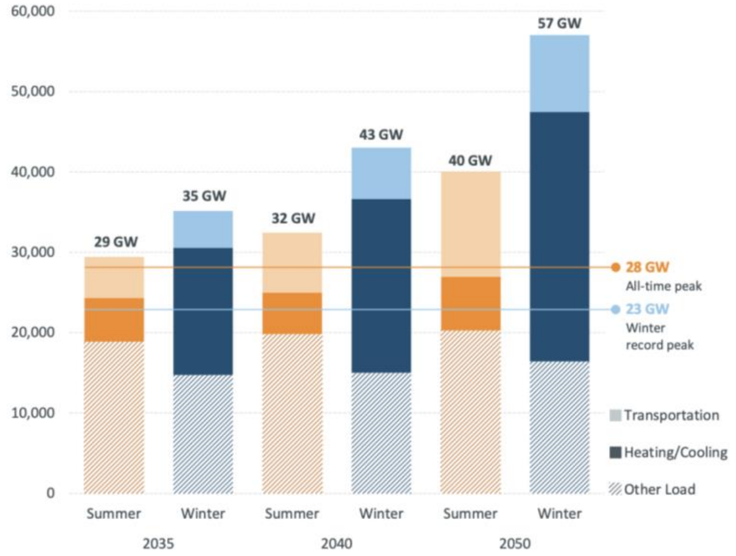
Estimated Cost of Transmission Needs

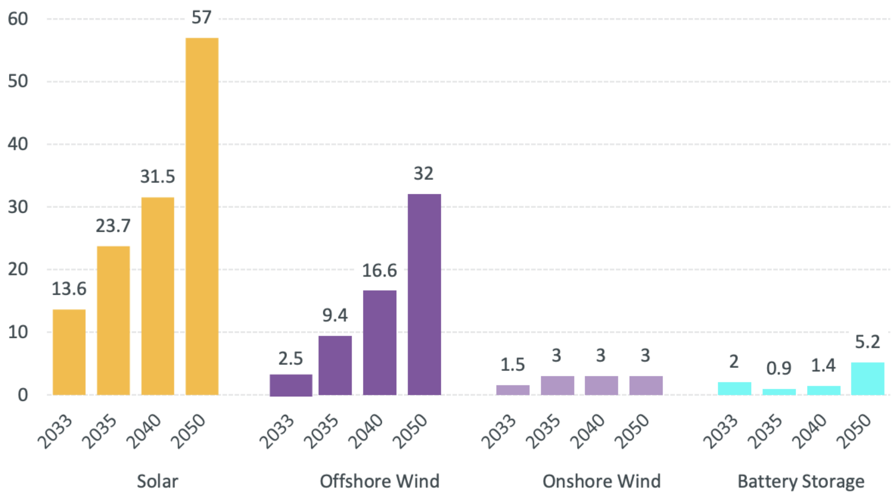


Policy-driven input assumptions

(Middle) Study Year Load Levels [MW]

(Right) Installed Resource Capacities [GW]

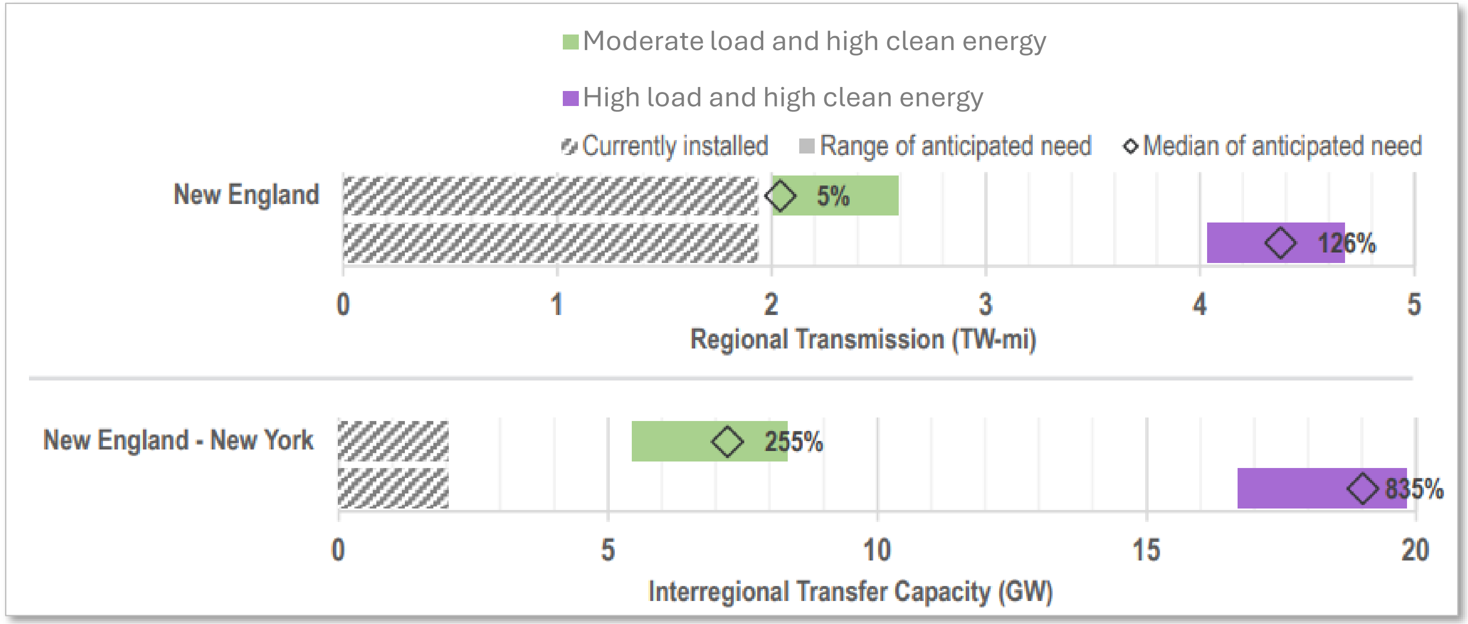




DOE National Transmission Needs Study

- **In 2023, the DOE highlighted regional and inter-regional transmission needs compiled from a range of studies investigating resource and transmission needs through 2035**
- **The studies were grouped into categories based on their underlying assumptions on load growth and clean energy penetration**
  - The results indicate that while clean energy adoption is an important factor, the scale of new transmission investment needs are more directly tied to load growth assumptions, with the high load cases showing the largest incremental need
- **Results intended to act as a common reference point and help identify priority transmission corridors**

Transmission Need Findings



DOE Study Groupings

	Load Growth	Clean Energy Penetration
Moderate	3,974-7,000 TWh	38.6%-80% by 2040
High	>7,000 TWh	>80% by 2040

Summary of Transmission Needs

	Type of Need	Driver(s)	Study	Magnitude of Need (MW)	Cost ($M)	Delivery Year
Asset Condition List	Asset condition	Triggered by aging infrastructure or equipment failure	Asset Condition List (October 2025)	CMP: 10 projects MEPCO: 1 project	CMP: $96.8M MEPCO: $7.2M	List currently extends through 2028, but ongoing process
Reliability Transmission Upgrades (RTUs)	Reliability needs	Increasing loads and integration of new resources	RSP Project List (October 2025)	Upper Maine (UME) 2029 solutions vary in nature	Est. total cost of $151M for UME solutions	Currently planned for 2024-2028
Maine Interface Transfer Upgrades (pursuant to 2025 LTTP RFP)	Combination of reliability, economic, and policy-driven needs	Triggered by LTTP process but addresses medium-term reliability need in southern New England	2050 Transmission Study (2024) LTTP RFP (2025)	Increase Maine-New Hampshire interface limit to 3,000 MW and Surowiec-South to 3,200 MW; facilitate interconnection of 1,200 MW of onshore wind at Pittsfield	Current proposals range from $2.1-2.2B, based on preliminary results of LTTP procurement	Est. in-service Q4 of 2032 based on RFP responses
Northern Maine Renewable Integration	Combination of economic and policy-driven	Renewable energy integration in Northern Maine	Third Maine Resource Integration Study (2024)	At least 1,200 MW of renewables	TBD	Expected to coincide roughly with LTTP upgrades (see below)
Interregional Transmission Expansion	Combination of reliability, economic, and policy-driven needs	Likely necessary to achieve clean energy targets while maintaining reliability	Maine Energy Plan: Pathways to 2040 (2025), DOE Transmission Needs Study (2023)	5 GW between Canada and Maine by 2050 (up from 1,200 MW from NECEC currently), ~7 GW between New England and New York under moderate load by 2035 (up from ~2 GW)	TBD	New England <> New York needs identified in 2035, increase in Canadian hydro imports grows through 2050
Gulf of Maine Offshore Wind Integration	Combination of economic and policy-driven	Offshore wind integration in the Gulf of Maine	Offshore Wind Roadmap, Wind Energy Needs Assessment (2022)	Up to 2,776 MW of offshore wind by 2050	TBD	Depends on technological advancement and onshore infrastructure buildout

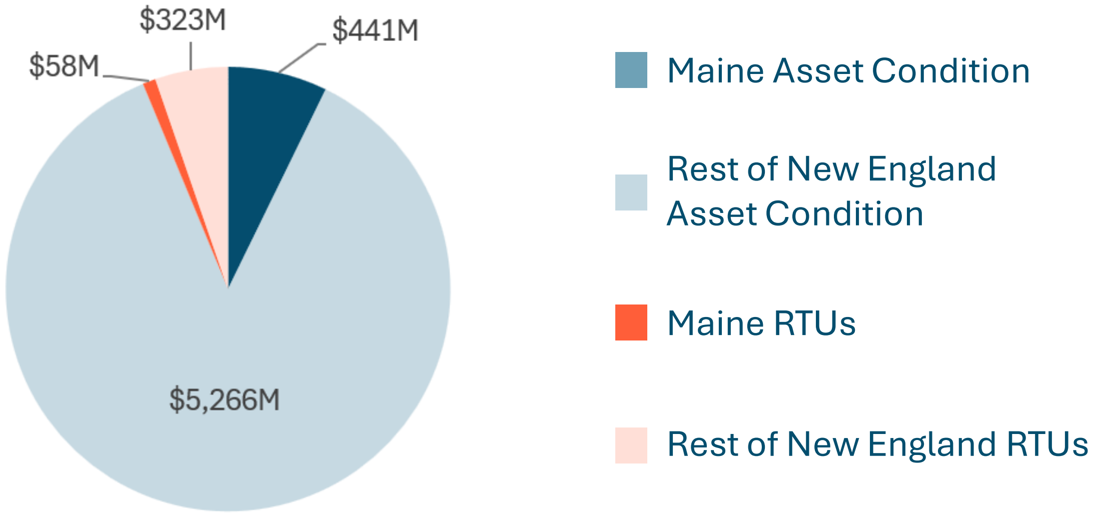
Description of Need
Asset Condition and Reliability Upgrades

+ **11 asset condition structure replacements in ME:**
  - 9 planned by CMP at estimated cost of $92M
  - 1 planned and 1 under construction by MEPCO at estimated cost of $351M, esp. ongoing replacement of 345 kV poles along Sections 396 and 3001
+ **One major reliability transmission upgrade project currently under development in the state, known as Upper Maine (UME) 2029**
  - Designed to address voltage issues in both Versant and CMP's service territories
  - Total cost of UME 2029 solution expected to be $151M from 2024 through 2028 (of which $53M is remaining)
  - Portion of solution in Avangrid's service territory has not yet received Transmission Cost Allocation (TCA) approval

Status of Planned and Under Construction Major Transmission Projects in ISO-NE as of October 2025

Project Type	Maine	ISO-NE
Asset Condition	11 projects ($441M)	109 projects ($5.7B)
Reliability Transmission Upgrades (RTUs)	5 projects ($58M)	17 projects ($381M)

Forecasted Investment in Asset Condition and Reliability Upgrades in ME and ISONE (2026-2030)



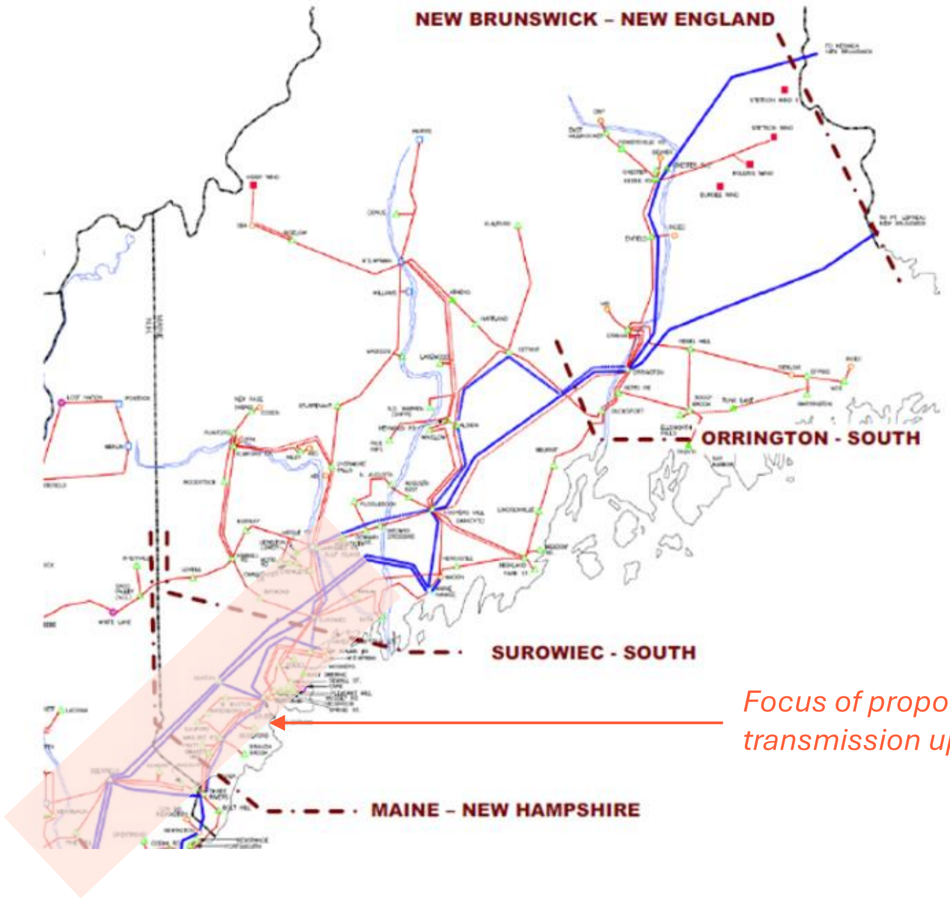
Description of Need

Maine Interface Transfer Upgrades *(pursuant to 2025 LTTP RFP)*

- **In 2050 Transmission Study, ISO-NE identified as high-likelihood concerns a series of interfaces connecting southern Maine to New Hampshire that collectively constrain transfer capability between Maine and the rest of New England**
  - Need based on observed thermal overloads during winter peak periods; interface constraints limit economic delivery of power to high-load areas in southern New England, esp. Boston
    - Alleviating these constraints would also yield reliability benefits in Maine, enabling increased imports at other times of year
- **Finding resulted in the 2025 LTTP RFP**
  - RFP solicited solutions to increase transfer across Surowiec-South and Maine–New Hampshire interfaces by 3+ GW each, plus interconnection of 1.2 GW of onshore wind at Pittsfield
  - Proposed solutions submitted by bidders in September 2025, two of which remain under evaluation by ISO-NE. Both utilize existing ROWs, have bids ~$2.2B, and have planned CODs in late 2032
  - Results expected by late summer 2026, then preferred solution may be selected if it passes economic screening threshold

ISO-NE Maine Interfaces

Key Corridor from Pownal, ME to Hampton, NH

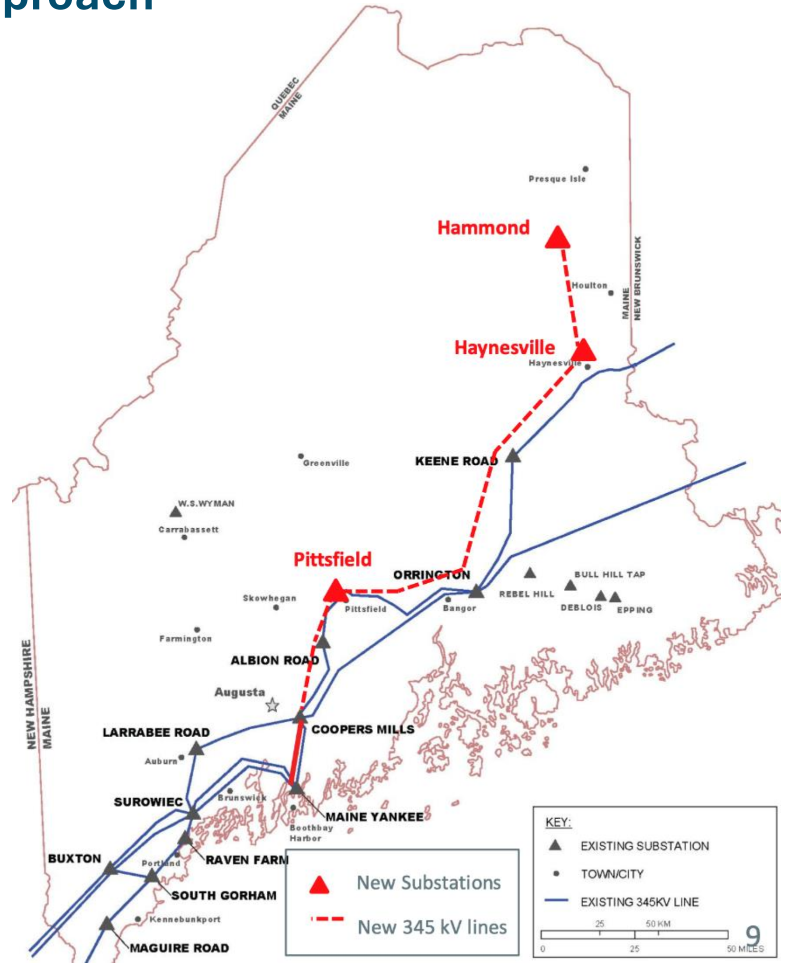


Focus of proposed transmission upgrades

Description of Need
Northern Maine Renewable Integration

- **ISO-NE's Third Maine Resource Integration Study (MRIS) confirmed need for additional transmission to deliver renewables from northern Maine to southern New England**
  - Cluster Enabling Transmission Upgrade (CETU) study in response to two or more interconnection requests that would be unable to interconnect without new transmission line greater than 115 kV (or HVDC)
- **Triggered by ~1,500 MW of proposed projects in Aroostook and Penobscot counties**
  - Performed steady-state and stability studies on two scenarios for both N-1 and N-1-1 across multiple load conditions with 2027 base year
  - Identified new 345 kV line from northern Maine to existing 3023 Orrington-Albion Road 345 kV line at a new substation called Pittsfield
- **Solicitation underway via Northern Maine Renewable Energy Development Program**

ISO-NE's Preferred Transmission Upgrade Approach

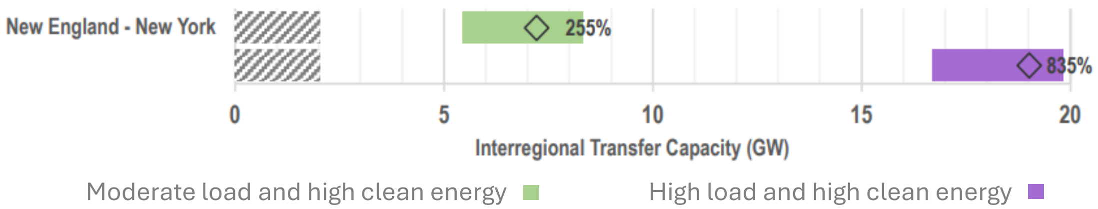


Description of Need

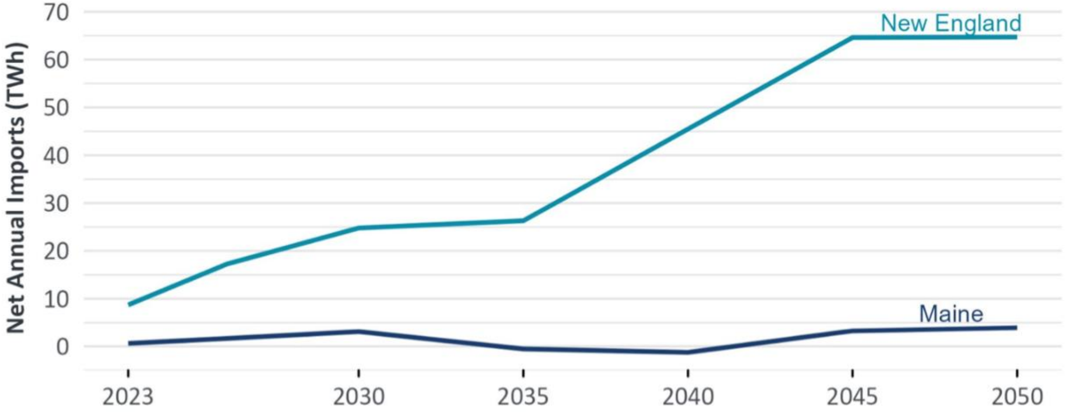
Expanding Interregional Transfer Capacity

+ **Multiple studies have indicated need for expanded transfer capacity with neighboring regions**
  - 2023 DOE Transmission Needs Study identified significant inter-regional transmission investment need by 2035, particularly under the high load growth scenario:
    - Ranging from 5 GW to 17 GW, depending on load growth assumptions
    - Focused on interties with NY, though benefits shared across broader region
  - The Maine Energy Plan focused on reliability benefits from additional transmission capacity between Maine and Canada
    - This study focused on potential reliability benefits from increased access to hydro imports in Canada, and identified the need for expanded interties
      - Since study assumptions were set, conditions have changed: Québec drought now limits near-term hydro import potential
      - Meanwhile, Atlantic Canada is expanding wind, and stronger interties with Maine could enable beneficial imports
    - New England <> Canada interface may require up to 10 GW in incremental transfer capability by 2050

Range of Inter-Regional Transmission Need by 2035 from *DOE Transmission Needs Study*



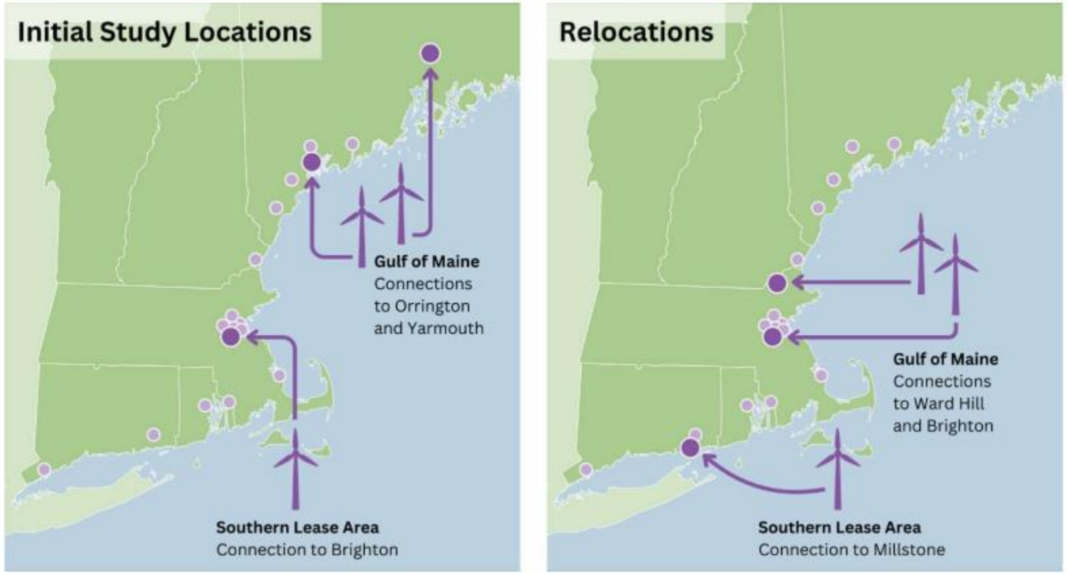
Net Annual Electricity Imports in Maine and New England for Core Pathway from *Pathways to 2040*



Description of Need
Gulf of Maine Offshore Wind Integration

- **ISO-NE's Offshore Wind Analysis, a follow-on to the 2050 Transmission Study, examines impact of different point of interconnection (POI) locations for Gulf of Maine Wind**
  - If POIs are located in Maine, it would require significant upgrades to the Maine-New Hampshire and North-South transmission interfaces
    - These upgrades of course would facilitate any increased north-south transfer, not just offshore wind. Some of these needs are being addressed in the LTTP RFP
  - The study also explored whether relocating the POIs to Massachusetts could avoid some onshore transmission investments; while potentially true when looked at in isolation, the Maine-New Hampshire and North-South interfaces upgrades are likely still necessary for broader reliability and economic dispatch benefits
- **Though critical for understanding the conditions in which OSW may play a role in the future, investments of this kind are unlikely in the near-term due to market and policy headwinds**

Potential Offshore Wind Configurations



Q&A and Discussion Guidelines

- **This is a meeting of the Stakeholder Group**
  - *We'll take questions and comments from observers if there is time*
- **It's OK to bring different perspectives**
  - *Show others the respect you'd want people to show you*
- **Please be brief**
  - *Share the space with others and send any additional feedback via email (**doer@maine.gov**)*
- **Please stay on topic**

Existing and Emerging Technology and Construction Methods

Energy+Environmental Economics

Emerging Technologies Overview

+ What are advanced transmission technologies (ATTs)?

- These are an innovative set of hardware and software solutions focused on modernizing the transmission grid

+ Why are ATTs important?

- ATTs provide the opportunity to cost effectively and rapidly unlock significant capacity from the existing transmission grid, and/or within existing transmission corridors
- They have the potential to improve grid resiliency and access to renewable resources
- They can help defer the need for new-build transmission

+ ATTs covered today

1. Dynamic Line Ratings (DLRs)*
2. Power Flow Controls (PFCs)*
3. Topology Optimization*
4. Storage as a transmission asset
5. Virtual Power Plants
6. Advanced Conductors
7. Advanced Line Design
8. High-Voltage Direct Current (HVDC) Lines

*DLRs, PFCs, and Topology Optimization are often collectively referred to as Grid-Enhancing Technologies (GETs), a subset of ATTs. These technologies are aimed specifically at enhancing the utilization and transfer capability of existing transmission infrastructure, without any new poles or wires deployment, hence the name

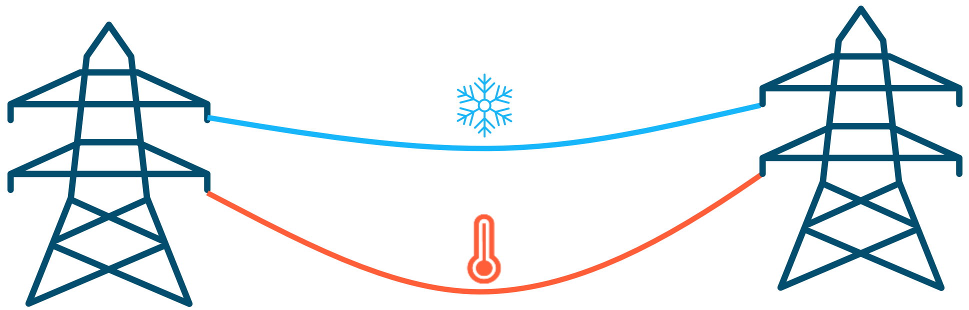
Traditional Transmission Infrastructure

+ **The grid is made of high-voltage alternating current (AC) transmission lines interconnecting generators, substations, and load centers**
+ **Core characteristics**
  - Power flows follow physics (impedance), not operator intent
  - Requires synchronized balancing of supply and demand to maintain stability and reliability
+ **Expanding capacity can be slow and costly**
  - Upgrades can take over 3 years
  - New greenfield projects can take over 10 years
  - High capital costs for both upgrades and new builds
+ **Deployment considerations**
  - Traditional AC transmission lines have formed the backbone of the grid to date:
    - In some circumstances they will continue to be the best option to meet a transmission need
    - We are at a point when many other technologies can also meet grid needs, and they must be fairly evaluated along with conventional solutions

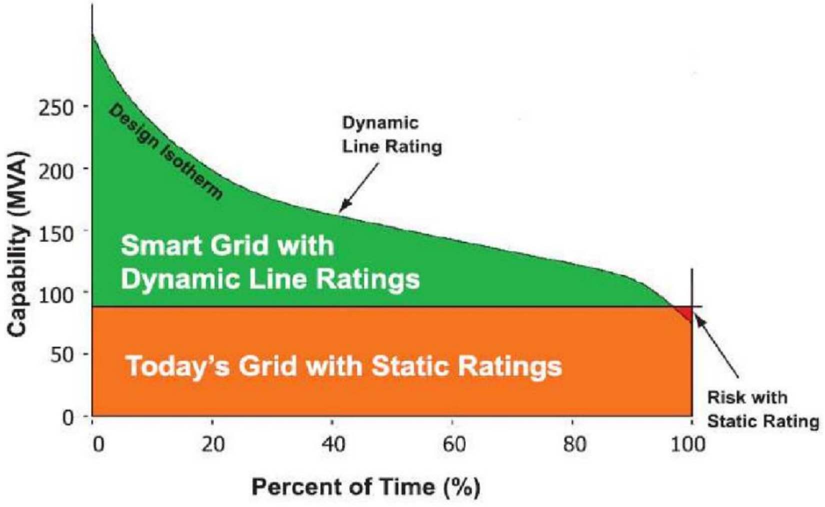
Dynamic Line Ratings (DLRs)

+ **Dynamic Line Ratings (DLRs) incorporate real-time or near-real-time environmental conditions to determine transmission line ratings**
  - System adjusts line rating based on field conditions
    - Direct: Monitor the line itself
    - Indirect: infer line conditions based on temperature, wind, and solar effects
  - Aims to increase overall use of line
+ **Traditionally, transmission operators have assumed constant environmental variables to determine transmission line ratings**
  - Some operators use seasonal ratings, depending on time of year (typically summer and winter)
+ **ISO-NE is planning on incorporating ambient air temperature, but not wind or solar effects on line rating, by the end of 2026***

Weather conditions impact line sag and tensile strength



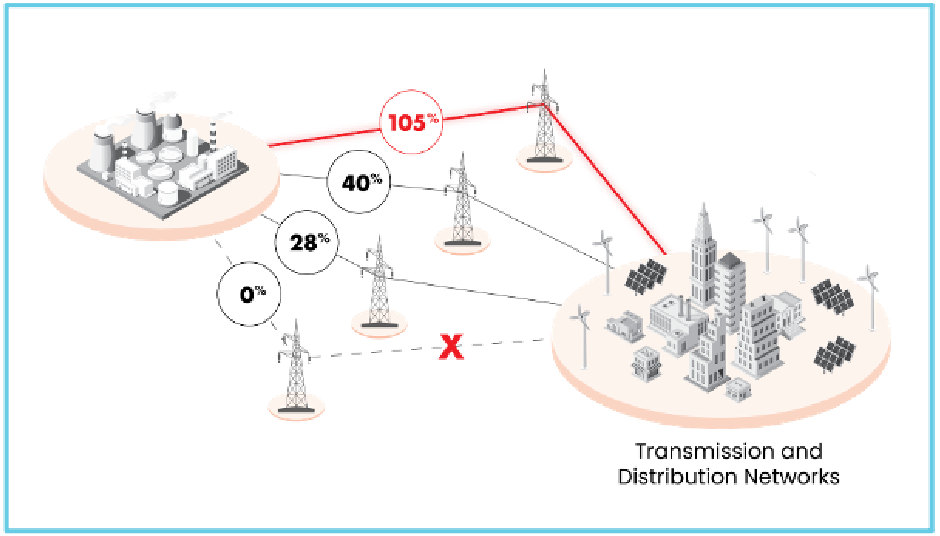
Capacity potential from Dynamic vs Static Line Rating



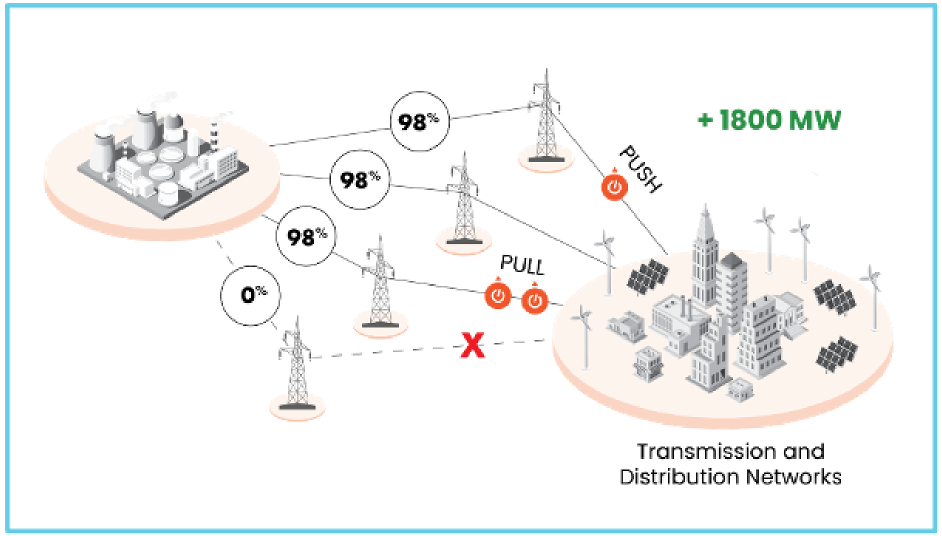
Power Flow Control

+ **Advanced Power Flow Controls (APFCs) enable changing reactance in line through power electronic devices that allow dynamic adjustment of network power flow**
  - Enables the redistribution of power from lines that are overcapacity to lines with available capacity reducing congestion
  - Most applicable in meshed networks with multiple long transmission lines

Before Power Flow Control

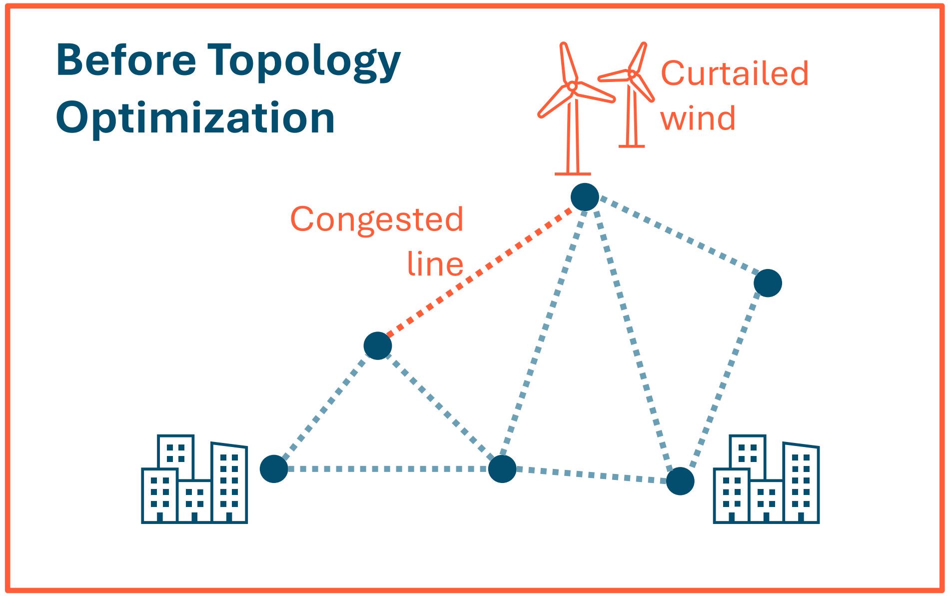


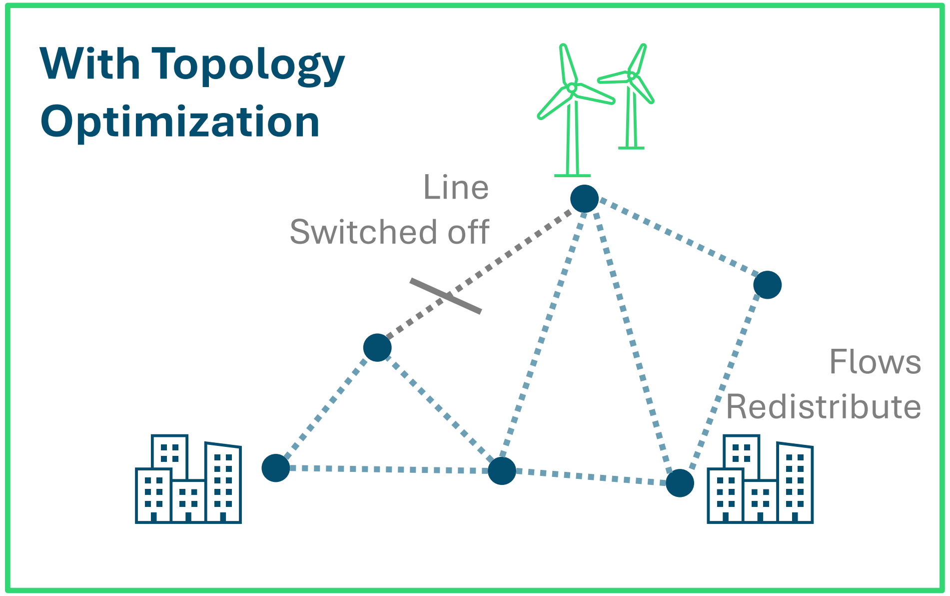
With Power Flow Control



Topology Optimization

+ Topology optimization software models automatically find reconfigurations to route flow around congested elements
+ Requires software to identify optimal configuration but utilizes existing physical grid infrastructure
+ Operates like Google Maps, finding the optimal route using real-time information





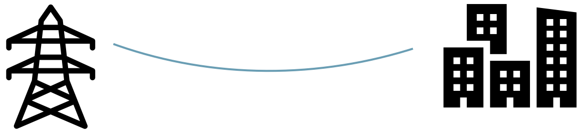
Storage as Transmission Asset

- **Flexible use of storage to directly address transmission issues**
  - Primary use case is to relive security constraints on dispatch
  - Can also provide voltage support and relieve thermal constraints
- **Requires case-by-case evaluation**
  - Best implemented on congested interfaces and in geographically isolated areas
  - Can be used to defer longer-term investments
- **Storage is a proven technology, and is generally lower cost than transmission infrastructure**
  - Most effective at managing prices and deferring transmission needs if managed by the transmission operator rather than as a merchant resource
- **Brings ROW and permitting advantages relative to conventional solutions**
- **ITC funding opportunity**

Before Battery Installation

Congestion limits flow to **100 MW**

Peak Demand is **150 MW**



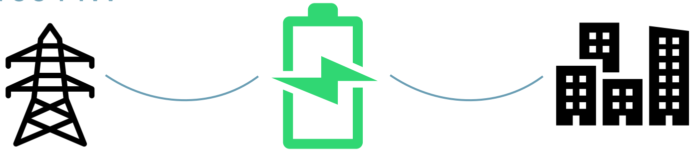
At peak demand, congestion creates **price spikes** and costly **transmission upgrade** may be required

With Battery Installation

Max flow = 100 MW

Charges during off peak, discharges during peak

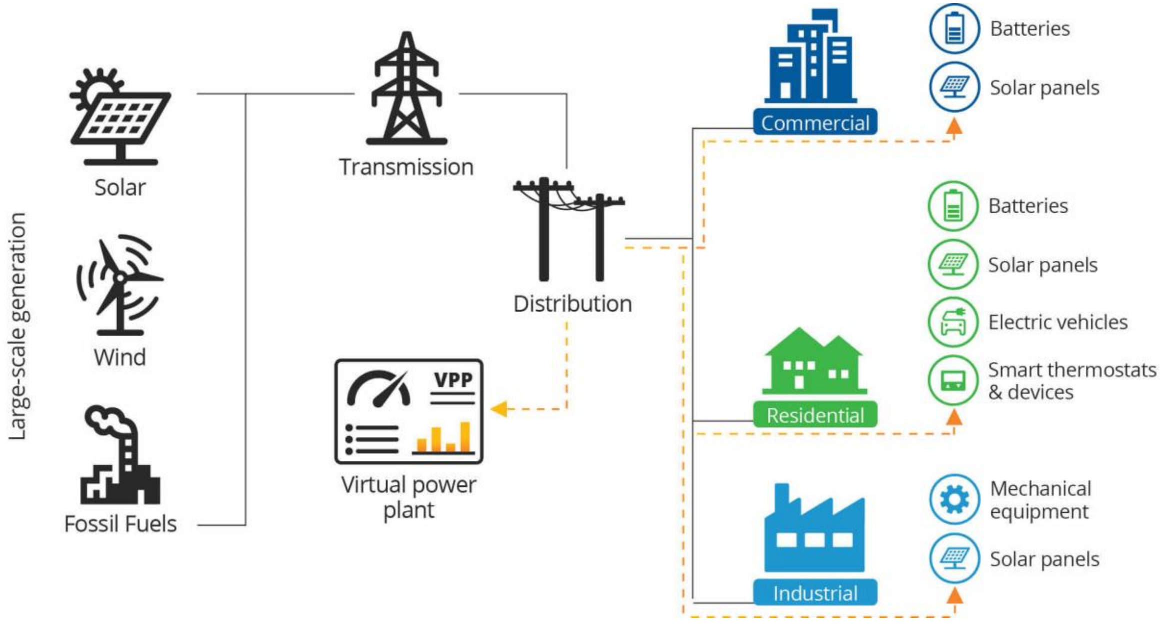
Peak Demand is 150 MW



Battery dispatch **avoids peak pricing**, and **defers need for transmission upgrades**

Virtual Power Plants

- **Virtual Power Plants (VPPs) are software platforms that aggregate distributed energy resources to mimic dispatchable resources**
  - Examples include rooftop solar with batteries, EVs and chargers, and commercial and industrial loads.
  - Individual resources may be too small to engage in market activities, but in aggregate may have significant impacts
- **VPPs can be used to reduce grid stress by reducing load or discharging power in certain parts of the grid**
  - Most deployed VPPs are concentrated in states that have favorable regulatory mechanisms such as CA, TX, and NY.
- **VPPs can defer new transmission investment by reducing peak needs in transmission constrained parts of the grid**

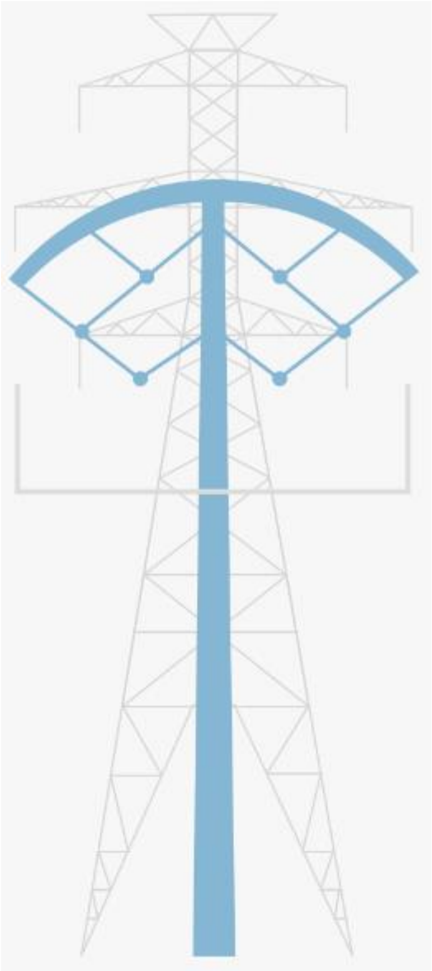


Advanced Conductors

- **Composite core conductors with lower thermal expansion rate allow for higher operating temperatures and significantly more power flow than traditional high voltage lines**
- **Other benefits include:**
  - Reductions in line sag
  - Corrosion resistance
  - Reductions in energy losses
  - The option to include fiber-optic cable within the conductor
- **The most common version being deployed is called Aluminum Conductor Composite Core (ACCC), though other designs exist**
- **Advanced conductors do have a cost premium over conventional conductors**

Advanced Line Design

- **Optimized tower designs allow for increased capacity, efficiency, and power quality**
  - Capacity increase of 5-60% and efficiency increases of up to 33%, depending on individual design
  - Reduced tower heights (30%) mitigate some permitting challenges and avian impacts
  - EMF mitigation can also reduce permitting challenges
  - Reported project costs are 8-18% cheaper than traditional line designs
- **Viable for greenfield transmission and rebuilds within existing Rights-of-Way (ROWs)**
  - Cannot reuse existing infrastructure for rebuilds
- **Power quality benefits for long lines (50+ miles)**
  - Eliminates Sub Synchronous Resonance (SSR) issues
- **Primary vendor is BOLD (Breakthrough Overhead Line Design)**
  - 5 projects operating for AEP in Ohio (100+ miles)
  - 7 additional projects being constructed (250 miles)

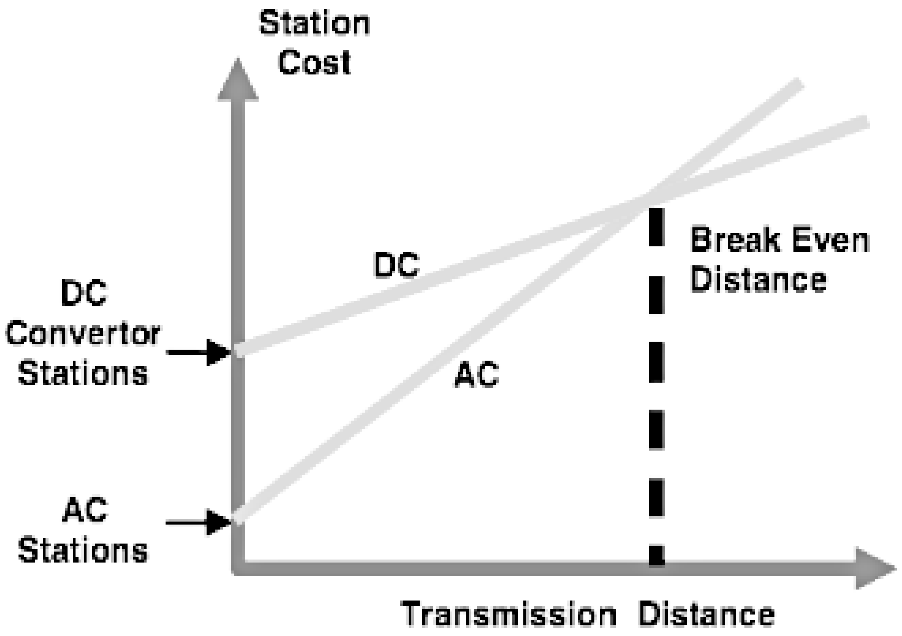


Source: BOLD Transmission Technology ; BOLD Transmission Rob Park Project

High Voltage Direct Current (HVDC) Systems

- **HVDC solutions can yield substantial benefits but also carry very high development costs, and so are best suited for specific use cases. Select benefits and challenges include:**
  - Increase in line capacity between 40 – 200% over AC lines, particularly over long distances or through water (e.g. subsea)
  - Variety of reliability benefits including reactive power regulation, frequency stabilization, congestion relief, and more
  - Requires development of expensive converter stations to integrate with the AC grid, leading to meaningful cost premium in many situations
- **Enabling conditions:**
  - High-capacity feeds to city centers
    - Typically only economic when greater than ~60% capacity increase is required and ROW cannot be expanded
  - Long distance high-capacity lines (technically infinite power transfer distance)
  - Grids with high percentages of inverter-based resources
  - Interconnections between different synchronous grids
  - Underground or subsea lines

AC v DC Transmission Line Cost Considerations



ATT Summary and Applications in Maine (1/2)

Type	Technology	Description	Potential Applications in Maine	Pros	Cons
Grid Enhancing Technology (GET)	**Dynamic Line Rating**	Adjusting line and transformer ratings in near-real time in response to environmental conditions	May be used to increase line ratings and reduce congestion, especially during winter months	• Low cost to deploy • Does not require line rebuild. • Can yield near term benefits that more than offset costs	• Relatively small transfer impacts compared to any hardware upgrade. • Depending on future need this may not be "right sized"
	Advanced Power Flow Controls	Changing reactance in line to change power flow direction and increase line capacity	May redirect power from congested lines to alternate circuits, reducing congestion costs. Less beneficial in radial portions of Maine's grid	• Low cost to deploy • Quick deployment • Improves reliability	• Better for mesh-networked and long-distance lines • Requires installation of hardware devices
	Topology Optimization	Software models automatically reconfigure power flow routes around congested elements	May more efficiently utilize spare grid capacity to bypass congestion	• Low cost to deploy • Quick deployment • Improves reliability	• Better for mesh-networked and long-distance lines • Requires installation of sensors
NWA	**Energy Storage as T&D**	Energy storage to inject reactive power for voltage control and real power for N-1-1 contingency response	Strategically placed storge resources to prevent load shedding	• Can support reliability and grid resilience • Can defer need for higher cost upgrades	• Hardware deployment and complex studies • Limited to N-1-1 contingency support

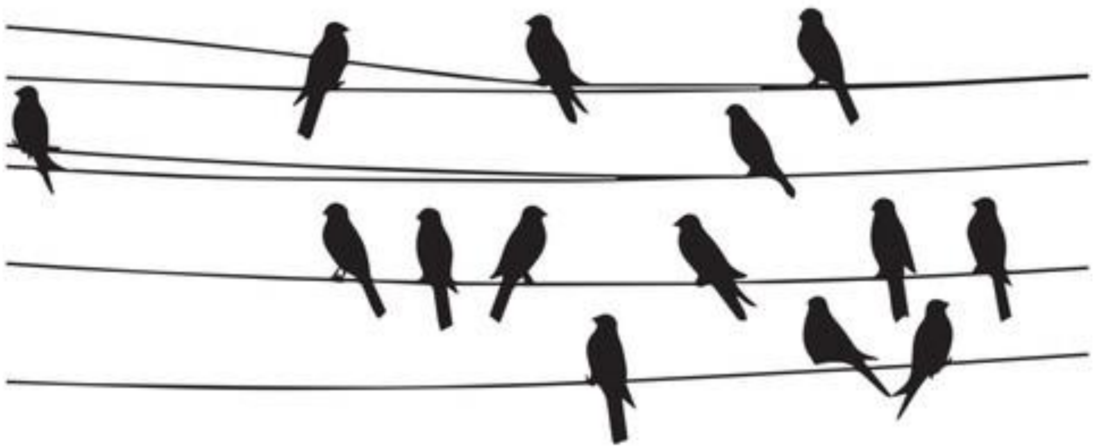
ATT Summary and Applications in Maine (2/2)

Type	Technology	Description	Potential Applications in Maine	Pros	Cons
NWA	**Virtual Power Plants (VPPs)**	Aggregate distributed energy resources / behind the meter resources	Can flexibly dispatch power in key regions to mitigate congestion	• Reduces need for generation and transmission upgrades	• Complex integration and coordination of many resources
Advanced Line and Tower Solutions	**Advanced Conductors**	Using advanced materials in lines with enhanced performance in conducting lines	Reconductor high-usage or long lines to increase capacity. Utilize advanced conductors in new builds to gain throughput advantages	• Reconductoring is ~1/3 the cost of a full rebuild but can double line capacity.	• Cost savings are greatest where towers can get reutilized; less beneficial where towers are old. • Limited cost savings if need to rebuild towers, though throughput advantages remain
	Advanced Line Design	Optimized tower designs allow for increased capacity, efficiency, and power quality	Option when rebuilding existing lines or constructing new lines	• Reported capacity increase of up to 60%, • Height reduction relative to conventional towers	• Requires full line rebuild or new build
	HVDC	High-voltage direct-current transmission lines used in-place of standard alternating-current lines	Dedicated DC line from high-capacity generation region to high demand center, bypassing system limits	• Minimizes losses over long distances • Requires smaller right-of-way than comparable AC solutions	• Requires full line rebuild or new build • May be oversized depending on scale of future need

ATTs offer benefits and warrant proactive consideration; however, prudent implementation is still required

Key Considerations:

+ Comprehensive cost/benefit estimates should be used to inform the most economically efficient solution to meet a given need
+ When ATTs are deemed the best available solution, planning and implementation should follow all standards of Good Utility Practice to ensure system reliability is maintained, and ATT is operated to maximize its function
+ Transmission planners have the capability to expand the list of technologies they evaluate, and create frameworks to incorporate new technologies over time



+ Ultimately, the focus should be on ensuring planning processes robustly evaluate all options, including new and traditional approaches, to identify the most cost-effective portfolio to meet system needs
+ Sharing information about experiences and best practices with ATTs can help improve implementation throughout the industry

Source: FERC Order 1920

Relevant FERC Orders Driving Regional Planning Updates

- **Order 1920 requires transmission providers (TPs) to assess whether existing transmission facilities can be "right-sized"**
  - Right-sized replacements must be evaluated alongside conventional solutions during long-term transmission planning process
- **Order 1920 also requires TPs to consider DLRs, PFCs, advanced conductors, and transmission switching**
  - TPs must explain how these types of solutions are incorporated into long-term transmission planning processes, with goal being transparency for stakeholders
- **ISO-NE stakeholder discussions around Order 1920 compliance are ongoing, and complaince filings due June 2027 for 2029 effective date**
- **Order 881 requires TPs use ambient-adjusted ratings (AARs) for lines when evaluating requests for transmission service**
  - AARs reflect up-to-date forecast of ambient air temperature plus absence of solar heating during night-time period, at hourly granularity or more
  - Though similar to DLRs, the latter also includes impact of wind, line tension or sag, etc. on similar time scale and can yeild greater capacity benefits
- **ISOs/RTOs must establish systems that allow transmission owners (TOs) to electronically update line ratings on hourly basis**
  - If TOs wish to implement even more accurate ratings, ISOs/RTOs must accommodate
- **ISO-NE's website lists December 15, 2026 as effective date for Order 881 compliance**
  - Includes new application to track line ratings and calculation of AARs for use in day-ahead market

Q&A and Discussion

Next Steps for Engagement

- DOER will conduct 2 more group meetings prior to the submission of the report.
- The meetings will continue to follow the content outlined in Section 1 of the Resolve.
  - **June 2, 2026, 12pm-2pm:** Overview of the types of existing rights-of-way and opportunities for potential use of those rights-of-way for siting of electric transmission infrastructure in the State; explore strategic undergrounding and a cost-benefit analysis of various undergrounding options
  - **August 5, 2026, 12pm-2pm:** Overview of the draft Maine Instructure Study and how its content evolved based on stakeholder input
- The study will be completed and submitted to the Legislature by September 1, 2026.

Help Shape the Next Energy Plan

maine.gov/energy/plan

- **Request a meeting** or a presentation with DOER staff
- **Sign up for email updates** to stay informed about the 2027 Energy Plan
- **Share your feedback** using the **online survey** →

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Appendix

Energy+Environmental Economics

Existing Analyses
CMP and Versant Local System Plans (LSPs)

Resource	Year Published	Analytical Approach	Future Scenarios	Need Findings
Central Maine Power (CMP) LSP	October 2025	Transmission planning process that analyzes Tx infrastructure based on NERC reliability and NPCC standards, ISONE OATT, and MPUC local Tx planning criteria/Safe Harbor Stipulation document. Analyzes local Tx system (34.5-115 kV).	Uses ISO-NE's CELT load forecast (10 year planning horizon). Models generation of intermittent resources based on historical output in territory.	CMP has >500 mi of 345 kV Tx lines, >1250 mi of 115 kV Tx lines, and over 1000 mi of 34.5 kV Tx lines (non PTF). CMP's LSP identified the following projects for 2026-2028: • 6 Conceptual, 14 Planned, and 2 Proposed Reliability projects • 5 Planned and 3 Under Construction Asset Condition projects • 14 Planned and 6 Proposed Generator Interconnection projects
Versant Power LSP **(Bangor Hydro District)**	2025	Summary of needs assessment results, criteria, data, and study assumptions, proposed alternatives, and solution study results. Identifies Tx system criteria of system needs (34.5kV+) that are not under ISONE planning (non-PTF).***	Power flow analysis of Tx system needs using Transmission 2000**. Conducts Stability Assessment, Steady State Assessment, Fault Current Assessment, and Economic Assessment. Loads are based on ISONE MOD Case, Versant Power refine this. Use latest assumptions of Tx, Generation, and demand from ISONE's RSP.	BHD's LSP identified the following projects (2025-2029): • 8 Under Construction • 19 Planned • 7 Proposed • 14 Conceptual

*Pooled Transmission Facilities
**Load flow software program

***Stakeholders may submit written requests for economic or public policy planning studies to the TP. Must be received by April 1 of the year of the plan.

Existing Analyses
Maine

Resource	Year Published	Analytical Approach	Future Scenarios	Need Findings
Maine Won't Wait	Originally released in 2020, most recently updated in 2024	Four-year climate action plan that includes strategies and goals to emit less carbon, increase renewable production, and address impacts of climate change	N/A	Explicitly calls out procurement of at least 1,200 MW of renewable energy in northern Maine and associated transmission
Maine Energy Plan and Maine Pathways to 2040	January 2025	Pathways analysis of how Maine might meet its clean energy and climate goals using Evolved Energy Research's (EER) EnergyPATHWAYS stock rollover tool and the Regional Investment and Operations (RIO) optimization model RIO captures the buildout of interzonal & intrazonal transmission lines, local distribution lines, and generator spur lines (but assumes no existing headroom); assumes Aroostook Renewable Gateway or similar project is built	1. Core 2. 100% Renewable Generation 3. Hybrid Heat 4. High Flexible Load 5. No Flexible Load 6. High DER + High Flex	Buildout of T&D system required to accommodate increasing loads and facilitate balance between New England and Eastern Canada (esp. hydro): • Lower T&D upgrades required in scenarios with flexible load and hybrid heating technologies • New resource integration drives upgrade need (e.g., Aroostook County and Gulf of Maine) • 3 GW of transmission upgrades by 2040, esp. in southern ME • 4.6 GW of regional upgrades connecting to rest of New England required by 2040 • Increase HQ transfer capacity from 1.2 GW from NECEC to 5 GW by 2050 • Overall transfer capacity with Canada increases from 2 GW to 12.3 GW by 2050 under **Core** and 16.5 GW under **100% Renewable Generation** EER specifically calls attention to the following needs: 1. Regional upgrades between Maine and Boston (or "North-South/Boston Import upgrades") 2. Upgrades to access 1.2–2.4 GW of onshore wind from northern Maine 3. Upgrades to interconnect up to 3 GW of offshore wind in the Gulf of Maine.

Existing Analyses

Maine

Resource	Year Published	Analytical Approach	Future Scenarios	Need Findings
Maine Offshore Wind Roadmap	February 2023	Broad-reaching, strategic development plan for the offshore wind industry in Maine plus several technical reports, including *Offshore Wind Transmission Technical Review* (August 2022) and *Wind Energy Needs Assessment* (November 2022)	N/A	Identifies regional transmission as a strategic priority, incl. engagement with the New England Regional Transmission Initiative, ISO-NE, and FERC; Request for Interest on transmission with MA, NH, CT, & RI; developer access to project financing; support for HVDC technology advancement Highlights importance of offshore transmission “backbones” to minimize ecosystem impacts; co-location of onshore transmission cables with existing linear development (e.g., existing roads or transmission corridors)
Wind Energy Needs Assessment	November 2022	Scenario analysis of offshore wind development in the Gulf of Maine under range of potential future electricity supply and demand conditions	Includes three supply scenarios that vary the amount of land-based transmission and renewable energy development costs: 1. Constrained Onshore Development (COD): Northern Maine line build (1,200 MW), but no incremental onshore transmission in Maine beyond ~800 MW of projects in pipeline 2. Unconstrained Onshore Development (UOD): no constraints on resource selection or transmission development; aggressive offshore wind cost reduction 3. Diverse Portfolio (DP): constrained offshore development plus additional onshore transmission (~3,000 MW of total capacity)	COD scenario effectively increases competitiveness of OSW; under UOD scenario, no incremental OSW is built beyond research array and Monhegan due to high cost of floating turbines; additional ~1 GW of onshore transmission assumed under DP scenario still constrains onshore wind, so offshore wind remains economic Key takeaway is that additional onshore transmission capacity unlocks lower cost onshore wind, avoiding need for floating turbines; this finding should likely be investigated further using resource adequacy model to ensure sole reliance on onshore resources remains reliable

Existing Analyses
Maine

Resource	Year Published	Analytical Approach	Future Scenarios	Need Findings
Greater Portland Certificate of Public Convenience and Necessity (CPCN)	September 2025	CMP states the project is "necessary to resolve anticipated reliability criteria violations and ensure reliability for the Greater Portland area…The needs identified by CMP are driven by forecasted load growth in the area and asset condition." Petition was filed in Docket 2025-00276.		**Phase 1 includes:** • A new 115kV Tx line from Raven Farm Substation in Cumberland to Bayside Substation (12.2 miles total) • A new 115/12.47kV substation (East End of Downtown Portland) • Expansion of two existing substations in Cumberland and Portland • One substation demolition in Yarmouth • Rebuild of three 34.5kV transmission line sections (20 mi) Total cost: $546.97 M (-25/+50%) **Phase 2 anticipates:** • A new 115 kV connection between Bayside Substation and the South Portland Loop • A new 115 kV transmission line between Old Orchard Beach and Scarborough • Other upgrades and asset renewal in South Portland Loop
Northern Maine Independent System Administrator (NMISA) 7-Year Outlook	May 2025	NMISA conducts annual outlook for planned development of Northern Maine Transmission System (NMTS) with seven-year horizon: 1. Load forecast 2. Generation resources 3. Resource adequacy 4. Transmission planning Includes overview of any system impact studies performed by Transmission Owners (TOs), including steady state, stability, and short circuit analyses.	A single Base Case designed to inform market participants of any forecasted long-term deficiency in resource adequacy or transmission capability.	Routine annual capital projects projected for planning period include a series of capitalized maintenance projects by Versant Power Maine Public District (MPD) that are likely to increase system reliability and decrease transmission O&M expenses. These projects are not expected to increase the Total Transfer Capacity (TTC) of the MPD system, which currently sits at 134 MW for both imports from and exports to New Brunswick.

Existing Analyses
Northeast States Collaborative

Resource	Year Published	Analytical Approach	Future Scenarios	Need Findings
Northeast States Collaborative's Strategic Action Plan Whitepaper	April 2025	Multi-state, interregional transmission planning framework based on a synthesis of existing national and regional studies: • DOE 2023 Tx Needs Study, DOE NTPS, GE-NRDC study, MA Decarbonization Pathways study, LBNL IREZ study, NERC ITCS study Includes a qualitative analysis of gaps in current ISO/RTO processes and identifies "low-regrets" projects through RFIs and coordinated state-led evaluations.	1. No Decarbonization 2. High decarbonization, moderate load 3. High decarbonization, high load	Identifies consistent and low-regrets needs for interregional Tx, including: • 2 GW between NY and PJM by 2035, and 4 GW by 2040 (up to 6 GW for high decarbonization, high load scenarios) • 1.7 GW between NY and ISO-NE by 2035, and 3 GW by 2040 (up to 7 GW for high decarbonization, high load scenarios) • 0.4 GW by 2033 and 5 GW by 2050 between Quebec and ISO-NE • 1.9 GW by 2033 and 5 GW by 2050 between Quebec and NY

Overview of ISO-NE Planning Processes

Process Name	Study Name	Study Type	Study Topic	Results in Solicitation?	Study Horizon	Study Frequency	Recent Examples and Link
Regional System Plan (RSP)	Reliability Transmission Upgrade (RTU)	Reliability	Transmission addition or upgrade identified by ISO-NE as necessary to ensure system's continued reliability	When Needs Assessment reveals non-time-sensitive reliability need, ISO-NE conducts RFP	10 years	Biennial	2025 Regional System Plan (December 2025): https://www.iso-ne.com/static-assets/documents/100030/final_2025_rsp.pdf
	System Efficiency Transmission Upgrades (SETUs)	Economic	Transmission addition or upgrade identified by ISO-NE as providing net reduction in total production cost to supply system load	When System Efficiency need identified, ISO-NE conducts RFP	10 years	Biennial	2025 Regional System Plan (December 2025): https://www.iso-ne.com/static-assets/documents/100030/final_2025_rsp.pdf
	Public Policy Transmission Upgrades (PPTUs)	Public Policy	Improvements of or additions to regional transmission system designed to meet state, federal, and local (e.g., municipal or county) public policy requirements that drive transmission needs	When Public Policy need identified, ISO-NE conducts RFP	10 years	Biennial	2025 Regional System Plan (December 2025): https://www.iso-ne.com/static-assets/documents/100030/final_2025_rsp.pdf
Longer-Term Transmission Planning (LTTP)	Longer-Term Transmission Studies (LTTSs)	Public Policy	Transmission studies requested by the New England States Committee on Electricity (NESCOE) that identify high-level concepts of transmission infrastructure to meet an energy policy, mandate, or legal requirement based on state-identified scenarios and time frames	2050 Transmission Study resulted in the 2025 LTTP RFP addressing the Maine-New Hampshire interface	Varies	Ad hoc	2050 Transmission Study (February 2024): https://www.iso-ne.com/static-assets/documents/100008/2024_02_14_pac_2050_transmission_study_final.pdf

Existing Analyses
ISO-NE

Resource	Year Published	Analytical Approach	Future Scenarios	Need Findings
ISO-NE Regional System Plan	December 2025	Summarizes updated load forecasts, new supply resources, and resource adequacy. Includes overview of reliability, economic, and public policy transmission studies performed by ISO-NE.	N/A	Reliability Transmission Upgrades (RTUs) • For June 2025 through end of 2028, estimated cost of RTUs currently under construction is ~$0.45B • 20 project components currently proposed, planned, or under construction System Efficiency Transmission Upgrades (SETUs) • No solutions identified to date due to RTU-driven benefits and development of economic resources in response to wholesale markets Asset Condition Projects • Estimated $5.8B in spending through 2032
Economic Planning for the Clean Energy Transition (EPCET)	October 2024	Study of potential economic challenges to clean energy transition that includes 33 scenarios and over 2,800 simulations.	Three core scenarios: • Benchmark • Market Efficiency Needs • Policy	Designing power system requires balance of reliability, economic efficiency, and carbon-neutrality. • Most paths to low-carbon grid involve high variability in supply and demand • Increased variability will require vastly different supply levels from year to year • Emissions reductions are seasonal • Renewable-only build-outs may be vast, with later additions seeing diminishing economic and environmental returns • Higher variability increase value of dispatchable resources • Current revenue structures may not adequately compensate resources for their value to the grid • Firm, dispatchable, zero-carbon generation could help • Difficult minimum load conditions, energy adequacy challenges, and potential system congestion may appear in 2030s

Existing Analyses
ISO-NE

Resource	Year Published	Analytical Approach	Future Scenarios	Need Findings
Future Grid Reliability Study (FGRS) Phase 1: 2021 Economic Study	2022	Hourly production cost simulation of security-constrained unit commitment and economic dispatch model, ancillary services analysis via an augmented production cost model, RA screen, and probabilistic resource availability analysis	32 future scenarios/alternatives of varying resource mixes and load profiles for 2040, with 4 main scenarios: • Low Decarbonization • Moderate decarbonization • Import-Supported Decarbonization • Deep Decarbonization	• All FGRS Scenarios found the need for multiple 345 kV AC Tx lines • Increase Tx limits in Northern NE and SEMA/RI area • Electrification of heating/transportation will drive up to 33 GW of new demand by 2040 (Scenario 3) and require transmission upgrades • Future studies should use nodal modeling of Tx system instead of 13 zone ‘pipe and bubble’ model, and share with NYISO • FGRS Phase 1 (2022) did not include cost of Tx upgrades)

Existing Analyses

ISO-NE

Resource		Year Published	Analytical Approach	Future Scenarios	Need Findings
ISONE's 2050 Transmission Study	Longer-Term Transmission Study	February 2024	Regional transmission needs assessment based on load forecasts and future portfolios from Massachusetts' "All Options Pathway" from the Deep Decarbonization Roadmap, published in December 2020. Contingency analysis of snapshot years restricted to thermal steady-state analysis, not voltage, short-circuit, or transient stability. Tested peak load boundary conditions (i.e., most extreme cases of combined load and renewable resource outputs), which typically occur during cold winter peak hours when weather conditions result in low renewable production.	Single scenario ("All Options Pathway") with three snapshot years (2035, 2040, and 2050), combination of winter and summer load forecasts, and potential resource mixes for 13 "snapshots" in total: • Highest load modeled was 2050 winter evening peak snapshot at approximately 57 GW	Key takeaways related to transmission include: • Reducing peak load significantly reduces transmission cost (esp. above ~51 GW, after which upgrades are roughly double in cost) • Incremental upgrades can be made as opportunities arise (e.g., reconductoring, bundling multiple conductors per phase on 115 kV lines, or upgrading existing lines) • Location of generators vis-à-vis load centers affects overloads (esp. in import-constrained areas like Boston) • Transformer capacity is crucial as reliance on high-voltage transmission increases (esp. 345/115 kV transformers that were not designed to handle large loads assumed in study) High-likelihood concerns flagged by ISO-NE that are relevant to Maine: • Maine-New Hampshire and North-South transmission interfaces connecting Maine and New Hampshire to northeastern Massachusetts

Existing Analyses
ISO-NE

	Resource	Year Published	Analytical Approach	Future Scenarios	Need Findings
ISONE's 2050 Transmission Study	Offshore Wind Analysis	March 2025	In response to feedback on initial study, ISO-NE conducted N-1 and N-1-1 DC thermal steady-state analysis to address following topics: 1. Offshore wind relocation: connecting further south to reduce overloads on North-South interface 2. High-level offshore wind interconnection screening: examine potential POIs for viability	Examines subset of high-likelihood concerns and roadmaps from initial study • Relocates Gulf of Maine wind farm POIs from Yarmouth, ME to Brighton, MA and Orrington, ME to Ward Hill, MA • Relocates MA/RI lease area POI from Brighton, MA to Millstone, CT	Connecting some of initial study's hypothetical future offshore wind further south could reduce necessary upgrades: • Relocating offshore wind POIs from Maine to Boston area may lead to significant transmission cost savings • System still needs upgrades on North-South and Maine-New Hampshire interface Around 9,600 MW of additional onshore wind may be able to interconnect in New England without new transmission infrastructure: • Up to 86% of existing major coastal substations may be able to interconnect 1,200 MW of offshore wind without new transmission infrastructure; up to 38% may be able to do so without any upgrades to existing transmission infrastructure either • A small subset of these substations may be able to interconnect 2,000 MW without any new transmission infrastructure • Depending on location, up to 9,600 MW of wind farms may be able to operate simultaneously at full output without new transmission infrastructure or significant curtailment

Existing Analyses
Neighboring Regions

Resource	Year Published	Analytical Approach	Future Scenarios	Need Findings
NYISO 2023-2042 System & Resource Outlook	July 2024	Summary of NYISO's Comprehensive System Planning Process (CSPP), including potential resource and transmission development driven by economic or public policy needs. • Potential resource mixes that achieve New York's public policy mandates, while maintaining reserve margins, and capacity requirements • Regions of New York where renewable or other resources may be unable to generate at their full capability due to transmission constraints; • Extent to which these transmission constraints limit delivery of renewable energy to consumers • Opportunities for transmission investment that may provide economic, policy, and/or operational benefits.	Five potential futures in which New York achieves its climate change policy requirements: • Base Case: similar to status quo • Contract Case: evaluates impact of ~16 GW of additional renewable capacity procured by state • (3) Policy Case: State Scenario, Higher Demand, Lower Demand	Transmission findings: 1. Historic levels of investment in the transmission system are happening, but more will be needed. 2. Additional dynamic reactive power support must be added to the grid in upstate New York to alleviate congestion and fully utilize the transmission capability of the Central East interface. 3. Opportunities for further transmission investment in Western and Northern New York should be monitored as resources are developed in those regions. 4. Planning energy exchange with neighboring systems is becoming more complex and will be increasingly so in the future as each system transitions to more decarbonized systems.
Hydro-Québec Action Plan 2035	November 2023	Establishes priorities and long-term strategic approach for Hydro-Québec over the next ten years.	N/A	Calls for $45-50B of investment by 2035 to increase capacity of transmission system and maximize access to new generation resources. Three lines are currently under development: 1. Côte-Nord 2. Vallée-du-Saint-Laurent 3. Appalaches-Bas-Saint-Laurent

Existing Analyses

Neighboring Regions

Resource		Year Published	Analytical Approach	Future Scenarios	Need Findings
New Brunswick Power	Energizing Our Future: Strategic Plan 2023-2035	June 2023	Strategic plan designed to help New Brunswick achieve its climate and clean energy goals.	N/A	In response to growing load and aging assets, NB Power must invest in new clean energy and the transmission grid. • Adopt smart metering and advanced distribution management systems • Upgrade grid to handle increased demand, two-way power flows, etc. • Develop smart grid technologies for monitoring and outage response
New Brunswick Power	2023 Integrated Resource Plan	August 2023	Long-term picture of New Brunswick’s energy supply and demand, with focus on reducing GHGs and achieving net-zero electricity system by 2035. Typical IRP process in which input assumptions developed, technical and policy constraints defined, and least-cost portfolio identified via capacity expansion and production cost modeling.	Scenario matrix with two dimensions (electrification and technological development): 1. **Scenario A**: high electrification, rapid technological development 2. **Scenario B**: high electrification, moderate technological development 3. **Scenario C**: low electrification, moderate technological development 4. **Scenario D**: low electrification, rapid technological development	Alleviate transmission constraints through new infrastructure, targeted demand reductions, and strategically located generation. Integration of new wind drives need for transmission, but operational studies required. Decisions around two plants, Belledune and Mactaquac, have significant impacts on transmission requirements to maintain system reliability. NB Power also identified opportunities to expand interregional transmission capacity with Québec and Nova Scotia. • Active participant in the federal government’s Atlantic Loop initiative, which seeks to define transmission upgrades required to deliver clean power from Québec or Newfoundland and Labrador to the Maritimes. • A sensitivity exploring Atlantic Loop, which includes an additional 1,150 MW of transmission between Québec and New Brunswick, found the project helped the region achieve decarbonization but increased costs for residents by 7-9% during the 2040s. • A lower cost solution would be to simply build carbon-free resources in New Brunswick.
New Brunswick Power	Renewable Integration and Grid Security (RIGS) Project	July 2025	N/A	N/A	New 500 MW generator in Westmorland County and >$300 million in transmission upgrades to facilitate integration of intermittent renewables.

Existing Analyses
U.S. Department of Energy

Resource	Year Published	Analytical Approach	Future Scenarios	Need Findings
DOE's National Transmission Needs Study	October 2023	Aggregating and synthesizing results from multiple prominent national transmission modeling efforts, providing ranges of findings	The studies were grouped into categories based on their underlying assumptions on load growth and clean energy penetration. Moderate load growth is defined as being between a 2021 baseline of 3,974 TWh and 7,000 TWh. High load growth exceeds 7,000 TWh. Moderate clean energy penetration ranges between the 2021 baseline of 38.6 percent and 80 percent by 2040. High clean energy penetration exceeds 80 percent by 2040. Interregional transmission capacity expansion results in these studies are reported as the percent increase by category groupings and by year (2030, 2035, and 2040).	Significant intra- and inter-regional transmission investments necessary by 2035, esp. under high load and clean energy growth scenario: • New England transmission need expected to increase by 126% relative to 2020 system under high load and high clean energy growth • Inter-regional transfer capacity between New England and New York expected to increase by 255% under moderate load and high clean energy growth, 835% under high load and high clean energy growth
DOE Atlantic Offshore Wind Transmission Study	March 2024	Compares varying Tx planning and topology to unlock 85 GW of OSW by 2050.	Models OSW buildout to 85 GW by 2050. Load scenarios include: 1. Reference/Moderate electrification 2. High electrification 3. Deep decarbonization/net-zero Generation scenarios include OSW buildout, high renewables mix, reduced fossil gen, storage deployment, and imports/interregional flows	• Tx costs range from $96B-$116B, with radial being the base case (cheapest), and costs increasing from intra- to inter- to inter-intra regional, and finally a backbone being the most expensive • Tx upgrades would add 27 GW of OSW to ISO-NE
DOE Grid Resilience and Innovation Partnership (GRIP)	2023 & 2024	Funding allocated for grid modernization and resilience	N/A	Maine-specific Projects: 1. Georgia Tx Corporation: Smart Technology for Advanced Resilient Transmission (START) Project ($92.9M Grid Resilience Utility and Industry Grant) 2. Central Maine Power: $30.3M Smart Grid Grant 3. Maine Governor's Energy Office: $65.4M Smart Grid Grant 4. MA Dep. Of Energy Resources: $389.3M Grid Innovation Grant