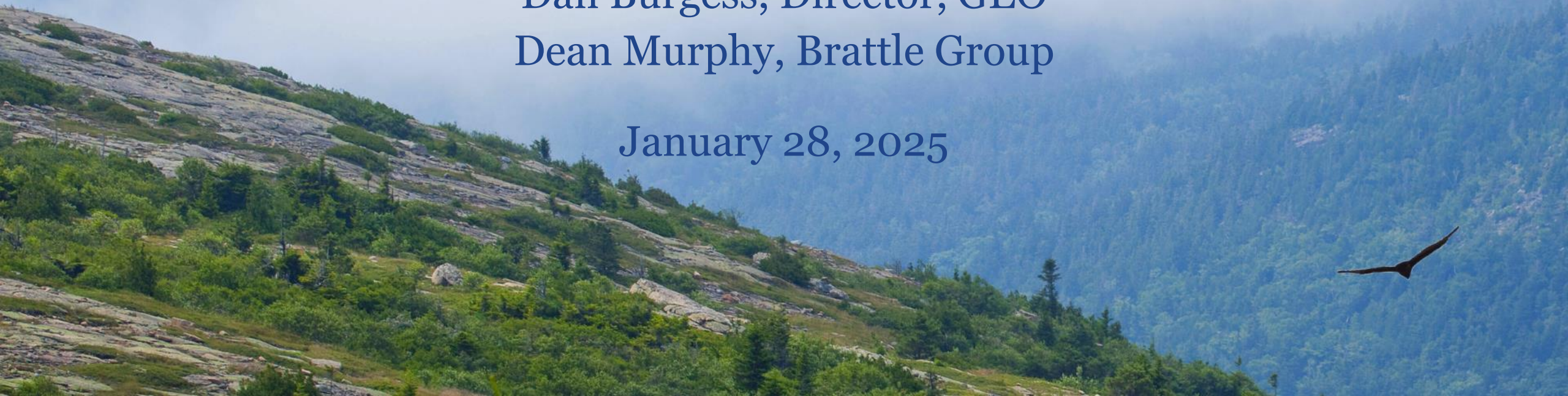
MAINE GOVERNOR'S
Energy Office

Maine Energy Plan:
Overview of Technical Report and Energy Plan Objectives

Dan Burgess, Director, GEO
Dean Murphy, Brattle Group

January 28, 2025



Agenda

- Introduction and overview of Maine Energy Plan process
- Presentation of Technical Report
- Presentation of Maine Energy Plan objectives

Maine Energy Plan - Background

- Per statute, the Governor's Energy Office (GEO) is required, biennially, to develop a state Energy Plan
- In 2023, Governor Mills directed GEO to develop a plan to achieve Maine's goal of **100 percent clean energy by 2040.**
- GEO retained The Brattle Group (Brattle) and Evolved Energy Research (EER) to conduct a **modeling and technical analysis**: "Pathway to 2040" which informed the Maine Energy Plan.

Maine Energy Plan Timeline

February 2023
Governor Mills directs GEO to develop pathway to 100% clean energy; GEO retains Brattle/EE

August 2023
GEO hosts an initial stakeholder webinar; begins Energy Plan process, opens pathways for public feedback

September & November 2023
GEO hosts public webinars, continues modeling and stakeholder engagement

October - November 2024
GEO publishes draft Pathway to 2040 report, holds webinar with Brattle, and seeks public comments

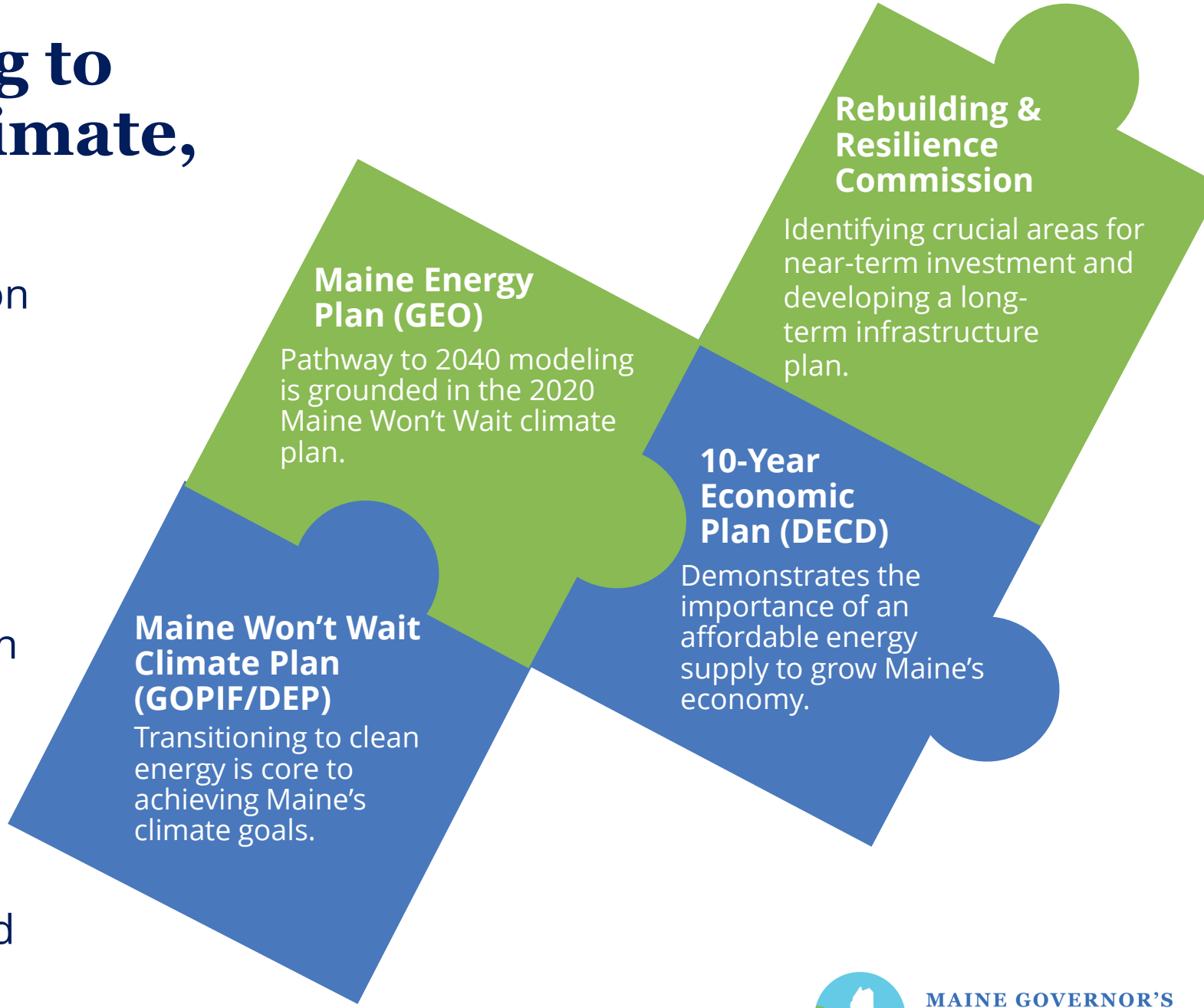
December 2024
GEO publishes draft Energy Plan

January 2025
Publish Energy Plan and final 2040 Report

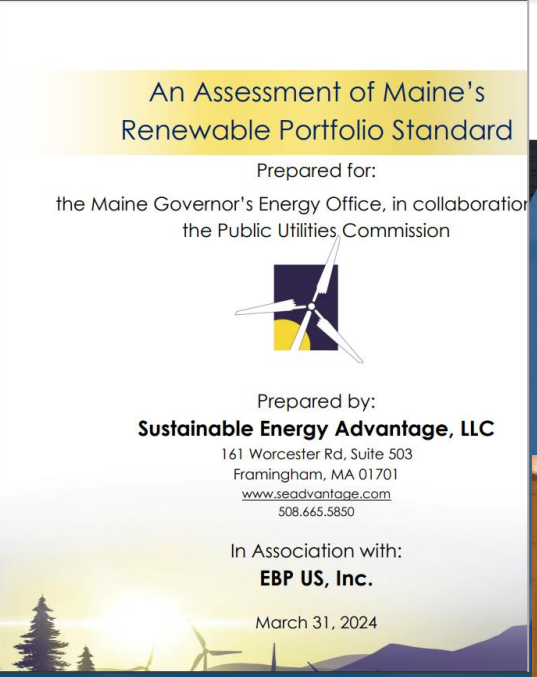
MAINE GOVERNOR'S Energy Office

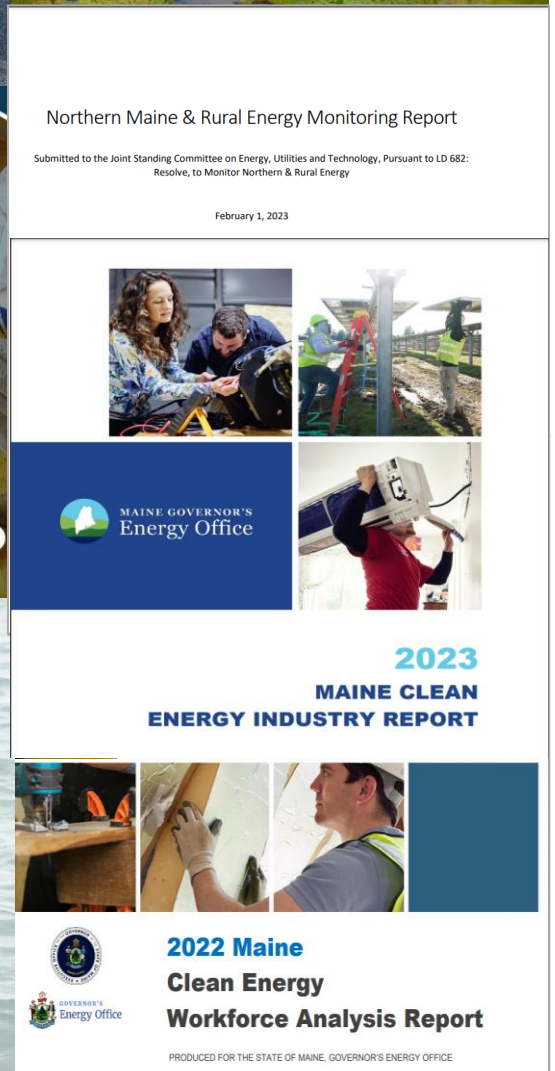
Maine is coordinating to achieve its energy, climate, and economic goals

- Representatives from GEO served on the Climate Council throughout the Maine Won't Wait process
- The Pathway to 2040 modeling is grounded in the 2020 Maine Won't Wait plan and energy and demand analysis
- The draft Energy Plan is aligned with key actions from the Maine Won't Wait's 2024 Climate Action Plan
- The Energy Plan is also coordinated with the objectives of the state's 10-Year Economic Plan and the Maine Infrastructure Rebuilding and Resilience Commission.



MAINE GOVERNOR'S Energy Office





The Maine Energy Plan is informed by years of studies, working groups, research, and analysis.

MAINE GOVERNOR'S Energy Office

Maine Energy Plan

PATHWAY TO 2040: STUDY RESULTS AND IMPLICATIONS

THE BRATTLE GROUP
EVOLVED ENERGY RESEARCH

ON BEHALF OF THE
MAINE GOVERNOR'S ENERGY OFFICE

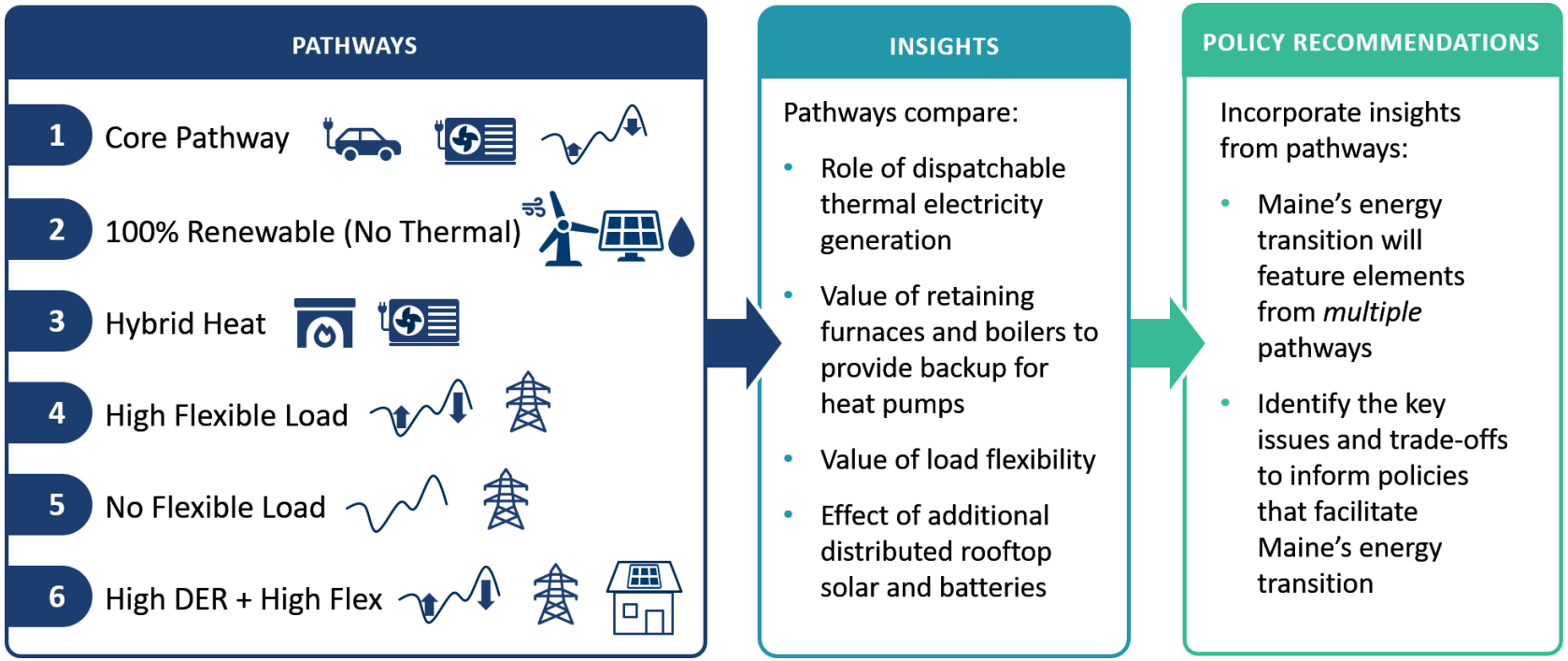
Brattle

EVOLVED ENERGY RESEARCH

GOVERNOR'S Energy Office

What is a Pathway? All pathways achieve Maine's clean energy goals

- **"Core" is a high-renewables, high-electrification pathway.**
  Alternative pathways are designed to illustrate **key issues and trade-offs** that will arise in decarbonizing Maine's energy sectors, including when those issues will likely emerge and when they must be addressed
- Performance of these pathways are **compared across several dimensions**, including cost, emissions, and energy use, to identify the factors that may make some pathways more achievable and affordable
- Pathways were formulated to address key questions identified by stakeholders during the initial meetings



All pathways incorporate key Maine policies and targets through 2050

Economy-wide GHG reductions:

- 45% reduction by 2030; 80% by 2050 (vs 1990 levels);
- Carbon neutrality by 2045

80% renewable portfolio standard by 2030, with supporting procurements

100% clean electricity by 2040

3,000 MW of offshore wind by 2040

400 MW of energy storage by 2030

100,000 new heat pumps by 2025 (already achieved), plus an additional 175,000 by 2027

Planned resource and transmission projects

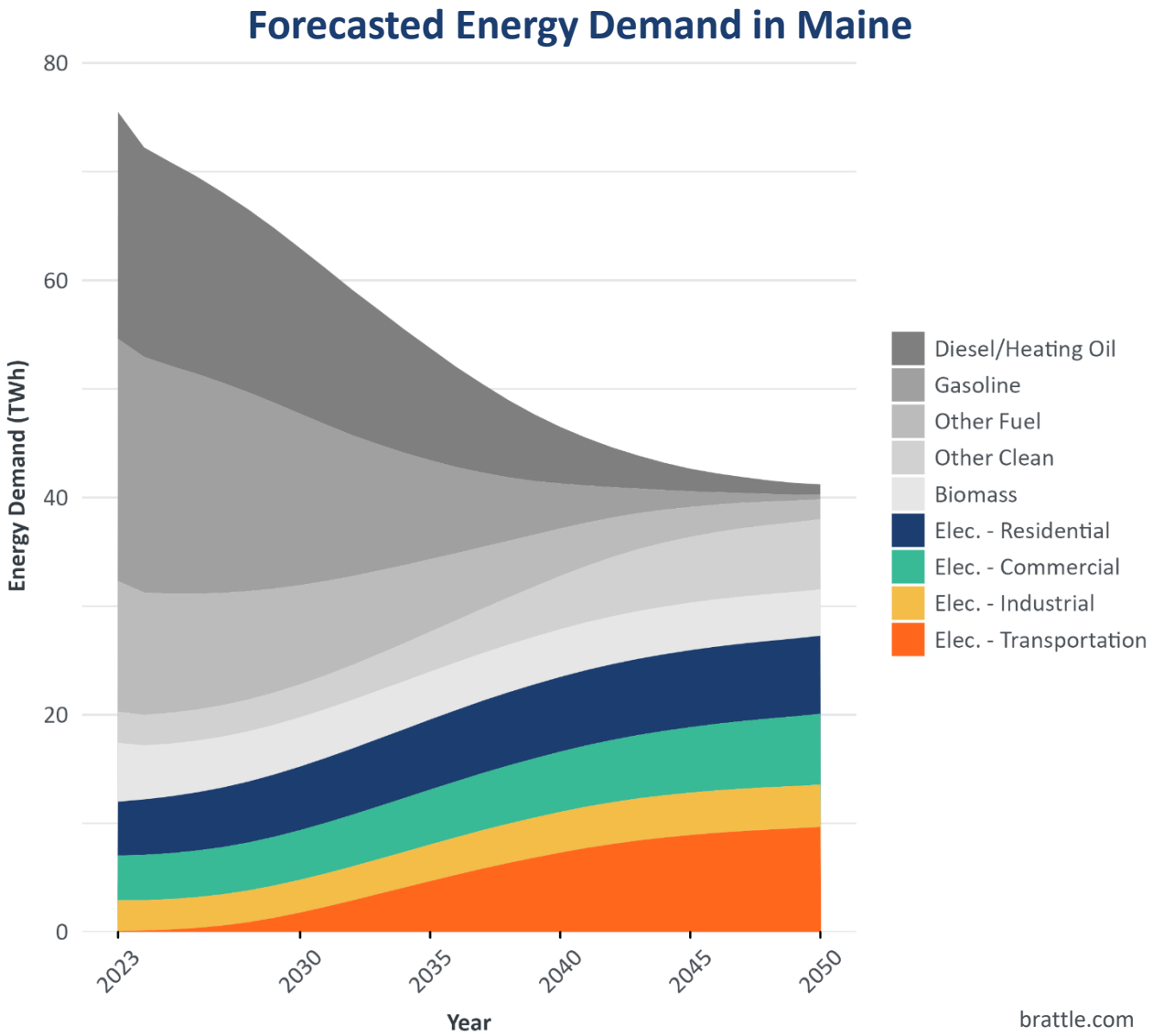
CORE PATHWAY

Widespread Electrification of Transportation and Heating

Electrification of transportation, space heating, and industry produce significant electric load growth, as electricity displaces fossil fuels

- Maine's annual total electricity consumption is projected to more than double—from 12 TWh in 2023 to 23 TWh in 2040—as fossil use declines
- About 60% of the **new electric energy** demand is for transportation, 30% space and water heating, 10% industrial
- **Peak electricity** demand nearly triples by 2040, driven by space heating

Declining fuel use accompanies electricity demand increase

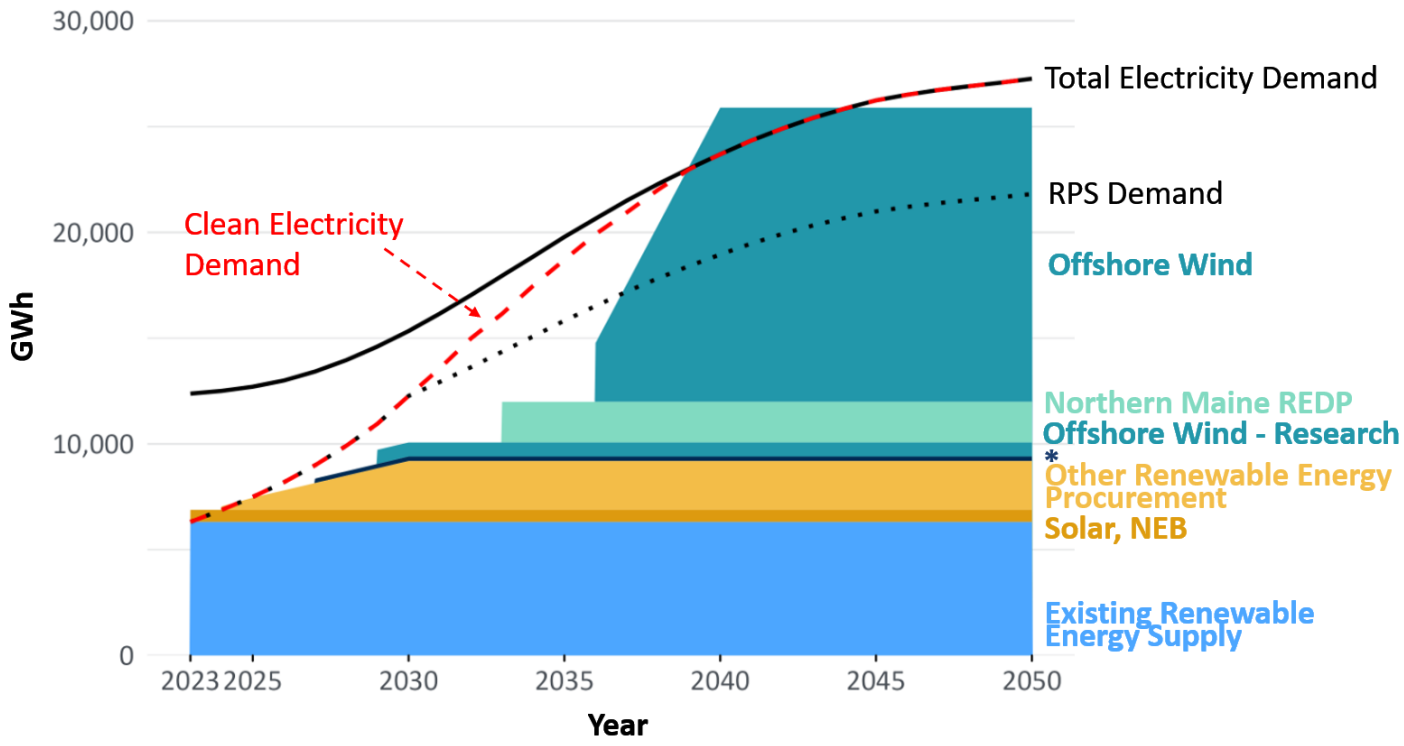


Changing Electricity Supply to Meet 100% Clean Electricity by 2040

Maine's planned renewable energy procurements will meet most of Maine's clean electricity demand by 2040

- Maine will add clean electricity resources through its commitments to offshore wind, the Northern Maine Renewable Energy Development Program, and other renewable energy procurement (see figure)
- The remaining gap can be addressed by procuring additional resources or contracts, and/or REC purchases
- Maine will need to expand its transmission system to connect these new resources, balance renewables output, and maintain reliability

Maine's Clean Electricity Demand and Planned/Contracted Resources



*Wood-fired CHP program

Key Policy Implications – Facilitate Clean Electricity Infrastructure

Maine Must Follow Through on its Commitments to Procure Clean Energy to Meet its 2040 Goals

- Maine is making strides with its commitments to renewable energy generation projects, and **must continue**
- Maine must **clearly define which energy resources qualify as clean** (beyond wind, solar, and hydro) to ensure it can plan, develop, and maintain them in an orderly way to meet the 2040 target

Policymakers Must Continue to Modernize Transmission and Distribution Planning to Facilitate Clean Energy Goals

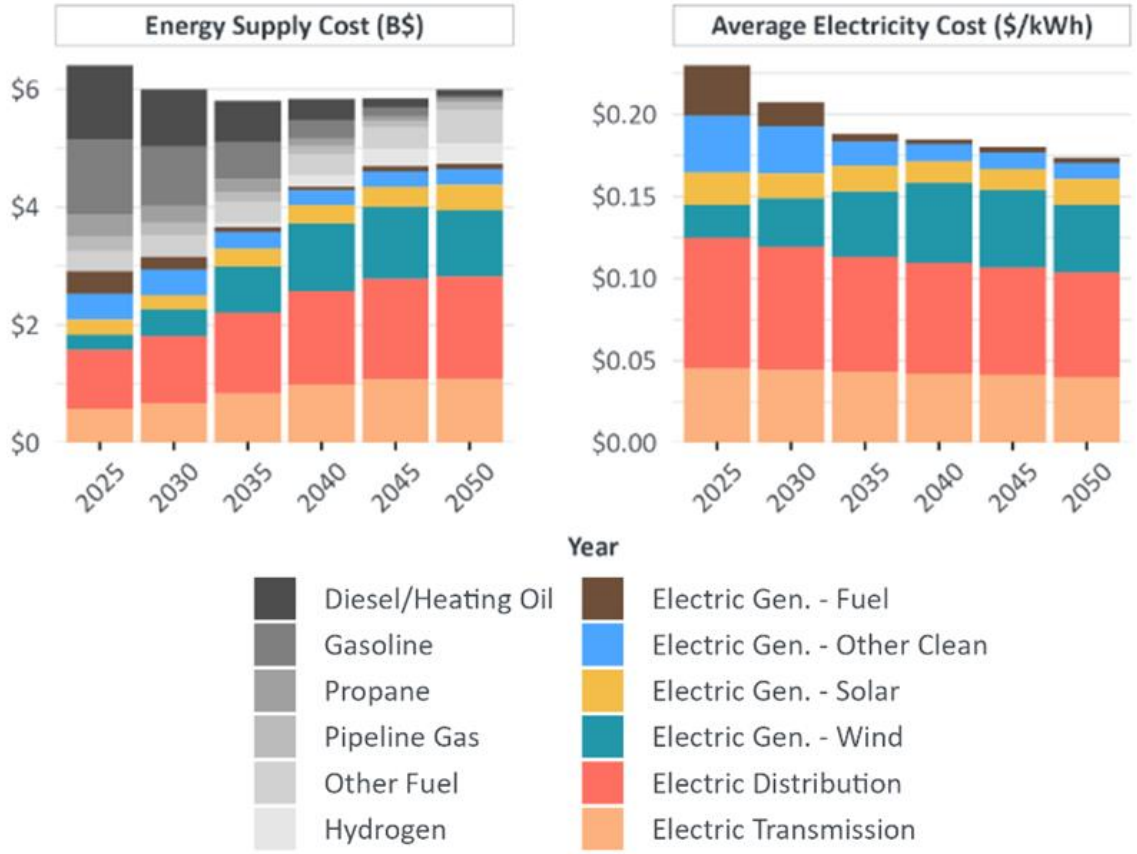
- The clean energy transition in Maine (and other NE states) will require significant **expansion of the regional electric power system**, including transmission and distribution infrastructure
- Policymakers and grid planners in Maine must **collaborate** with each other and with other entities across the region on proactive planning processes to ensure timely and cost-effective upgrades and expansion to achieve all New England states' clean electricity goals

Energy Supply Costs and Average Electricity Costs

Transition to clean energy will avoid fossil fuel cost volatility and reduce overall energy supply costs

- Electricity expenditures (for G, T, & D) rise with electricity demand—but are offset by savings from decreased fossil fuel use
  - Average unit electricity cost (delivered) will fall modestly over time, as sales volumes increase slightly faster than costs (in real $)
- Renewable costs are stable, once developed (avoiding volatile fuel prices)
  - Continued over-reliance on fossil fuels is riskier, and probably higher cost
- Household total energy costs behave similarly—declining modestly, then stable

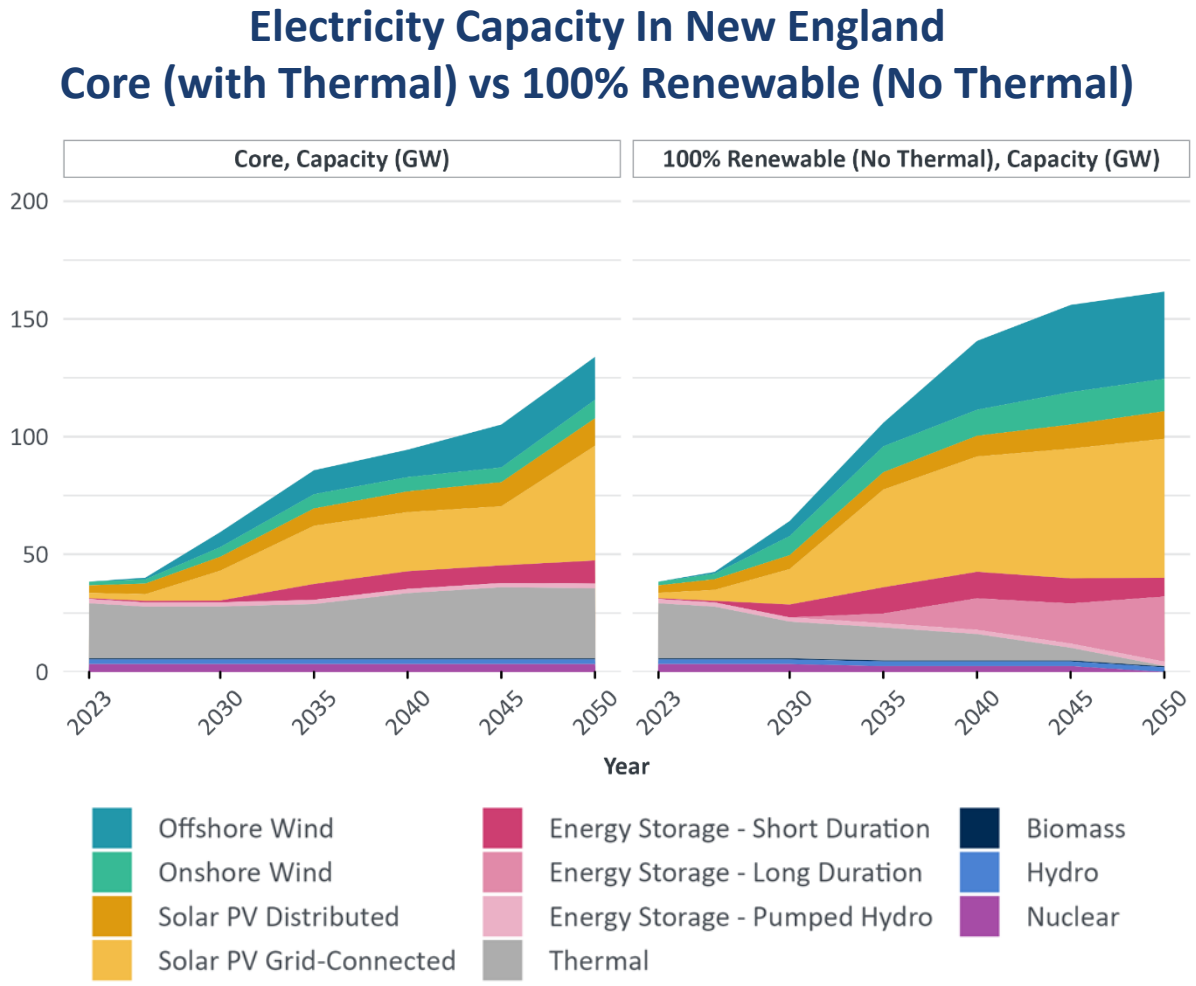
Energy Supply Costs and Average Societal Electricity Cost For Maine (2022$)



The Role of Thermal Generation with Clean Fuel

Cost-effective power sector decarbonization involves high renewables, storage and load flexibility – plus thermal generation (with clean, carbon-neutral fuels), used sparingly

- In Core pathway, dispatchable **clean thermal provides just the last 5-10% of energy** (but substantial capacity) to cover infrequent periods of extended renewable shortfall
- More cost-effective to utilize clean thermal generation for the last 5-10% than 100% renewable
  - Large amounts of long-duration storage needed to cover infrequent renewable droughts
  - Much additional renewable generation is needed to charge it
  - These additional renewable and storage resources would be utilized infrequently

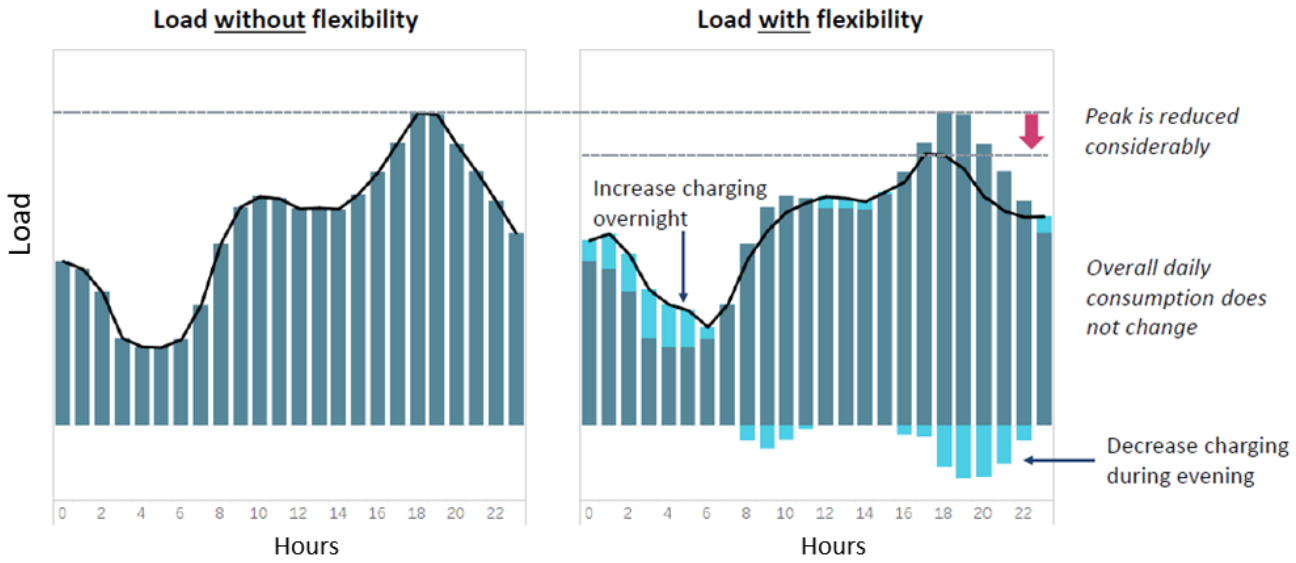


Flexible loads decrease electricity system peaks, and thus costs

Load flexibility can significantly reduce electricity demand peaks

- Flexibility comes predominantly from **shifting EV charging** schedules
  - EVs are a very large load, inherently flexible
- Flexibility helps control electric system peaks, **limiting T&D upgrades, generation, and storage needs**, and associated costs
- Absent load flexibility, electric peaks grow substantially
  - Higher peaks require more renewable and thermal generation, more storage, more transmission and distribution—increasing costs

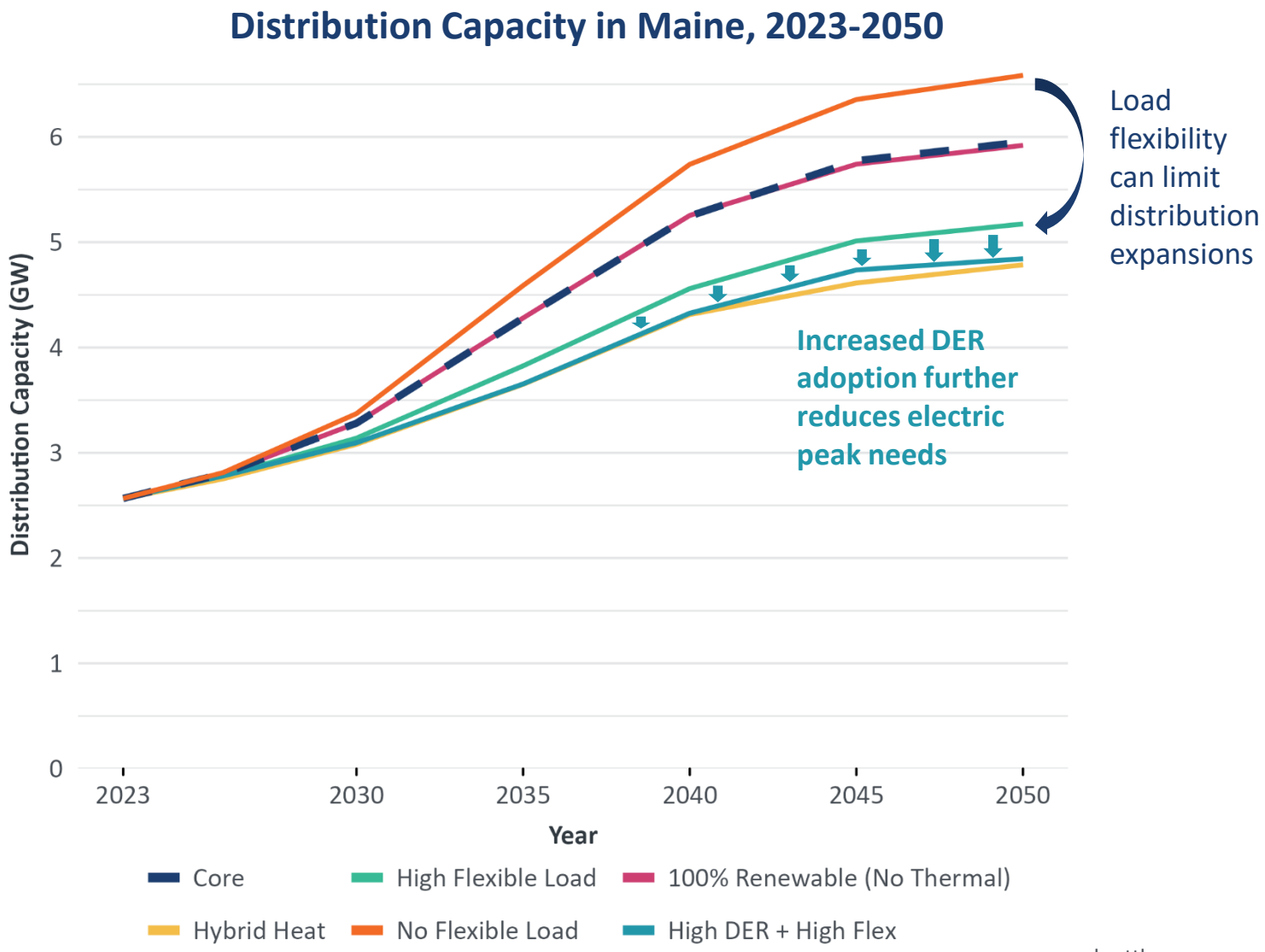
Load Flexibility: Electric Vehicle Charging



Distributed energy resources (DERs) further reduce system peak

Increasing adoption of DERs would further reduce electricity demand peaks and associated costs

- But the potential savings may be outweighed by the cost of the DERs themselves, if deployed widely
- Instead of deploying uniformly across the system, it will likely be more cost-effective to **target DER adoption in strategic locations** where they can defer or avoid distribution system upgrades



Key Takeaways

Maine can achieve its greenhouse gas emissions reduction and clean energy goals cost-effectively while maintaining reliability.

Maine must follow through on its procurement commitments for clean energy to meet its 2040 goals.

Thermal electricity generation with clean fuel, utilized sparingly, can facilitate high renewable penetration.

Policymakers must continue to modernize transmission and distribution planning to facilitate clean energy goals.

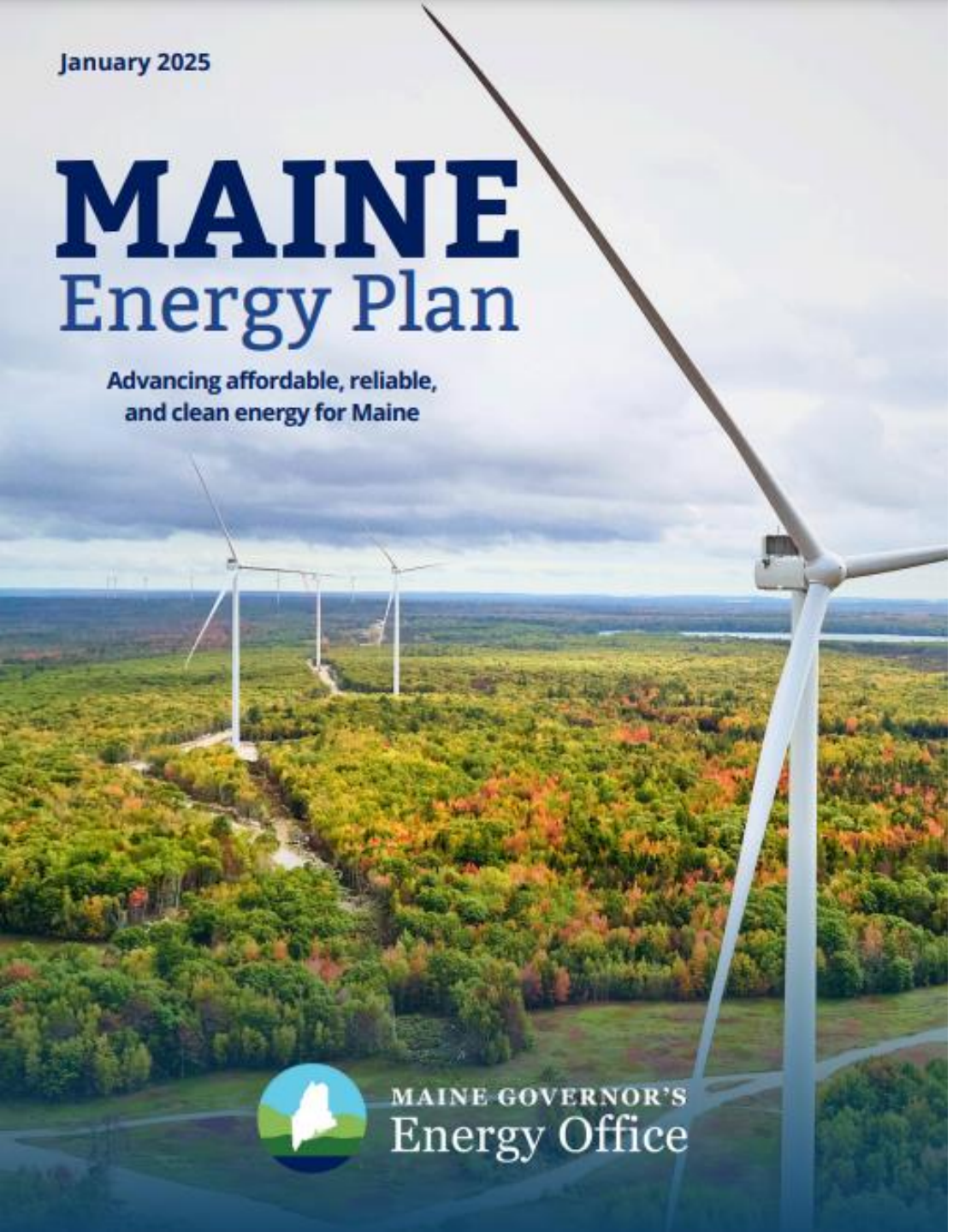
Electrifying transportation is key to cost-effective GHG reductions and electricity grid investment.

Load flexibility is a cost-effective approach to reducing peak loads.

Barriers to adoption including upfront costs, customer education, market opportunities, interconnection challenges, siting and permitting delays, among others must be addressed.

Continued investments in the workforce needed to install and maintain infrastructure are needed.

Regional coordination and cooperation is critical.



Submitted to the Legislature January 2025

Available at **www.maine.gov/energy**

MAINE GOVERNOR'S
Energy Office

Maine Energy Plan Objectives

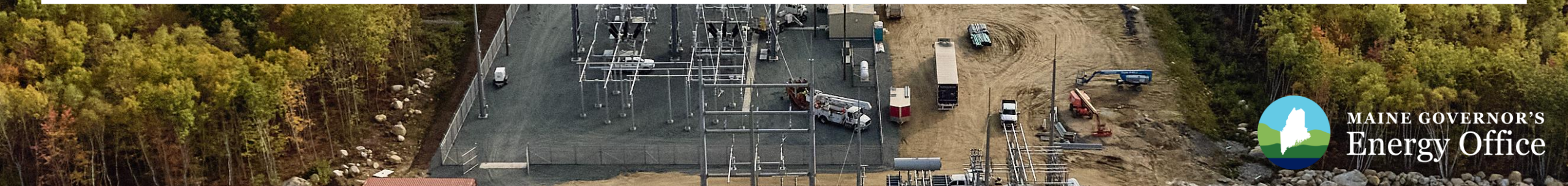
A
Deliver Affordable Energy for Maine People and Businesses

B
Ensure Maine's Energy Systems are Reliable and Resilient in the Face of Growing Challenges

C
Responsibly Advance Clean Energy

D
Deploy Efficient Technologies to Reduce Energy Costs

E
Expand Clean Energy Career Opportunities for Maine People and Advance Innovation



MAINE GOVERNOR'S
Energy Office

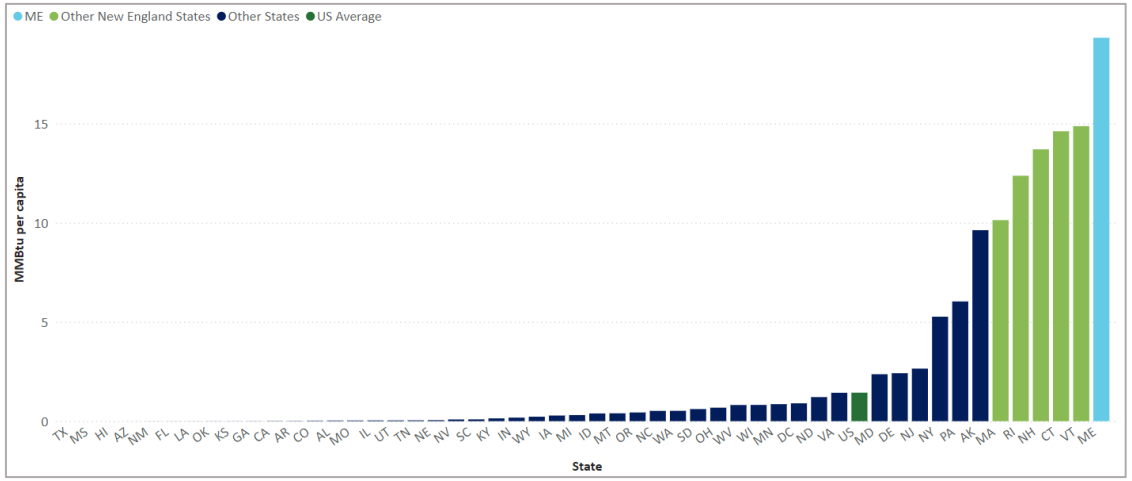
Objective A:
Deliver affordable energy for Maine people and businesses

Strategy A: Reduce Maine's dependence on imported fossil fuels for heating and electricity

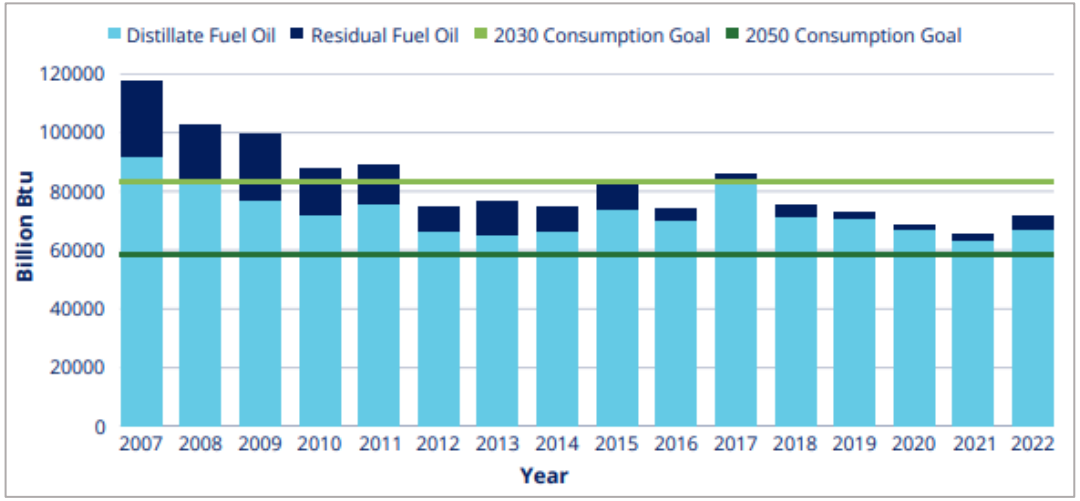
Strategy B: Reduce energy burden for low- and moderate-income households

Strategy C: Review existing approaches to identify additional electricity cost control opportunities

Distillate fuel oil consumed by the residential sector by location (2022)



Maine Fuel Oil Total Consumption in Relation to State Oil Dependence Reduction Targets



MAINE GOVERNOR'S Energy Office

Objective B: Ensure Maine's energy systems are reliable and resilient in the face of growing challenges

Strategy A: Establish ambitious, data-driven targets for energy resilience

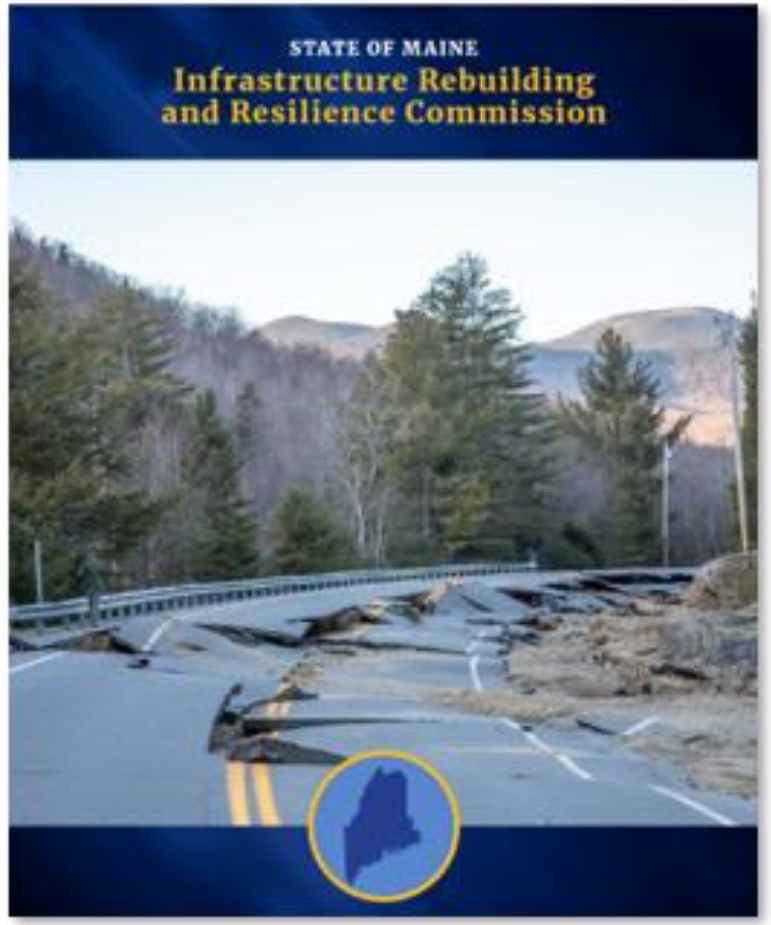
Strategy B: Increase coordination and information-sharing across energy-related emergency management and resilience entities

Strategy C: Deploy targeted resources to advance innovative and modern resilience solutions including microgrids

Strategy D: Leverage innovative technologies including energy storage to increase resilience and reduce greenhouse gas emissions

Strategy E: Strengthen planning and engagement by utilities to identify and address climate and resilience threats cost-effectively

Strategy F: Advance partnerships and coordination to enhance Maine's energy security and maximize relevant federal and other funding opportunities



MAINE GOVERNOR'S
Energy Office

Objective C: Responsibly advance clean energy

Strategy A: Establish a new Clean Energy Standard (CES) to ensure all Maine people have access to cost-effective, reliable, 100% clean energy by 2040

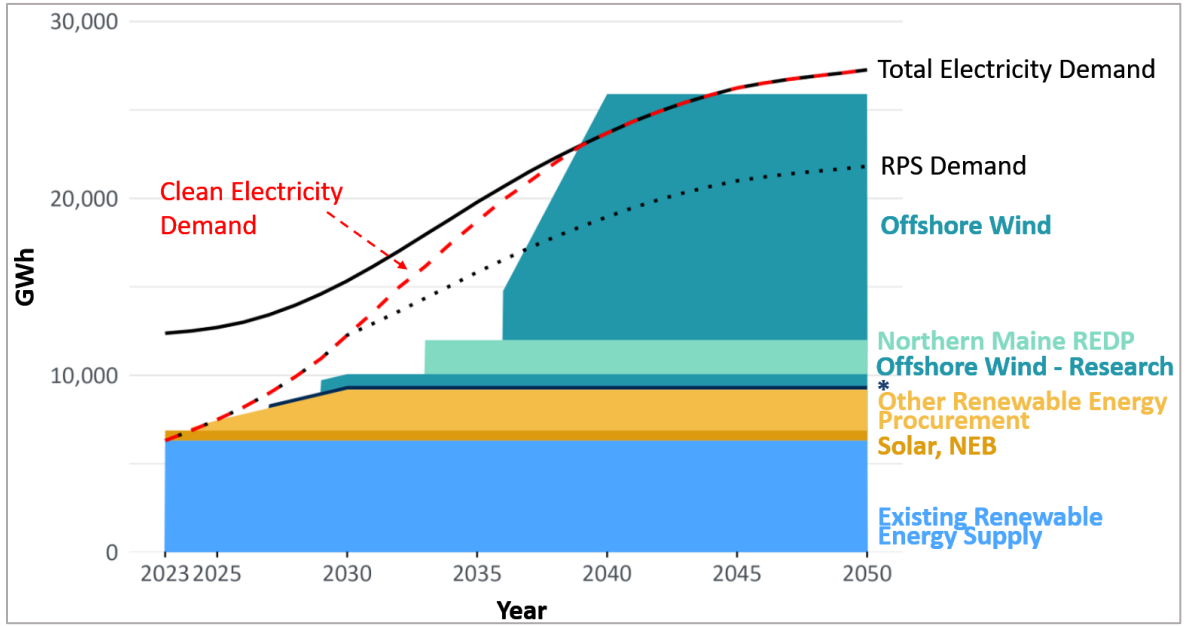
Strategy B: Establish a regular schedule of competitive energy purchases

Strategy C: Advance responsible deployment of offshore wind energy

Strategy D: Advance efficient, necessary infrastructure to modernize Maine's energy systems

Strategy E: Coordinate and collaborate regionally to maximize benefits and achieve shared goals

Maine's Clean Electricity Demand and Planned/Contracted Resources



MAINE GOVERNOR'S Energy Office

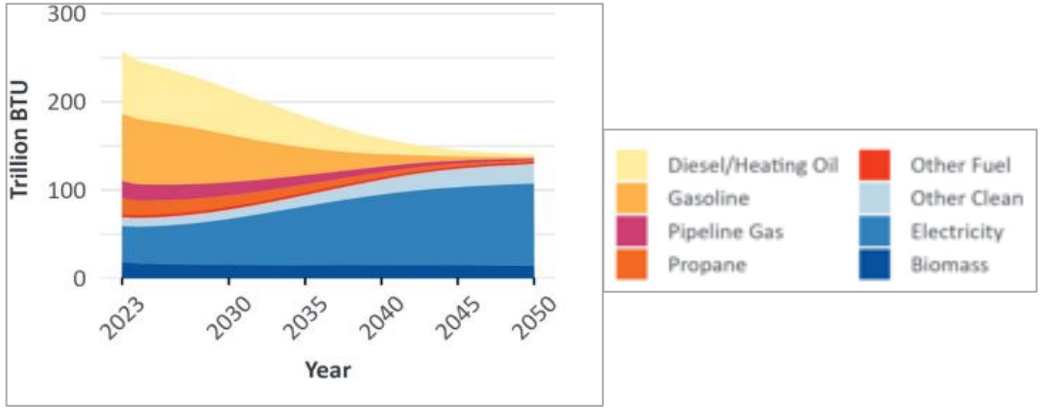
Objective D: Deploy efficient technologies to reduce energy costs

Strategy A: Advance beneficial electrification and weatherization to reduce energy costs and increase overall grid efficiency

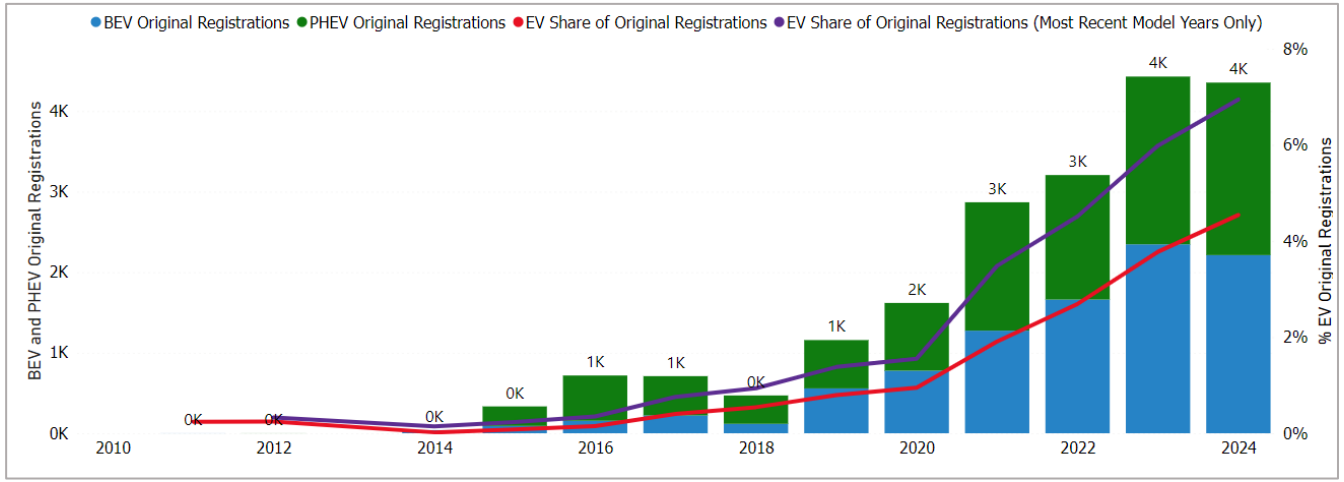
Strategy B: Leverage electrified technologies to unlock grid benefits to consumers

Strategy C: Expand Maine's EV charging network

Forecasted Overall Energy Use in Maine



Registrations of EVs and plug-in hybrids in Maine



MAINE GOVERNOR'S Energy Office

Objective E: Expand clean energy career opportunities for Maine people and advance innovation

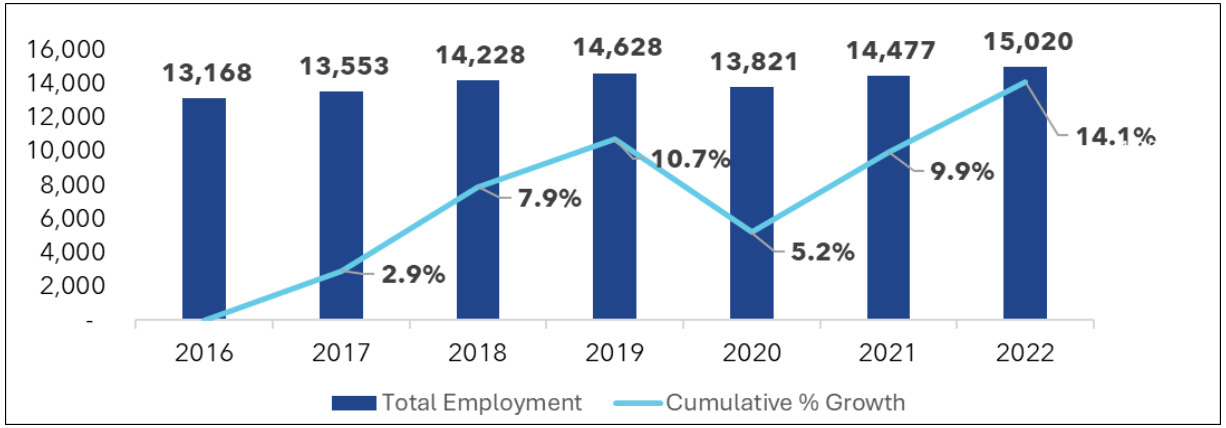
Strategy A: Raise awareness of clean energy careers and connect employers to the local workforce through the Clean Energy Partnership

Strategy B: Advance clean energy curricula development, technical training, and experiential learning

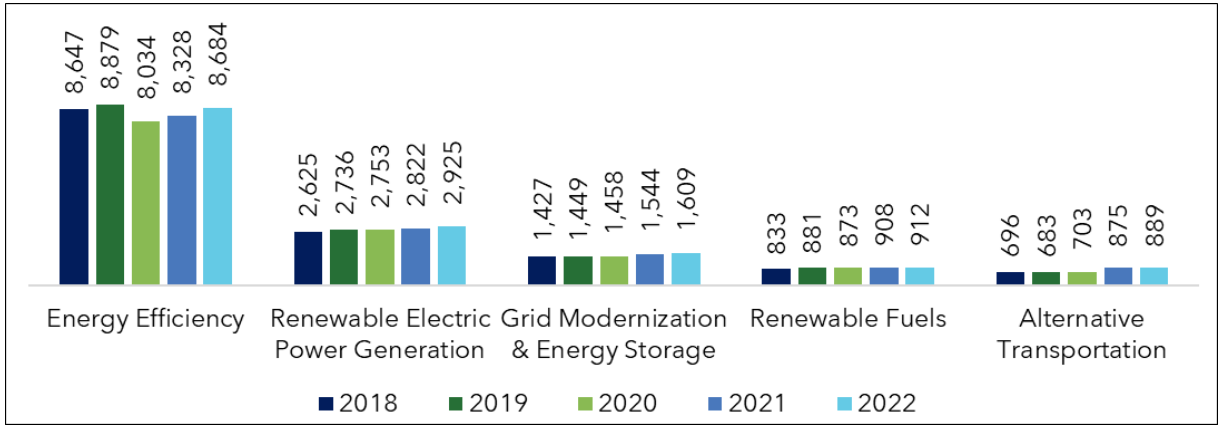
Strategy C: Coordinate with educational institutions, technical and vocational training centers, labor unions, and employers to expand and promote clean energy career pathways

Strategy D: Expand pilot programs, technical assistance, and funding for clean energy innovation and foster partnerships with research, education, and innovation institutions and the private sector to advance clean energy innovation

Clean Energy Job Growth in Maine



Clean Energy Jobs in Maine by Sector



MAINE GOVERNOR'S Energy Office

MAINE GOVERNOR'S
Energy Office

Thank You

Visit us at
www.maine.gov/energy

Sign up for the GEO email newsletter

MAINE GOVERNOR'S
Energy Office