Maine Climate Council

Energy Working Group Meeting

Co-Chairs:
Dan Burgess, Governor's Energy Office
Ken Colburn, Symbiotic Strategies, LLC

GOVERNOR'S OFFICE OF
Policy Innovation and the Future

MAINE DEPARTMENT OF
Environmental Protection

November 21, 2023

Meeting Agenda

1. Welcome, Meeting Objectives
2. Maine Energy Plan: Pathway to 2040 – Overview & Discussion
3. Discussion of Additional Energy Modeling Resources
4. Identifying Priority Considerations – Discussion
5. Next Steps

Maine Energy Plan

PATHWAY TO 2040

THE BRATTLE GROUP
EVOLVED ENERGY RESEARCH

ON BEHALF OF THE
MAINE GOVERNOR'S ENERGY OFFICE

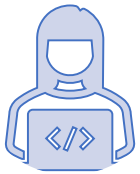
Brattle

EVOLVED ENERGY RESEARCH

GOVERNOR'S Energy Office

"Pathway to 2040" Study Outcomes

3-5 modeling scenarios, informed by public input and ongoing aligned processes



Concise, accessible digital summary of findings and comparison of different scenarios

Policy considerations based on the scenario comparison and interpretation

Incorporation into Maine Energy Plan

The "Pathway to 2040" study will be included as a technical volume within Maine's Energy Plan, delivered to the Governor and the Legislature in early 2024.

Key Questions to be Addressed:

How to meet 100% clean electricity by 2040?

- Renewable energy is clearly able to cost-effectively decarbonize the bulk of the electricity system
- What supply resources may be best for the "last mile" to 100%?
  - Additional renewables with storage?
  - What is the role of clean thermal generation?
  - What other resources may be needed, based on operational considerations and economics?
    - E.g., Gas w Carbon Capture, Large Hydro, Nuclear?

Can Flexible Load help mitigate reliability concerns and/or reduce costs?

What are the impacts of emerging technologies, including:

- Hybrid Heating (renewable fuel-fired heating systems used as backup in extreme cold conditions)
- Distributed energy resources

Limitations – What This Study Cannot Do

Cannot predict the future:

- Technologies and fuels – uses reasonable assumptions for progress on technology cost and performance
  - Not assuming breakthroughs or unproven technologies for electric generation, EVs, heat pumps, etc.
  - Similarly for fuels (esp. clean fuels) – cost and availability projections are reasonable, though may differ from future outcomes

Cannot identify/evaluate specific generation or transmission projects or their costs

- Will identify "generic" project types, using best available estimates of cost, performance, etc. for Maine
  - But cannot specify particular generation projects or transmission paths, nor precise costs of those projects
- Results of this study can be used to identify promising pathways, which can be developed in further detail

Cannot address detailed and granular implementation issues

- Though can identify some types of issues that will likely be encountered, and perhaps approaches to address them

Pathways incorporates key Maine policies and targets through 2050

Economy-wide greenhouse gas reduction: 45% reduction by 2030; 80% by 2050 (vs 1990 levels)

80% renewable portfolio standard by 2030 and 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 and an additional 175,000 by 2027

Planned resource and transmission projects

Our modeling implementation for these are described in the following slides

Viewing Maine in the Regional Context

Maine is part of regional fuel and electricity markets

- Electricity: Maine is ~10% of ISO-NE demand
  (Not counting NMISA – outside ISO-NE, ~155 MW peak, ~850 GWh load)

Other New England states also have ambitious decarb and renewable/clean electricity goals

- Modeling the regional context on an hourly basis captures important opportunities and challenges as multiple states pursue decarbonization objectives
- Modeling assumes all NE states pursue similar strategies, to yield realistic picture of system requirements
- Hourly results can be aggregated to annual and peak demand measures

≥80% by 2050	Five states mandate greenhouse gas reductions economy wide: MA, CT, ME, RI, and VT (mostly below 1990 levels)
100% by 2040	CT zero-carbon electricity requirement
80% by 2050 Net-Zero by 2050	MA clean energy standard MA statewide emissions requirement
100% by 2050 Carbon-Neutral by 2045	ME renewable energy goal ME emissions requirement
100% by 2030	RI renewable energy requirement
90% by 2050	VT renewable energy requirement

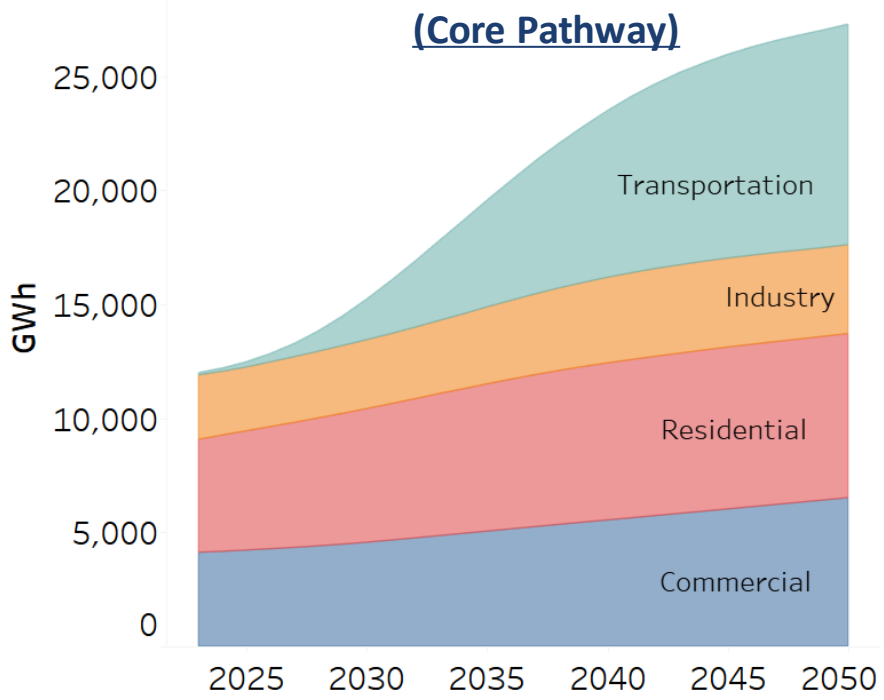
Figure Source: ISO-NE

Prior Results

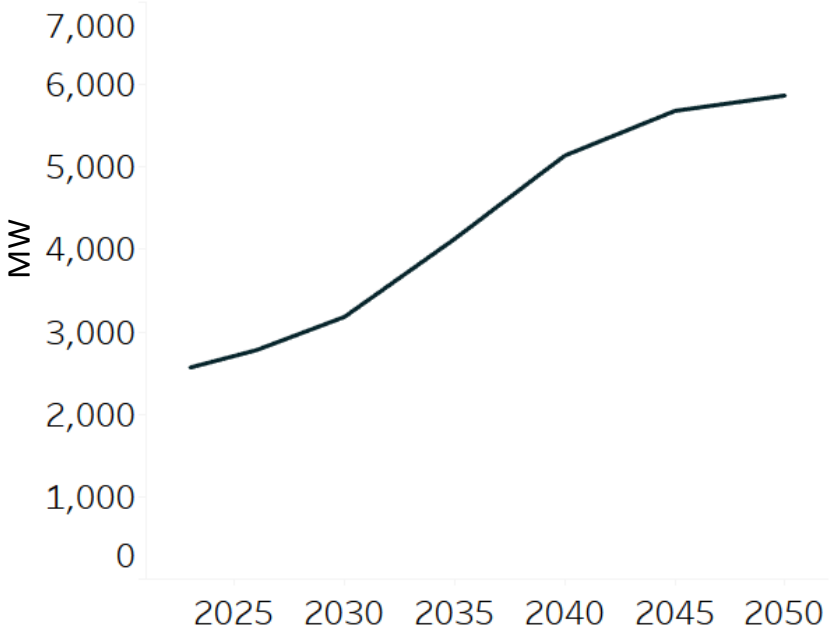
Electricity demand increases via electrification (mostly heating and transport)

- Nearly doubling electric demand by 2050, while reducing overall energy use (electricity is more efficient)
- Peak may increase by 2-3x, with implications for T&D expansion, as well as generation and storage capacity
  - Peak impact depends on Load Flexibility – and much of the new electrification load can be flexible

Electricity Demand, Maine (Core Pathway)



Distribution System Capacity, Maine (Core Pathway)

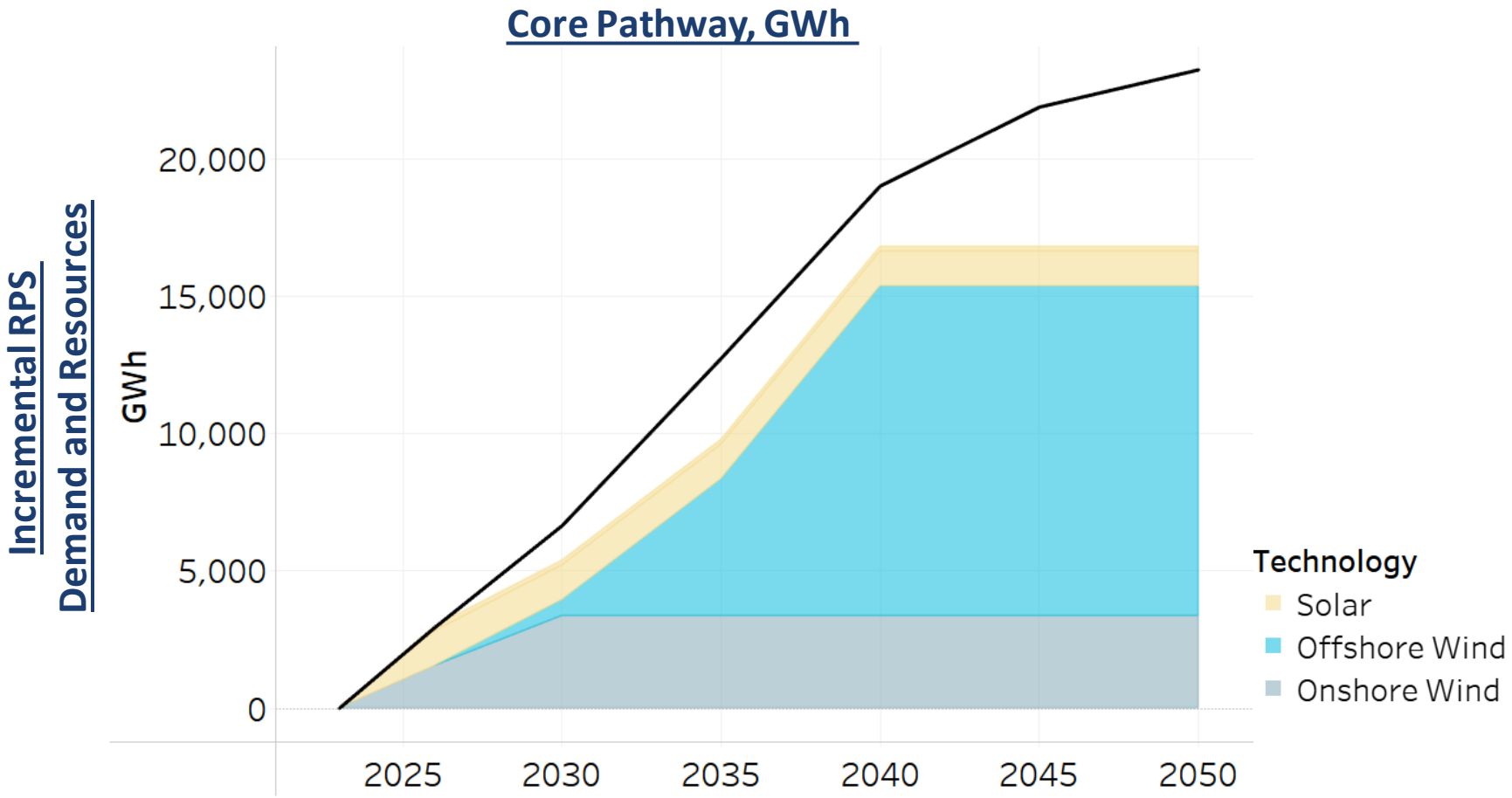


Precise impacts on electricity demand, peak, and fuel use differ by Pathway, but all show significantly increased reliance on electricity

DRAFT RESULTS

Maine's Incremental Clean Generation Needs

Currently contracted/committed resources meet most of Maine's incremental 2040 clean energy needs*



* In-service dates are estimated

DRAFT RESULTS

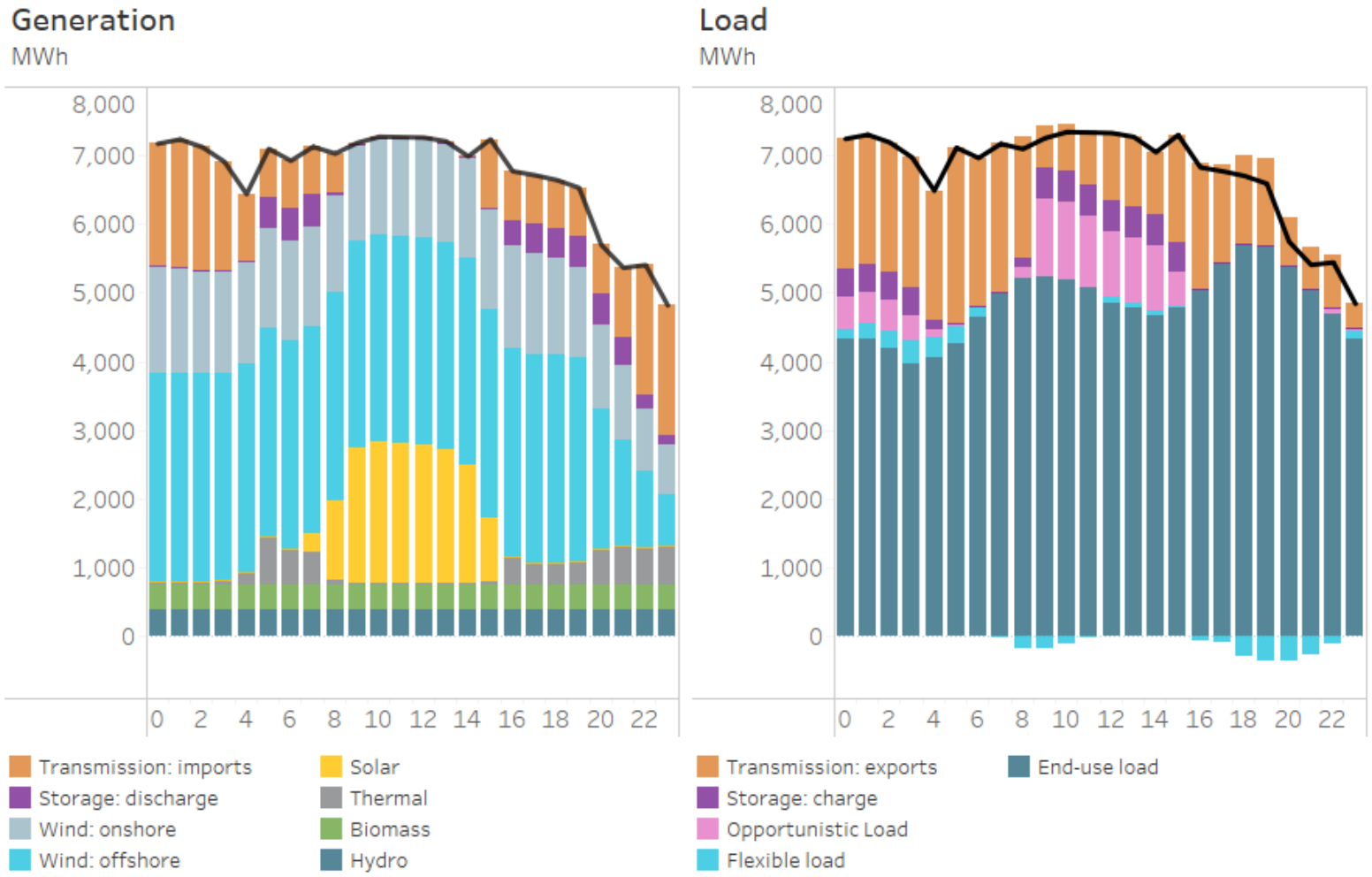
100% Clean Electricity System: Hourly Operations on a Typical Winter Day

Generation

- Renewable output, particularly from offshore wind, is high across most hours
- Storage and thermal generation dispatch during shoulder hours

Demand

- Load is high in the early morning and evening due to heating loads, but flexible load moderates peaks
- Electrolysis (H_2) and storage consume excess renewable output



*Opportunistic load refers to large industrial loads, such as electrolysis, that are not must-serve in each hour

DRAFT RESULTS

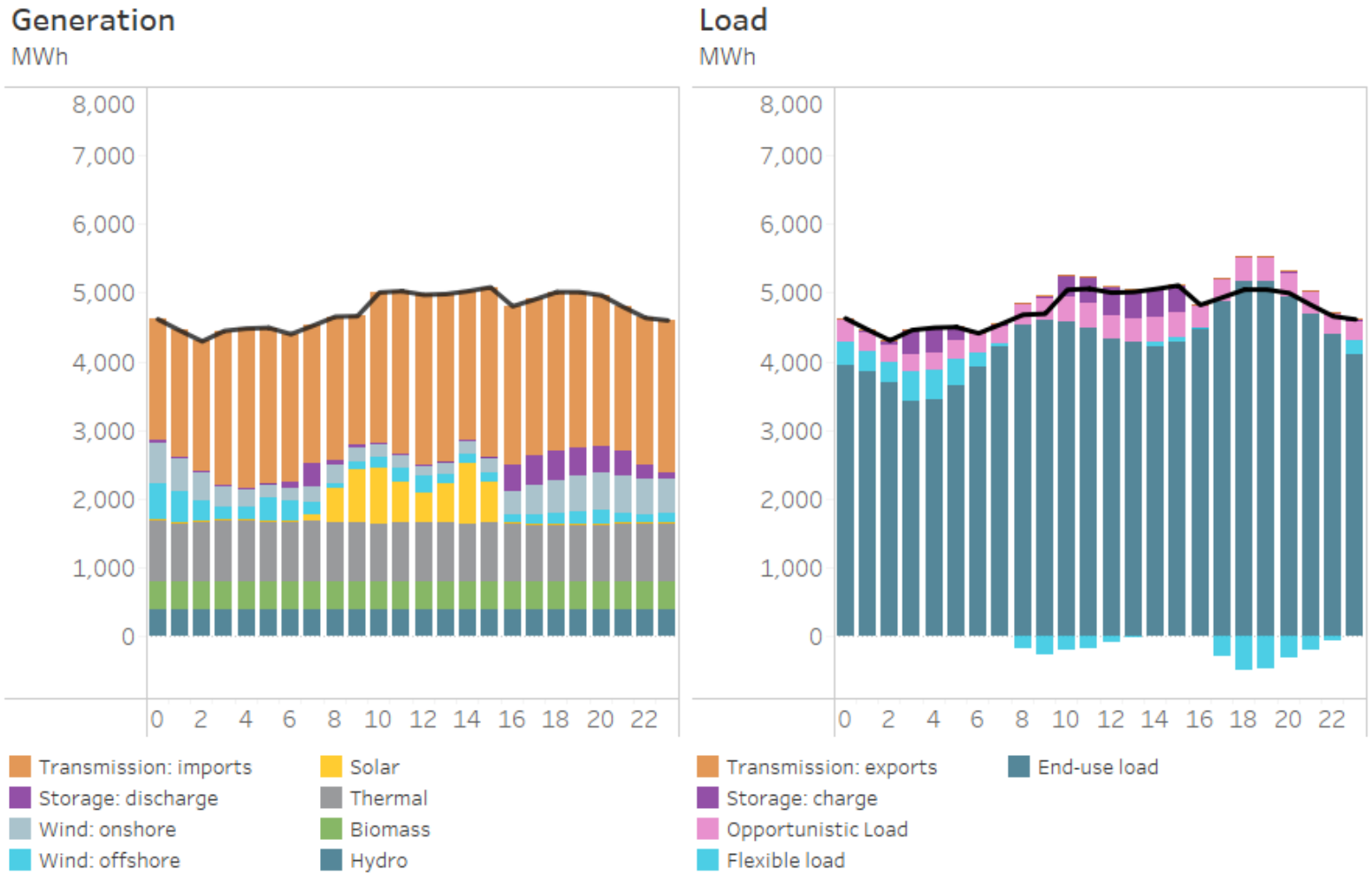
100% Clean Electricity System: Hourly Operations on a (Rare) Challenging Day

Generation

- Wind and solar generation is minimal
- Thermal resources burn zero-carbon fuel across the day
- Energy storage, flexible load and clean (mostly Canadian) imports contribute to maintain resource adequacy

Demand

- Storage, electrolysis and export demand all decline significantly
- Flexible load helps flatten total load but cannot address extended RE drought

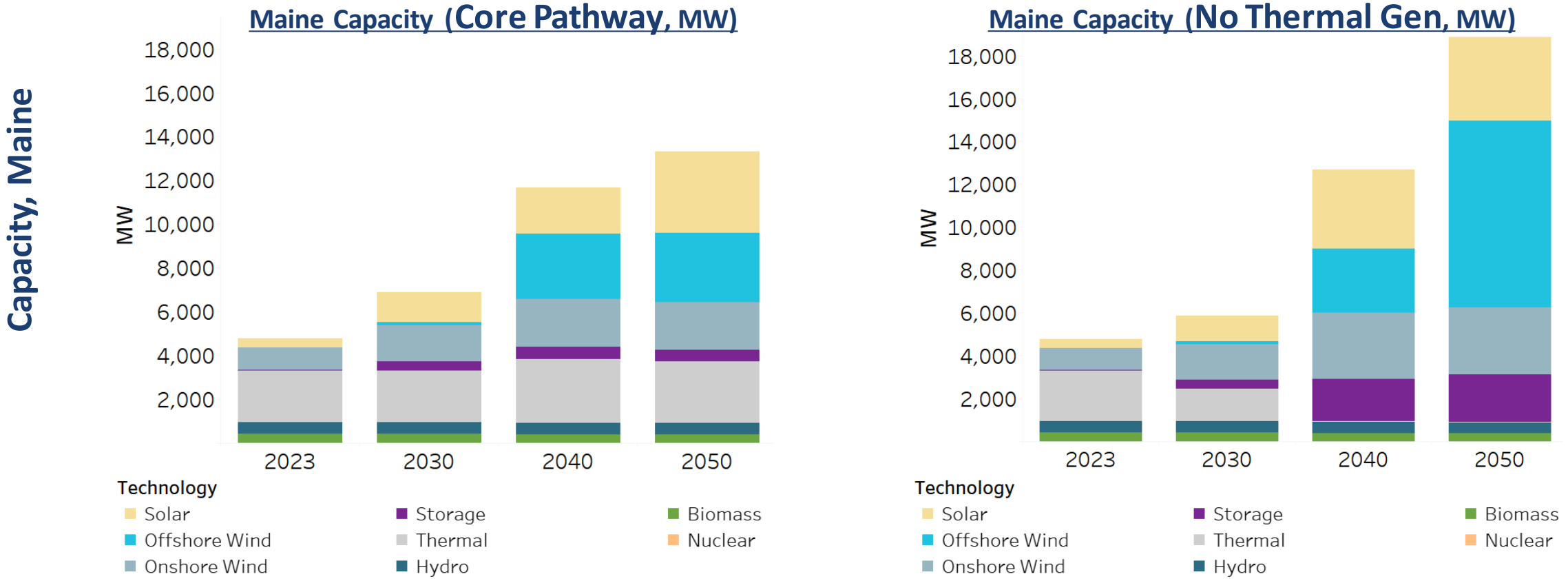


*Opportunistic load refers to large industrial loads, such as electrolysis, that are not "must-serve" in each hour

DRAFT RESULTS

100% Clean Energy by 2040 – What Resources for "Last Mile" to 100%?

The **No Thermal Gen** pathway shows considerably higher resource needs (less thermal; much more storage, as well as wind and solar), and thus higher cost, than **Core** (which allows thermal/clean fuel).
- Greater renewable resource needs may have significant land use implications, as well.



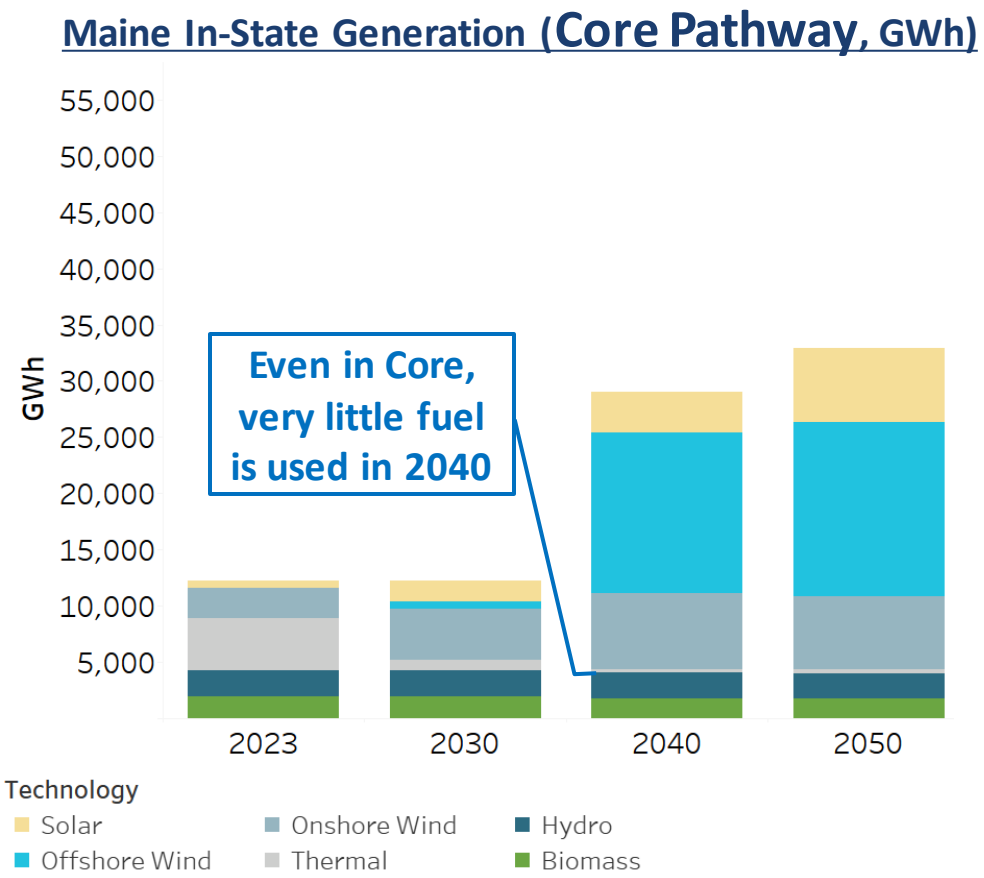
Note: Core pathway selects renewables, keeps thermal with clean fuel; other options (CCS, nuclear, new large hydro) were available but have higher cost

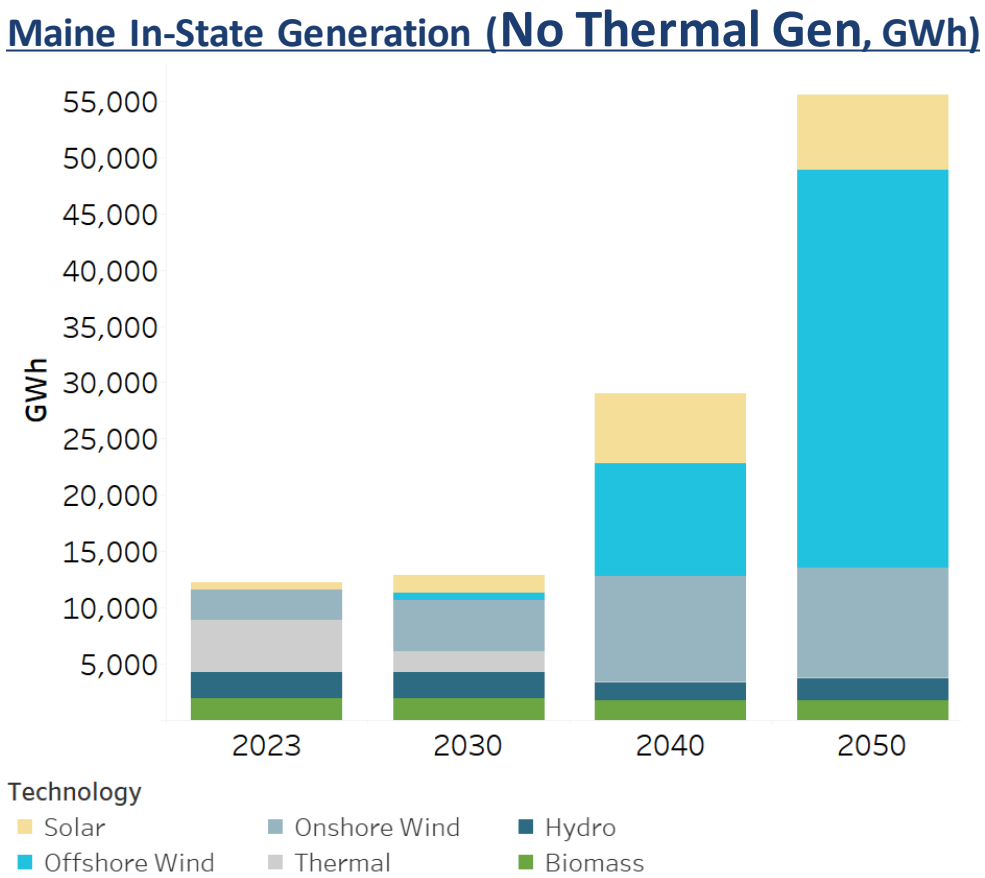
DRAFT RESULTS

100% Clean Energy by 2040 – What Resources for "Last Mile" to 100%?

Despite retaining significant thermal capacity in **Core**, it is used very infrequently, for little total fuel use
(Additional renewables in **No Thermal Gen** provide energy at times it's not needed; utilized for e-fuels)

Energy, Maine

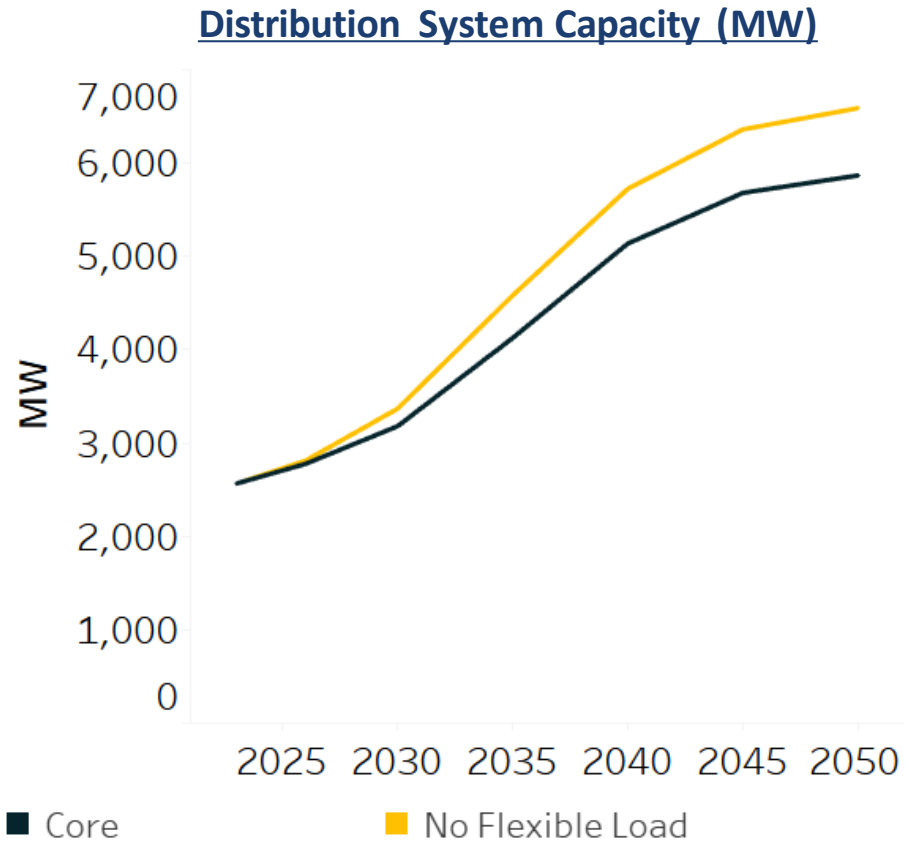




Note: Core pathway selects renewables, keeps thermal with clean fuel; other options (CCS, nuclear, new large hydro) were available but have higher cost

Load Flexibility – Pathway Results

Load flexibility significantly mitigates electricity net peak, limiting distribution peak growth (thus T&D upgrade needs), generation and storage needs, and costs. The “Medium” level of flexibility in the Core pathway has a significant impact (High Flexibility case is still under evaluation)



DRAFT RESULTS

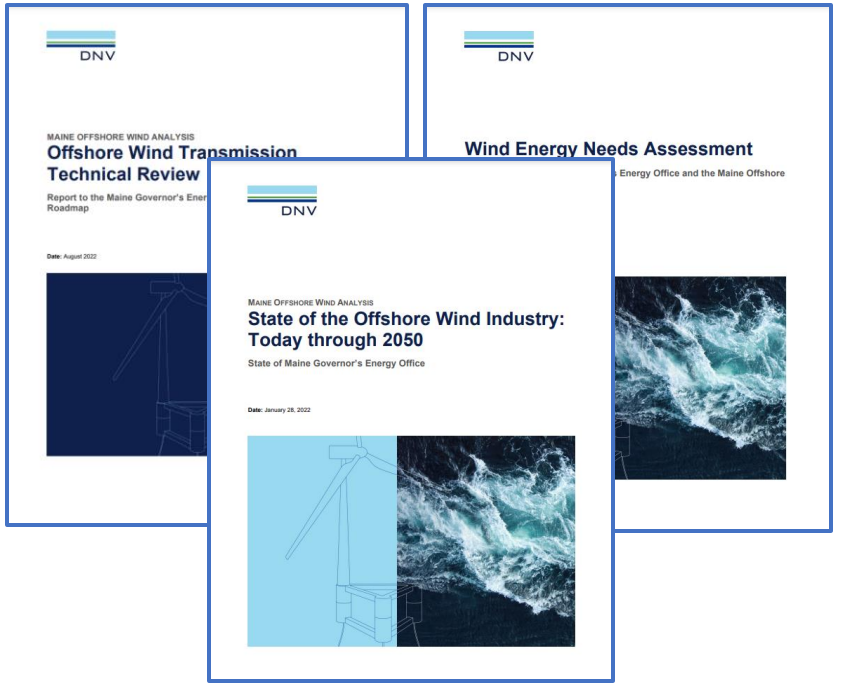
Discussion

Next Steps

- Consultant team to finalize modeling
- Consider policy implications
- Draft final report
- Stakeholder meeting with Draft Report (Early 2024)
- GEO to publish Maine Energy Plan as required under Maine Law

Maine Offshore Wind Roadmap - Energy Markets and Strategies Working Group Technical Analyses

The *Maine Offshore Wind Roadmap* included numerous technical studies prepared with input from various working groups.



Particular studies relevant to the work of the Energy Working Group include:

- State of the Offshore Wind Industry: Today through 2050
  - Overview of key technologies, cost drivers, cost reductions, pilot and commercial projects, and deployment projections
- Offshore Wind Transmission Technical Review – Initial and Final Reports
  - Overview of key technologies, grid and market considerations, and potential points of interconnection
- Maine Offshore Wind Energy Needs Assessment
  - Energy modeling to forecast anticipated Gulf of Maine offshore wind energy development to meet Maine and regional needs

All technical studies are available on the GEO's website.
https://www.maine.gov/energy/studies-reports-working-groups/completed-reports

New and continued *opportunities*

1. New goal: Achieving 100% clean energy by 2040 – comprehensive energy planning process underway

2. Ensuring Maine households and businesses have access to clean, affordable, reliable and adequate energy in the coming decades

3. Optimizing the operation of the grid, and reducing its cost as demand increases, through the adoption of distributed energy resources, grid planning, and demand management strategies.

4. Building the workforce to support a clean energy transition

New and continued *opportunities*

New goal – 100% clean by 2040; and Maine's other energy / climate goals

Ensuring access to clean, affordable, reliable, adequate energy

Let's start here

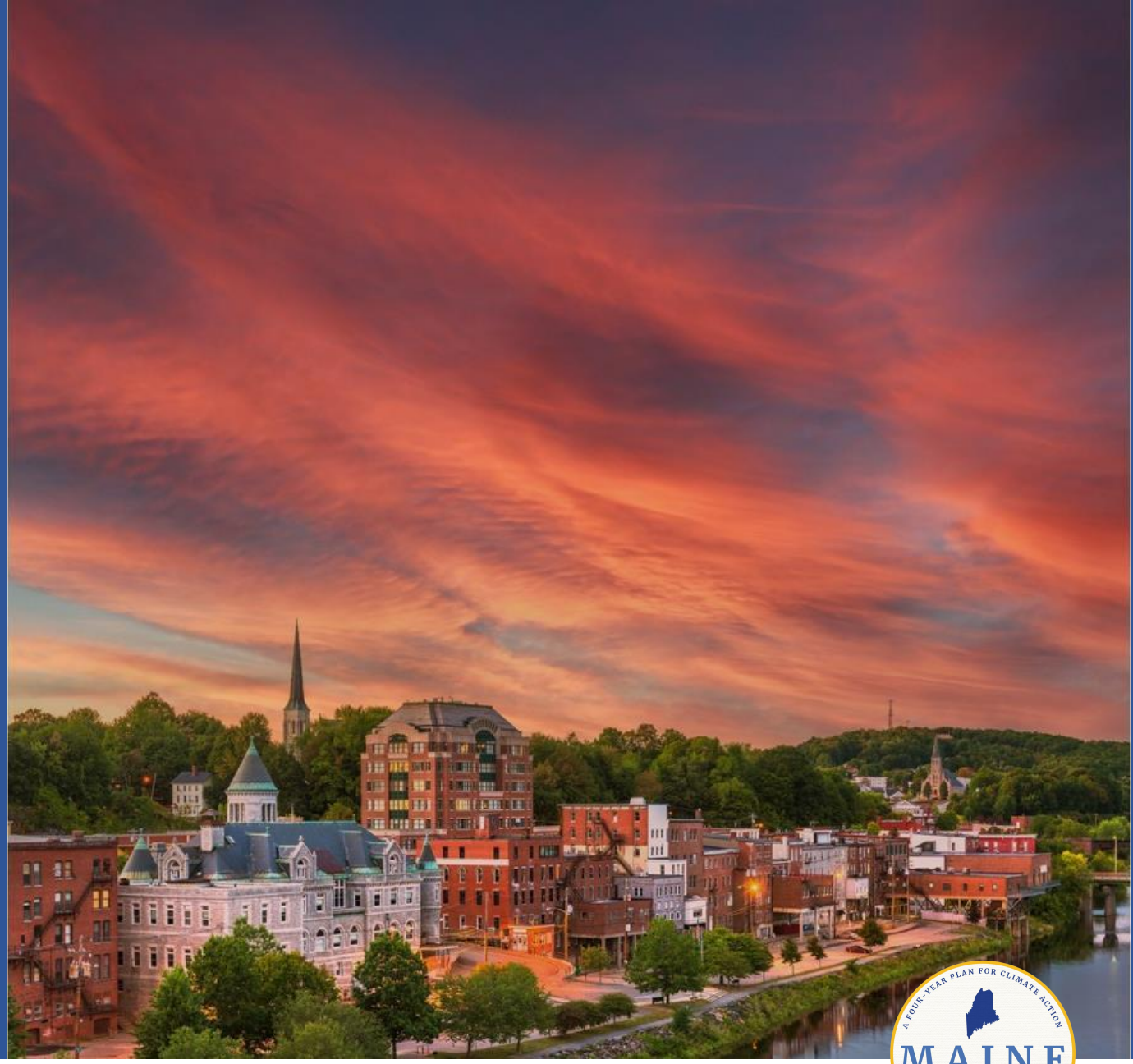
Building the workforce to support the clean energy transition

Optimizing grid operation

What are the most important considerations the EWG should discuss as it develops new and updated strategy recommendations for Maine's updated climate action plan?

Mentimeter

Next Steps and Adjournment



SurveyMonkey

surveymonkey.com/r/6BLSVYQ

Contact the Maine Climate Council

Please contact the Maine Climate Council via the form below.

To learn more about opportunities to provide feedback, and be notified when they are available, please sign up for the Maine Climate Council newsletter.

All fields are required.

My comments are about:

Energy Working Group

First Name: Last Name:

Email: Town/City:

Affiliation/company: Job Title:

Message:

Feedback is welcome at anytime to EWG staff.

We also encourage use of the MCC feedback form which will go directly to the EWG and MCC staff:

https://www.maine.gov/future/initiatives/climate/climate-council/contact

Next EWG Meeting:

TBD, December (virtual/Zoom)


A FOUR-YEAR PLAN FOR CLIMATE ACTION
MAINE
WON'T WAIT
MAINE CLIMATE COUNCIL