Sebastian Lombardi
Assistant Secretary

October 18, 2021

VIA ELECTRONIC MAIL

TO: PARTICIPANTS COMMITTEE MEMBERS AND ALTERNATES

RE: Supplemental Notice of October 25, 2021 NEPOOL Participants Committee Working Session

Pursuant to Section 6.6 of the Second Restated New England Power Pool Agreement, supplemental notice is hereby given that the October Future Grid "Pathways Study" meeting will be held **in person on *Monday*, October 25, 2021, at 9:30 a.m. at the Doubletree Hotel, 5400 Computer Drive, Westborough, MA** for the purposes set forth on the attached agenda and posted with the meeting materials at nepool.com/meetings/.

The safety protocols that will be in effect for in-person attendance at the October 25 Participants Committee meeting can be viewed here. In summary, only those who are fully vaccinated, and have provided in advance of the meeting proof of full vaccination (to pmgerity@daypitney.com), will be permitted to attend in person. Additional safety measures are outlined in the protocols.

As with any in-person meeting, there will be COVID-related risks associated with in-person attendance at the October 25 working session, but there are also substantial benefits from being together in-person. Efforts have been made to reduce the risks and to ensure that no unvaccinated people attend the meeting, but each of you will need to perform your own risk/benefit calculus in deciding whether to participate remotely or in-person.

If you plan to attend the October 25 Pathways Study meeting in-person, we ask that you please let us know via e-mail (kdube@daypitney.com) by no later than this Friday, October 22. For those who otherwise attend NEPOOL meetings but plan to participate in the October 25 meeting virtually, please use the following dial-in information: **866-803-2146; Passcode: 7169224.** To join using WebEx, click this link and enter the event password **nepool**.

For your information, the October 25 meeting will be recorded. NEPOOL meetings, while not public, are open to all NEPOOL Participants, their authorized representatives and, except as otherwise limited for discussions in executive session, consumer advocates that are not members, federal and state officials and guests whose attendance has been cleared with the Committee Chair. All those in attendance or participating, either in person or by phone, are required to identify themselves and their affiliation at the meeting. Official records and minutes of meetings are posted publicly. No statements made in NEPOOL meetings are to be quoted or published publicly.

Respectfully yours,

/s/
Sebastian Lombardi, Assistant Secretary

NEPOOL

FINAL AGENDA
NEPOOL Participants Committee
In-Person Working Session: Pathways to the Future Grid
October 25, 2021
Doubletree Hotel, Westborough, MA
Start time: 9:30 a.m.

The agenda items for the October 25 working session are as follows:

1. To approve the draft minutes of the September 23, 2021 Participants Committee "Pathways Study" meeting. The draft preliminary minutes of that meeting are included with this supplemental notice and posted with the meeting materials.

2. Analysis Group to provide preliminary set of results for the central cases from their ongoing pathways analyses. An update on modeling progress and next steps will also be discussed. Analysis Group's presentation materials will be circulated under separate cover when received.

Additional stakeholder feedback received from Eversource on the request that AGI study a scenario that compares the cost of an offshore wind transmission system versus the costs of offshore wind projects with individual generator lead lines is attached and posted with the meeting materials.

PRELIMINARY

Pursuant to notice duly given, a meeting of the NEPOOL Participants Committee was held via teleconference beginning at 1:00 p.m. on Thursday, September 23, 2021. A quorum determined in accordance with the Second Restated NEPOOL Agreement was present and acting throughout the meeting. Attachment 1 identifies the members, alternates and temporary alternates who participated in the teleconference meeting.

Mr. David Cavanaugh, Chair, presided and Mr. Sebastian Lombardi, Acting Secretary, recorded.

APPROVAL OF JULY 21 PATHWAYS STUDY MEETING MINUTES

Mr. Cavanaugh referred the Committee to the preliminary minutes of the July 21, 2021 Pathways Study meeting, as circulated and posted in advance of the meeting. Following motion duly made and seconded, the Committee unanimously approved those minutes.

ANALYSIS GROUP (AGI) PRESENTATION

Mr. Cavanaugh then introduced Mr. Todd Schatzki of AGI, who, along with his colleague Mr. Chris Llop, reviewed materials, circulated and posted in advance of the meeting. Mr. Schatzki informed the Committee that the purpose of their presentation was to provide information on the following outstanding quantitative model inputs and assumptions: (i) load assumptions across the study years (2020-2040); (ii) behind-the-meter solar; (iii) summer/winter qualified capacity; (iv) resource siting and transmission upgrade costs; and (v) status quo resource mix.

Mr. Chris Llop began by discussing the load assumptions across the study years. He indicated that for years 2030 and 2040, the model would assume loads based on the Massachusetts Decarbonization Roadmap: 80x50 Study, and that for the base year, they planned to assume actual

2019 load from ISO-NE's 2020-2029 Forecast Report of Capacity, Energy, Loads and Transmission (CELT 2020 Report).

Turning to behind-the-meter solar modeling assumptions, Mr. Llop explained that the behind-the-meter solar growth in 2021-2030 in all scenarios will be based on the 2021 CELT Report. For years 2031-2040, behind-the-meter solar growth assumptions will be constant and equal to the incremental growth in 2030. He further noted that the behind-the-meter solar photovoltaic (PV) would be modeled as supply and would be eligible for clean energy certifications (CECs) under the Forward Clean Energy Market (FCEM) framework.

Concerning summer/winter Qualified Capacity (GC) modeling assumptions, Mr. Llop stated that, for all resources, AGI planned to estimate QC (for meeting resource adequacy) as the average of summer and winter QC. He added that they would rely upon existing ISO-NE rules for the summer and winter QC assumptions for new and existing intermittent resources, noting that seasonal QC for such resources would be the median output during intermittent reliability hours, as currently defined in the ISO-NE Tariff and calculated using generation profiles that differ by location and rely on 2019 weather patterns. For dispatchable resources, Mr. Llop indicated that the seasonal claimed capacity in the CELT Report would be used and clarified that if a resource was not reflected in the CELT Report but cleared in FCA15, the summer and winter QC from that auction would be used in the modeling.

Mr. Schatzki then discussed resource siting and transmission upgrade cost modeling assumptions, noting that the pathways study effort aimed to compare differences in outcomes, including total costs, between alternative approaches to decarbonization. He indicated the intent to assume reasonable estimates for new resource costs that reflect differing factors affecting development of new resources, including plant costs (and cost change due to technological change),

transmission costs, and other plant siting challenges. Referencing AGI's presentation materials, Mr. Schatzki then proceeded to provide the Committee with an overview of the approach AGI planned to take with respect to resource siting and transmission upgrade cost modeling assumptions for onshore and offshore wind resources. He explained that new resource capital costs would reflect both generation plant and transmission upgrades for onshore and offshore wind, and that the transmission upgrade cost assumptions would reflect existing available transmission capability and incremental transmission upgrades needed to increase deliverability. Mr. Schatzki concluded AGI's presentation with a brief overview of the planned modeling assumptions for the *status quo* resource mix, noting that, as previously discussed with the Committee, AGI's modeling assumptions would align with the findings of certain state-commissioned deep decarbonization studies.

In response to a question about the constant growth rate for behind-the-meter solar PV, Mr. Llop explained that they would need to see the results of the scenarios and let the model play out. When asked about data on pricing as a result of the model, Mr. Schatzki confirmed that certain market economic outcomes from AGI's modeling, such as pricing, would be shared with the Committee, but that the form in which this information would be shared was still being determined. When asked about whether AGI would consider different behind-the-meter configurations, Mr. Llop clarified that AGI did not intend to model generic utility-scale solar. Responding to a question about assumptions for establishing qualified capacity levels/ratings, Mr. Llop indicated that AGI intended to look at the historical requirements and make assumptions without modeling variability. A question about the permitting of solar PV and the land available for such projects was addressed by Mr. Schatzki, who noted that the model would consider the impact of incremental costs associated with less available land for future projects due to increased solar PV project development. In response to an inquiry as to whether AGI's model plans to incorporate any

changes to ISO-NE's minimum offer price rule (MOPR) construct or take into account FERC Order 2222 implications, Mr. Schatzki noted that neither would be part of the model.

Addressing next steps, Mr. Schatzki indicated that an initial set of results for each of the central cases would be presented in October 2021. In December, updates based on stakeholder feedback would be provided along with an initial set of results for the scenarios. Mr. Cavanaugh noted that the next Future Grid Pathways Study meetings were scheduled for October 25 and December 6.

There being no further business, the meeting adjourned at 3:16 p.m.

Respectfully submitted,

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Sebastian Lombardi, Acting Secretary

PARTICIPANTS COMMITTEE MEMBERS AND ALTERNATES
PARTICIPATING IN THE SEPTEMBER 23, 2021 TELECONFERENCE MEETING

PARTICIPANT NAME	SECTOR/ GROUP	MEMBER NAME	ALTERNATE NAME	PROXY
American Petroleum Institute	Fuels Industry Participant	Paul Powers		
AR Large Renewable Generation (RG) Group Member	AR-RG	Alex Worsley		
AR Small RG Group Member	AR-RG	Erik Abend		
AR Small Load Response (LR) Group Member	AR-LR	Brad Swalwell		
Ashburnham Municipal Light Plant	Publicly Owned Entity		Brian Thomson	
Associated Industries of Massachusetts	End User			Doug Hurley
AVANGRID: CMP/UI	Transmission		Jason Rauch	
Belmont Municipal Light Department	Publicly Owned Entity		Dave Cavanaugh	
Block Island Utility District	Publicly Owned Entity	Dave Cavanaugh		
Boylston Municipal Light Department	Publicly Owned Entity		Brian Thomson	
BP Energy Company	Supplier			José Rotger
Braintree Electric Light Department	Publicly Owned Entity			Dave Cavanaugh
Brooks, Dick	End User	Dick Brooks		
Calpine Energy Services, LP	Supplier	Brett Kruse		Bill Fowler
Castleton Commodities Merchant Trading	Supplier			Bob Stein
Chester Municipal Light Department	Publicly Owned Entity		Dave Cavanaugh	
Chicopee Municipal Lighting Plant	Publicly Owned Entity		Brian Thomson	
CLEAResult Consulting, Inc.	AR-DG	Tamera Oldfield		
Clearway Power Marketing LLC	Supplier			Pete Fuller
Concord Municipal Light Plant	Publicly Owned Entity		Dave Cavanaugh	
Connecticut Municipal Electric Energy Coop.	Publicly Owned Entity	Brian Forshaw		
CPV Towantic, LLC	Generation	Joel Gordon		
Cross-Sound Cable Company (CSC)	Supplier		José Rotger	
Danvers Electric Division	Publicly Owned Entity		Dave Cavanaugh	
DTE Energy Trading, Inc.	Supplier			José Rotger
Dynegy Marketing and Trade, LLC	Supplier			Bill Fowler
Emera Energy Services	Supplier			Bill Fowler
Eversource Energy	Transmission			Parker Littlehale
Exelon Generation Company	Supplier	Steve Kirk	Bill Fowler	
FirstLight Power Management, LLC	Generation	Tom Kaslow		
Galt Power, Inc.	Supplier	José Rotger	Jeff Iafrati	
Generation Group Member	Generation			A. Worsley
Georgetown Municipal Light Department	Publicly Owned Entity		Dave Cavanaugh	
Great River Hydro	AR-RG			Bill Fowler
Groton Electric Light Department	Publicly Owned Entity		Brian Thomson	
Groveland Electric Light Department	Publicly Owned Entity		Dave Cavanaugh	
Harvard Dedicated Energy Limited	End User			Doug Hurley
H.Q. Energy Services (U.S.) Inc. (HQUS)	Supplier		Bob Stein	
Hingham Municipal Lighting Plant	Publicly Owned Entity	John Coyle	Dave Cavanaugh	
Holden Municipal Light Department	Publicly Owned Entity		Brian Thomson	
Holyoke Gas & Electric Department	Publicly Owned Entity		Brian Thomson	
Hull Municipal Lighting Plant	Publicly Owned Entity		Brian Thomson	
Ipswich Municipal Light Department	Publicly Owned Entity		Brian Thomson	
Littleton (MA) Electric Light and Water Department	Publicly Owned Entity		Dave Cavanaugh	
Long Island Power Authority (LIPA)	Supplier		Bill Killgoar	
Maine Power LLC	Supplier	Jeff Jones		
Mansfield Municipal Electric Department	Publicly Owned Entity		Brian Thomson	
Maple Energy LLC	AR-LR			Doug Hurley
Marblehead Municipal Light Department	Publicly Owned Entity		Brian Thomson	
Mass. Attorney General's Office (MA AG)	End User		Ben Griffiths	

PARTICIPANTS COMMITTEE MEMBERS AND ALTERNATES
PARTICIPATING IN THE SEPTEMBER 23, 2021 TELECONFERENCE MEETING

PARTICIPANT NAME	SECTOR/ GROUP	MEMBER NAME	ALTERNATE NAME	PROXY
Mass. Bay Transportation Authority	Publicly Owned Entity		Dave Cavanaugh	
Mass. Municipal Wholesale Electric Company	Publicly Owned Entity	Brian Thomson		
Mercuria Energy America, LLC	Supplier			José Rotger
Merrimac Municipal Light Department	Publicly Owned Entity		Dave Cavanaugh	
Middleborough Gas & Electric Department	Publicly Owned Entity		Dave Cavanaugh	
Middleton Municipal Electric Department	Publicly Owned Entity		Dave Cavanaugh	
National Grid	Transmission	Tim Brennan	Tim Martin	
Natural Resources Defense Council	End User	Bruce Ho		
Nautilus Power, LLC	Generation		Bill Fowler	
New England Power Generators Association (NEPGA)	Fuels Industry Participant	Bruce Anderson		
New Hampshire Electric Cooperative	Publicly Owned Entity	Steve Kaminski		Brian Forshaw; Dave Cavanaugh
North Attleborough Electric Department	Publicly Owned Entity		Dave Cavanaugh	
Norwood Municipal Light Department	Publicly Owned Entity		Dave Cavanaugh	
NRG Power Marketing LLC	Generation		Pete Fuller	
Pascoag Utility District	Publicly Owned Entity		Dave Cavanaugh	
Paxton Municipal Light Department	Publicly Owned Entity		Brian Thomson	
Peabody Municipal Light Plant	Publicly Owned Entity		Brian Thomson	
Princeton Municipal Light Department	Publicly Owned Entity		Brian Thomson	
Reading Municipal Light Department	Publicly Owned Entity		Dave Cavanaugh	
Rowley Municipal Lighting Plant	Publicly Owned Entity		Dave Cavanaugh	
Russell Municipal Light Dept	Publicly Owned Entity		Brian Thomson	
Shrewsbury Electric & Cable Operations	Publicly Owned Entity		Brian Thomson	
South Hadley Electric Light Department	Publicly Owned Entity		Brian Thomson	
Sterling Municipal Electric Light Department	Publicly Owned Entity		Brian Thomson	
Stowe Electric Department	Publicly Owned Entity		Dave Cavanaugh	
Sunrun Inc.	AR-DG			Pete Fuller
Taunton Municipal Lighting Plant	Publicly Owned Entity		Dave Cavanaugh	
Templeton Municipal Lighting Plant	Publicly Owned Entity		Brian Thomson	
The Energy Consortium	End User			Doug Hurley
Vermont Energy Investment Corporation	AR-LR		Doug Hurley	
Vermont Electric Power Company (VELCO)	Transmission	Frank Ettori		
Vermont Public Power Supply Authority	Publicly Owned Entity			Brian Forshaw
Village of Hyde Park (VT) Electric Department	Publicly Owned Entity		Dave Cavanaugh	
Wakefield Municipal Gas and Light Department	Publicly Owned Entity		Brian Thomson	
Wallingford DPU Electric Division	Publicly Owned Entity		Dave Cavanaugh	
Wellesley Municipal Light Plant	Publicly Owned Entity		Dave Cavanaugh	
West Boylston Municipal Lighting Plant	Publicly Owned Entity		Brian Thomson	
Westfield Gas & Electric Department	Publicly Owned Entity		Dave Cavanaugh	
Wheelabrator North Andover Inc.	AR-RG		Bill Fowler	

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Pathways Study

Evaluation of Pathways to a Future Grid

Todd Schatzki and Chris Llop

October 25, 2021

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Overview

- Purpose of today's presentation is to summarize preliminary results and findings of the quantitative analysis of alternative Pathways to decarbonizing the New England grid
  - Four approaches: Status Quo, Forward Clean Energy Market (FCEM), Net Carbon Pricing (NPC), and Hybrid
  - Core Central Case results presented today; scenario results initially to be presented at December meeting
- Quantitative analysis is one element of our assessment of the alternative policy approaches
  - Discussion of qualitative aspects of our analysis to come in future presentations and report

- Status of analysis
  - Results presented today are ***preliminary***

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Summary of Key *Preliminary* Modeling Results

Preliminary findings regarding policy approaches include:

- Market prices and resulting incentives vary widely across approaches and have important consequences for market outcomes – for example:
  - Storage resource build out and utilization varies depending on energy market incentives created for non-carbon-emitting generation
  - Extent of available renewable energy that does not clear energy market ("economic curtailments") varies given market incentives for storage
  - Efficiency (and resulting carbon-intensity) of fossil (gas-fired) resources reflects incentives for clean energy versus carbon reduction
- Net Carbon Pricing approach produces the lowest production costs, with similar but somewhat higher costs for the FCEM and Hybrid approaches
  - The Status Quo approach leads to notably higher costs, reflecting multiple factors including absence of market incentives for clean energy/decarbonization and higher renewable curtailment
  - Assumed clean energy resource mixes reflecting state decarbonization "roadmaps" and plans

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Agenda

- Central Case Assumptions: A Brief Overview
- Quantitative Modelling: Achieving Decarbonization Targets
- Comparison of Outcomes Under Alternative Policy Approaches
  - Impact of Differences in Energy Market Incentives
  - Costs and Payments
- Proposed Set of Scenarios

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Central Case Assumptions: A Brief Overview

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Recap of Pathways Analysis

- Pathways analysis is evaluating alternative regulatory/policy approaches to decarbonizing the New England grid
  - Focus is on comparison of the implications of alternative regulatory approaches on economic outcomes, including the incentives for decarbonization
- **Four policy approaches:**
  - **Status Quo:** continued reliance on state-authorized procurements of multi-year contracts for renewable energy from new resources
  - **Forward Clean Energy Market:** market for clean energy, where "clean energy" is assumed to include electricity generated from nuclear, renewables, hydropower and biomass (but not storage)
  - **Net Carbon Pricing:** carbon pricing with generator payments for carbon emitted credited to load
  - **Hybrid:** combination of carbon pricing to cover existing clean energy "missing money" plus a forward clean energy market for not-yet-in-service resources

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Central Case Assumptions: Period, Targets

- **Central Case** assumptions are held constant across policy approach studied
  - Further detail on Central Case assumptions has been provided in prior presentations to the Participants Committee

- Overview of Central Case assumptions
  - Time period: **2020 to 2040**
  - Geographic scope: **ISO New England system only**, with assumed imports
  - 2040 decarbonization target: **80% of 1990 carbon emissions for the New England electricity sector**
  - No MOPR

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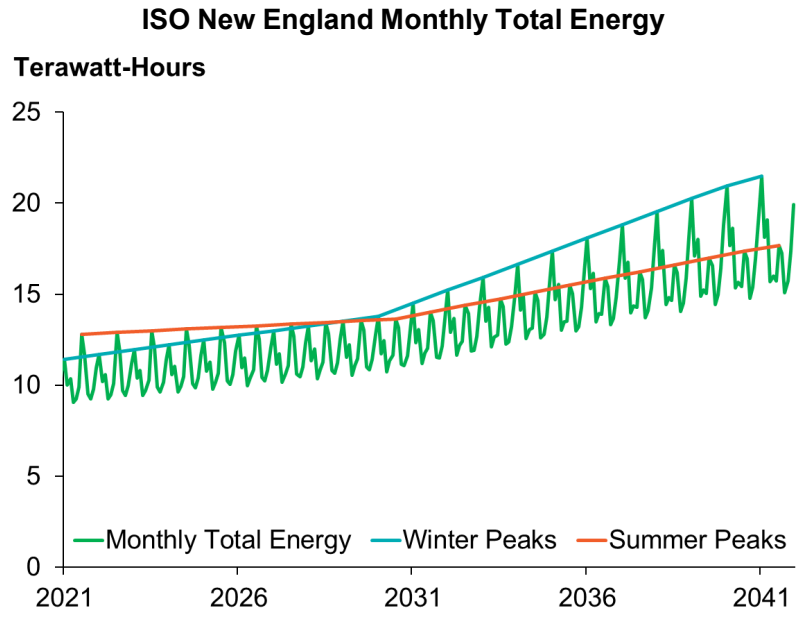
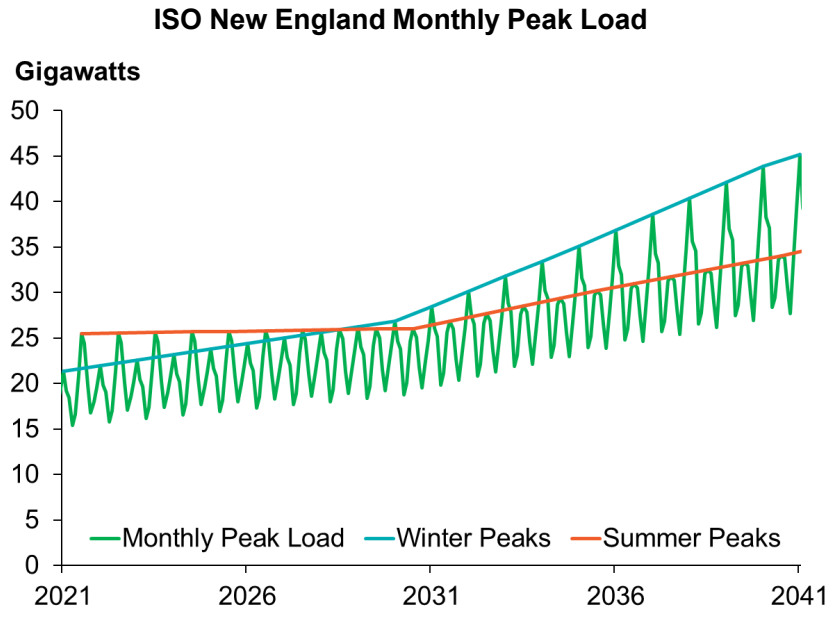
Central Case Assumptions: Loads

- **High load** assumed, reflecting electrification of transportation and heating (consistent with FGRS Scenario 3)





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Central Case Assumptions: Supply-Side

- Resource mix including existing and new resources
- ***Baseline state policies***: All studies assume baseline state clean energy policies, including: offshore wind procurements, New England Clean Energy Connect, and mix of other resources
- ***Incremental resources***
  - All cases assume the same mix of potential new resources and associated costs
  - Only considers existing technologies, with assumed decreasing costs
  - ***Status Quo case***: assumes renewables from state Plans, Roadmaps, and studies
  - ***FCEM, NCP, Hybrid***: least-cost mix of solar, offshore wind, onshore wind to meet carbon target given policy-specific constraints
  - Dispatchable resources in all cases: battery storage and gas-fired resources

Assumed Resources in State Clean Energy Policies

	2020-2040 Incremental Build (GW)					
State	Offshore Wind	Onshore Wind	Solar	Storage	NECEC	Total
Connecticut	4.7	0.4	2.3	2.2	-	9.7
Maine	-	2.0	0.7	0.5	-	3.2
Massachusetts	9.2	0.4	5.5	0.4	1.2	16.6
New Hampshire	-	-	-	-	-	--
Rhode Island	2.0	-	1.4	1.0	-	4.4
Vermont	-	0.2	0.8	-	-	1.0
Total	16.0	3.0	10.7	4.1	1.2	35.0

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Quantitative Modelling Results: Achieving Decarbonization Targets

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Central Case Results: Some Basics

System resources and energy evolve over time

- Start with an overview of a single case to show how the mix of energy and resources changes over the 20-year study period
  - Preliminary results for the Net Carbon Price case are provided below
  - Results are broadly similar for the other three cases because the key drivers of changes in resource/energy outcomes – decarbonization and growing loads – are the same across cases
- Review of results across years for one case will provide context for comparison of outcomes across cases

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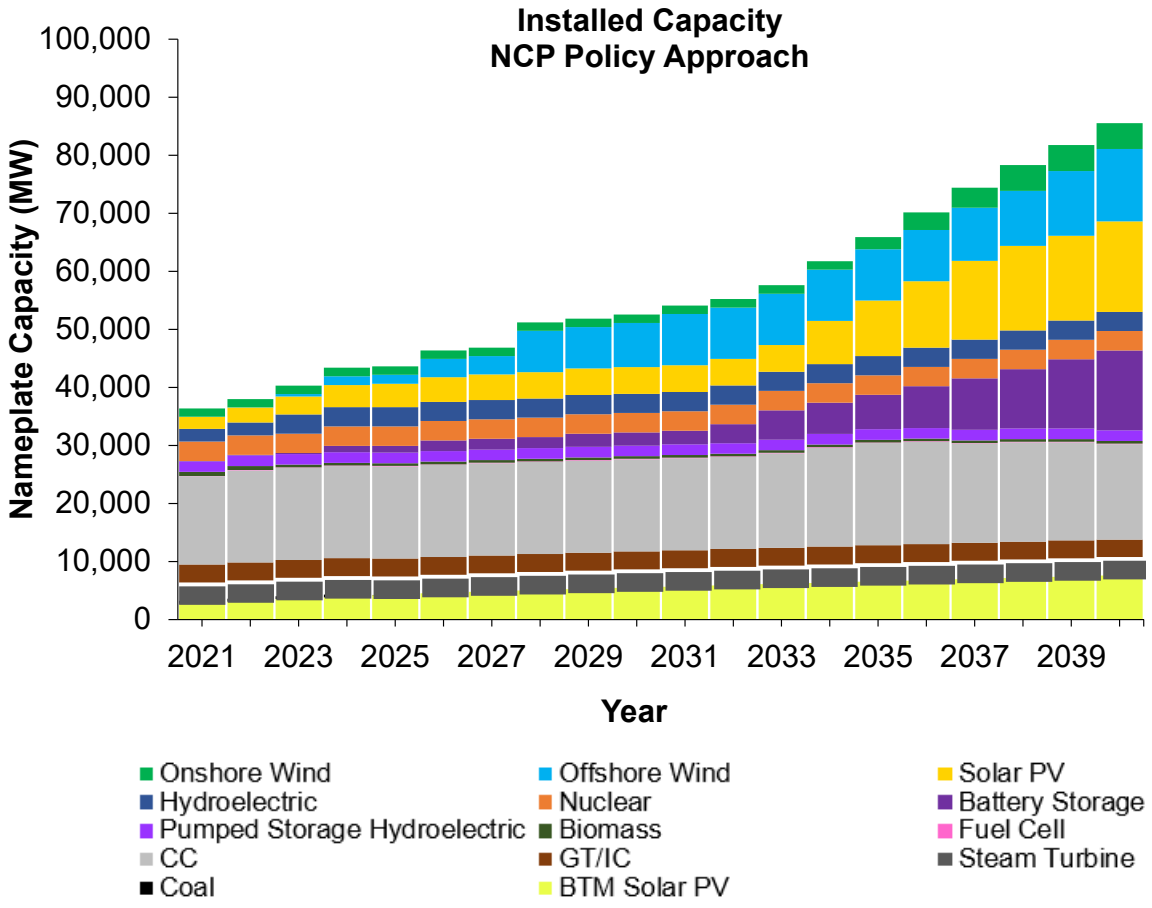
Central Case Results: Resource Mix

Decarbonization target and load growth drive increases in resources



Mix of resources reflects:

- Renewable build to achieve decarbonization target
- New dispatchable resources, particularly batteries, to supply energy when renewables are not available to meet load
- Existing resources needed to maintain resource adequacy and supply energy needs

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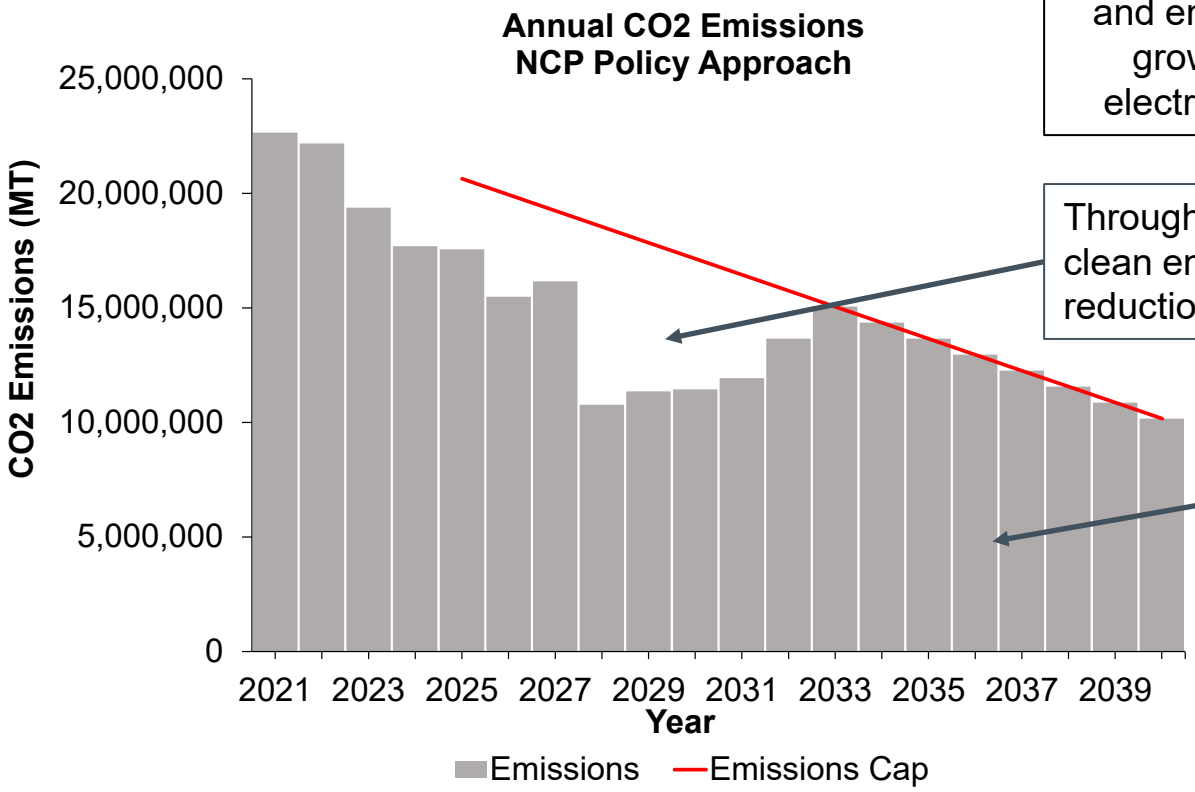
Central Case Results: Carbon Emissions

Alternative policy approaches bind starting in 2033



But-for assumed state baseline policies and emission targets, annual emissions grow as transportation and heating electrification increase customer loads

Through 2032, assumed baseline state clean energy policies produce sufficient reductions to meet decarbonization target

As of 2033, additional clean energy resources are required to achieve emissions target

Analysis does not account for banking in FCEM and NCP, which can lower costs

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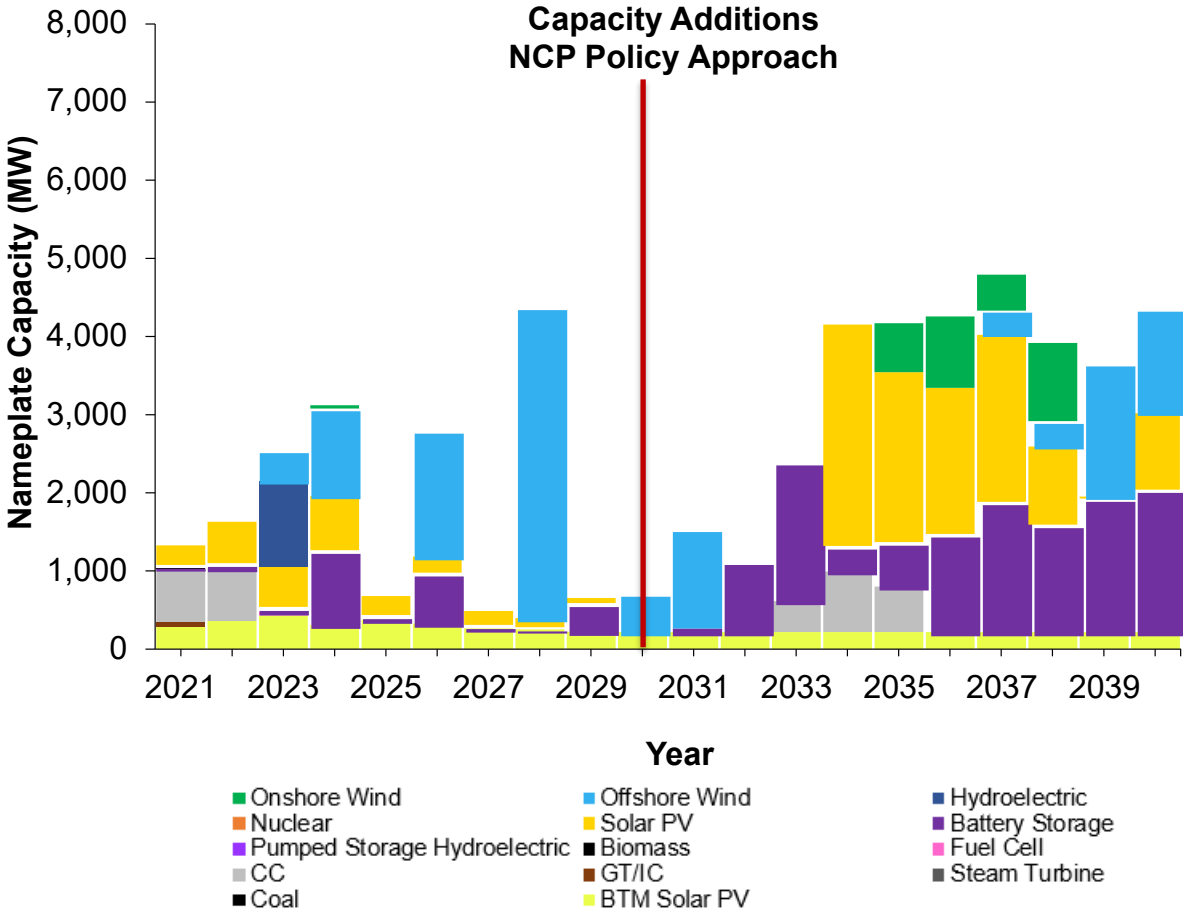
Central Case Results: Resource Additions

Resource additions reflect assumed and modelled resources



New capacity includes a wide mix of resources:

- In first decade, resource builds largely reflects baseline assumed state policies
- Second decade reflects resources needed to meet resource adequacy and clean energy requirements, including incremental renewable and dispatchable builds

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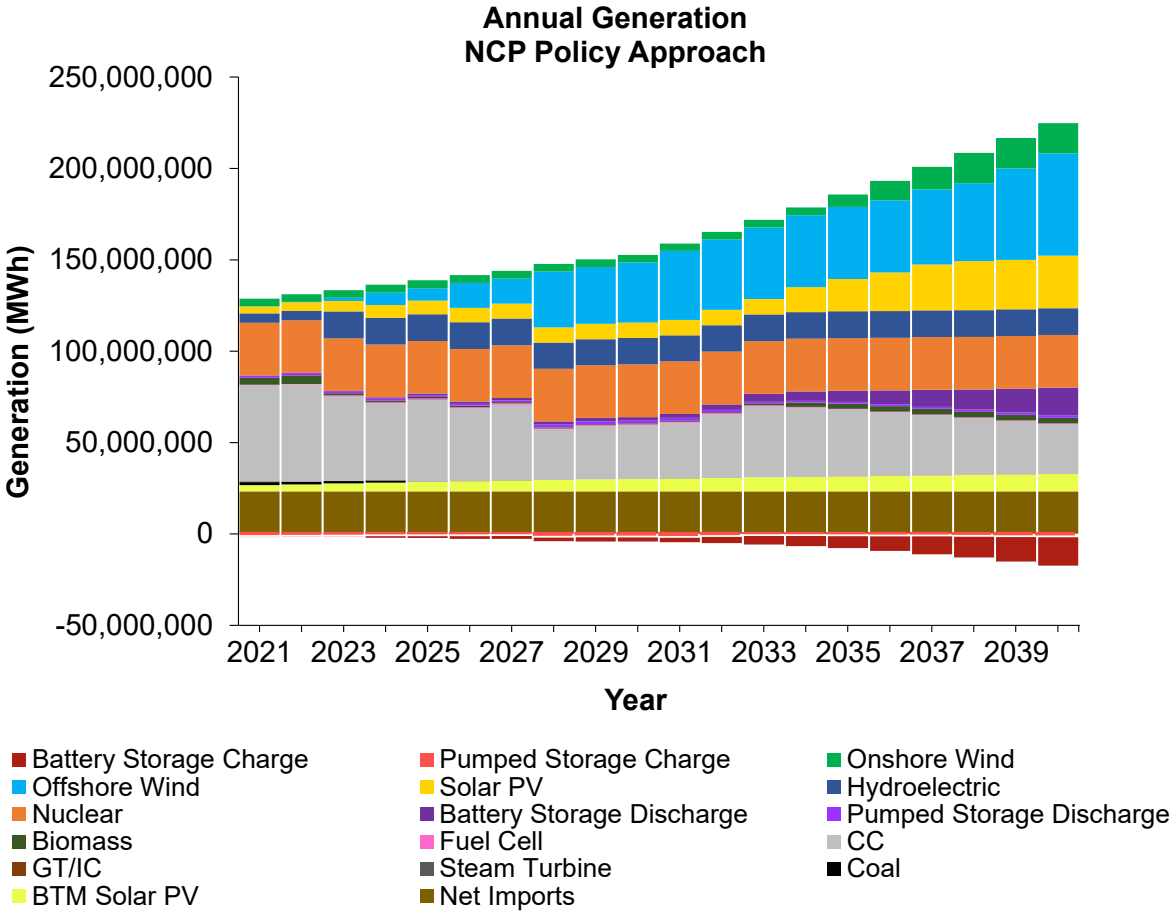
Central Case Results: Energy Mix

Energy mix driven by growing clean energy share and market dynamics



Changes in energy mix reflects evolving resource mix:

- Renewables: Increasing supply consistent with increased capacity (with some curtailed energy)
- Fossil resources: Reduced energy (and capacity factors) as non-emitting sources increase as share of load
- Batteries: Charging and discharging a small share of energy compared to battery's share of capacity
- Nuclear, imports: Assumed to be constant

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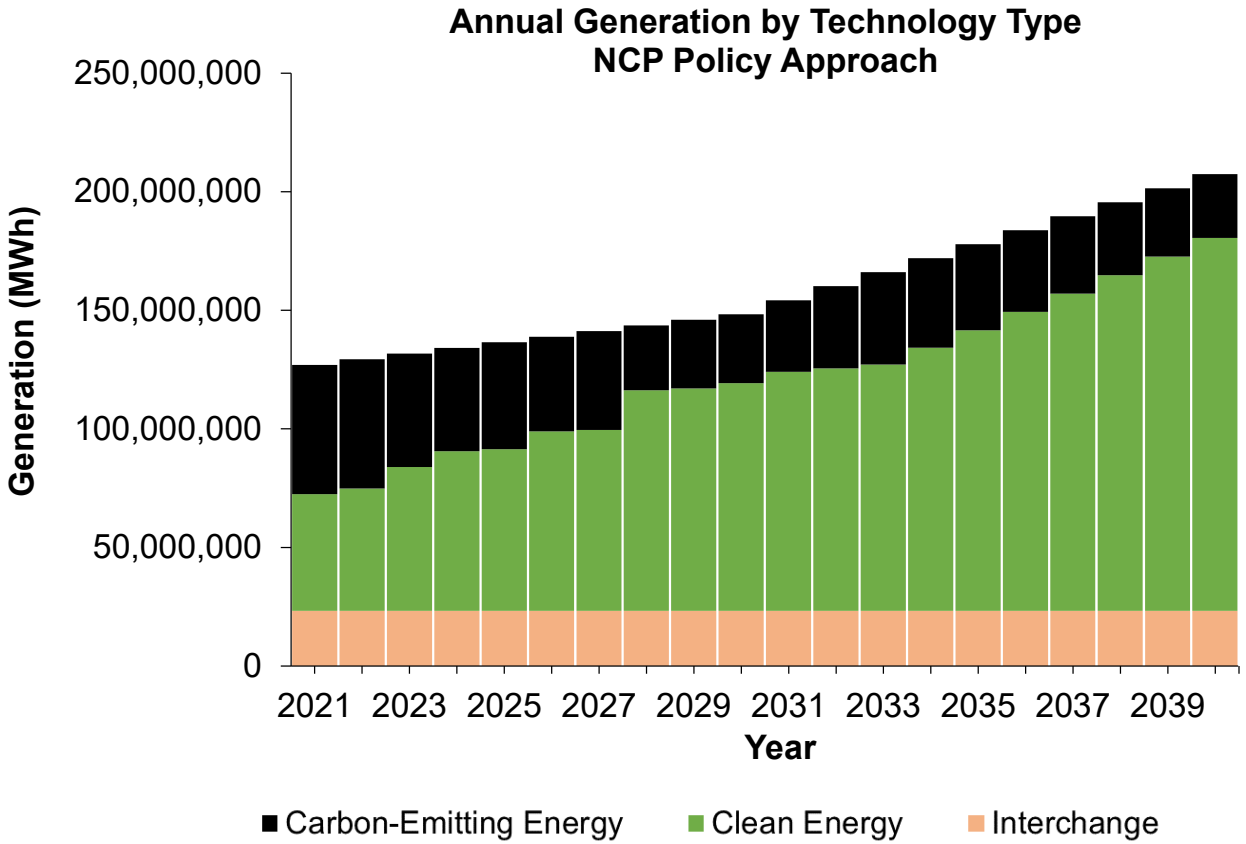
Central Case Results: Clean Energy

Clean energy share increases gradually to reflect assumed targets



- Clean energy's share of total energy increases over study period to achieve decarbonization goals
- "Clean energy" assumed to include:
  - Solar
  - Wind
  - Biomass
  - Nuclear
  - Hydroelectric

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Comparison of Outcomes Under Alternative Policy Approaches: Impact of Differences in Energy Market Incentives

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Central Case Results: Differences in Resource Mix and Utilization

System resources and energy evolve over time

- Policy and economic outcomes reflect the mix of resources arising under each approach and the use of resources given market incentives
- Policy approaches differ in terms of the resources that emerge and how they are used, reflecting a combination of factors and interactions
  - In the Status Quo, the absence of energy market incentives for clean energy reduces incentives for storage, leading to greater reliance on gas-fired capacity for resource adequacy and higher market curtailments of renewable resource supply
  - Net Carbon Pricing drives a more efficient mix of resources relative to FCEM by accounting for carbon-intensity of generation, rather than only rewarding clean energy (irrespective of the carbon-intensity of displaced energy)
  - FCEM creates energy market incentives for storage resources (even without rewarding storage with clean energy credits), but creates some inefficiencies by failing to account for carbon-intensity and through “pumping” of negative-LMP energy

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Central Case Results: Differences in Resource Mix and Utilization

System resources and energy evolve over time

- Hybrid approach blends tradeoffs between Net Carbon Pricing and FCEM
  - Under Hybrid approach, sensitivity of LMPs to a new-resource FCEM may create challenges for setting carbon price to reliably cover existing clean energy costs

- Differences in payments can affect market participation
  - Status Quo and Hybrid approaches result in differential payments to resources that provide otherwise similar services; potential consequences for resource retention and participation in ISO-NE markets

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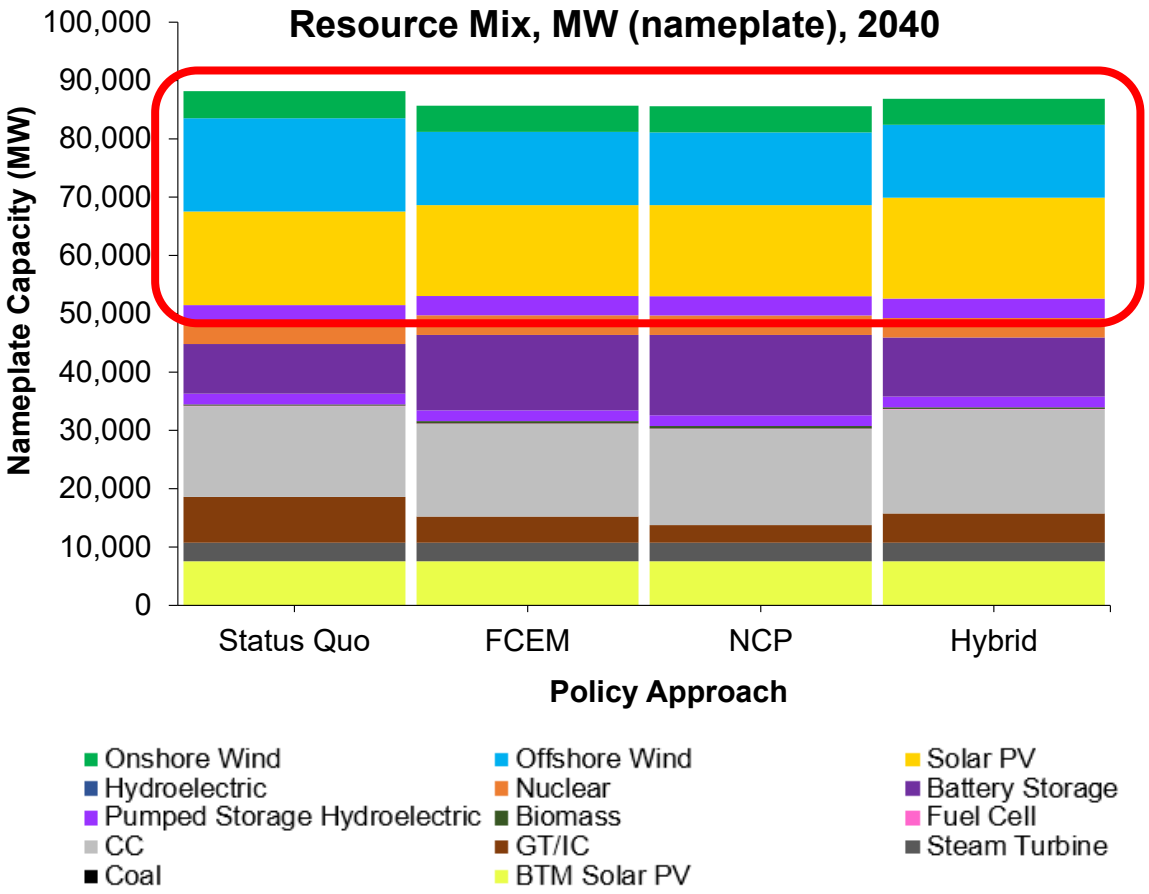
Central Case Results: Resources Mix

Policy approach affects renewable resource mix



- Renewable resource mix similar across approaches
  - Analysis assumes least-cost projects developed for each technology type (as defined by policy approach)
  - Total quantity of resources varies reflecting economic curtailments given battery storage incented by policy approach
  - Mix of technologies is roughly proportional across approaches, with differences reflecting resource preferences (in Status Quo), storage resources incented by approach, and accounting for carbon-intensity (between FCEM and NCP)

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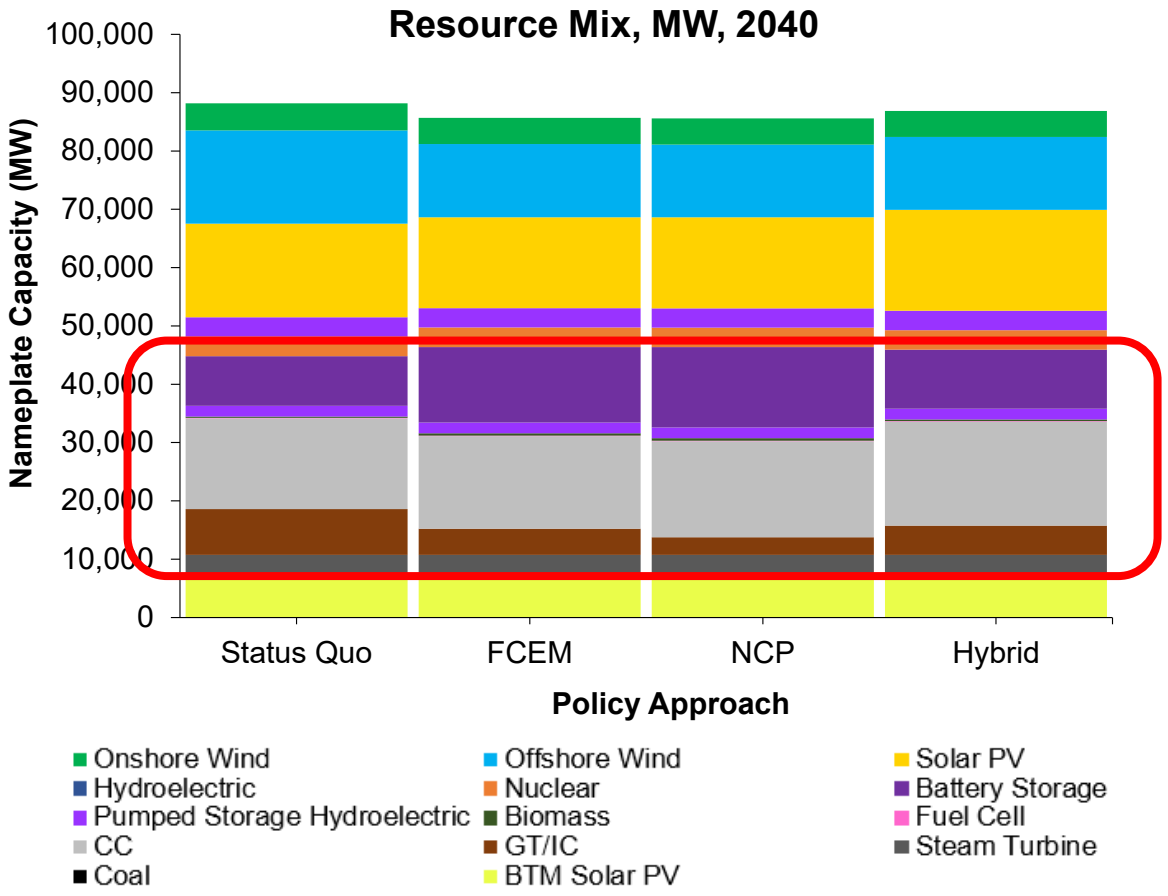
Central Case Results: Resources Mix

Policy approach affects dispatchable resource mix



- Dispatchable resources differ by policy approach depending on:
  - If the approach is sensitive to differences in emissions-intensity (true for Net Carbon Pricing, not for FCEM or Status Quo)
  - Incents storage capacity because environmental value is priced into EAS market (not the case for Status Quo) (more on this in subsequent slides)
- As a result, for example:
  - More CTs and less storage in Status Quo
  - More CCs (most efficient fossil unit) in Net Carbon Pricing

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Central Case Results: Prices

Prices vary widely across policy approaches

LMP, Environmental and Capacity Prices by Policy Approach, 2040

	SQ	FCEM	NCP	Hybrid
	[1]	[2]	[3]	[4]
Load-Weighted LMP ($/MWh)	19	10	106	39
Standard Deviation ($/MWh)	17	40	59	54
Maximum LMP ($/MWh)	63	63	249	116
Minimum LMP ($/MWh)	0	-75	0	-77
% Hours with $0 LMP	24%	0%	9%	1%
% Hours with Negative LMP	0%	26%	0%	22%

Note: All values are in $2020

Distribution of prices – levels, variation and range – differ widely across policy approaches:

- ***Average LMPs*** range from $10 to $106 / MWh due to differences in how environmental attribute is priced into energy markets
- ***Price variation*** (Std Dev, min/max) lower in Status Quo compared to market-based approaches
- Large fraction of zero or negative prices under all approaches, reflecting renewable build-out

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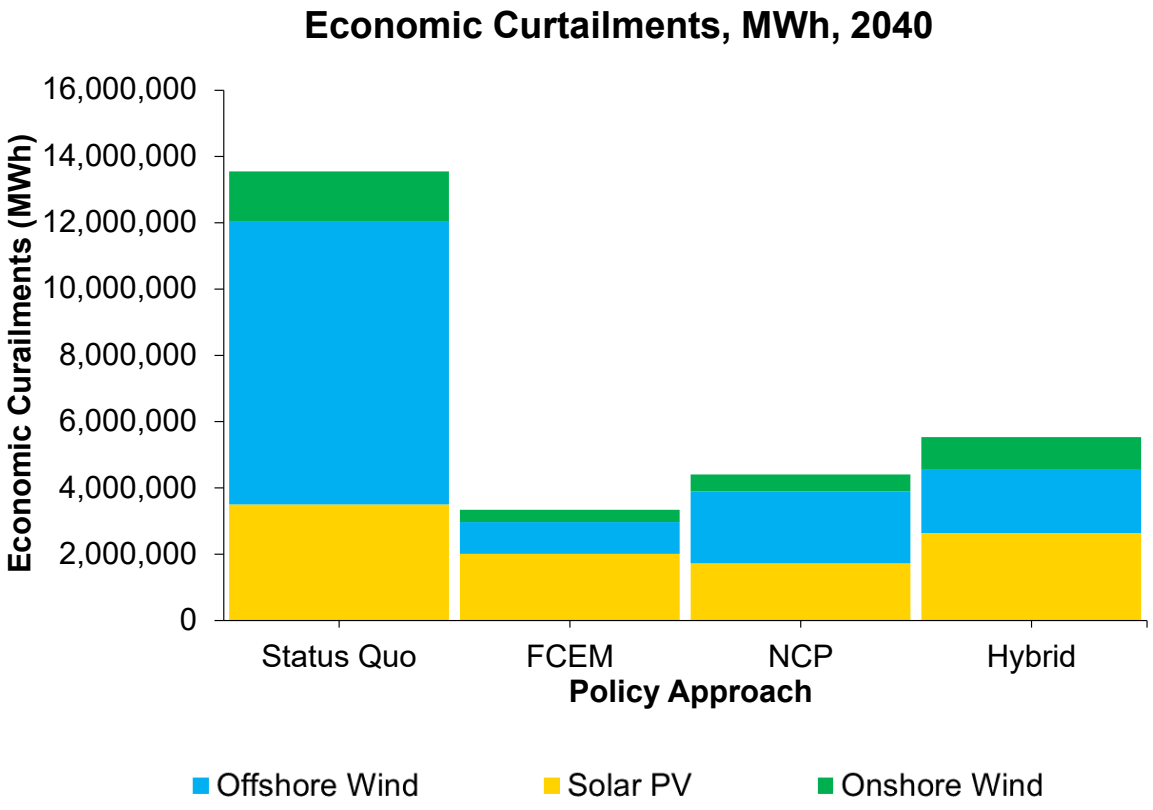
Central Case Results: Market Curtailments

Market curtailment of renewable energy varies across policy approach



- "Curtailments" reflect energy that does not clear the market given market-clearing prices
- The curtailments vary across cases depending on both storage capacity and energy market pricing
  - Market curtailments are highest in Status Quo because of lower storage capacity. With less storage, there is less capability to shift renewable supply from hours when it does not clear the market to hours when it will clear
  - Lower storage reflects diminished arbitrage opportunities given absence of pricing of environmental attributes (as discussed in following slides)

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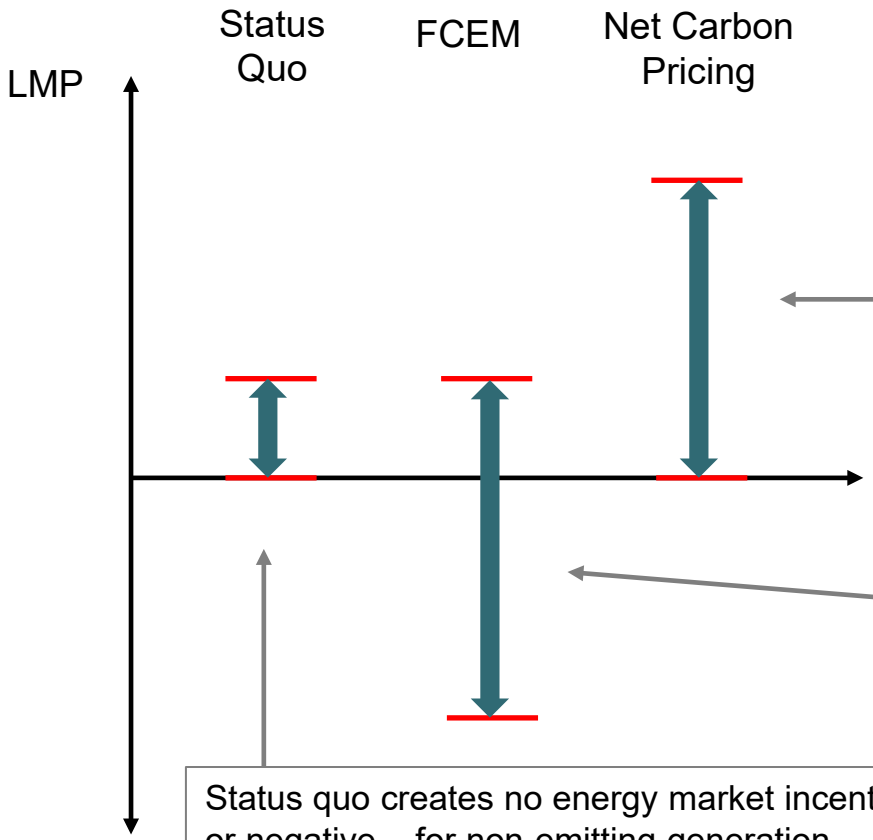
Incentives for Energy Storage Vary with Policy Approach

Energy market spreads larger with carbon pricing or CECs



Financial viability of storage resources depends on opportunities to arbitrage LMPs at different points in time

With Net Carbon Pricing, carbon price increases LMPs when gas-fired resources are price-setting because cost of carbon is included in offers
– provides a larger spread for storage resources to arbitrage

With FCEM, CEC values leads to negative LMPs when renewable resources are price-setting because they submit negative-priced offers due to CEC subsidy
– also, provides a larger spread for storage resources to arbitrage

Status quo creates no energy market incentives – positive or negative – for non-emitting generation

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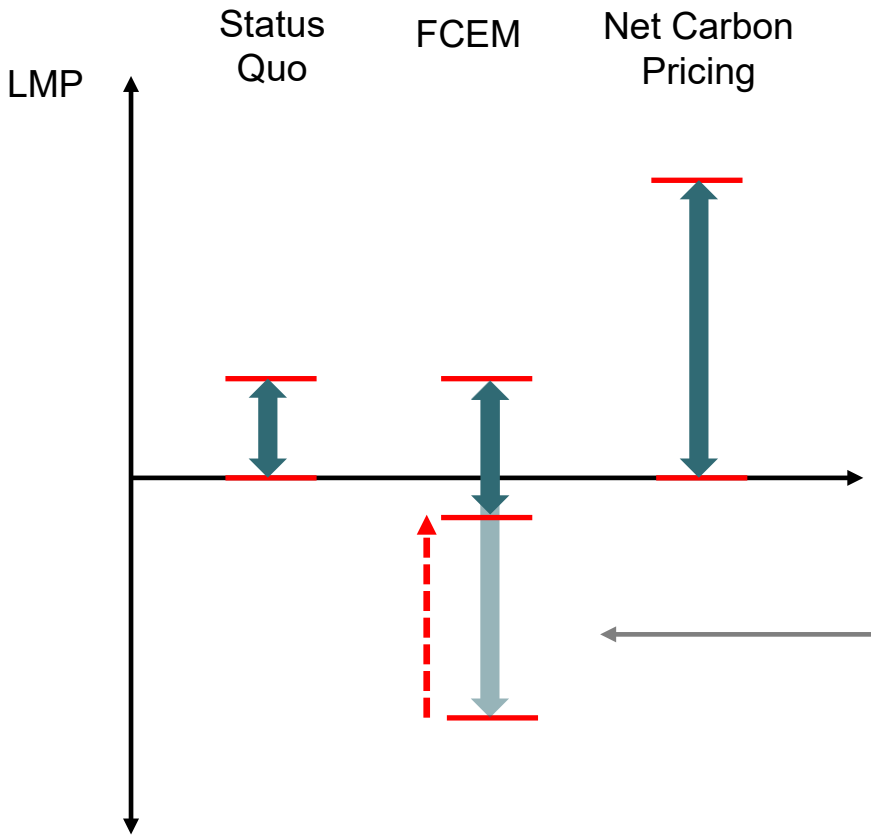
Incentives for Energy Storage Vary with Policy Approach

Negative pricing creates incentives for storage



Negative prices provide an opportunity for storage resources to earn money simply by charging and then discharging a smaller quantity due to energy loses:

- With negative prices, storage resource is ***paid*** to charge and ***pays*** to discharge
- Payments received for charging exceed payments made for discharging because a smaller quantity of energy is discharged than charged due to energy losses

Equilibrium negative prices are greater (less negative) due to this storage activity – that is, storage resource tends to reduce frequency of negative prices

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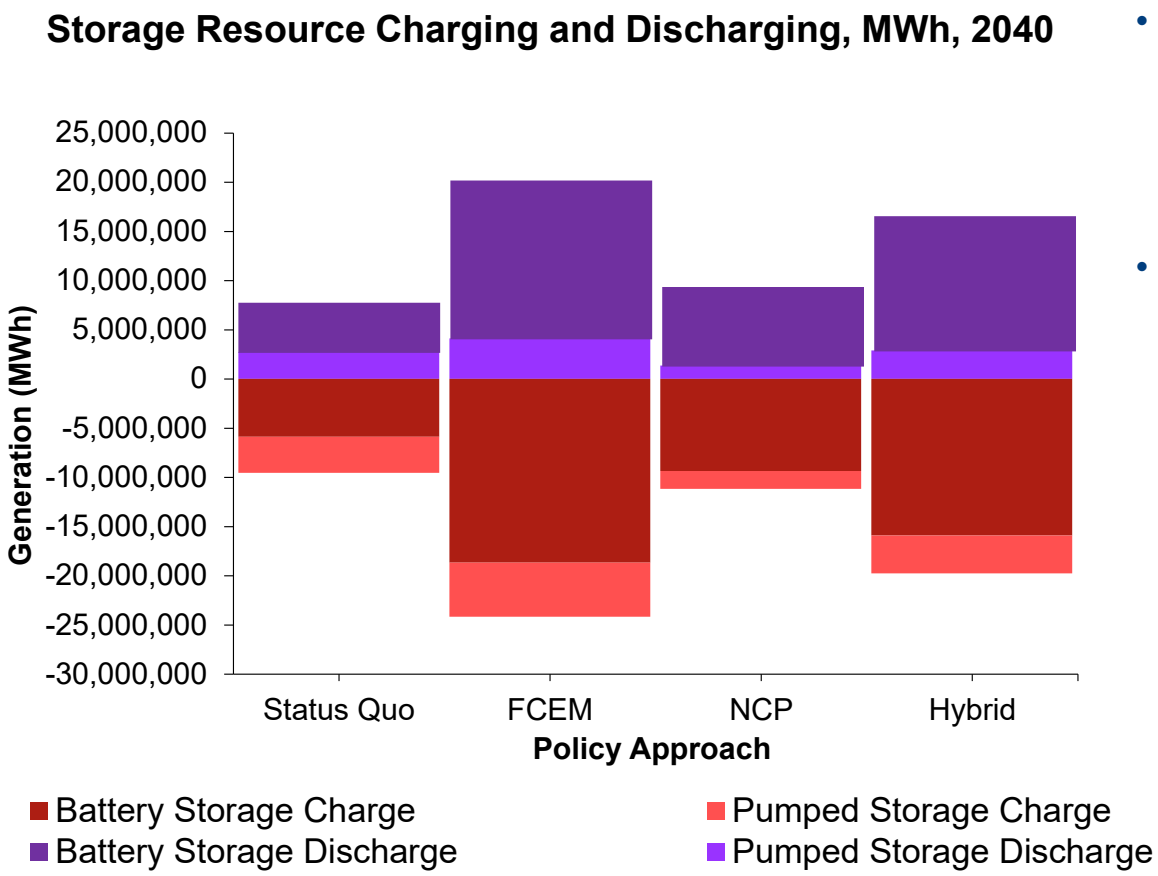
Central Case Results: Storage Charging/Discharging

Market incentives affect opportunities for storage



- Negative pricing with FCEM incents increased storage charging and discharging
- NCP provides large spread and opportunities for arbitrage, but fewer $0 hours than SQ.

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Comparison of Outcomes Under Alternative Policy Approaches: Costs and Payments

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Central Case Results: Costs and Payments

Status of Analysis of Costs and Payments

- Presentation today includes estimated total costs of each approach

- Analysis of payments is on-going but not yet complete
  - Results will be included in the December presentation and the report
  - Analysis of payments is complex given the need to determine terms of future PPAs (entered into at different points in time), compensation to existing resources in the market (e.g., nuclear plants), outcomes of others ISO-NE markets (e.g., FCM), etc.

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Central Case Results: Differences in Costs

Economic outcomes reflect efficiencies in achieving carbon target

- Economic outcomes reflect the mix of resources arising under each approach and the use of resources given market incentives
- Important differences in prices, costs and payments emerge because of a combination of factors affecting quantity, type and utilization of resources under each policy approach
  - In the Status Quo, costs reflect mix of resources assumed under state policies, the absence of energy market incentives for clean energy or carbon reduction, and the greater quantity of renewable resources required given the diminished incentives for storage
  - Net Carbon Pricing drives more efficient resources investment and operation, producing the lowest social costs
  - FCEM costs are slightly higher than Net Carbon Pricing because of increased resource investment because of less-efficient price signals to incent optimal storage development and use, investment in less efficient gas-fired generation, and a less-efficient mix of renewable resources
  - Hybrid approach blends tradeoffs between Net Carbon Pricing and FCEM

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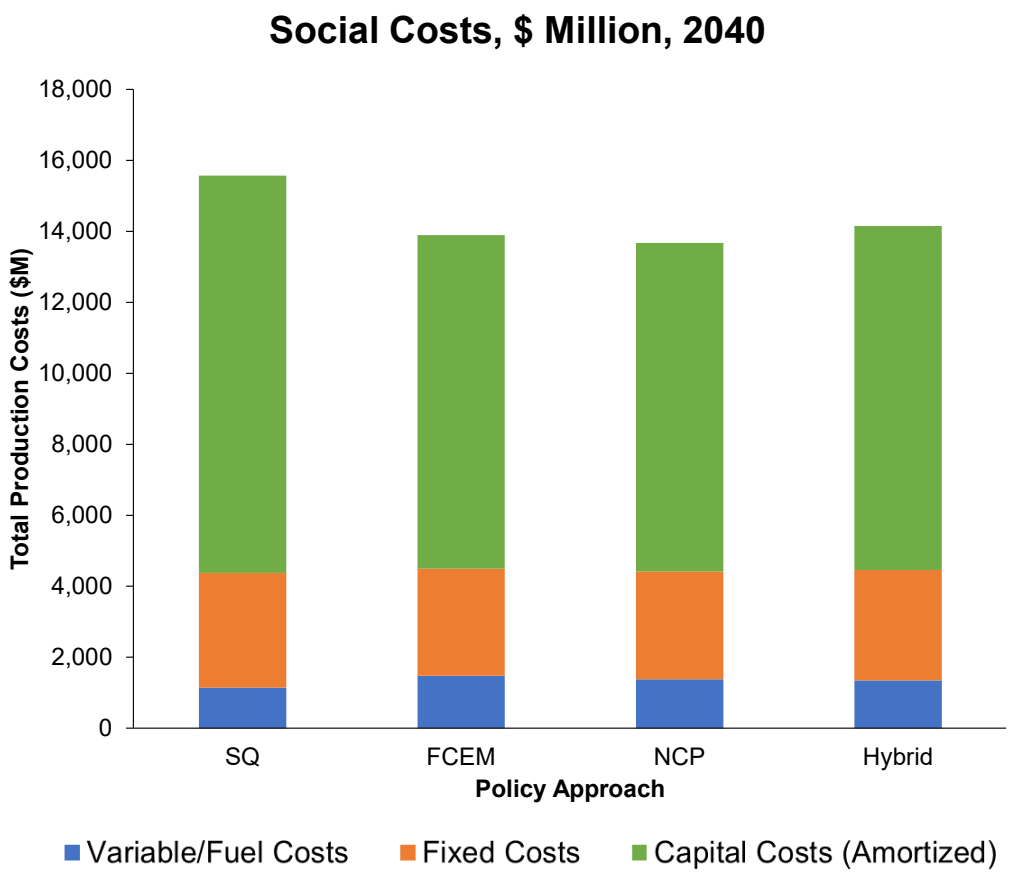
Central Case Results: Social Costs

Social costs similar between FCEM and NCP, higher for Status Quo



- Social costs reflect gains to producers and consumers (i.e., consumer and producer surplus)
- Analysis measures social cost as production costs including fuel, variable O&M, fixed O&M, and (amortized) capital costs
  - Social costs are highest for Status Quo
  - Costs are lowest for NCP, and similar but somewhat higher for FCEM and Hybrid
  - Cost differences reflect a combination of factors, particularly the differences in energy market incentives for each approach
  - All approaches include the least-cost resources, subject to different constraints
- Analysis does not account for all expected effects (e.g., changes in demand given differences in marginal prices)

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Central Case Results: Prices

Prices vary widely across policy approaches

LMP, Environmental and Capacity Prices by Policy Approach, 2040

	SQ	FCEM	NCP	Hybrid
	[1]	[2]	[3]	[4]
LMP ($/MWh)				
Load-Weighted LMP	19	10	106	39
Environmental Attributes				
Clean Energy Credit ($/MWh)		75		76
Carbon Price ($/MT)			280	101

Note: All values are in $2020

LMPs and prices for environmental attributes vary across cases

- *Results are preliminary*
- LMPs vary due to impact of CEC revenues and carbon prices on resource offers
- Prices are an element of the estimated payments

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Central Case Results: Differences in Payments to Resources

Results to be presented in future meetings

- Future presentations and the report will include comparisons of differences in payments
  - Results will include total payments, payments by state, and payments to different types of resources
  - Differences across approaches will reflect the different ways in which clean resources are incented (Status Quo PPA's versus in-market compensation) and the different market prices providing in-market compensation
  - Assessment will also include qualitative assessment of other differences between approaches with consequences for payments to customers
- Compensation will differ by states depending on state-level targets/contributions

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Central Case Results: Differences in Payments to Resources

Approaches differ in compensation to similarly situated resources

- The NCP and FCEM provide uniform compensation and impose costs uniformly across resources
  - FCEM provides resources generating clean energy with CECs
  - NCP imposes same carbon price on carbon-emitting resources
- Status Quo and Hybrid provide compensation that differs across resources
  - Status Quo offers PPA contracts for new resources, but no other compensation mechanism for existing resources other than energy and capacity market
    - Absent other arrangements, this compensation scheme would be expected to cause, to some degree, resources to retire early and/or sell energy in other markets (e.g., NYISO)
  - Hybrid offers differential compensation to new and existing resources providing otherwise identical services
- Future presentations and the report will include comparisons of differences in compensation

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Proposed Set of Scenarios

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Scenarios

- As discussed previously, assumptions different from those in the central case are being evaluated quantitatively through alternative scenarios, to the extent feasible
- The list of scenarios presented today reflects our current thinking and review of all submitted feedback and stakeholder discussion to date, plus the removal of some scenarios given the addition of the hybrid approach
  - We look forward to stakeholder feedback on this proposed list of scenarios, particularly in light of these changes and preliminary central case results being presented today
- We appreciate all the feedback, discussion, and continued interaction from stakeholders to date

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Potential Quantitative Scenarios

- Preliminary results to be provided in 2021
  - Across approaches:
    - Alternative regional carbon target
    - Alternative levelized costs of new entry for renewable resources
    - Alternative distribution of costs amongst states
    - Additional retirements
  - Status Quo
    - Alternative costs of long-term renewable contract procurement
- Preliminary results to be provided in 2022
  - Across approaches
    - Inclusion of basic transmission congestion (to support qualitative assessment of approach differences)
  - Hybrid
    - Alternative carbon price levels

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Next Steps

- December
  - Present updates to central cases, if any, based on stakeholder feedback and on-going research
  - Present initial set of scenario results, and take feedback on scenario results

- Next Steps
  - Present draft report with central case and updated scenario results
  - Take feedback on additional scenario results and draft report
  - Present on final report

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Contact

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Appendix

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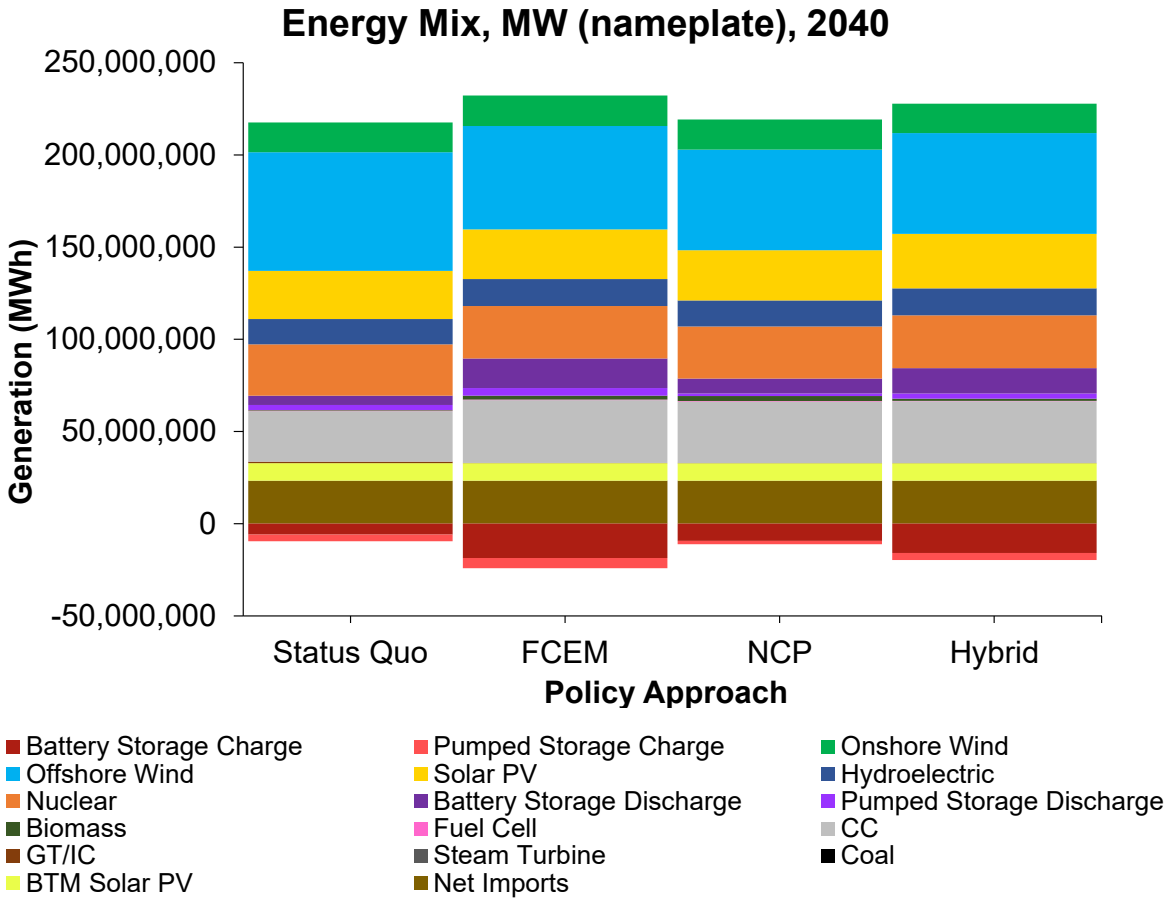
Central Case Results: Generation Quantities

Generation mix reflects a variety of factors



Energy mix varies across policy approaches

- Total generation highest in FCEM and Hybrid due higher storage utilization; lower generation in Status Quo and NCP due to lower storage utilization
- Smaller differences in other resource use given market incentives (e.g., CCs, biomass)

EVERSOURCE ENERGY

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Westwood, MA 02090
781-441-8258

October 18, 2021

Dear NEPOOL Participants and Stakeholders,

During the September 23, 2021 Pathways to the Future Grid working session, National Grid requested that the Analysis Group study a scenario that compares the costs of an offshore wind (OSW) transmission system versus the costs of OSW projects with individual generator lead lines.

Eversource does not support this request for the following reasons:

- First, comparing the costs of various transmission configurations will not affect the results. According to Analysis Group's September 23 presentation, "Because resource siting and transmission upgrade cost modeling assumptions will be the same in all central cases, differences in the level of costs (potentially higher or lower than the true cost) will tend to have comparable effects on each approach." The central cases are designed to compare differences in outcomes between alternative market-based approaches to decarbonizing the power sector. Comparing costs of different transmission configurations does not provide information related to different market-based approaches for decarbonizing the resource mix. The consultant specializes in economic analysis and would likely need support from transmission engineers to develop transmission cost estimates that would then become assumptions in the analysis. This additional work, while providing little additional information germane to the analysis, would further increase the time associated with its completion. Stakeholders eagerly await the results of the analysis as an input into subsequent discussion of market design and potential reform considerations.

- Second, this request is beyond the scope of the Pathways study. Determining the relative costs of a potential OSW transmission system versus the costs of individual generator lead lines with a reasonable degree of accuracy would require a detailed engineering study and an assessment of the business and timing risks that each approach could impose on OSW generation. To the extent that the costs of transmission facilities for OSW are expected to have a material impact on the study results, Eversource suggests using a high-level range of potential costs rather than expanding the scope of the Pathways effort.

- Finally, Eversource believes that this request will add further delay to an already extensive process. In 2020, the Massachusetts Department of Energy Resources (DOER) held an Offshore Wind Transmission Technical Conference, which was sandwiched around two sets of Offshore Wind Transmission Stakeholder Q&A's and represents a significant amount of perspectives immediately available to stakeholders. As mentioned above, stakeholders are eagerly awaiting

the results of the analysis as in input to time-sensitive market design and potential reform proposals.

Thank you for the opportunity to comment and we look forward to continuing to work on this important initiative for New England market participants and stakeholders.

Sincerely,

James Daly
Vice President Energy Supply