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Pathways Study

Evaluation of Pathways to a Future Grid

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December 6, 2021

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Overview

- Purpose of today's presentation is to continue to provide preliminary results of the quantitative analysis of the Pathways Study
  - Pathways Study is evaluating alternative policy approaches to decarbonizing the New England Grid
  - Four approaches: Status Quo (SQ), Forward Clean Energy Market (FCEM), Net Carbon Pricing (NCP), and Hybrid
- We will summarize updates to Central Case results and findings:
  - Overview of changes to approach and results due to a change to modeling inputs based on stakeholder feedback at the prior meeting
  - Additional results on production costs and customer payments
- In addition, we will summarize preliminary results of scenario analysis that tests the sensitivity of the central case results to a change in a key input assumption:
  - More stringent decarbonization target
  - Alternative capital costs
  - Additional retirements
  - Alternative allocation of costs across states

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Summary of Key *Preliminary* Modeling Results

Preliminary findings regarding policy approaches include:

- Approaches vary in the incentives created to achieve decarbonization targets, with differences affecting competitiveness of energy storage and more efficient fossil resources, and, in turn, economic curtailment of variable renewables
- Social cost is lowest with Net Carbon Pricing, slightly higher for the FCEM and Hybrid Approach, and notably higher for the Status Quo
- Customer Payments are similar across all policy approaches, but potentially higher under the Status Quo. Difference in total payment outcomes can arise due to several factors – for example:
  - Some policy approaches pay different amounts for clean energy "services" to different types of resources (e.g., paying nuclear or existing renewables less than new renewables)
  - Some policy approaches depend on assumptions regarding the resource mix
- Preliminary scenario results change magnitude of results, but not the general findings (although our assessment continues as we refine and further review results)

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Agenda

- Central Case
  - Updated results
  - Adjustments due to and responses to stakeholder comments
  - Costs, payments and prices
- *Preliminary* Scenario Results
  - More stringent decarbonization target (forthcoming)
  - Alternative capital costs
  - Additional retirements scenario
  - Alternative allocation of costs across states
- Appendix: Additional central case and scenario results

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Updated Central Case Results

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Updated Central Case Results

- Central case analysis have been updated
  - Primary change is allowing resources with out-of-market PPAs to submit negative priced offers
  - Other minor changes
- Responses to stakeholder questions regarding preliminary results provided in October
  - Interpretations of the hybrid case results
  - Differences in variable costs across cases
  - These will be addressed in the course of discussing the results
- Payments and prices
  - Preliminary results presented in October did not include payments and prices

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Contracted Resources and Negative Price Offers

- Certain resources in the ISO-NE fleet have out-of-market PPA contracts for the purchase of electricity
  - All cases assume certain resource PPAs through baseline state policies
  - The Status Quo case includes incremental PPAs sufficient to achieve decarbonization targets
- Results presented in October assumed that these contracted resources would not offer their energy at a price below $0
- Further review of contracts indicates that contracted resources have an incentive to offer energy at the negative of their PPA price
  - Contracts include a “clawback” provision that reduces compensation under the PPA when LMPs are below zero by an amount equal to the negative of the market clearing LMP
  - For example, if the PPA price is $50/MWh and LMP = -$20/MWh, then the resource earns $30/MWh (i.e.., $50/MWh + (-$20/MWh))
  - In this case, the resource continues to earn positive revenues for energy market offers as low as the negative of its PPA price, when it earns $0 per MWh
  - Because variable renewables have variable costs (approximately) equal to $0/MWh, the updated central cases now assume that they offer energy at the negative of their PPA price (i.e., -$50/MWh in the example above)

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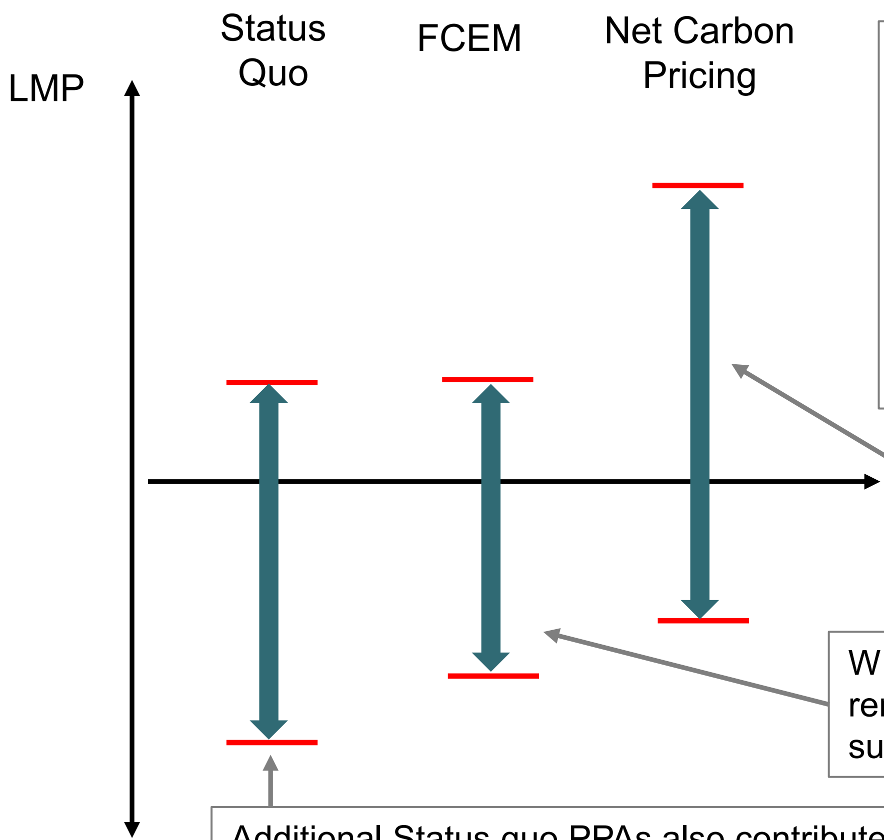
Incentives for Energy Storage Vary with Policy Approach

Energy market spreads vary with offer incentives (*figure illustrative*)



- Storage resource financial viability depends on opportunities arbitrage large LMP price spreads
- Spreads depend on differences in pricing when market clears at higher-price fossil resources and lower-priced renewables
- All approaches include some negative priced energy from baseline state policy renewables with PPAs

With Net Carbon Pricing, carbon price increases LMPs when fossil resources are price-setting because cost of carbon is included in offers

With FCEM, CEC value leads to negative LMPs when renewable resources are price-setting because they submit negative-priced offers to earn CEC subsidy

Additional Status quo PPAs also contributes to negative prices from negative-priced offers from resources with PPAs

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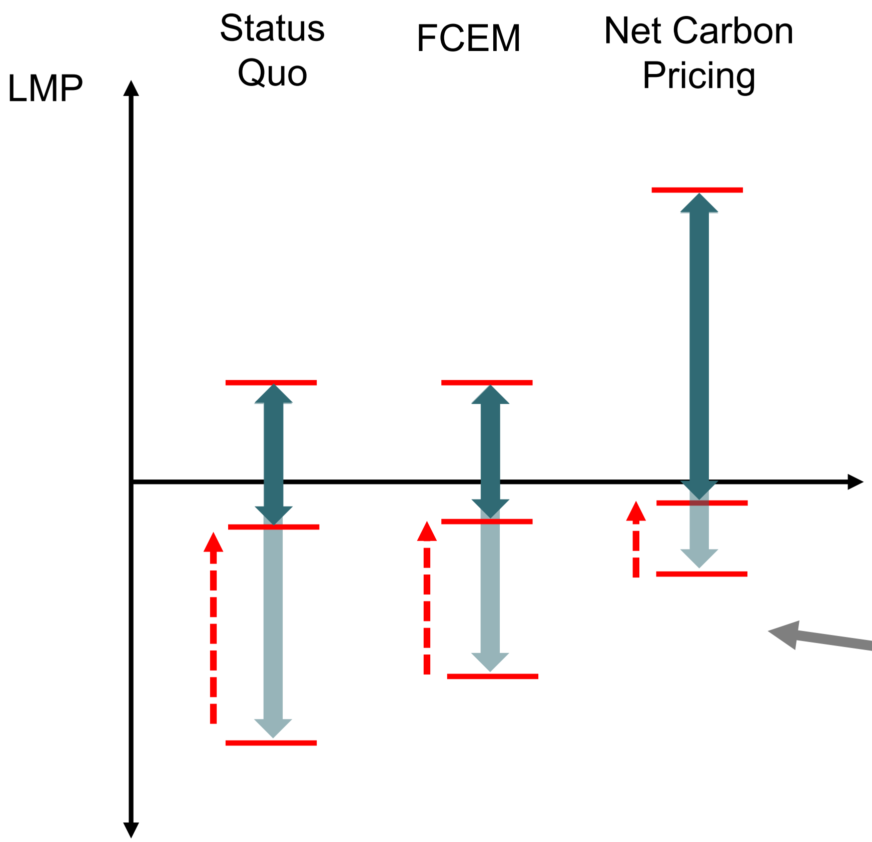
Incentives for Energy Storage Vary with Policy Approach

Negative pricing creates additional 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 the magnitude of negative prices

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Contracted Resources and Negative-Priced Offers

- This assumption affects results for all cases, but especially the Status Quo – compared to results reported in October:
  - Negative LMPs when market clears at renewable resources
  - Larger price spreads in all cases, which increases incentives for energy storage resources
    - Increased battery storage capacity
    - Decreased capacity from fossil resources, as increased battery storage capacity helps meet resource adequacy
  - Lower LMPs lead to an increase in capacity, CEC and carbon prices

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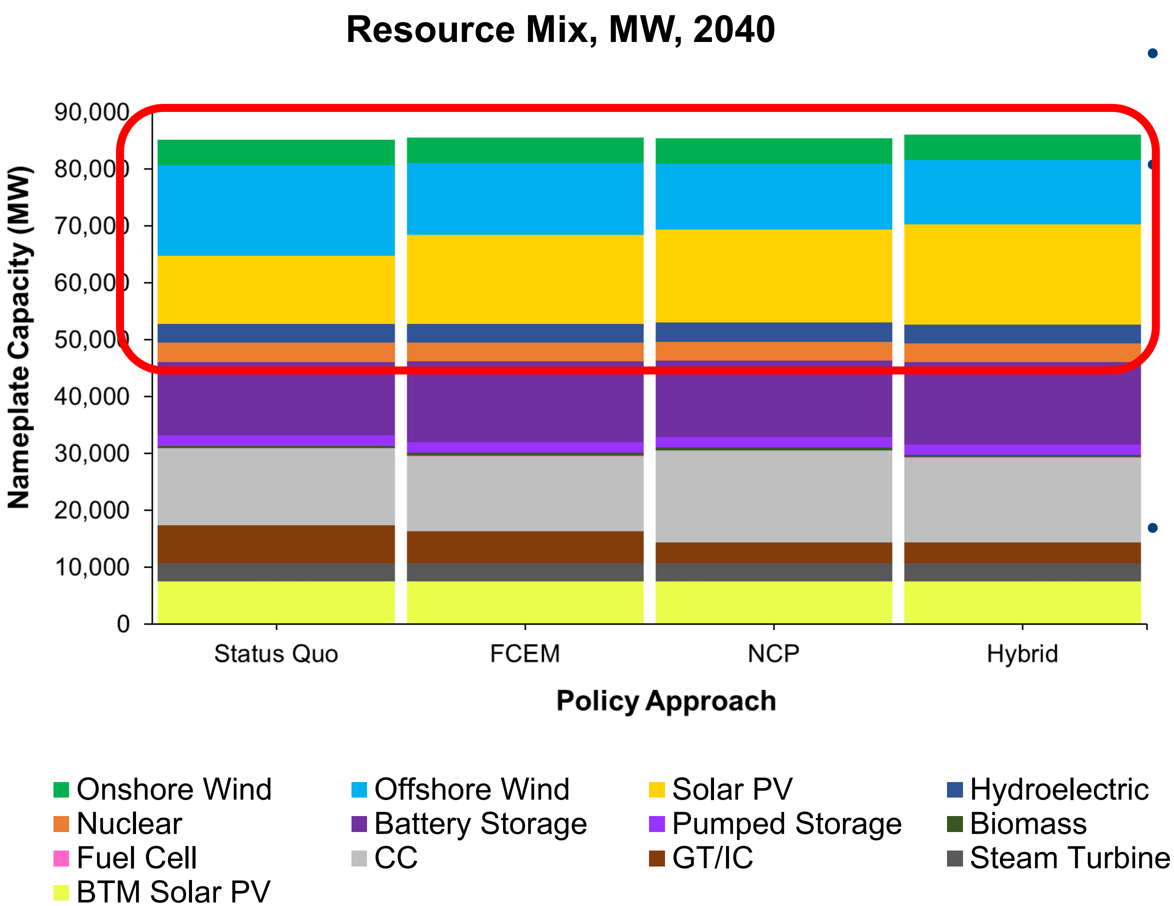
Central Case Results: Capacity Mix by Policy Approach

Policy approach affects renewable resource mix



- Renewable mix varies across approaches
- Balance of offshore wind and solar PV varies across cases – Status Quo has largest share of offshore wind, while Hybrid approach has the lowest share
- Onshore wind equal across cases

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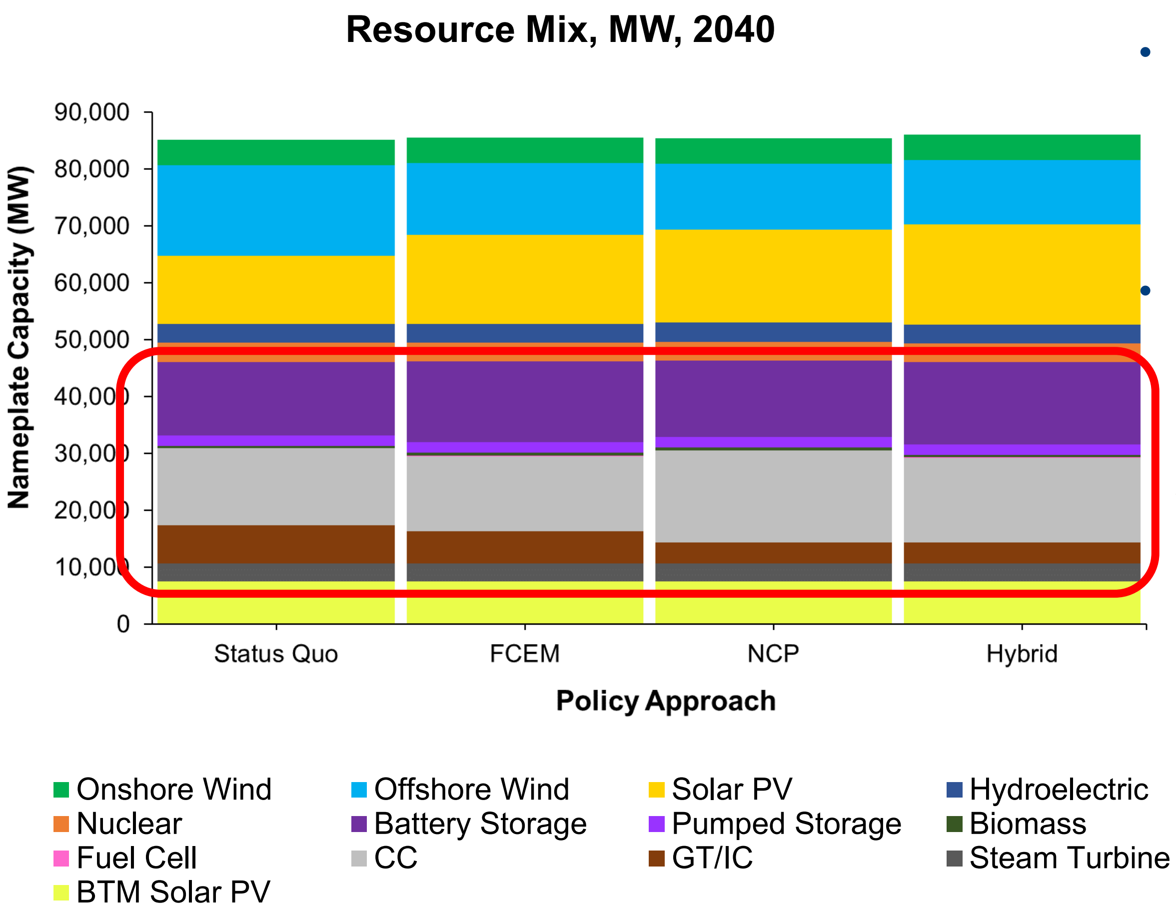
Central Case Results: Resources Mix Changes

Policy approach affects dispatchable resource mix



- SQ battery storage capacity similar across approaches – highest in FCEM, and lowest in Status Quo
- Fossil-fuel mix reflects incentives for fossil fuel efficiency across approaches
    - Hybrid and NCP are sensitive to emissions intensity, thus have more CCs while Status Quo and FCEM have more GT

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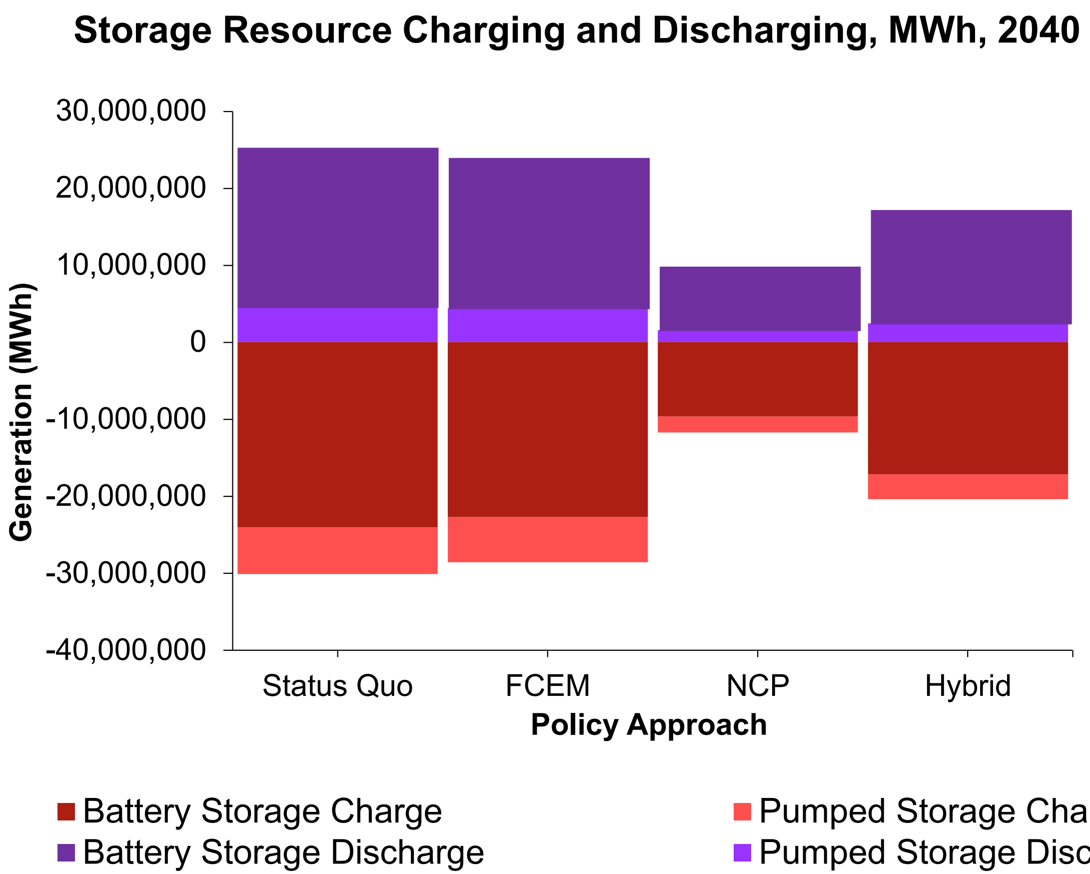
Central Case Results: Storage Charging/Discharging

Market incentives affect opportunities for storage



- Higher frequency of negative pricing with Status Quo and FCEM incents comparatively higher level of storage charging and discharging
- Lower frequency of energy storage utilization in NCP because of fewer hours with negatively charged pricing

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Costs and Prices

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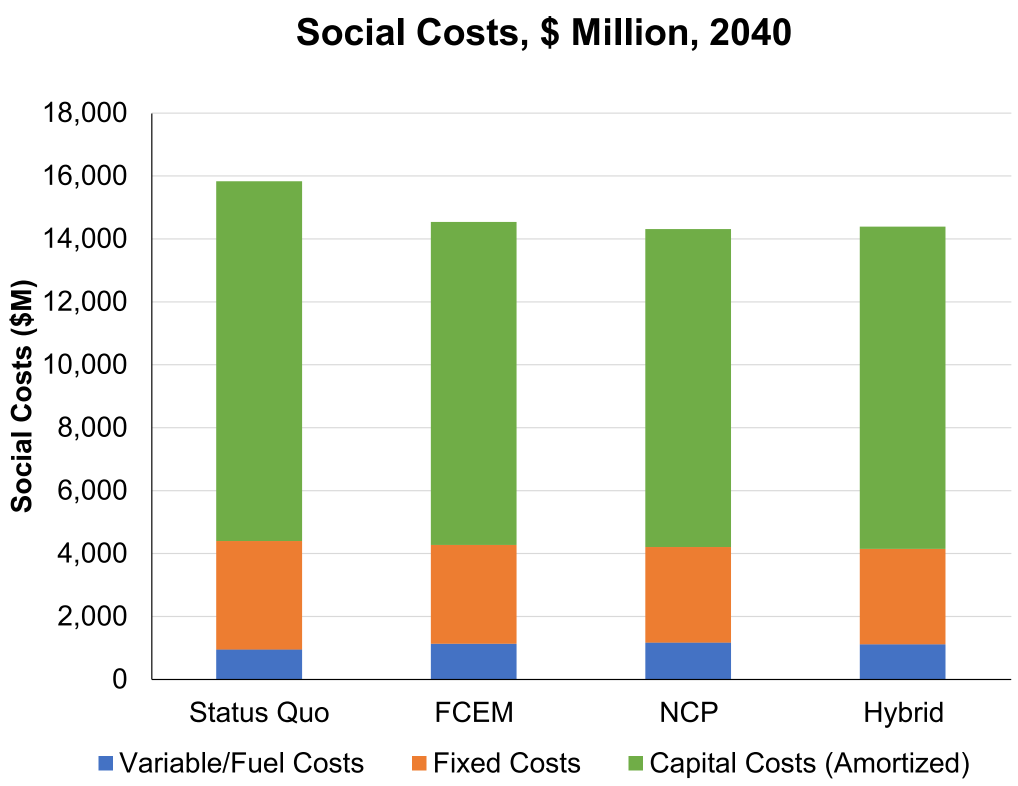
Central Case Results: Social Costs

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



- In the electricity sector, social costs include production costs associated with 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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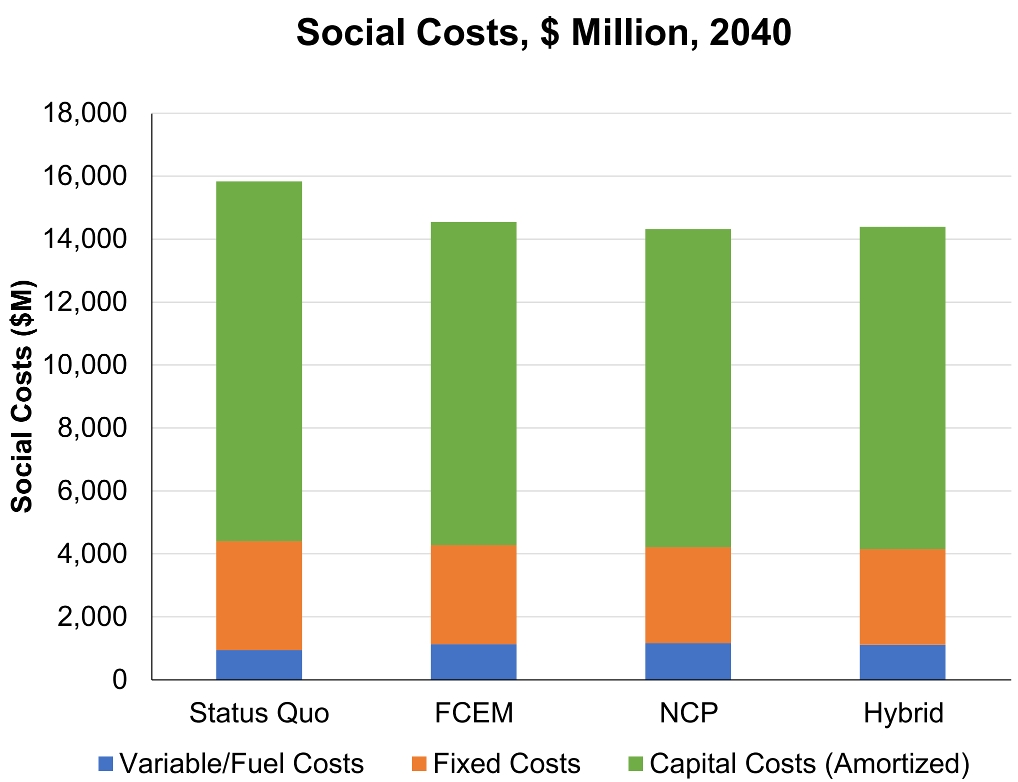
Central Case Results: Social Costs

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



Question from October:

- Why does Status Quo have lower variable/fuel costs compared to other cases?

Answer:

- The Status Quo has less fossil-fired generation and more renewable and battery generation relative to the other cases

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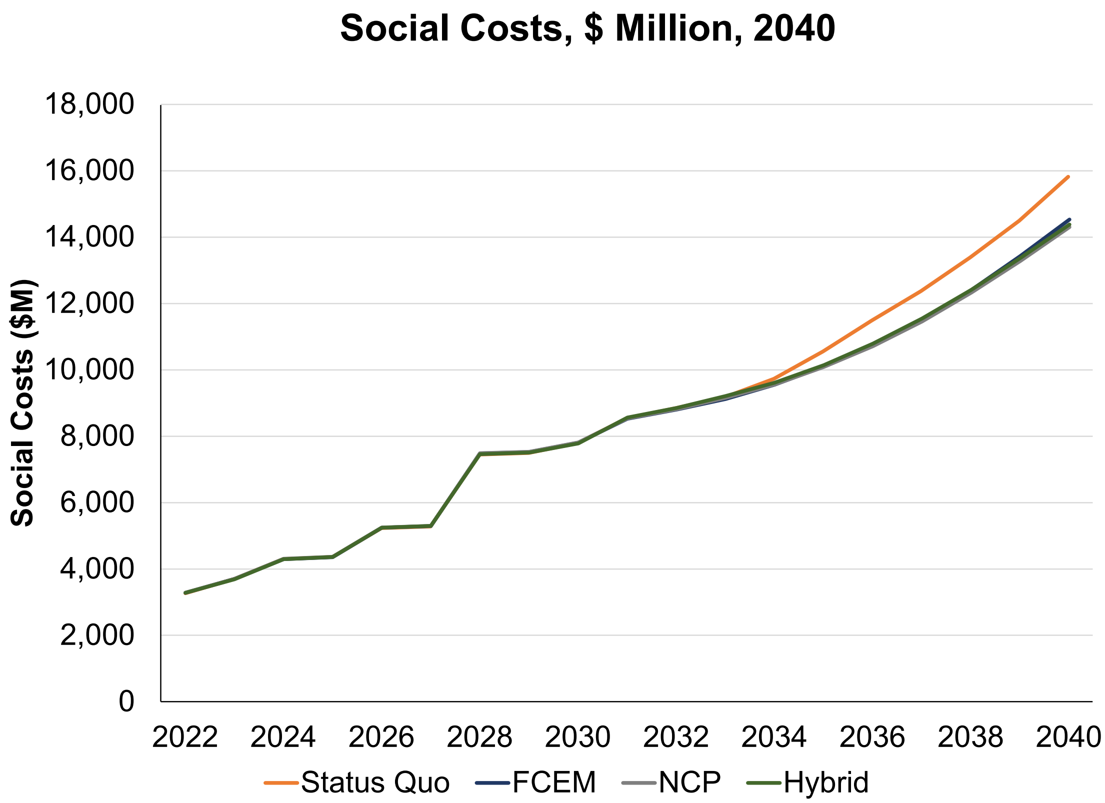
Social Costs over time

Status Quo is most expensive



Note: All values are in $2020

- Social costs are lowest for Net Carbon Pricing and slightly higher for FCEM and Hybrid Approach; costs are highest for the Status Quo
  - Results are consistent with economic theory of relative cost among centralized approaches
  - Status Quo may achieve decarbonization targets less cost-effectively
- Difference between status quo and the other approaches is large and grows over time
  - Cost differences reflect a combination of factors, particularly the differences in energy market incentives for each approach and resource mix chosen in Status Quo

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Central Case Results: Prices

Prices vary widely across policy approaches

LMP Prices by Policy Approach, 2040

	SQ	FCEM	NCP	Hybrid
	[1]	[2]	[3]	[4]
LMP ($/MWh)				
Load-Weighted LMP	-7	1	109	54
Standard Deviation	54	50	60	42
Maximum LMP	68	296	407	180
Minimum LMP	-100	-102	-17	-48
% Hours with $0 LMP	0%	0%	7%	1%
% Hours with Negative LMP	33%	30%	1%	16%

Note: All values are in $2020

Energy prices (LMPs) range across cases

- ***Average LMPs*** range from $-7 to $109 / MWh due to differences in how environmental attribute is priced into energy markets
- Larger fraction of zero or negative prices, reflecting renewable build-out
  - Larger quantity of resources bidding in negative-priced offers compared to prior results

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Central Case Results: Prices

Prices vary widely across policy approaches

LMP and Environmental Prices by Policy Approach, 2040

	SQ	FCEM	NCP	Hybrid
	[1]	[2]	[3]	[4]
LMP ($/MWh)				
Load-Weighted LMP	-7	1	109	54
Environmental Attributes				
Clean Energy Credit ($/MWh)		108		47
Carbon Price ($/MT)			298	117

Note: All values are in $2020

LMPs and prices for environmental attributes vary across cases

- With NCP, higher LMPs because carbon prices included in offers
- With FCEM and Status Quo, CEC value and PPA prices cause negative-priced offers, reducing LMPs
- Hybrid Approach leads to intermediate LMPs, due to CEC subsidy (which lowers LMPs) and carbon prices (which raises LMPs)

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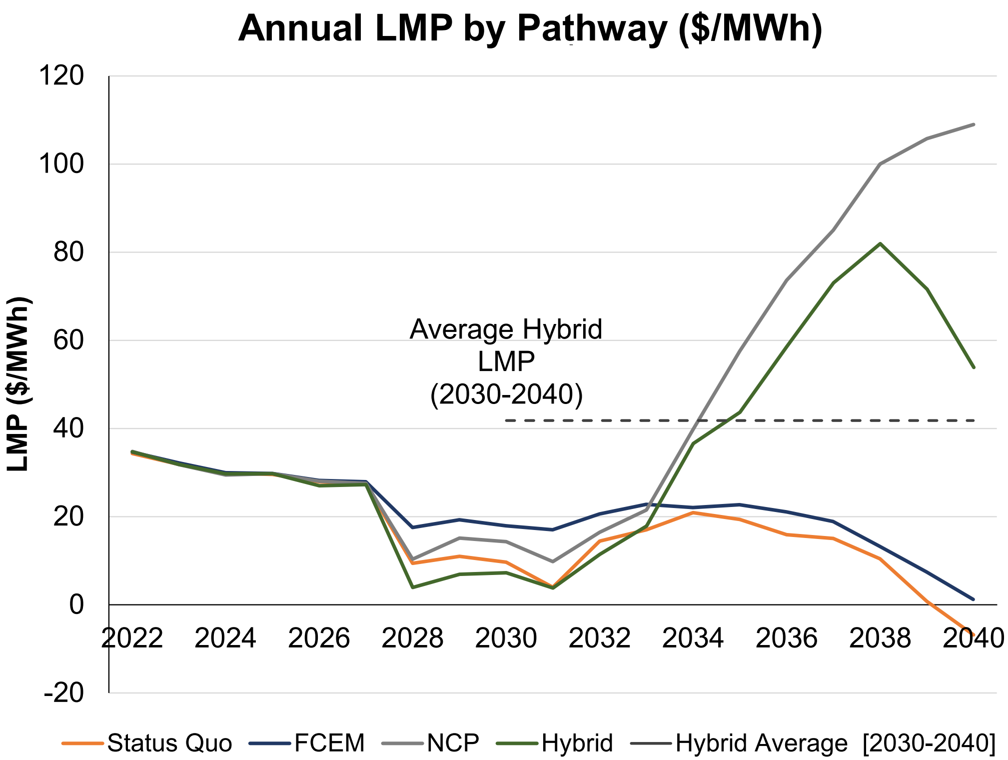
Central Case Results: Prices Over Time

Prices vary widely across policy approaches



Difference in LMPs among the approaches grows over time

- Differences become apparent starting in the late 2020s, as the resource mix is impacted by different responses to anticipated environmental constraints
- When the environmental prices begin to bind, LMPs begin to diverge more dramatically
- Hybrid LMP is ~$41 on average starting in 2030 (relevant as benchmark compensation for existing clean energy resources)

Note: All values are in $2020

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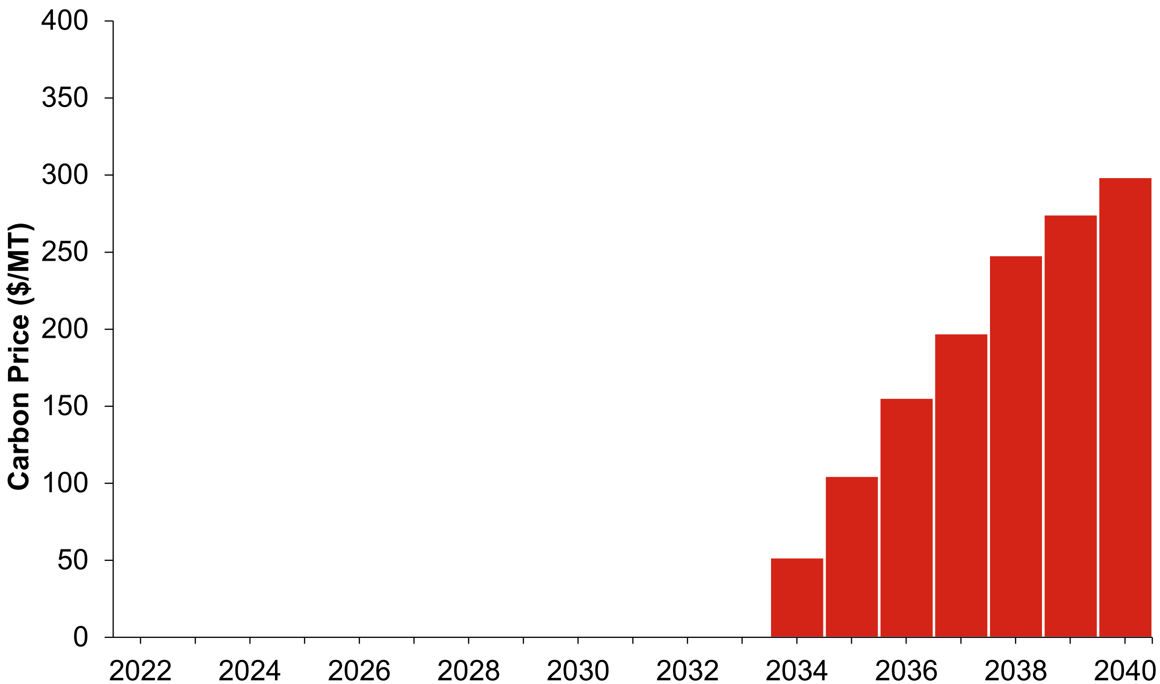
Central Case Results: Carbon Prices Over Time

Carbon prices grow with increasing target stringency

Carbon Price ($ per Metric Ton of CO_2)



Note: All values are in $2020

- Assumed baseline state clean energy polices produce sufficient reductions to meet decarbonization targets through 2033
- Carbon prices reflect the cost of marginal abatement in each year
  - Increases in emission target, load, and cost of new entry lead to increases in carbon prices
- Allowance banking would flatten carbon prices – higher in earlier years, lower in later years

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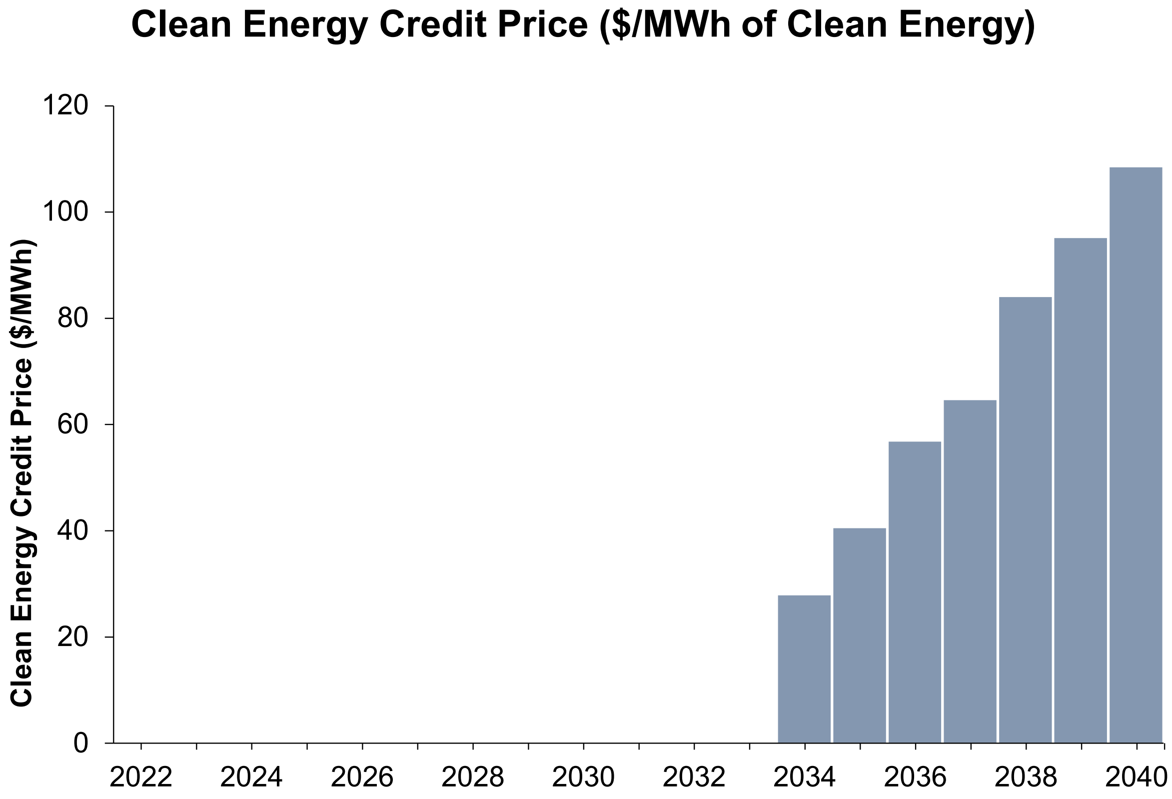
Central Case Results: CEC Prices Over Time

CEC prices grow with increasing target stringency



- Assumed baseline state clean energy polices produce sufficient reductions to meet decarbonization targets through 2033
- CEC prices reflect marginal cost of new clean energy entry
  - Increases in emission target, load, and cost of new entry lead to increases in CEC prices
- CEC banking would flatten CEC prices – higher in earlier years, lower in later years

Note: All values are in $2020

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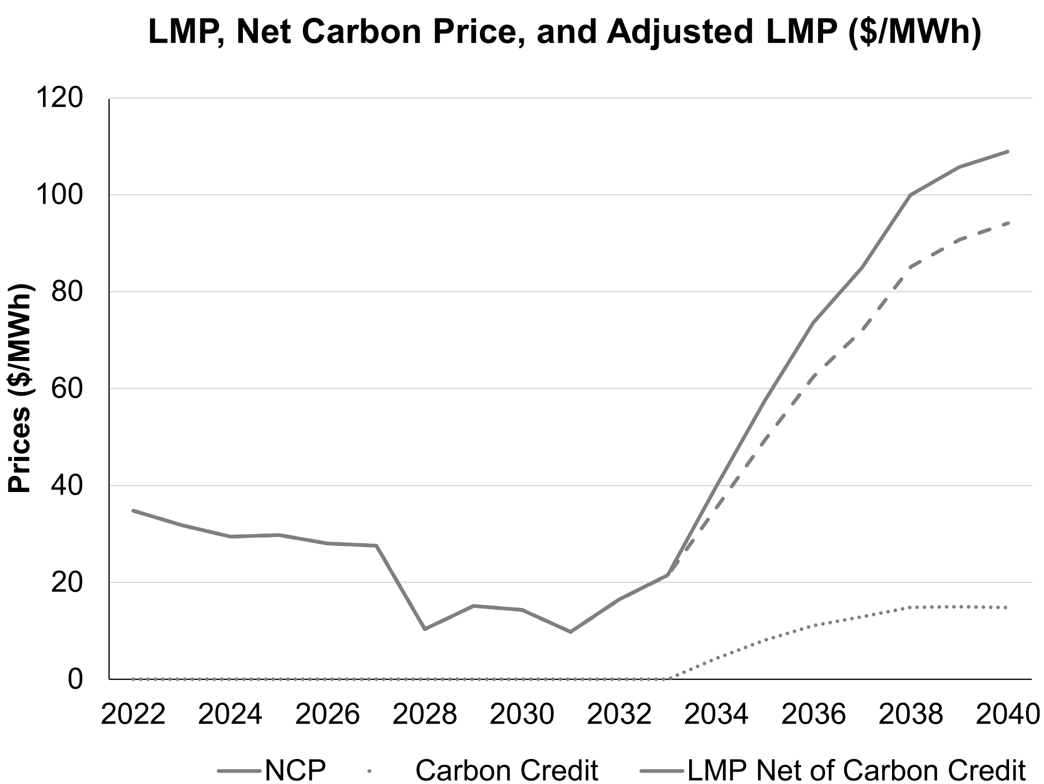
Central Case Results: Net Carbon Price

Credit of carbon prices lowers effective LMP charged to customers



Note: All values are in $2020

- The carbon price does not take into account that the revenues are rebated to load
- LMPs include the impact of carbon taxes on marginal price-setting fossil resources
- The "carbon credit" reflects the impact of carbon credit provided to customers in terms of reducing LMPs
  - In 2040, this is $15/MWh
- The "LMP Net of Carbon Credit", the net energy market price to consumers, reflects the difference between observed LMP and the net carbon price (dashed line)

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Takebacks on the Preliminary Hybrid Results

- At the October meeting, questions were asked about interpretations of the preliminary results for the Hybrid Approach
  - Updated results show that Hybrid Approach outcomes are generally in between (or similar to) FCEM and Net Carbon Pricing
    - For example, quantity of battery storage capacity and other types of capacity is similar to that under FCEM and Net Carbon Pricing
    - Energy storage charging/discharging frequency is generally between that under FCEM and Net Carbon Pricing
    - Hybrid Approach CEC and carbon prices are lower than those under FCEM and Net Carbon Pricing, respectively
  - Analysis allows CEC and carbon prices to vary from year to year, while calibrating levels such that average LMP from 2030-40 hits the target level (i.e., $41/MWh)
    - Relationship among constraints – emission target, CEC constraints and carbon prices (to achieve target LMP) – is complex

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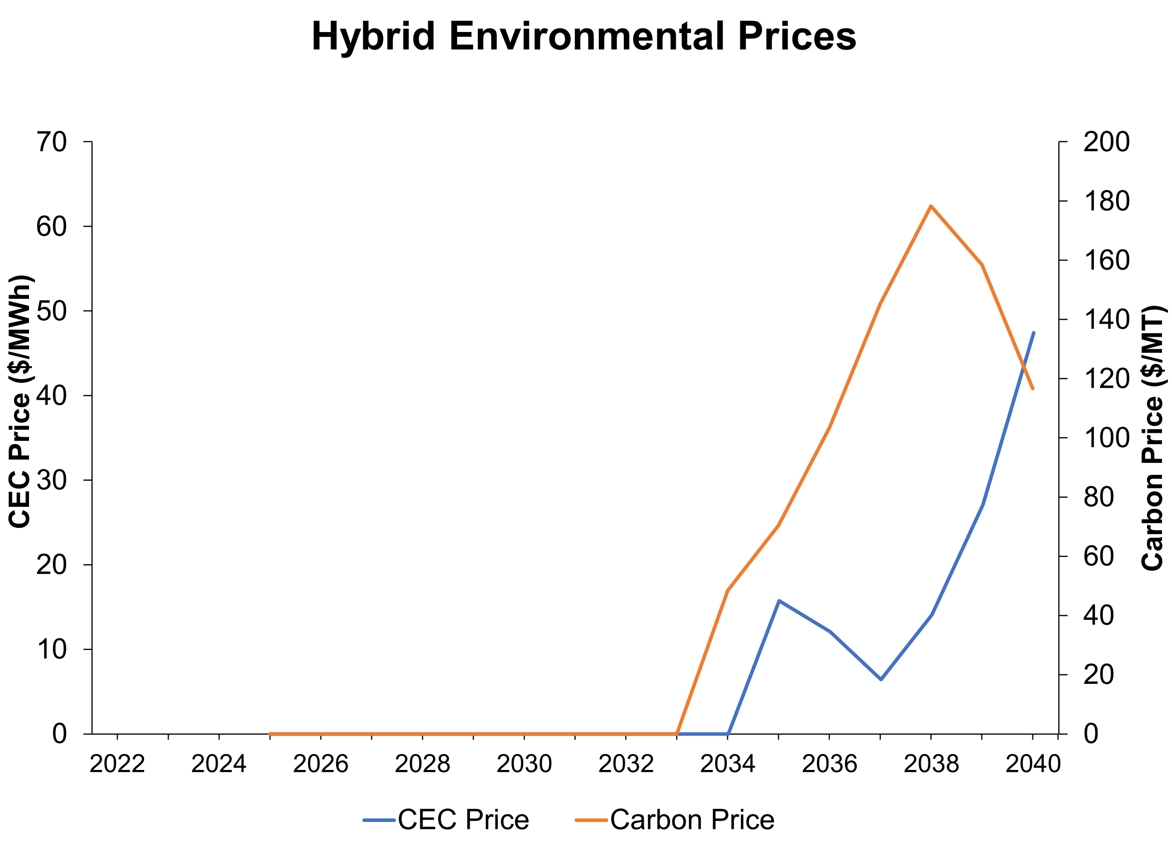
Central Case Results: Hybrid Approach

In Hybrid approach, environmental prices vary from year to year



- CEC and carbon prices vary from year to year
- Tradeoff between CEC and carbon price
  - Carbon price applies to all resources
  - CECs benefit new resources but lower LMPs for existing resources
- Challenging in practice to balance multiple constraints:
  - Emission target
  - CEC target
  - Carbon price, to achieve target LMP (e.g., $41/MWh)
- Other approaches (NCP, FCEM) only have one of these constraints

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Customer Payments

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Customer Payments

- From an economic perspective, social costs provides the best metric for evaluating the (opportunity) costs to society of achieving decarbonization targets
- However, we recognize stakeholder interest in comparing customer payments, which reflects gains to consumers (i.e., consumer surplus) and does not reflect consequences to producers (i.e., producer surplus)
- For each policy approach, total payments by customers reflects four components:
  - Energy market payments, including PPA contracts and LMPs (which reflect competitive offers including carbon prices)
  - Forward Capacity Market payments
  - CEC payments
  - Credit to customers for carbon tax payments (by generators) in Net Carbon Pricing and Hybrid Approach
- For the FCEM, Net Carbon Pricing and Hybrid Approach, the payments reflect in-market payments at market prices, in addition to the PPA contracts for currently legislated procurements assumed in all cases

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Customer Payments – Status Quo Assumptions

- Total payments under the Status Quo approach reflect out-of-market purchases of energy through PPAs
  - Total energy market payments are calculated assuming energy procured through PPAs is paid for at the PPA price, not the market-clearing LMP
  - PPA contract prices reflect levelized cost of supplying energy (net of FCM revenues) given changes in underlying costs (technological change, transmission), escalating curtailments, and market-clearing prices in PPA procurements
  - PPA contract prices include no adjustment for reductions in rate received for energy when LMPs are negative (future analyses may include this adjustment)

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Customer Payments – Status Quo Assumptions

- Total payments for the Status Quo approach are sensitive to whether existing clean energy resources are provided with payments for "clean energy" services in additional to energy market and FCM revenues
  - Absent payments for clean energy, revenues decline over time for existing clean resources with the expansion of procured renewable energy
- We assume that existing clean resources receive supplemental payments for clean energy in light of retirement risks and potential for sales to other regions
  - Existing nuclear receives $41/MWh (e.g., through an extended PPA)
  - Existing renewables (but not nuclear) receive an escalating REC payment, given "outside" options (e.g., sale of clean energy to New York or other region) – RECs rise from $0/MWh in 2030 to $60/MWh in 2040
  - These assumptions are toward the *lower* end of reasonable assumptions about compensation for existing renewables

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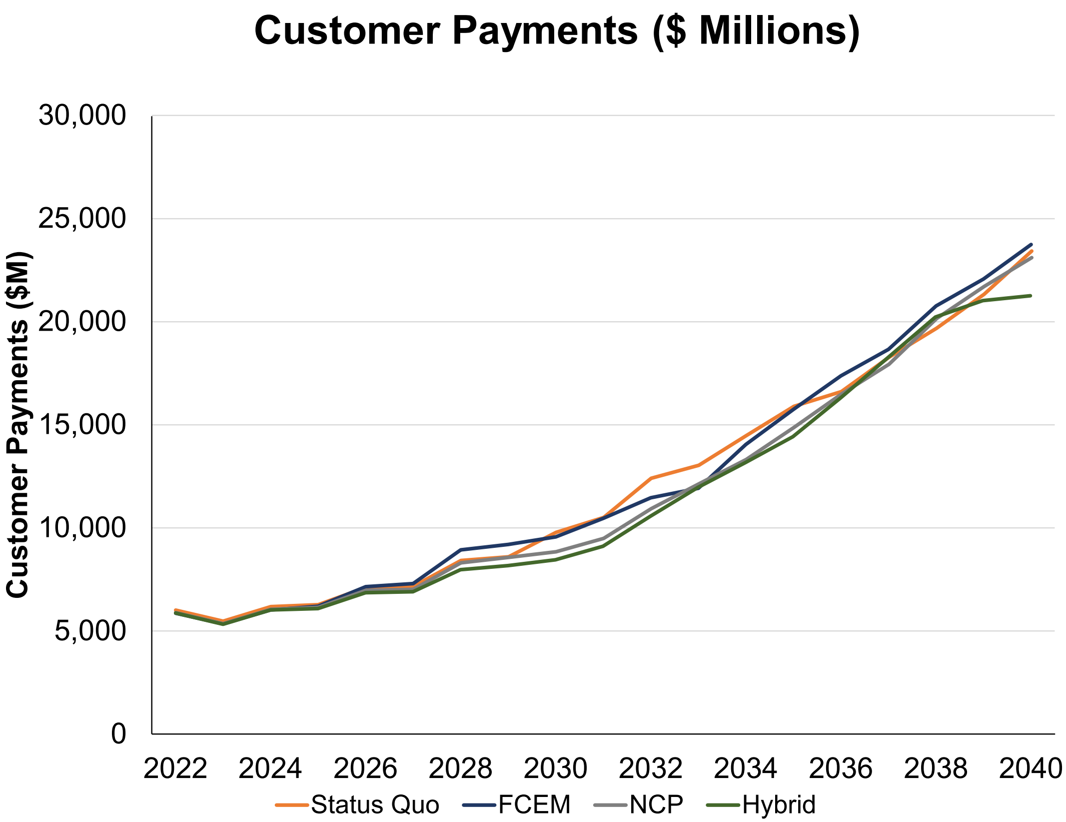
Customer Payments over time

Total payments comparable across approaches



Note: All values are in $2020

- Total payments generally similar across policy approaches, with some year-to-year variation
- FCEM has highest payments, and Hybrid the lowest payments

Pathway	Net Present Value of Total Customer Payments ($M)
Status Quo	136,418
FCEM	136,740
NCP	131,738
Hybrid	128,846

Note: All values are in $2020. NPV calculated assuming 5% discount rate.

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Customer Payments – Alternative Status Quo Assumptions

- Status Quo assumptions in prior slide reflect payments to existing clean energy at lower rates than received by new clean resources (via PPAs)
- In alternative Status Quo assumptions, existing clean energy is compensated at same level as new clean energy (via PPAs)
  - Total payments increase compared to Central Case assumption
- Payments that assume existing clean energy is compensated at the same level as new clean energy reflects an upper bound on plausible payments

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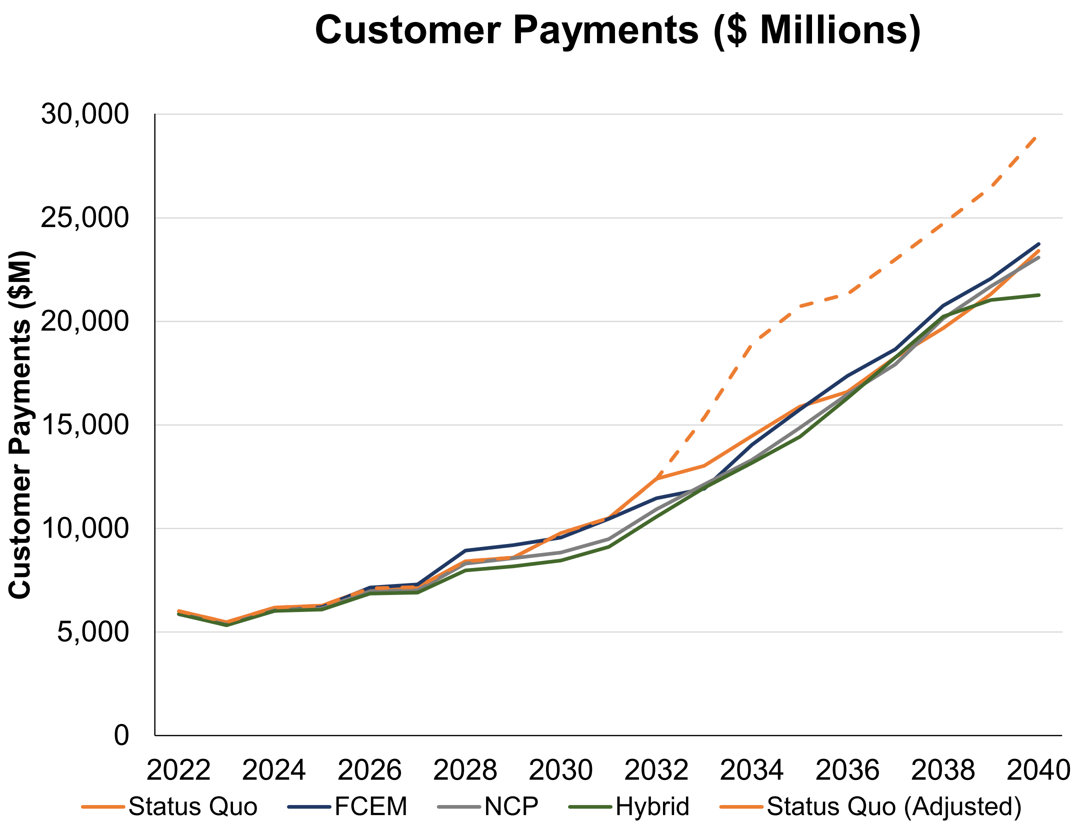
Customer Payments over time

Status Quo payments sensitive to treatment of existing clean energy



Note: All values are in $2020

- If existing clean energy was compensated at same level as new clean energy (via PPAs), total payments would be substantially higher (see dashed line)

Pathway	Net Present Value of Total Customer Payments ($M)
Status Quo	136,418
Status Quo (Adjusted)	154,411
FCEM	136,740
NCP	131,738
Hybrid	128,846

Note: All values are in $2020. NPV calculated assuming 5% discount rate.

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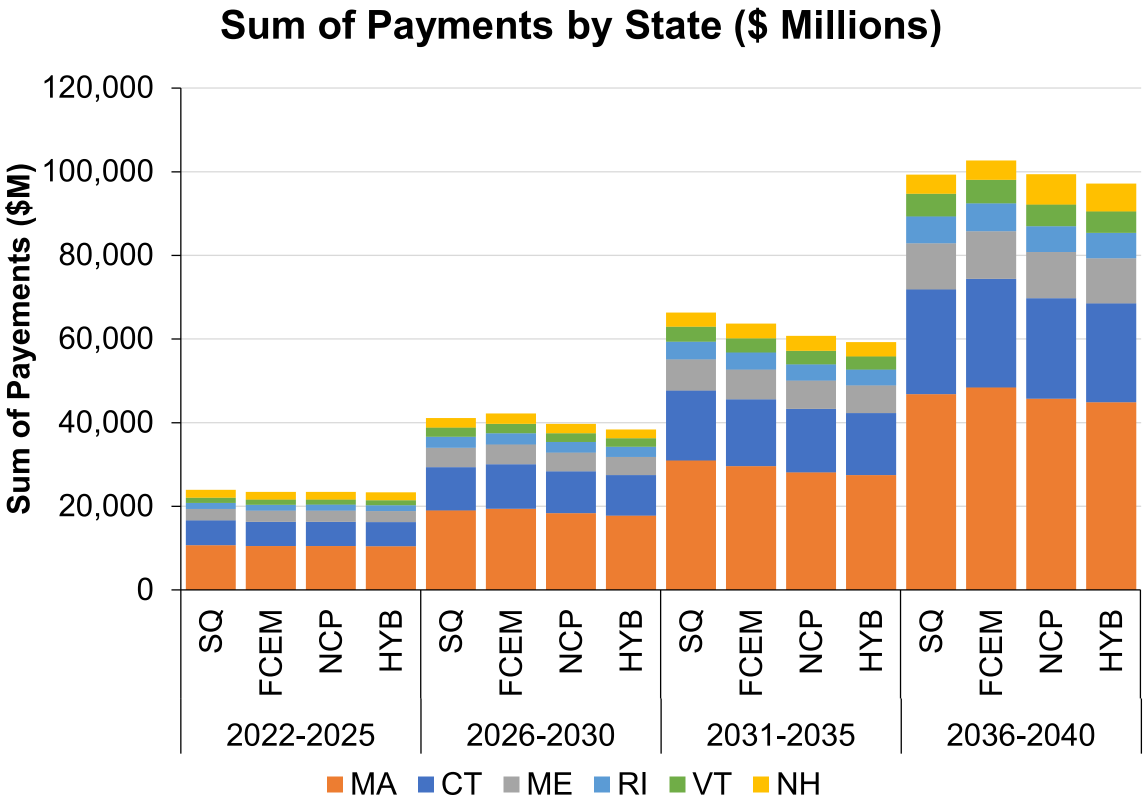
Customer Payments by State

Payments vary by state, largely due to load differences



Note: All values are in $2020

- States with more ambitious emission reduction goals bear a larger fraction of total payments in the Status Quo and FCEM
- When approach includes carbon prices, payments are spread more evenly across states, in proportion to load; Hybrid Approach (combining carbon pricing and CECs) shares payments proportionately, but to a lesser degree

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Comparison of Scenarios

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Quantitative Scenarios

- Preliminary results to be provided today -- each scenario evaluated across all policy approaches:
  - Alternative regional carbon target – 85% below 1990 emission by 2040
  - Alternative levelized costs of new entry for renewable resources
  - Additional retirements
  - Alternative distribution of costs amongst states
- Today’s discussion will focus on how model inputs and assumptions differ in each scenario from the Central Case and focusing on key and interesting results, including changes from the Central Case
  - Additional data and tables of scenarios presented today will be included in the final report
- Preliminary results to be provided in 2022
  - Include transmission
  - Hybrid only: alternative LMP targets for existing renewables
  - Status Quo: alternative costs of long-term renewable contract procurement

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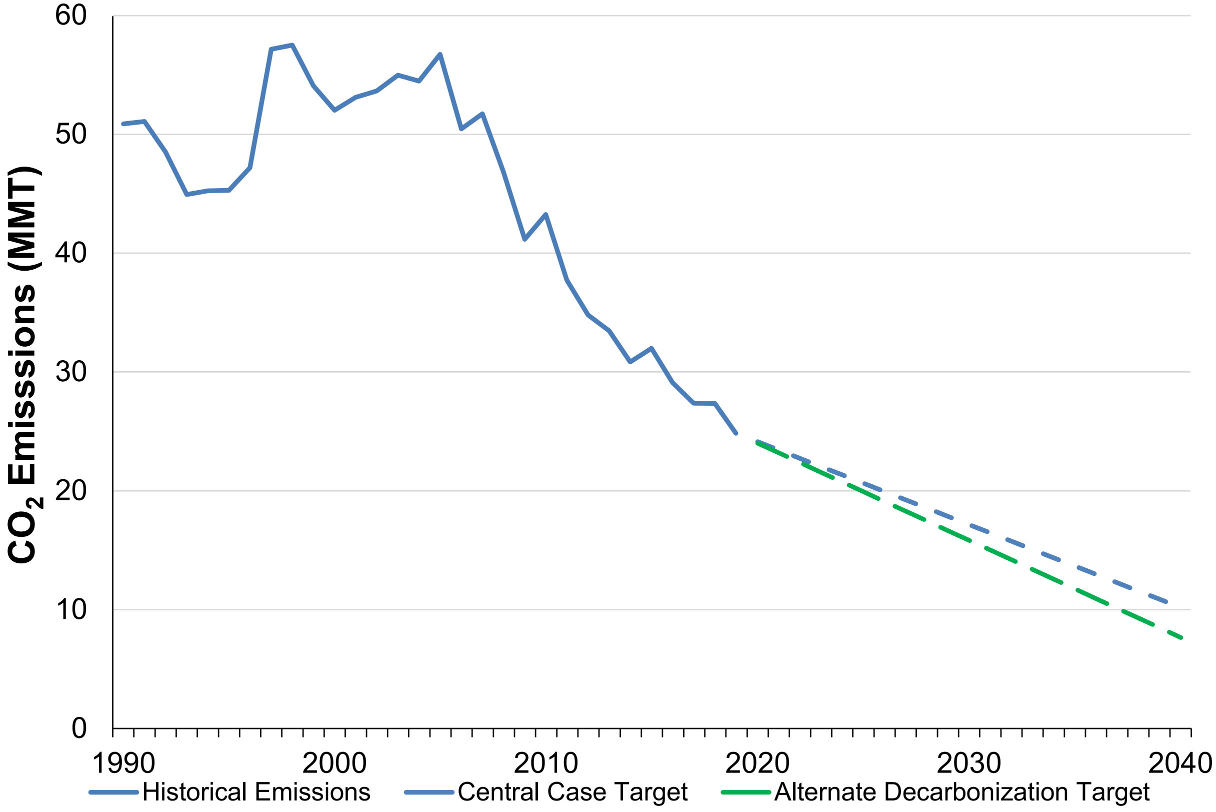
Scenario: Alternative Decarbonization Target

More stringent target – 85% below 1990 levels by 2030



Source: EIA, Electricity, Detailed State Data, available at https://www.eia.gov/electricity/data/state/

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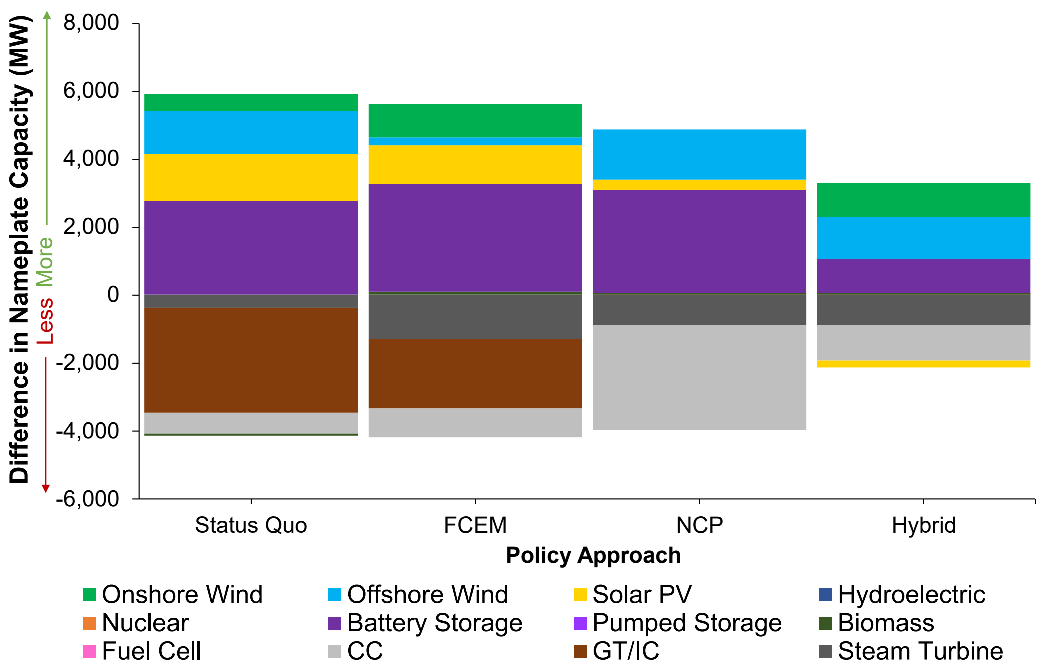
85% Decarbonization Results: Resource Mix

Changes in resource mix vary with policy approach

Difference in Scenario Resource Mix Compared to Central Case, MW, 2040



- Positive value reflects *more* capacity of that technology type than in the central case
- Negative value reflects *less* capacity of that technology type than in the central case
- Reflects changes to retirements *and* new entry
  - More fossil retirements and less new fossil in all cases
  - More new batteries and renewables in all cases
  - New renewable resource entry varies by case

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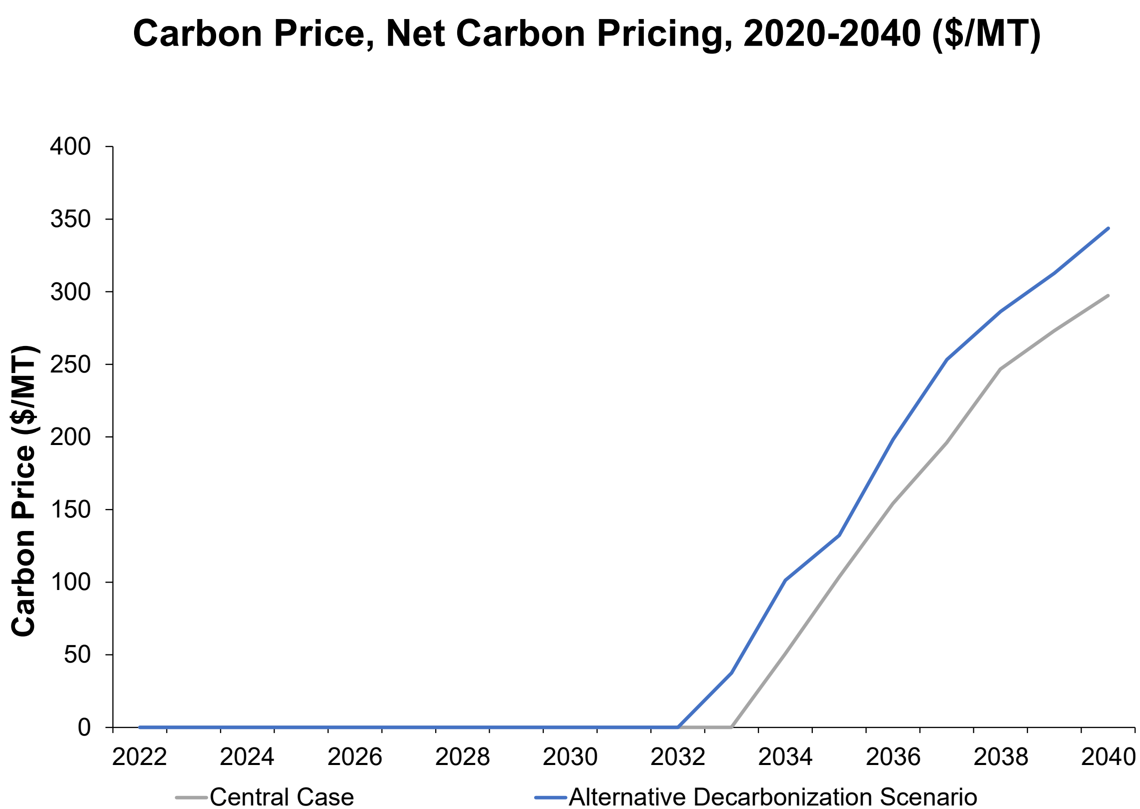
85% Decarbonization Results: Carbon Prices

Higher carbon prices with more stringent target



- Under Net Carbon Pricing, carbon prices are higher with more stringent emission target
  - Carbon price binds one year sooner
  - 2040 carbon price is $344 – 16% higher than central case
  - Trajectory of prices is otherwise very similar

Note: All values are in $2020

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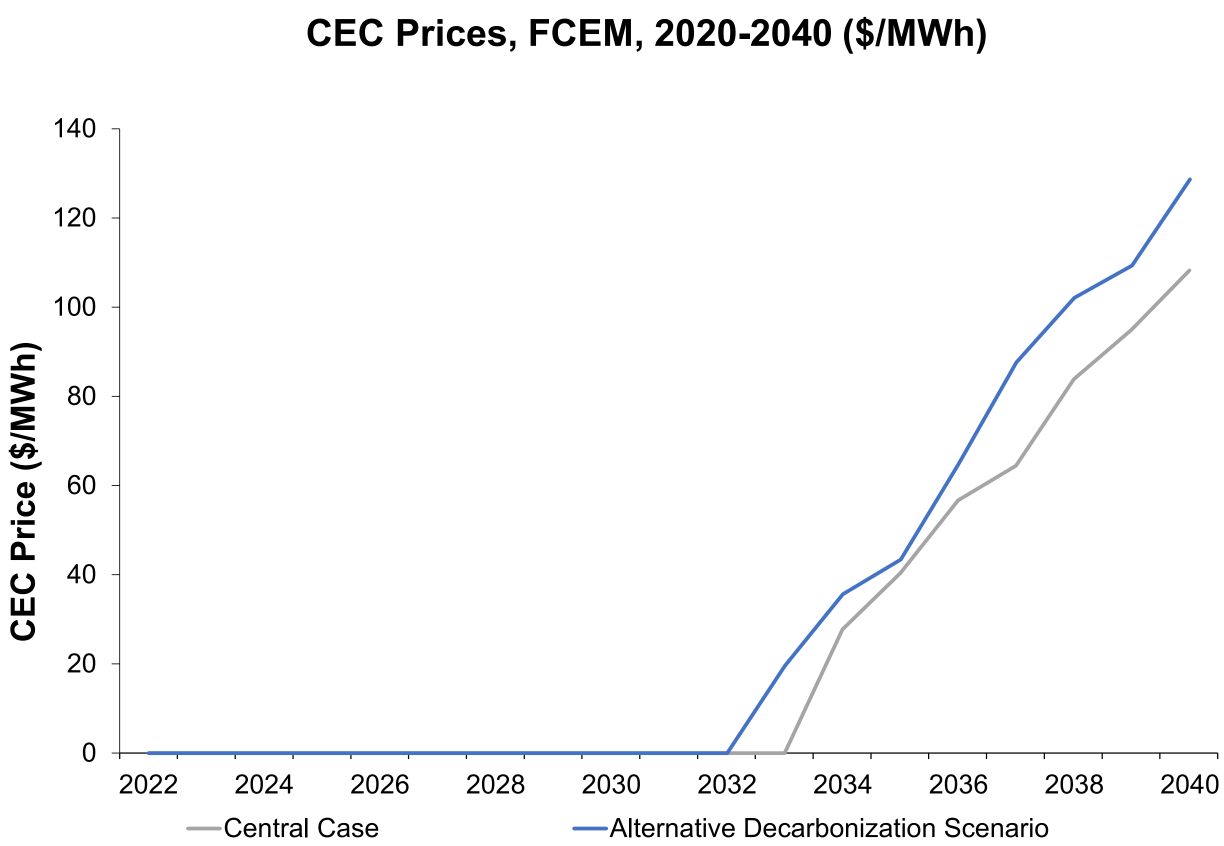
85% Decarbonization Results: CEC Prices

Higher CEC prices with more stringent target



Note: All values are in $2020

- Under the FCEM, CEC prices are higher with more stringent emission target
  - CEC price binds one year sooner
  - 2040 CEC price is $129 – 19% higher than central case
  - Trajectory of prices is otherwise very similar

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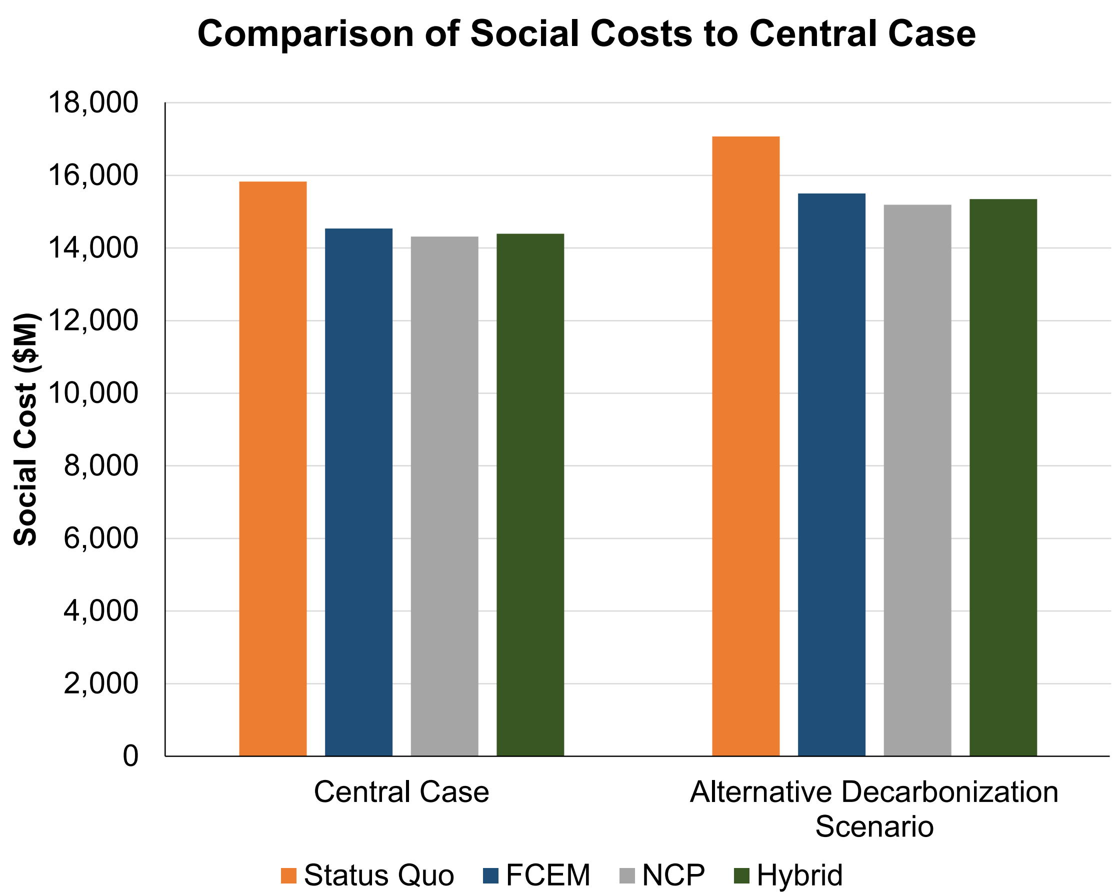
85% Decarbonization Results: Social Costs

Social costs are higher



- Total social costs increase for all policy approaches
- Increase in cost for Status Quo is greater than for the other cases
- Social costs remain highest for SQ, and lowest for the NCP

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Scenario: Alternative Capital Costs

- Central case assumes capital costs based on 2021 EIA AEO
- Alternative capital costs will use NREL's 2021 Annual Technology Baseline
  - Among dispatchable resources, CC become relatively more cost-effective
  - Among renewable resources, onshore wind and offshore wind become more cost-effective relative to solar.
- These changes in the relative costs are reflected in different resource mixes

	Overnight Capital Cost ($/kW)			
	2021		2040	
Resource Type	**EIA AEO**	**NREL ATB**	**EIA AEO**	**NREL ATB**
CT F-Class	801	838	603	730
CC H-Class (2 x 1)	1,134	952	897	871
Battery Energy Storage	1,201	1,282	633	686
Solar	1,276	1,288	808	692
Wind Onshore	1,680	1,291	1,391	819
Wind Offshore	6,360	3,446	3,458	2,112

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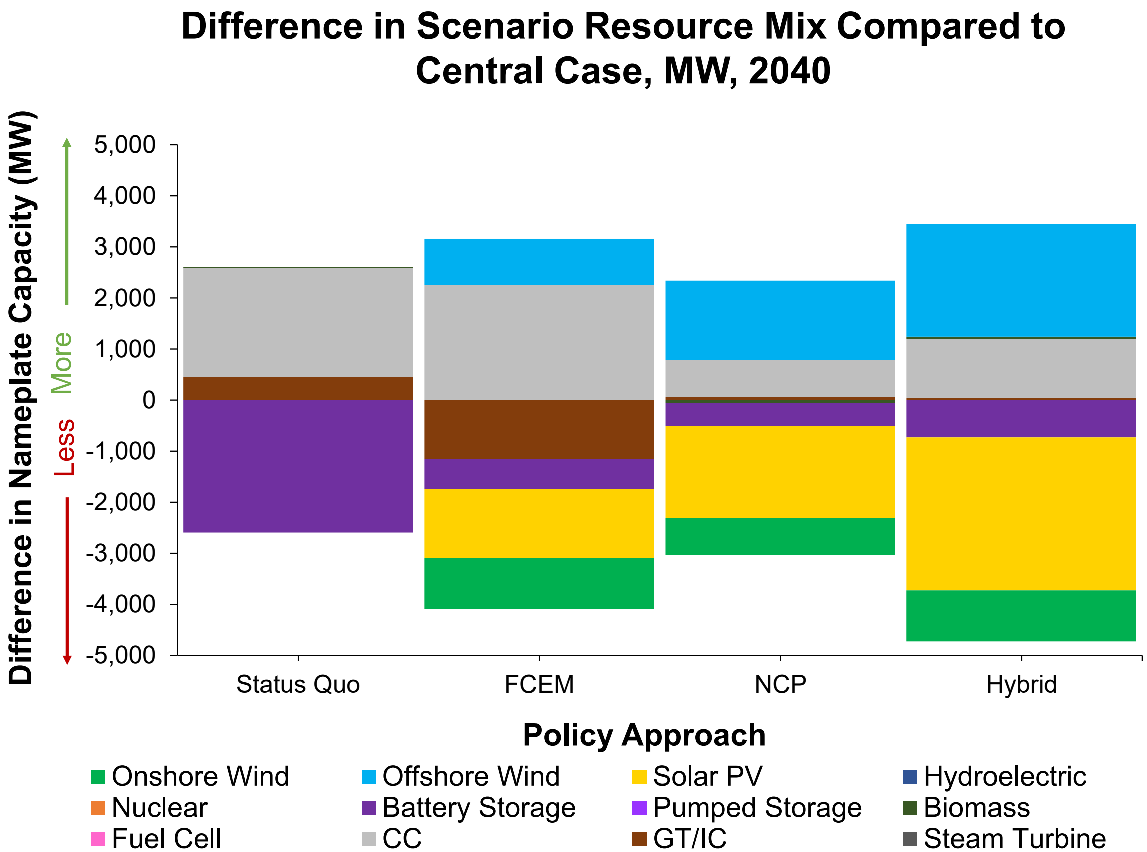
Alternative Capital Costs: Difference in Resource Mix

Resource mix changes reflect differences in relative costs between resources



- Dispatchable resources: More gas-fired and less storage
- Renewables:
  - Status Quo mix assumed to remain unchanged
  - FCEM, NCP, Hybrid: more offshore wind, Less PV solar and onshore wind

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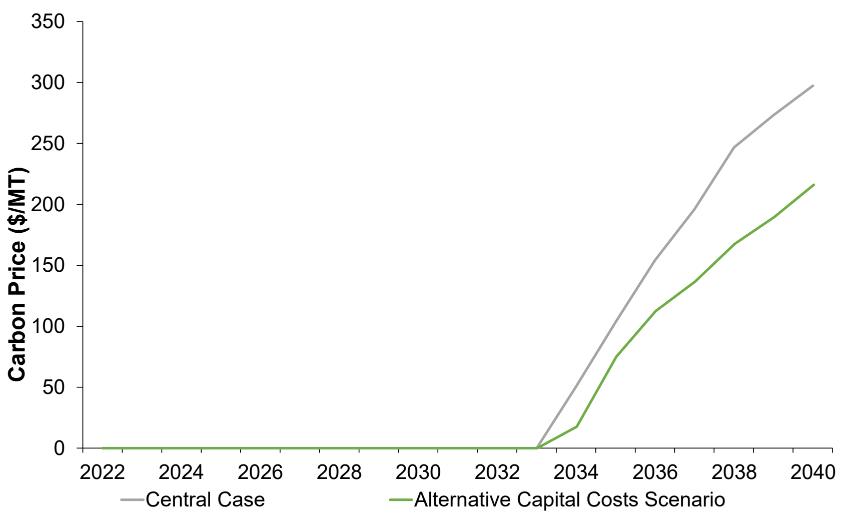
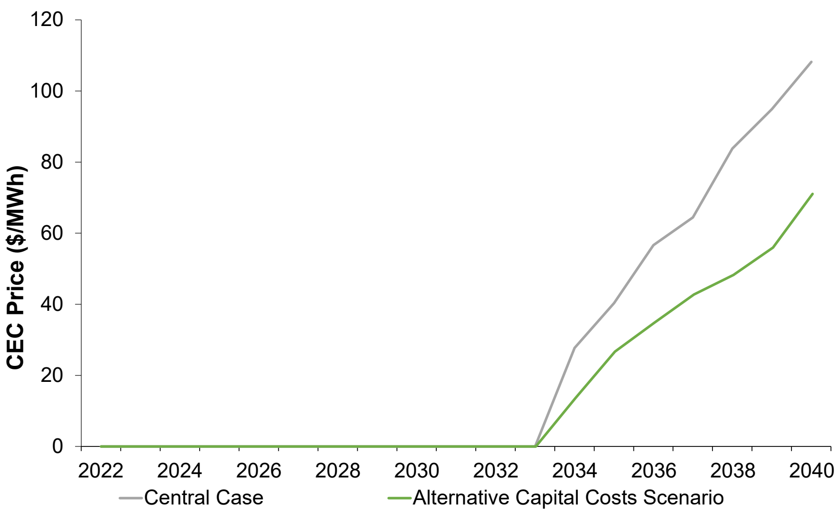
Alternative Capital Costs: Environmental Prices

Consistent with lower capital costs, environmental prices are lower

Comparison of Carbon Prices



Comparison of CEC Prices



Note: All values are in $2020

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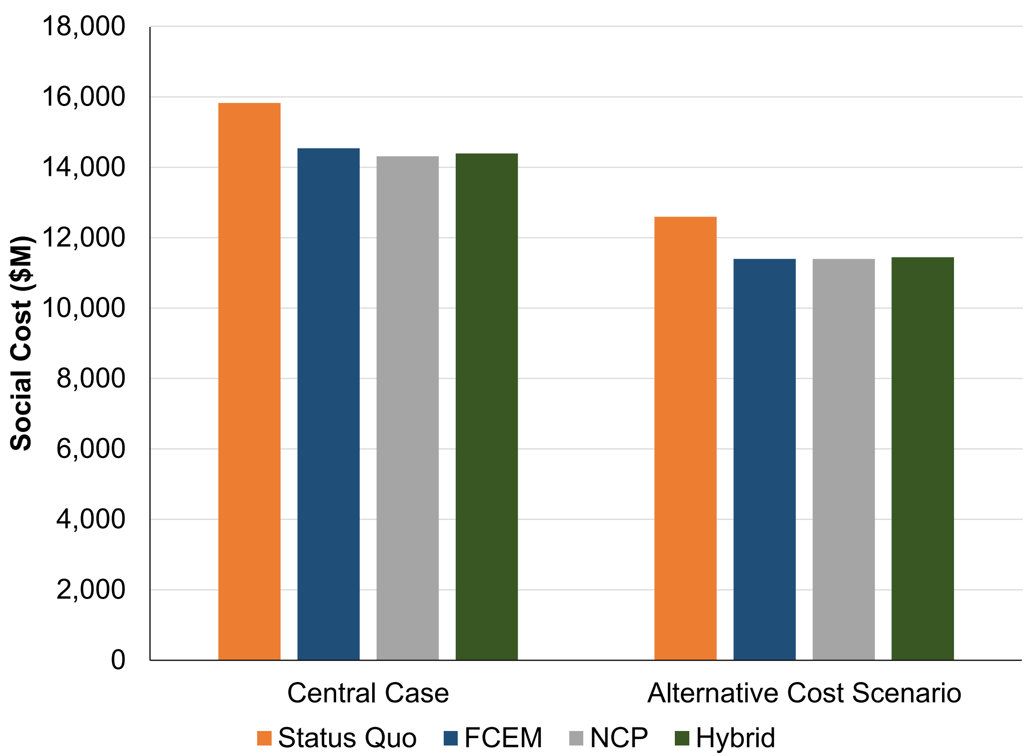
Alternative Capital Costs: Social Costs

Social costs are Lower

Comparison of Social Costs to Central Case



Note: All values are in $2020

- Production costs are lower because capital costs of nearly all types of resources are lower
- Status Quo declines more than the other cases
  - This reflects the reliance on offshore wind in the SQ, which had the biggest difference in capital costs

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Scenario: Additional Retirements

Increased fossil retirements, including "at risk" units

- Central case results retire approximately 7,200-7,800 MW of capacity
  - SQ and FCEM retire less, NCP and Hybrid retire more.
- However, the model may not accurately capture all events may cause units to retire, particularly large forced maintenance events requiring large capital cost that can result in an older unit retiring
- We assume that, in addition to all of the retirements in the NCP central case, all of the "at risk" units identified by ISO-New England also retire (see: https://www.iso-ne.com/about/what-we-do/in-depth/power-plant-retirements)
- This assumption results in an approximately 3,700-4,300 MW of retired fossil fuel capacity than in the central cases.

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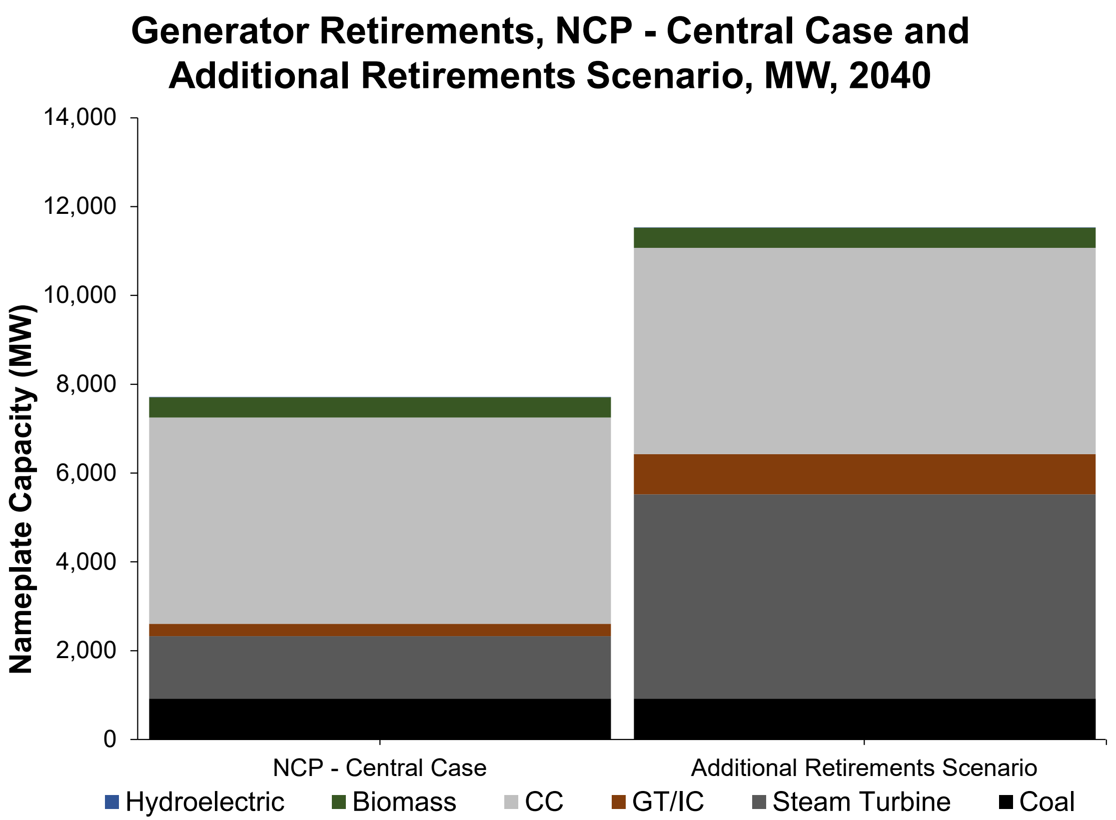
Additional Retirements: Total Retirements

Additional retirements include steam and gas turbine units



- The at-risk units not retired in the NCP central case account for an additional ~3,800MW of capacity
- ~3,200MW are steam units
- Oldest units assumed to retire first
- Timing of additional assumed retirements is distributed from 2024-2040

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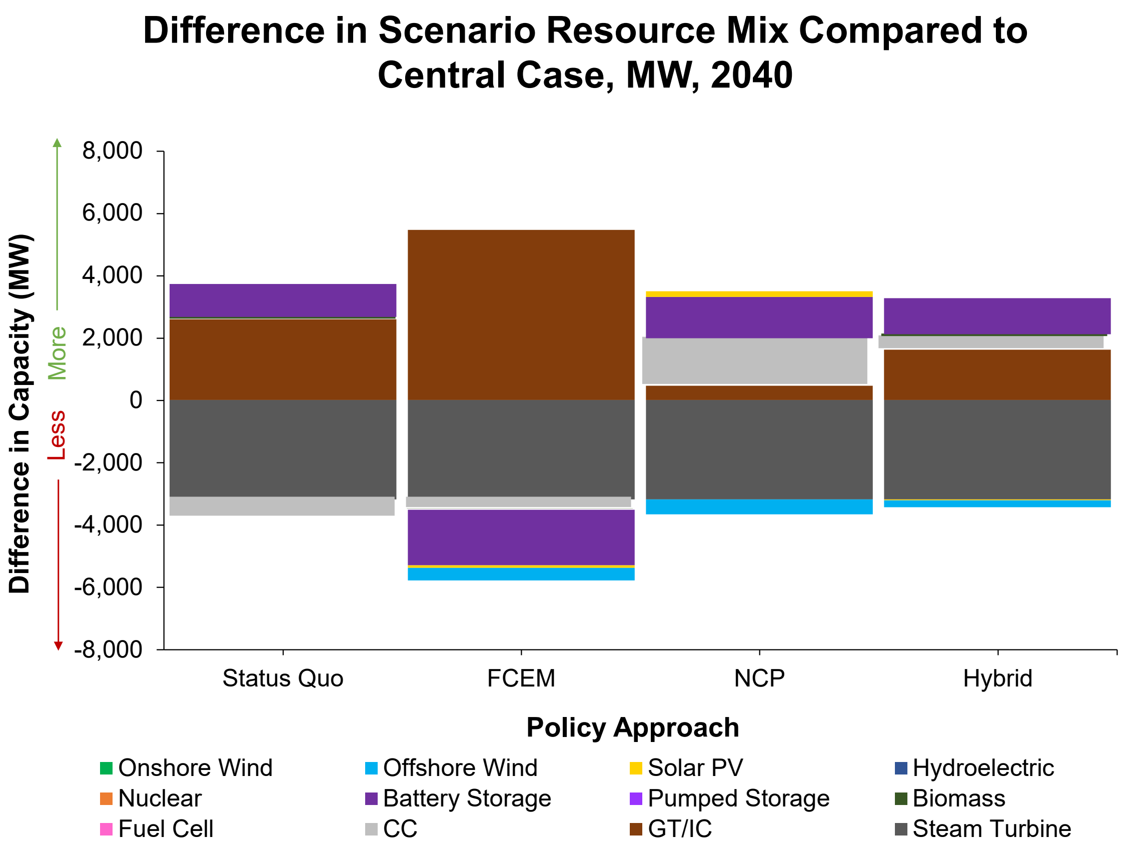
Additional Retirements: Differences in Resource Mix

New, more efficient gas-fired resources and storage replace retired resources



- The additional retirements are replaced by a mix of dispatchable units, not renewables
  - New fossil generation accounts for largest share of replacement resources
  - Additional storage under three of four approaches (less storage in FCEM)
- Less renewables needed because less efficient, higher emission resources retire

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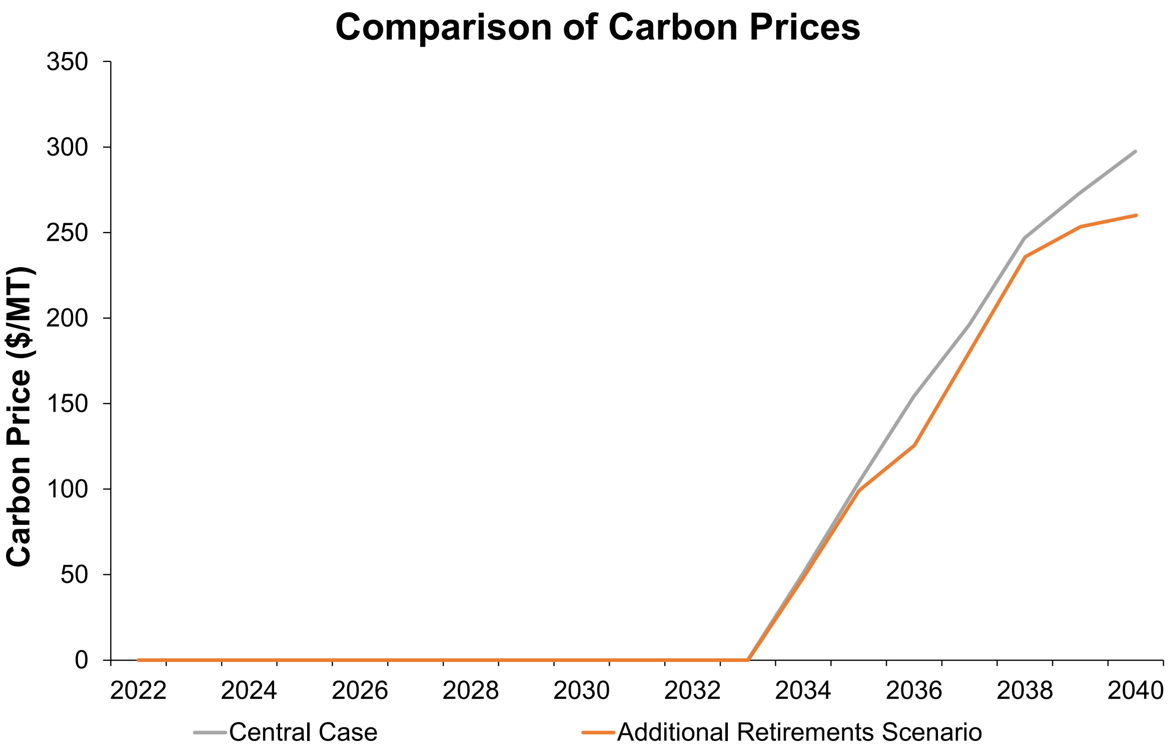
Additional Retirements: Environmental Prices

Environmental prices lower with more efficient gas-fired resources



- Carbon prices are lower as at-risk units are very emissions intensive
- These units are replaced by lower emitting units, such that in some hours the marginal unit is now more fuel efficient, lower emission source with a lower carbon cost
- More efficient resources relied on more frequently in later years when peak load is larger, leading to a larger difference in carbon price over time
- Similar story for CEC price

Note: All values are in $2020

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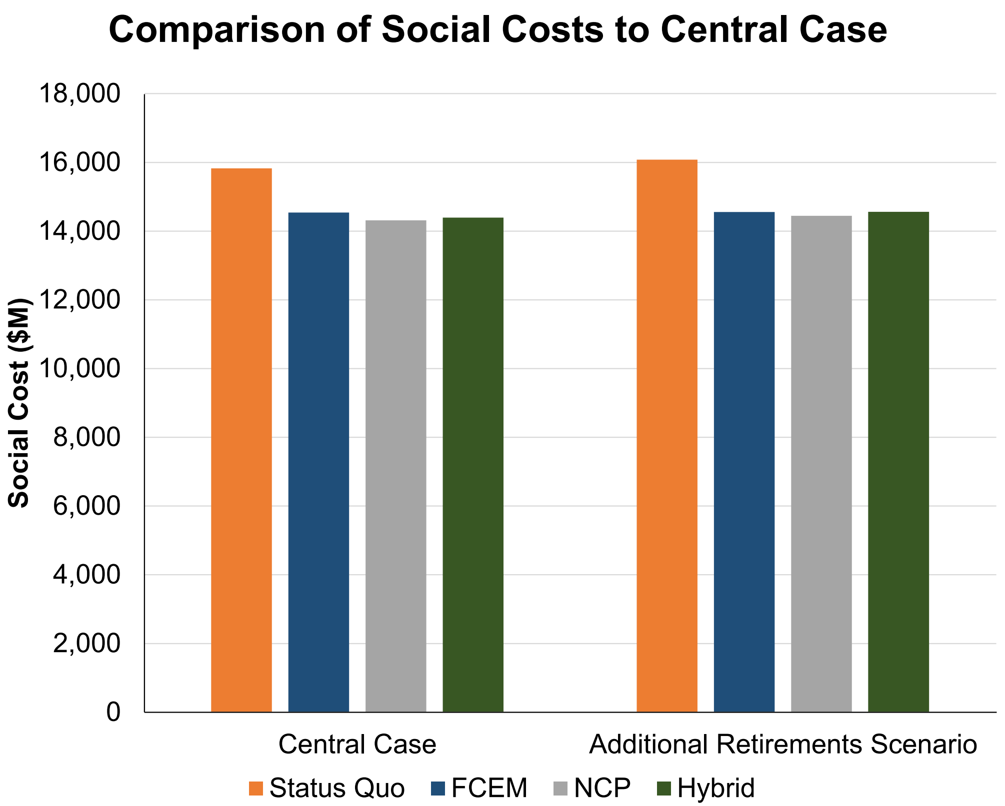
Additional Retirements: Social Costs

Social costs are higher



Note: All values are in $2020

- Production Costs are slightly higher
  - These results show that the "at-risk" units were not retired in the central cases because keeping them was least cost

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Scenario: Alternative Payments by State

Total payments remain unchanged, allocation of payments modified

- In the central case, we assume that customer payments for CECs and the cost of PPAs will be allocated across states based on their relative decarbonization goals
- In the alternative payment allocation:
  - Total payments remain unchanged
  - We assume that each state will bear the cost of the region's clean energy targets in proportion to their share of total electricity demand

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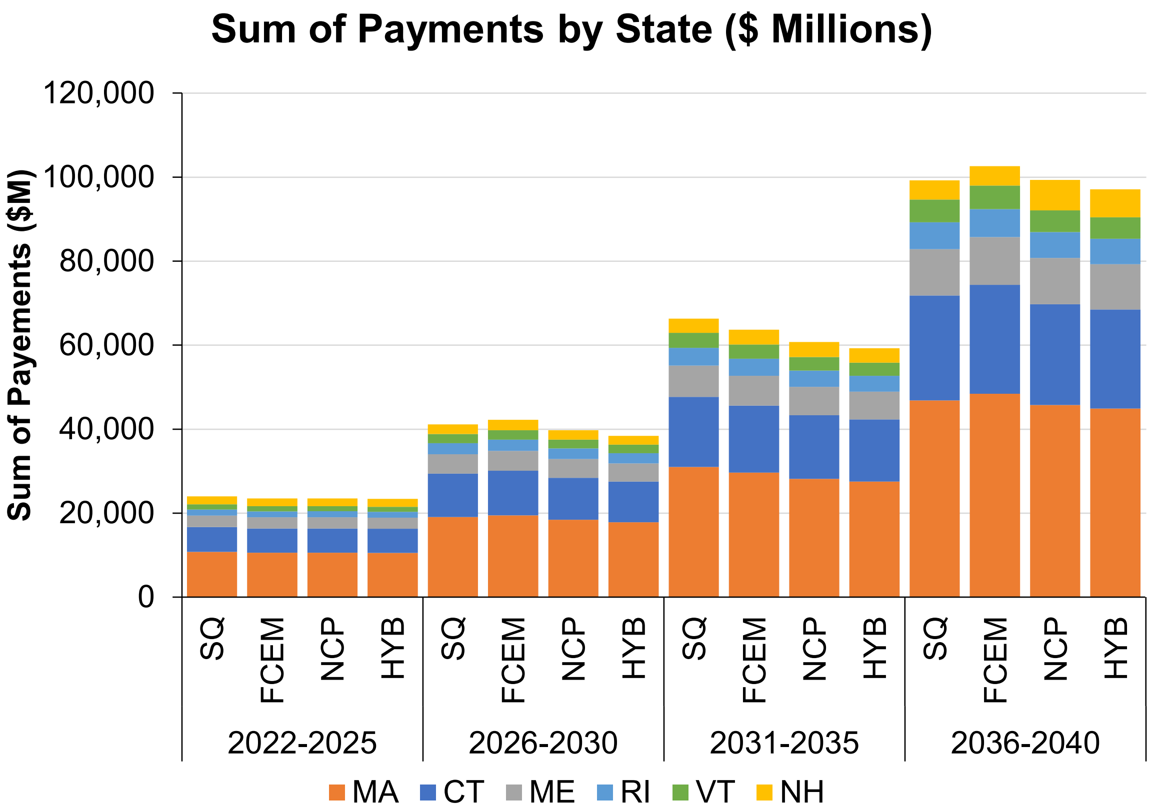
Scenario: Alternative Payments by State

Payments weighted by electricity demand



- Under alternative payment allocation assumption, all costs are proportional to energy consumed

Note: All values are in $2020

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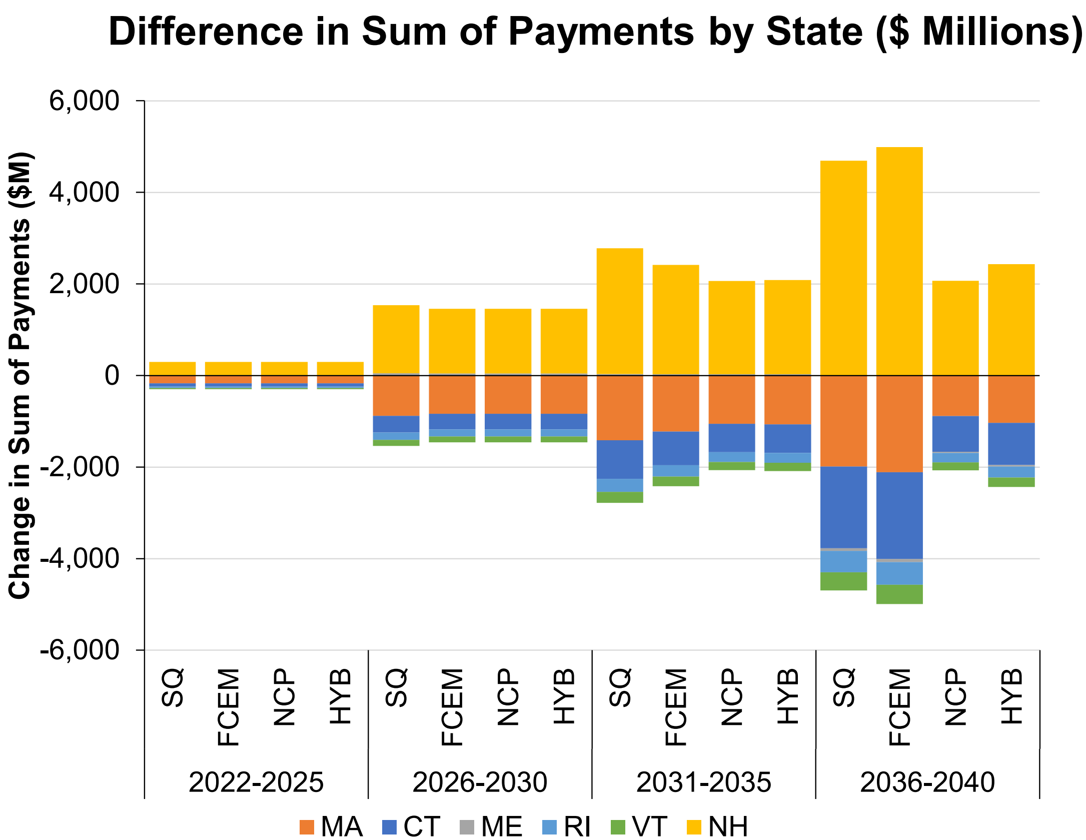
Scenario: Alternative Payments by State

States with lower emission reduction targets pay more



- In alternative payment allocation, costs are shifted to states with lower relative emission reduction contributions in Central Case (i.e., New Hampshire)

Note: All values are in $2020

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Next Steps

- 2022
  - 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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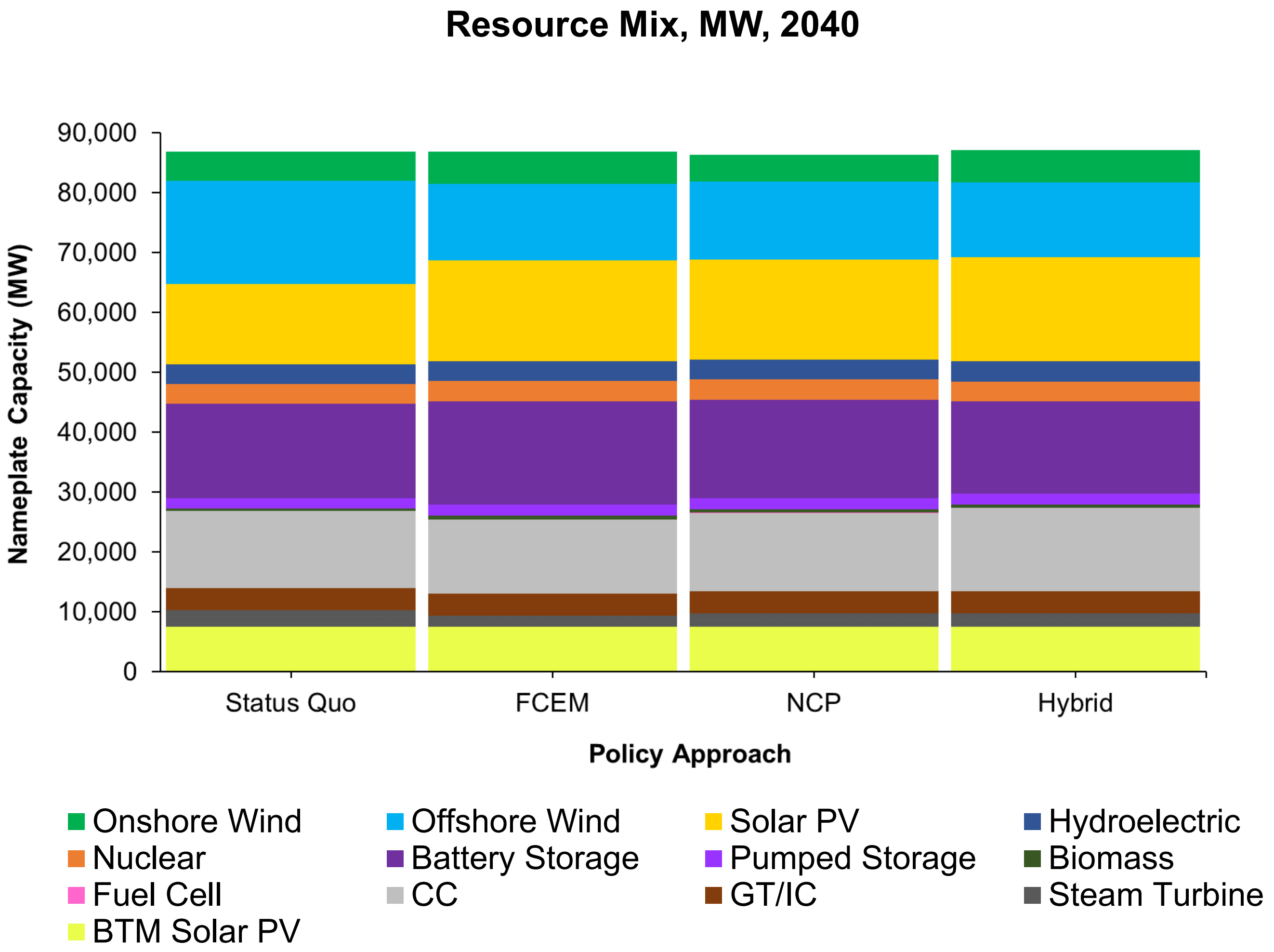
85% Decarbonization Results: 2040 Resource Mix



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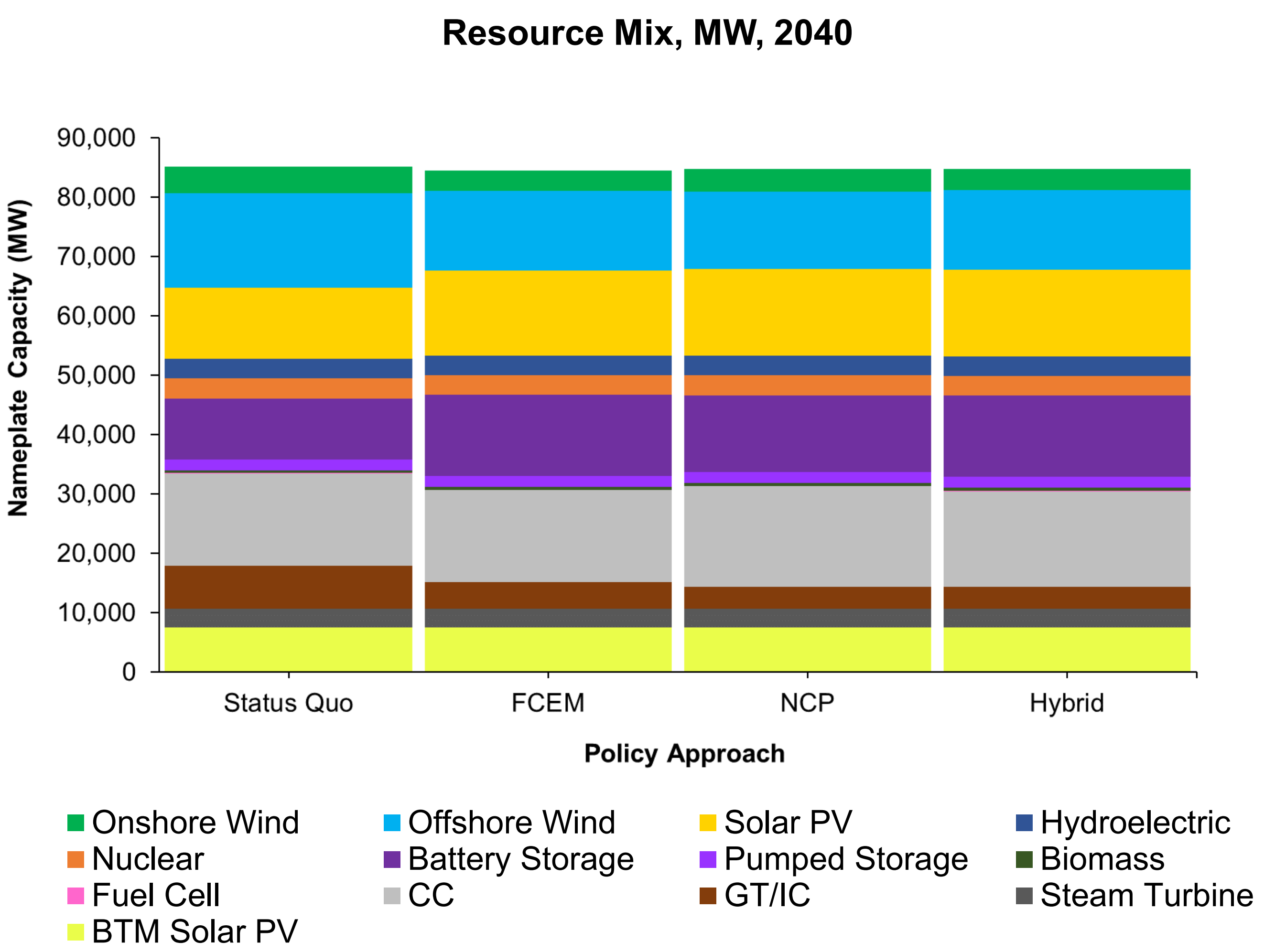
Alternative Capital Costs: 2040 Resource Mix



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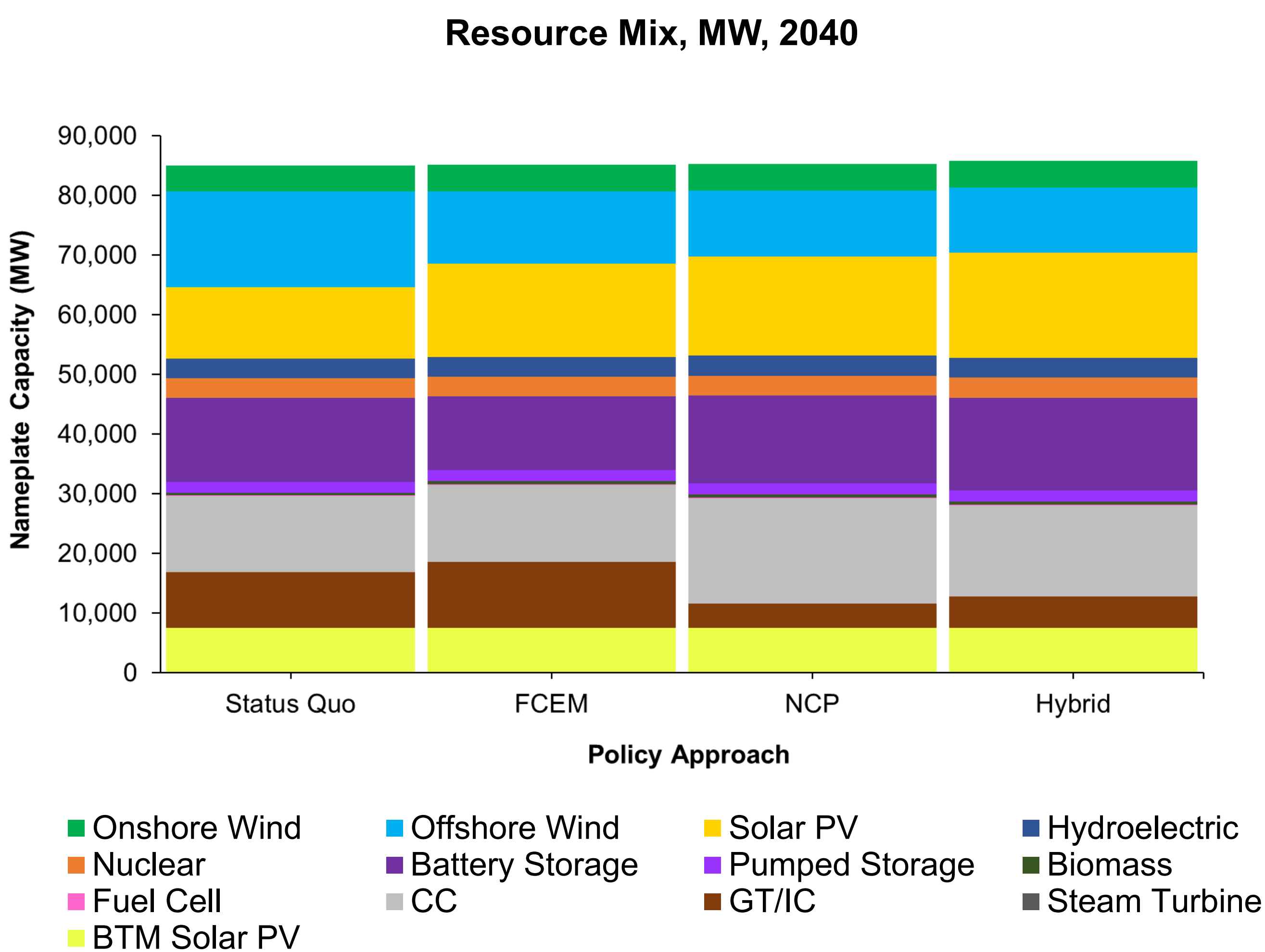
Additional Retirements Scenario: 2040 Resource Mix



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Updated Central Case Results - NCP

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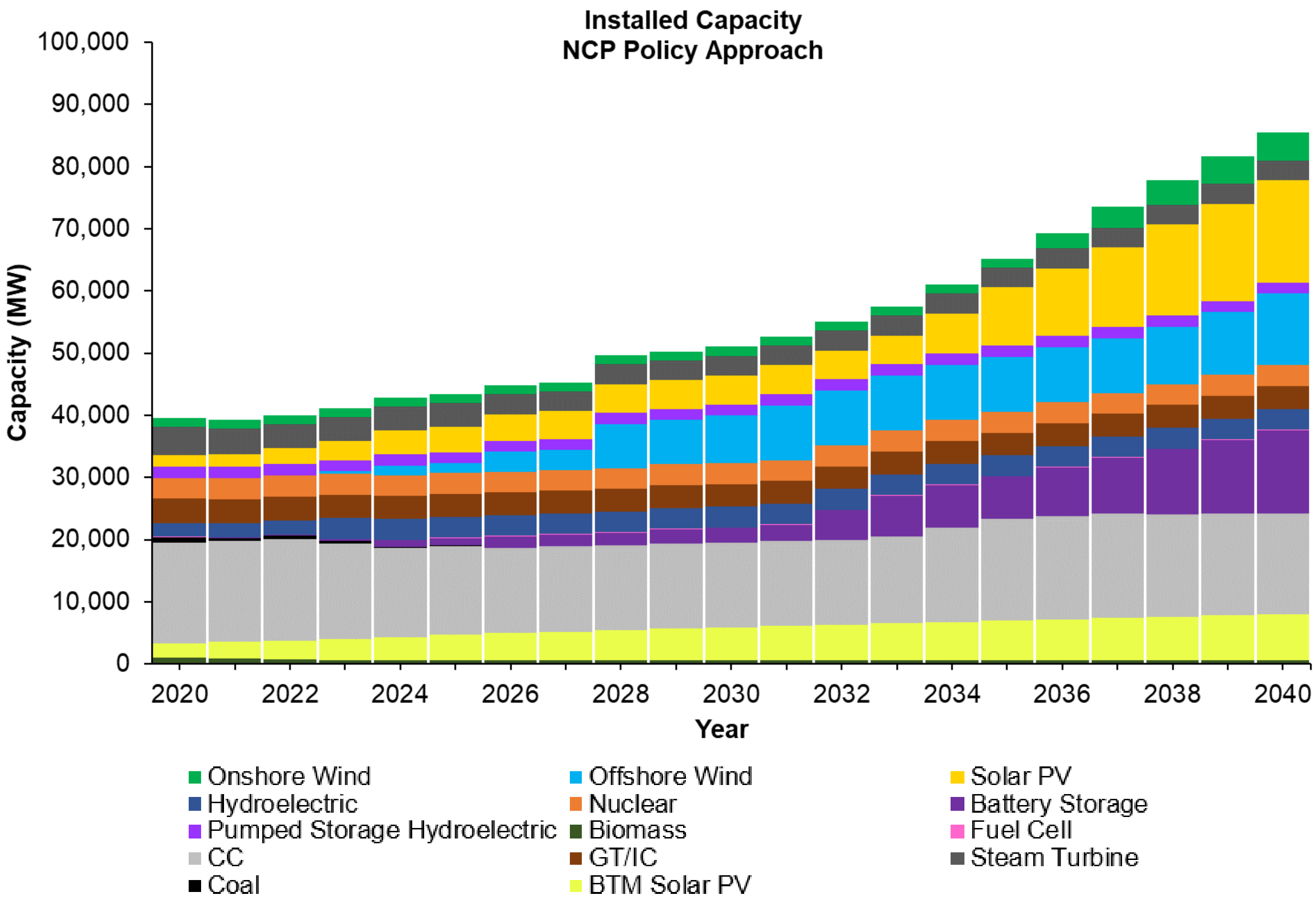
Central Case Results - NCP: Resource Mix



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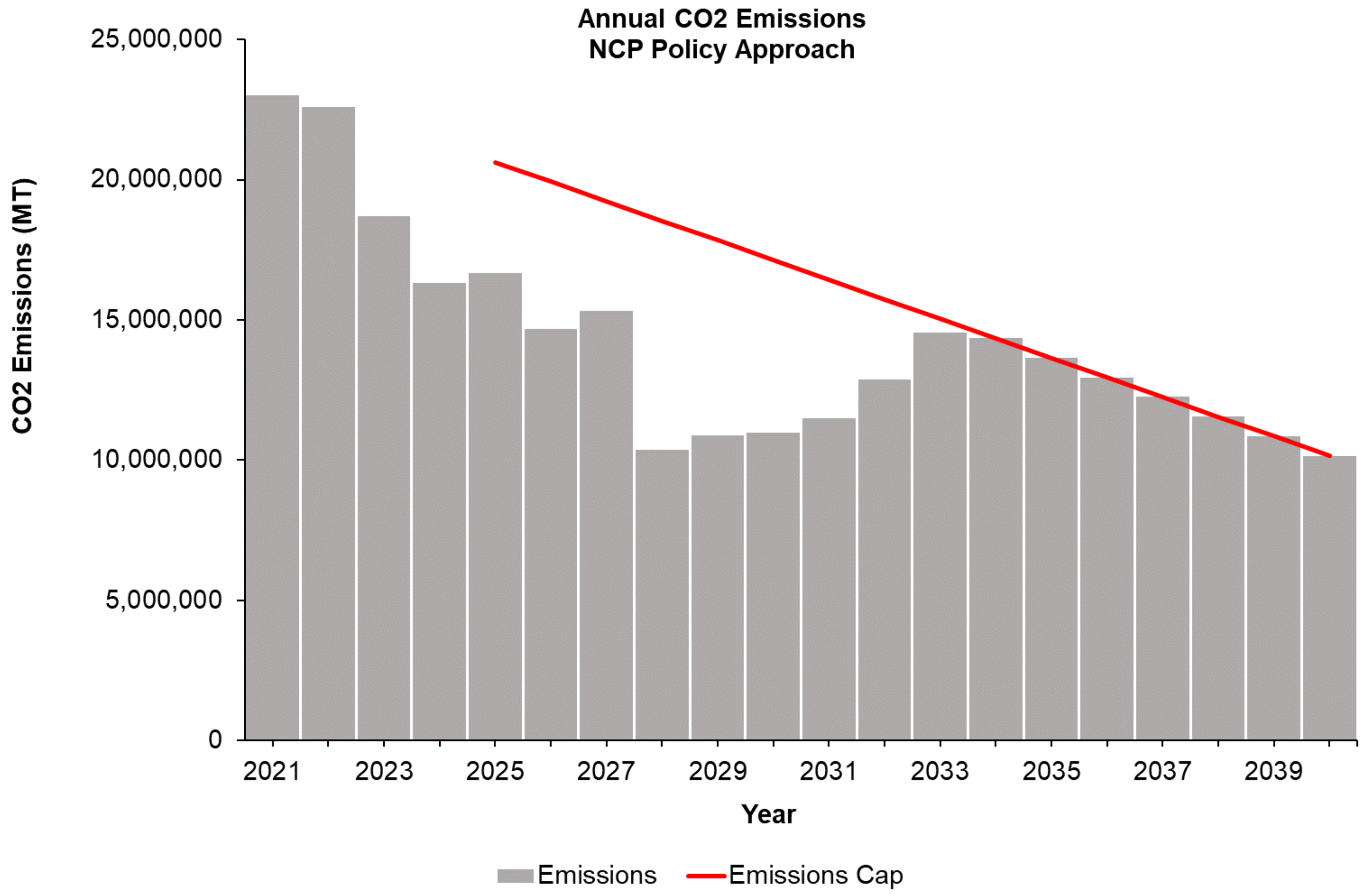
Central Case Results - NCP: Carbon Emissions



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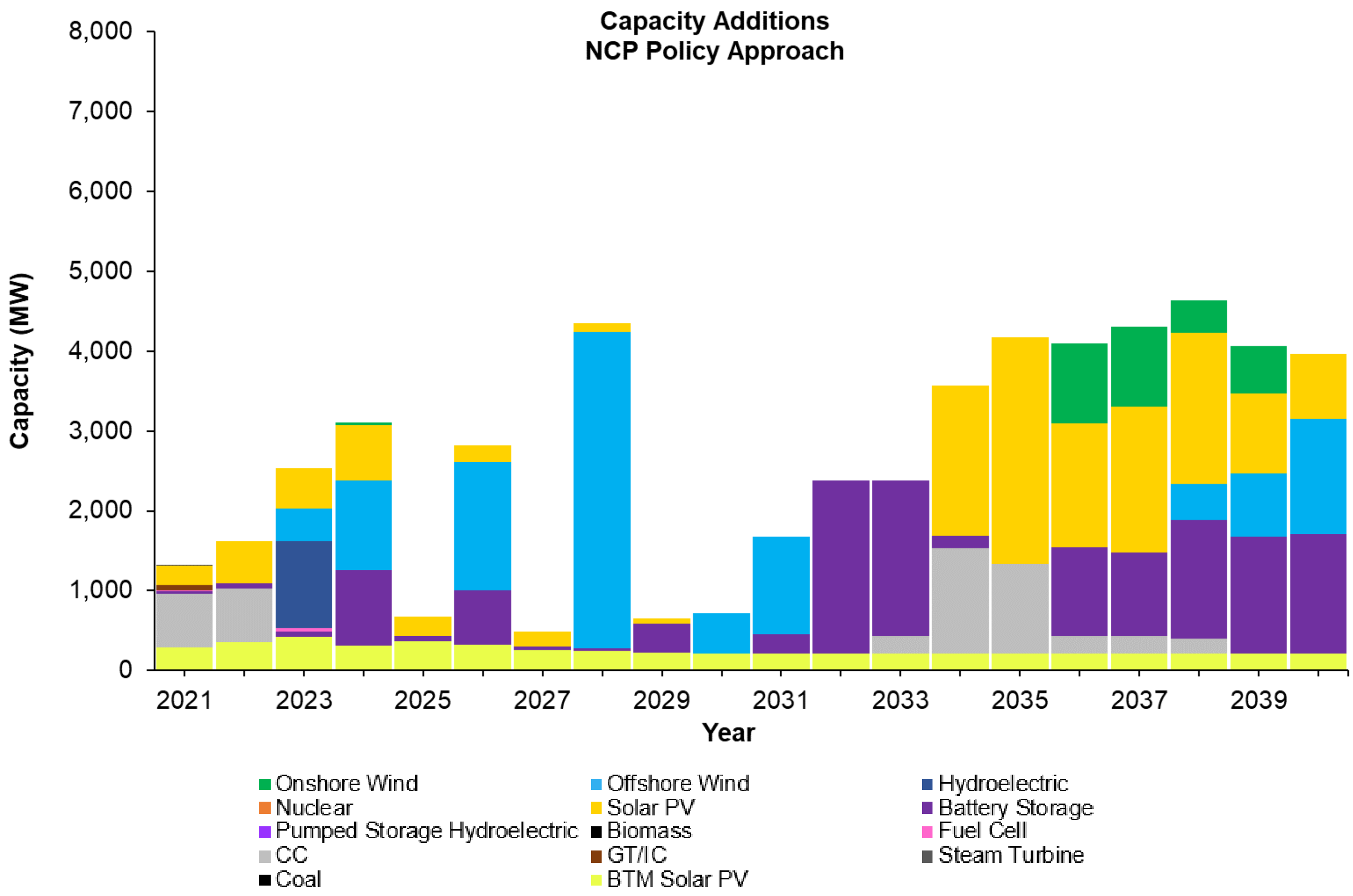
Central Case Results - NCP: Resource Additions



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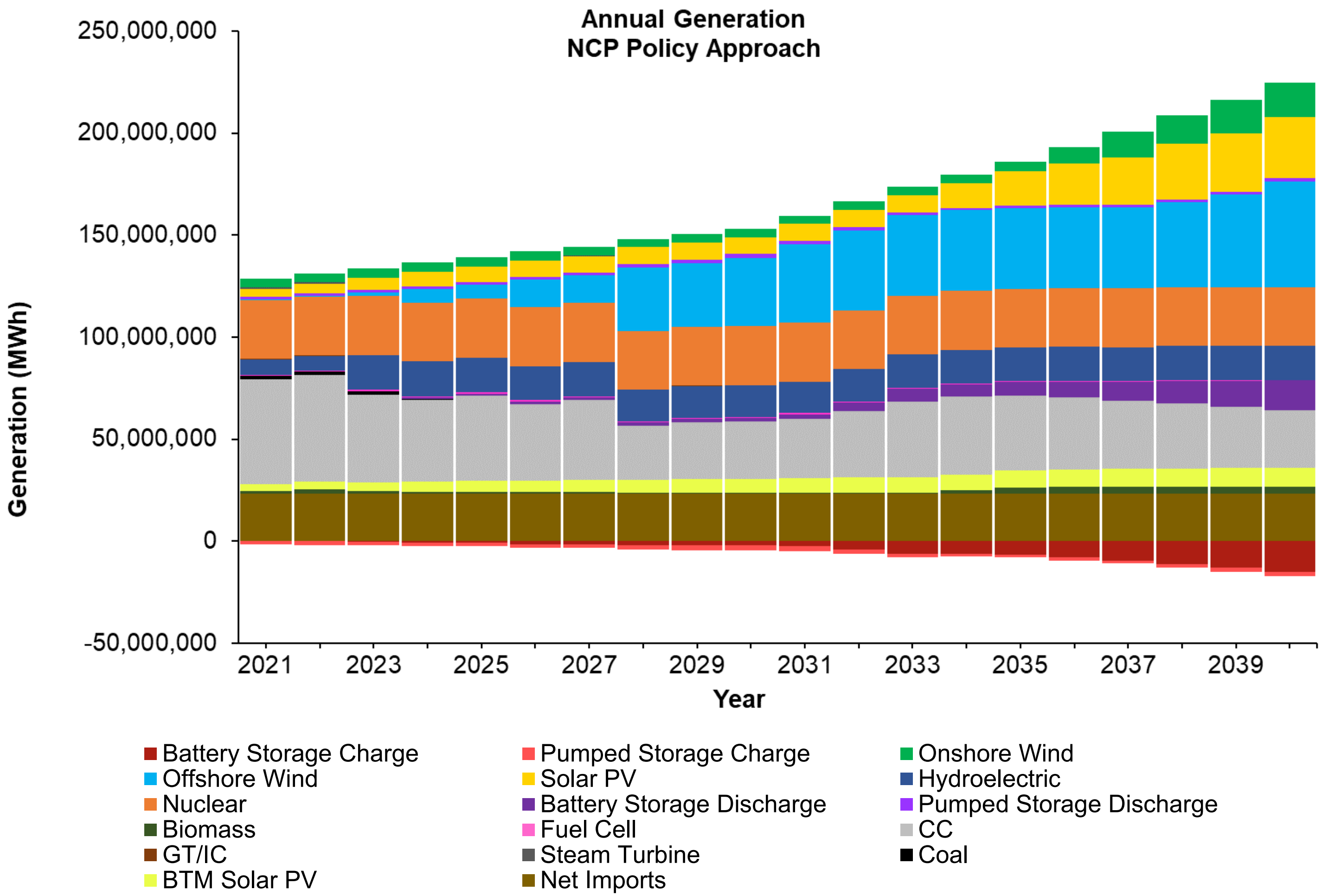
Central Case Results - NCP: Energy Mix



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Updated Central Case Results - FCEM

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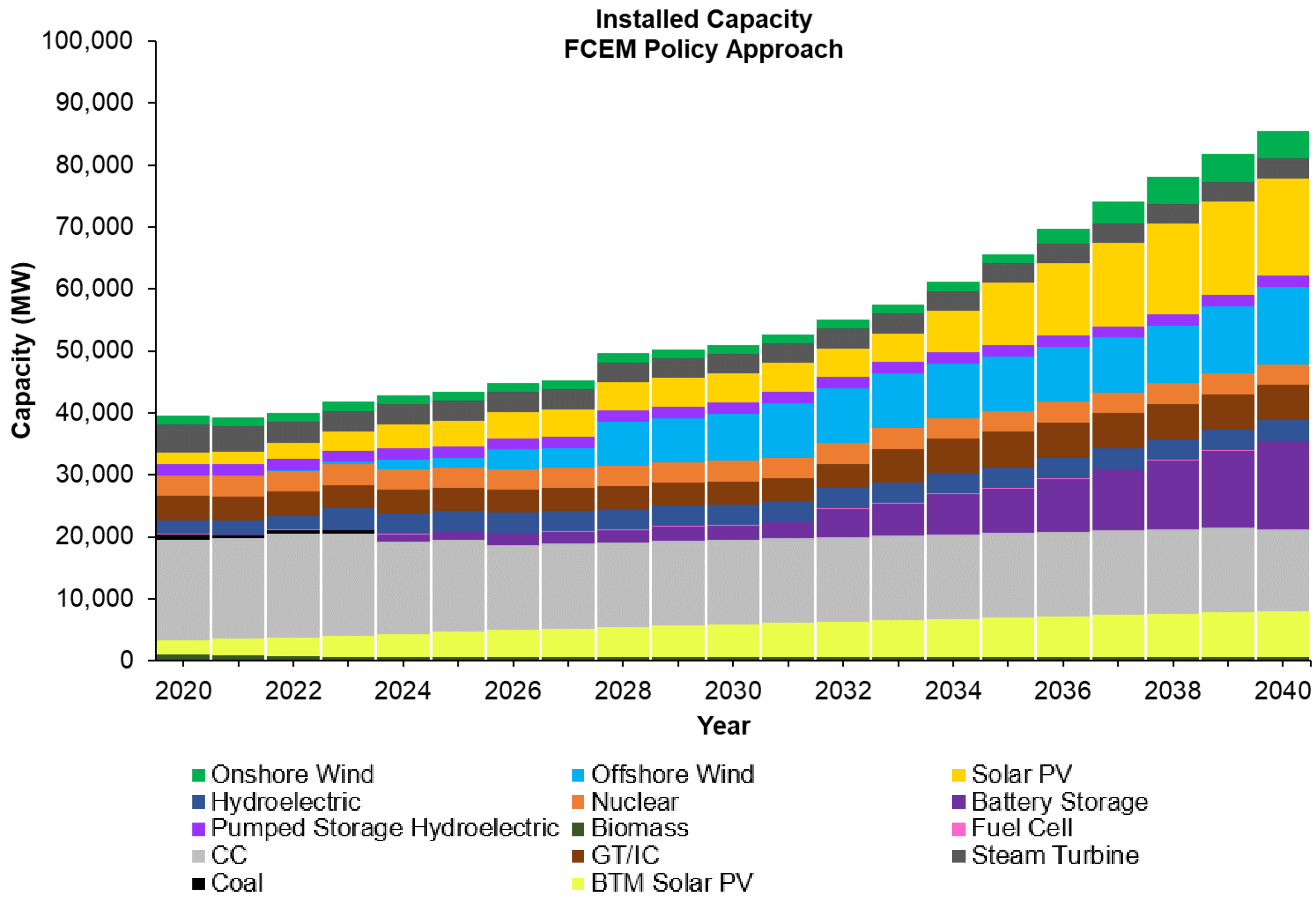
Central Case Results - FCEM: Resource Mix



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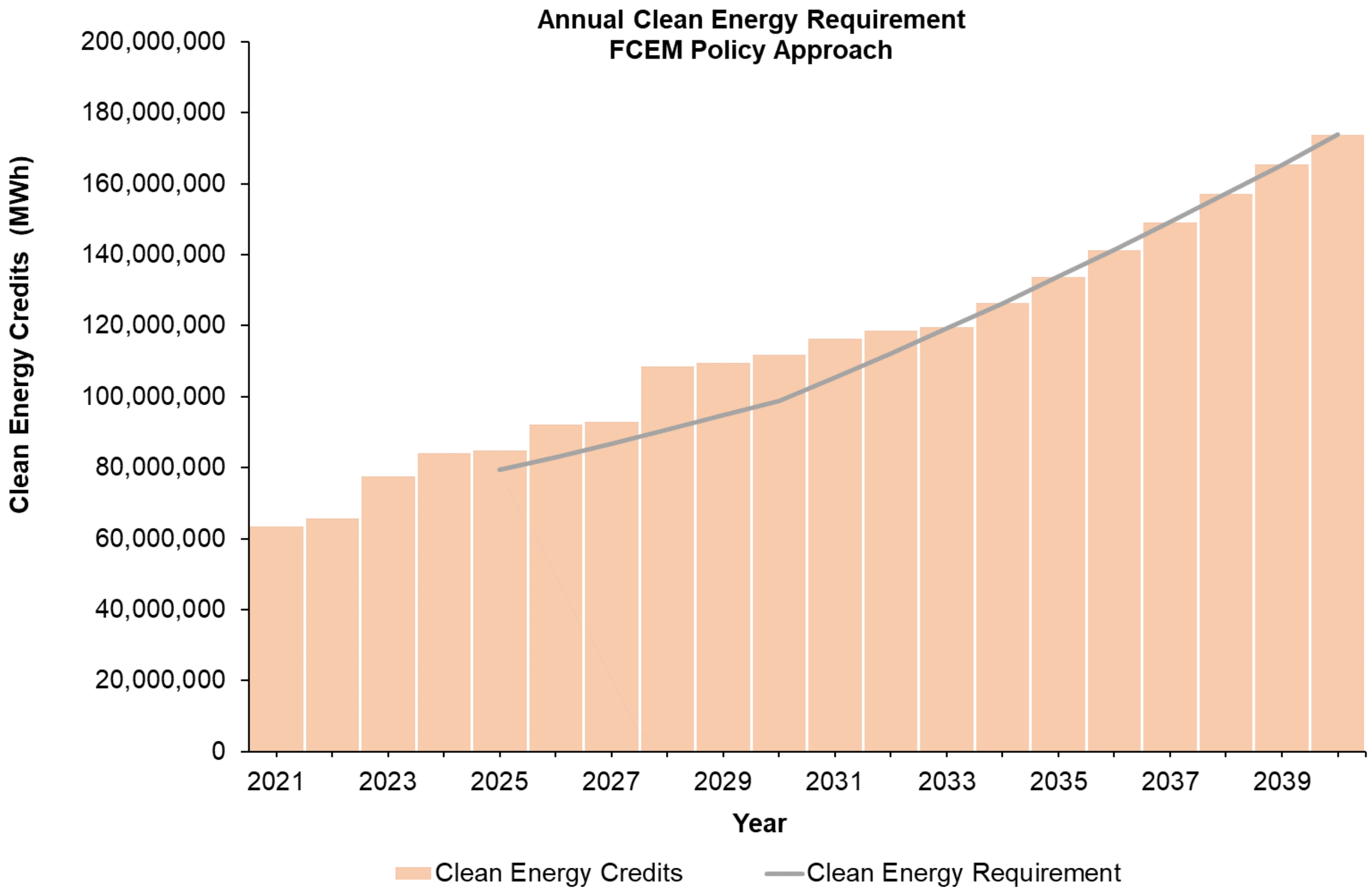
Central Case Results - FCEM: Clean Energy



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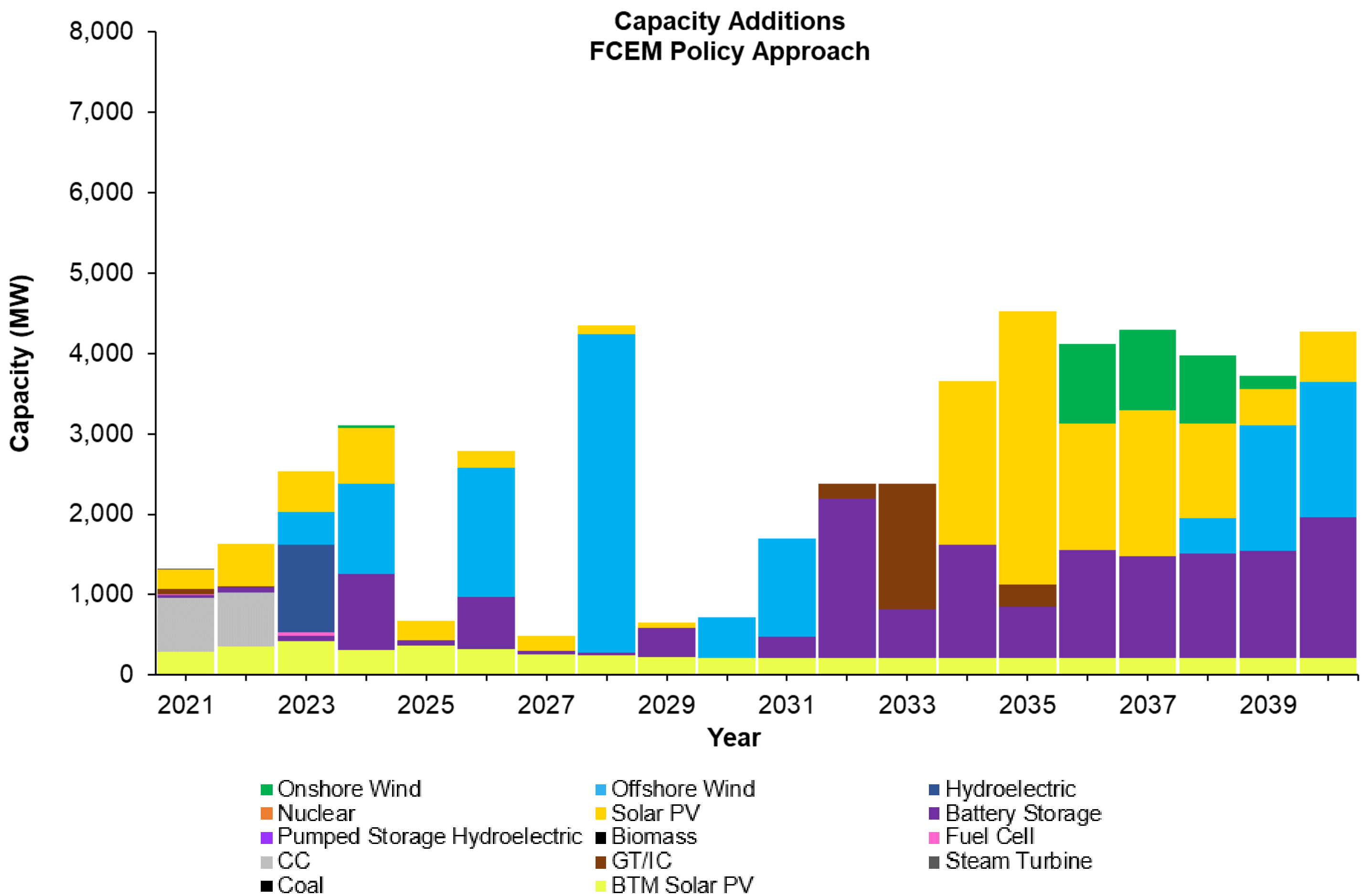
Central Case Results - FCEM: Resource Additions



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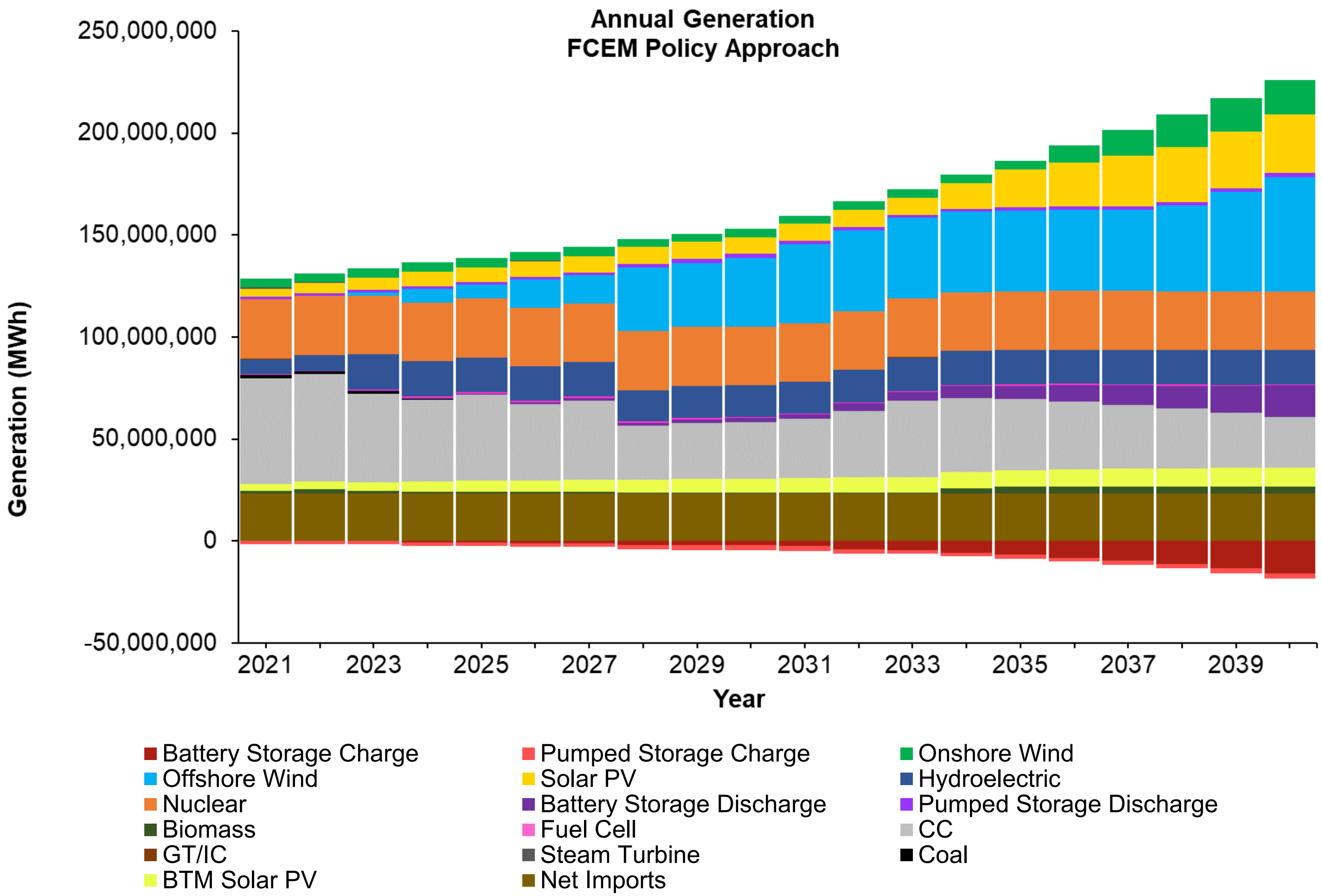
Central Case Results - FCEM: Energy Mix



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Updated Central Case Results – Status Quo

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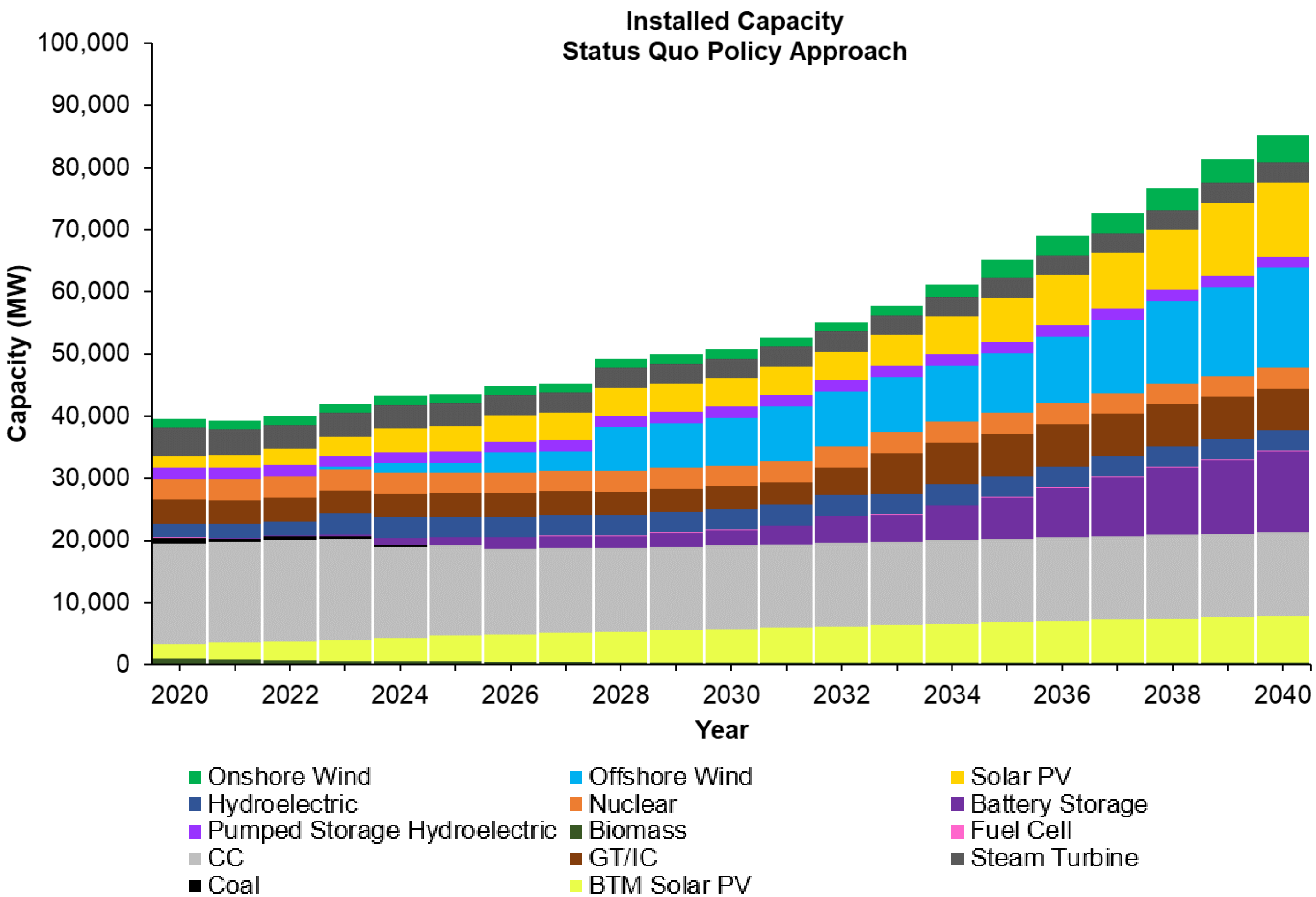
Central Case Results - SQ: Resource Mix



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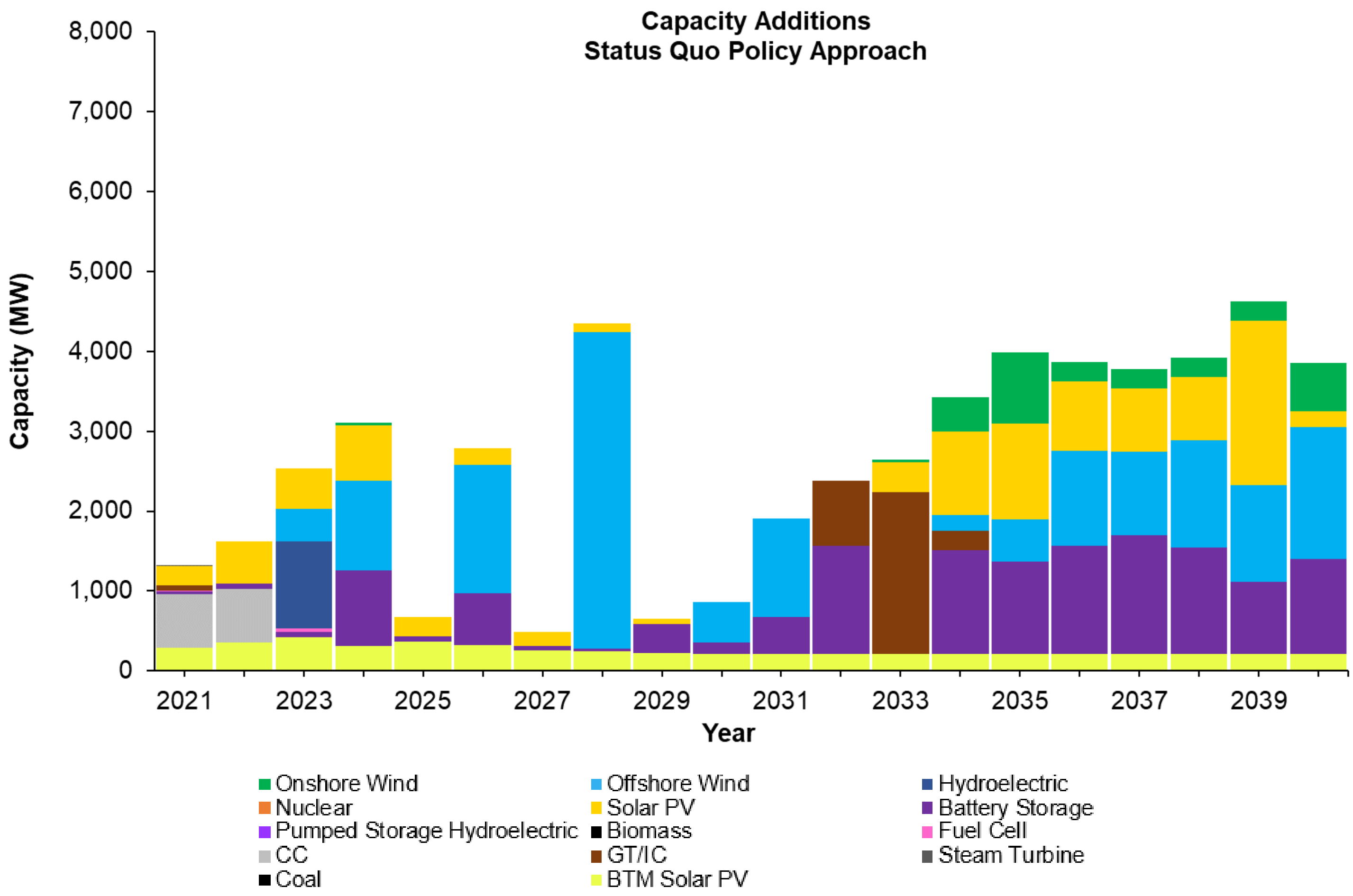
Central Case Results - SQ: Resource Additions



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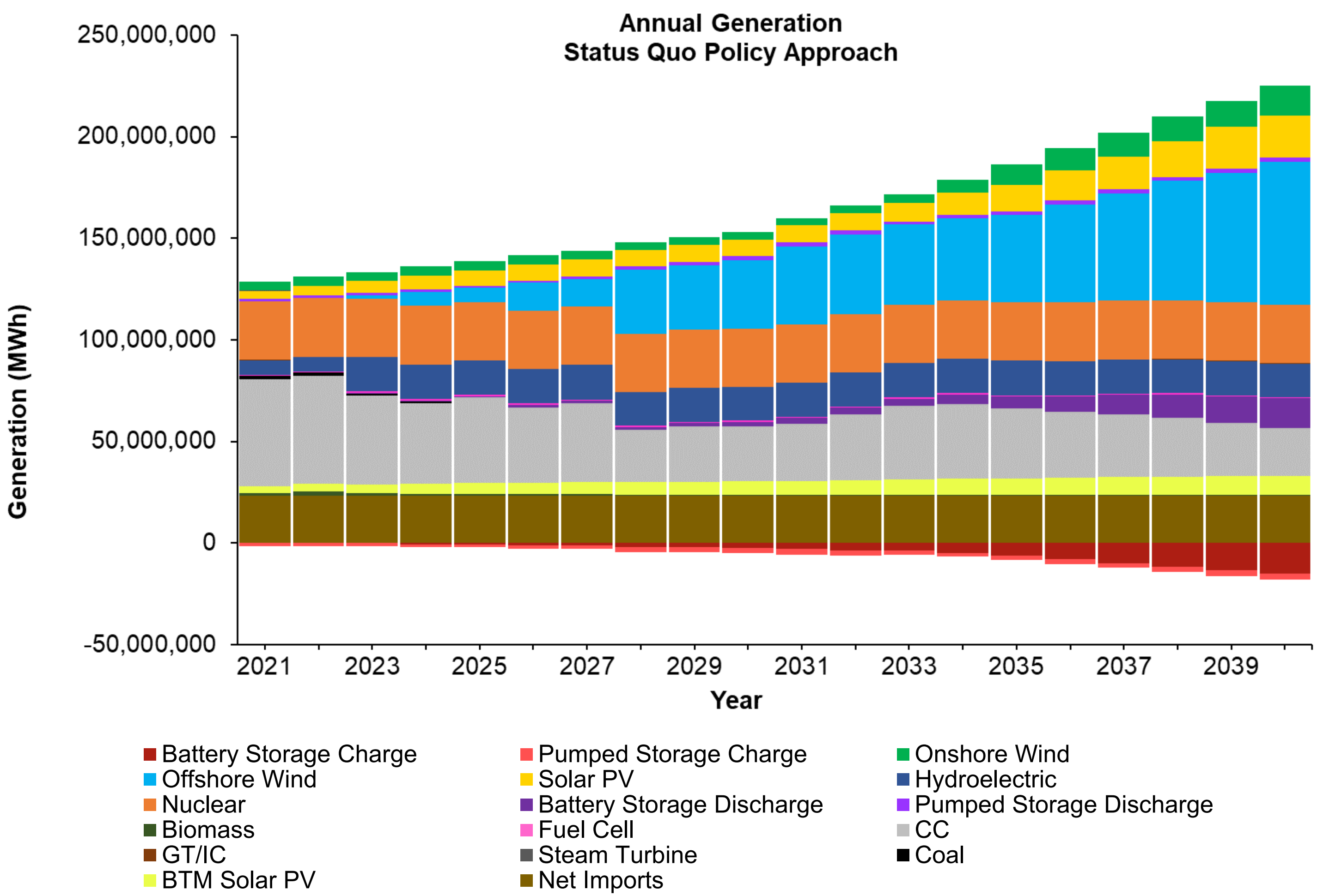
Central Case Results - SQ: Energy Mix



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Updated Central Case Results - HYB

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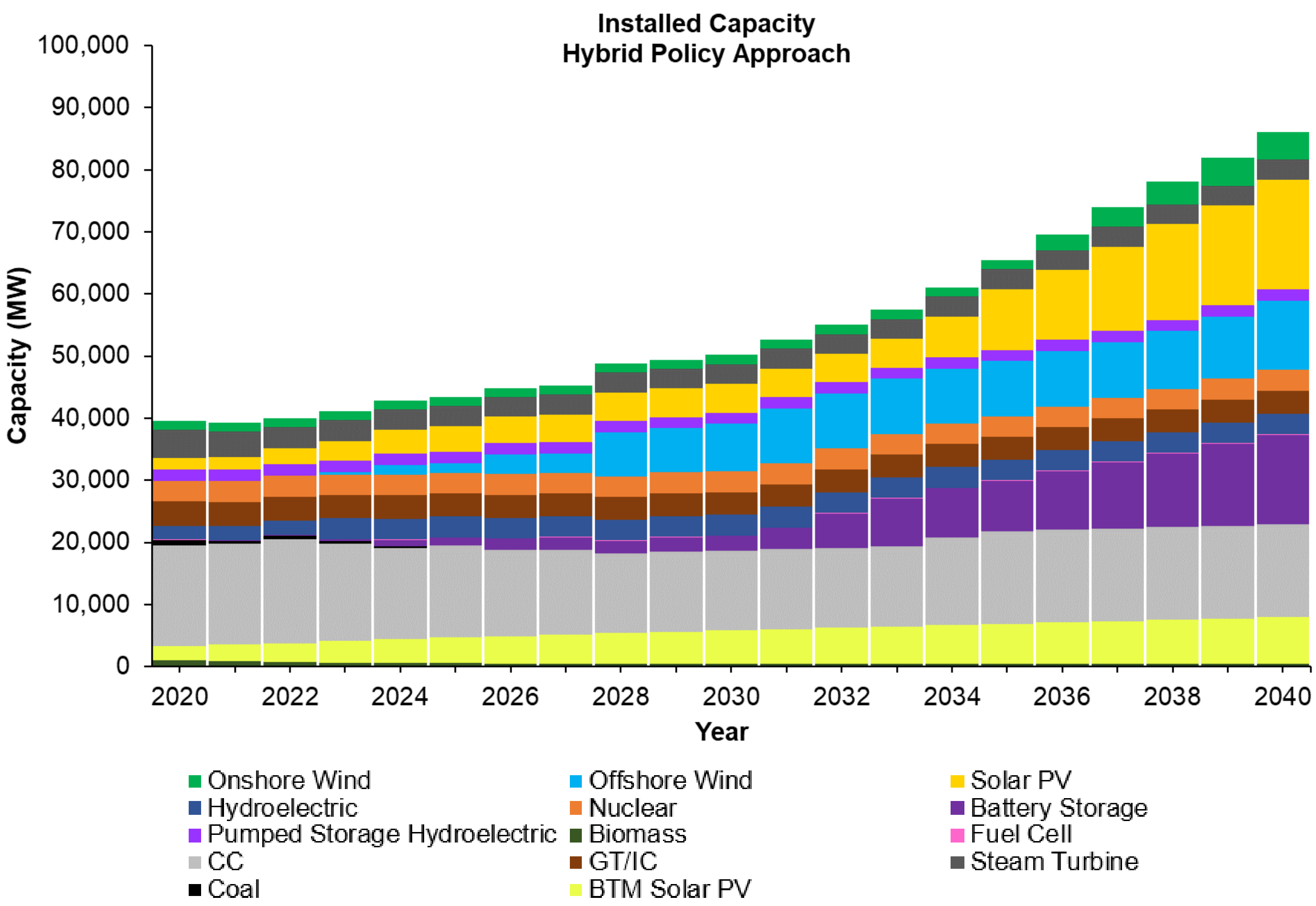
Central Case Results - HYB: Resource Mix



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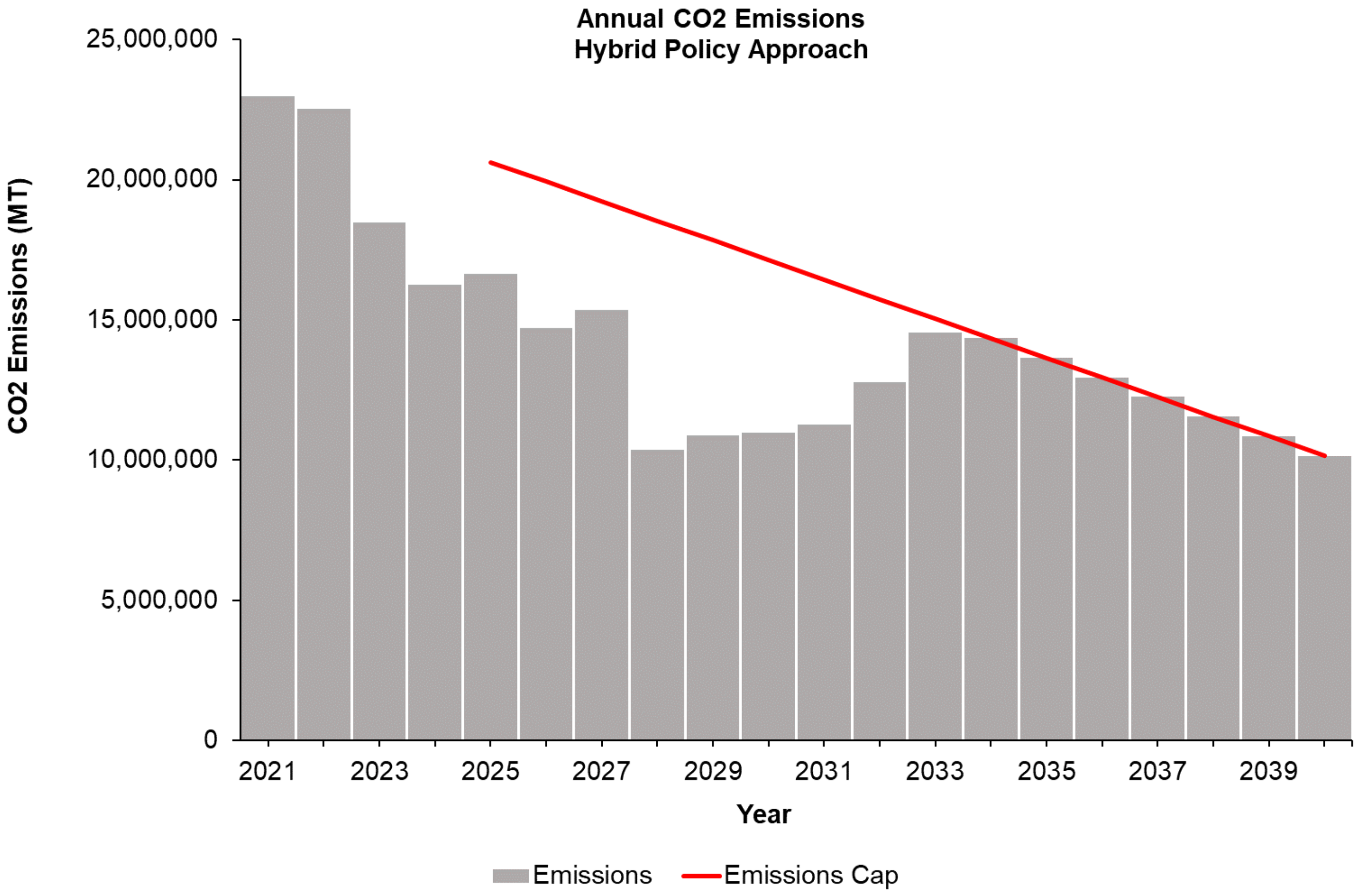
Central Case Results - HYB: Carbon Emissions



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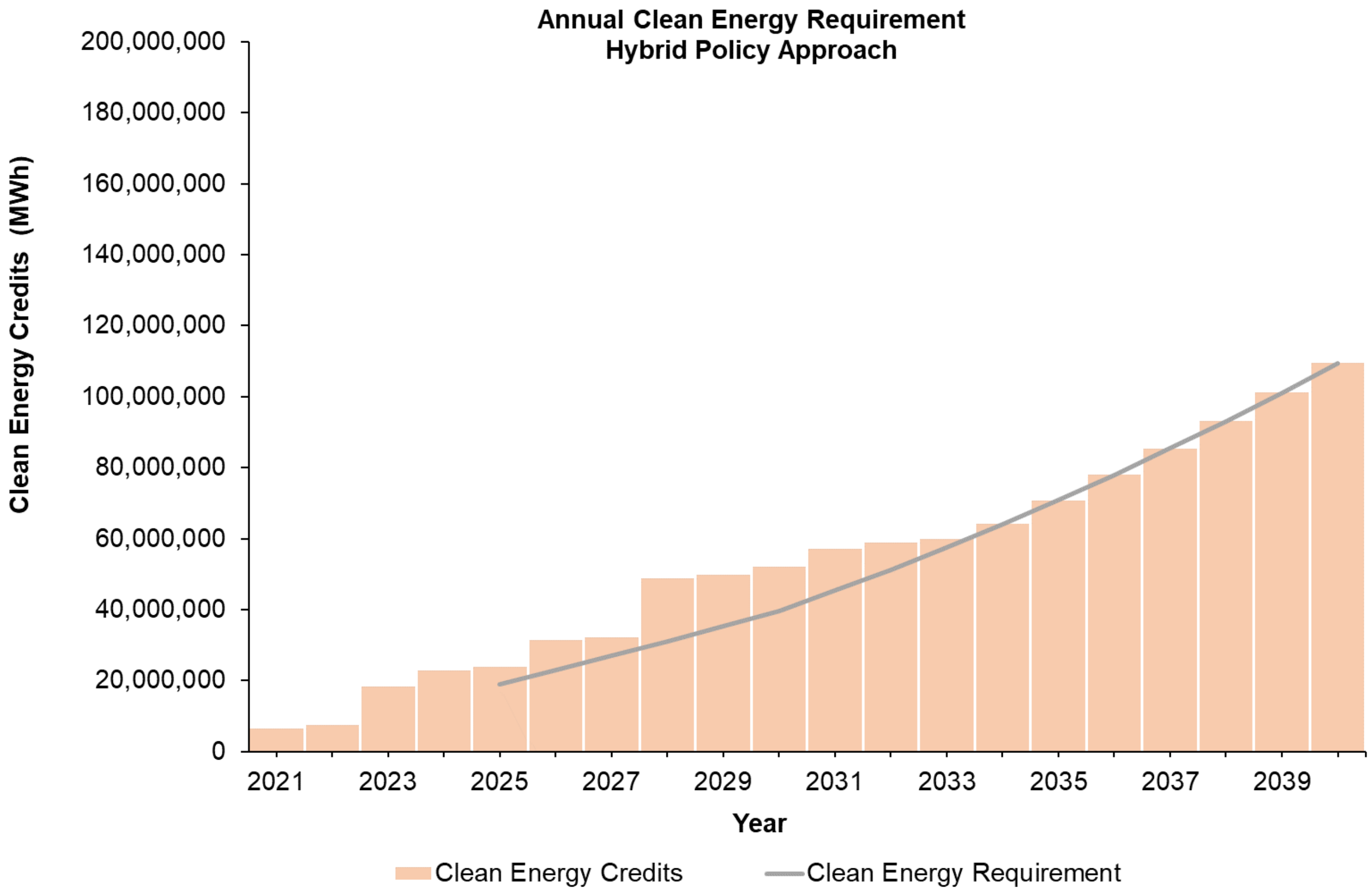
Central Case Results - HYB: Clean Energy



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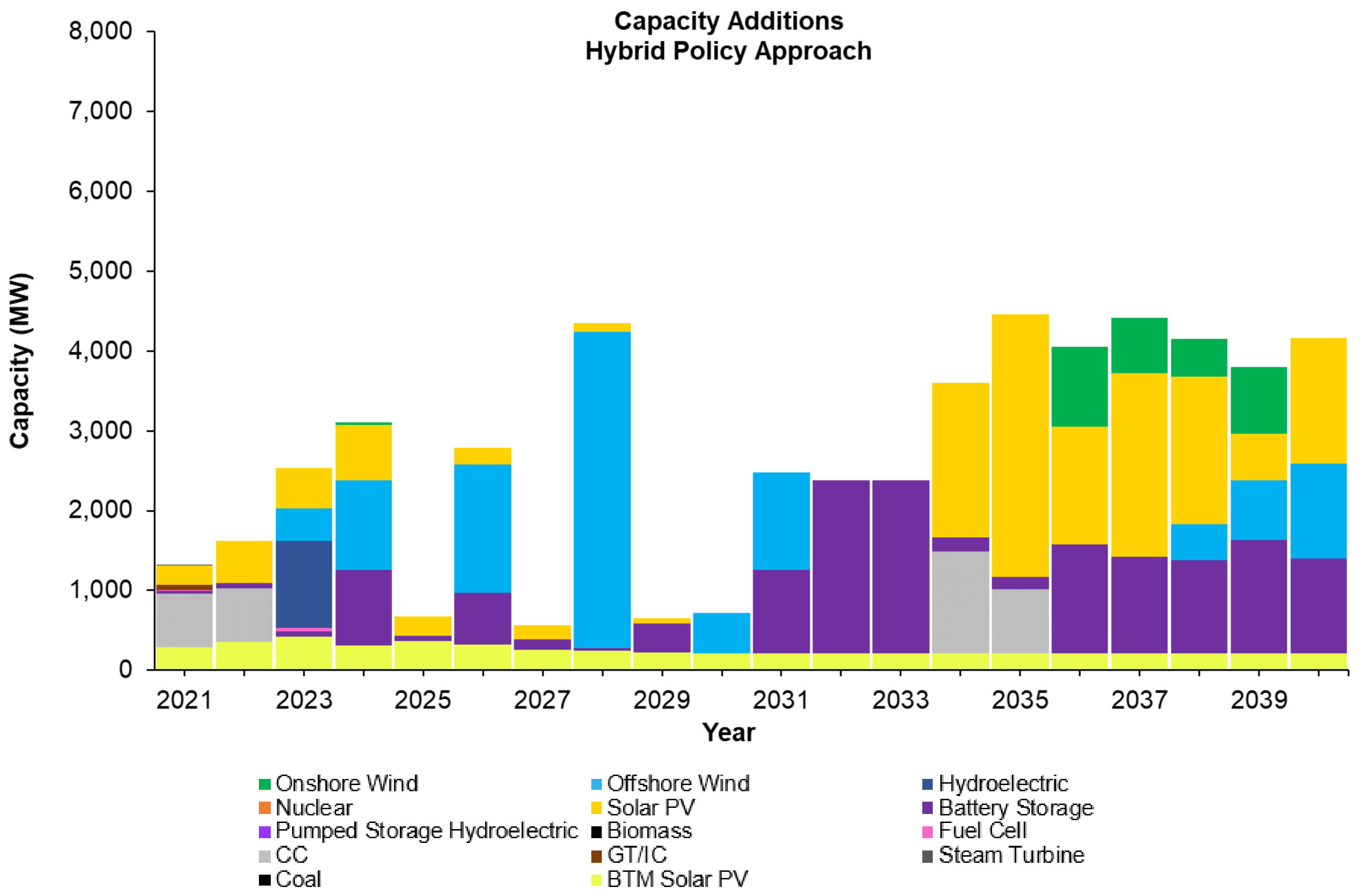
Central Case Results - HYB: Resource Additions



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Central Case Results - HYB: Energy Mix