March 30, 2021

MEMORANDUM

TO: **Council Members**

FROM: **John Ollis, Manager of Planning and Analysis**

SUBJECT: **Summary of Coal Retirement Scenario Findings**

BACKGROUND:

Presenter: Gillian Charles, John Ollis and Ben Kujala

Summary: The work on this scenario thus far has focused on early retirement of coal plants inside and outside the region. An early retirement date of 2027 for all in-region and 2030 for out-of-region coal plants was set to test the combined effect on regional resource strategies. In comparison to the baseline, this results in nearly 15 gigawatts nameplate of additional coal generation retiring before the end of the plan.

Some needs assessment and resource strategy analysis information from this presentation is pending as staff analyzes ongoing simulation results.

Relevance: One of the least expensive methods for reducing greenhouse gas emissions in the Seventh Plan, was the retirement of coal generation. The goal of this scenario is to inform resource strategy development in comparison to other emissions reduction techniques or policies.

Workplan: A.6.1 Complete scenario analysis for the plan

More Info: Simulation results related to this scenario will be discussed at the upcoming March 31st System Analysis Advisory Committee (SAAC), and

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were discussed previously at the March 24th Power Committee and the March 17th SAAC.

March 24 Power Committee Webinar

March 19 Update to SAAC

March 17 SAAC Results

March 17 Scenario Background

Early Retirement of Coal Scenario

Council Meeting – April 7, 2021

Gillian Charles, John Ollis, Ben Kujala

THE 2021
NORTHWEST
POWER PLAN
FOR A SECURE & AFFORDABLE
ENERGY FUTURE

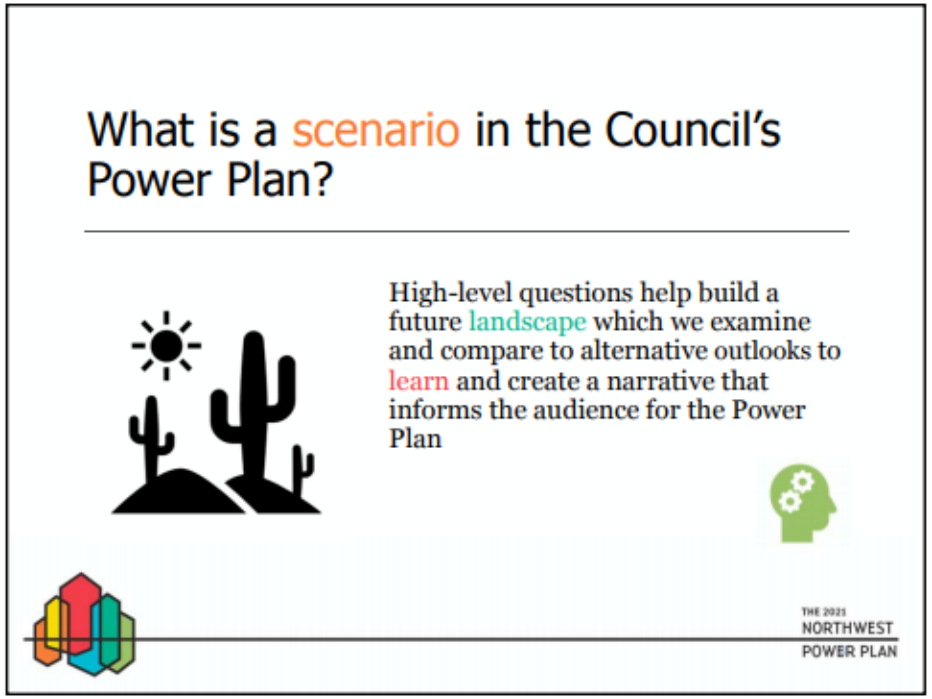
For discussion today…

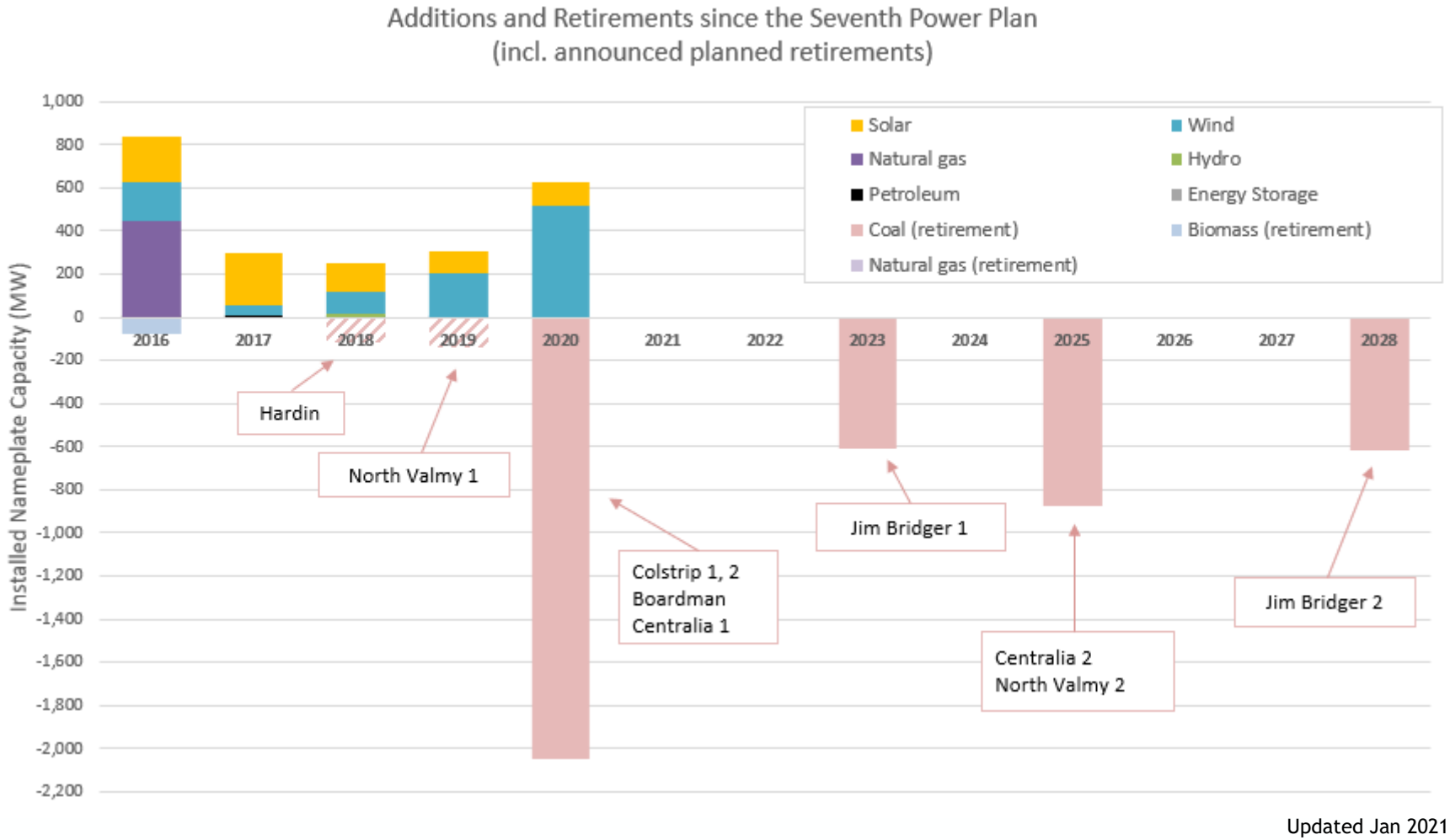
- **Setting up the scenario** – what are we exploring and what are the assumptions?
- **Draft results**

Scenario assumptions

Proposed Coal Retirement Scenario: 2021 Power Plan

- Purpose: to analyze effect on resource strategies of 100% coal retirements in the region/WECC
  - What does this do to emissions, system cost?
  - What are the replacement resources?
  - How to maintain adequacy and reliability?
- High level parameters – Retire all coal by
  - **2027 for Region**
  - **2030 for WECC**





Updated Jan 2021

Planned retirements based on agreements, announcements, IRPs; subject to change
Hardin Generating Station was sold to an out-of-region cryptocurrency company; therefore no longer "counts" towards the region
Idaho Power ended its participation in North Valmy 1 in Dec 2019; unit will likely retire in 2021 (NV Energy)
Uncertainty remains over timing of Jim Bridger 1,2 potential accelerated retirements
Uncertainty remains over Idaho Power's participation in North Valmy 2; may divest ownership in 2022, with unit retiring in 2025
Colstrip 3,4 owners have discussed potential retirement dates, but nothing official announced

Data source: Council's project database

Region Assumptions: Retire all coal units by 2027

Coal Plant Unit	Nameplate Capacity (MW)	Announced/Existing Retirement Date (EOY)	Baseline Conditions*	Scenario: Early Retirement (EOY)
Colstrip Unit 1	358	2019	Retired	Retired
Colstrip Unit 2	358	2019	Retired	Retired
Boardman	601	2020	Retired	Retired
Centralia 1	730	2020	Retired	Retired
North Valmy 1	277	2019**/2021	Retired	Retired
Centralia 2	730	2025	2025	2025
North Valmy 2	289	2025	2025	2025
Jim Bridger 1	608	2023	2023	2022
Jim Bridger 2	617	2028***	2028	2026
Colstrip 3	778	--	2037	2025 (WA Legislation)
Colstrip 4	778	--	2037	2025 (WA Legislation)
Jim Bridger 3	608	--	2037	2026
Jim Bridger 4	608	--	2037	2026

Accelerated coal unit retirement

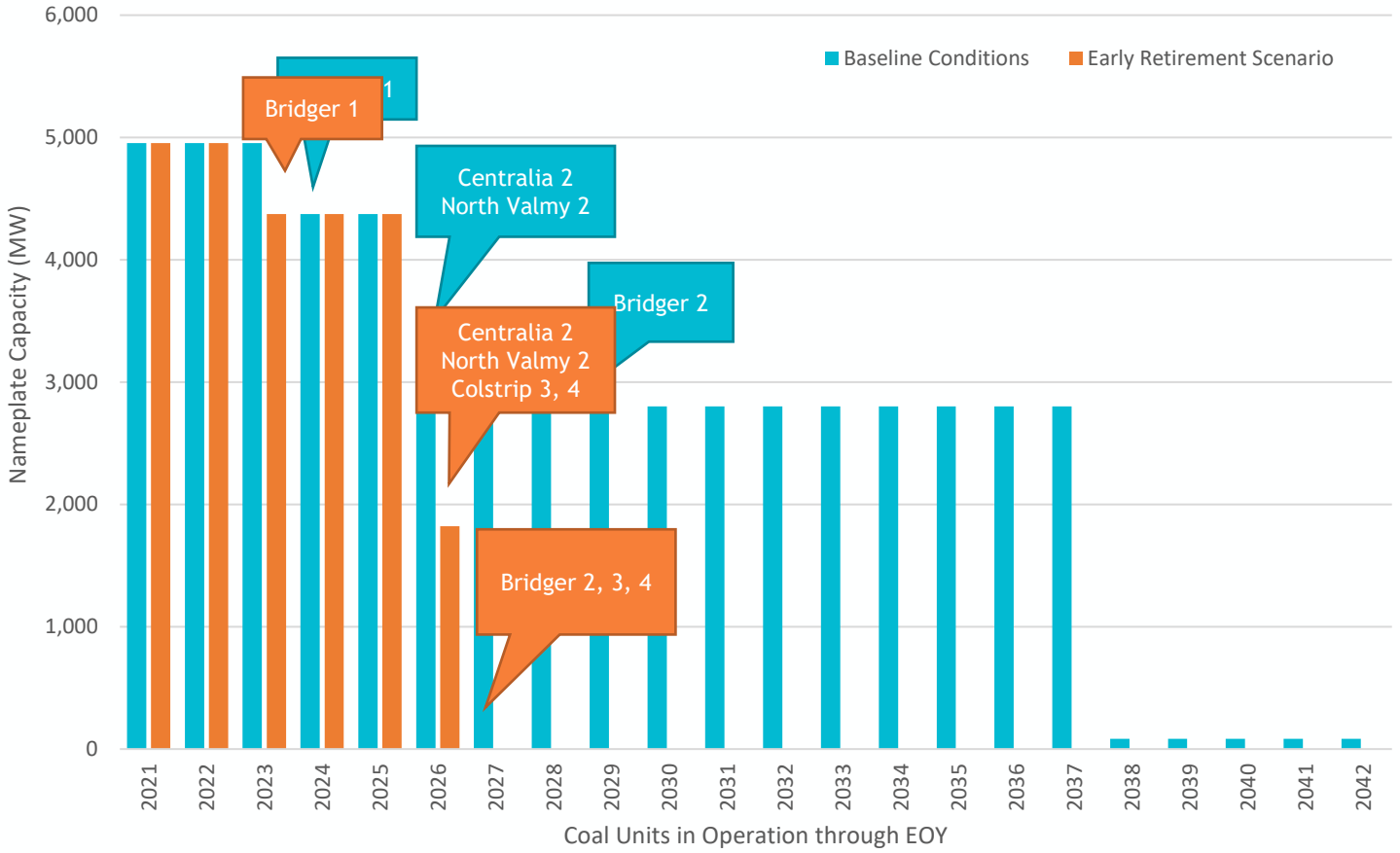
EOY = End of Year

* Baseline conditions – announced retirement date or expected end-of-useful life estimate

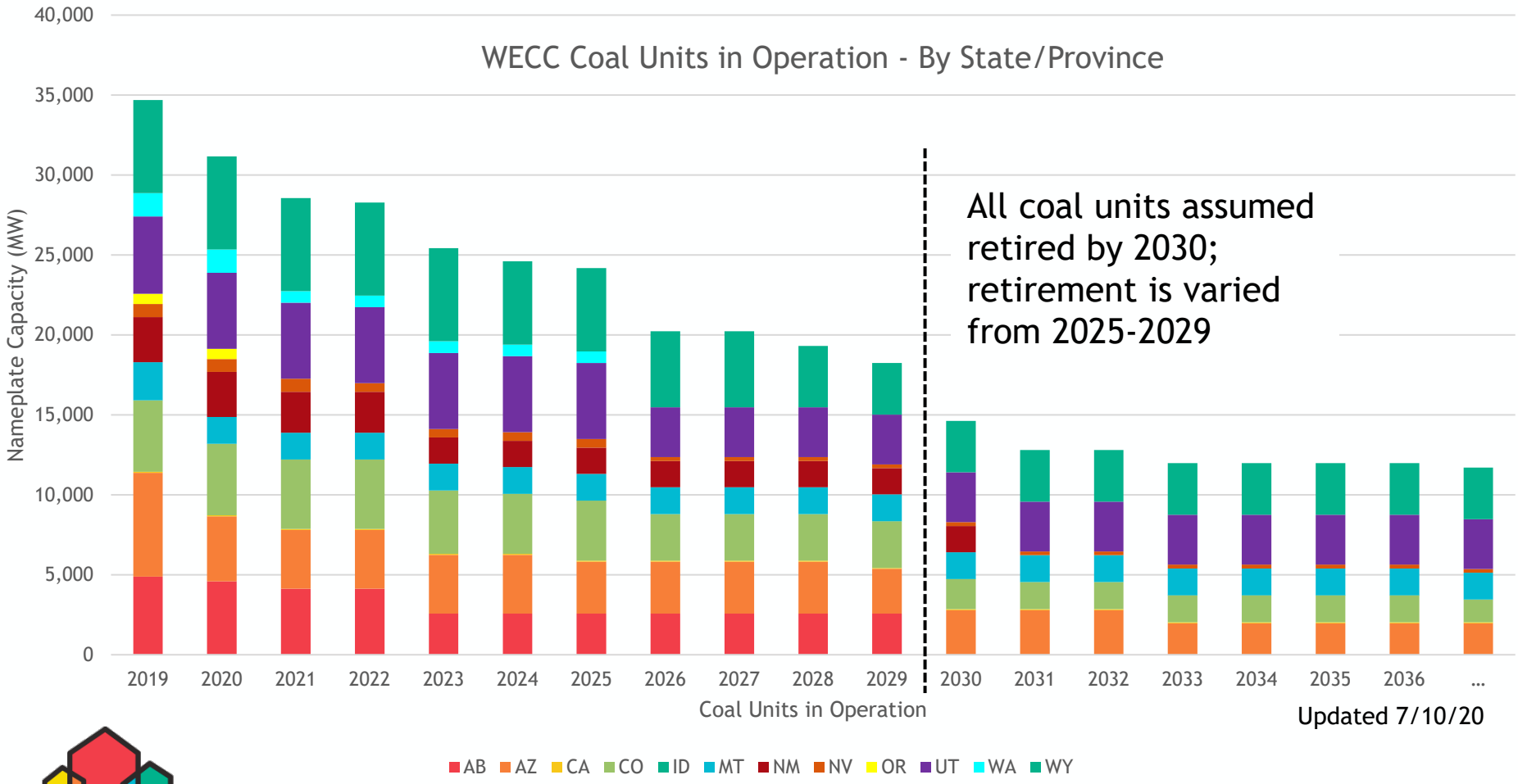
** Idaho Power ended it's participation in North Valmy 1 in 2019

*** PAC and IPC still working out details of the accelerated retirement of Bridger 2, date could be considered tentative.

Coal Unit Retirements: Baseline Conditions vs. Early Retirement



WECC Assumptions: Retire all coal units by 2030



Updated 7/10/20

Status of Colstrip 3, 4

	Colstrip 3	Colstrip 4
Nameplate Capacity (MW)	778 MW	778 MW
Location	Rosebud, MT	Rosebud, MT
Owners	Talen (30%) Puget Sound Energy (25%) Portland General Electric (20%) Avista (15%) PacifiCorp (10%)	NorthWestern Energy (30%) Puget Sound Energy (25%) Portland General Electric (20%) Avista (15%) PacifiCorp (10%)

Considerations:

- Washington's Clean Energy Transformation Act (CETA): **No coal by end of year 2025**
  Subject to deadline: PSE, Avista, PAC
- Oregon's Clean Electricity & Coal Transition Plan: **No coal by 2030**
  Subject to deadline: PGE, PAC
  (PGE has special extension until 2035)

Photo from Talen Energy

Future of Colstrip 3, 4

Puget Sound Energy: Exit Colstrip 3, 4 by EOY **2025**

Portland General Electric: Exit Colstrip 3, 4 by **2035**

Avista: Exit Colstrip 3, 4 by EOY **2025** (for WA customers); Draft 2021 IRP – Most economic to exit units 3, 4 earlier than 2025 (for WA and ID customers)

PacifiCorp: Assumed early exit of **2027** in 2019 IRP – most economic option in preferred portfolio; end of useful life assumed in 2037; further analysis underway for draft 2021 IRP

NorthWestern Energy: Continue operations; end of useful life **2042**

Talen Energy: Continue operations

Potential Future Options:

- Sell/transfer ownership shares and continue running one or both units
- Retire units 3, 4
- Consider Carbon Capture and Sequestration at Colstrip
- Consider brownfield development of small modular nuclear (SMR) or enhanced geothermal systems (EGS)

Status of Bridger 3, 4

	Jim Bridger 3	Jim Bridger 4
Nameplate Capacity (MW)	608 MW	608 MW
Location:	Sweetwater County, WY	Sweetwater County, WY
Owners:	PacifiCorp (66.7%) Idaho Power (33.3%)	PacifiCorp (66.7%) Idaho Power (33.3%)

Considerations:

- Washington's Clean Energy Transformation Act (CETA): **No coal by end of year 2025**
  Subject to deadline: PAC
- Oregon's Clean Electricity & Coal Transition Plan: **No coal by 2030**
  Subject to deadline: PAC

Photo from Andrew Graham/WyoFile

Future of Bridger 3, 4

PacifiCorp: Exit by 2030 for OR customers; Assumed retirement in 2037, as part of 2019 IRP preferred portfolio; further analysis underway for draft 2021 IRP

Idaho Power: Exit by 2028 and 2030 (unit order TBD), as identified in the 2019 IRP update.

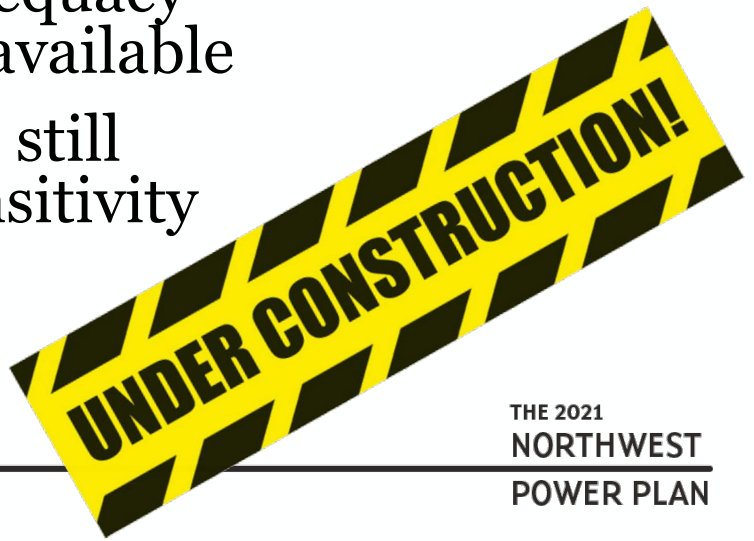
While several early retirement dates are being considered, Idaho Power and PacifiCorp have not come to any official decision or agreement about these units.

Potential Future Options:

- Run units until end of useful life, as determined by owners
- Accelerate retirement for one or both units
- Other?

Sensitivity Study: Run Colstrip 3, 4 to 2042(?)

- Run a sensitivity that allows Colstrip 3 and 4 to run through 2042 (date TBD)
  - Colstrip 3 and 4 have six owners between the two units
  - Each owner has a preferred strategy for the future operation of the unit(s)
  - In NorthWestern Energy's 2020 Supplement to the 2019 Electricity Supply Resource Procurement Plan, Colstrip 4 runs through 2042
- Purpose: Test the reliability and adequacy of the system with these coal units available
- Logistics around this sensitivity are still under development; it may be a sensitivity to a different scenario



Draft Results

WECC Buildout, Mid-C Prices, Emissions, Adequacy Need

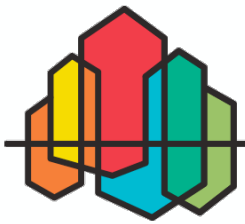
Summary

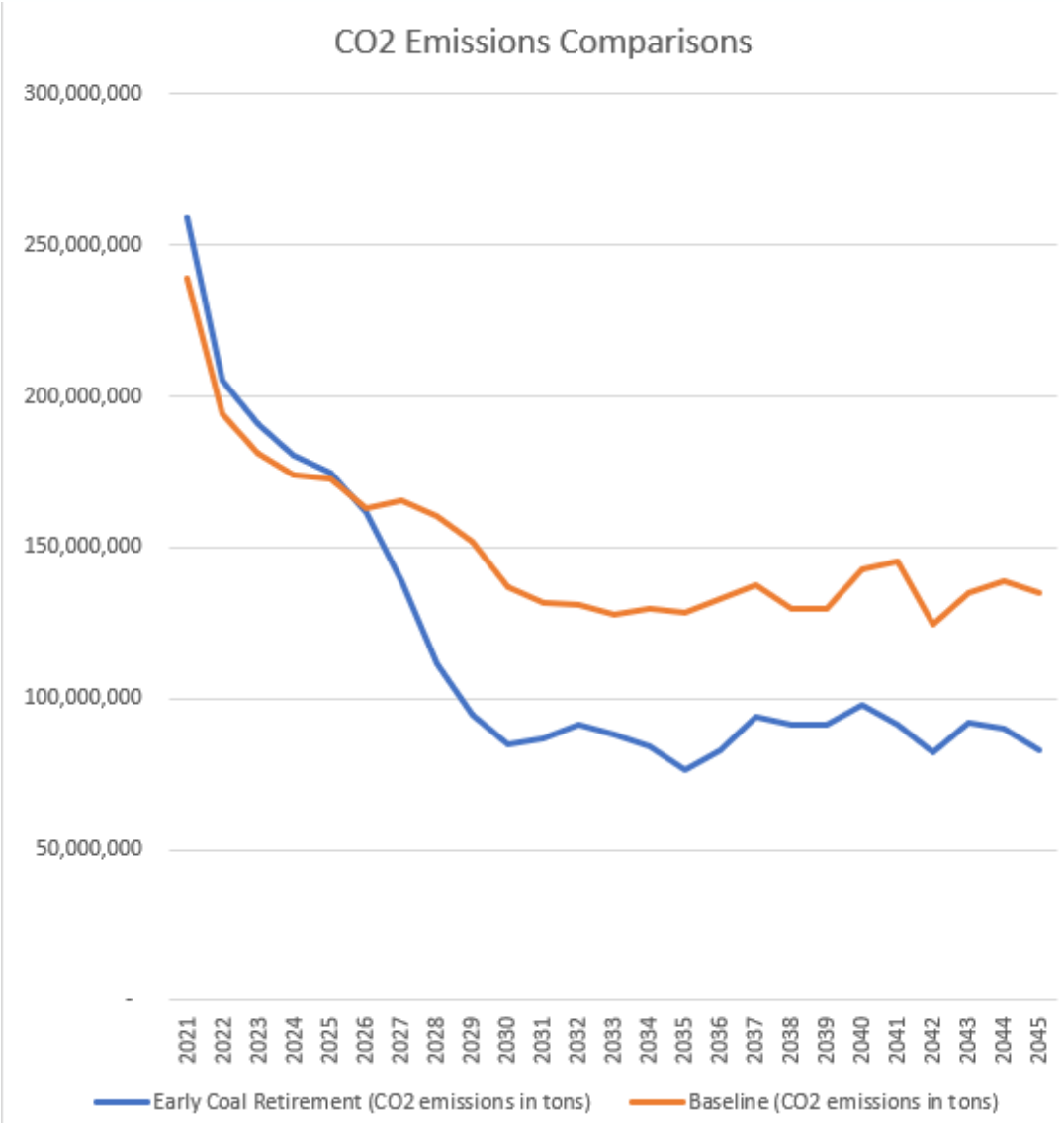
- Bigger WECC buildout from early coal retirement than in baseline.
- Emissions and market emissions rate drop considerably in early coal retirement scenario in comparison to baseline.
- Market prices are slightly lower in later years than in the baseline.
- Needs shift from early 2020's in the baseline, to 2027 and 2031 after the early coal retirements.

Summary of Revised Results

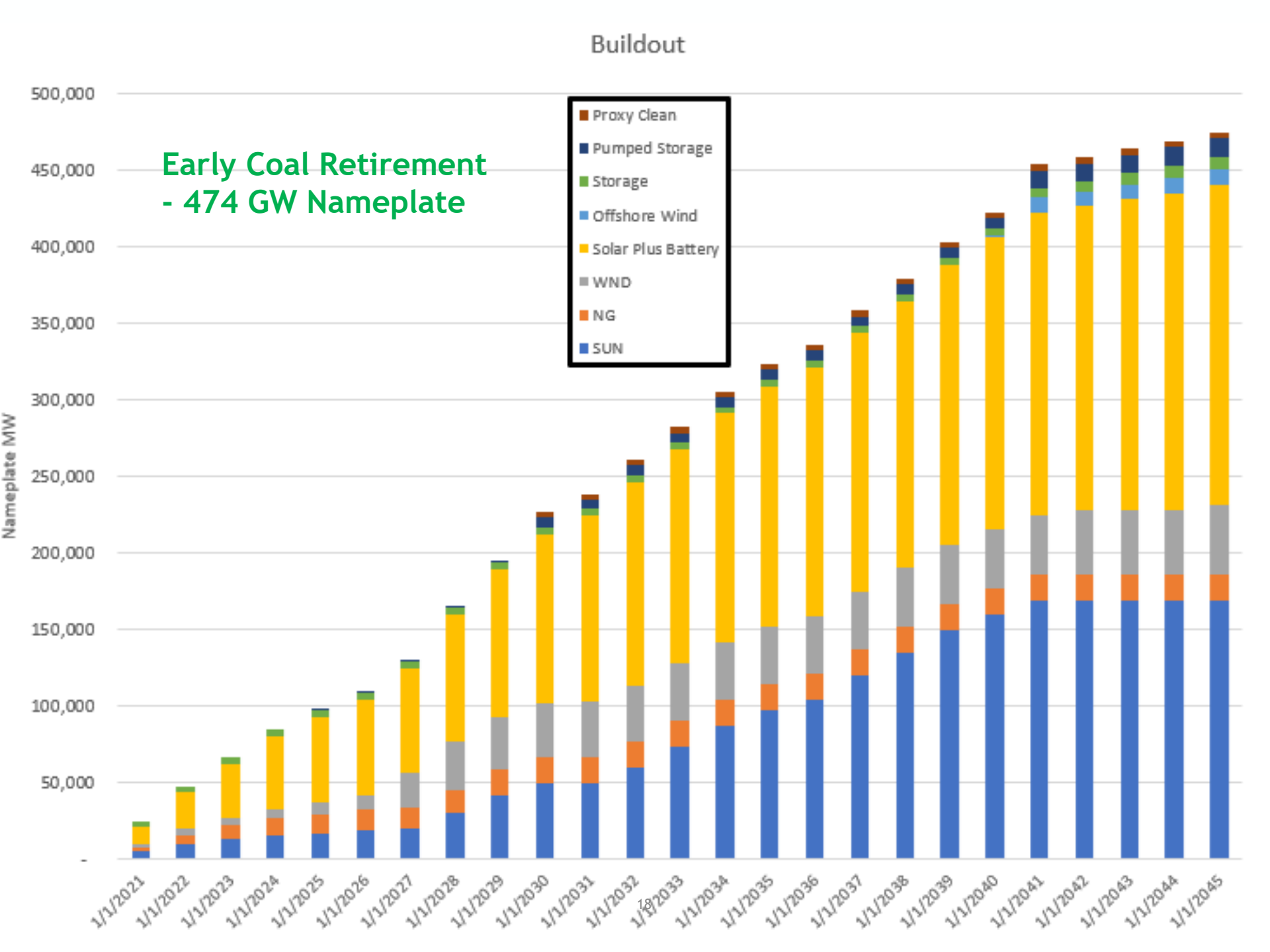
Overall WECC build is 45 GW higher than baseline

1. CO_2 Emissions drop by 39% from baseline by 2045
2. Annual/seasonal planning reserve margins are less effective at efficiently enforcing adequacy on a power system with the following characteristics:
   - High penetration of renewables
   - Massive thermal retirements by 2030
3. Clean requirements are more expensive to meet than in the baseline (more renewable curtailment, less overall system flexibility).





Emissions Drop By 38% in 2030 and by 39% in 2045


Buildout
Early Coal Retirement
- 474 GW Nameplate
Proxy Clean
Pumped Storage
Storage
Offshore Wind
Solar Plus Battery
WND
NG
SUN
Nameplate MW
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
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1/1/2036
1/1/2037
1/1/2038
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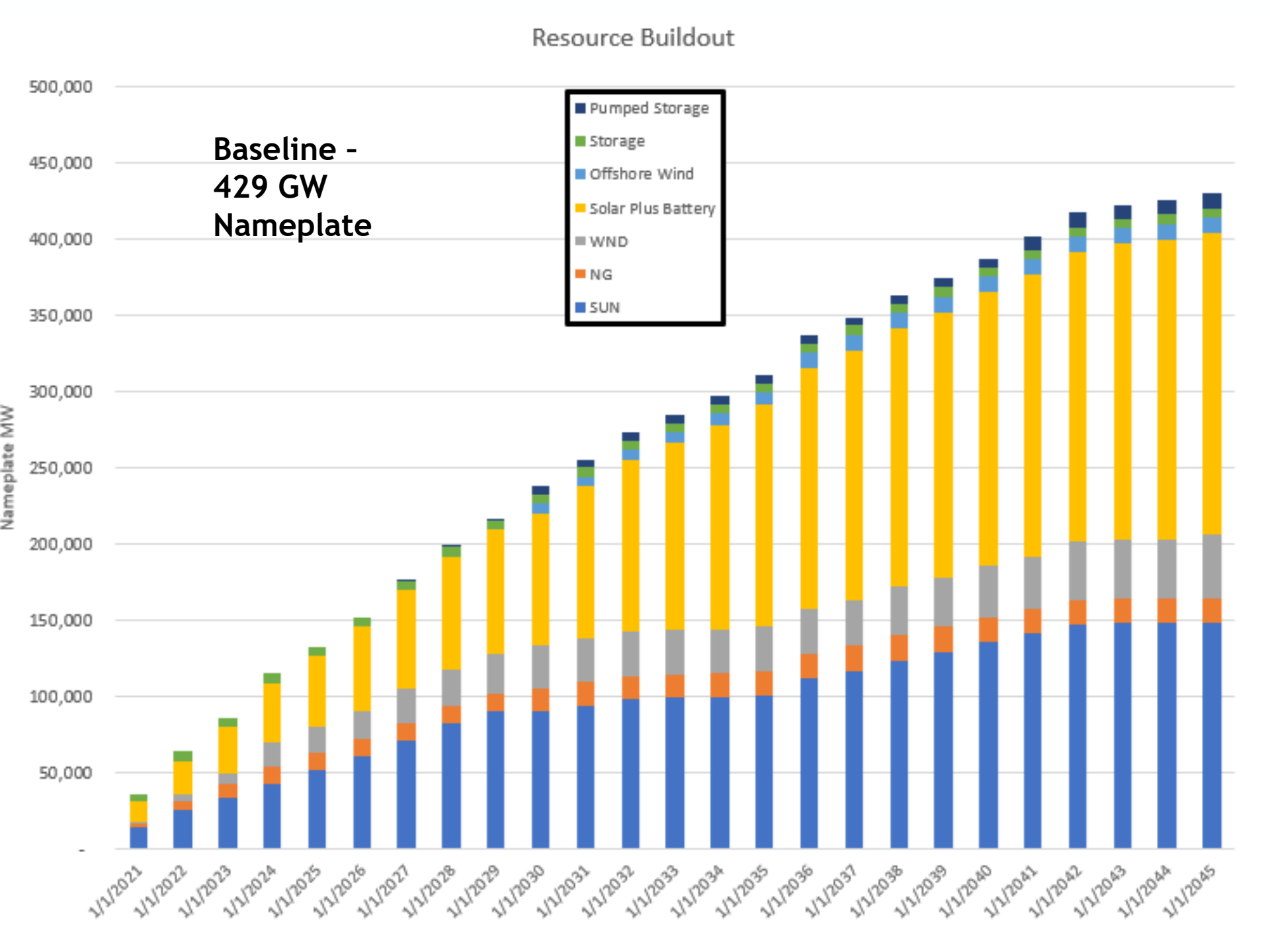
1/1/2044
1/1/2045


Resource Buildout
Baseline – 429 GW Nameplate
Pumped Storage
Storage
Offshore Wind
Solar Plus Battery
WND
NG
SUN
Nameplate MW
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
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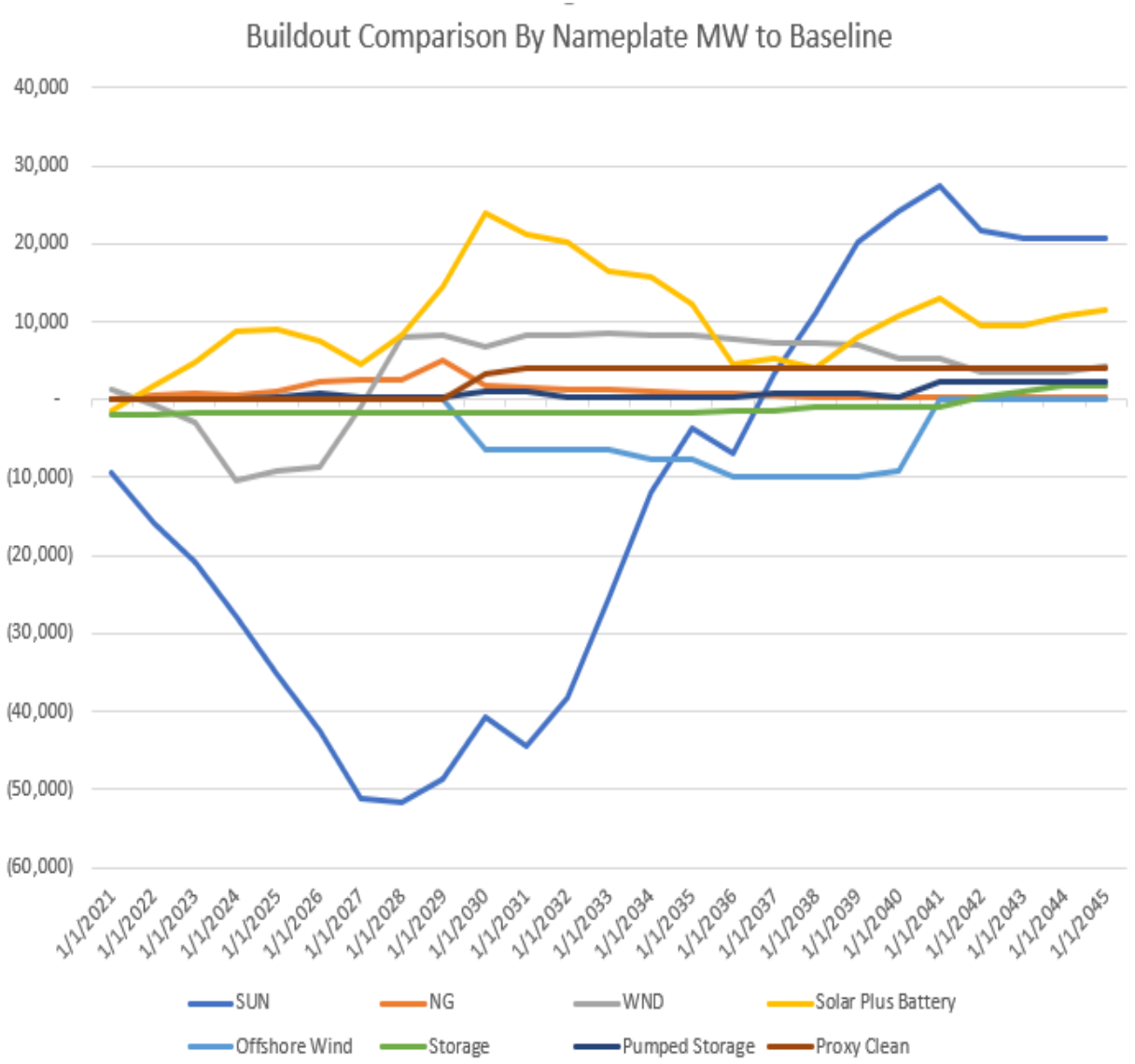
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045

More Builds in a Coal Retirement Scenario

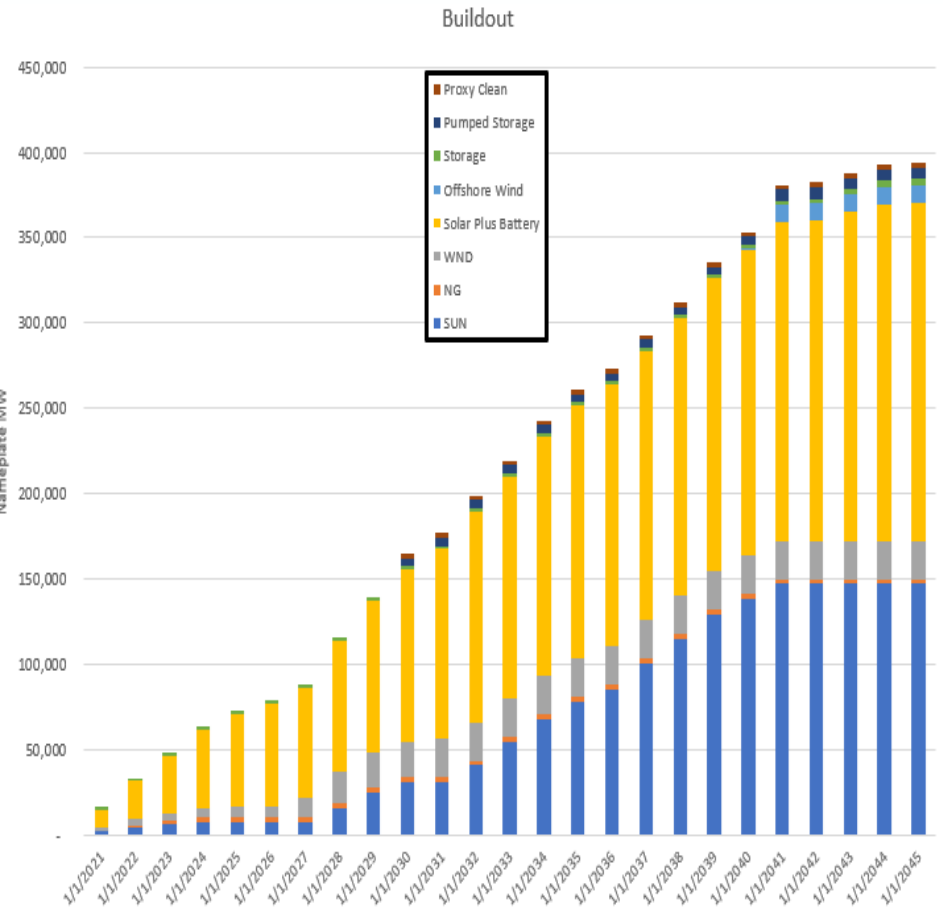
Observations:

1. Less solar early, more late, more solar plus battery.
2. Builds of offshore wind and storage deferred to later in study
3. Proxy clean resource builds in first year available.

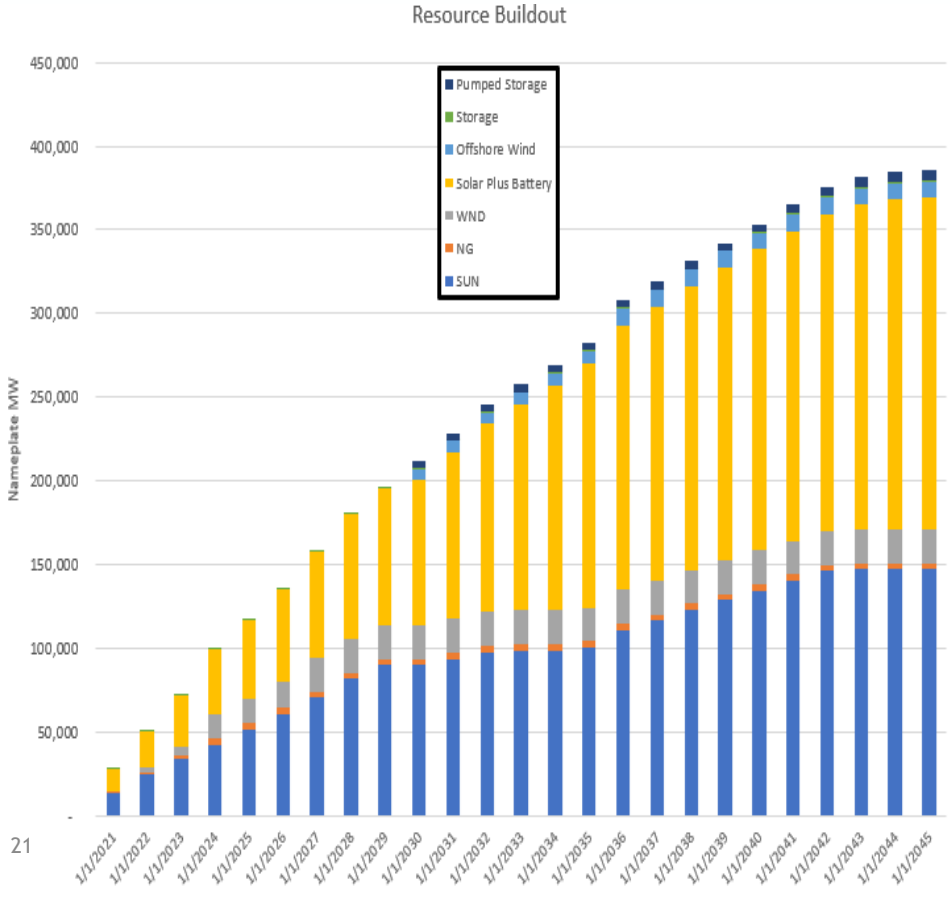


Almost 8 GW more resource built in California, Desert SW and Mexico

Early Coal Retirement

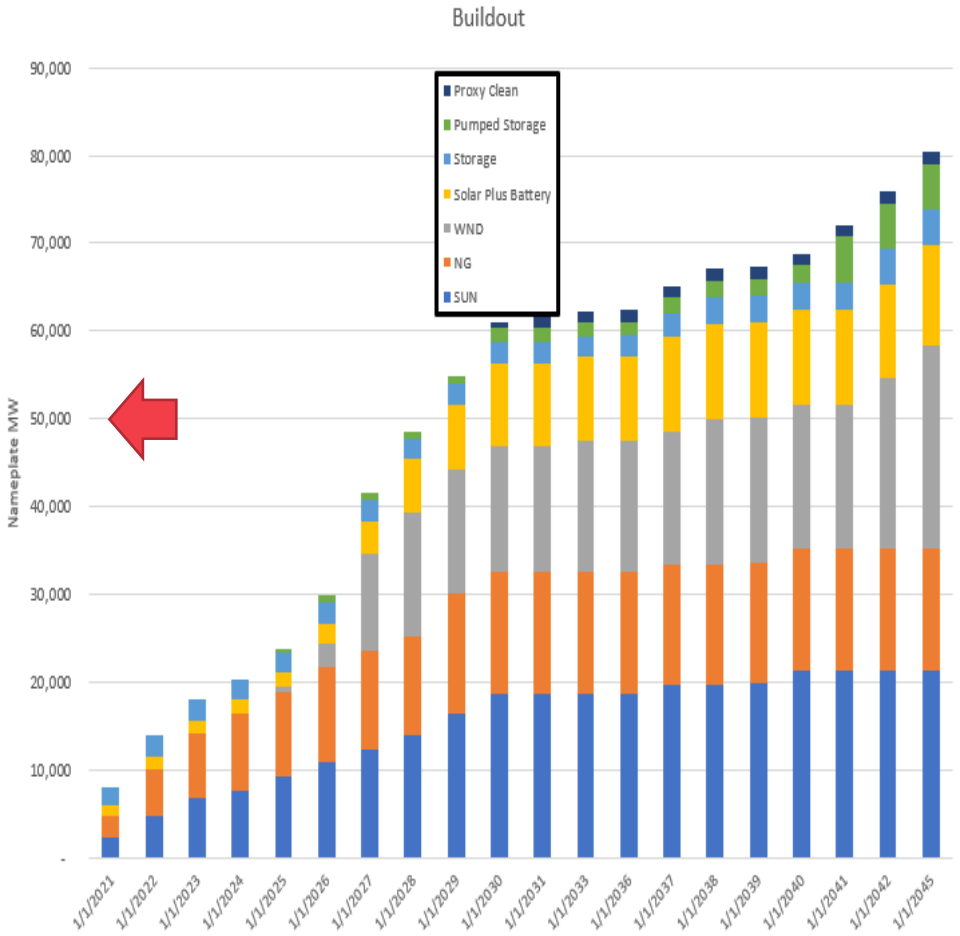


Baseline

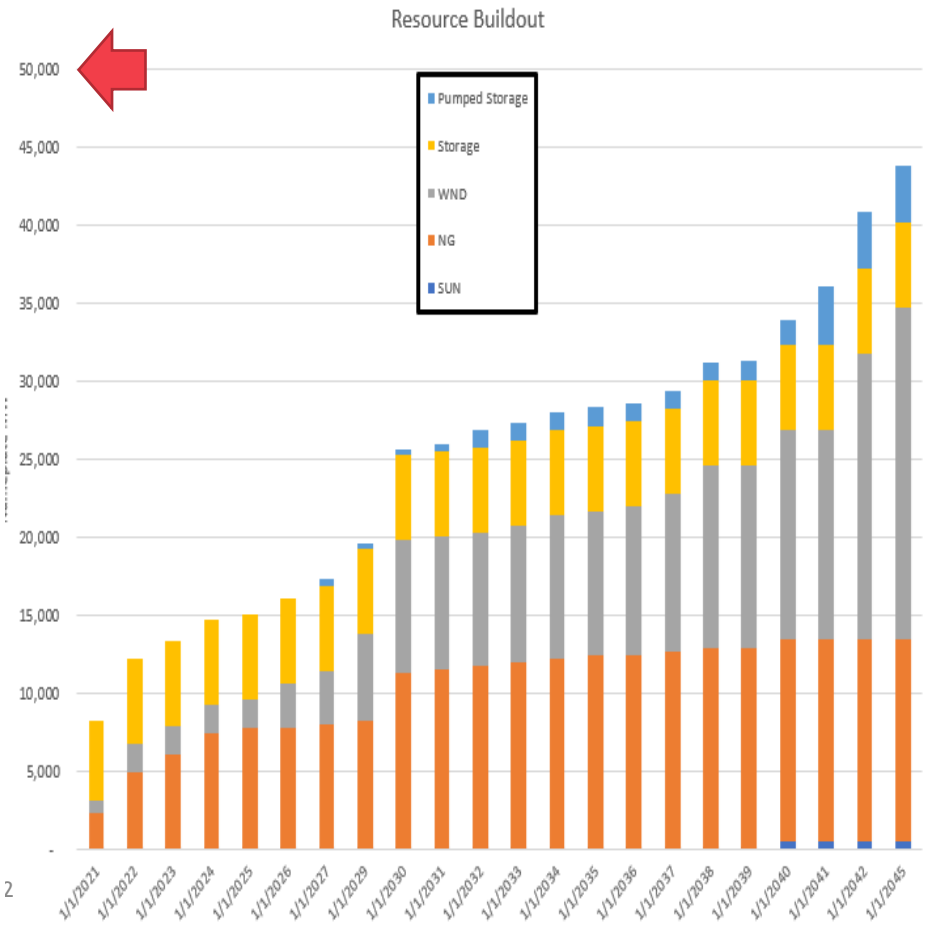


37 GW More Resource Built in the Pacific NW, Mountain West and Canada

Early Coal Retirement

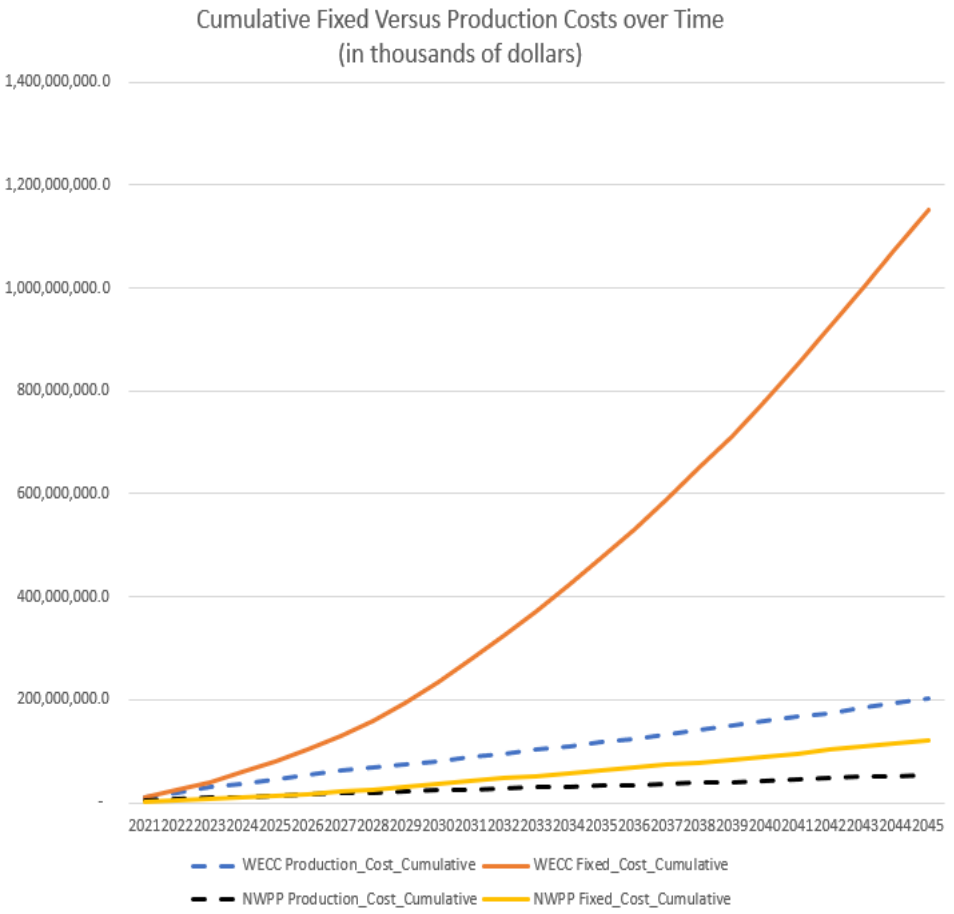


Baseline

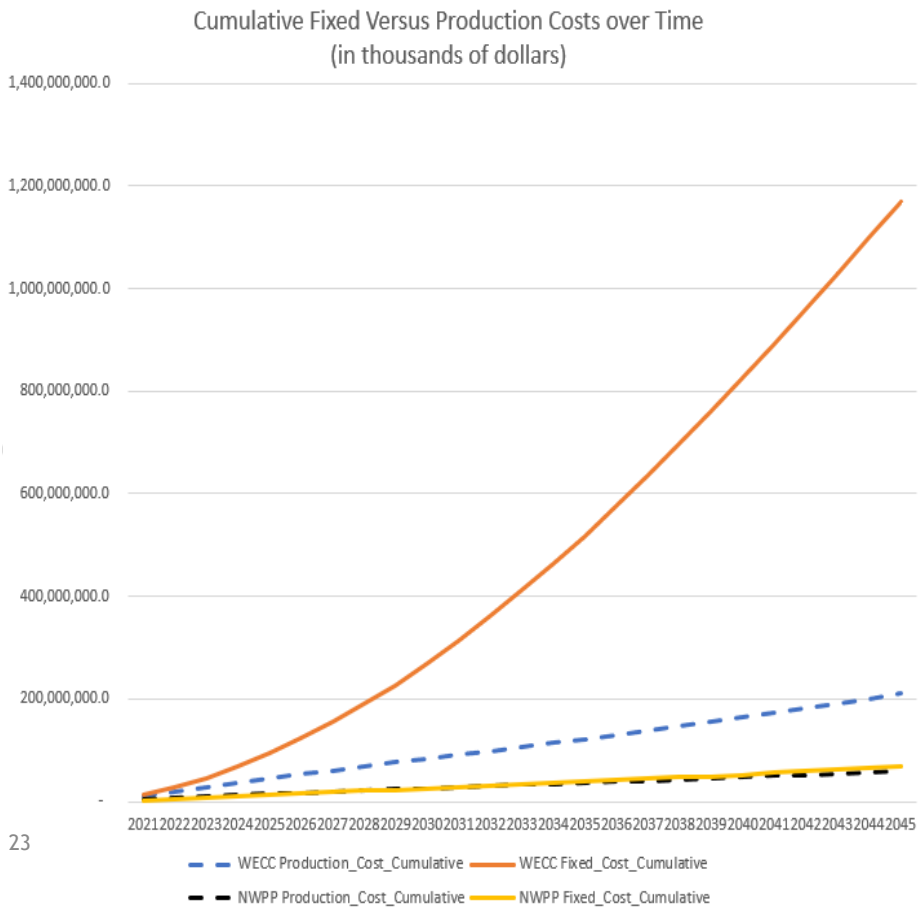


With Larger Build in NW Comes a Higher Proportion of Costs, Costs Similar to Baseline Overall

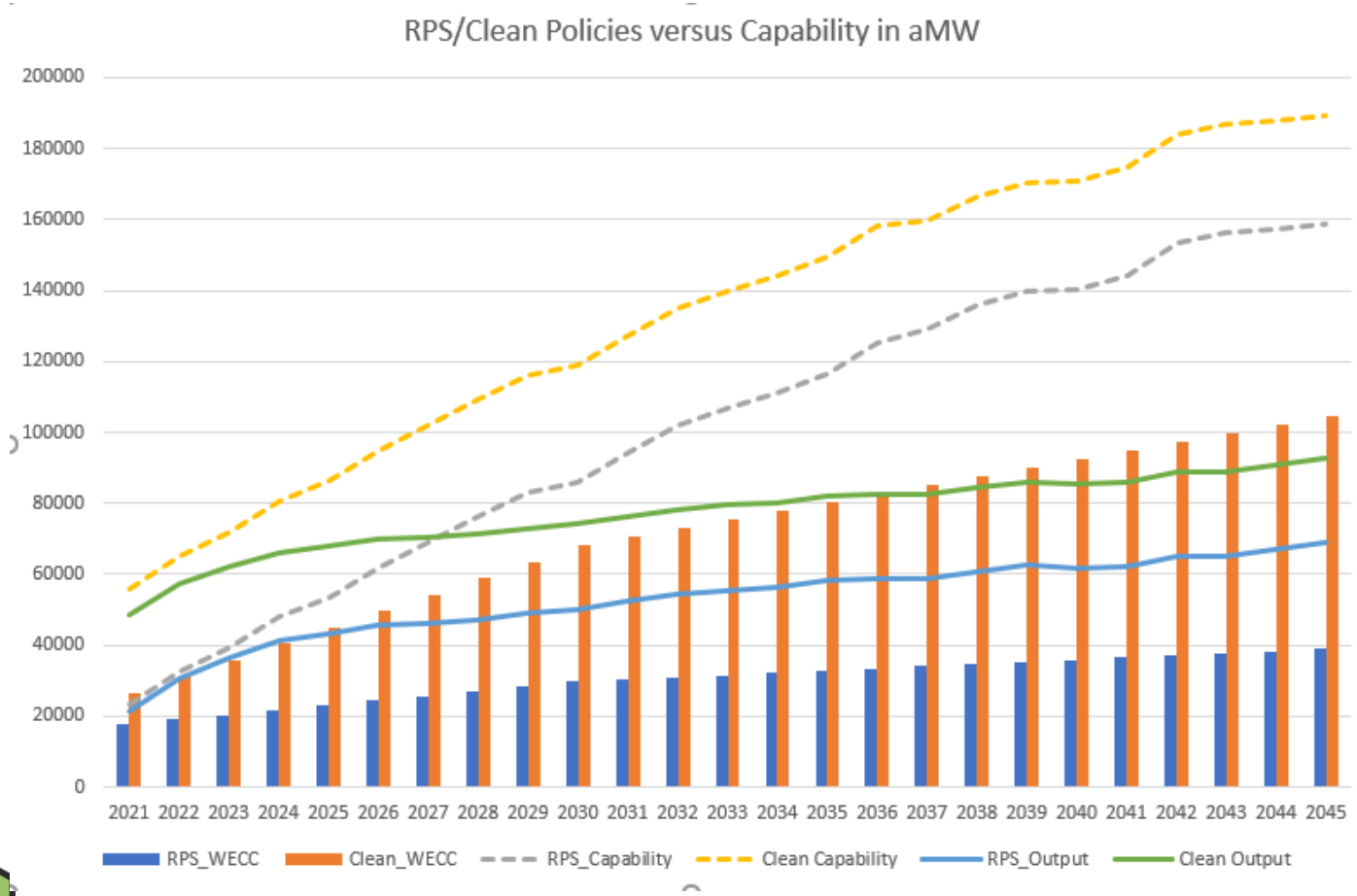
Early Coal Retirement



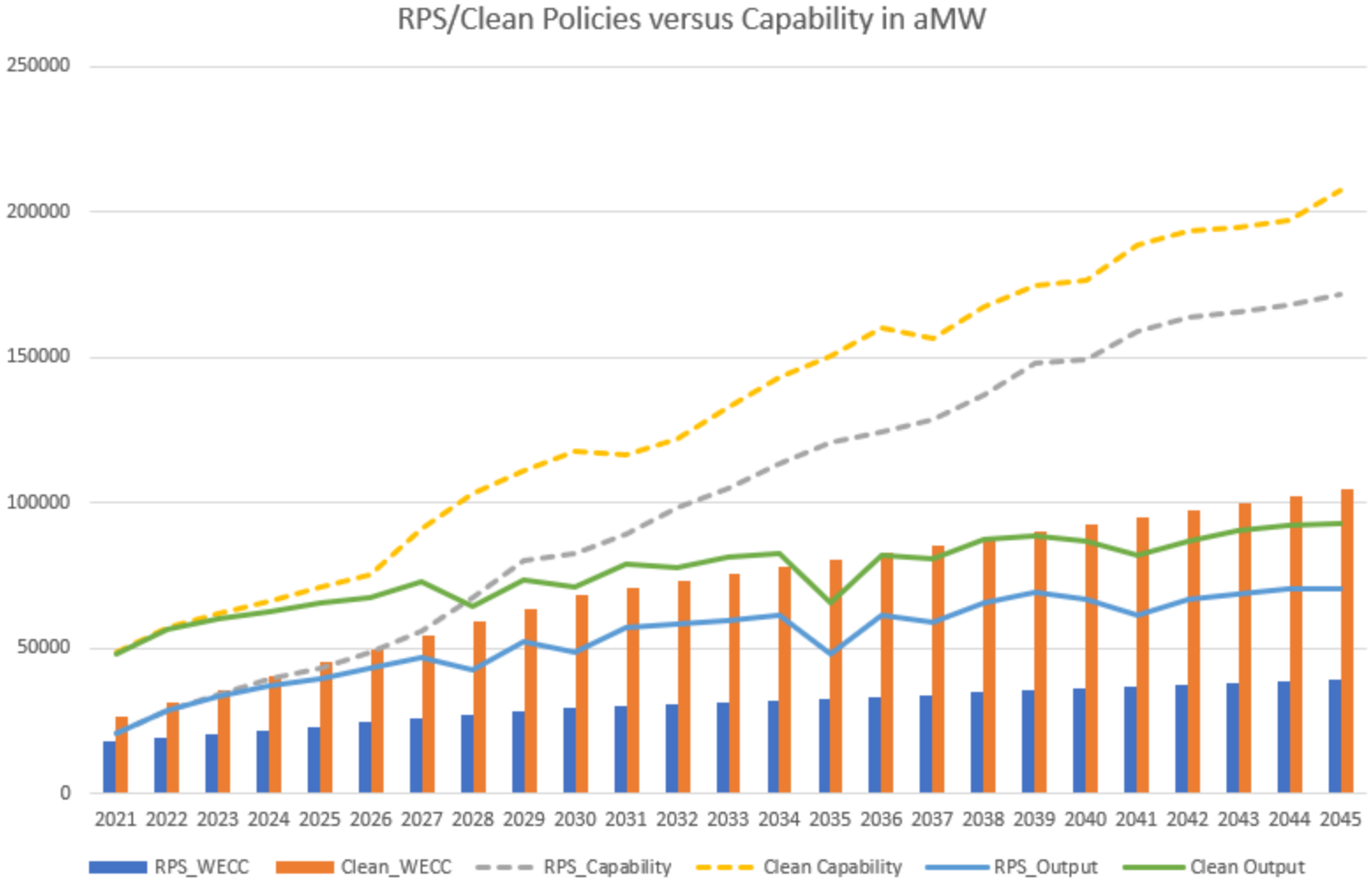
Baseline



Recall: Baseline Clean Policies Met Until 2037



Clean Policies Mostly Met Until Late 2030s, Significantly More Curtailment than Baseline

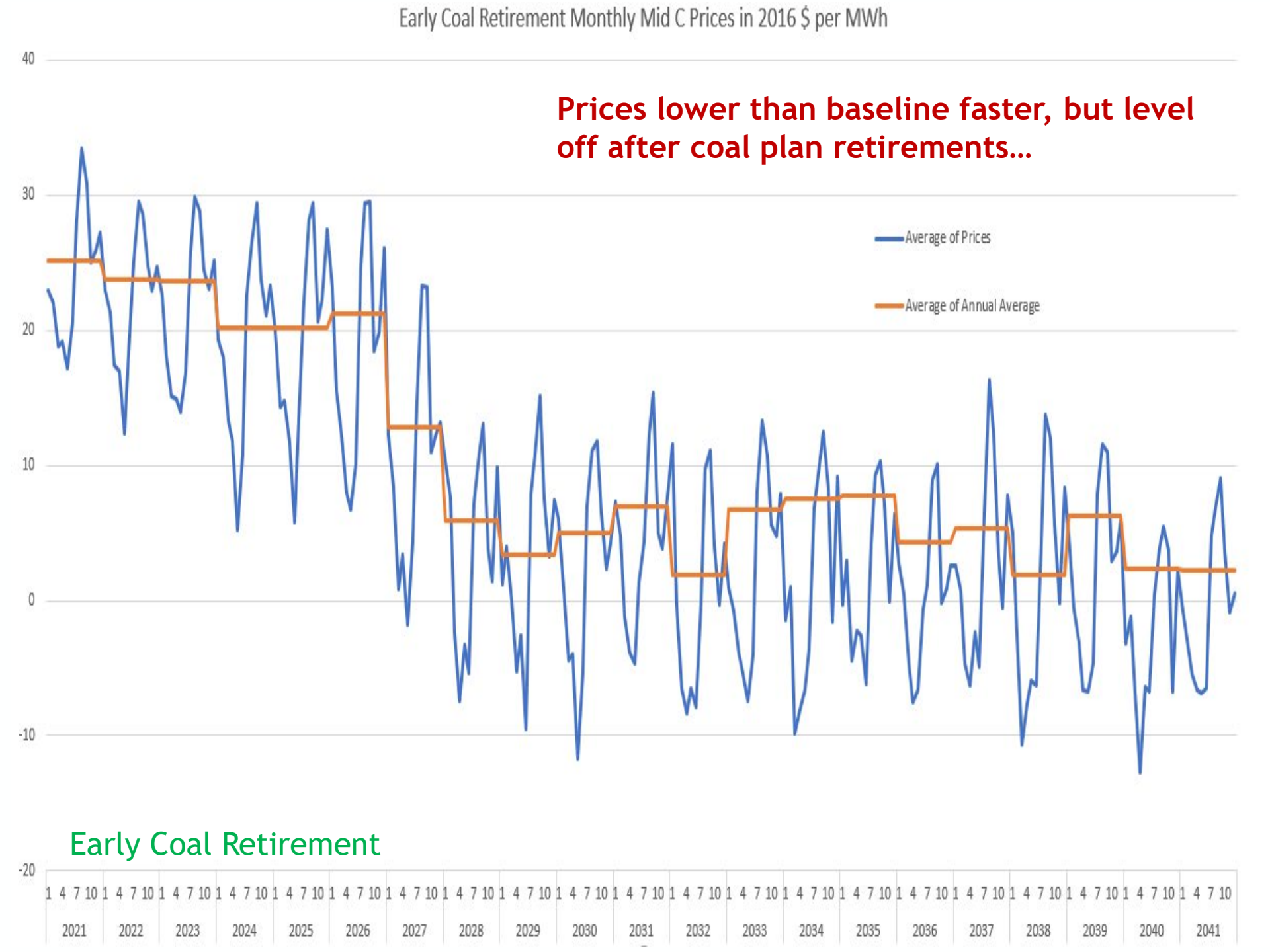


Buildout Observations

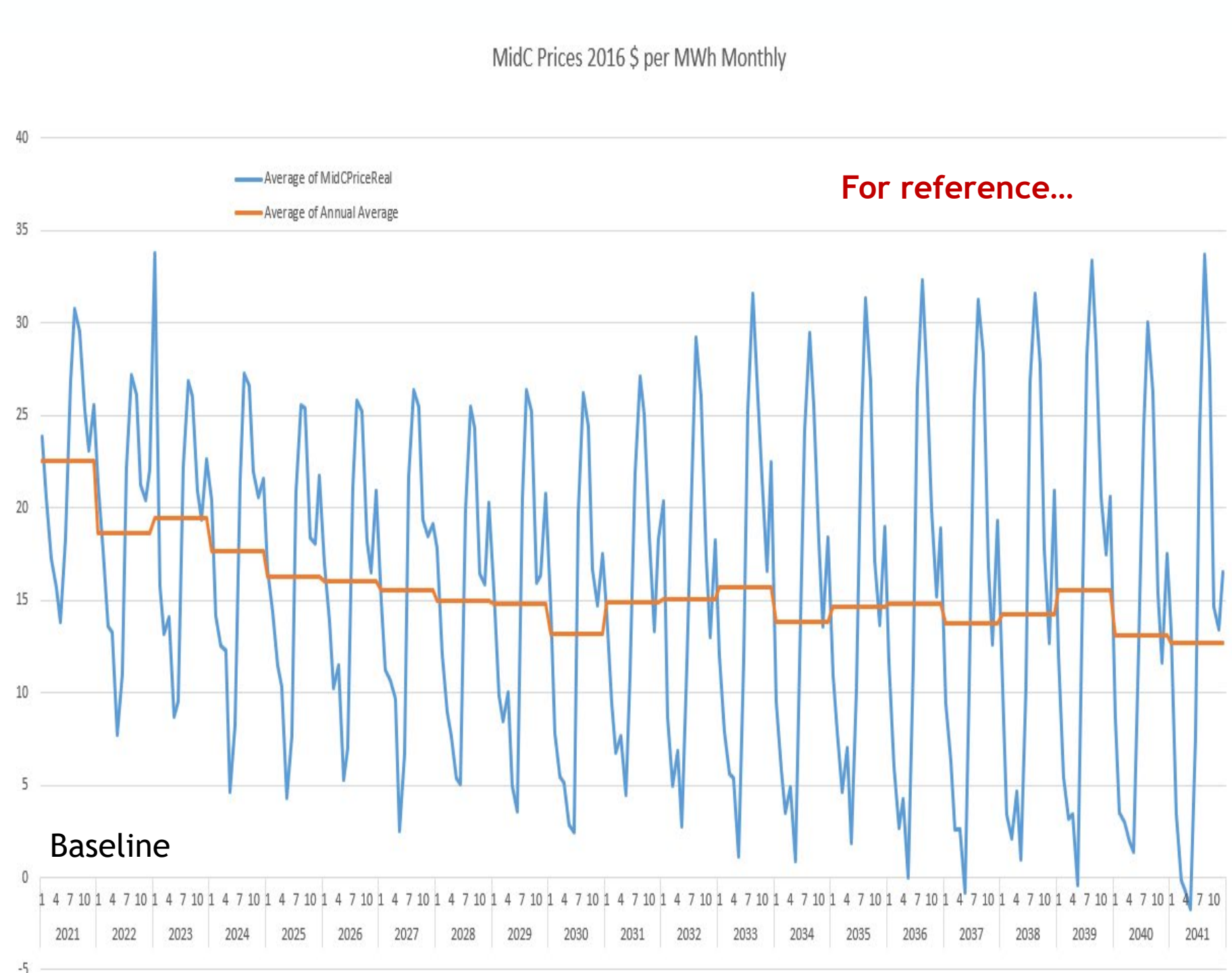
- Current buildout is less adequate and less successful at fulfilling policies than the baseline run
  - Many resources were available to meet PRMs and clean requirements.
  - Model likely could be tuned better to improve run, but for price purposes seems good enough.
  - This build reflected SAAC suggestions on improving build presented in 3/17/2021 meeting
- This will likely show more price volatility and definitely a lower market emissions rate.
- Buildout will likely show a less surplus market in needs assessment, since more build in Pacific NW.

Pricing and Emissions Summary for the Early Coal Retirement Scenario

- Prices at the Mid-Columbia go lower than baseline on an annual basis.
  - More renewable builds in the NW than in the baseline
- Slightly less seasonal price variability than baseline.
  - Less renewable builds in general than the baseline
- Avoided CO2e Emissions Rate decreases faster than the baseline and ends up about 50% of the baseline market emissions rate



Early Coal Retirement


MidC Prices 2016 $ per MWh Monthly
Average of MidCPriceReal
Average of Annual Average
For reference…
Baseline
40
35
30
25
20
15
10
5
0
-5
2021
2022
2023
2024
2025
2026
2027
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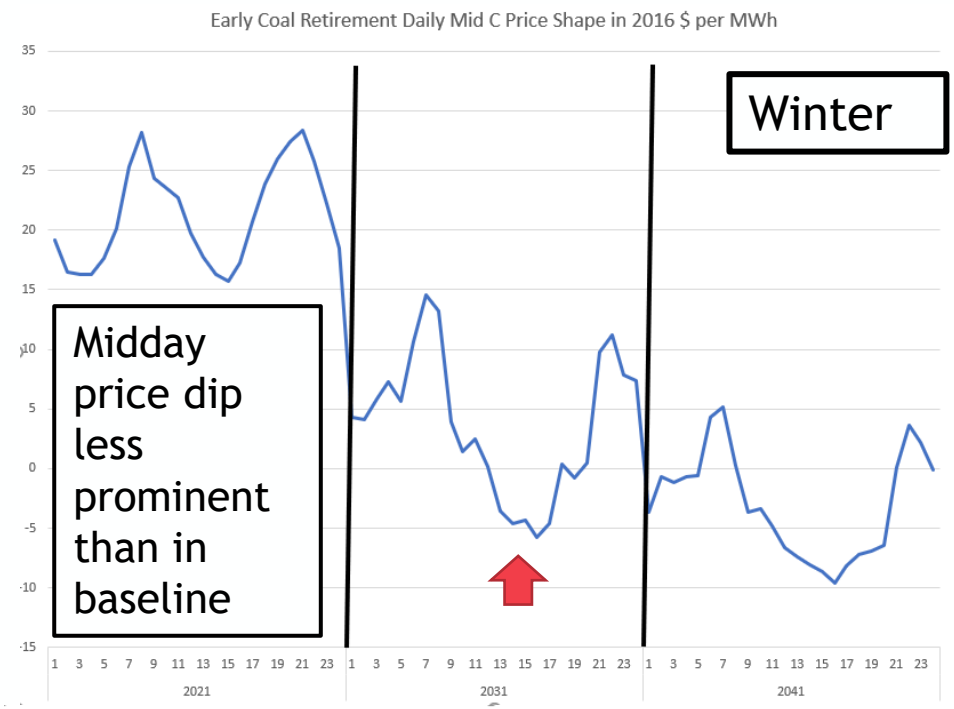
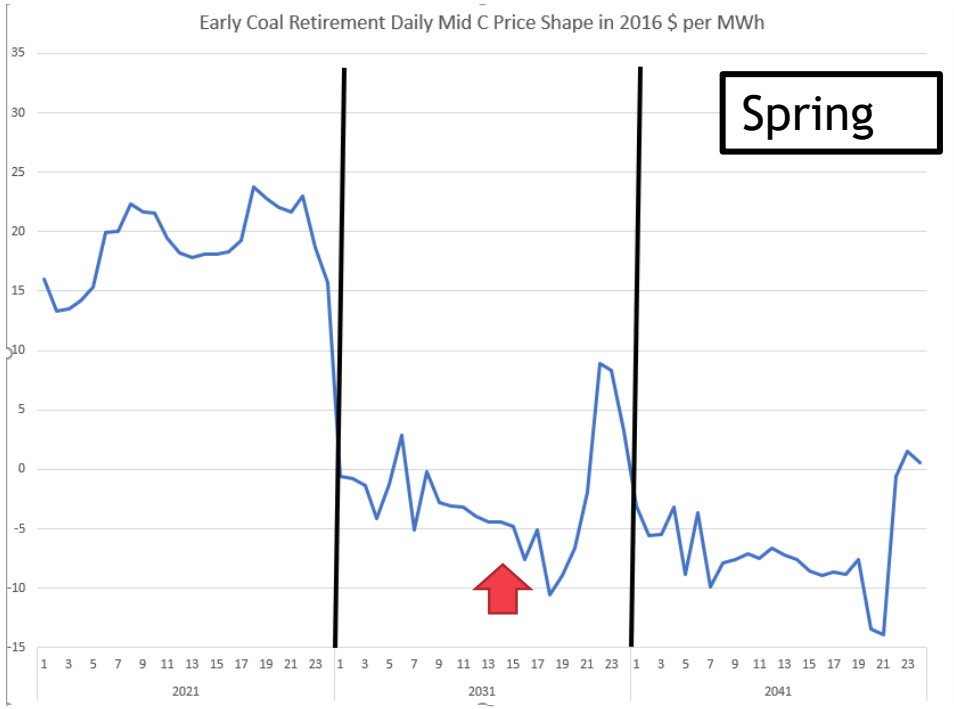
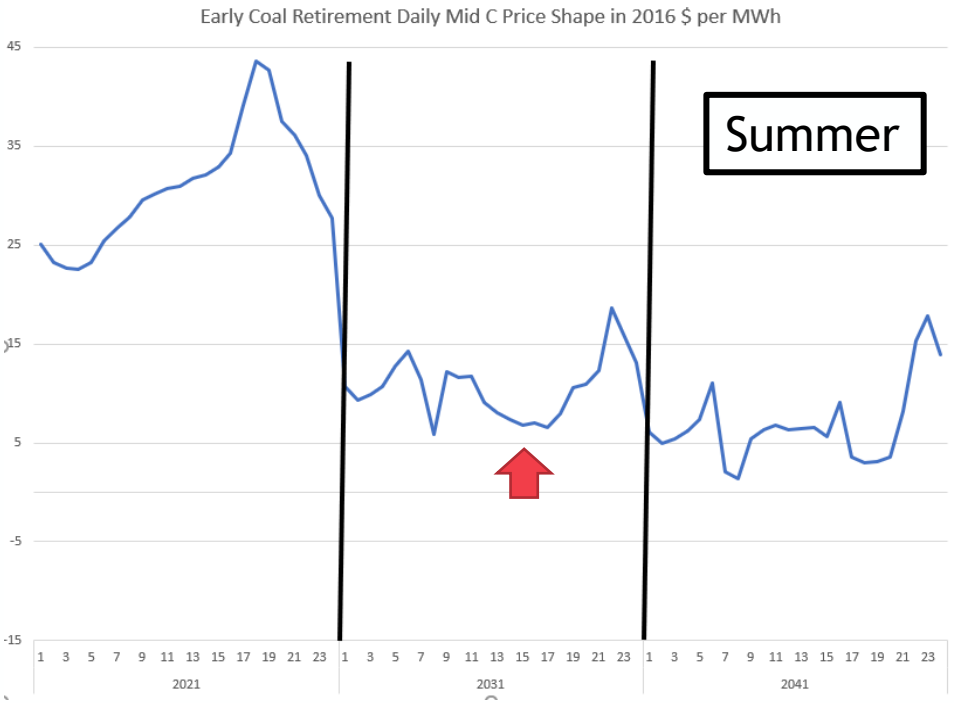
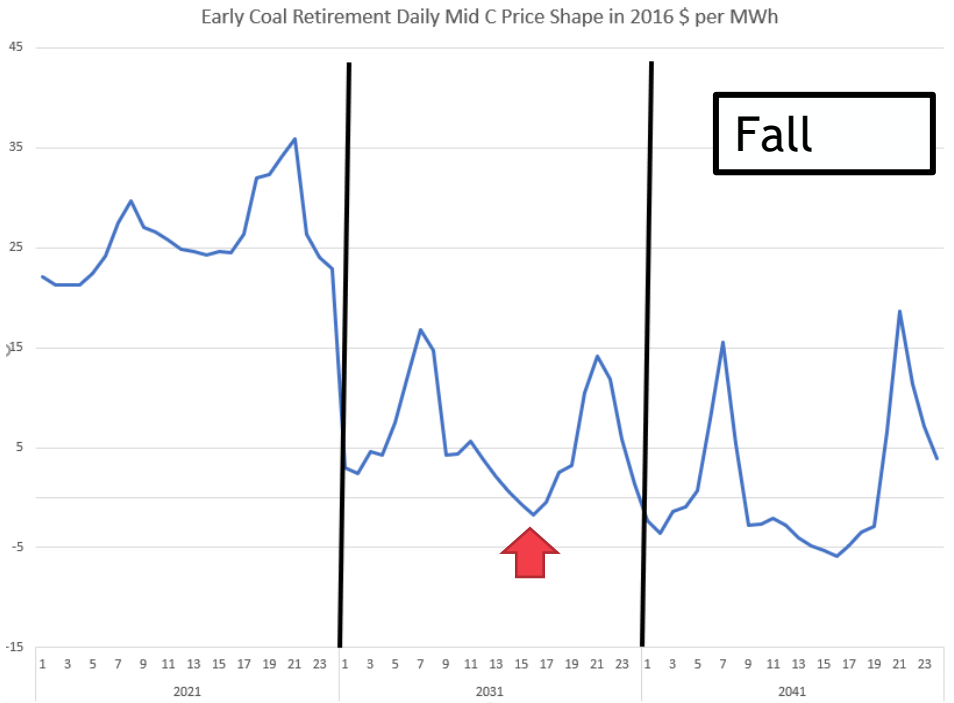

Early Coal Retirement Daily Mid C Price Shape in 2016 $ per MWh
Winter
Midday price dip less prominent than in baseline
2021
2031
2041

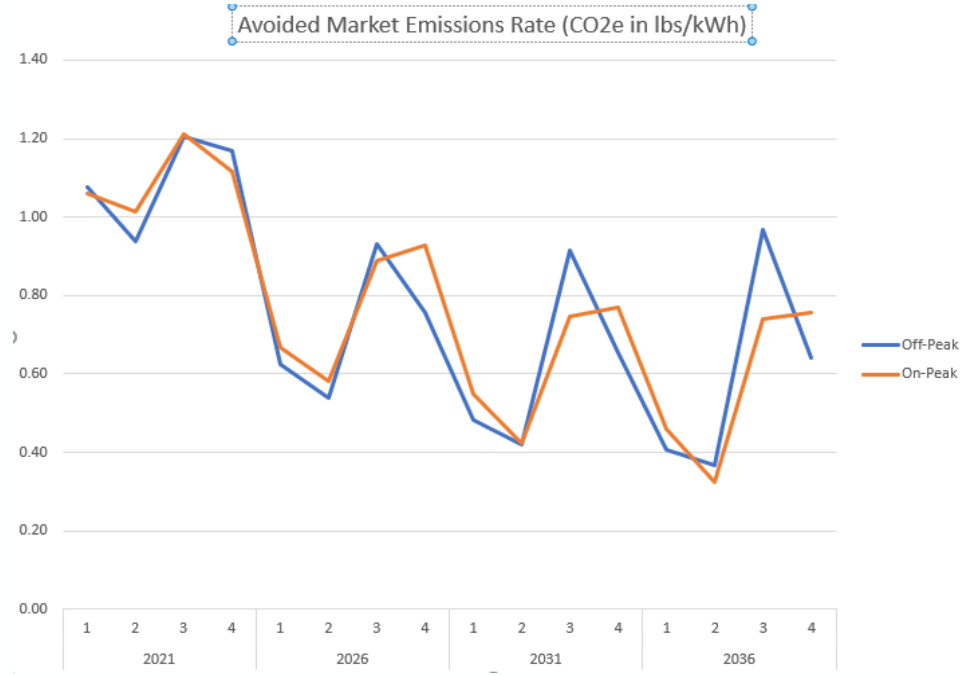

Early Coal Retirement Daily Mid C Price Shape in 2016 $ per MWh
Spring
2021
2031
2041


Early Coal Retirement Daily Mid C Price Shape in 2016 $ per MWh
Summer
2021
2031
2041

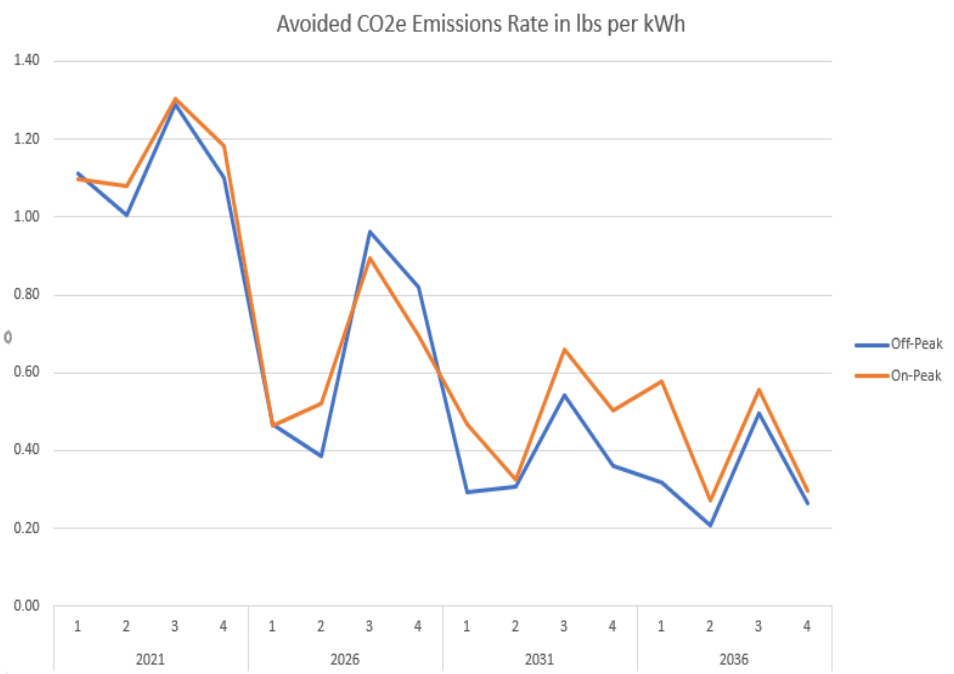

Early Coal Retirement Daily Mid C Price Shape in 2016 $ per MWh
Fall
2021
2031
2041

Avoided CO2e Emissions Rate decreases slightly faster than the baseline and is half the magnitude by the end of the study.

Baseline



Early Coal Retirement

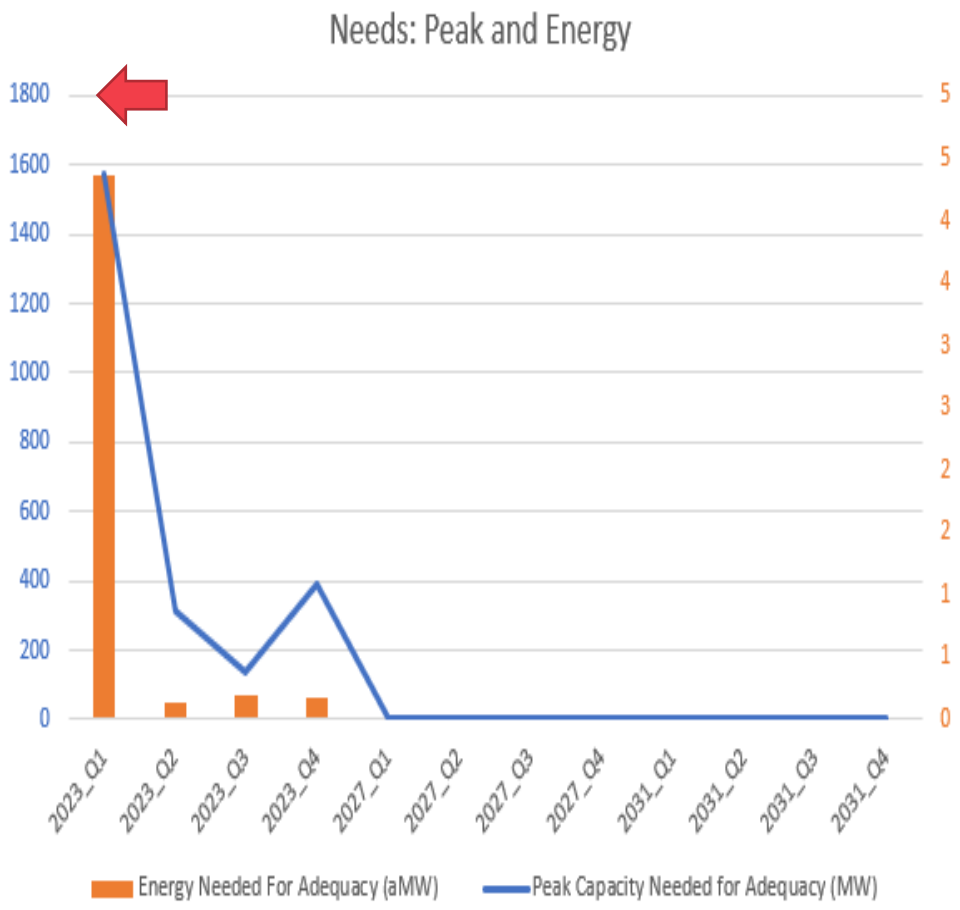


Needs Assessment Results

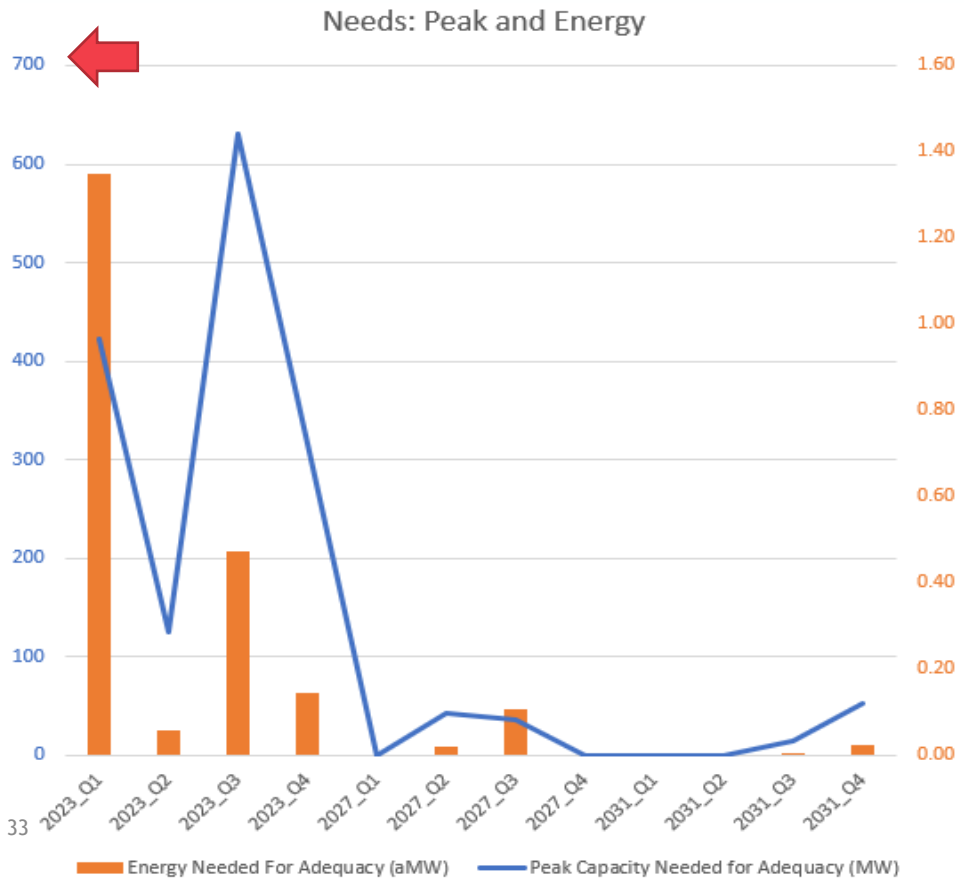
- Needs in 2023 in baseline are lessened in winter and increase in summer by changing market supply early.
  - Earlier and more gas builds in AURORA by neighboring regions
- Less regional resource available in 2027 and 2031 to meet regional needs.
  - More renewables built in Pacific NW to backfill coal in AURORA buildout. These are not part of external market in needs assessment and are removed from GENESYS analysis.

Maximum Needs Change from Winter to Summer, Slight Increase in Needs After Retirements

Baseline

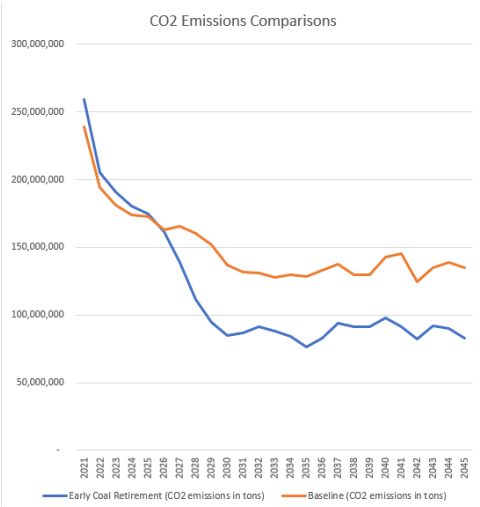


Early Coal Retirement



Conclusions

- Bigger, more diverse WECC buildout backfills for early retirements.
- Less emissions and lower market prices than in baseline
- Increase in regional needs coincides with the early coal retirements



Baseline Conditions Update

Change in Coordination between RPM and GENESYS

Previous approach overstated the resource needs in the Early Coal Retirement Scenario leading to overbuilding resources.

Adapted the approach to make sure when RPM has peak loads equivalent to the highest loads GENESYS tests, the resource need matches what GENESYS finds.

Based on these finding we decided updating the Baseline Conditions was appropriate.

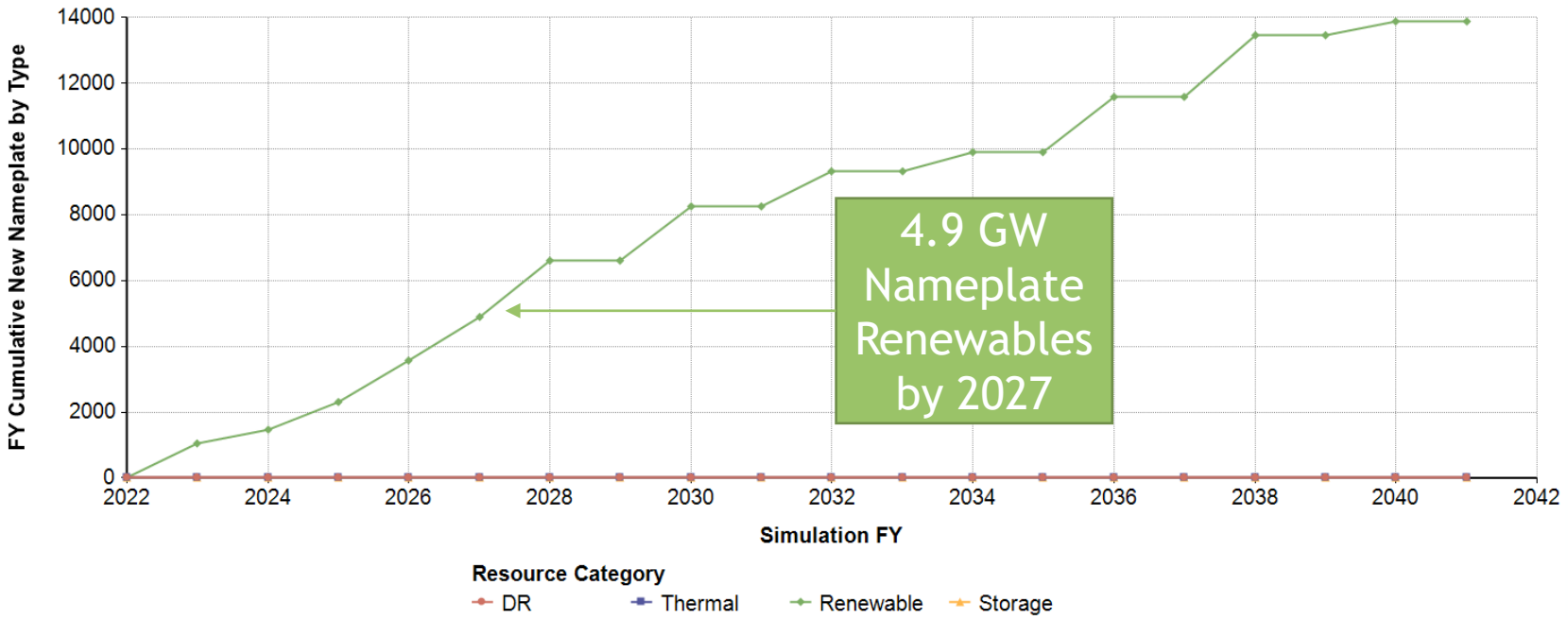
We are exploring further refinement of these results with respect to reserves which may further alter the results shared today – but the update is needed for comparing to the Early Coal Retirement Scenario.

Update Eliminated Both Natural Gas Generation and Demand Response

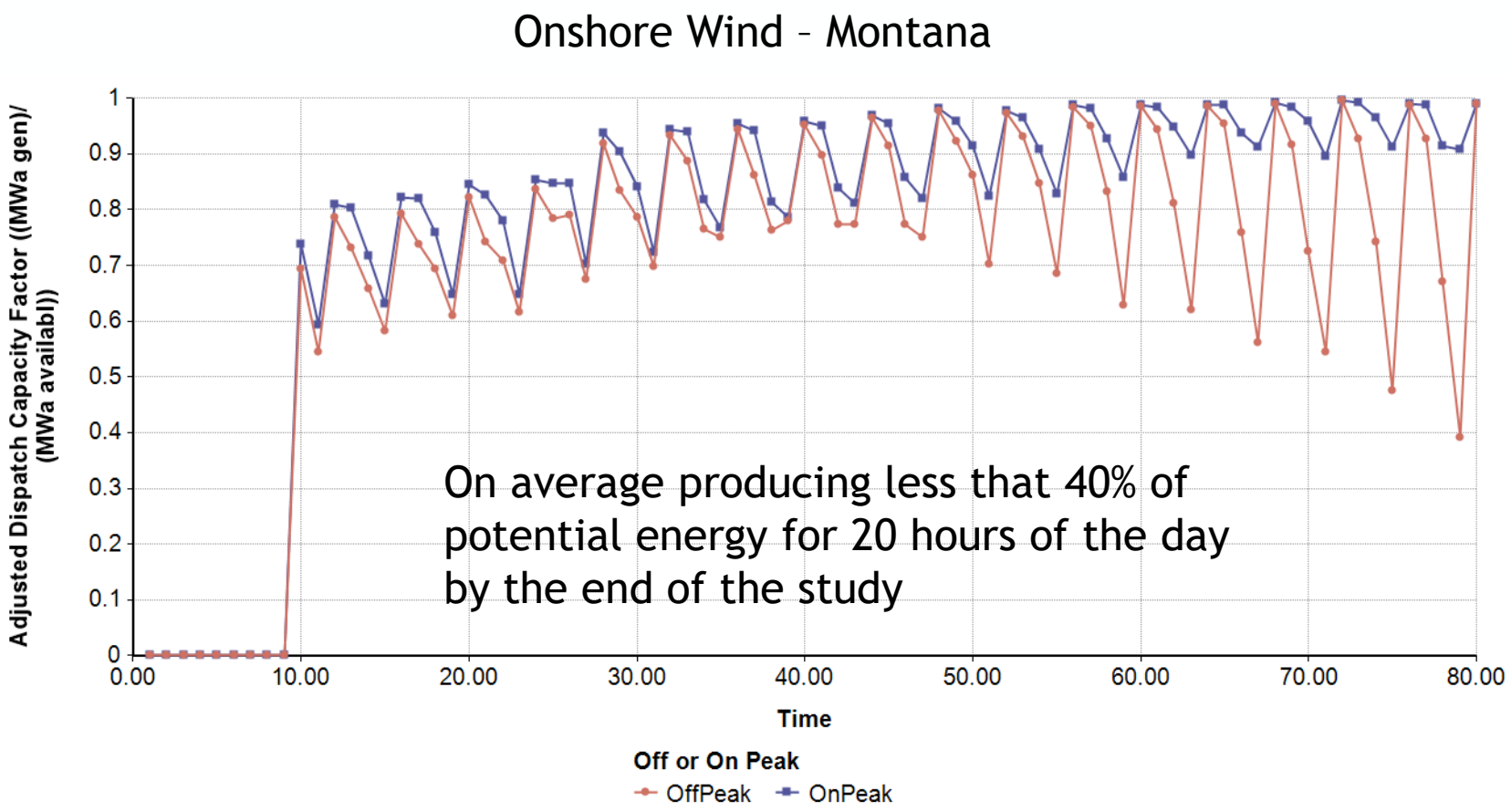
Results from the update to Baseline Conditions reduced the resources needed for adequacy and a lead to a some significant changes, including:

- No natural gas generation is built
- No demand response is selected
- Less renewables and energy efficiency are built

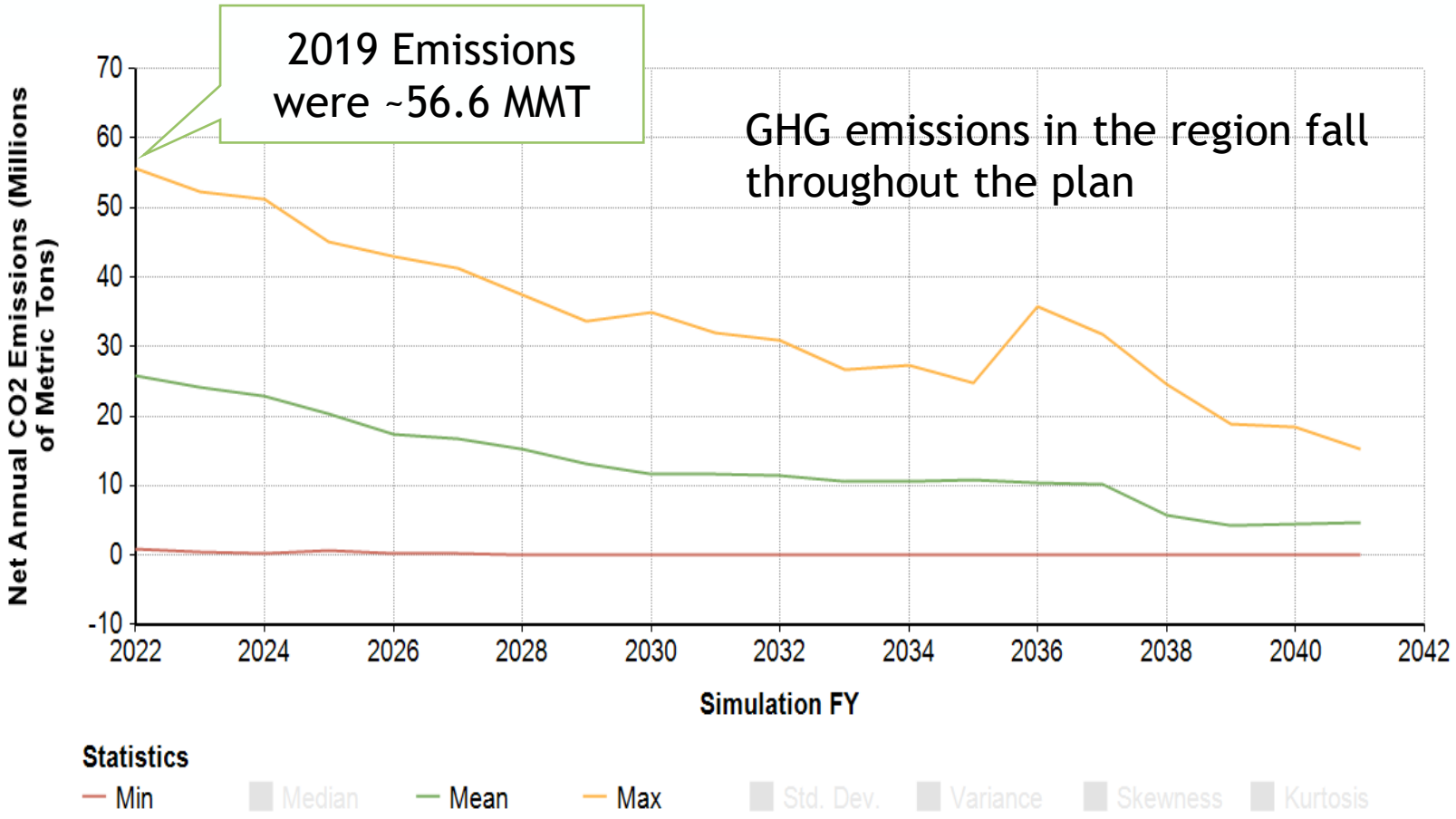
Large Build of Renewables



Renewable Curtailment

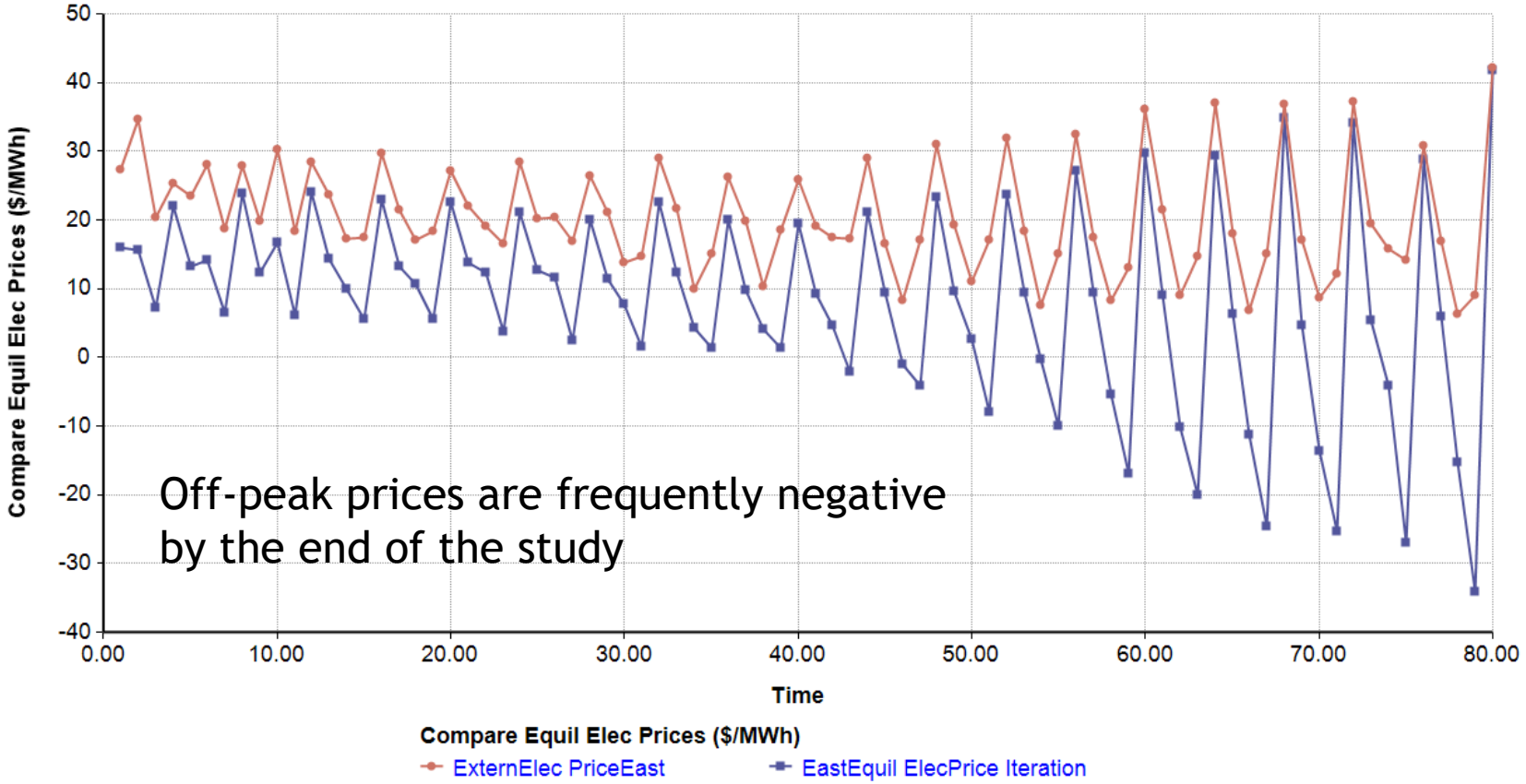


GHG Emissions



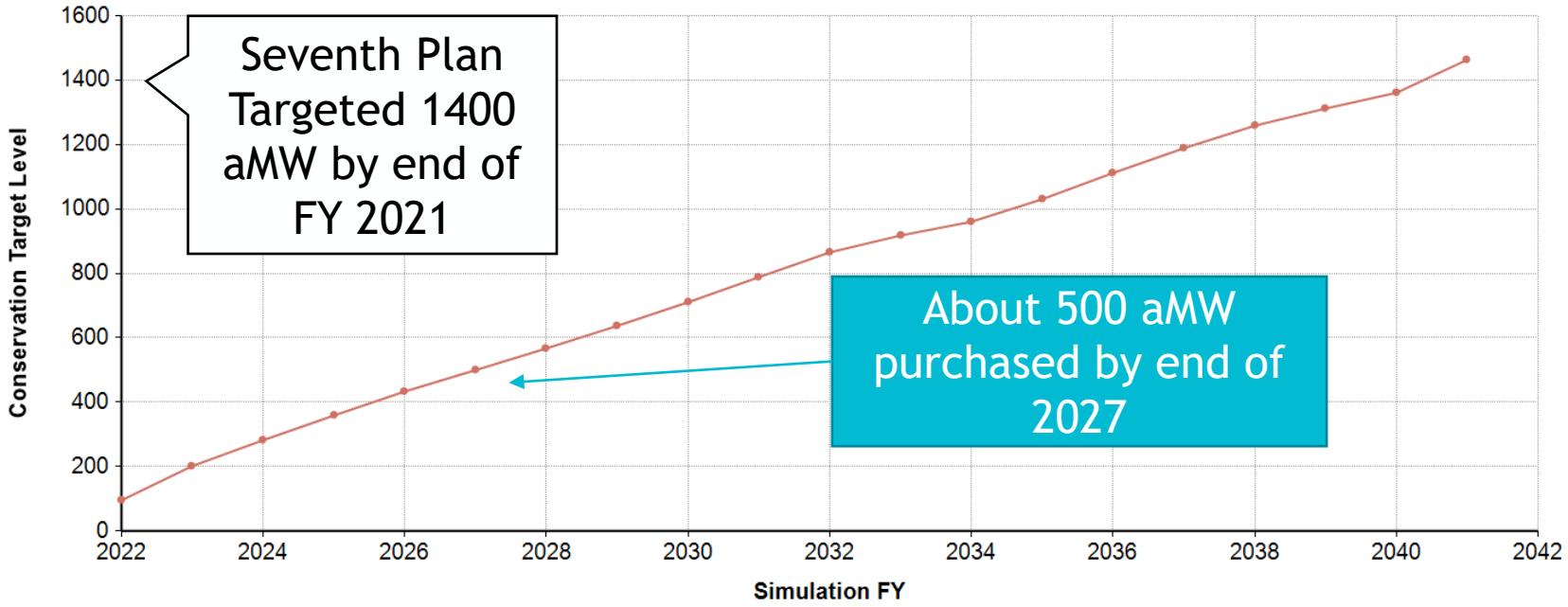
Impact of Electricity Price Forecast

Off-peak Electricity Prices



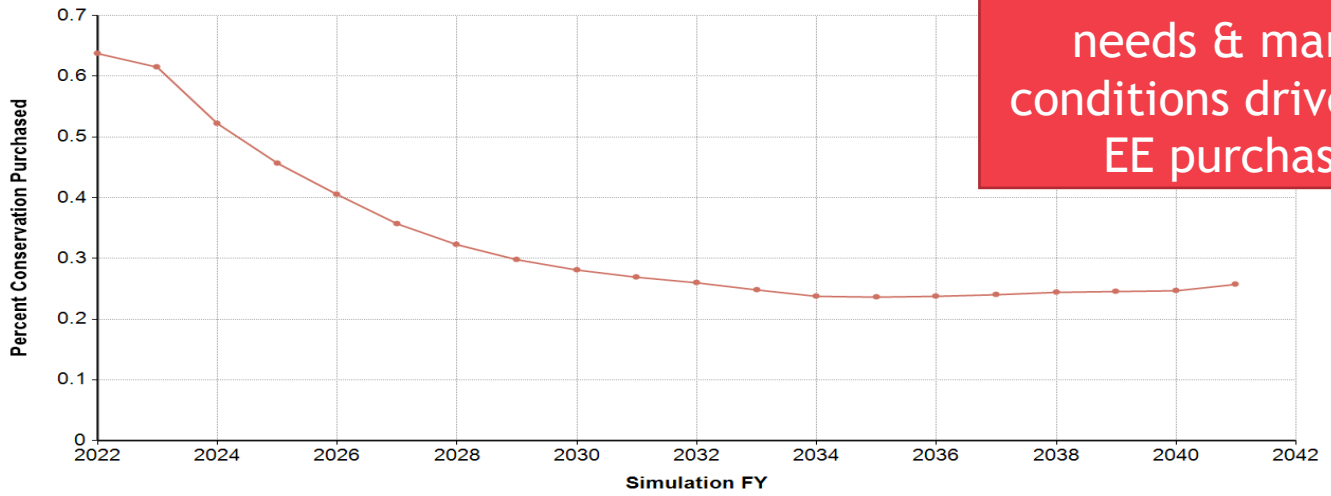
Off-peak prices are frequently negative by the end of the study

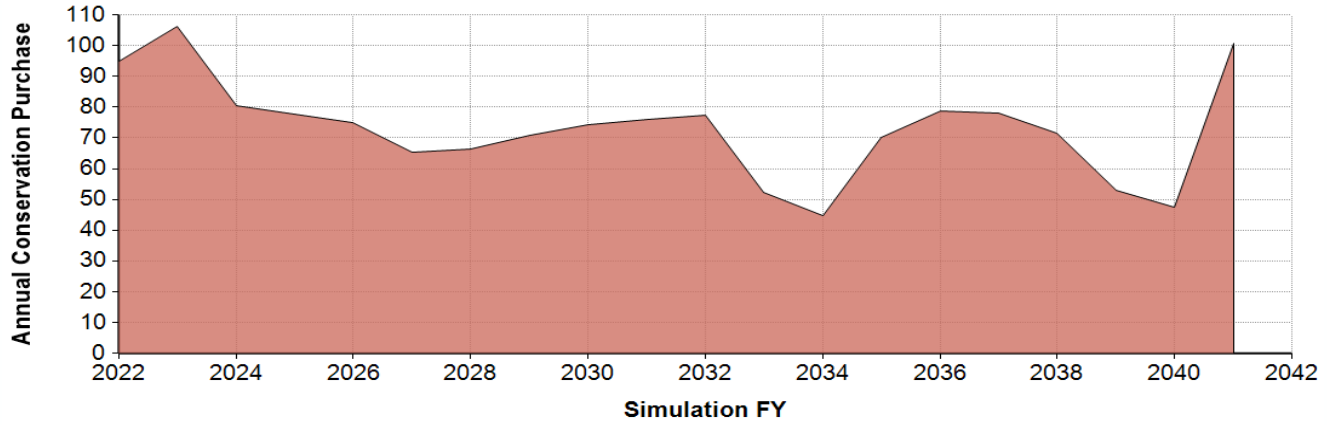
Maximum Amount of Conservation Purchased by FY



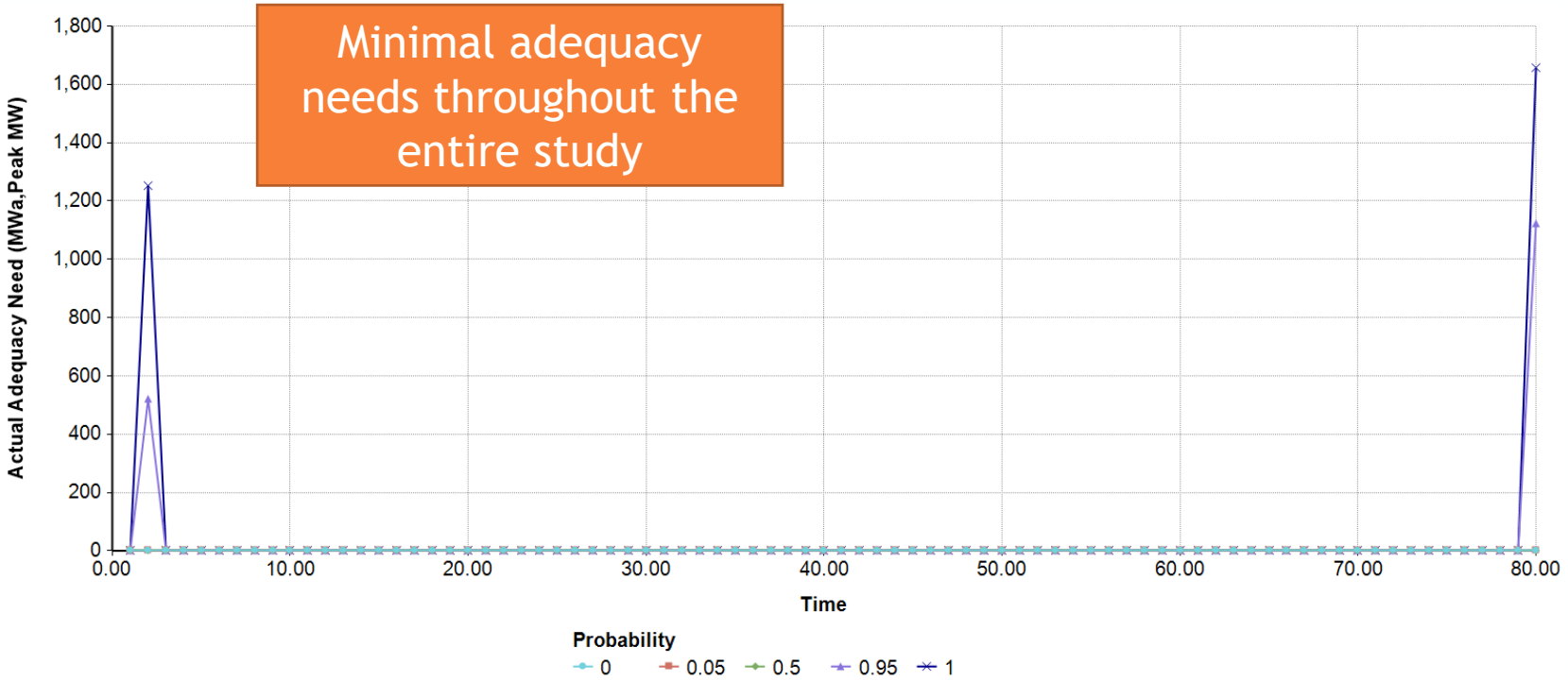
Percent of Conservation Supply Purchased

Near-term adequacy needs & market conditions drive early EE purchases

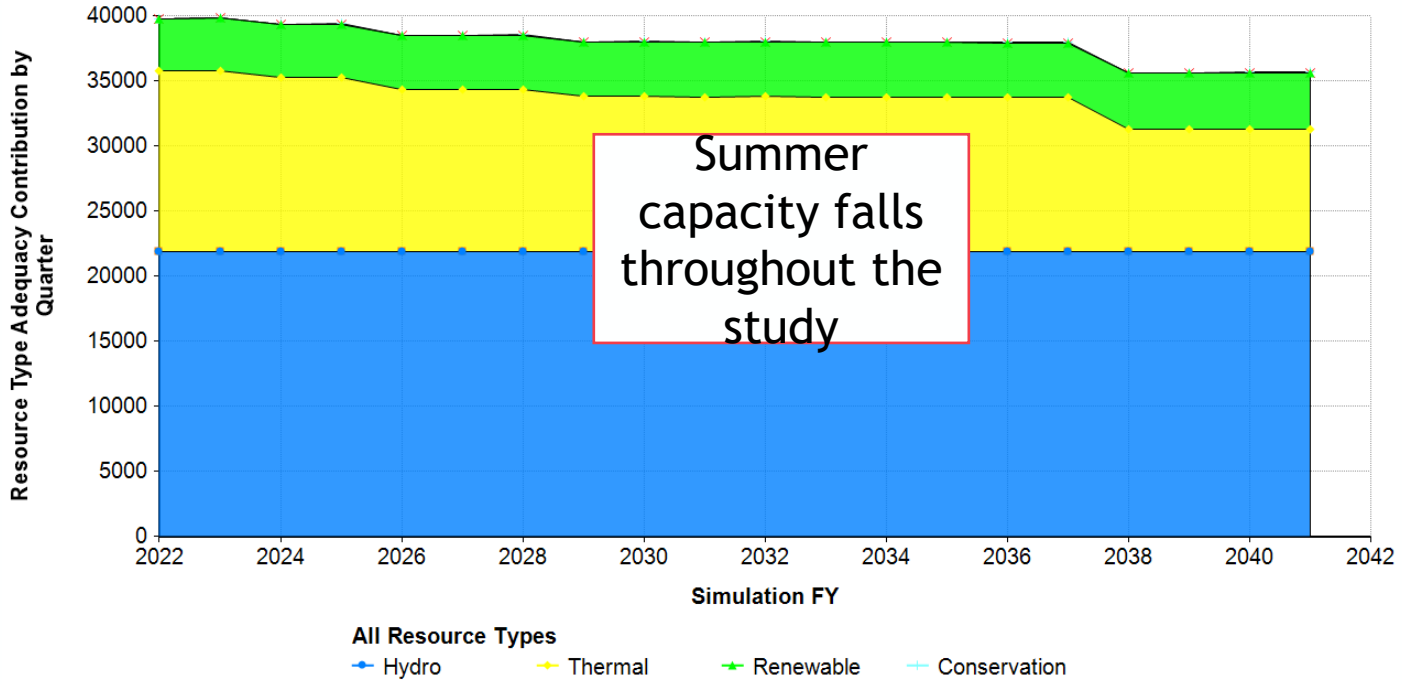




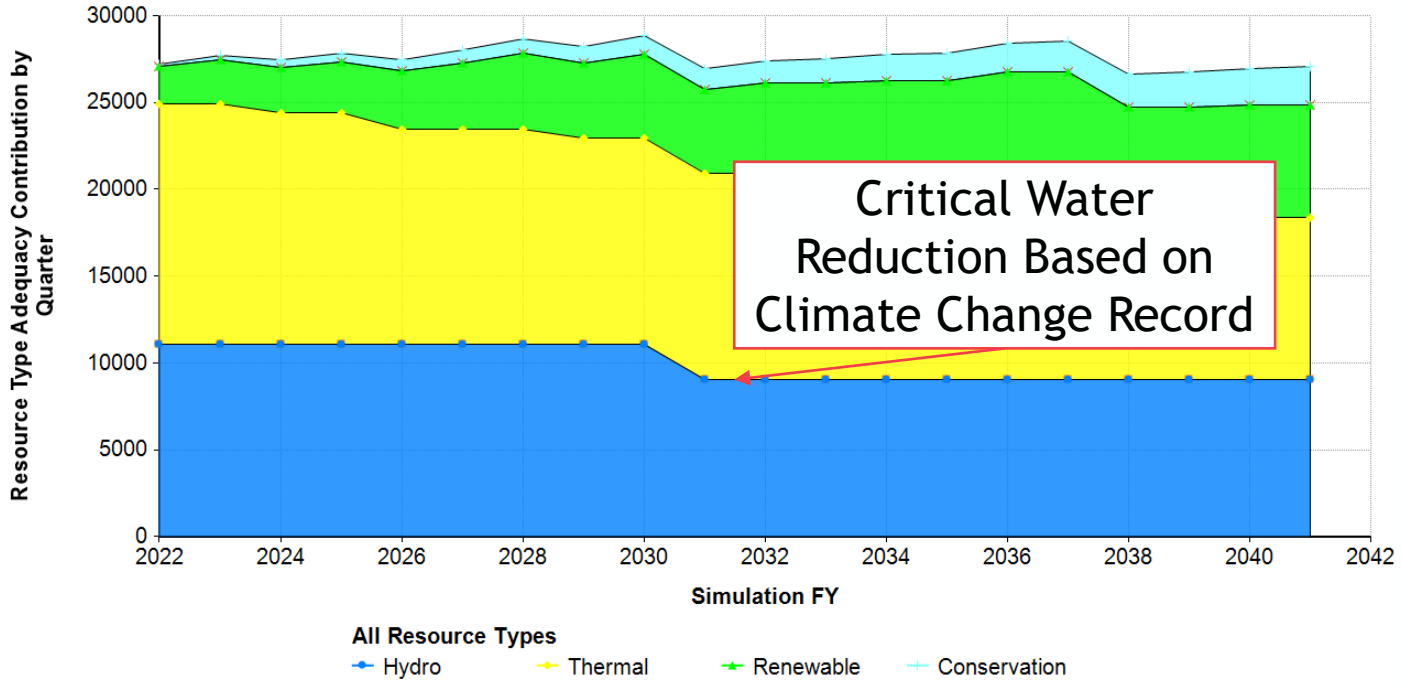
Immediate Adequacy Need



Resource Adequacy Contribution Summer – Capacity



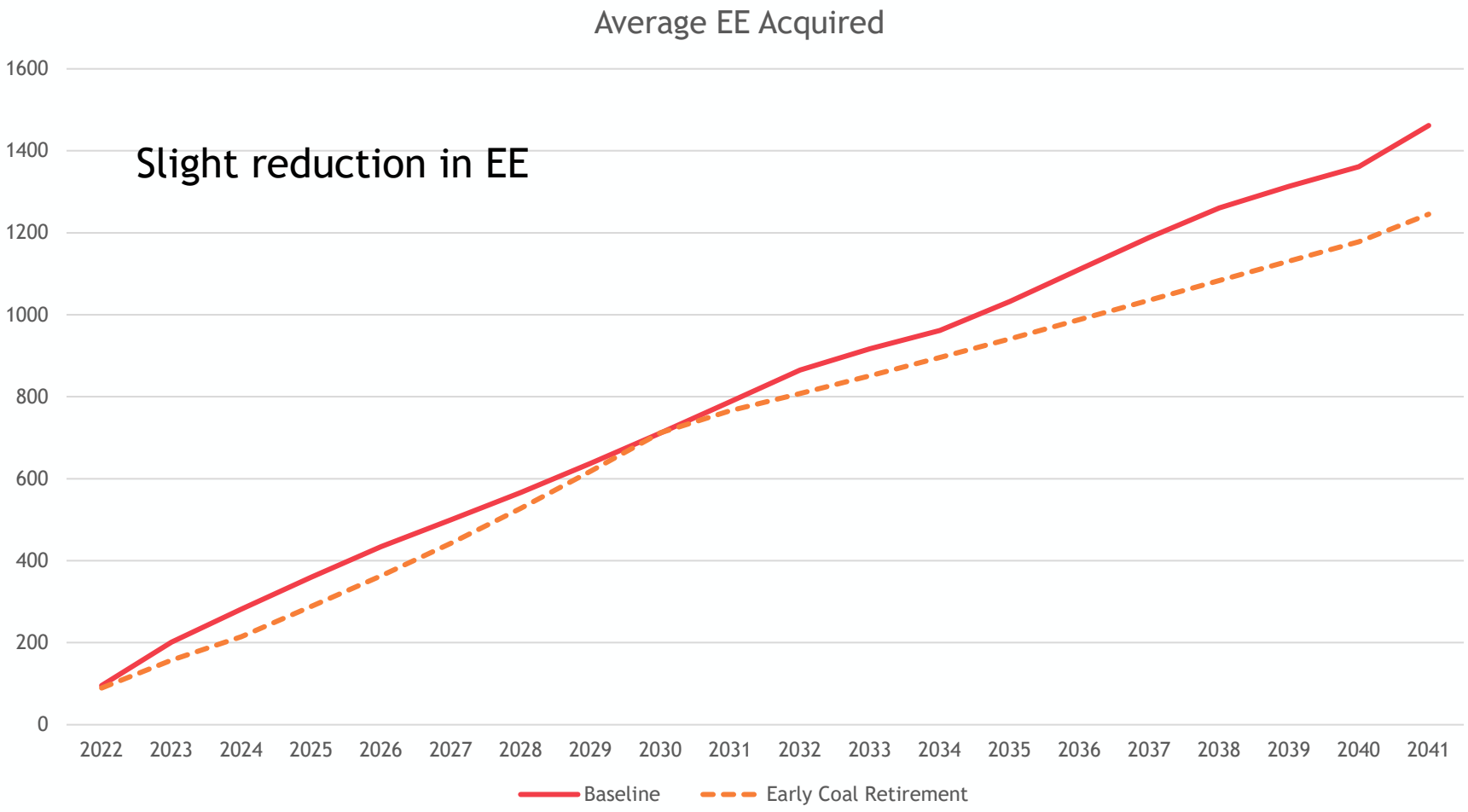
Resource Adequacy Contribution Summer – Energy

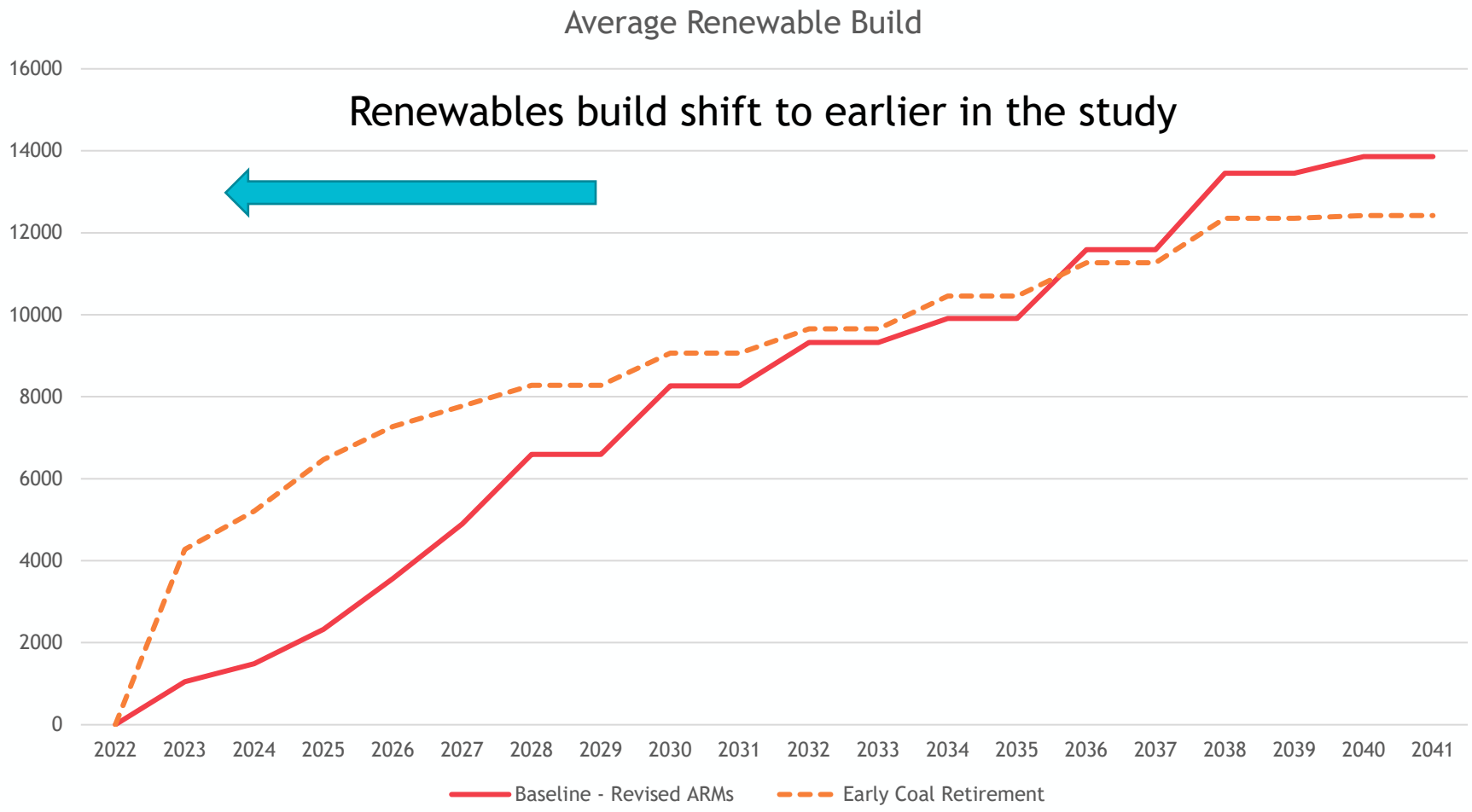


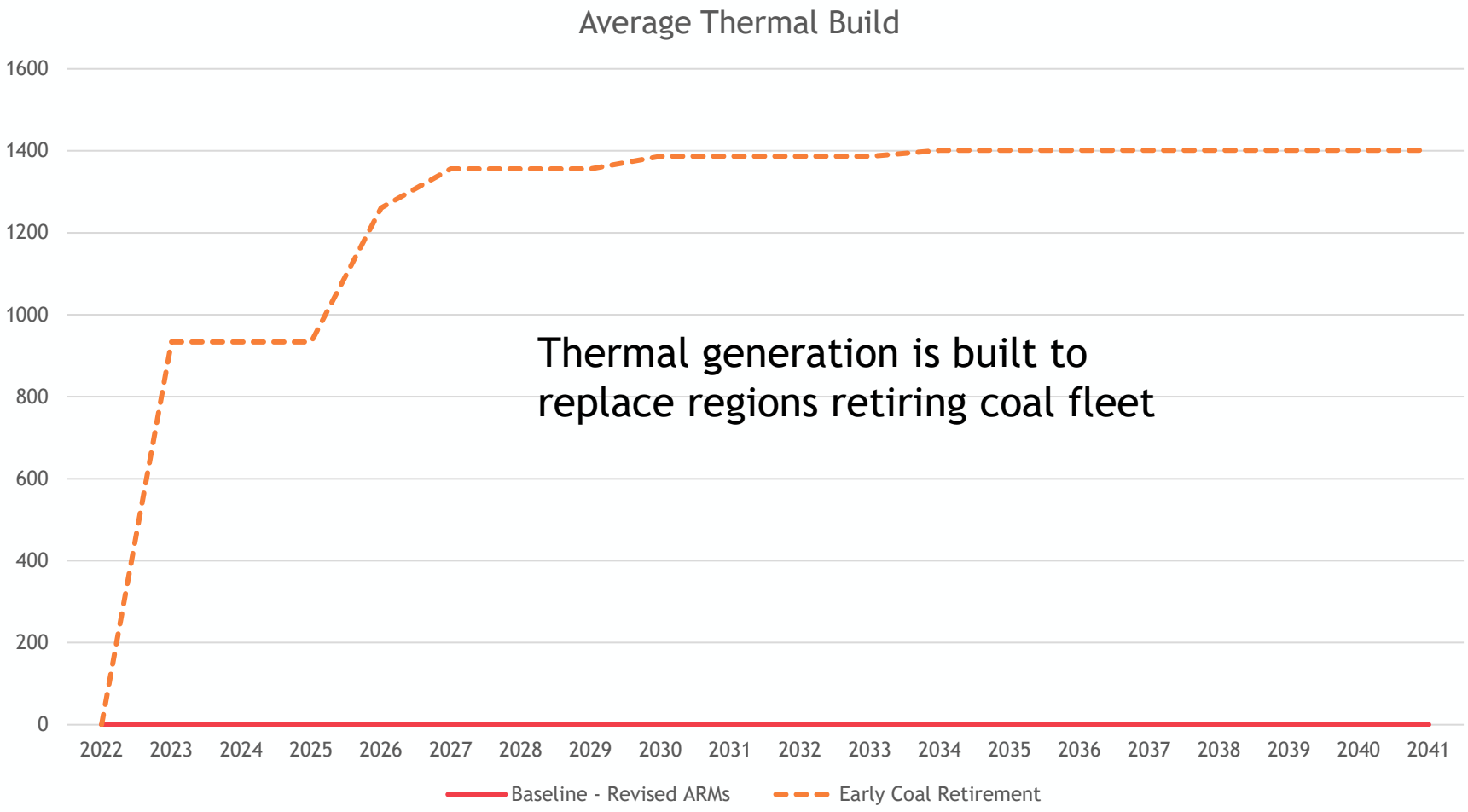
Early Coal Retirement Resource Strategy Comparison

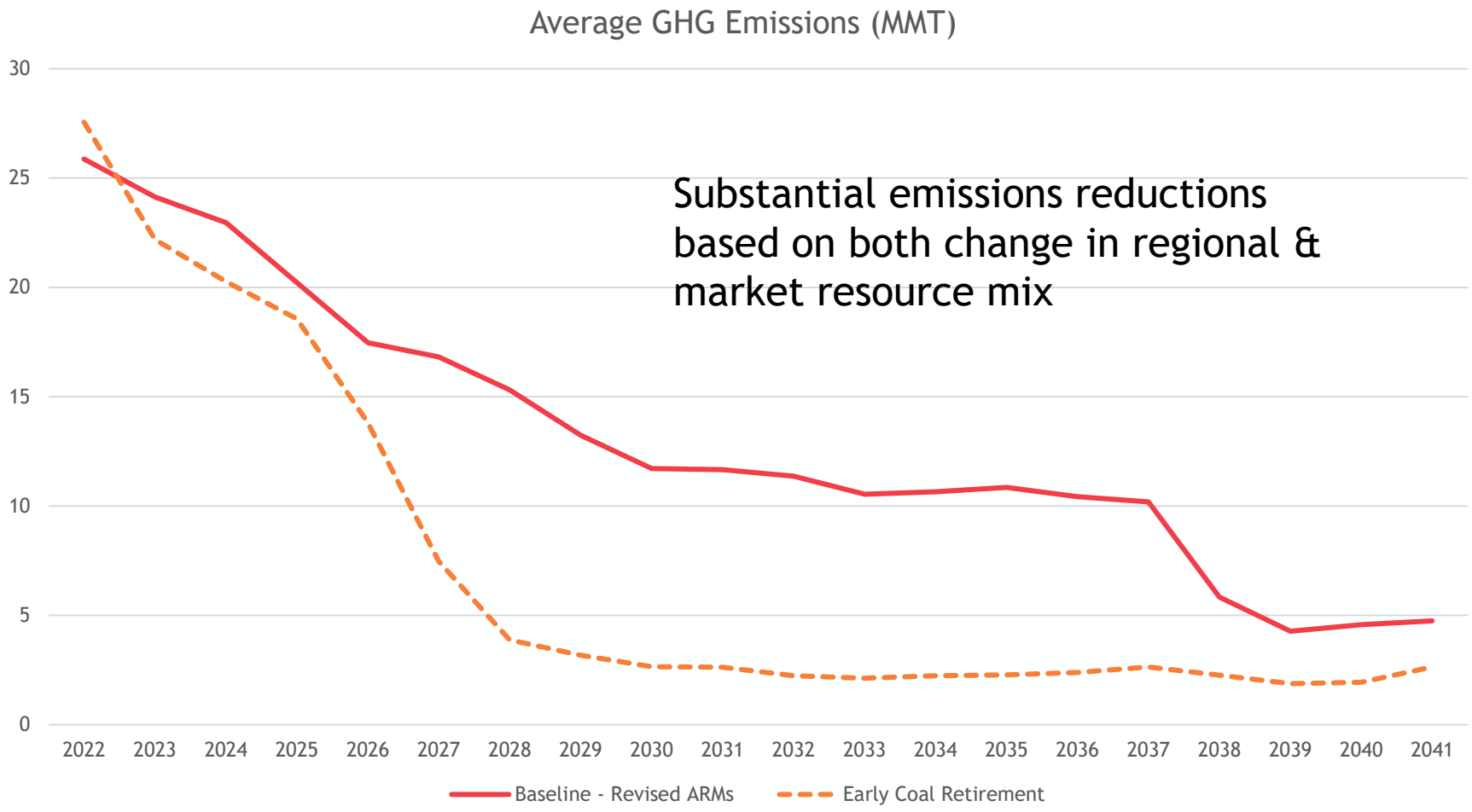
High-level Take-aways

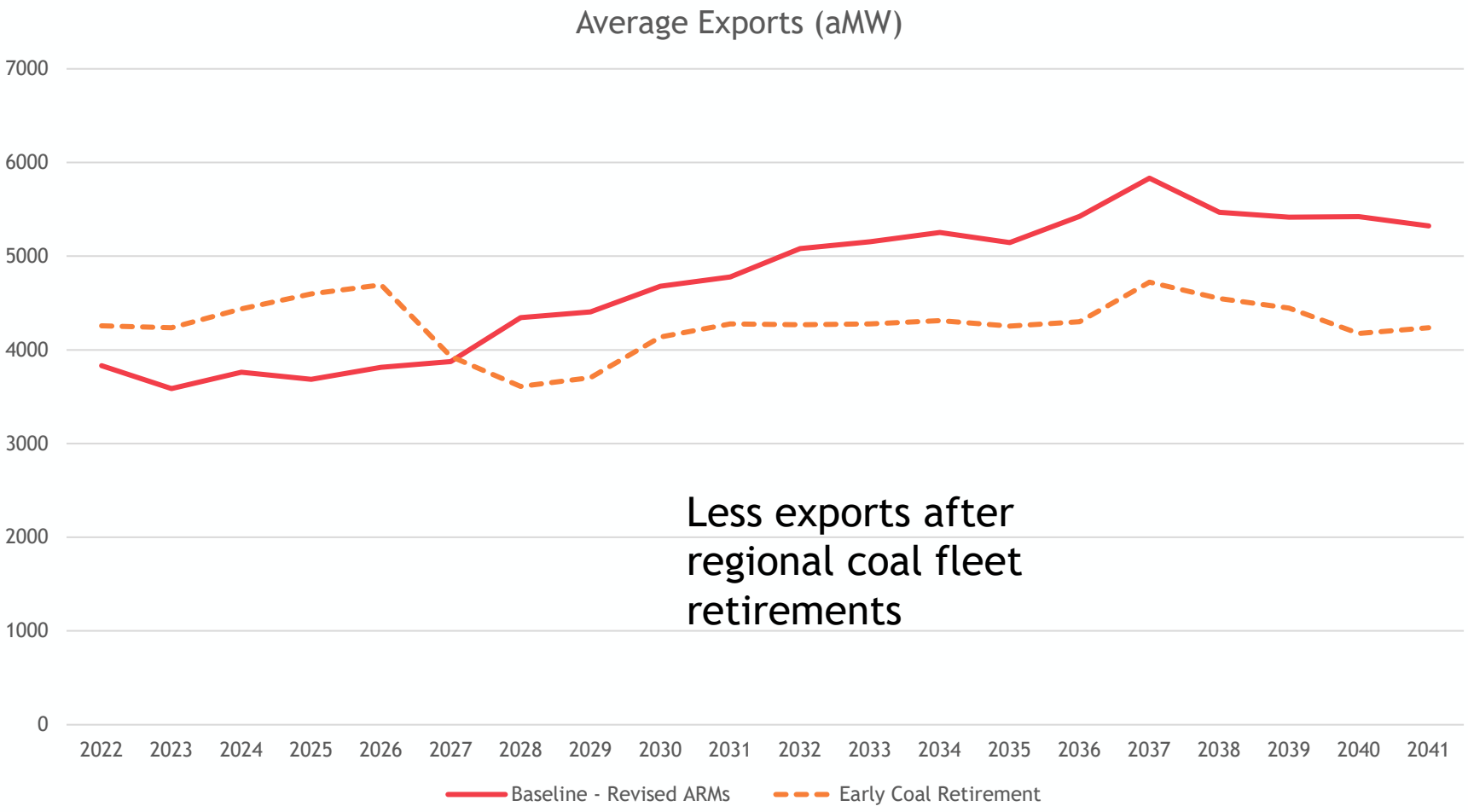
- Change in timing of renewable builds
- Increase in natural gas generation build
- Substantial near-term reduction in greenhouse-gas emissions
- Around 6% increase in residential bills over 20-years

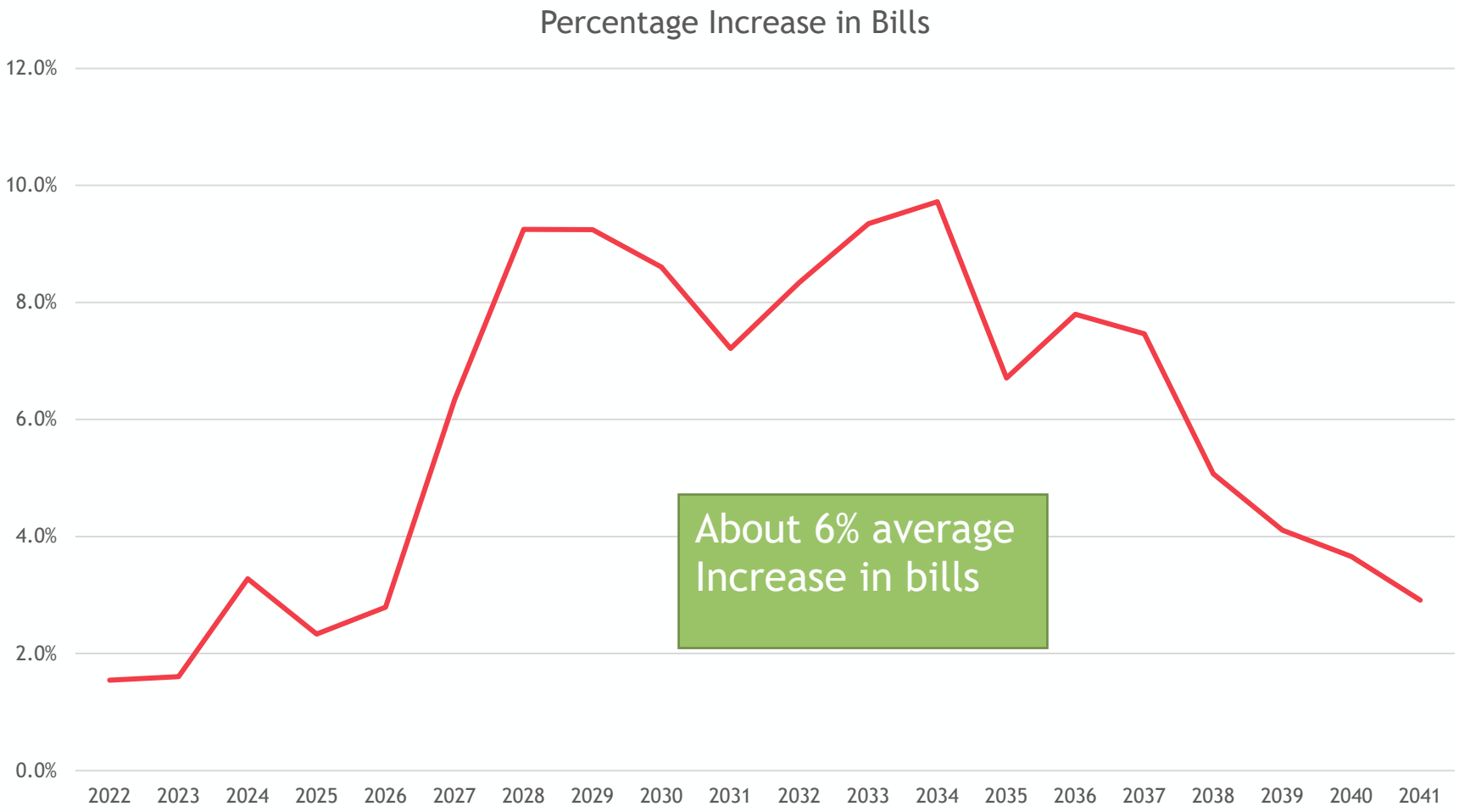

Average EE Acquired
Slight reduction in EE
1600
1400
1200
1000
800
600
400
200
0
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
Baseline
Early Coal Retirement


Average Renewable Build
Renewables build shift to earlier in the study
16000
14000
12000
10000
8000
6000
4000
2000
0
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
Baseline - Revised ARMs
Early Coal Retirement


Average Thermal Build
1600
1400
1200
1000
800
600
400
200
0
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
Thermal generation is built to replace regions retiring coal fleet
Baseline - Revised ARMs
Early Coal Retirement


Average GHG Emissions (MMT)
30
25
20
15
10
5
0
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
Baseline - Revised ARMs
Early Coal Retirement
Substantial emissions reductions based on both change in regional & market resource mix


Average Exports (aMW)
7000
6000
5000
4000
3000
2000
1000
0
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
Baseline - Revised ARMs
Early Coal Retirement
Less exports after regional coal fleet retirements


Percentage Increase in Bills
12.0%
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
About 6% average Increase in bills


Questions