Ascend Analytics

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STAG meeting 6: Modeling results

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November 1, 2023

Disclaimer

- This presentation has been updated from the version presented to STAG at its 6th meeting to correct for inaccuracies and fill in some missing information. The updated version was shared with STAG after the meeting.
- Even after this updated version, some data related to hydrogen costs changed. As a result, certain slides that reflect scenario costs are no longer accurate. A note has been included on these slides to reinforce this point.

Modeling Process

- Modeling for the 2023 IRP was conducted in the phases shown below
  - Baseline model with GWP's current and planned resources
    - Provides insight for GWP's portfolio for near term decisions
  - Capacity Expansion Models
    - Outcome of capacity expansion models provide the timing and quantity of new resource additions to meet the GWP requirements for capacity and renewables
    - Resource selection is based on economics and the ability of resources to satisfy GWP needs
  - Resource Adequacy Models
    - Provide metrics on the ability of GWP's system to serve load all hours of the year over a wide range of system conditions
  - Production Cost Models
    - Outcome of production cost models show how GWP's system would operate with the resource selection from the Capacity Expansion model
    - Important outputs include renewable generation serving load, carbon emissions, and portfolio costs

Capacity Expansion Inputs/Assumptions

- The following resources were considered in the GWP models
  - Geothermal – Provides firm power around the clock via the SWAC transmission path
  - Wind – Could be located in the Pacific Northwest via the PDCI path or the Southwest via the SWAC path
  - Solar – Available in Southern California via the SWAC path
  - Hydrogen – Assumes CT or ICE generators can run on 100% hydrogen by 2035
  - Long Duration Storage – Assumes a 100-hour battery available by 2035
  - Li-Ion storage – Model included 4-hr and 8-hr storage options.
- Resource selection met the capacity and the RPS/Clean energy requirements
  - 60% RPS by 2030
  - 100% Clean by 2035 or 2045
- Transmission was not directly modeled in the capacity expansion phase, instead limits were placed on resource construction

Production Cost Models

Outputs from Capacity Expansion models are fed into production cost models

- Resources are added to one of three locations --. Glendale, Southwest (SWAC line), Pacific Northwest (PDCI line)
- The model simulates GWP's system on an hourly basis, stepping through time to dispatch resources and serve load
- Outputs include
  - Carbon Emissions
  - Energy generation by resource
  - Load
  - Transmission flows
  - Market interactions
- Ascend ran the Production Cost models multiple times to adjust resources around the transmission limits and hit the RPS/Clean energy requirements

Define Clean vs Zero Caron Emission

Clean Generation per California policy mandates

- Utility serves retail load with carbon free energy
- Retail load is approximately 90% of “gross” load which includes power losses in the transmission and distribution lines.
- SB 1020 requires utilities to provide enough carbon free energy to cover roughy 90% of load (depending on the actual power losses in the utility)

Zero Carbon Emissions is more strict

- A portfolio with zero carbon emissions with have no fossil fuel generation

Scenarios

GWP

- Clean by 2045 per current California policy
  - Meets RPS and Clean energy Requirements with long-term contracts
- Zero Carbon Emissions by 2035
  - Meets the City Council target of fully clean by 2035
- Clean by 2045 with REC purchases for offsets
  - Meets RPS and Clean energy requirements partially with purchased RECs

STAG

- Zero Carbon Emissions by 2035
  - High DR, High BTM Solar, DER batteries
- Clean by 2042
  - Mid DR, Mid BTM Solar, DER batteries
- Zero Carbon Emissions by 2040
  - Mid DR, Mid BTM Solar, DER batteries

Key Finding 1

A transition to a clean energy system relies on technical progress

- Long Duration Storage (multi-day) – Show example products
  - Able to shift variable generation over several days
  - Not yet commercially available
  - Some pilot projects are being planned with small capacities
  - Installation require large amount of land – (Form Energy states 3MW per acre)
- Medium Duration storage (Eight to ten-hours)
  - Commercially available but not yet widely installed
  - Shifts variable generation from low demand to high demand hours within a day
- Clean Firm Generation (Dispatchable)
  - Most promising technologies are Green Hydrogen, CCUS, Renewable Natural Gas, and Small Modular Reactors
  - Not yet commercially available
  - Of the possible options, Green Hydrogen is considered the most likely and most cost-effective, but requires infrastructure and technical advancement

Key Finding 2

A full transition requires replacement of Grayson 9, ICEs and Magnolia with firm, clean options

- Retirements of in-basin natural gas resources create reliability challenges for GWP
- GWP is required to maintain operational reserves based on the N-1-1 contingency planning
  - In 2035, peak load is projected to be 416 MW
  - For N-1-1, GWP can rely on 100 MW from the SWAC line, remaining capacity must be local
  - Remaining resources add up to 372
- GWP must add 416 – 372 = **44 MW** of local capacity to meet load growth

	N-1-1 Resource Contribution	
	SWAC line (without STS)	100
	DR	8
	City Solar	10
	Magnolia	44
	ICE	54
	Grayson 9	48
	Eland Solar and Storage	25
	Energy Storage	75
	Scholl's Canyon	8
	Total Resources	**372**

Key Finding 3

Based on the projected resource costs and market outlook, the capacity expansion model selects geothermal, storage, hydrogen generation, and wind

- Solar is not selected by the capacity expansion models due to the heavy build out of solar in California which has pushed market prices lower during solar hours. Ascend added solar per the scenario requirements by replacing a portion of wind with solar
- Geothermal was selected as soon as possible in all scenarios due to its capacity and high RPS contribution
- Hydrogen was selected for capacity purposes
- Storage, especially long-duration, was selected to boost capacity and manage renewables

High level summary of scenarios

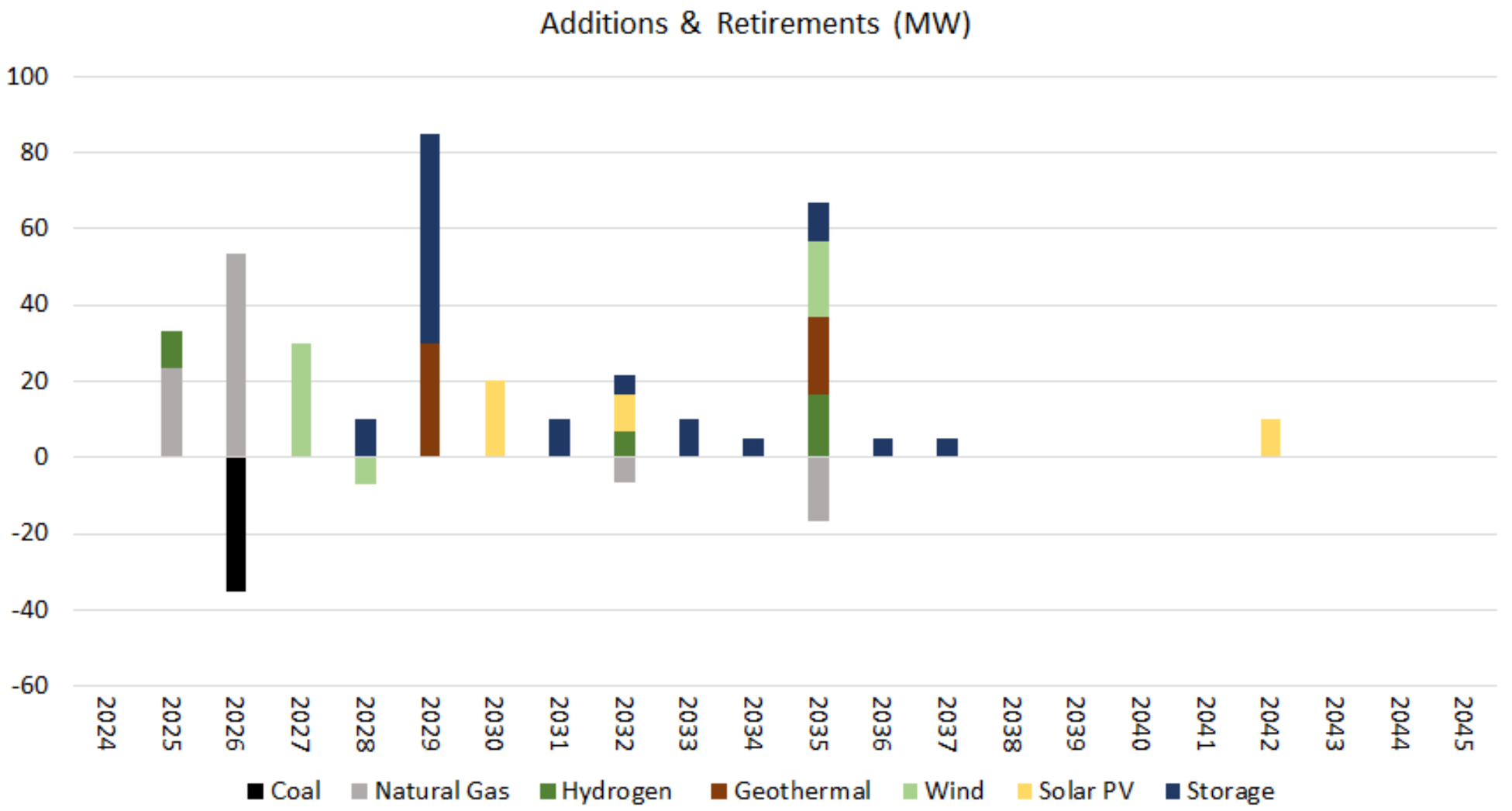
- GWP 1 – Clean by 2045. In this path, GWP will procure resources to meet the CA mandates for renewable energy and clean energy. The mandates state that GWP must serve 60% of the energy needs with renewable energy by 2030 and serve 100% of the retail energy with clean energy by 2045. In this path, GWP continues to develop wind and solar remotely while adding storage in Glendale.
- GWP 2 – Carbon Free by 2035. In this path, GWP will aggressively procure carbon free resources including geothermal, wind, and solar while also building storage early in the process. Natural gas generation will be replaced or converted to a clean fuel source such as hydrogen by 2035. The costs of the transition are uncertain as they depend heavily on the cost of replacing natural gas with hydrogen. This scenario aligns with the IRP of LADWP.
- GWP 3 – Clean by 2045 with offsets. Same as GWP 1, but with less renewable generation. The lower renewable generation is offset with purchases of renewable energy credits to meet the California mandates.
- STAG 1 – Carbon Free by 2035 with a focus on local resources. GWP would aggressively procure geothermal, wind, and solar at the utility scale while also pursuing customer sited resources. Rooftop solar increases significantly along with distributed batteries at residences. GWP would also work to increase energy efficiency.
- STAG 2 – Carbon Free by 2042. In the path, GWP will work to convert natural gas resources to run on a clean fuel by 2042. GWP will push for increased renewable procurement in the near- and mid-term while working towards the transition out of natural gas. One thing that stands out in STAG 2 is that Magnolia retires in 2038 instead of 2042 causing less emissions here compared to STAG 3. This scenario lines up with other smaller municipal utilities in the region.
- STAG 3 – Carbon Free by 2040. This is very similar to STAG 2 with a slightly more aggressive timeline.

Summary of Results

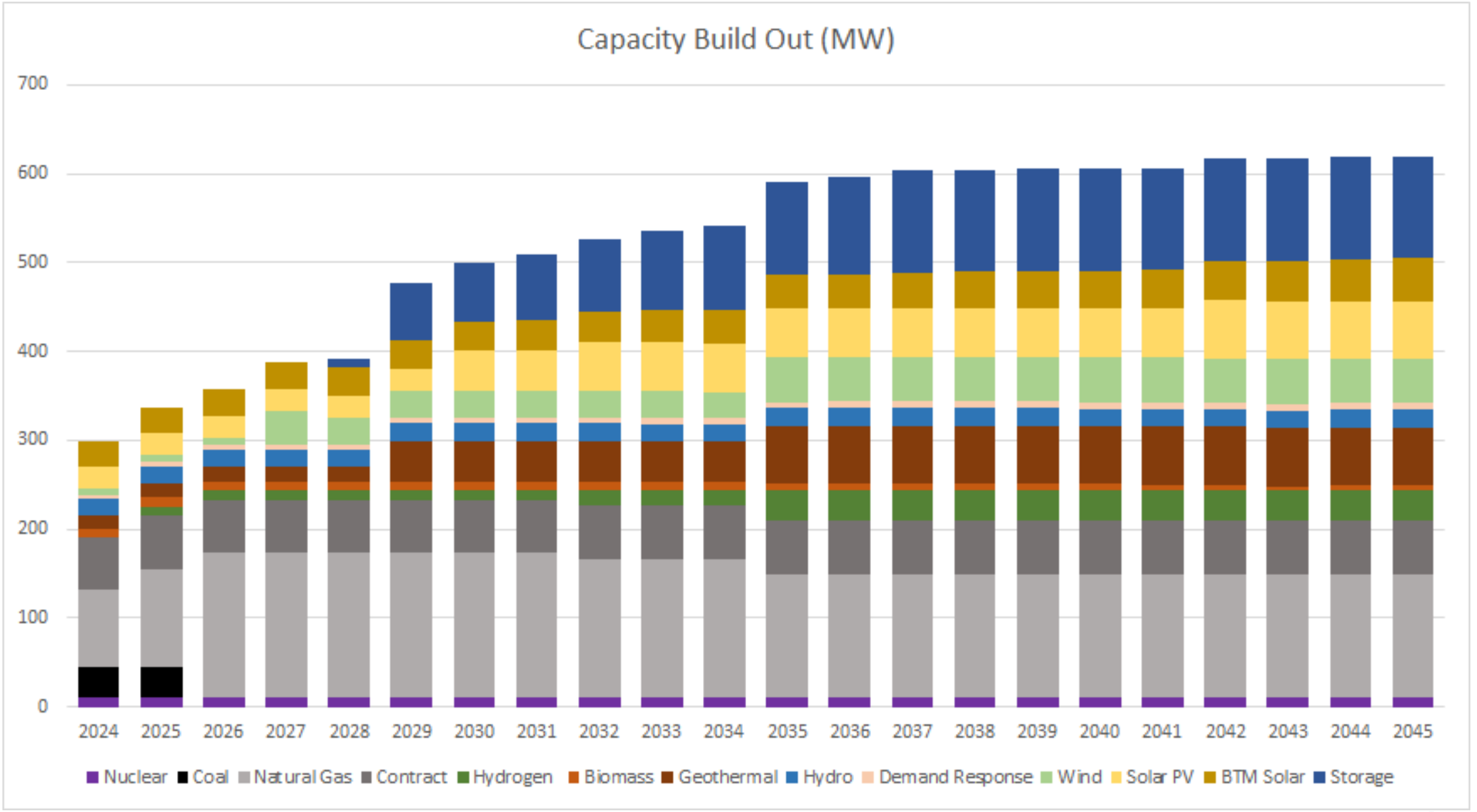
	Total New Resource Cost (Millions)	Percent Clean Energy in 2035	Total CO2 Emissions (Million Tons)	Total Cost of Carbon with SCC applied ($Million)
GWP CA Policy	$535	91%	2,597	$385
GWP Zero Emissions by 2035	$1,887	109%	1,642	$267
GWP CA Policy with Offsets	$497	82%	2,597	$385
STAG 1	$1,815	132%	1,434	$209
STAG 2	$1,344	103%	1,828	$290
STAG 3	$1,363	95%	2,032	$316

Note: Cost data has changed since the time of this meeting. The new resource costs reflected here are not the most recent or accurate.

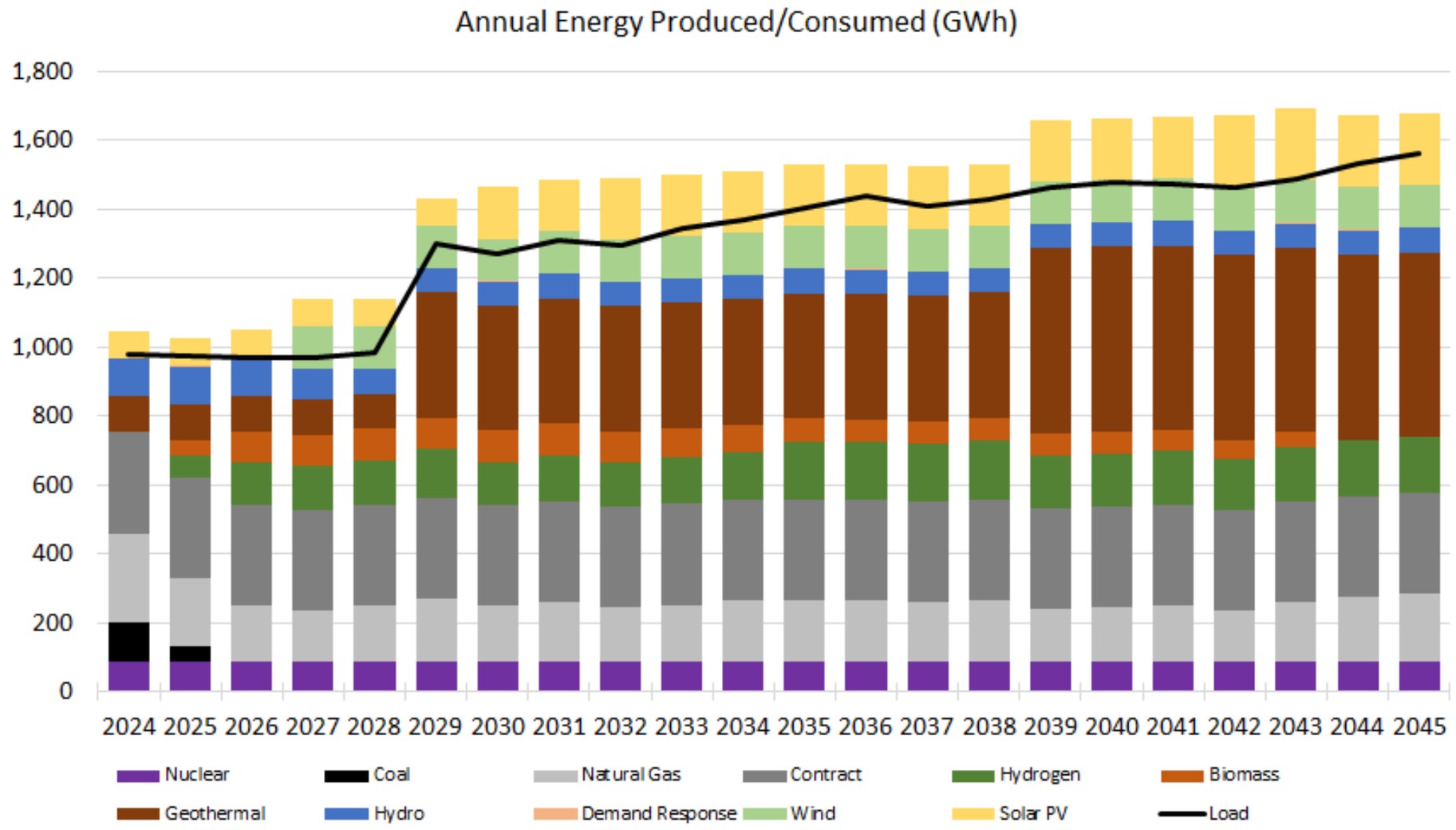
GWP California Policy Build Out



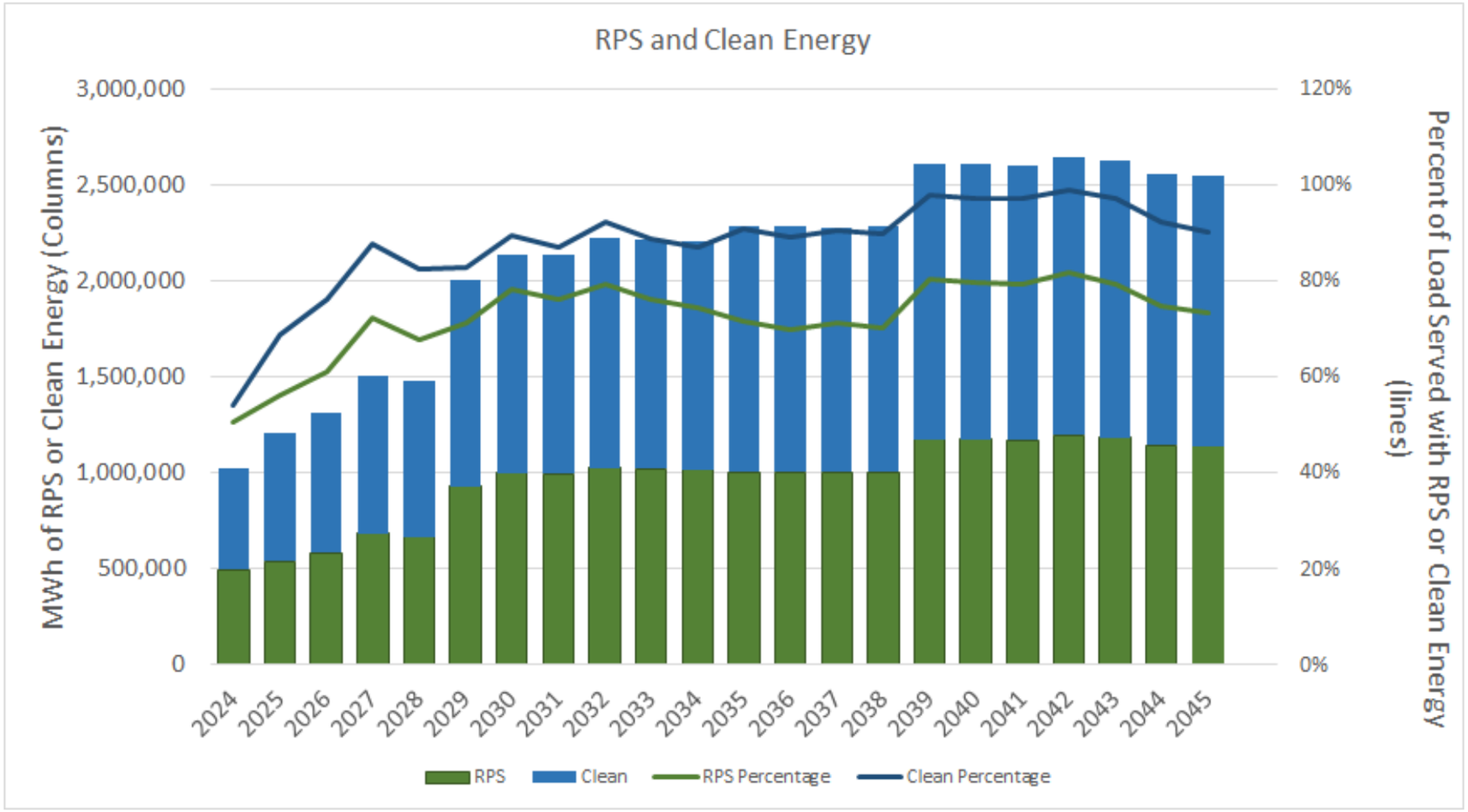
GWP California Policy Capacity



GWP California Policy Energy Mix



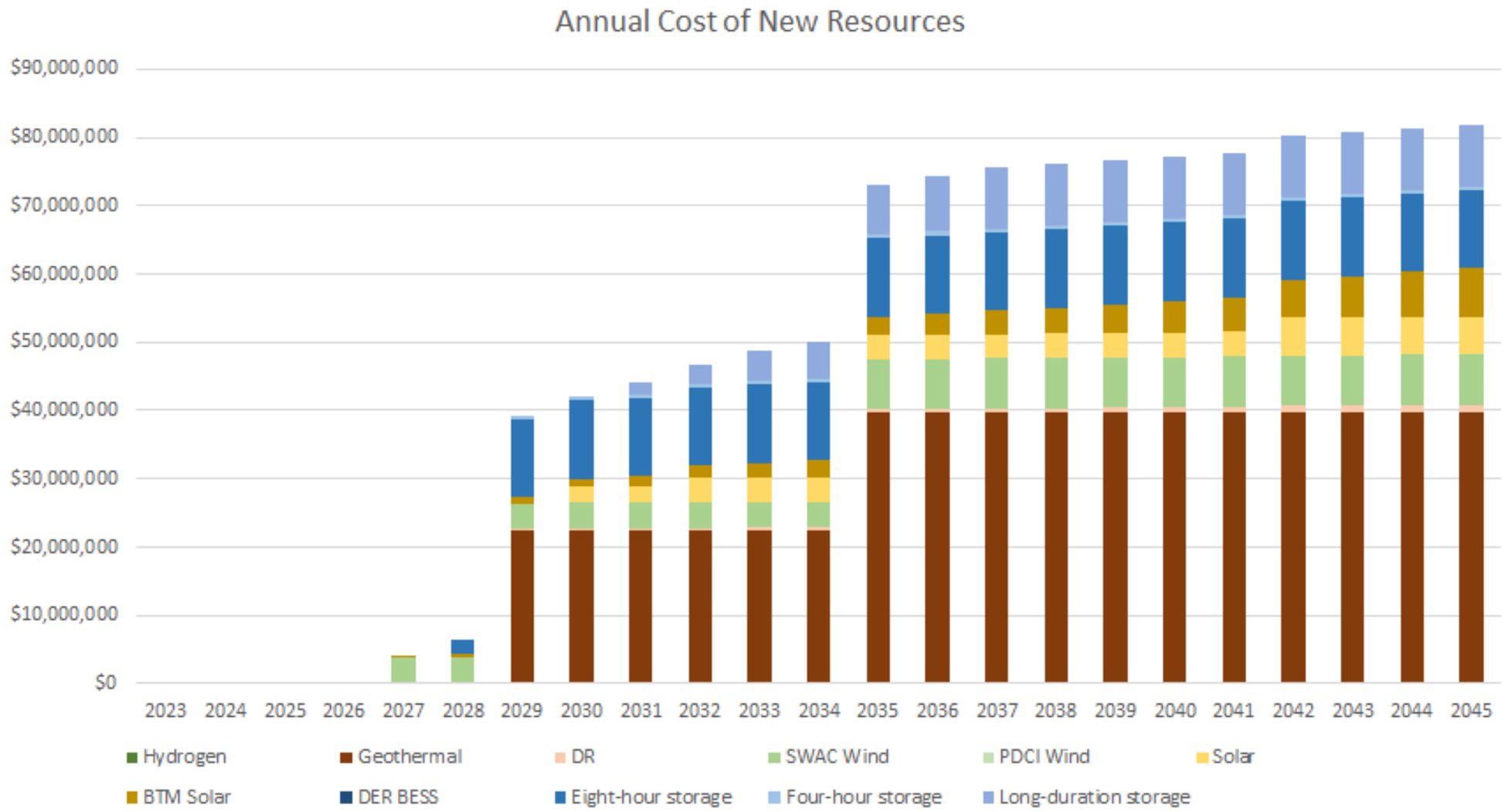
GWP California Policy RPS/Clean Generation



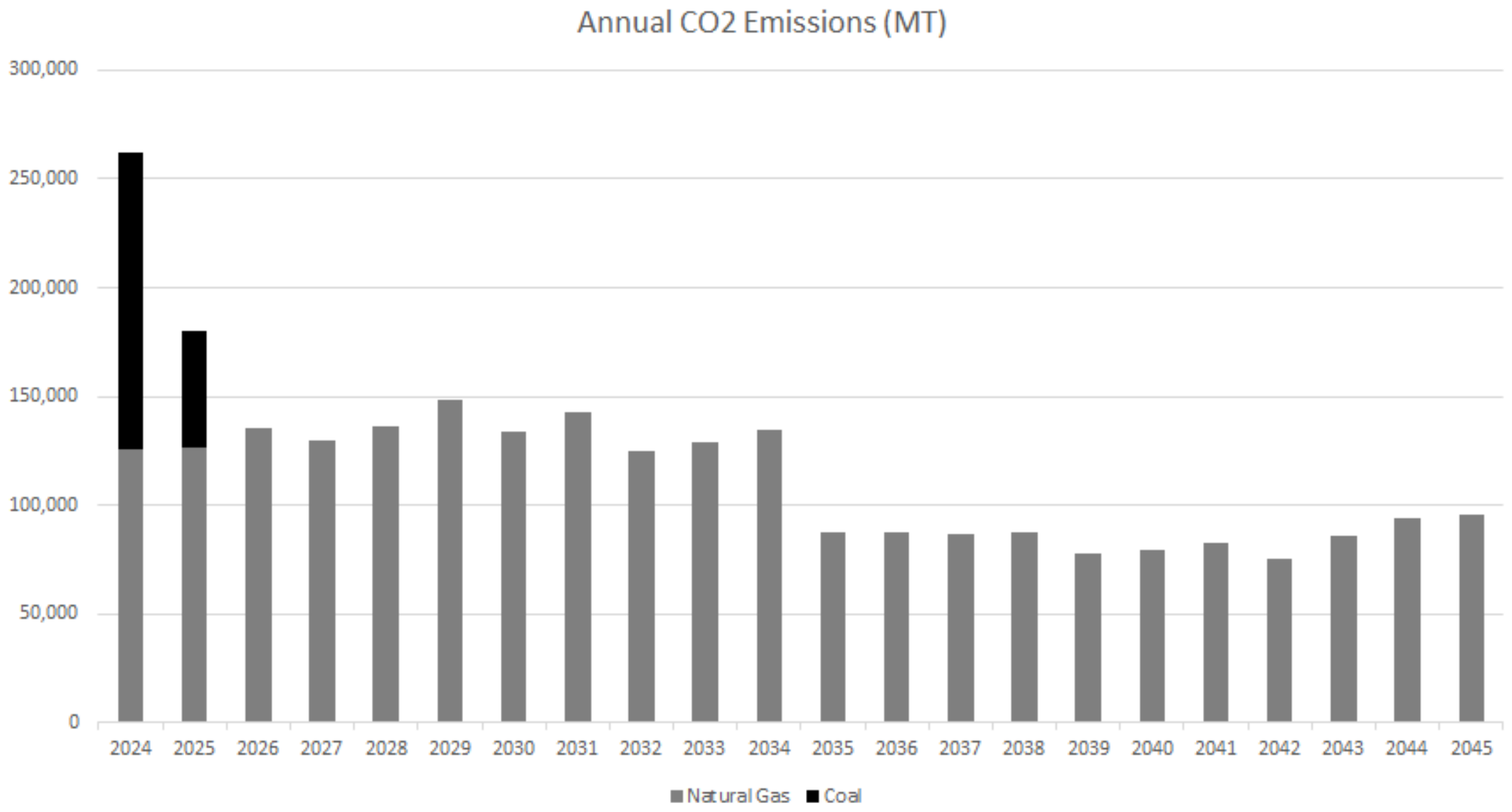
*RPS and Clean Energy percentage is measured compared to wholesale load in this slide. The California policy is measured against retail sales. Clean energy equal to 90% of gross load is approximately 100% of retail sales.

GWP California Policy Costs

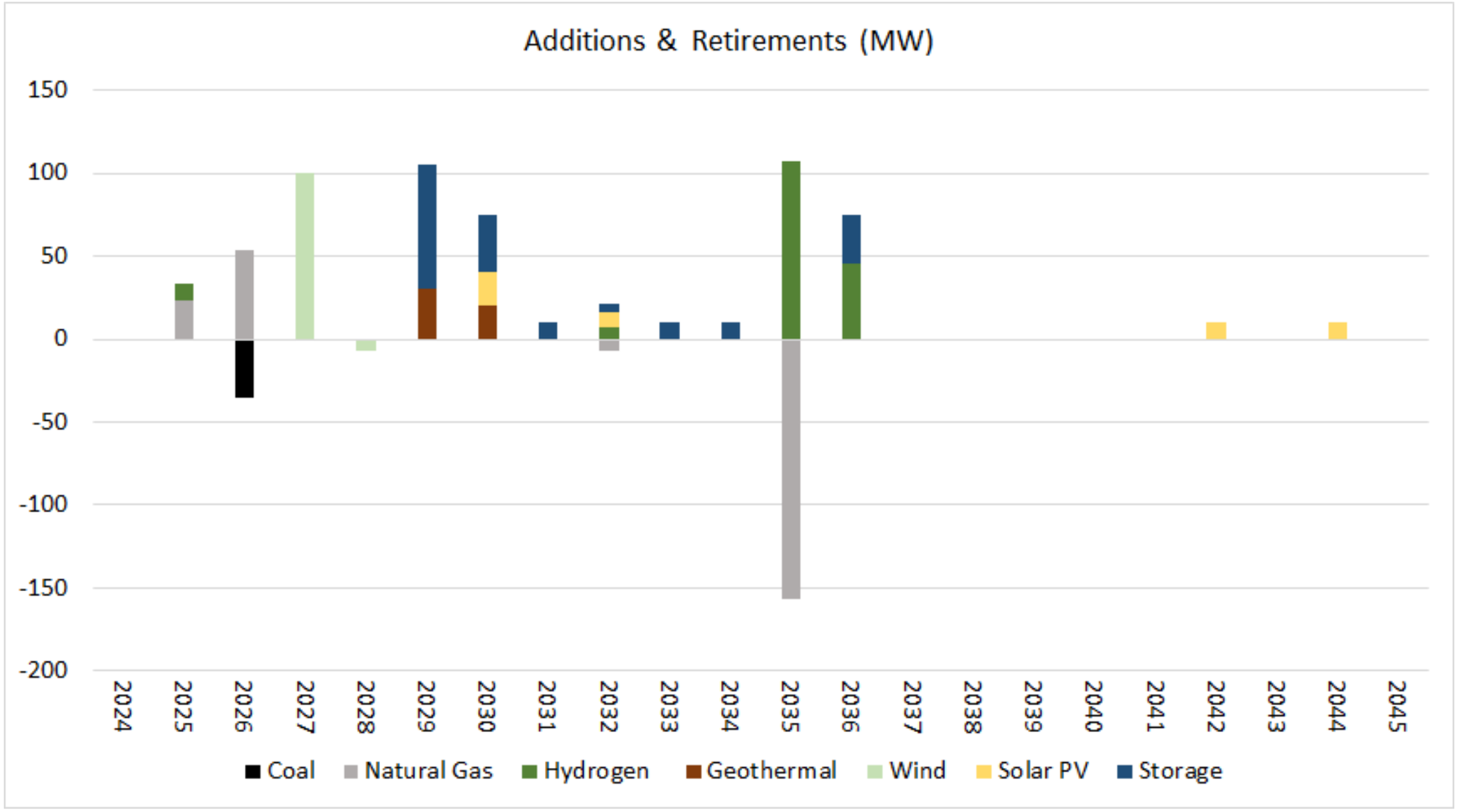
Net Present Cost of Resource Additions from 2023 to 2045 =



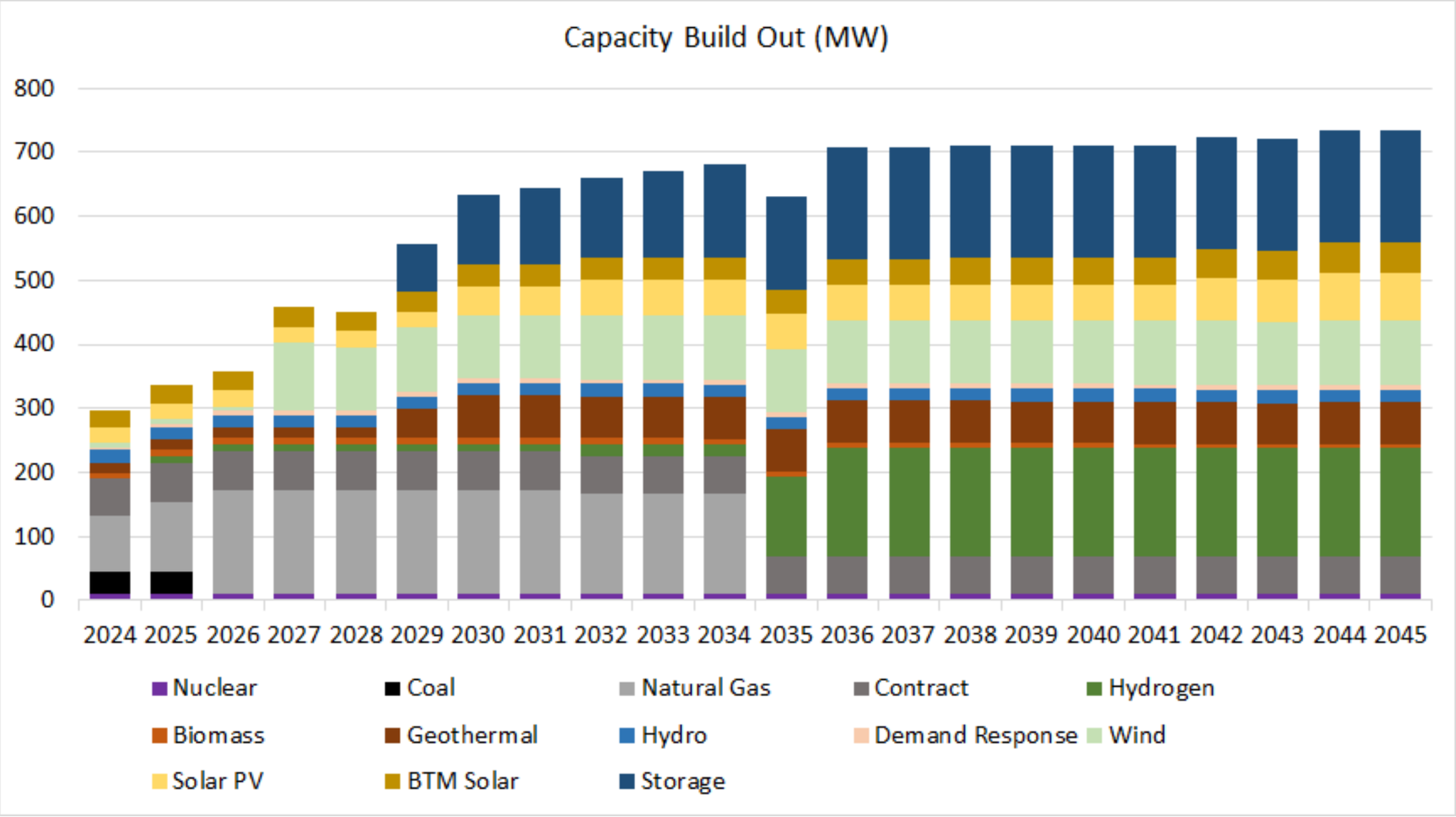
GWP California Policy Carbon Emissions



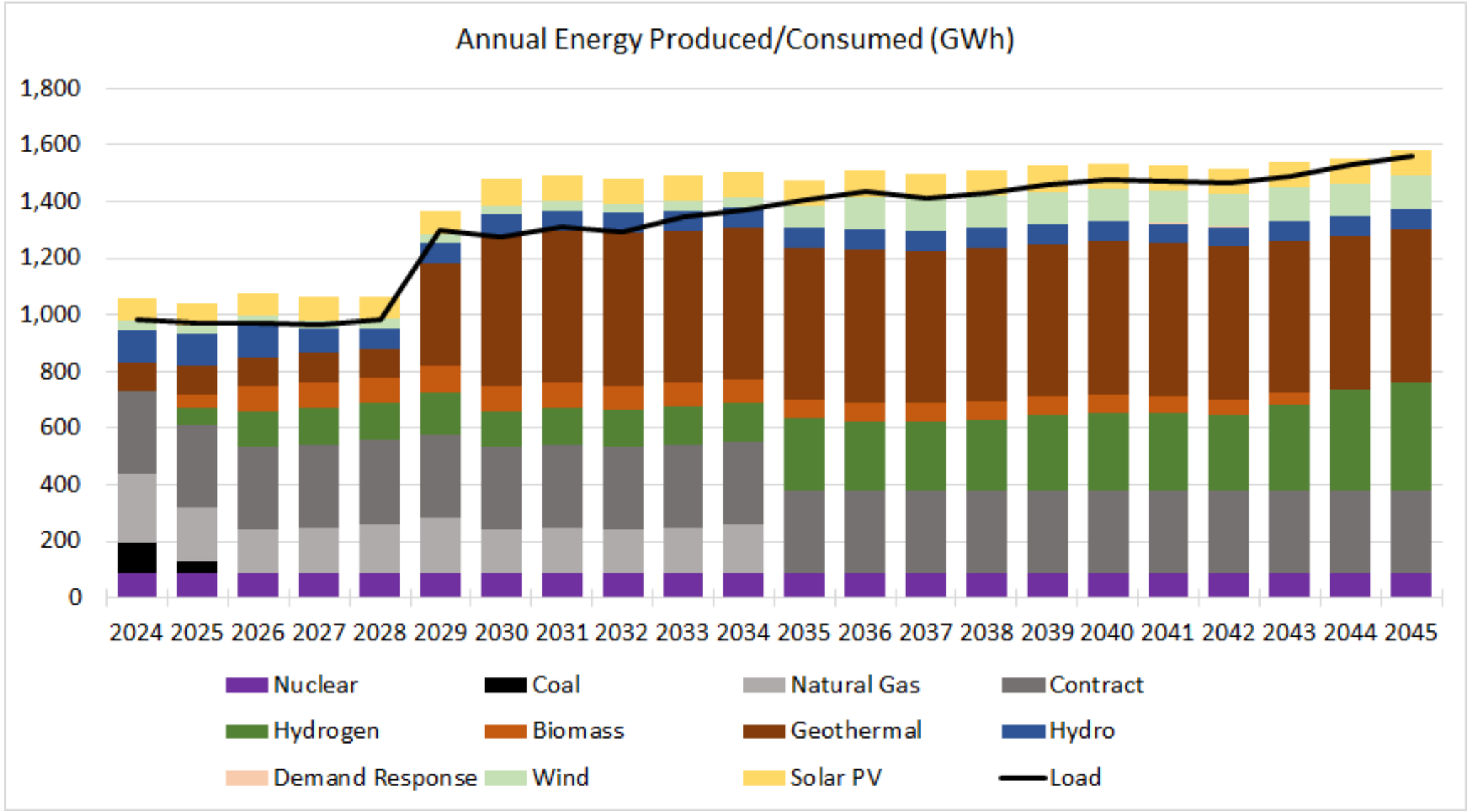
GWP Clean by 2035 Build Out



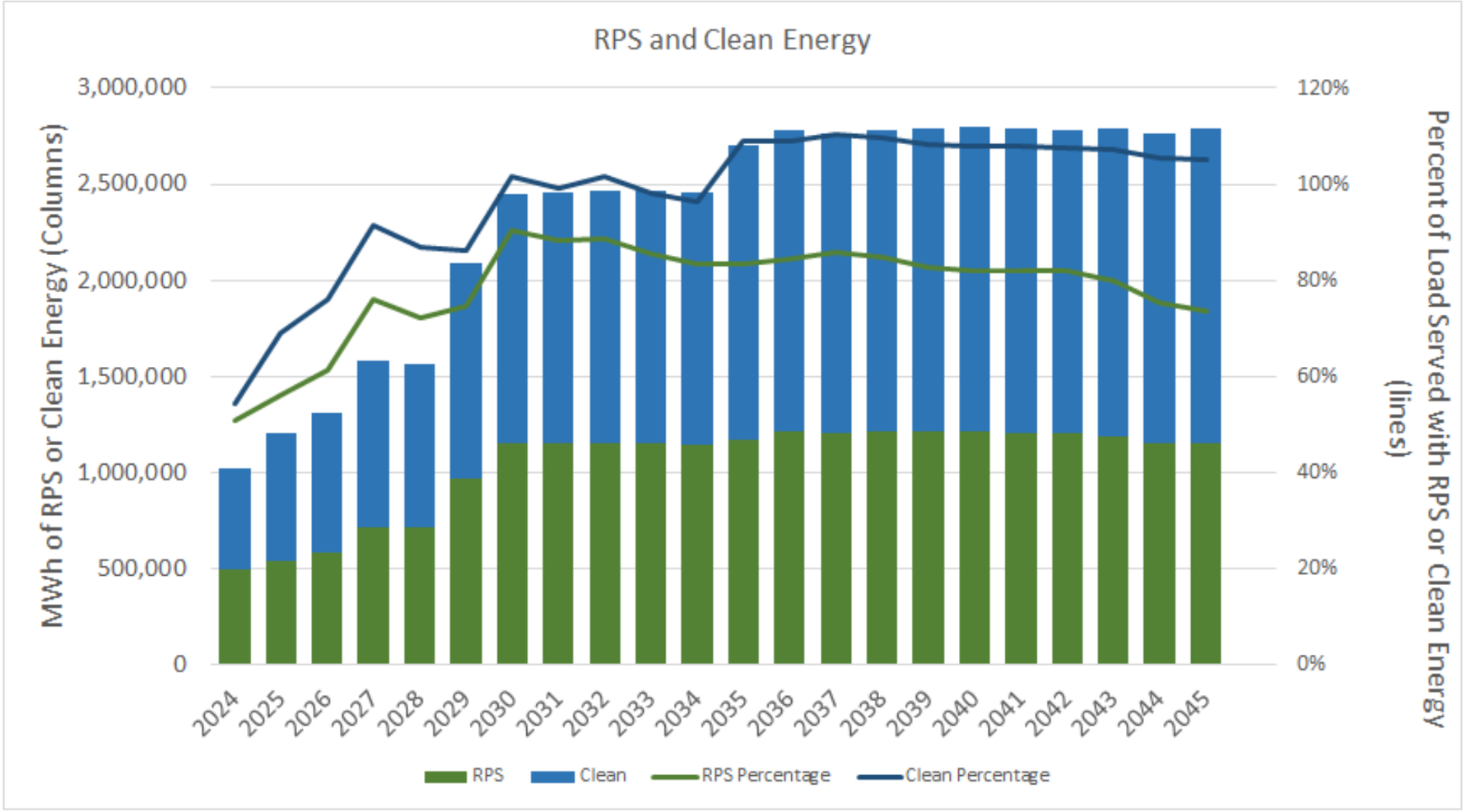
GWP Clean by 2035 Capacity



GWP Clean by 2035 Energy Mix



GWP Clean by 2035 RPS/Clean Generation



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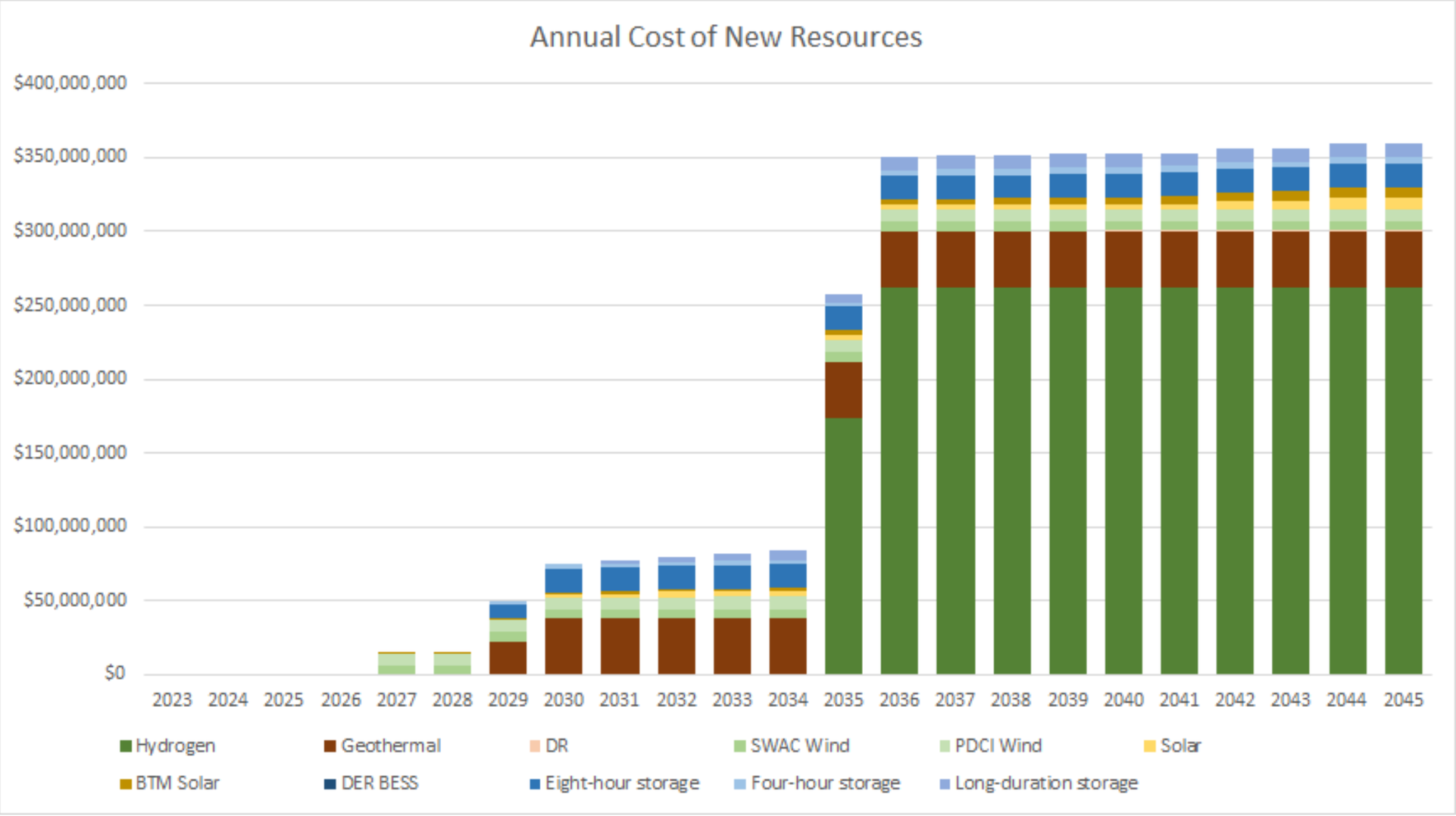
GWP Clean by 2035 Costs

Net Present Cost of Resource Additions from 2023 to 2045 = $1,888 Million



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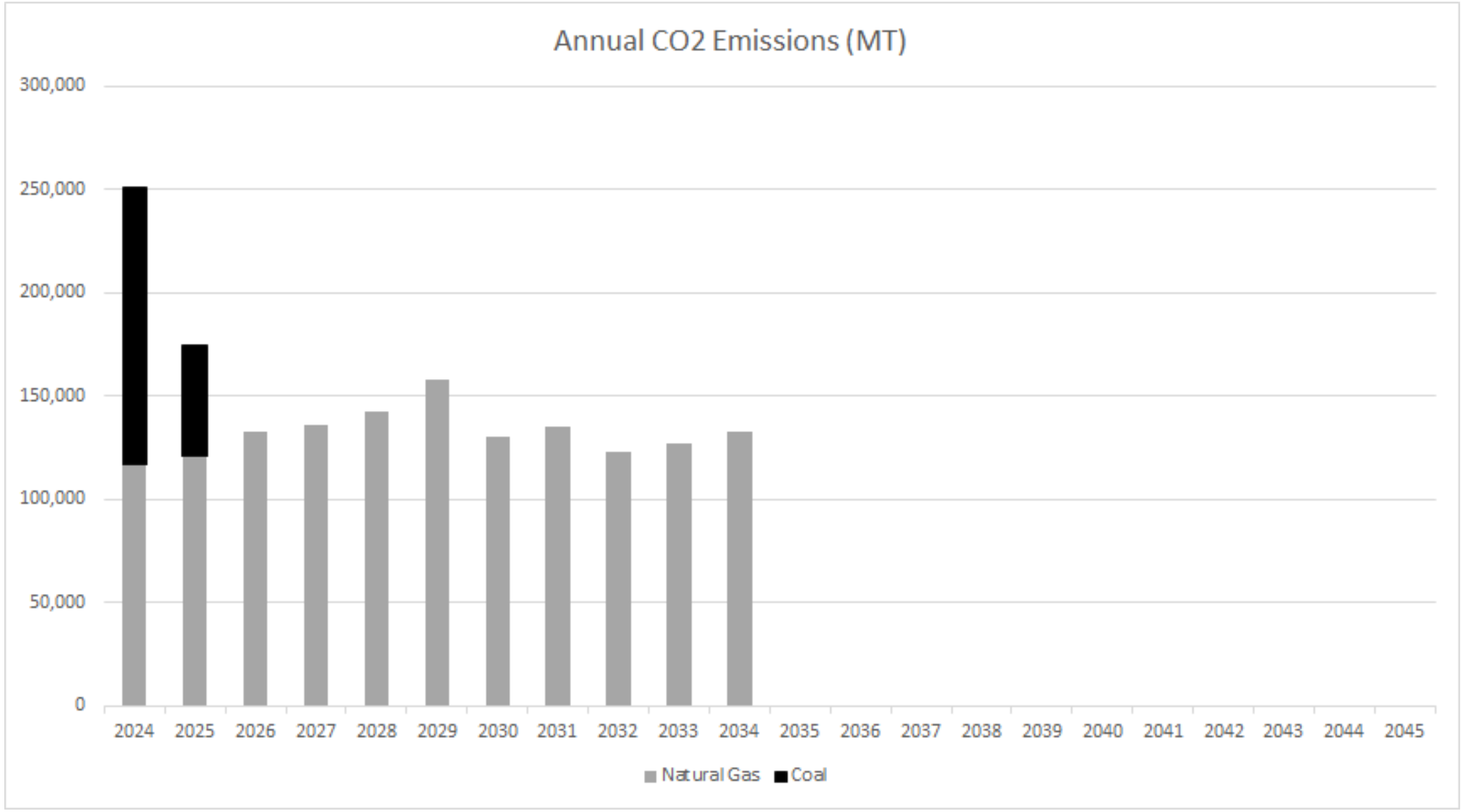
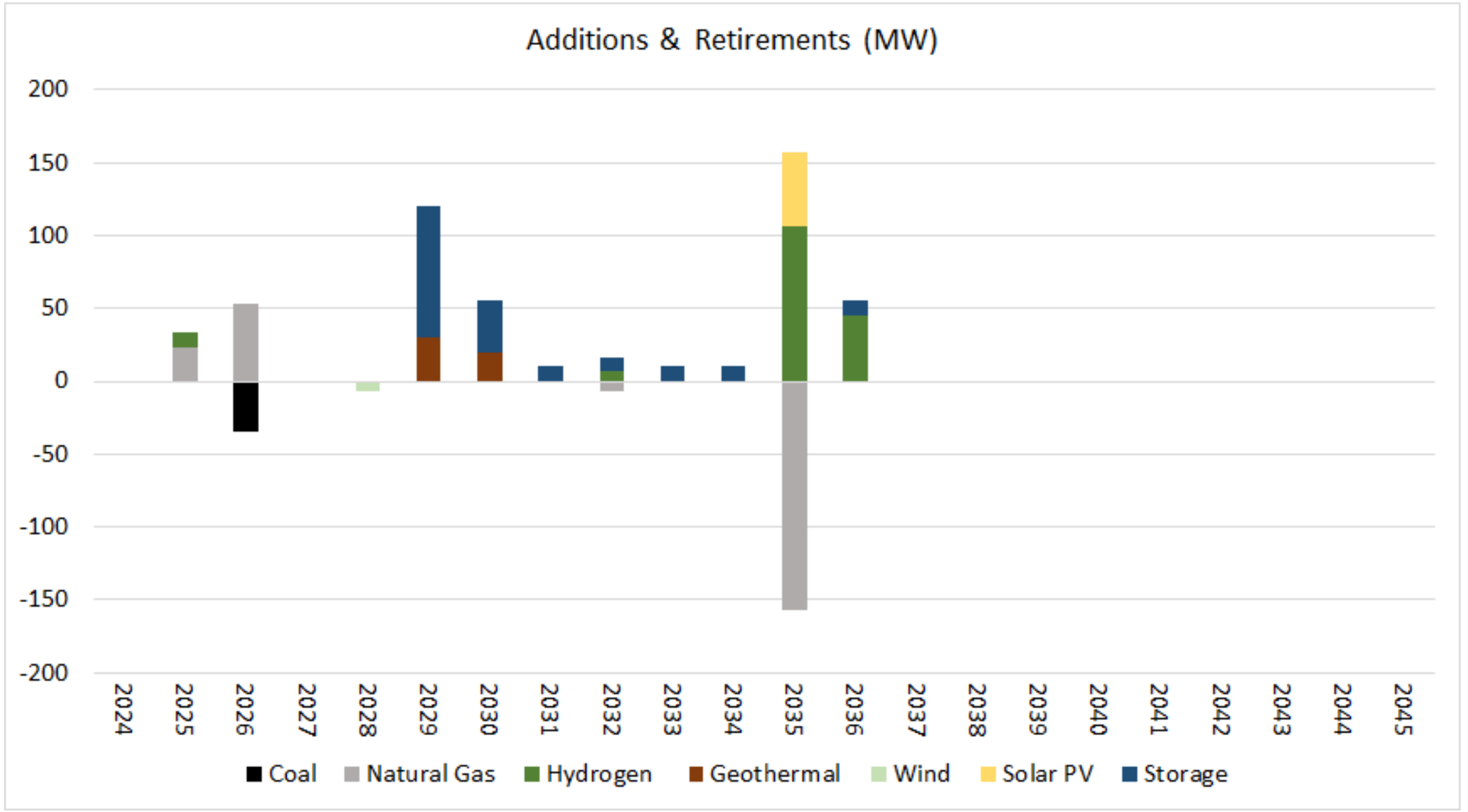
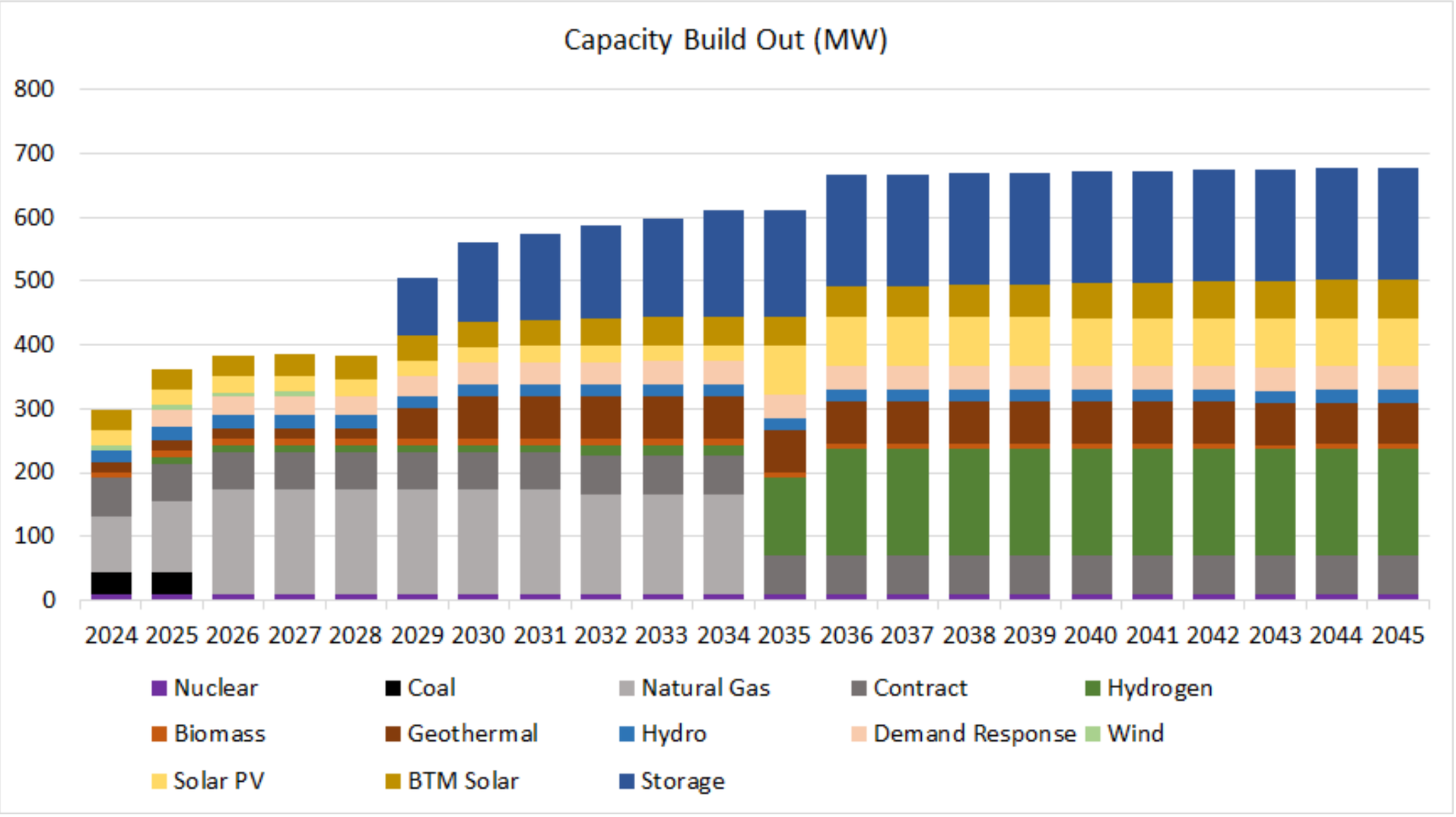
GWP Clean by 2035 Carbon Emissions



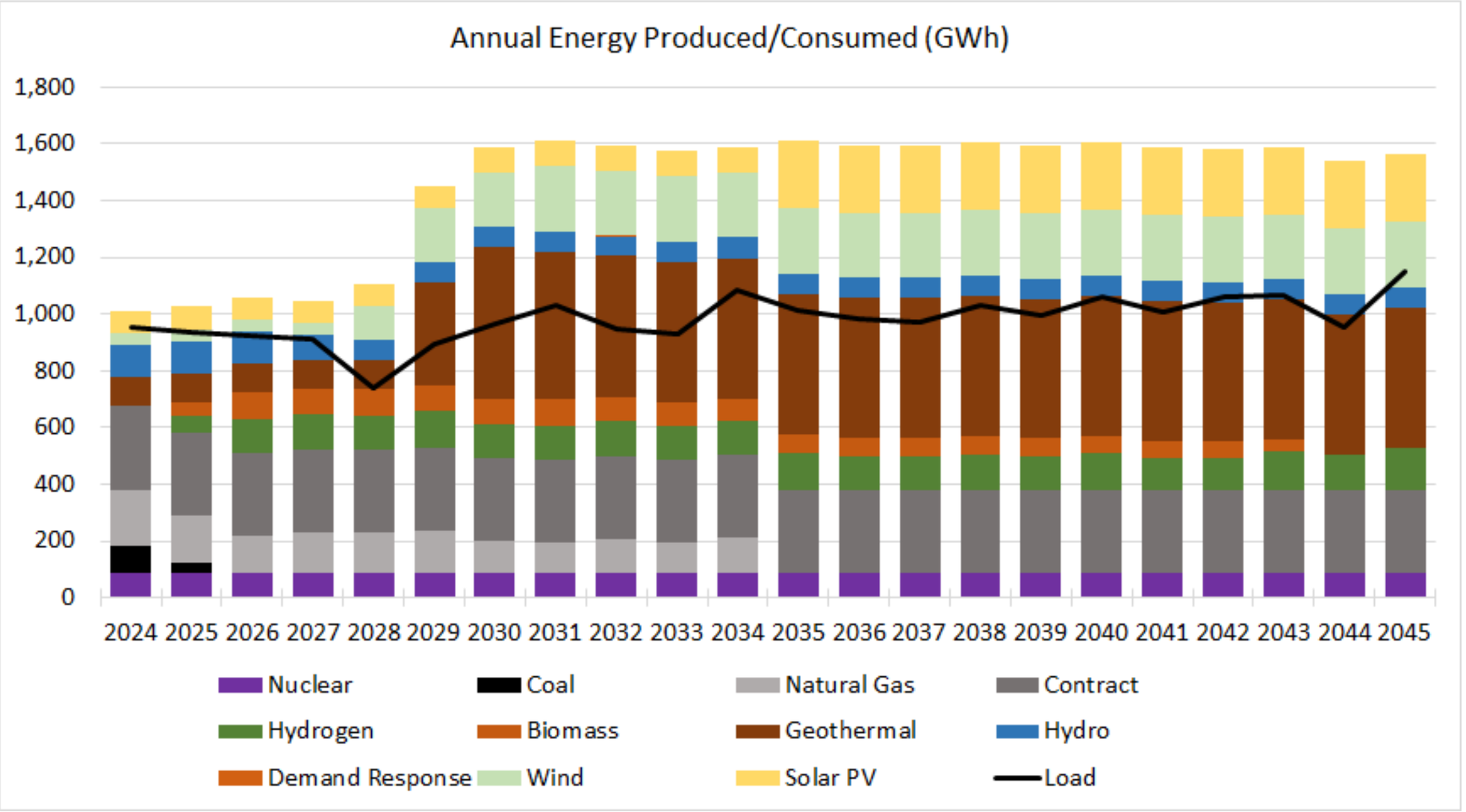
STAG 1 Build Out



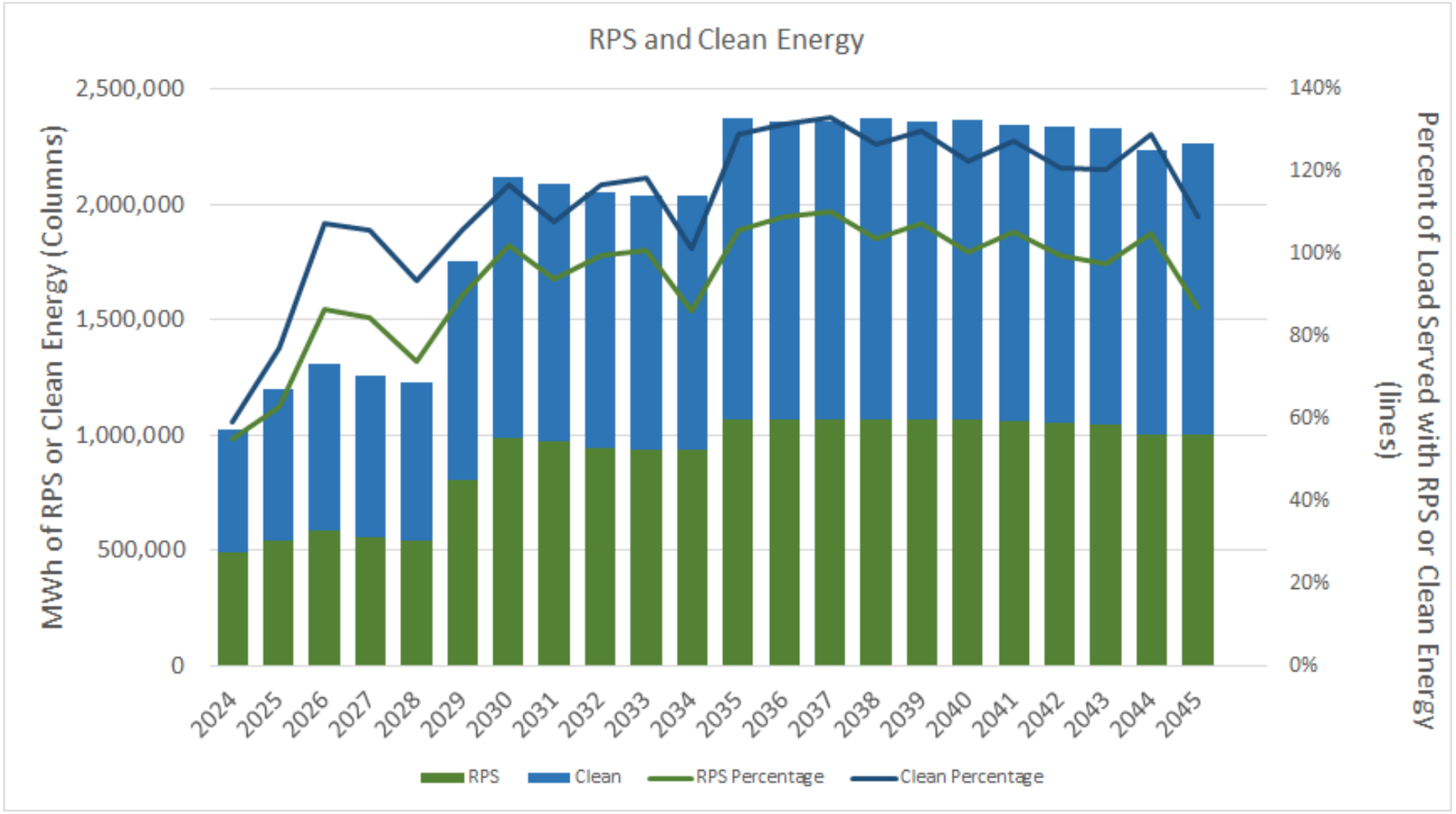
STAG 1 Capacity



STAG 1 Energy Mix



STAG 1 RPS/Clean Generation



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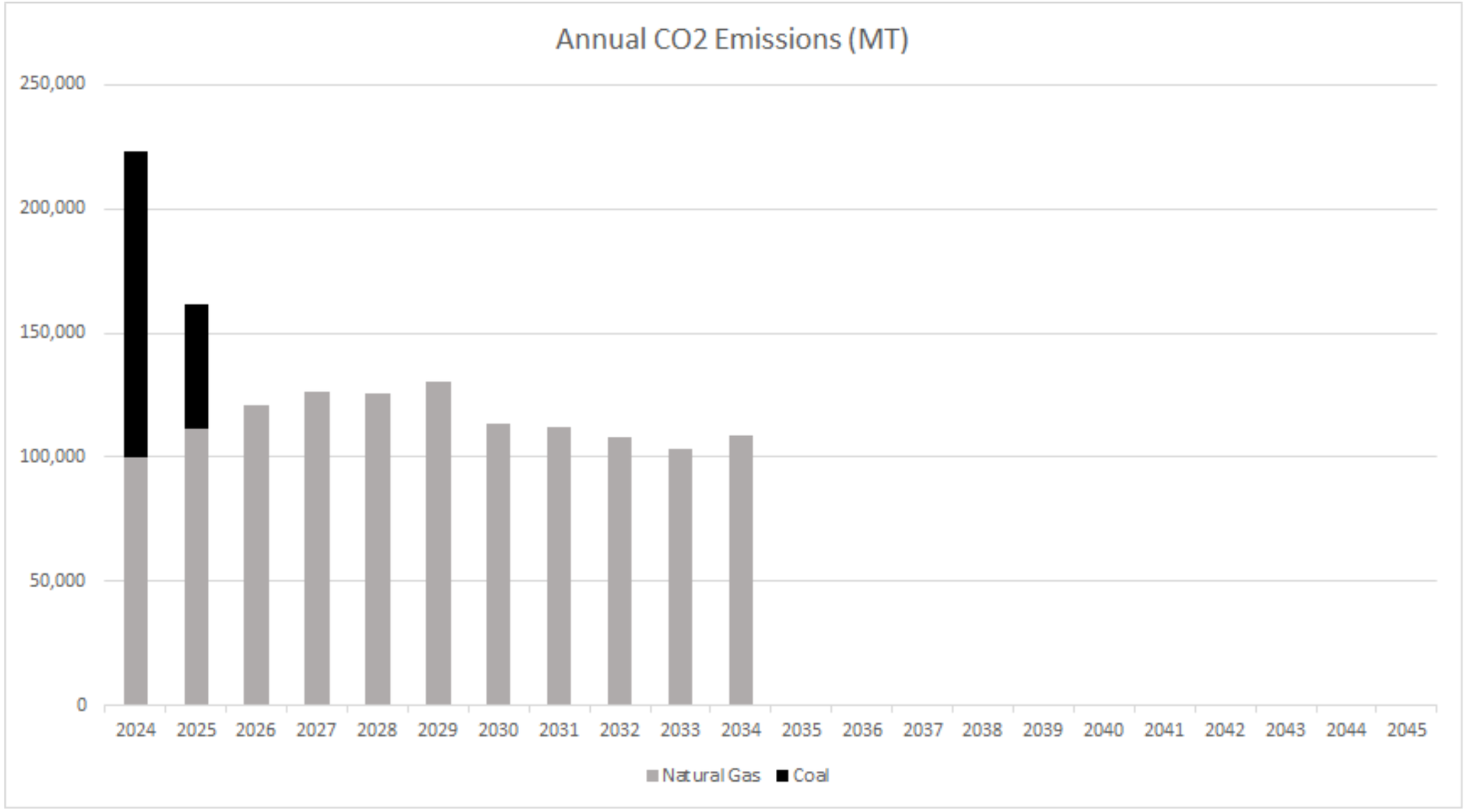
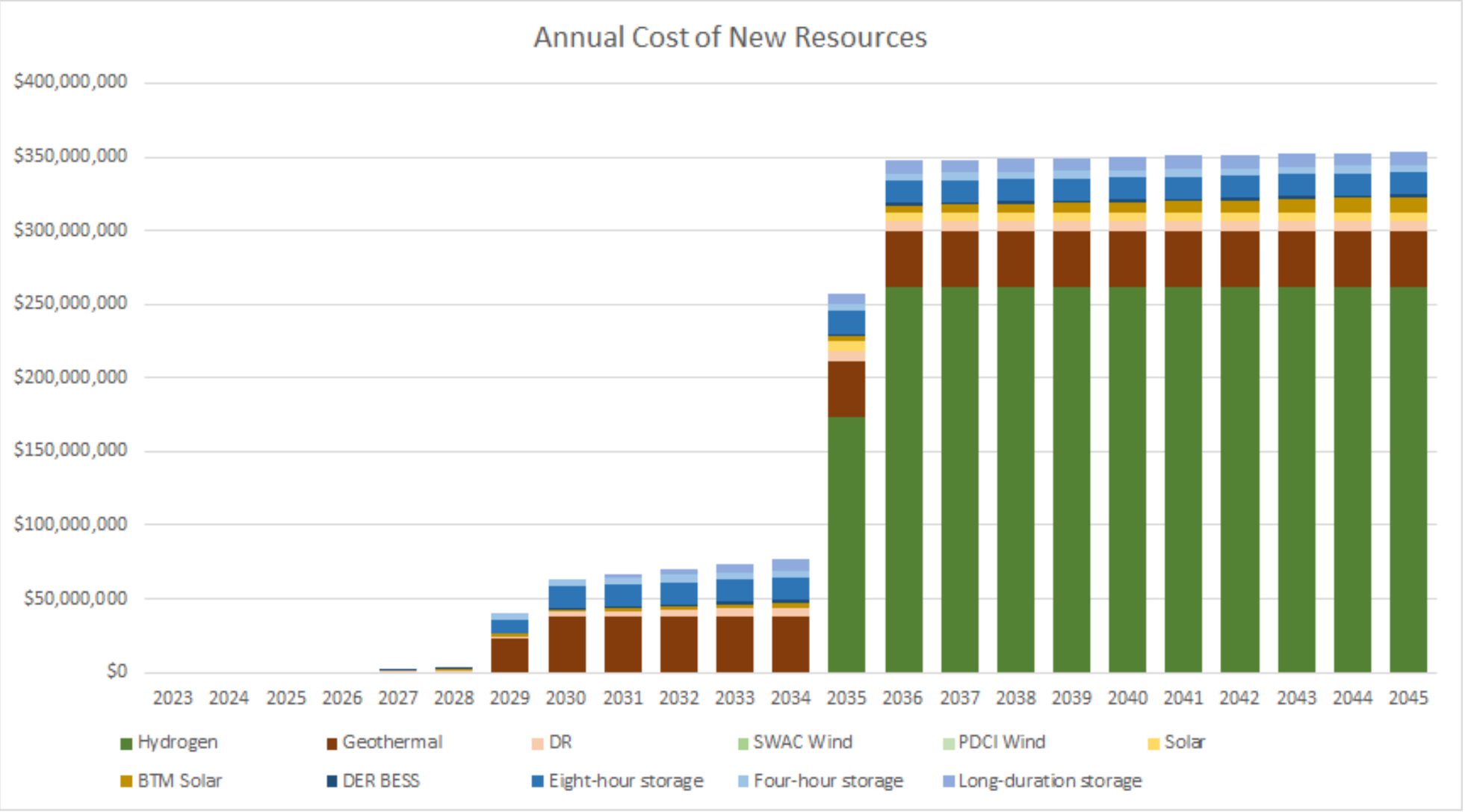
STAG 1 Carbon Emissions



STAG 1 Costs

Net Present Cost of Resource Additions from 2023 to 2045 = $1,816 Million



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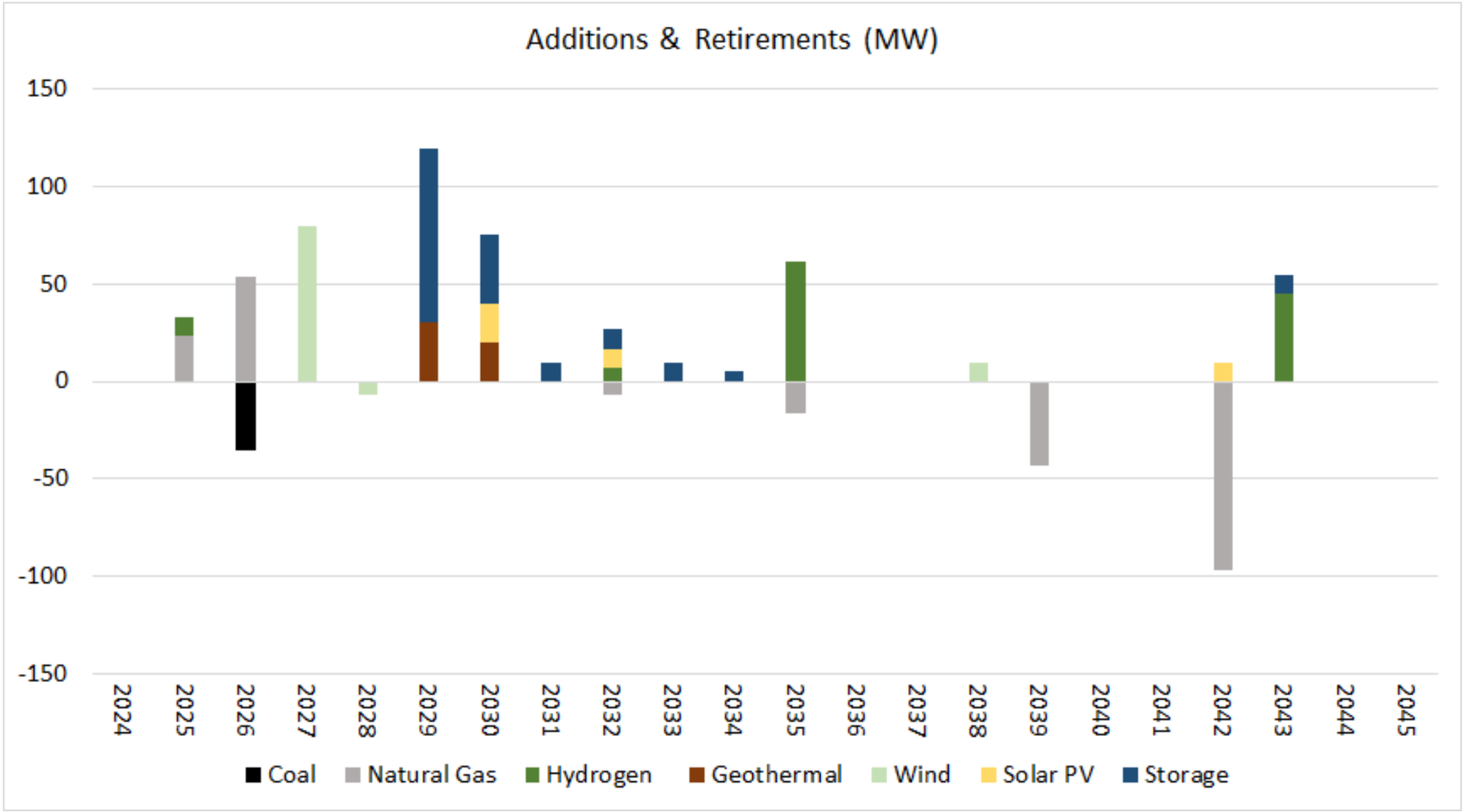
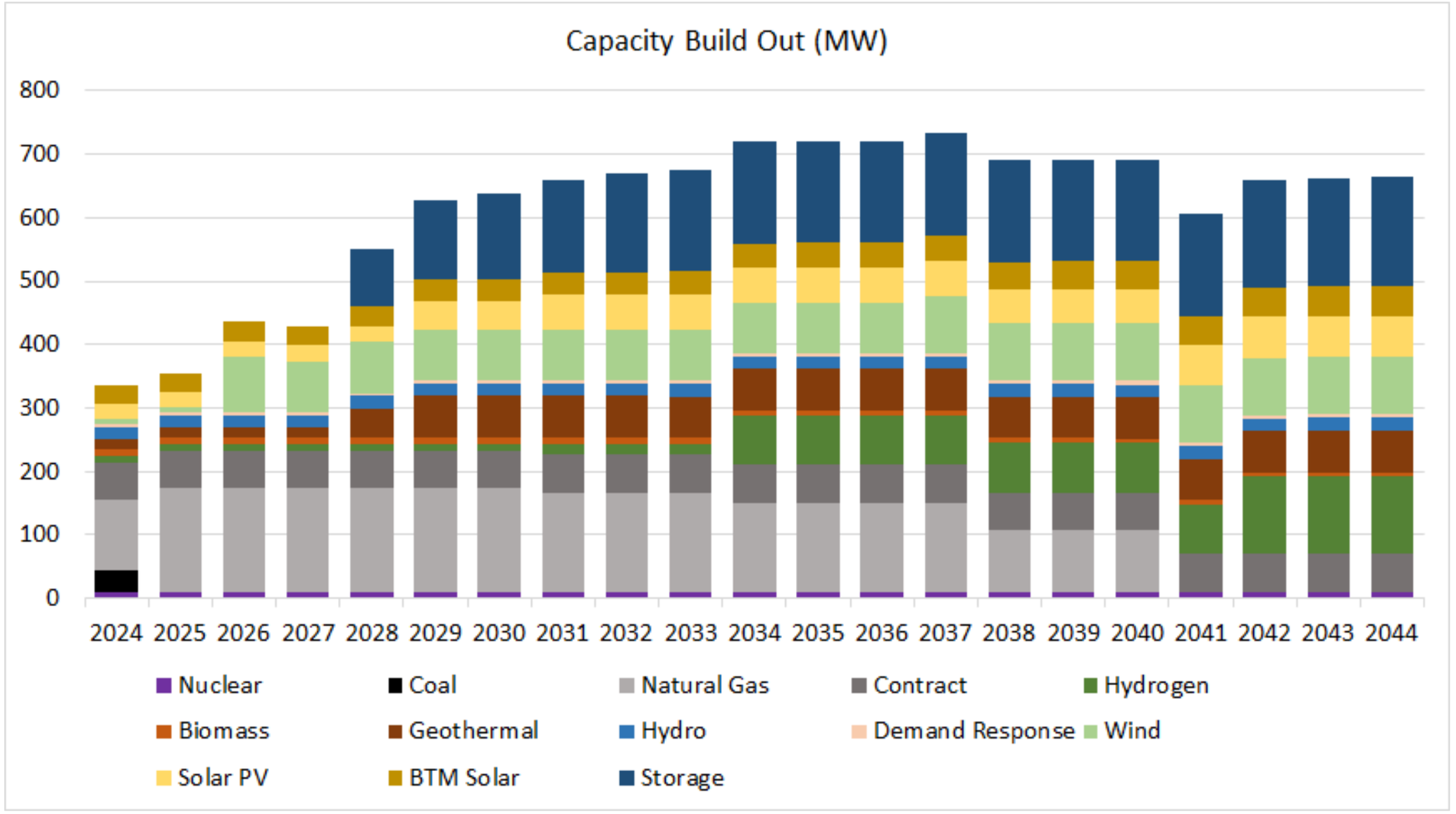
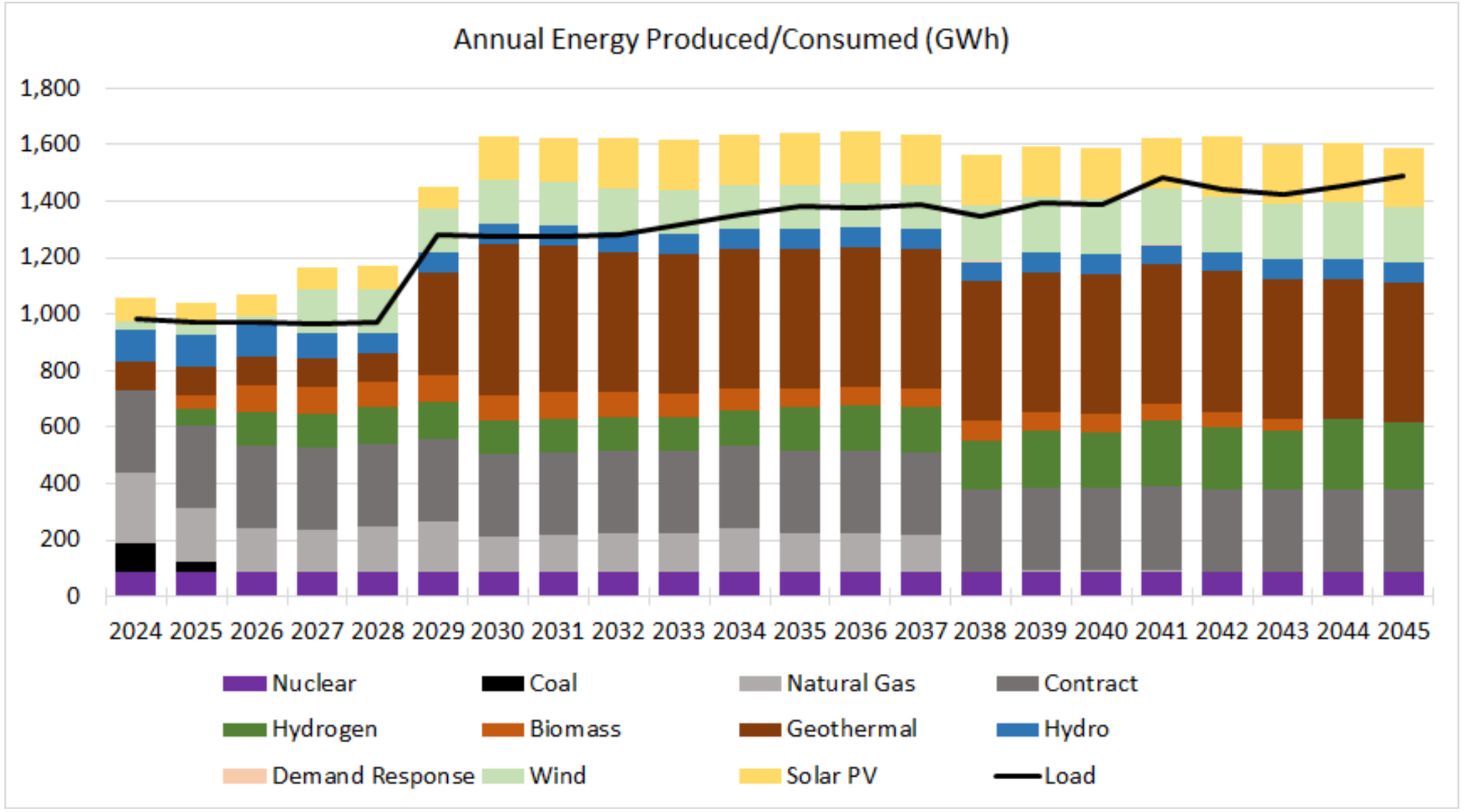
STAG 2 Build Out



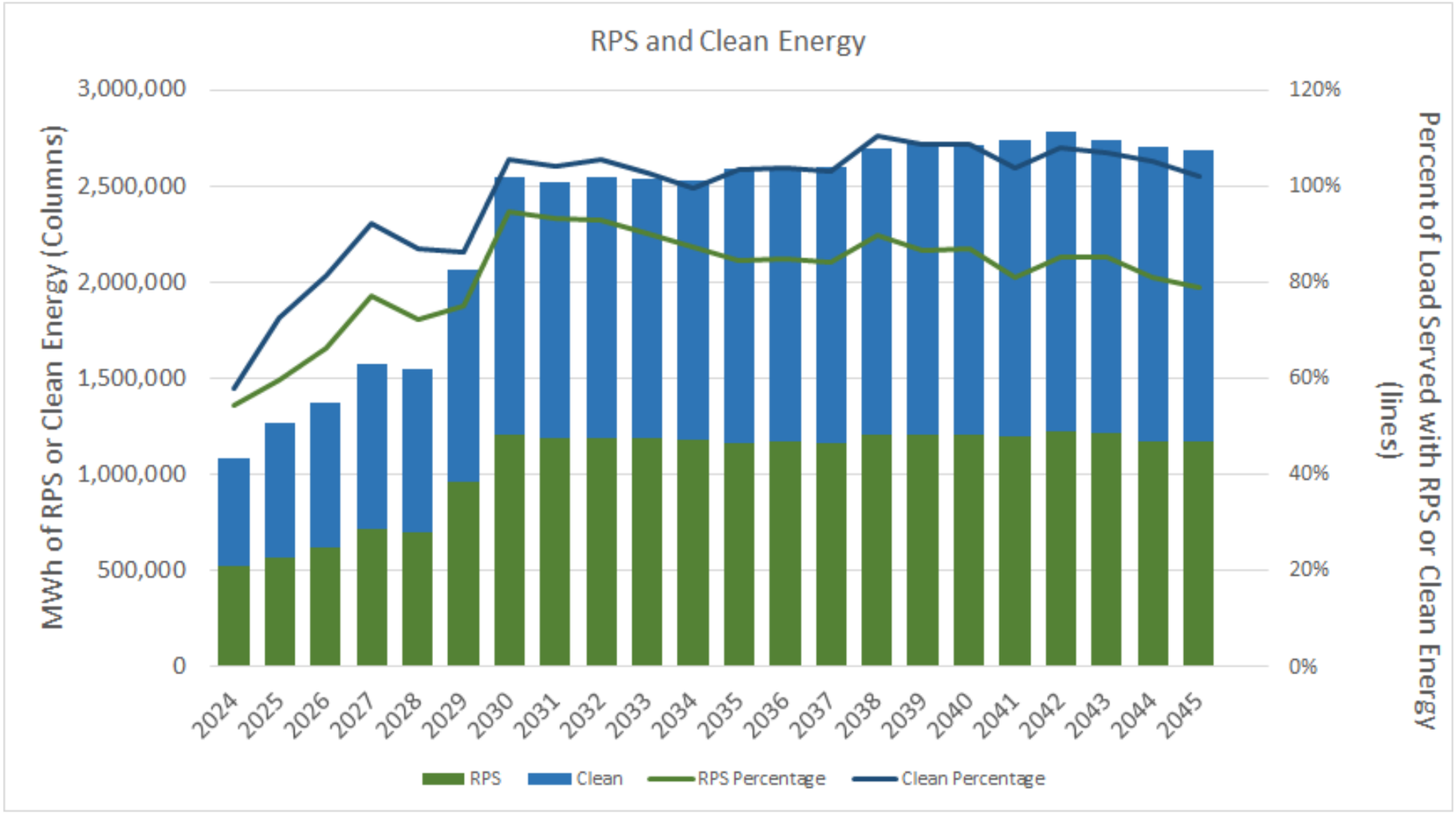
STAG 2 Capacity



STAG 2 Energy Mix



STAG 2 RPS/Clean Generation



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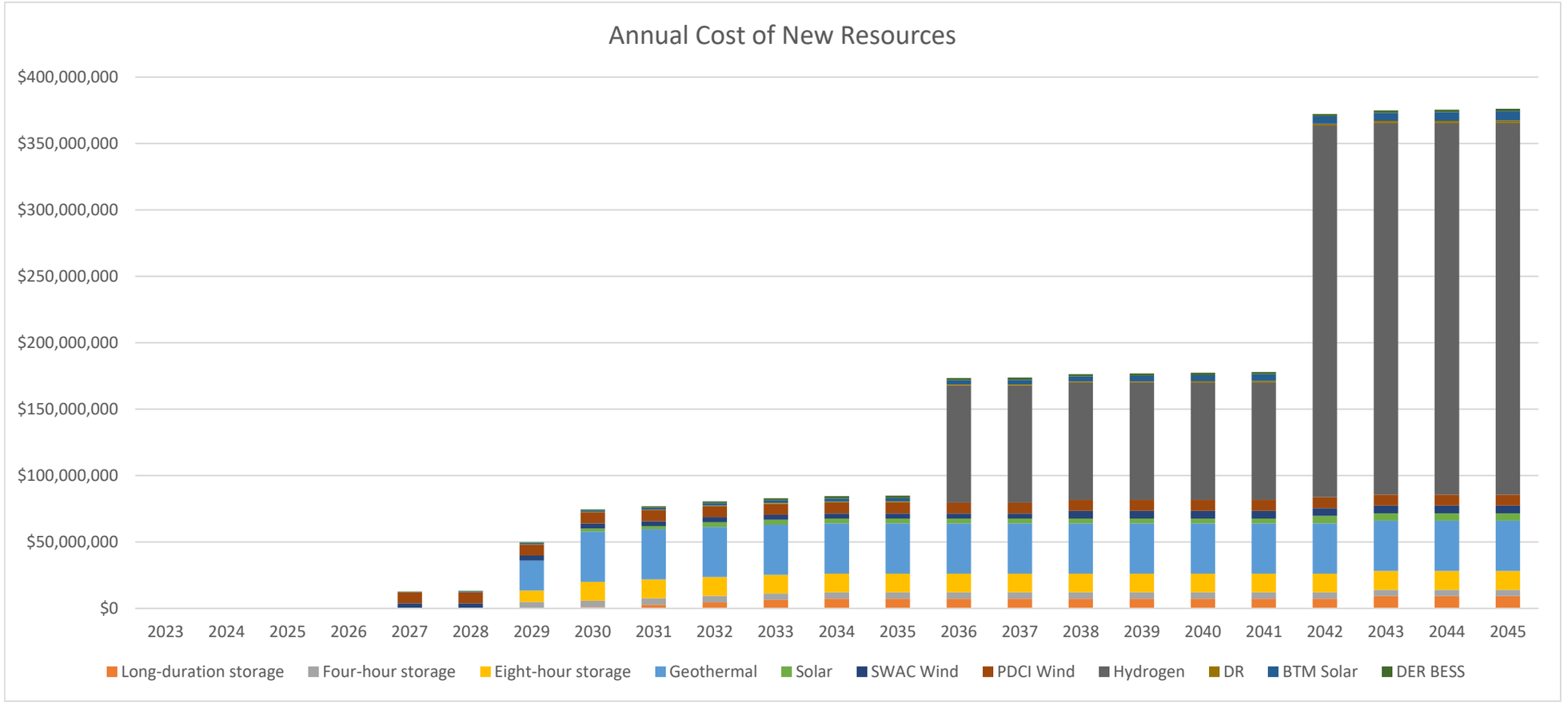
STAG 2 Policy Costs

Net Present Cost of Resource Additions from 2023 to 2045 = $1,344 Million



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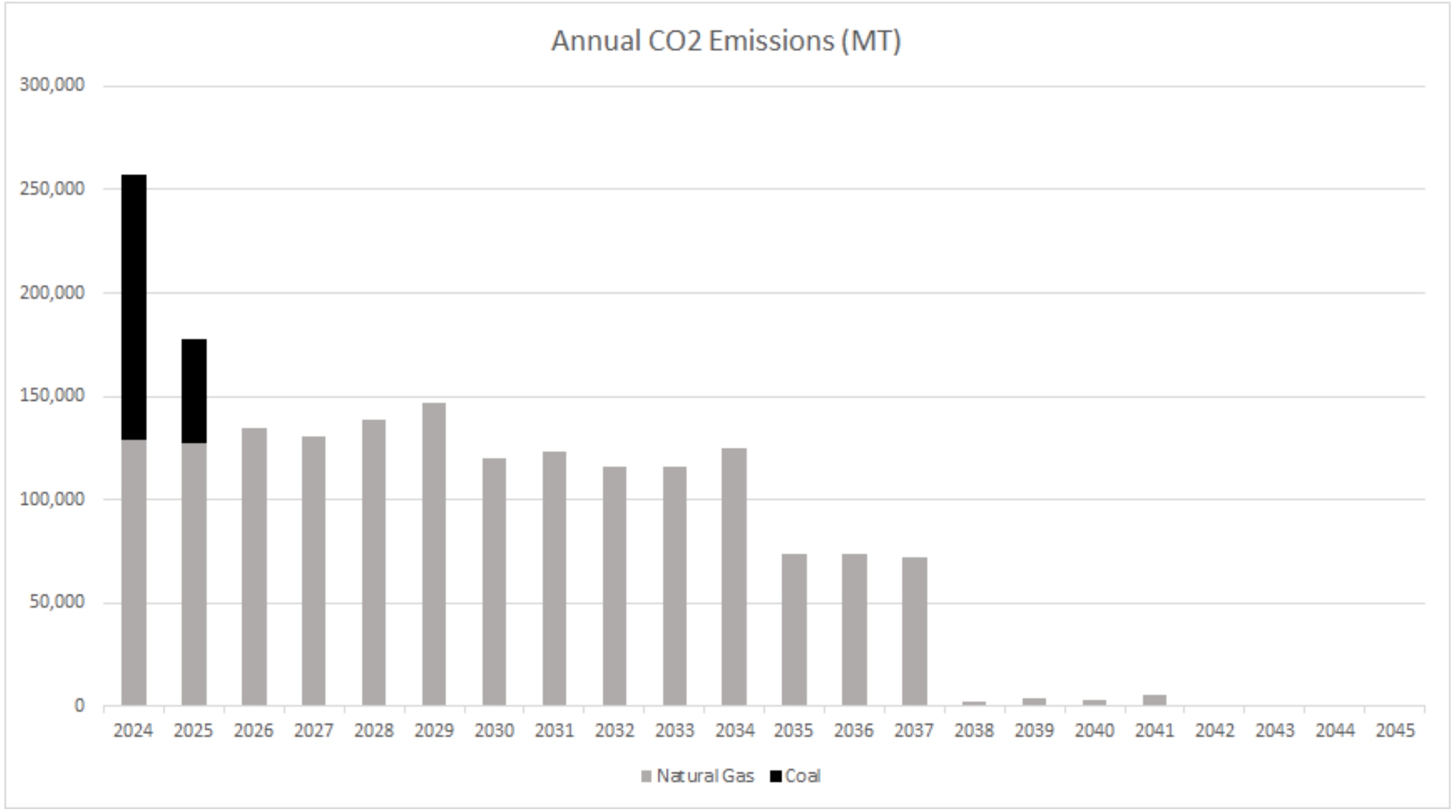
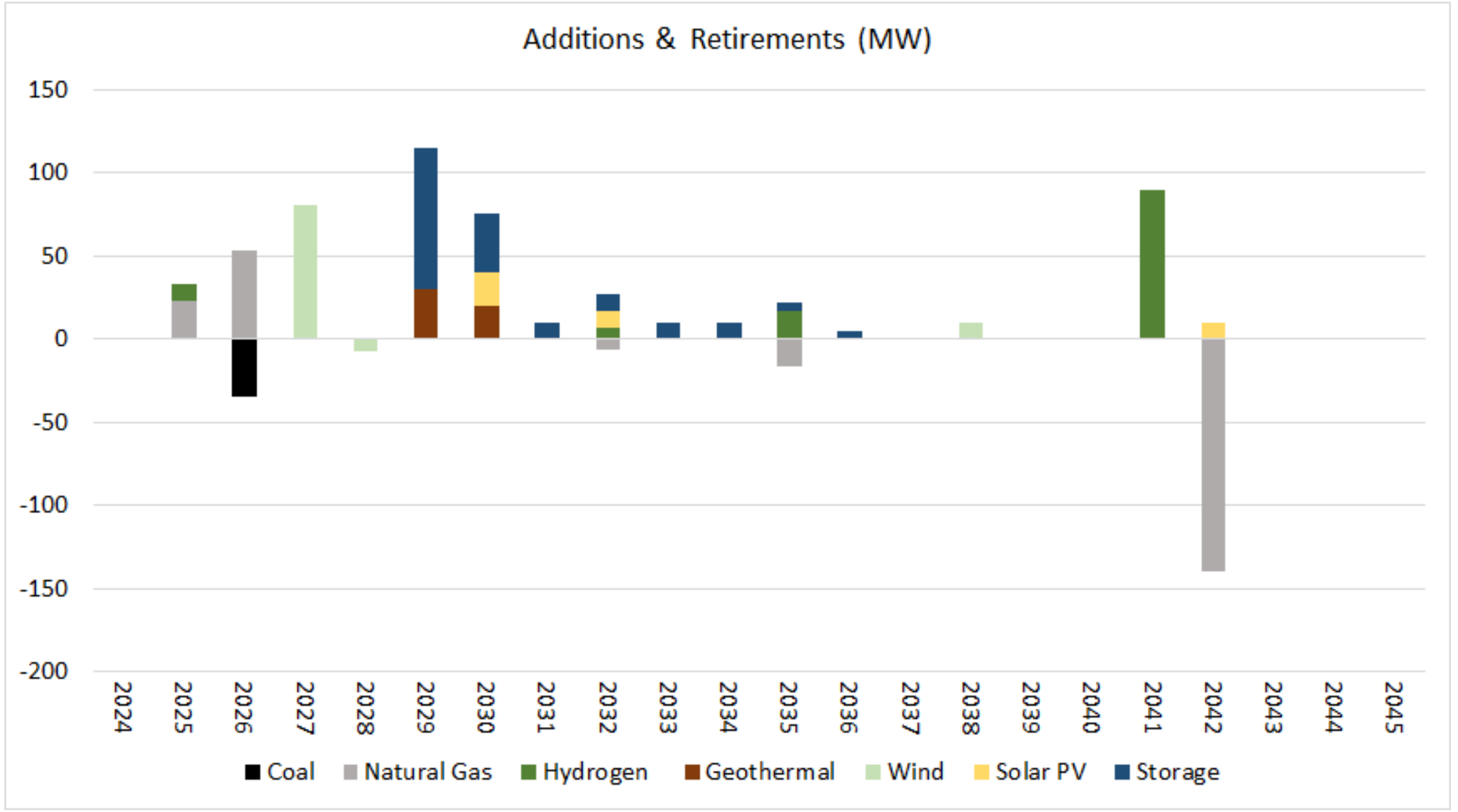
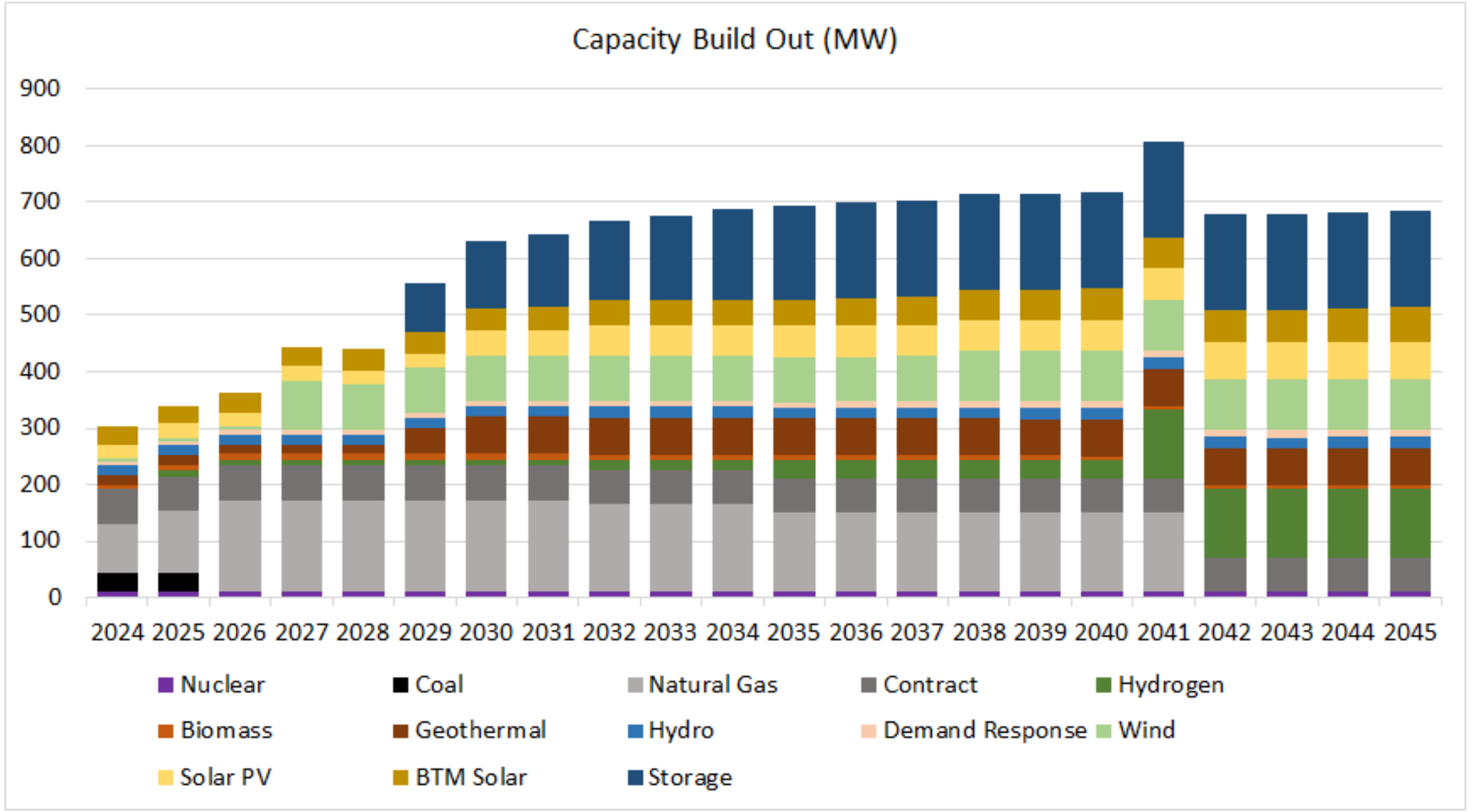
STAG 2 Carbon Emissions



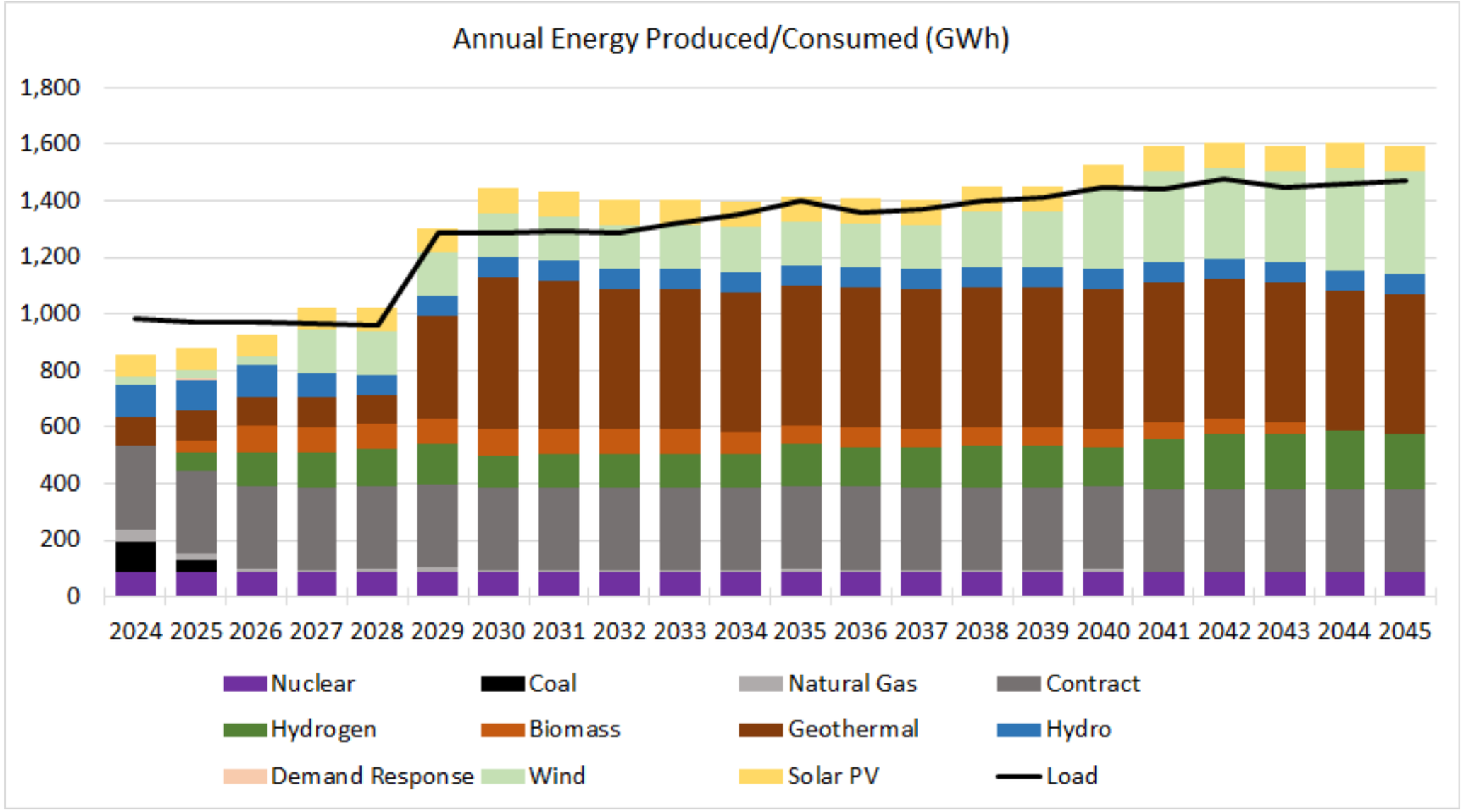
STAG 3 Build Out



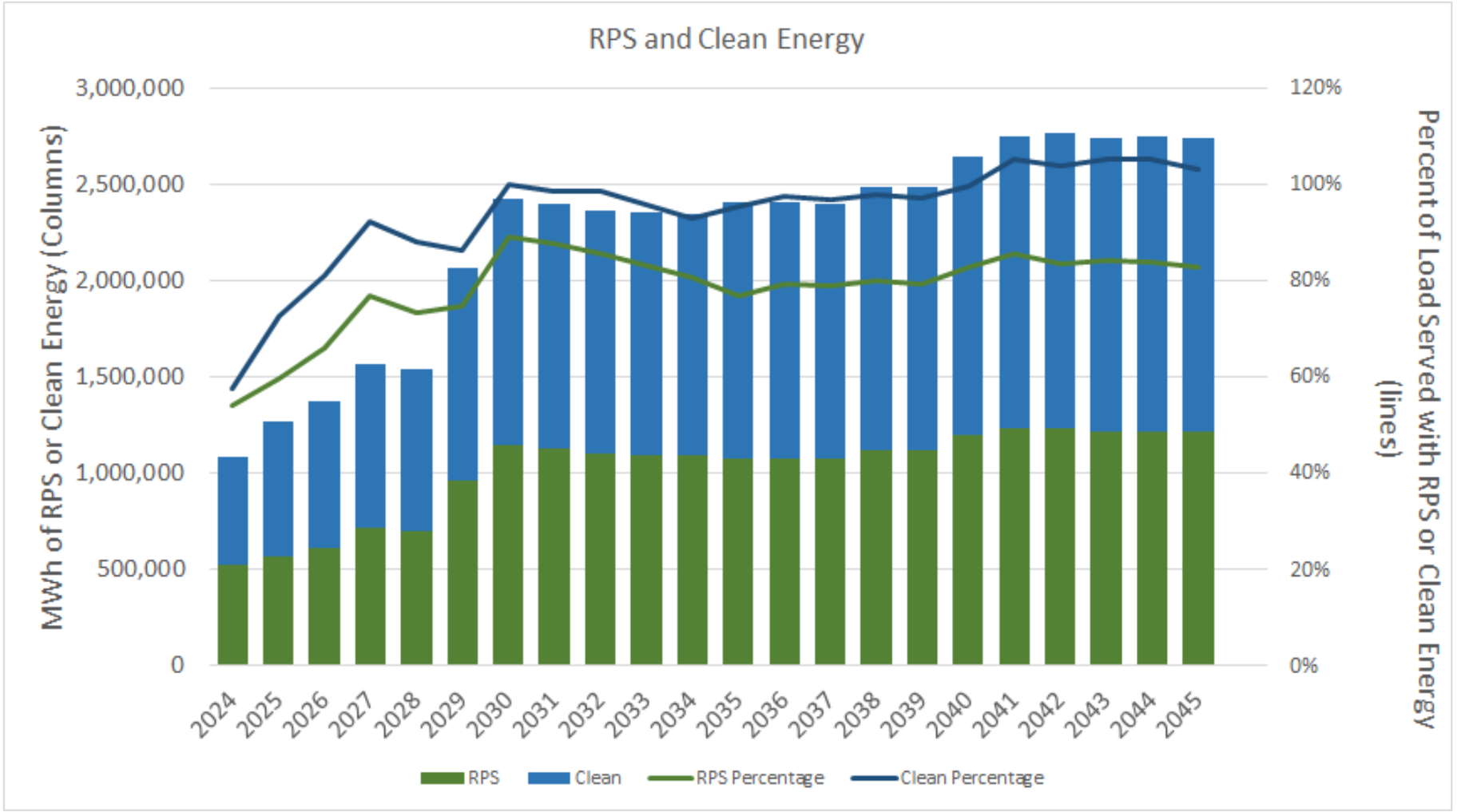
STAG 3 Capacity



STAG 3 Energy Mix



STAG 3 RPS/Clean Generation



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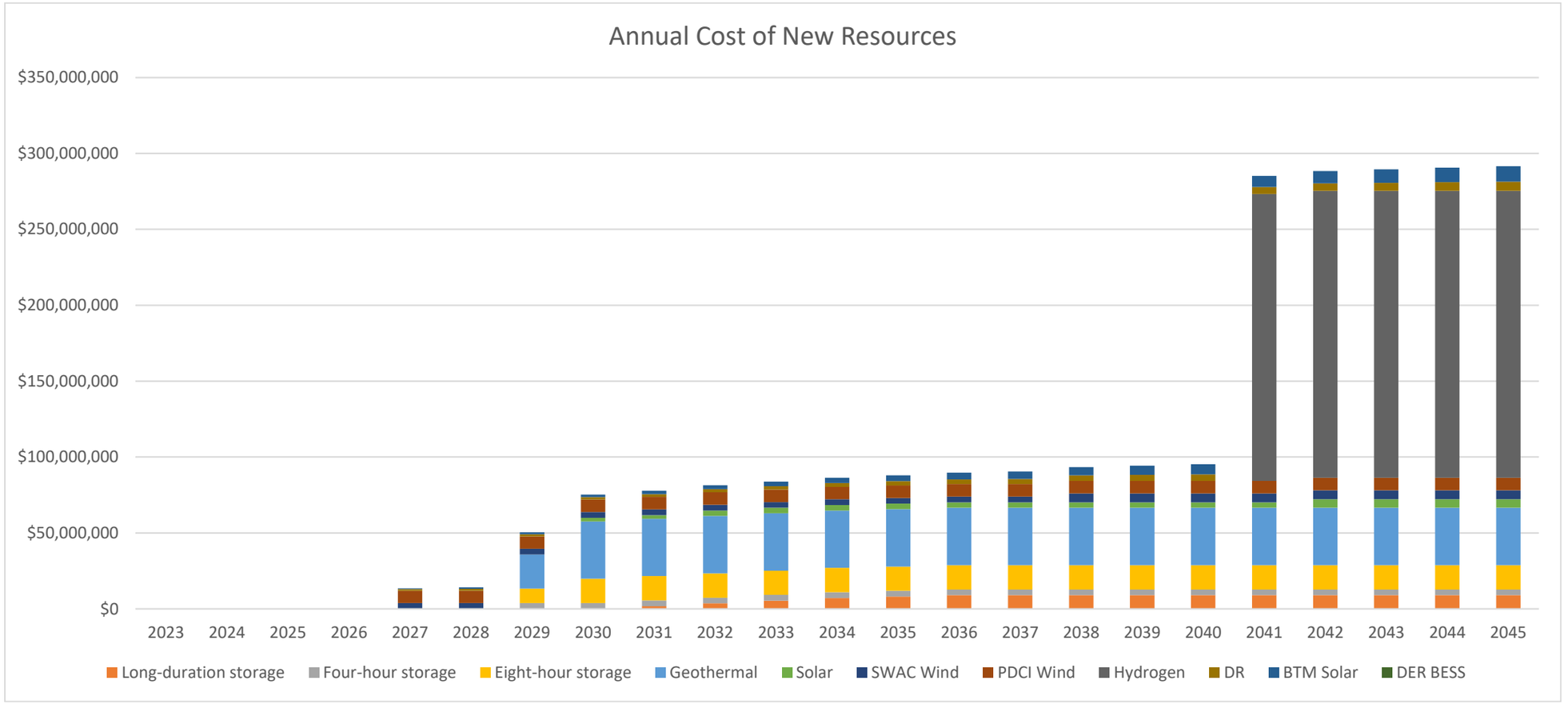
STAG 3 Policy Costs

Net Present Cost of Resource Additions from 2023 to 2045 = $1,363 Million



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STAG 3 Carbon Emissions