

Technical Appendix for “An Affordability Crisis of their Own Making”



August 2026



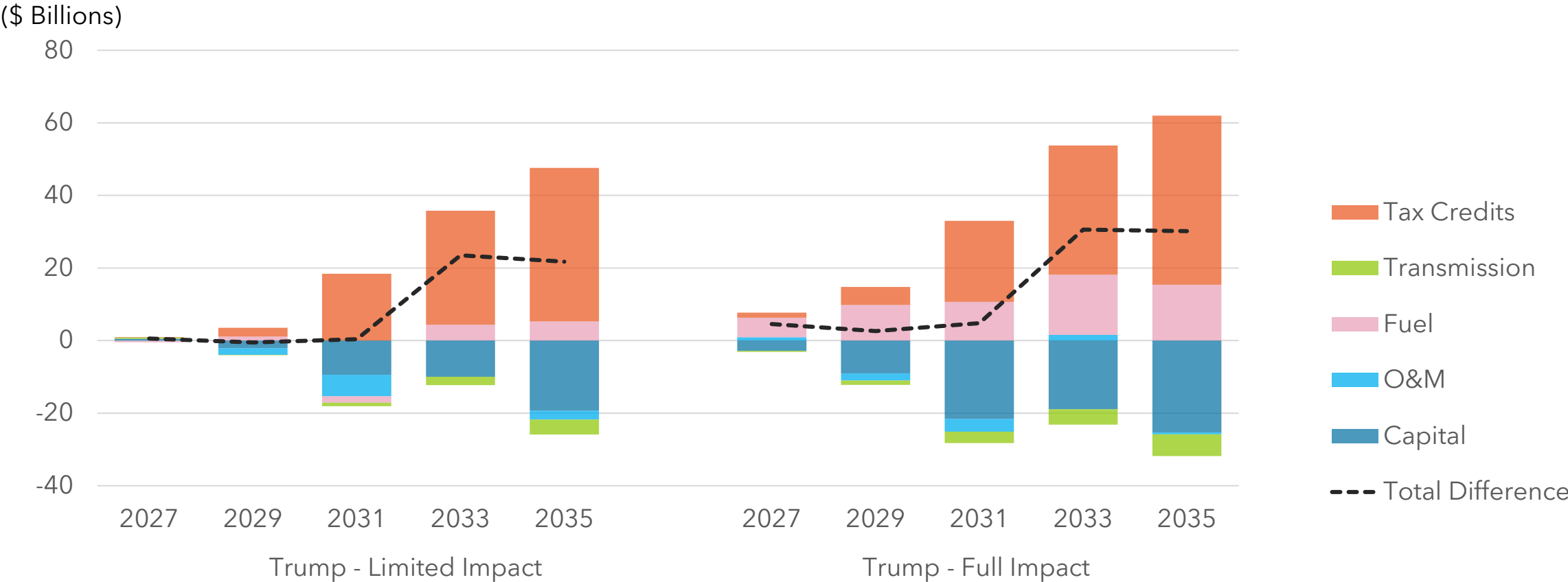
Additional Figures



Table A.1: Case Specifications

Specification	January 2025 Snapshot	Trump - Limited Impact	Trump - Full Impact
Policy	IRA + all finalized Biden energy regulations (EPA, DOT, DOE)	OBBBA and all Biden-era regulations repeals	
Tariff Level on Capex	None	Low tariffs on power sector capital costs through 2030	High tariffs on power sector capital costs through 2035
Offshore Wind Builds	Assume all under construction and permitted projects are built without delay and state OSW targets are met	Assumes all under-construction and permitted projects are built without delay, but state OSW targets are not met	Assumes all under-construction projects are built without delay, but permitted projects are remanded and delayed until 2032
LNG and Natural Gas	LNG exports and natural gas prices match EIA AEO/STEO reference case.		LNG exports and natural gas prices are 20% and 5.4% higher, respectively between 2025-2030.
202C Orders	Coal, gas, and oil plants retire as planned.		Coal, gas, and oil plants delay scheduled retirements until 2029.
Solar and Wind Permitting Headwinds	No additional constraints on solar/wind annual builds		Solar is constrained to 30GW/yr and no new wind projects, besides those under construction or in advanced development, are allowed through 2030.

Figure A.1: Change in Annual Power Sector System Cost between 2029 and 2035, relative to January 2025 Snapshot.



Note: Costs represent the sum of levelized capital costs and variable costs.

Figure A.2: Change in Cumulative Air Pollution from 2025 to 2035, Relative to January 2025 Snapshot Case

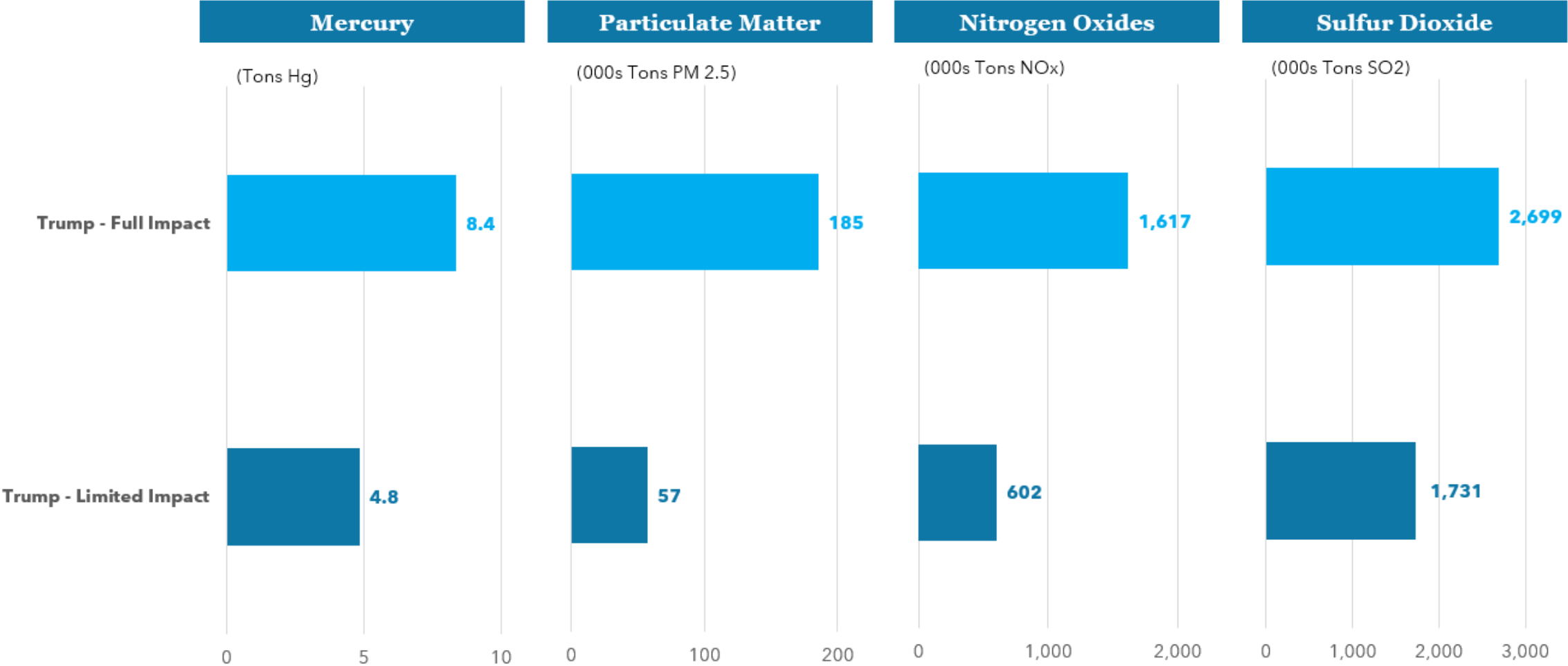
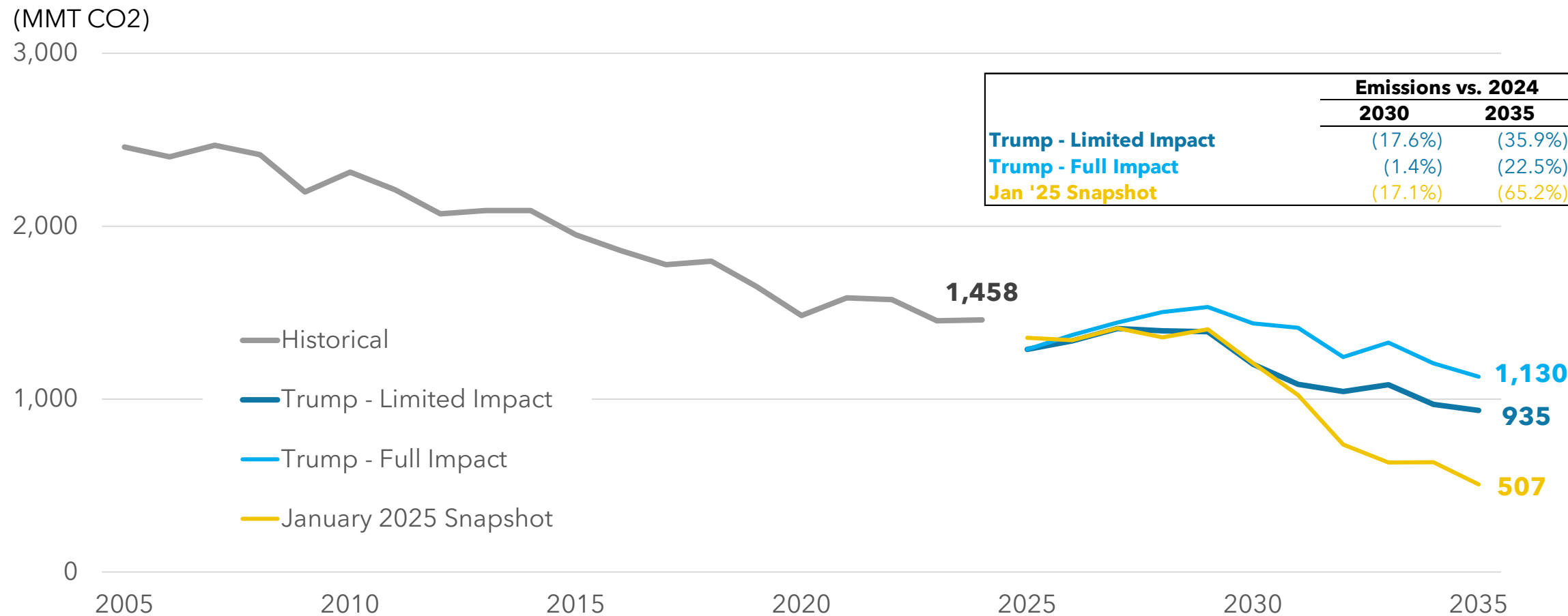
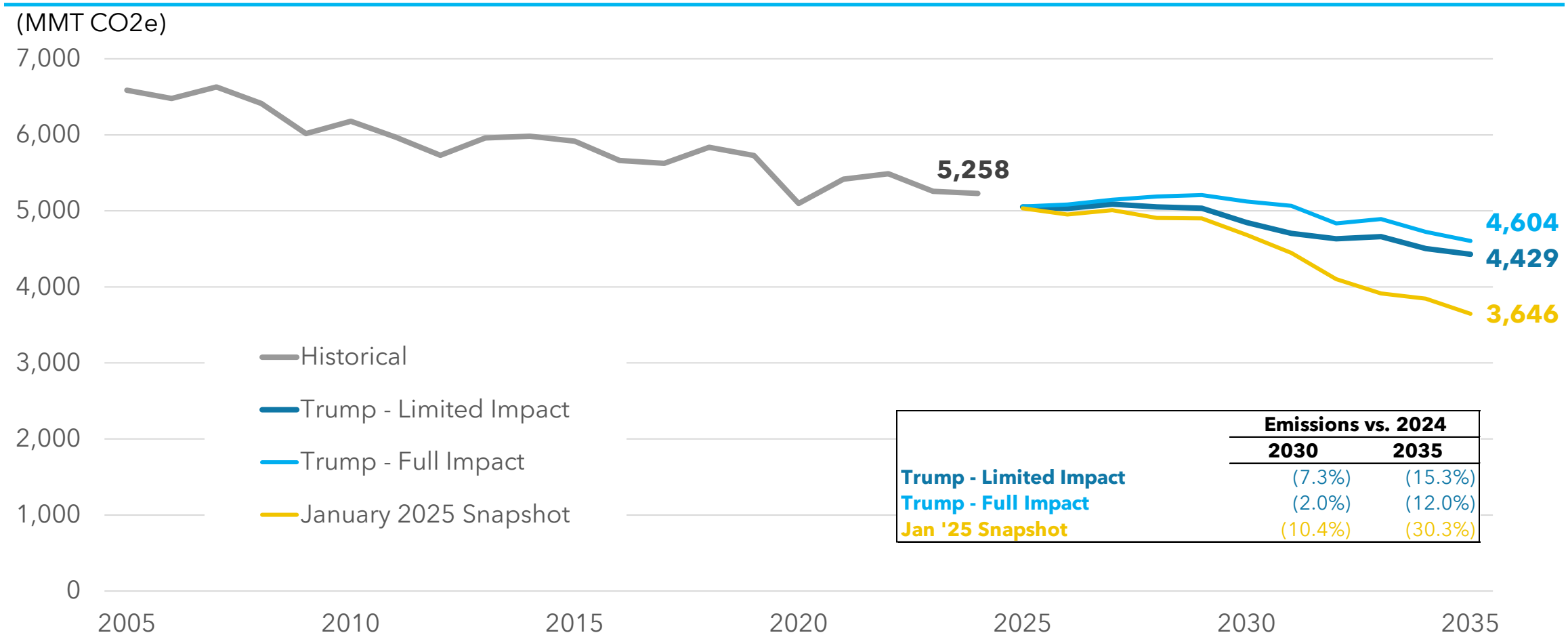


Figure A.3: Power Sector Greenhouse Gas Emissions



Note: Historical values are based on EPA Inventory of GHG Emissions and Sinks ([link](#))

Figure A.4: Economy-wide Greenhouse Gas Emissions

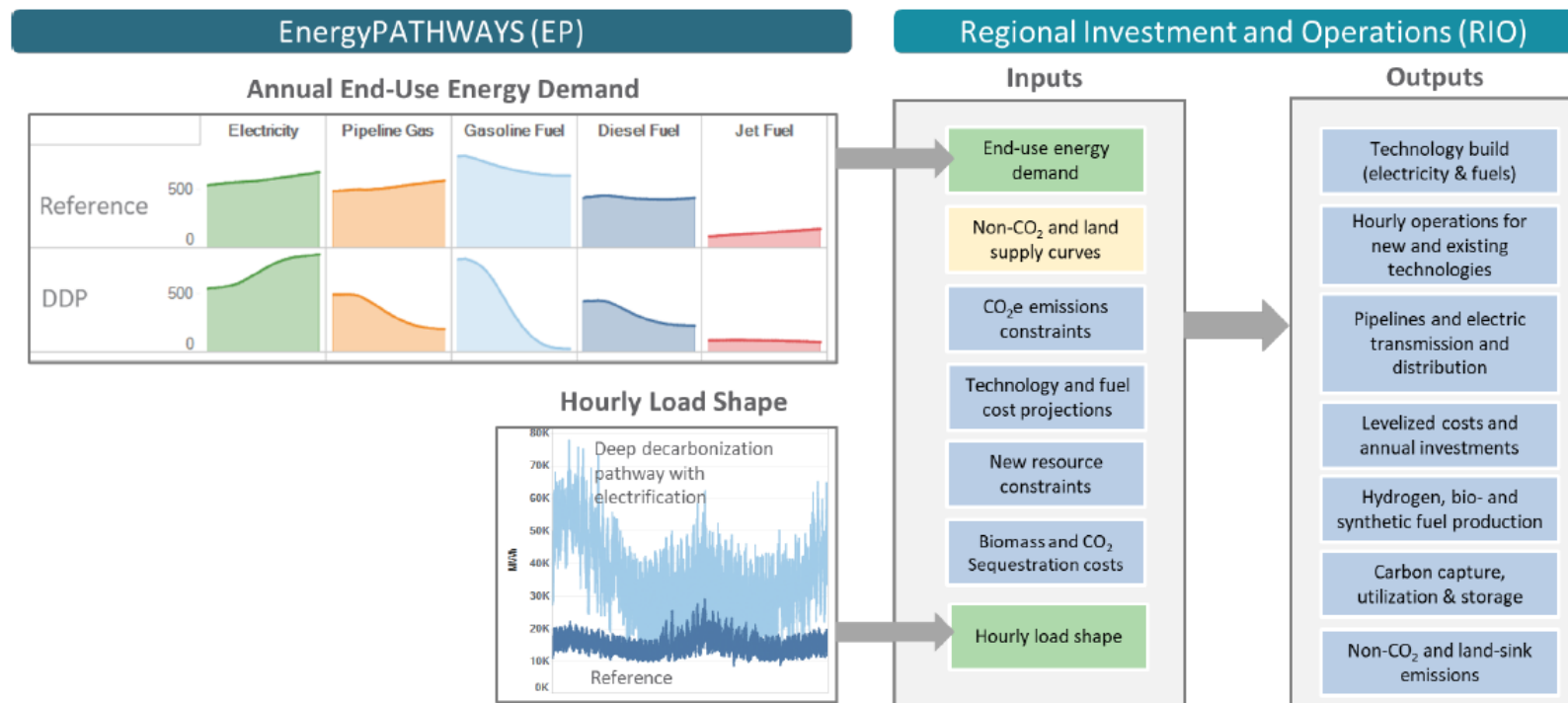


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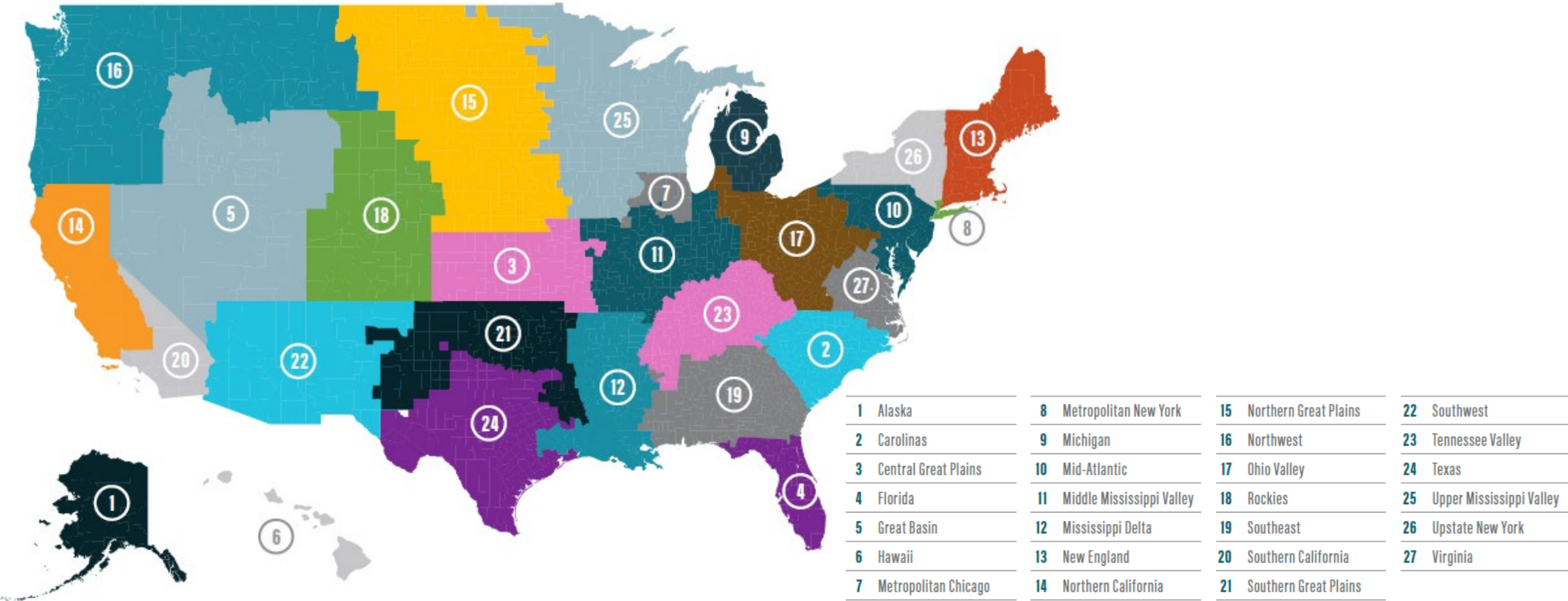
Overview of EnergyPathways + RIO

EnergyPATHWAYS + RIO Model Overview

- Final-energy demand scenarios are developed in EnergyPATHWAYS, which is a bottom-up stock accounting model with 64 demand subsectors
- These are then input into RIO, an economy-wide linear optimization model that finds the least-cost supply side pathway



RIO Zonal Representations



Model Run Specifications

- EnergyPATHWAYS and RIO models are run annually from 2025 – 2035 across 27 model regions
 - 2025 - 2030 are run as a single optimization, meaning there is foresight into near term policy, such as when many tax credits expire, but not when tariffs will end
 - 2031 – 2035 are run as individual, annual optimizations without foresight into future constraints
- Trump Action cases assume:
 - **Executive repeal:** executive actions the Trump administration has stated it will take to unwind Biden-era policies, including EPA GHG regulations, DOT vehicle fuel economy standards, and DOE efficiency rules
 - **OBBBA:** substantial rollback of most tax credits enacted by the IRA and funding for clean energy and climate programs. The version modeled is the final version passed by the Senate
- We then apply other Trump actions on top of these baseline assumptions...

Case Specifications

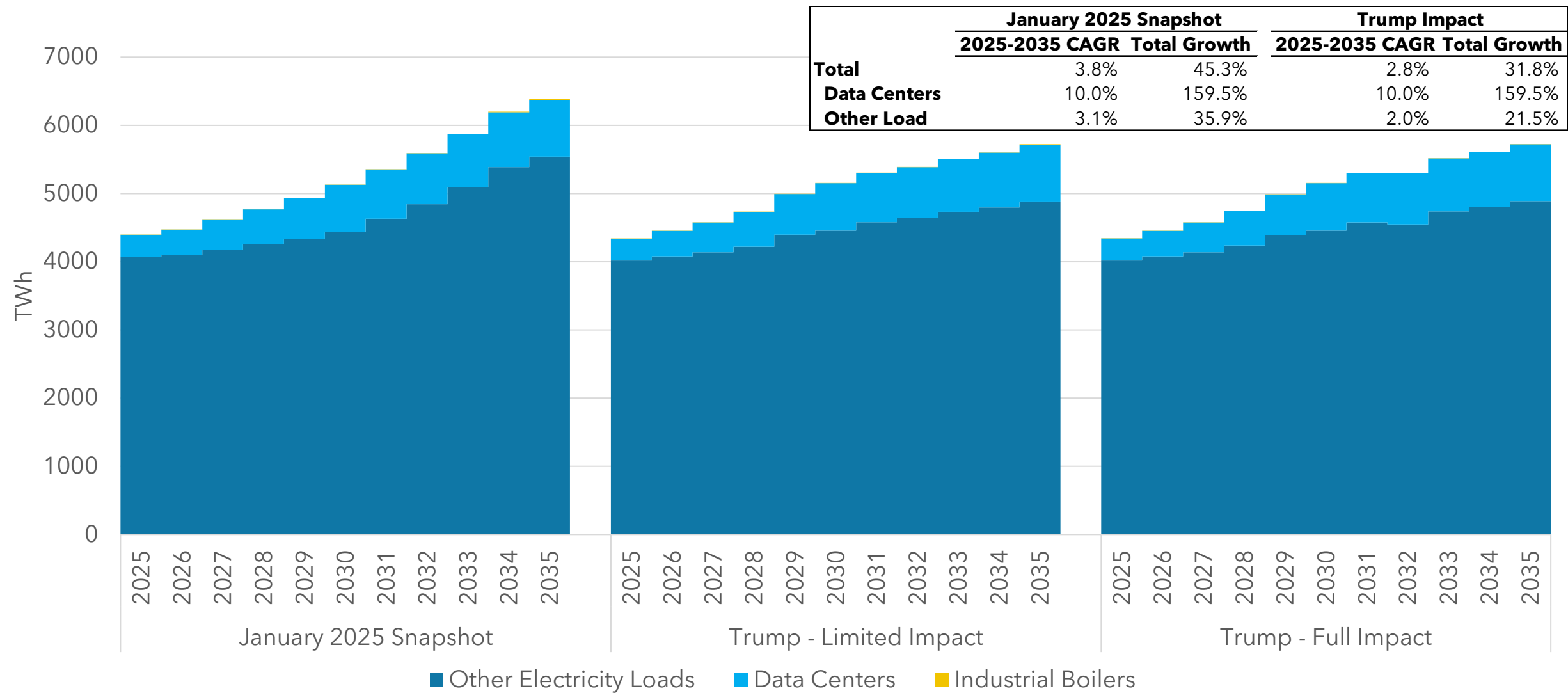
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Demand-Side Assumptions

EnergyPathways Demand-side Assumptions

Specification	January 2025 Snapshot	Trump Impact Cases
Data Center Demand	LBNL – 2024 United State Data Center Energy Usage Report • "Reference" demand trajectory at midpoint of estimated range	
Light- and Heavy-Duty Vehicles Stock	EPA's MOtor Vehicles Emission Simulator (MOVES 5.0) • Incorporates EPA light- & medium-duty multi-pollutant rule • Incorporates EPA heavy-duty GHG phase 3 rule	EPA's MOtor Vehicles Emission Simulator (MOVES 5.0) • Assumes repeal of light-, medium-, and heavy-duty EPA rules
State Vehicle Rules	• Includes Advanced Clean Trucks rules • Includes 17 state clean car rules	
Energy Efficiency	• Includes efficiency improvements in industrial sectors • Efficiency standards for residential and commercial appliances/equipment, primarily those laid out in a 2023 EIA study; also includes 2024 rules set by the Biden administration	• Absence of industrial sector energy efficiency improvements • Repeal of 2024 Biden era residential and commercial efficiency rules
Incentives	• Includes greater uptake of high efficiency/electric appliances due to IRA incentives for commercial HVAC as well as residential HVAC, building shell improvements, and water heating	• Absence of IRA incentives leads to stock rollover based on historical behavior, rather than increased uptake
Other Assumptions	• Primarily derived from EIA AEO 2023	

Trump Actions vs. Biden-era Policy Case: Electricity Load



Supply-Side Assumptions

RIO Supply Side Assumptions

Assumption/Constraint	January 2025 Snapshot	Trump Impact Cases
Power Sector Technology • Capital Cost • O&M Cost • Performance	NLR's Annual Technology Baseline 2024 • Most technologies use the "moderate" cost trajectory • Gas and coal w/CC (either new or retrofit) use the "advanced" trajectory • Offshore wind follows "moderate" trajectory • Nuclear LWR uses the "conservative" trajectory • Long duration storage costs are derived from PNNL Energy Storage Cost and Performance Database	NLR's Annual Technology Baseline 2024 • Most technologies use the "moderate" cost trajectory • Gas and coal w/CC (either new or retrofit) use the "moderate" trajectory • Offshore wind costs/performance frozen between 2028-2032 due to remands • Nuclear LWR uses the "conservative" trajectory • Long duration storage costs are derived from PNNL Energy Storage Cost and Performance Database
Commodity Costs	• Coal and oil costs primarily follow EIA's AEO 2023 reference case trajectories • Natural gas costs follow a blend of EIA's STEO, AEO 2025 reference case	• Coal and oil costs primarily follow EIA's AEO 2023 reference case trajectories • Natural gas costs follow a blend of EIA's STEO, AEO 2025 reference case, as well as effect of higher LNG exports
Biomass Cost and Potential	Derived from DOE's 2023 Billion-Ton study	
Transmission	The model can build interregional electricity transmission, CO2 pipelines, and H2 pipelines beginning in 2027/2028	
Other "conversion" technologies (e.g., electrolysis, blue h2, boilers, fuel production)	Derived from a variety of sources, including DOE studies, academic research, and gray literature	
State Policies	• State RPS/CES requirements are included • State offshore wind mandates are included in January '25 case	

RIO Technologies Modeled

Technology Type	January 2025 Snapshot and Trump Impact Cases	
Fixed (renewables)	• Fixed / floating offshore wind • Advanced geothermal	• Onshore wind and transmission sited solar • Rooftop solar
Thermal	• Coal power (incl. w/CC or retrofit) • Gas combined cycle (incl. w/CC or retrofit) • Gas combustion turbine	• Nuclear LWR • Biomass power allam w/CC
Storage	• Li-ion • Long duration storage	
Other	• Non-powered dams • Thermal energy storage • H2 storage	
Conversion technologies	• Iron and steel production: BF/BOF (and w/CC), continuous casting, hot rolling, cold rolling (and w/ H2), DRI, EAF, coke plants • Biofuels: (bio-gasification ch4, fischer-tropsch, h2), HEFA, alcohol-to-x, anaerobic digestion, ethanol, biomass fast pyrolysis • Reformation H2: autothermal reforming w/CC, steam reforming • Cement and lime clinker production (conventional, direct separation ccs, oxyfuel ccs, clinker substitute – limestone calcined clay cement, lime production (conventional, direct separation ccs, oxyfuel ccs), kiln burner (biomass, h2, msw, pipeline gas) • Direct air capture - solid sorbent • Electrolysis H2 • Boilers: electric boiler, geothermal boiler, h2 boiler, heat pump, pipeline gas boiler • E-fuels: methanation, fischer-tropsch liquids • Haber-Bosch • LNG production: LNG production, LNG production (electric) • Natural gas liquids fractionation	



Tariff Assumptions

Tariff Methodology

- We assess 3 types of tariff impacts for each generating technology:
 - Heavily impacted components (solar modules and battery racks)
 - Minerals subject to standalone tariffs (steel, aluminum, copper)
 - Any remaining components or equipment that are manufactured internationally outside of the above categories, subject to the average effective tariff rate (figure below)

	Effective Tariff	Import Share		Average Effective Tariff	
		Pre-Substitution	Post-Substitution	Pre-Substitution	Post-Substitution
China	27.9	14%	8%	3.8	2.3
Canada	13.1	13%	17%	1.7	2.2
Mexico	10.6	15%	19%	1.6	2.0
Rest of World	15.6	58%	56%	9.1	8.8
Total		100%	100%	16.2	15.3

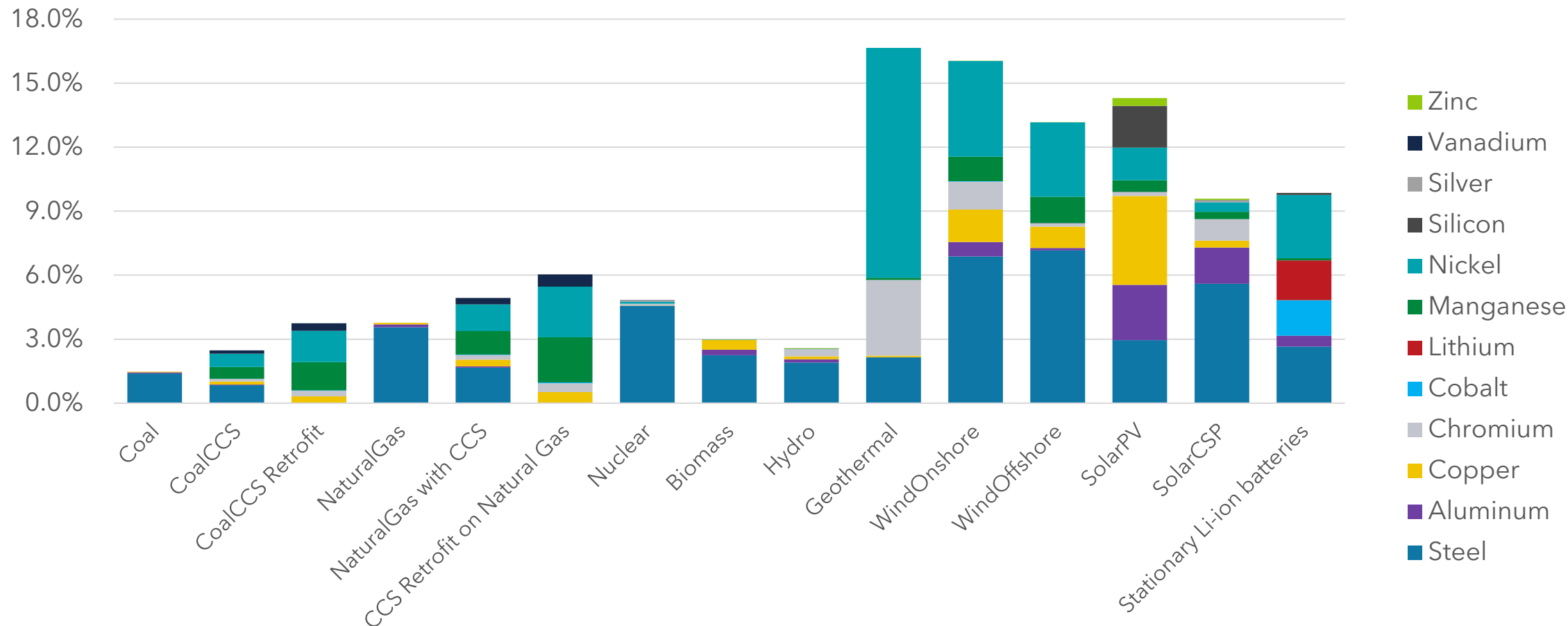
Tariff Impact Assumptions

Tariff	Low Tariff Scenario	High Tariff Scenario
Solar Module ¹	30% (import full modules)	61% (import cells, assembled domestically)
Battery Racks ¹	24% (30% tariff on Chinese imports)	49% (64% tariff on Chinese imports)
Steel ²	35% (2024-2025 market price increase)	50% (assume full impact of tariff)
Aluminum ³	42% (2024-2025 market price increase)	50% (assume full impact of tariff)
Copper ⁴	10% (2024-2025 market price increase)	50% (assume full impact of tariff)
Other components manufactured internationally ⁵	15.3% (post substitution effective tariff)	15.3% (post substitution effective tariff)

Sources:

- These estimates compare module prices pre- and post-tariffs. Although prices have fluctuated as tariffs have been announced and phased out, the latest round of Section 232 tariffs have kept prices significantly elevated relative to a pre-April 2025 baseline.
 - Hutchins, Mark and Ryan Kennedy, “Trump signs Section 232 tariffs, placing minimum import price on polysilicon imports,” *pv magazine*, August 7, 2026, <https://pv-magazine-usa.com/2026/08/07/us-announces-tariffs-minimum-import-price-on-polysilicon-imports>.
 - BloombergNEF, “Solar and Battery Makers Stung by Latest Tariffs,” August 7, 2025;
 - BloombergNEF, “Reciprocal Tariffs Spell Chaos for Clean Energy,” April 4, 2025.
- Nucor Consumer Spot Price
- London Metal Exchange and Platt Aluminum Premium Duty Paid US Midwest
- London Metal Exchange; Note: market price impact is lower due to tariffs only applying to finished or semi-finished products.
- Yale Budget Lab, “State of US Tariffs: August 7, 2025,” August 7, 2025, <https://budgetlab.yale.edu/research/state-us-tariffs-august-7-2025>.

Average Share of Capital Costs Associated with Critical Minerals

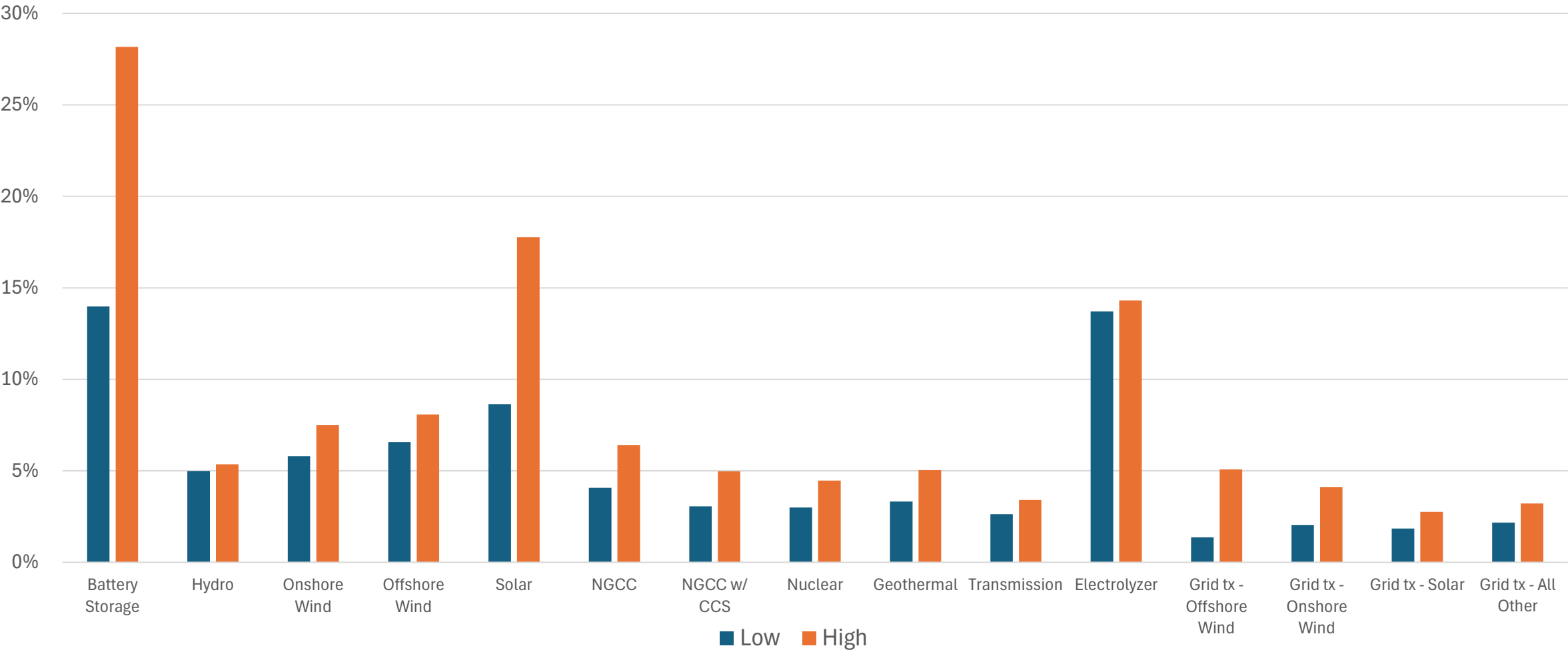


Note: Methodology is derived from Brown et al. (2025) This is also supplemented by NLR Renewable Energy Materials Properties Database (REMPD).

Sources:

- Brown, Maxwell, Eliza Hotchkiss, Gabriel Collins, Mirali Seyedrezaei, Morgan Bazilian, “No Minerals, No Megawatts: How material costs and availability shape the future of the US power sector,” *Resources Policy*, July 2025, <https://doi.org/10.1016/j.resourpol.2025.105607>.
- Cooperman, Aubryn, Annika Eberle, Dylan Hettinger, Melinda Marquis, Brittany Smith, Richard F. Tusing, Julien Walzberg, “Renewable Energy materials Properties Database: Summary,” *National Lab of the Rockies Technical Report*, August 2023, <https://docs.nlr.gov/docs/fy23osti/82830.pdf>.

Total Tariff Impact on Capital Costs



Details on Other Policy Assumptions

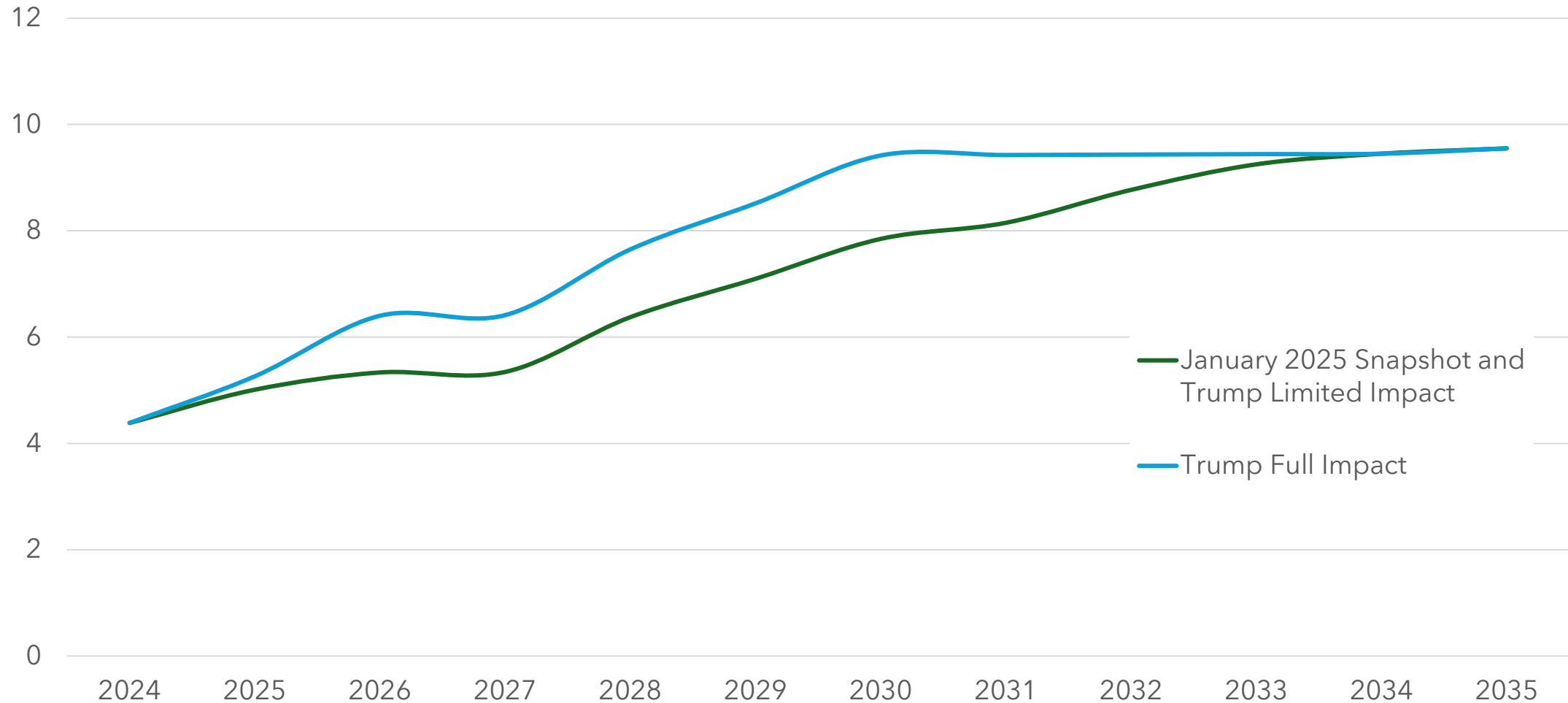
Offshore Wind Projects in Model, Including those Subject to Delays

Project	Status	Location	Online Date	Capacity (MW)
New England OSW 1 & 2	Permit to be revoked	Massachusetts	2028	2,600
Coastal VA OSW	Under construction	Virginia	2027	2,600
SouthCoast Wind	Permit threatened	Massachusetts	2030	2,400
Maryland OSW	Permit to be revoked	Maryland	2030	2,200
Sunrise Wind	Under construction	New York	Jul. 2027	924
Empire Wind	Under construction	New York	Jul. 2027	810
Revolution Wind	Operating	Rhode Island / Connecticut	Apr. 2026	704
Vineyard Wind 1	Operating	Massachusetts	Dec. 2025	403
Atlantic Shores	Permit revoked	New Jersey	Phase 1: 2028 Phase 2: 2030	3,020

Note: Delayed projects in the Trump Full Impact case are those that have permits revoked or threatened, and that are not under construction (in the table above, these are outlined with text in **red**). This list reflects projects in the model, which were in development at the time of the model development. Some, such as Revolution Wind, have come online fully since then.

LNG Exports by Scenario

(QBtus)



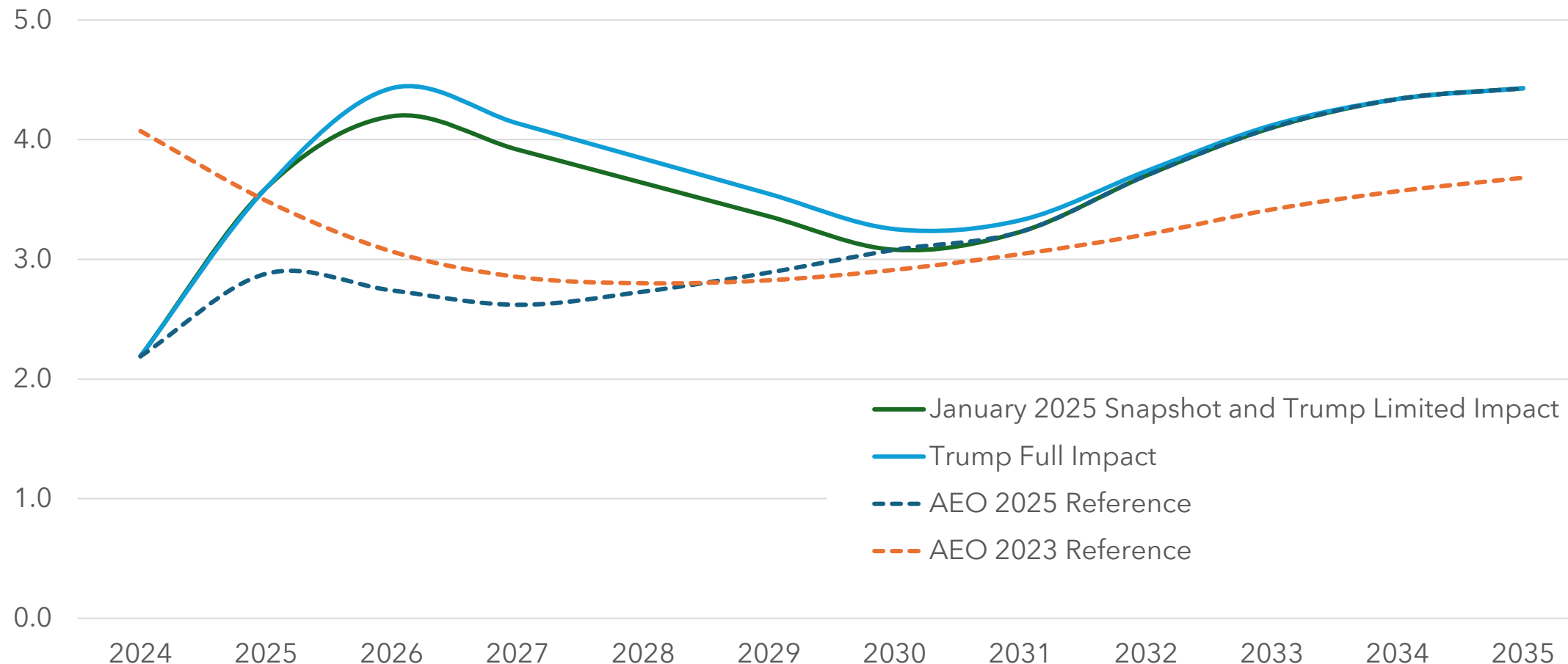
Note: Assume exports are 20% higher than EIA AEO Reference scenario in the Full Impact case, in line with estimates from BloombergNEF.

Source:

- BloombergNEF, US Gas Market Outlook 2030: LNG Export Surge Lifts Demand, September 16, 2025, <https://about.bnef.com/insights/commodities/global-gas-and-lng-outlook/>.

LNG Export Impact on Natural Gas Price by Scenario

(\$ per MMBtu)



Note:

1. Price impacts on domestic natural gas are estimated at a 5.4% increase from a 20% increase in LNG exports, as estimated in [Abuin \(2025\)](#)
2. Biden-era and Trump Policy cases are same as AEO 2025 Reference but adjusted to incorporate the EIA Short Term Energy Outlook data.

Source:

- Abuin, Constanza, "Power Decarbonization in a Global Energy Market: The Climate Effect of U.S. LNG Exports," March 18, 2025, https://bfi.uchicago.edu/wp-content/uploads/2026/02/Abuin-GlobalPowerDecarbonization_mar2025.pdf.

Other Key Assumptions

- In the Trump Full Impact case, we assume that all existing coal power, gas power, and oil power facilities that are scheduled to retire between 2026-2028 are subject to 202C orders and delay retirement until 2029.
- In that case, we also assume that solar and wind builds are constrained due to permitting challenges
 - Planned solar builds through 2027 are revised downwards from EIA estimates. Beyond planned builds through 2027, utility scale solar builds are constrained to 30 GW per year through 2030
 - Planned wind builds from 2026-2030 are revised downward to **only** projects that are already under construction or in advanced stages of development, with a known COD, as described in the table below.

Onshore Wind MWs	Commercial Operation Date (COD)									Total (w/ unknown COD)
	2026	2027	2028	2029	2030	2031	2032	2026 - 2032	Unknown	
Announced	741	1,522	4,839	6,463	805	0	2,000	16,369	15,517	31,886
Early Development	3,338	10,034	9,734	3,847	1,500	600	0	29,054	14,329	43,382
Advanced	1,333	1,698	1,557	247	0	0	0	4,835	2,415	7,250
Total	5,412	13,254	16,129	10,557	2,305	600	2,000	50,257	32,261	82,518