The Inflation Reduction Act and the Path to a Net-Zero America

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PRINCETON UNIVERSITY

ZERO LAB

Zero-carbon Energy Systems Research and Optimization Laboratory

Preliminary Report: The Climate and Energy Impacts of the Inflation Reduction Act of 2022

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1. Princeton University, Zero-carbon Energy Systems Research and Optimization Laboratory (ZERO Lab)
2. Dartmouth College, Thayer School of Engineering
3. Evolved Energy Research
4. Carbon Impact Consulting

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This version updated August 12, 2022

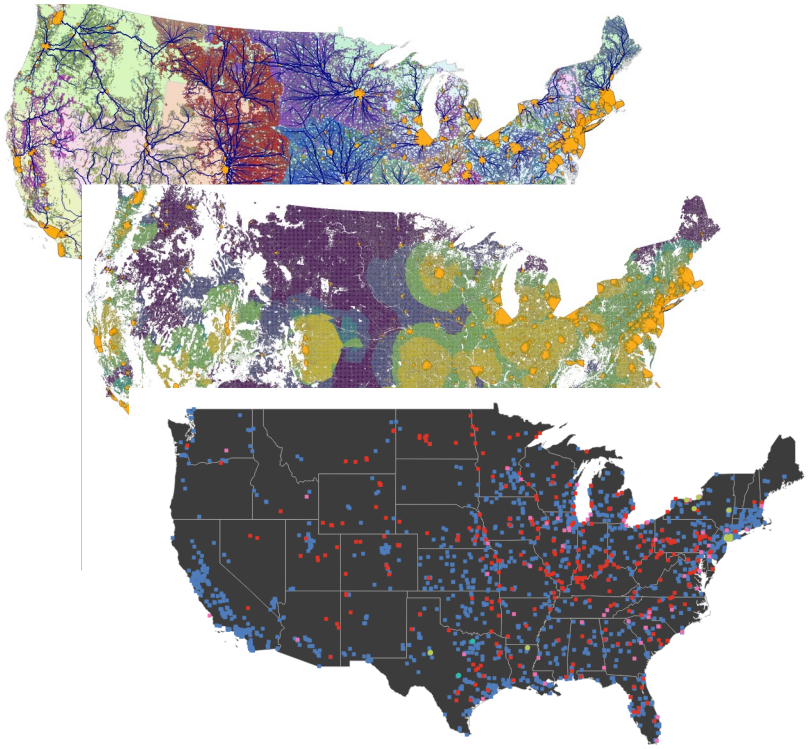
Access and download data and other resources at **repeatproject.org**

See a detailed section-by-section summary of all provisions in the legislation at **http://bit.ly/REPEAT-Policies**

Funding for the REPEAT Project was provided by a grant from the Hewlett Foundation.

Analysis Framework

1. Geospatially-resolved inputs



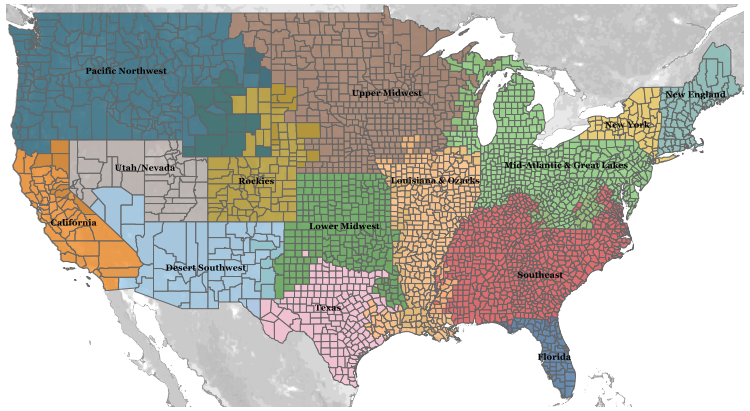
2. Macro-energy systems modeling

EVOLVED ENERGY RESEARCH

EnergyPATHWAYS scenario tool

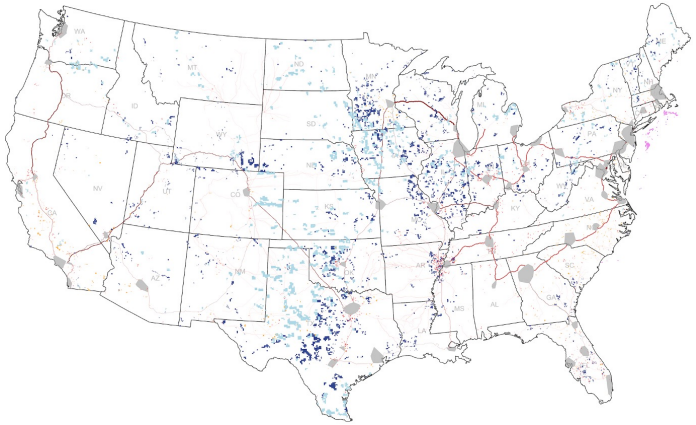
+

RIO optimization tool

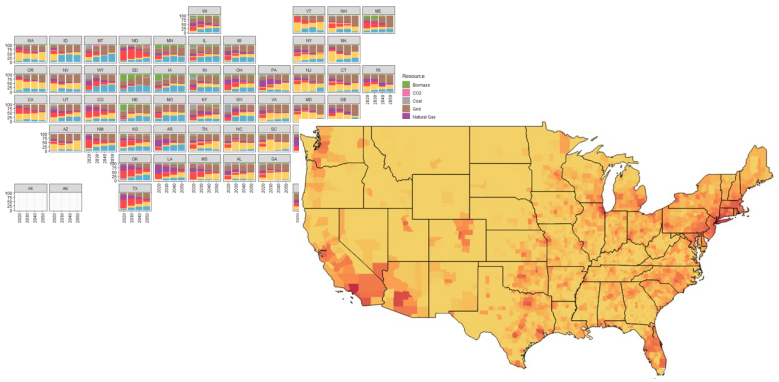


MIT-Princeton **GenX** model may be used for power-sector specific policies in future

3. Geospatially-resolved downscaling & mapping



4. Impact modeling (employment & air pollution)



For the first time in history, the full financial might of the federal government is aligned behind the clean energy transition...

The *Inflation Reduction Act* focuses on making clean energy* cheap

*** (and other climate solutions)**

Tax credits, grants, rebates, and loan guarantees for:

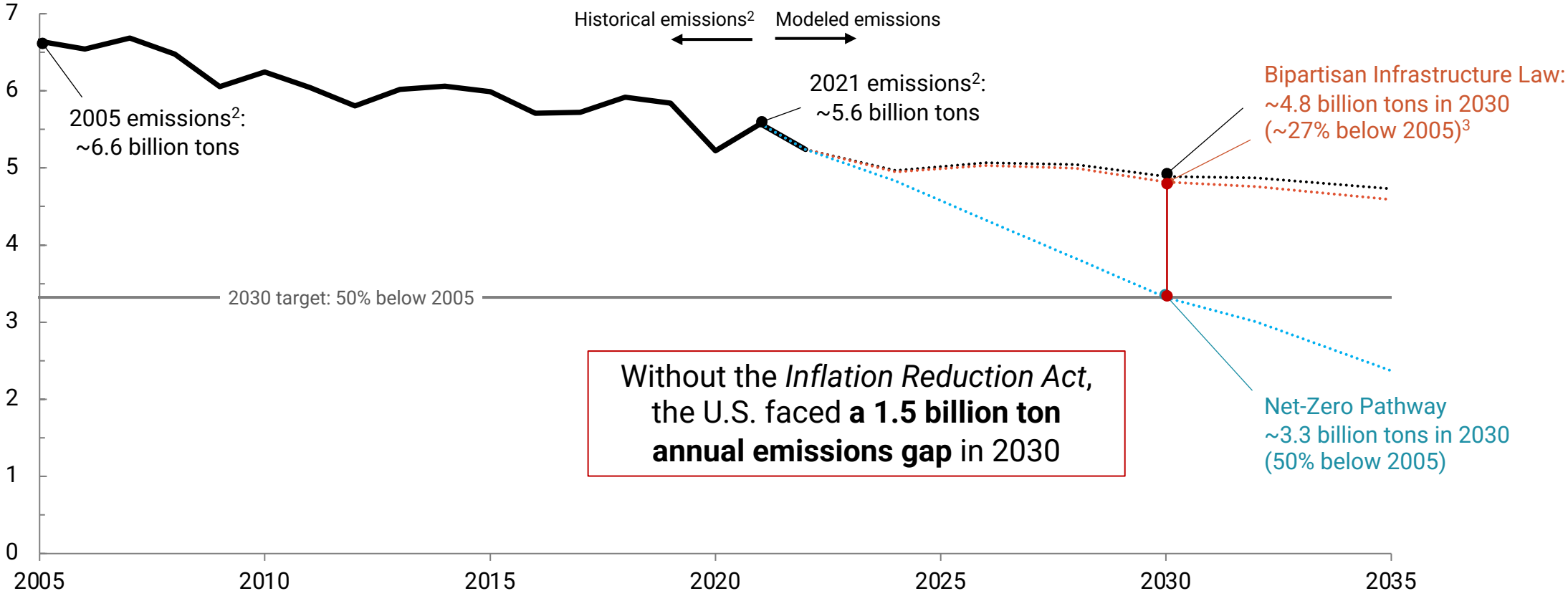
- clean electricity
- hydrogen and clean fuels
- carbon capture & storage
- electric vehicles
- energy efficiency & electrification
- clean energy manufacturing

Beyond the direct emissions reduction impacts of the policies modeled in this report, the *Inflation Reduction Act* contains important policy measures and programs that will build spur innovation and maturation of nascent advanced energy industries, build U.S. clean energy manufacturing and supply chains, improve public health and environmental justice, and drive investment and economic opportunities in communities across the United States.

- The Act builds on the demonstration and hubs funding in the Bipartisan Infrastructure Law by providing **early market deployment opportunities over the next decade that will drive innovation and maturation of important nascent clean technologies** that need to be ready for wide-scale deployment in the 2030s and 2040s, including clean hydrogen, carbon capture, zero-carbon liquid fuels, direct air capture, advanced nuclear and geothermal energy, and more.
- The Act contains **robust support for the development of American manufacturing of solar, wind, battery and electric vehicle components and assembly as well as critical minerals processing**. Those policies are important to expand supply chains and enable rapid scale-up of these technologies, and they will also **create hundreds of thousands of manufacturing jobs across the country**, giving countless communities a direct, tangible, near-term stake in the clean energy transition.
- A package of **environmental justice provisions** in the *Inflation Reduction Act* **provide at least $60 billion to reduce harmful pollution in environmentally overburdened communities**, ensure more equitable access to renewable energy and energy efficiency and building electrification opportunities, and improve public health and climate resiliency.
- The *Inflation Reduction Act* provides grants, loans, and tax incentives that will drive **hundreds of billions of dollars in cumulative investment in American energy communities between now and 2030.**

Historical and Modeled Net U.S. Greenhouse Gas Emissions (Including Land Carbon Sinks)

billion metric tons CO_2-equivalent (Gt CO_2-e)[1]



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3 - Modeled emissions exclude any changes in passenger and freight miles traveled due to surface transportation, rail, and transit investments in IIJA. According to the Georgetown Climate Center, emissions impact of these changes depend heavily on state implementation of funding from IIJA, which could result in anywhere from -14 Mt to +25 Mt change in CO_2 emissions from transportation in 2030.

4 - Results reflect preliminary modeling based on the July 27, 2022 draft legislation.

5 - Results reflect average of estimated high and low oil & gas production scenarios, which span +/- 20 Mt CO_2-e in 2030 (see p. 13-14). Impact on land carbon sinks based on analysis by Energy Innovation.

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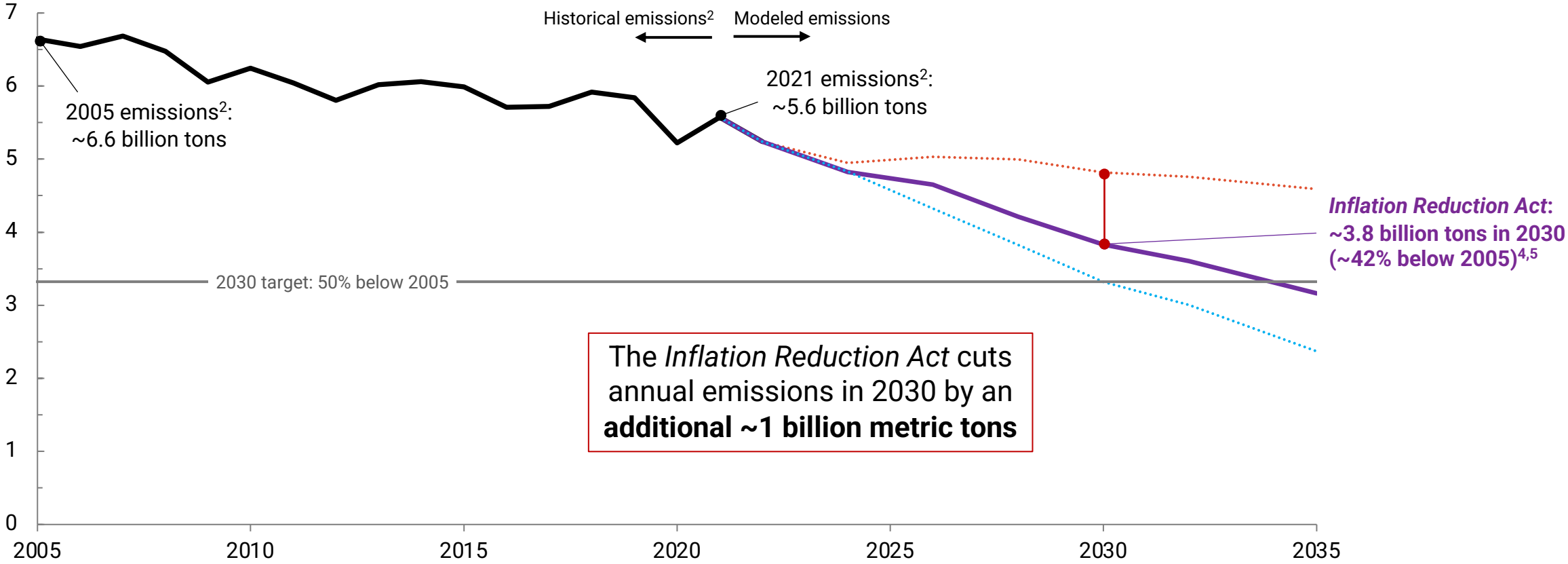

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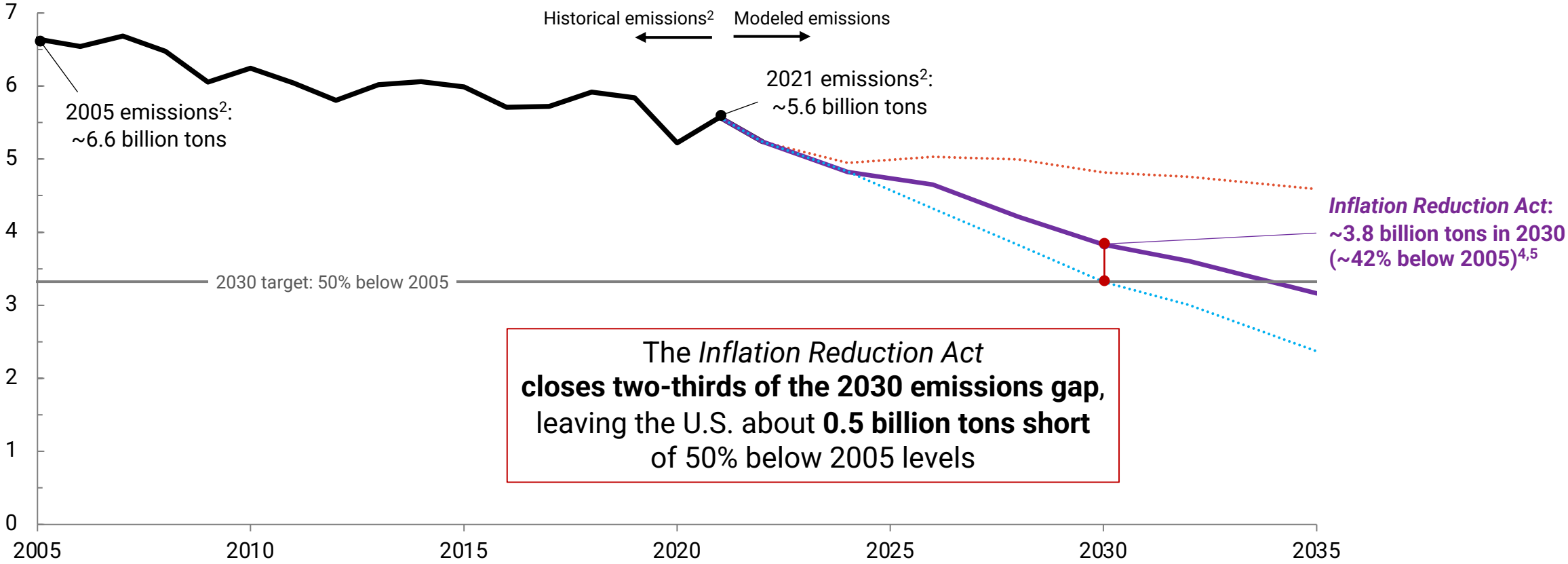

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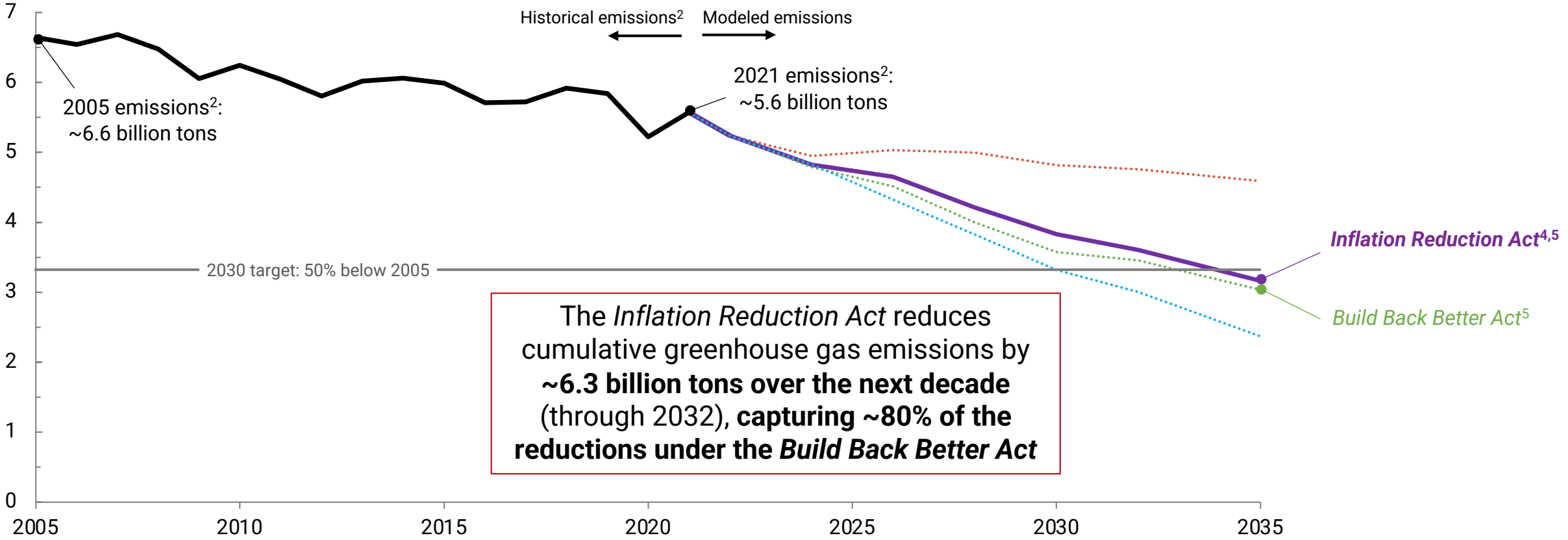

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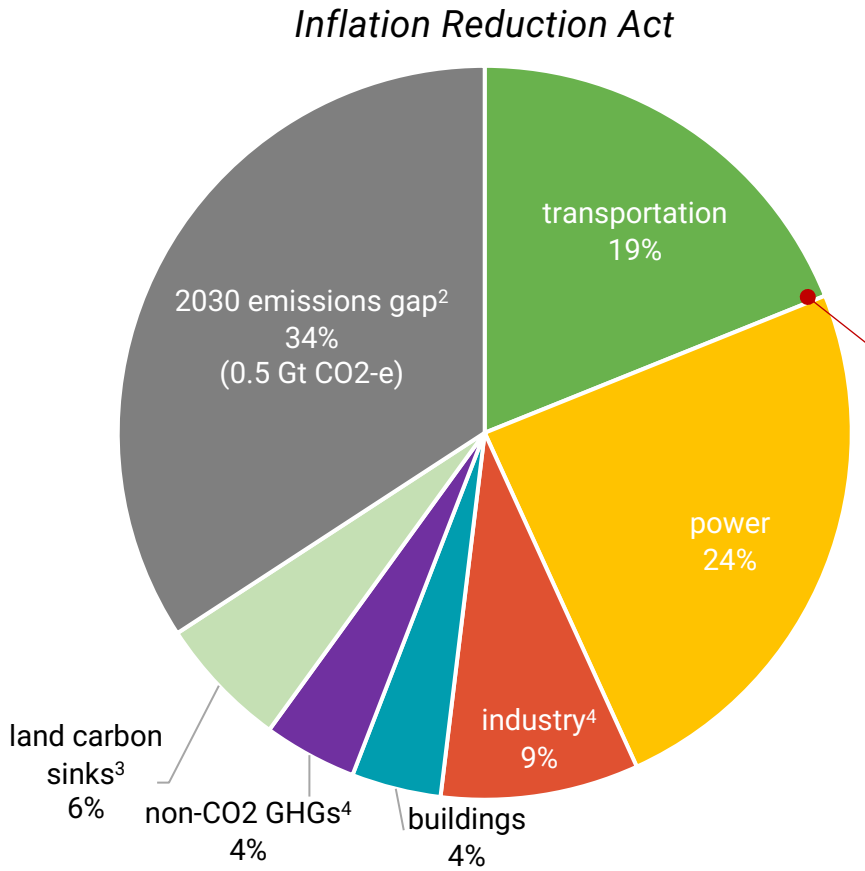
Contributions to Additional Net U.S. Greenhouse Gas Emissions Reductions Below Current Policy Needed to Reach 2030 Climate Target

percentage of net emissions reductions relative to Current Policy (including the Bipartisan Infrastructure Law) to reach 50% below 2005 levels (-1.5 Gt CO_2e)[1]



The *Inflation Reduction Act* cuts U.S. emissions primarily by **accelerating deployment of clean electricity and vehicles**, reducing 2030 emissions ~360 Mt and ~280 Mt respectively.

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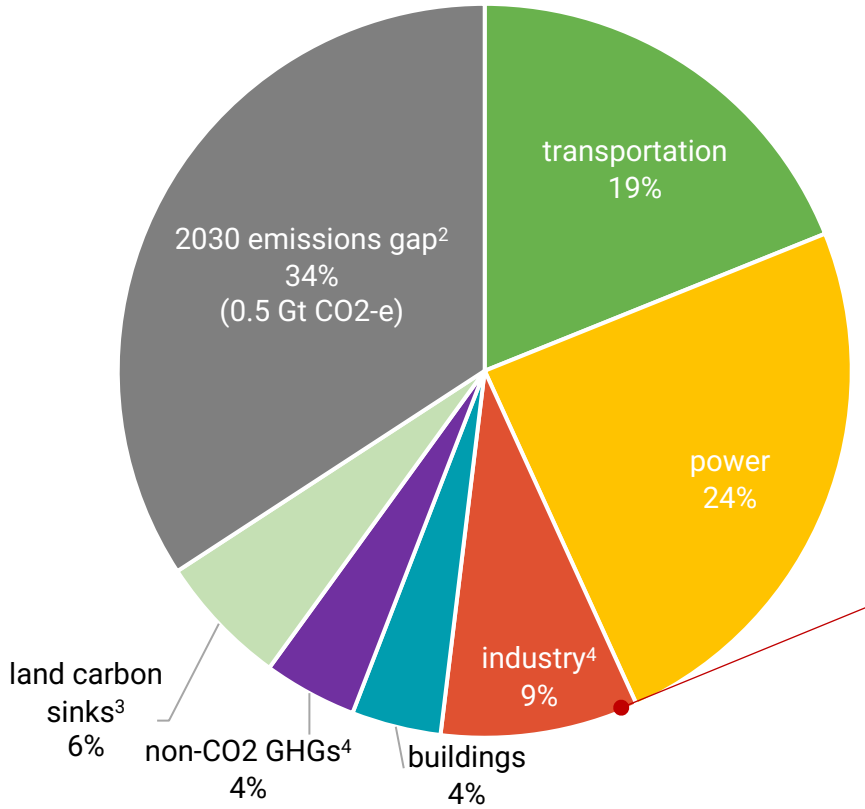
Inflation Reduction Act



The Act also incentivizes installation of **efficiency upgrades and carbon capture in industrial sectors**, contributing ~130 Mt of reductions.

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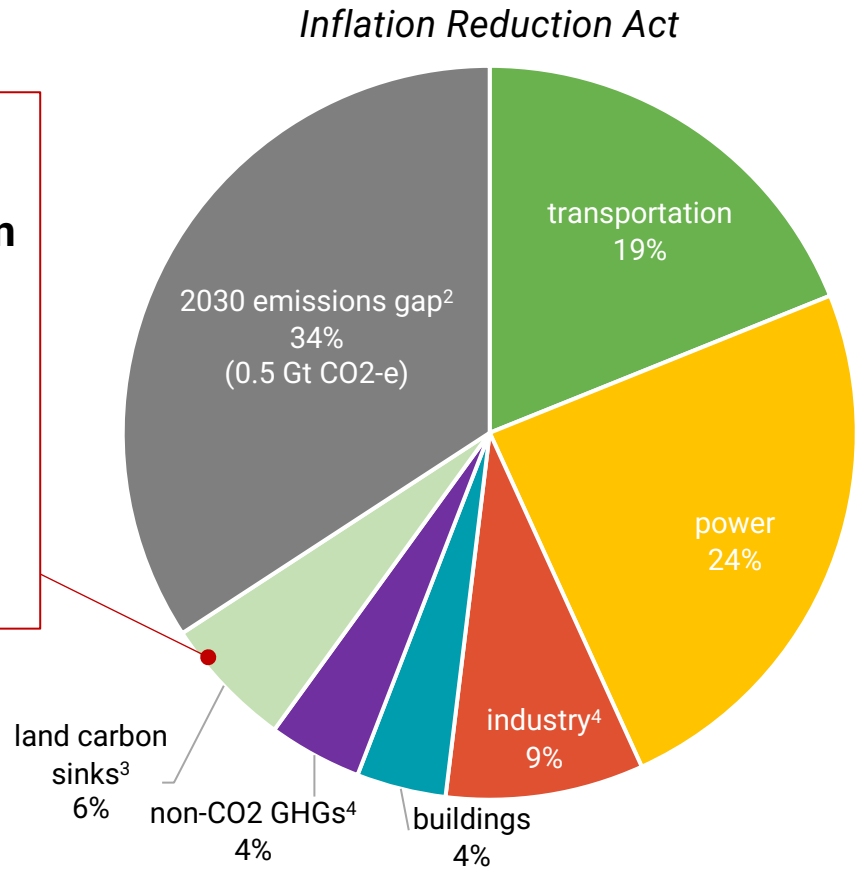
Rebates, tax credits and grants to spur **electrification and efficiency improvements in buildings**; **reductions in methane emissions in the oil and gas sector** spurred by the methane fee and grants; and funding to improve **conservation and carbon sequestration in forest and agricultural lands** also contribute important reductions (~210 Mt collectively).



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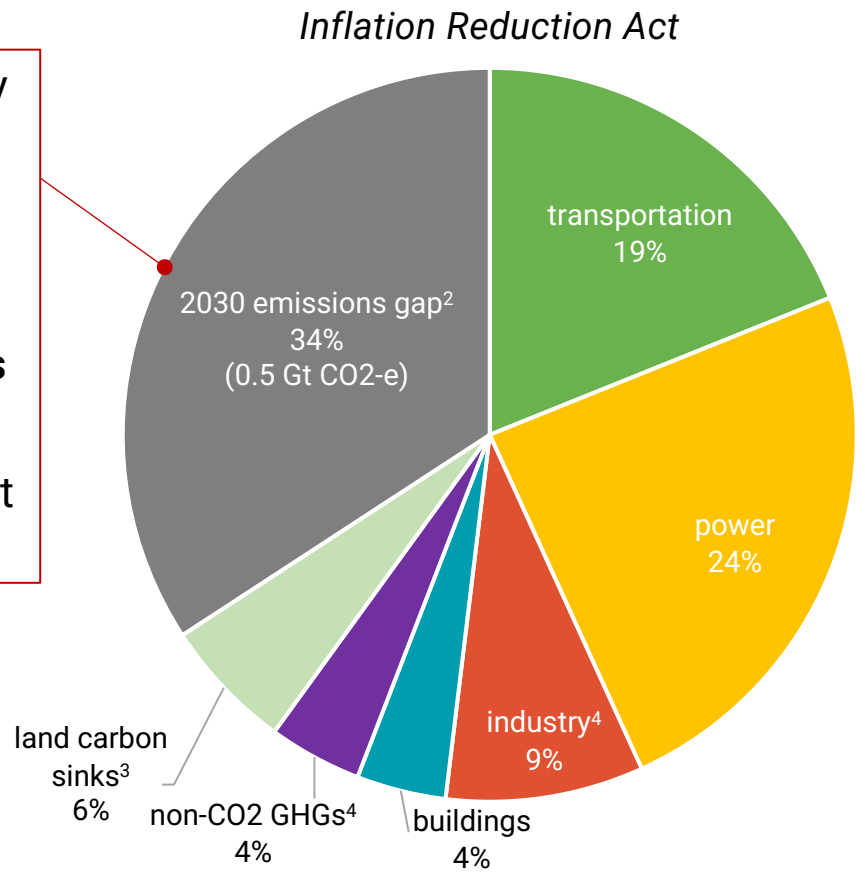
By driving down the cost of clean energy and other climate solutions, the Act **makes it easier for states or cities or companies to increase their climate ambitions.**

It also **reinforces the economic benefits of any future federal regulations**.

(These dynamic effects of the bill are not captured in this modeling.)



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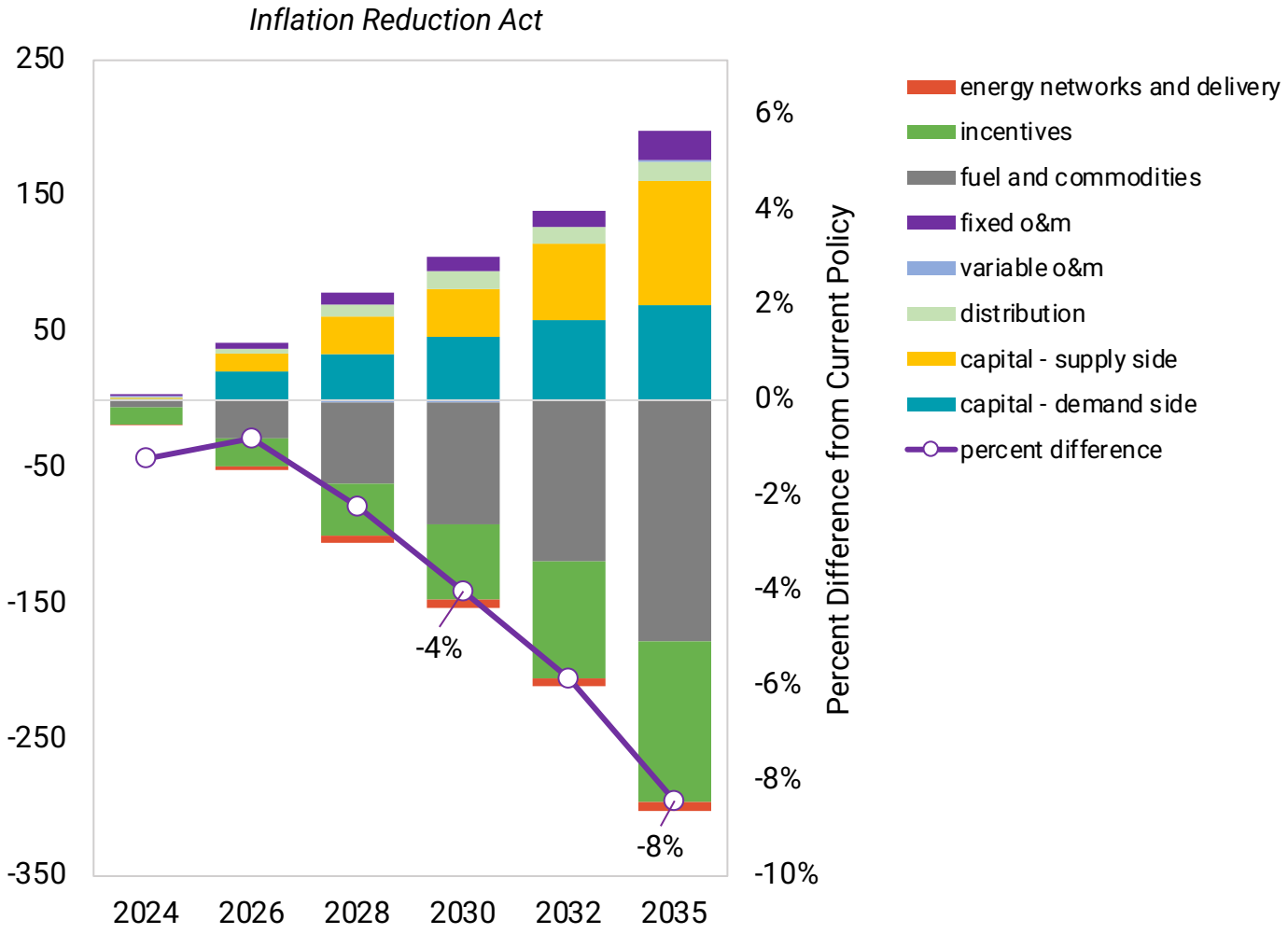
Change in Annual U.S. Energy Expenditures vs Current Policy (Including Bipartisan Infrastructure Law)

billion 2022 USD



Tax credits, rebates, and federal investments in the Act will **shift costs from energy bills to the progressive federal tax base** and reduce energy consumption.

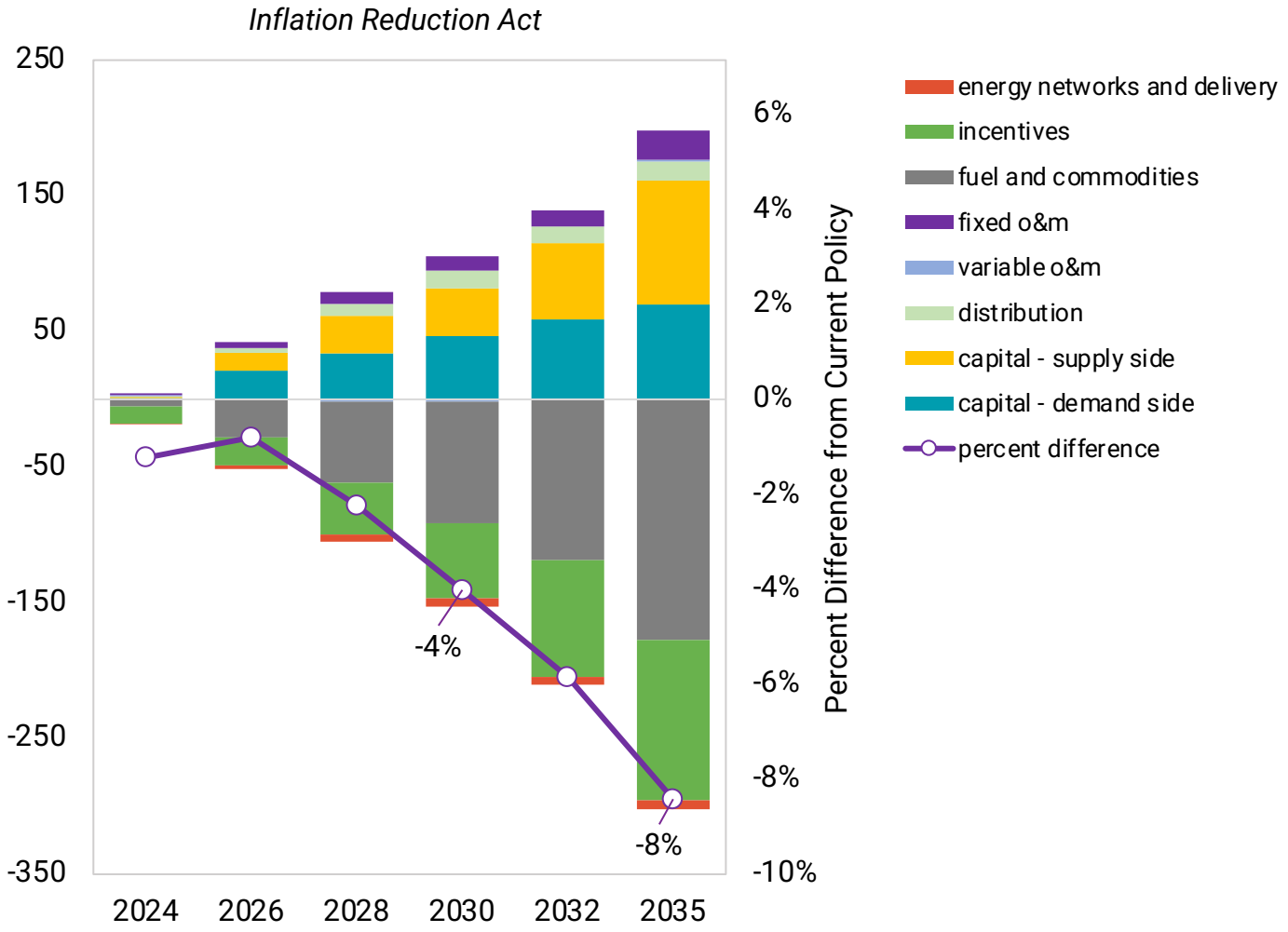
Annual U.S. energy expenditures fall at least 4% in 2030, a savings of nearly $50 billion dollars per year for households, businesses and industry.

That translates into **hundreds of dollars in annual energy cost savings for U.S. households**.

Savings double by 2035...

Change in Annual U.S. Energy Expenditures vs Current Policy (Including Bipartisan Infrastructure Law)

billion 2022 USD



These **savings do not include the additional downward pressure the Act will put on prices for oil and natural gas** by driving lower consumption of these commodities, which will further reduce U.S. energy costs. Price responses to changes in demand are not captured in our energy system modeling.

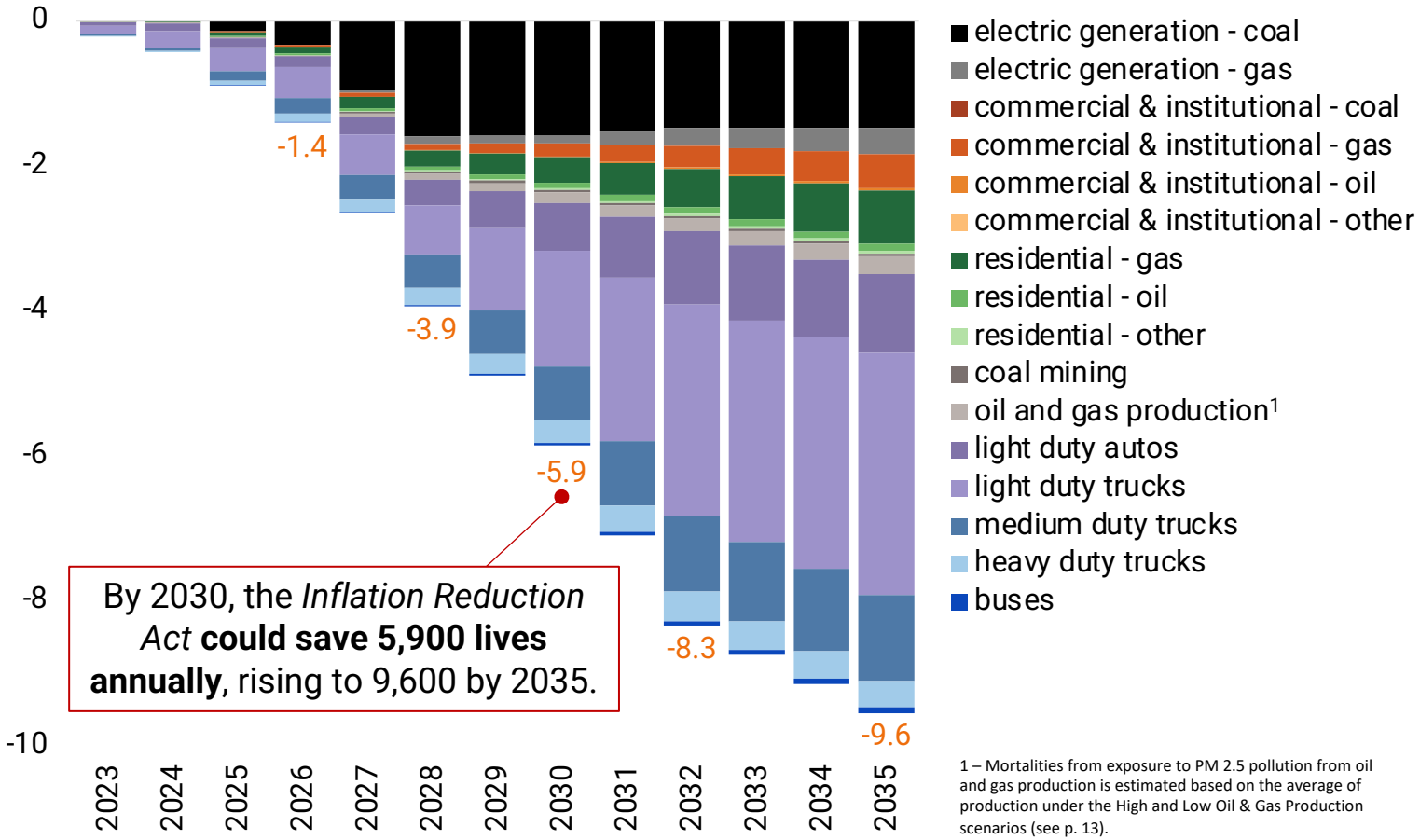
Using a spreadsheet model of oil and gas elasticities, REPEAT Project estimates that **lower U.S. consumption of petroleum products and natural gas could reduce crude oil prices by approximately 5% and reduce U.S. natural gas prices by ~10-20%** in the medium term (2030-2035).[1]

1 – Based on supply/demand model of an internationally traded product derived from the appendix of Prest, 2022, "Partners, Not Rivals: The Power of Parallel Supply-Side and Demand-Side Climate Policy," Resources for the Future, Report 22-06, April 2022, (see p. 31). Oil price effect reflects 5-year elasticity for supply of 0.6 for US producers, 0.5 for foreign producers, and elasticity of consumption of 0.2. Natural gas price effect reflects 5-year elasticity of supply of 0.3 for US producers, 0.25 for foreign producers and elasticity of consumption of 0.2. Demand shock based on REPEAT Project modeled reductions in 2030 US petroleum product and natural gas consumption and initial global supply and demand from EIA *Short-Term Energy Outlook.* Natural gas price effect is modeled for both a fully integrated global market (7% predicted price effect) and fully isolated US market (23% price effect). Constrained LNG export capacity makes the US gas market partially integrated with global markets, and thus the price effect from a U.S. demand shock should fall between this range, hence the reported estimate of ~10-20%. Estimates should be considered approximate and reflect order of magnitude impacts given uncertainty in assumptions.

Annual Avoided Premature Deaths From Exposure to Fine Particulate Matter From Energy Activities vs Current Policy (Including Bipartisan Infrastructure Law)

Thousands

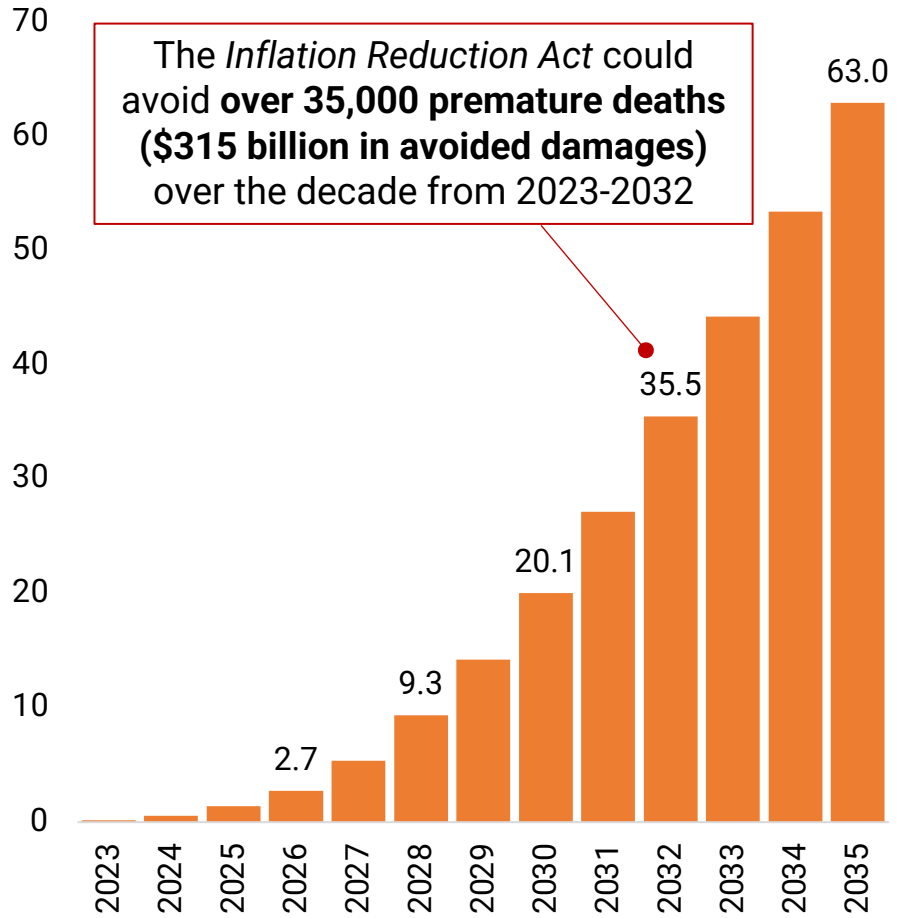
Inflation Reduction Act



1 – Mortalities from exposure to PM 2.5 pollution from oil and gas production is estimated based on the average of production under the High and Low Oil & Gas Production scenarios (see p. 13).

Cumulative Avoided Premature Deaths vs Current Policy (Including Bipartisan Infrastructure Law)

Thousands

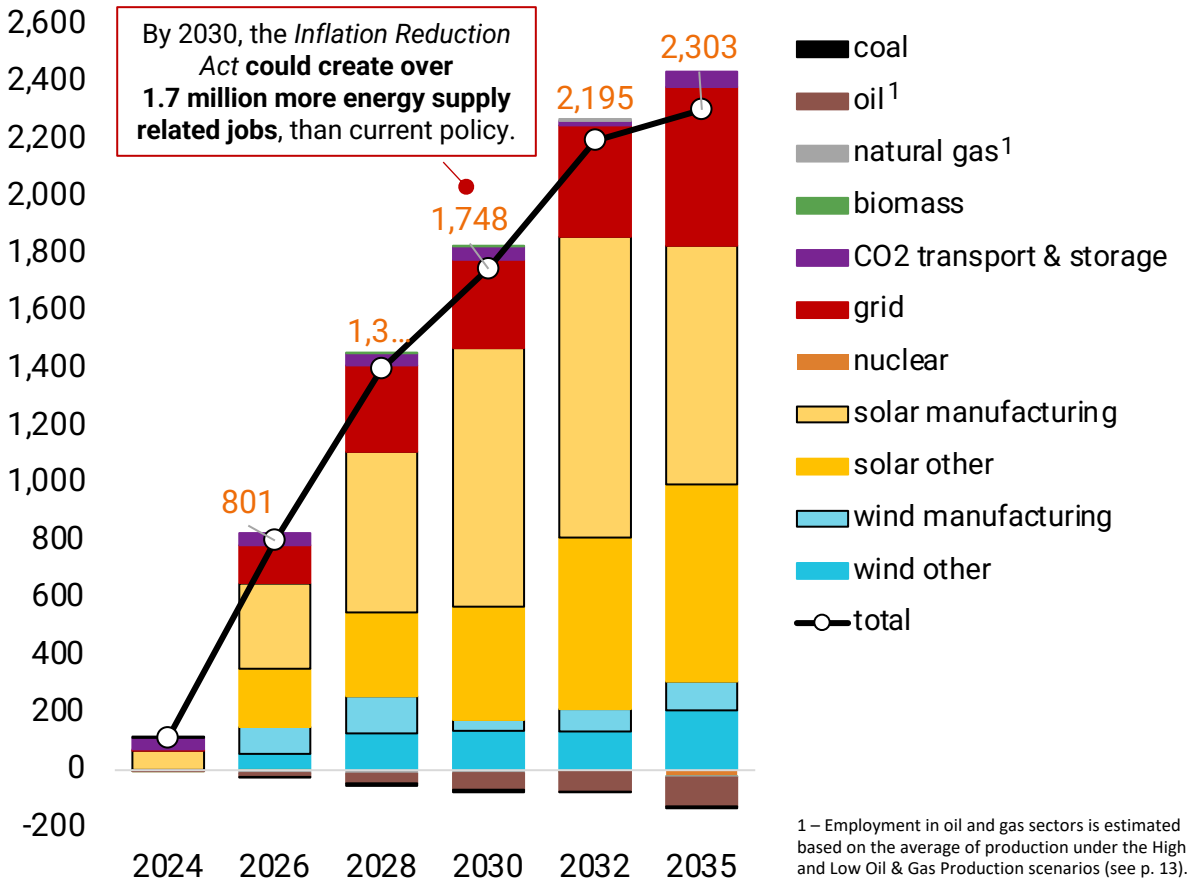


Change in Energy Supply-Related Employment vs Current Policy (Including Bipartisan Infrastructure Law)

Inflation Reduction Act

Employment by Resource

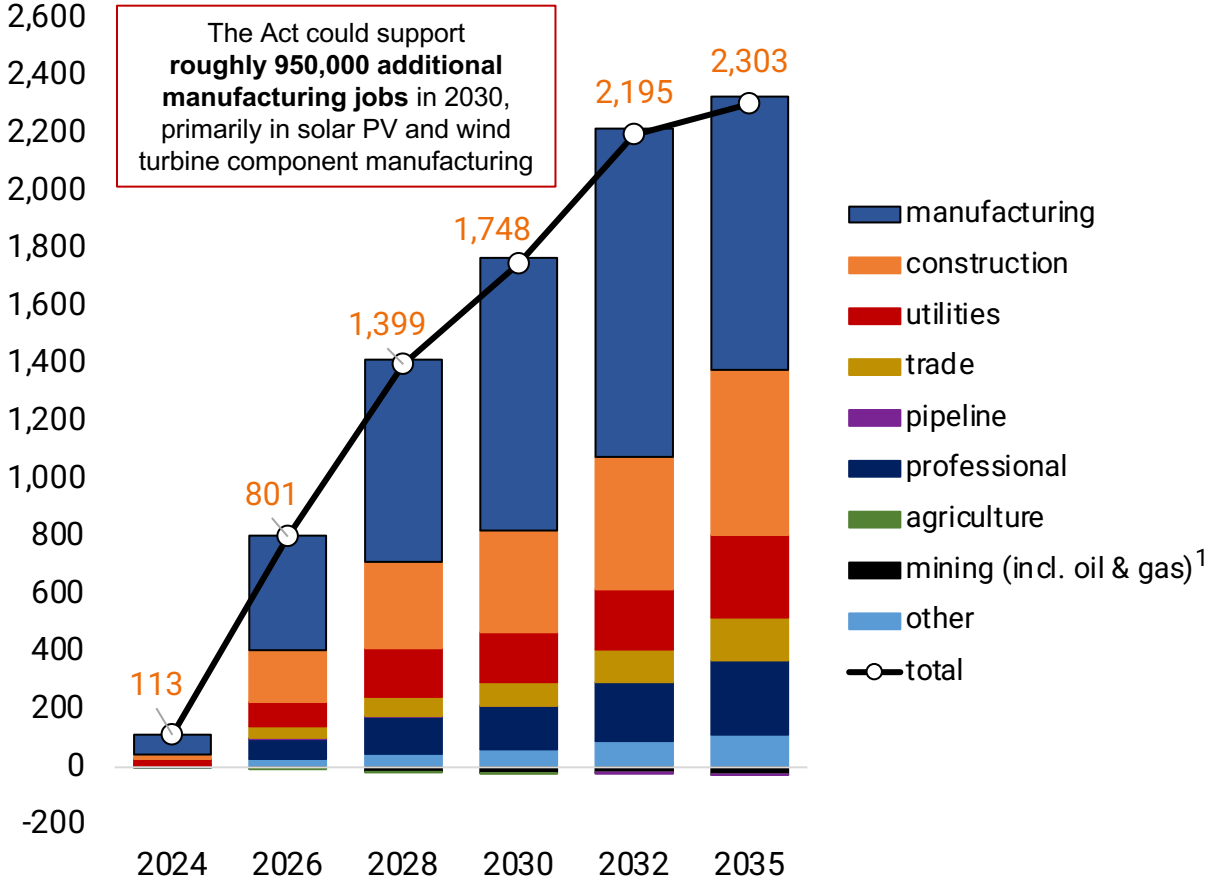
thousand jobs



1 – Employment in oil and gas sectors is estimated based on the average of production under the High and Low Oil & Gas Production scenarios (see p. 13).

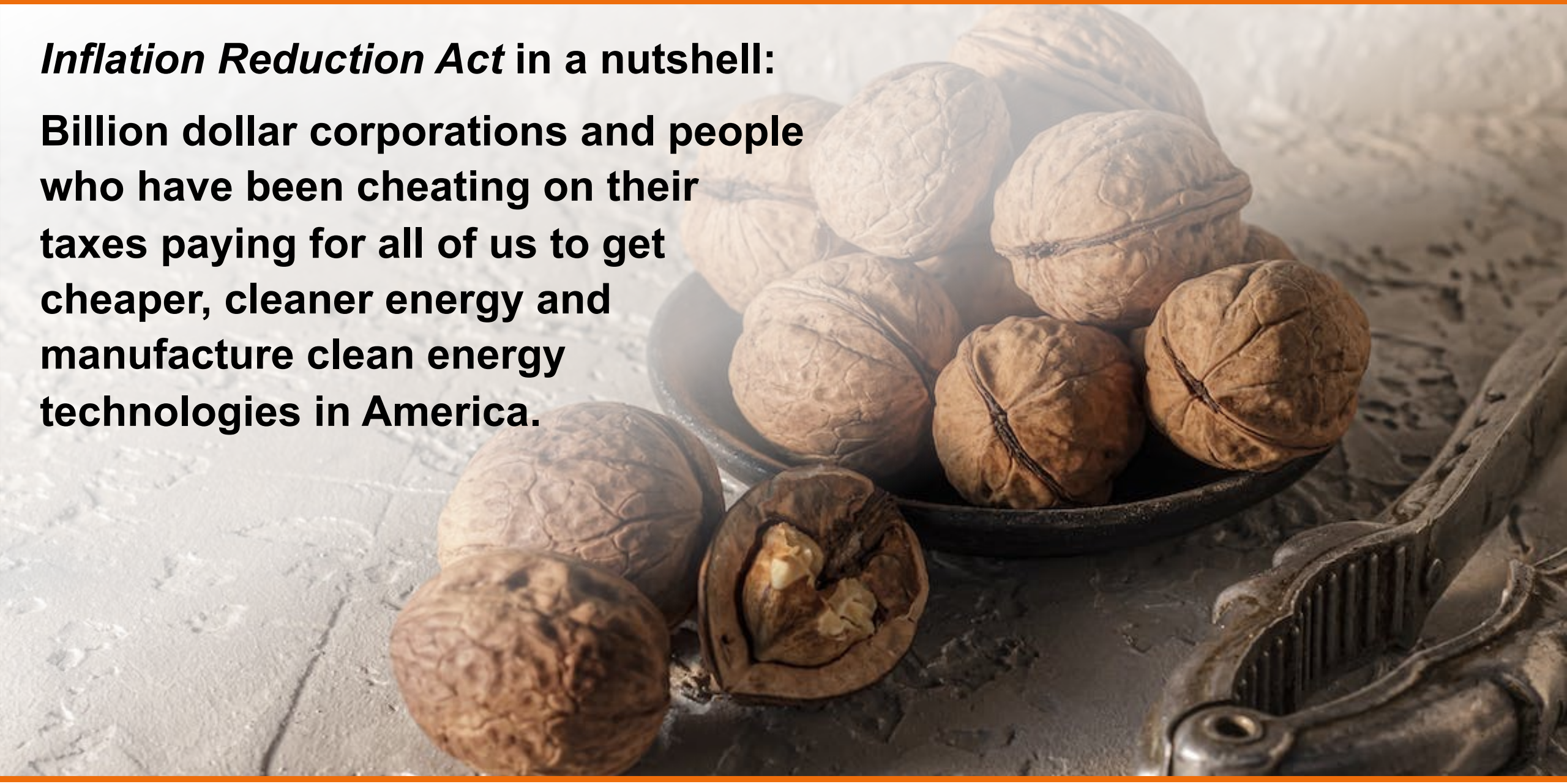
Employment by Sector

thousand jobs

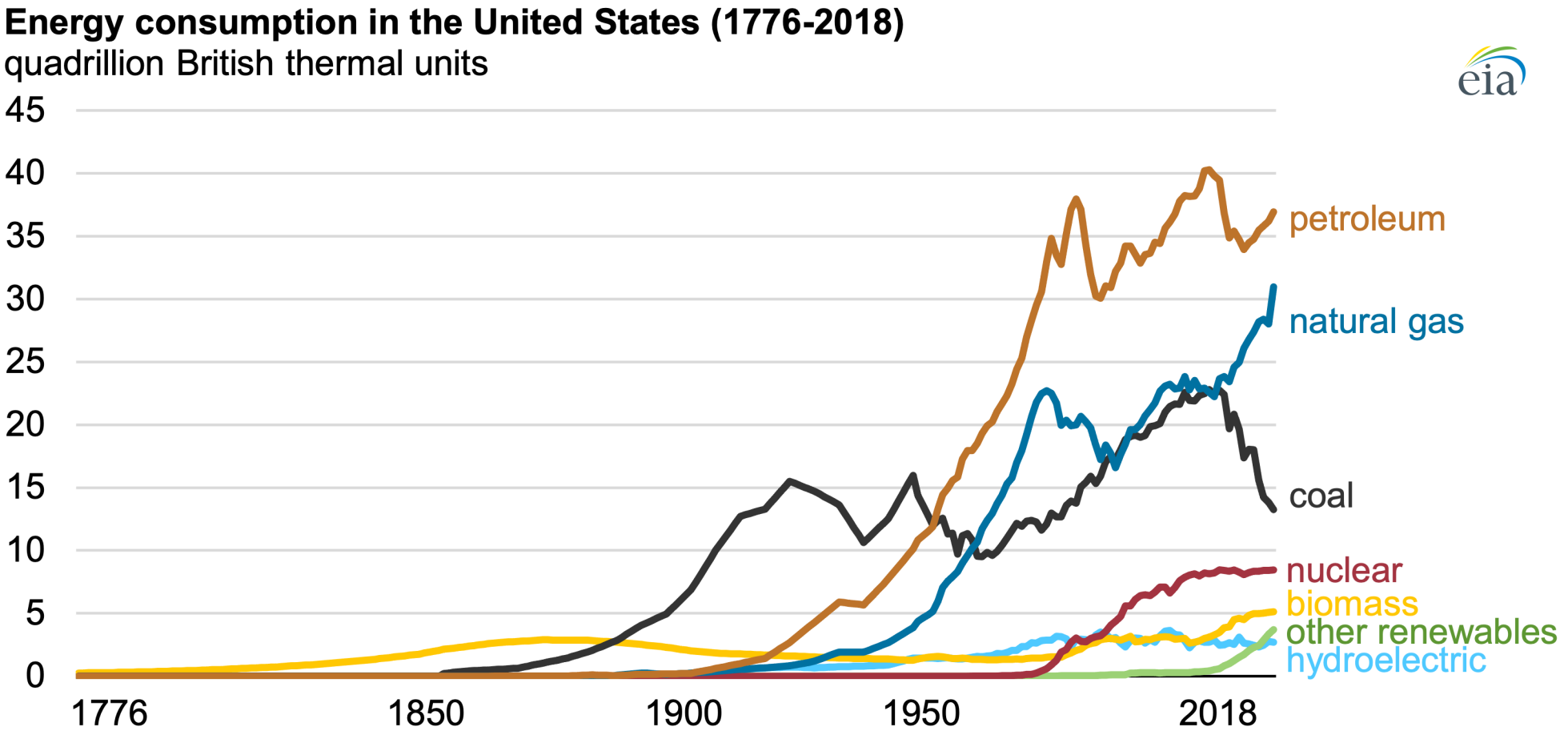


Inflation Reduction Act in a nutshell:

Billion dollar corporations and people who have been cheating on their taxes paying for all of us to get cheaper, cleaner energy and manufacture clean energy technologies in America.



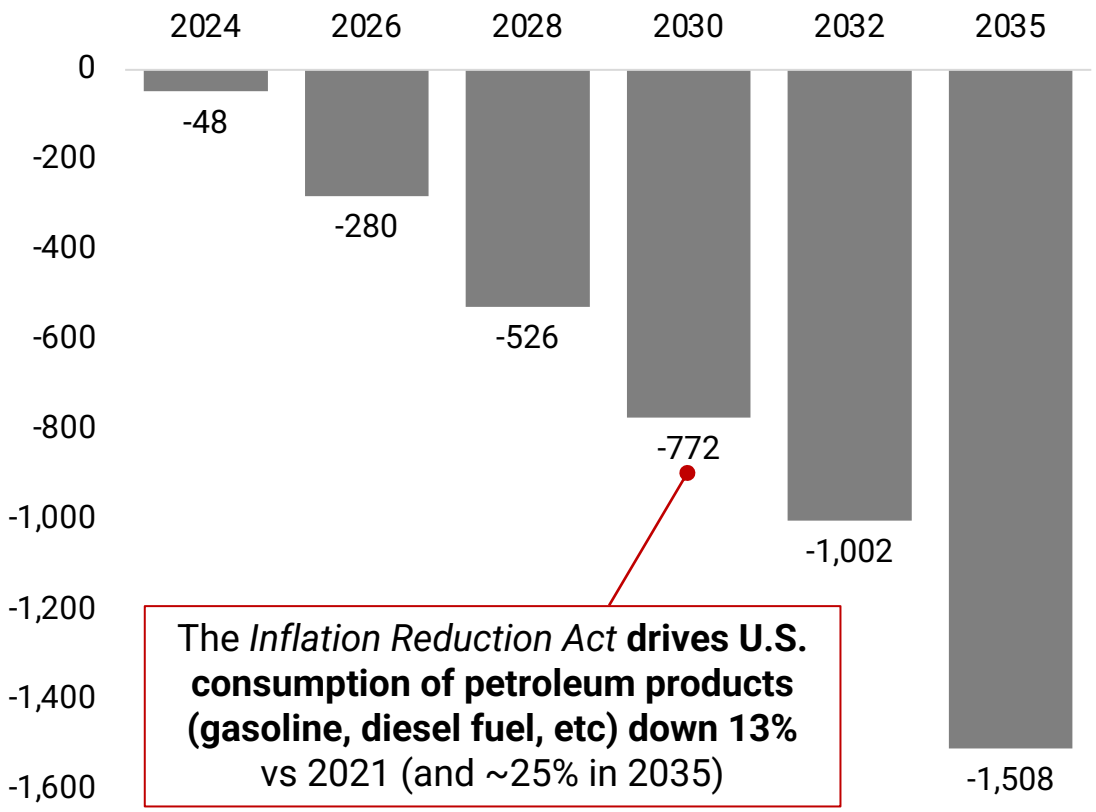
For all of U.S. history, petroleum and natural gas consumption has steadily risen (outside of recessions)…



Changes in Annual U.S. Petroleum Product and Natural Gas Consumption vs Current Policy (Including Bipartisan Infrastructure Law)

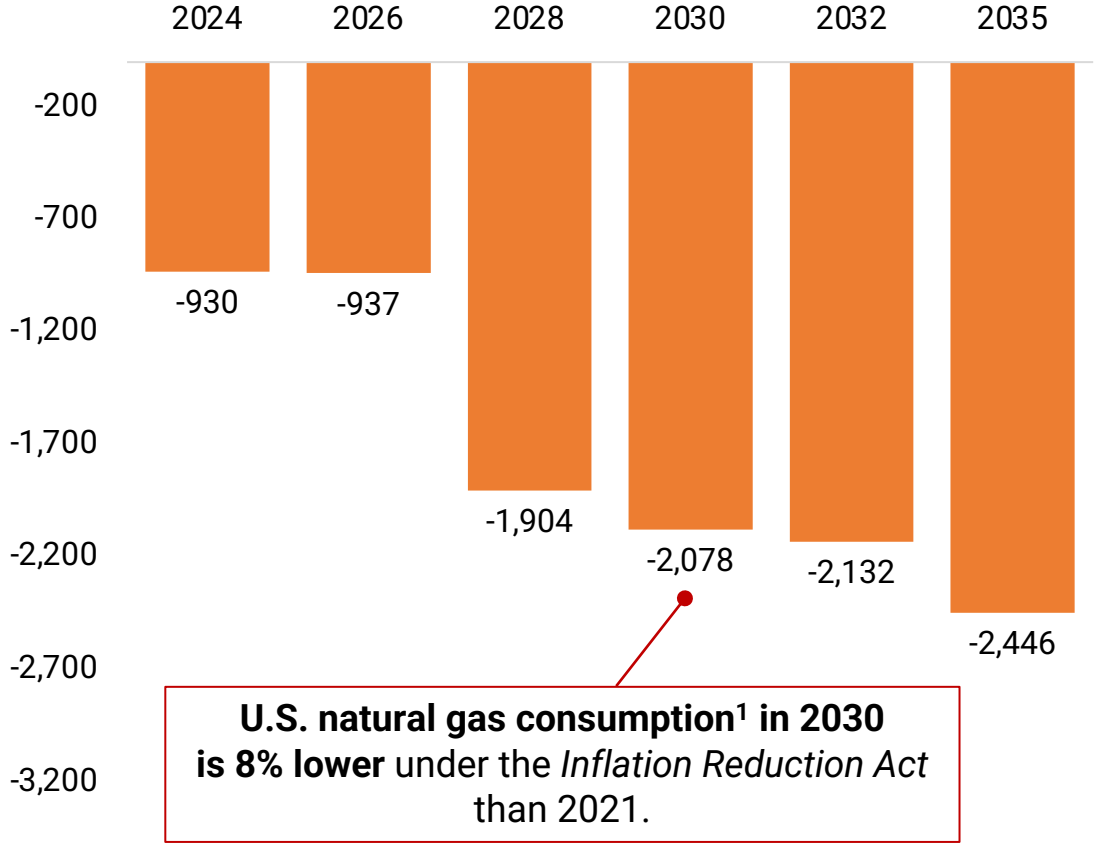
Inflation Reduction Act

Petroleum Products
million barrels per year (mmbbl/y)



The *Inflation Reduction Act* **drives U.S. consumption of petroleum products (gasoline, diesel fuel, etc) down 13%** vs 2021 (and ~25% in 2035)

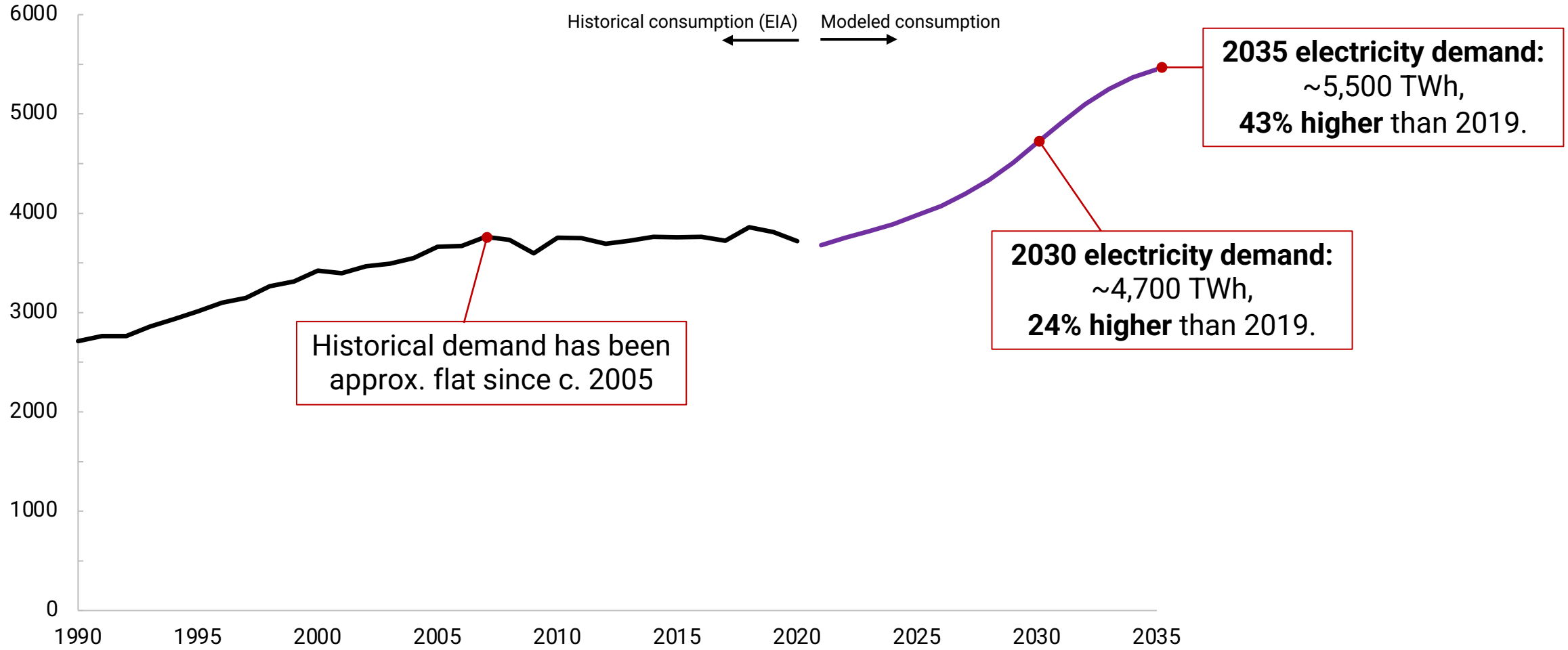
Natural Gas
billion cubic feet per year (bcf/y)



U.S. natural gas consumption[1] in 2030 is 8% lower under the *Inflation Reduction Act* than 2021.

Historical and Modeled Annual U.S. Electricity Consumption

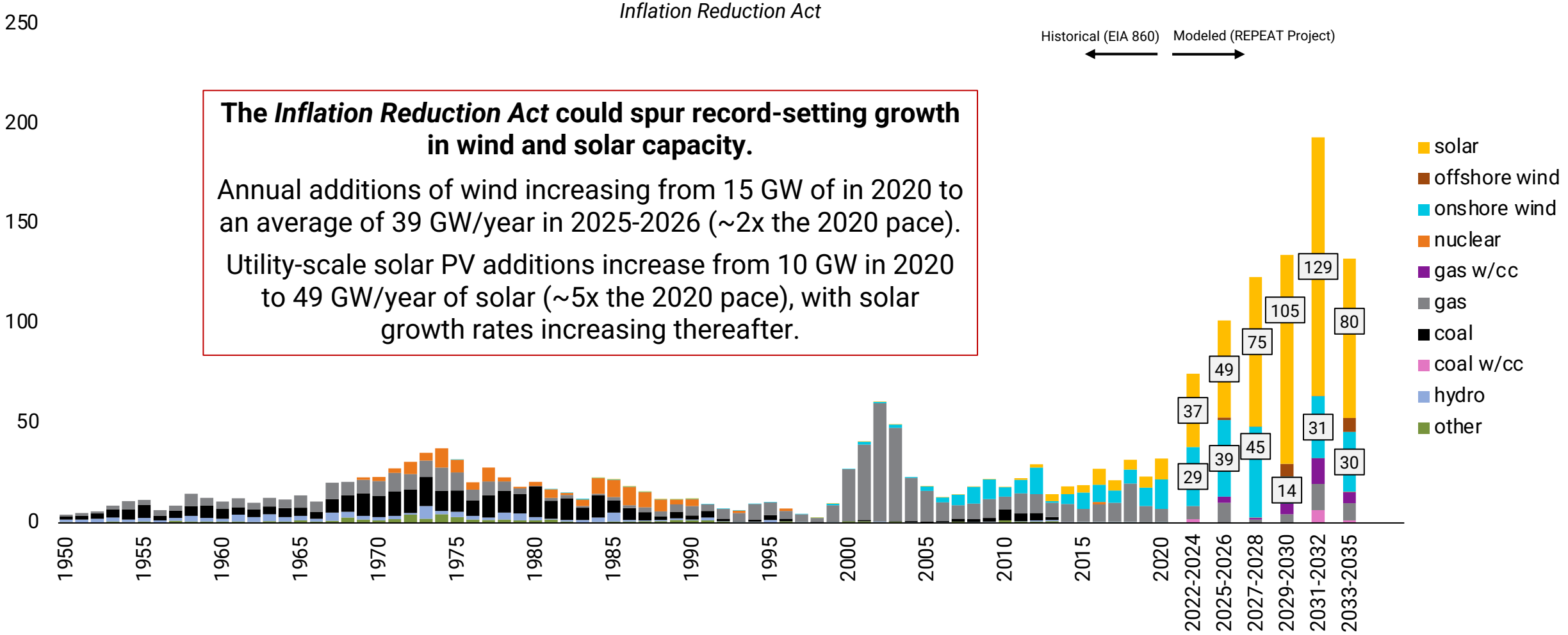
Terawatt-hours (TWh) per year



The new challenge: how *fast* can we scale??

Historical Annual Capacity Additions vs. Modeled Annual Average Capacity Additions

gigawatts/year



The *Inflation Reduction Act* could spur record-setting growth in wind and solar capacity.

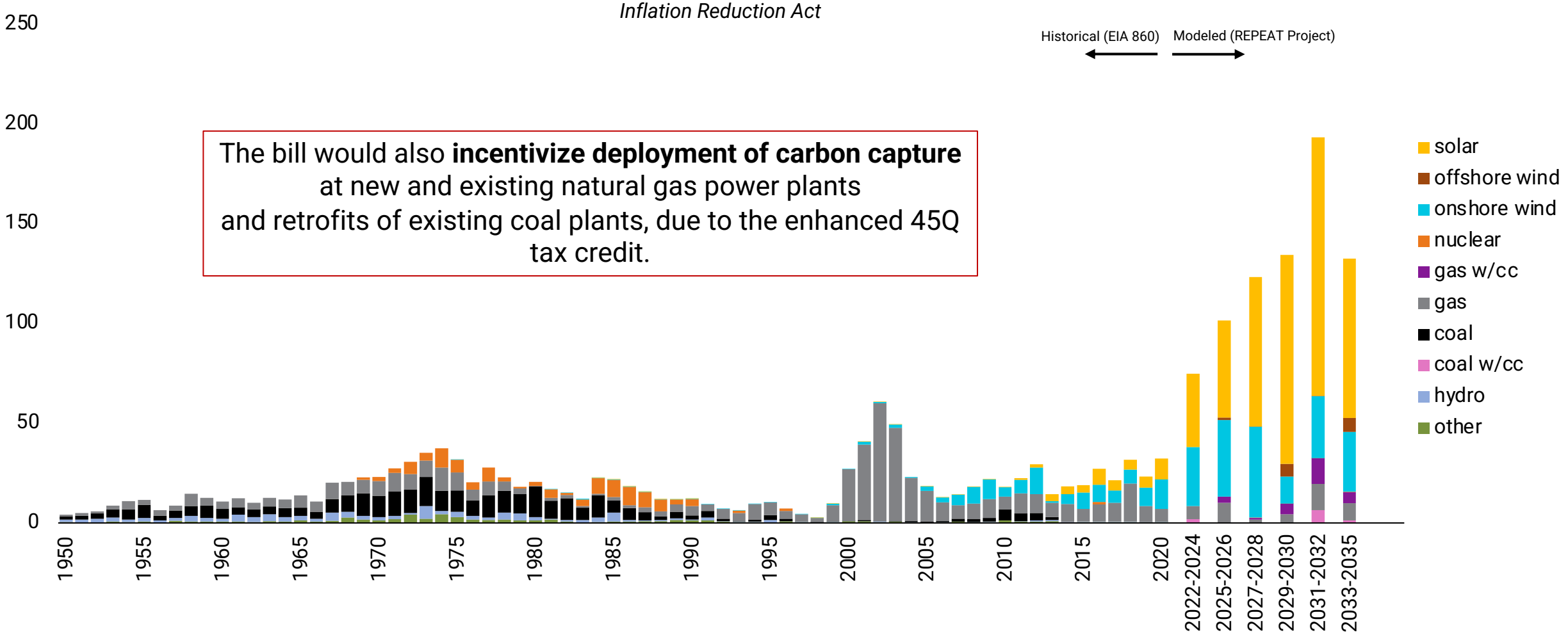
Annual additions of wind increasing from 15 GW of in 2020 to an average of 39 GW/year in 2025-2026 (~2x the 2020 pace).

Utility-scale solar PV additions increase from 10 GW in 2020 to 49 GW/year of solar (~5x the 2020 pace), with solar growth rates increasing thereafter.

Historical Annual Capacity Additions vs. Modeled Annual Average Capacity Additions

gigawatts/year

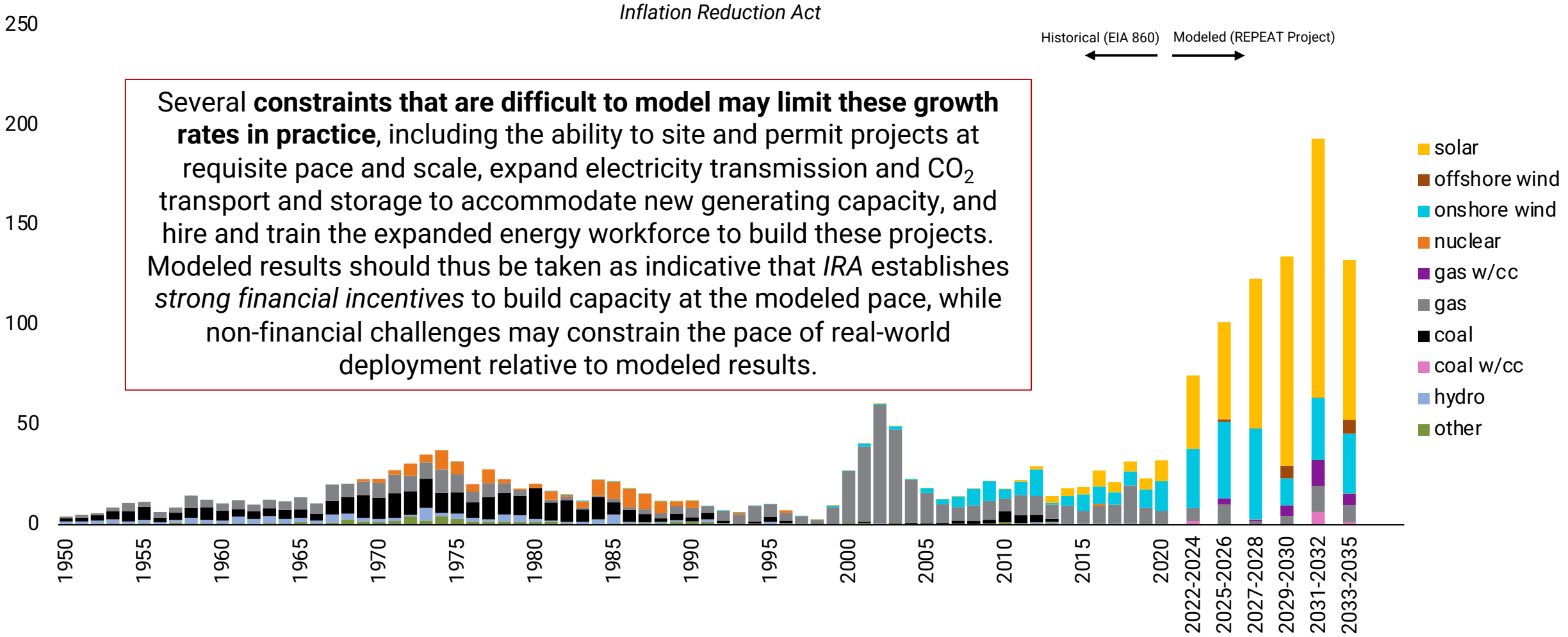
Inflation Reduction Act



The bill would also **incentivize deployment of carbon capture** at new and existing natural gas power plants and retrofits of existing coal plants, due to the enhanced 45Q tax credit.

Historical Annual Capacity Additions vs. Modeled Annual Average Capacity Additions

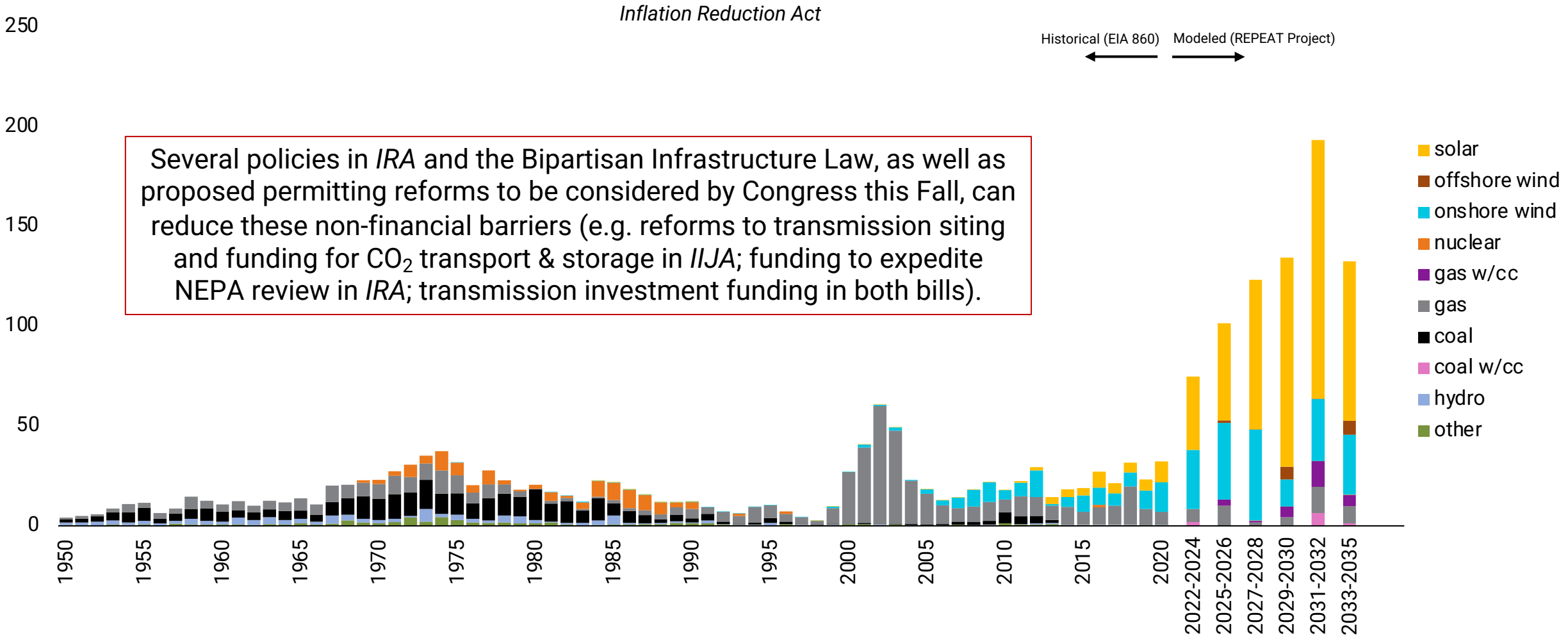
gigawatts/year



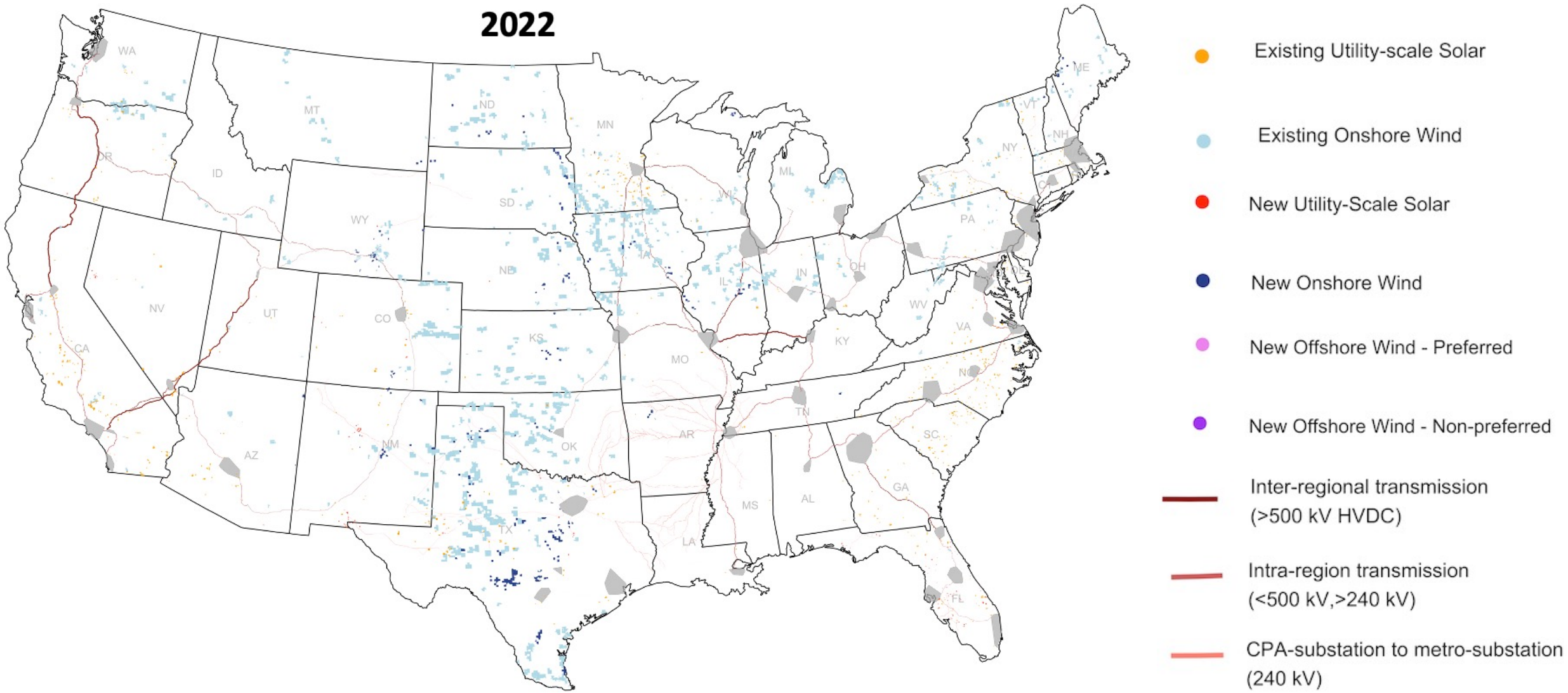
Several **constraints that are difficult to model may limit these growth rates in practice**, including the ability to site and permit projects at requisite pace and scale, expand electricity transmission and CO_2 transport and storage to accommodate new generating capacity, and hire and train the expanded energy workforce to build these projects. Modeled results should thus be taken as indicative that *IRA* establishes *strong financial incentives* to build capacity at the modeled pace, while non-financial challenges may constrain the pace of real-world deployment relative to modeled results.

Historical Annual Capacity Additions vs. Modeled Annual Average Capacity Additions

gigawatts/year



Several policies in *IRA* and the Bipartisan Infrastructure Law, as well as proposed permitting reforms to be considered by Congress this Fall, can reduce these non-financial barriers (e.g. reforms to transmission siting and funding for CO_2 transport & storage in *IIJA*; funding to expedite NEPA review in *IRA*; transmission investment funding in both bills).


2022
WA
OR
CA
ID
NV
MT
WY
UT
AZ
CO
NM
ND
SD
NB
KS
OK
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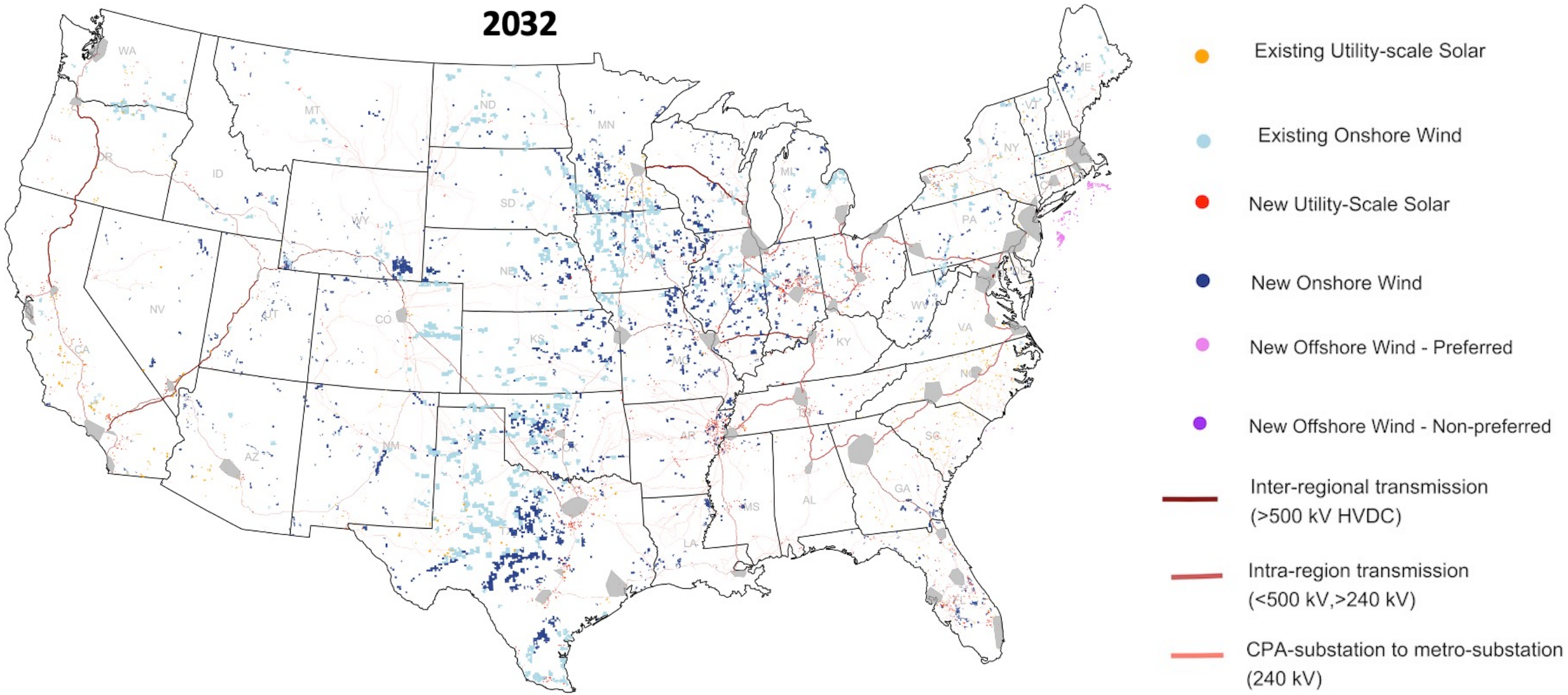
Existing Utility-scale Solar
Existing Onshore Wind
New Utility-Scale Solar
New Onshore Wind
New Offshore Wind - Preferred
New Offshore Wind - Non-preferred
Inter-regional transmission (>500 kV HVDC)
Intra-region transmission (<500 kV,>240 kV)
CPA-substation to metro-substation (240 kV)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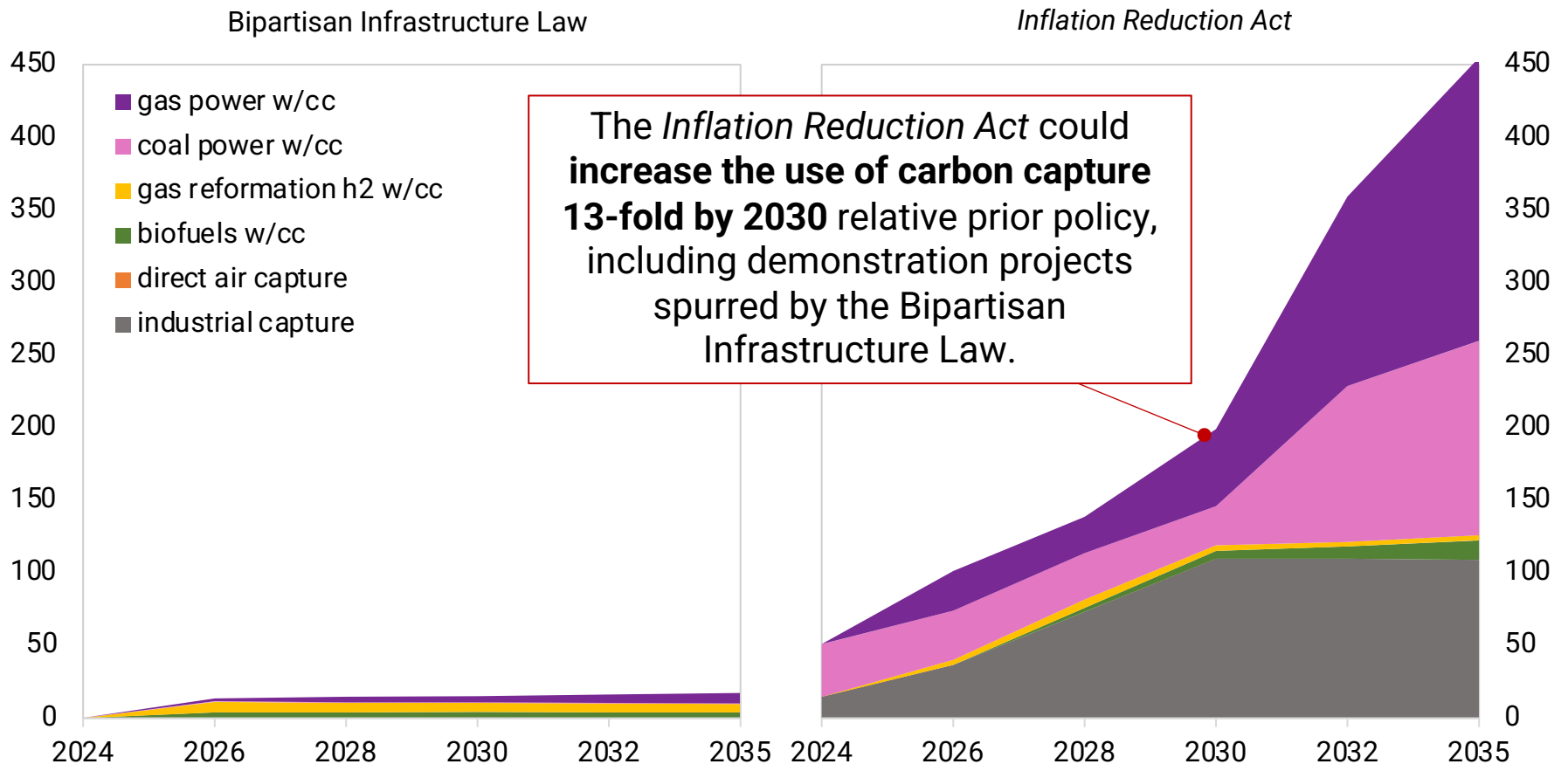
Annual Carbon Dioxide Captured for Transport and Geologic Storage

million tons per year (Mt/y)



The *Inflation Reduction Act* could **increase the use of carbon capture 13-fold by 2030** relative prior policy, including demonstration projects spurred by the Bipartisan Infrastructure Law.

Incentives for carbon capture, storage, and use in the *Inflation Reduction Act* would build on demonstration funding in the Bipartisan Infrastructure Law to **make carbon capture a viable economic option** for the most heavily emitting industries, such as steel, cement, and refineries, as well as power generation from coal and natural gas.

The total volume of CO_2 captured for transport and geologic storage across energy and industry could reach **200 million tons per year** by 2030, if sufficient investment in transport networks and storage basins can be deployed.[1]

1 – Growth in annual CO2 injection capacity in storage basins is likely to constrain the pace of carbon capture deployment. This modeling assume maximum annual CO2 injections increase to 200 Mt CO2/y by 2030 based on expert input and Princeton *Net-Zero America* study.

2 – Industrial CO_2 capture volumes are fixed exogenously based on analysis in Larson et al., 2021, "Capturing the Moment: Carbon Capture in the American Jobs Plan," Rhodium Group, April 2021. Carbon capture in fuels conversion (biofuels, hydrogen, ammonia) and power generation are optimized in RIO modeling, constrained by remaining available annual injection volume limit.

REPEAT Rapid Energy Policy Evaluation and Analysis Toolkit

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