REPEAT Rapid Energy Policy Evaluation and Analysis Toolkit

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Zero-carbon Energy Systems Research and Optimization Laboratory

Electricity Transmission is Key to Unlock the Full Potential of the Inflation Reduction Act

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Electricity Transmission is Key to Unlock the Full Potential of the Inflation Reduction Act

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Introduction

This report assesses the role of electricity transmission in enabling the full emissions reduction potential of the *Inflation Reduction Act (IRA*).

Previously, REPEAT Project estimated that ***IRA* could cut U.S. greenhouse gas emissions by roughly one billion tons per year in 2030** and reduce cumulative greenhouse gas emissions by 6.3 billion tons of CO_2-equivalent over the decade (2023-2032).[1] **That outcome depends on more than doubling the historical pace of electricity transmission expansion over the last decade** in order to interconnect new renewable resources at sufficient pace and meet growing demand from electric vehicles, heat pumps, and other electrification.

While our modeling finds this outcome makes economic sense, current transmission planning, siting, permitting and cost allocation practices can all potentially impede the real-world pace of transmission expansion. We thus model the impact of constrained growth in U.S. electricity transmission on emissions outcomes and the pace of renewable electricity expansion under *IRA.*

1. Jenkins, J.D., et al., "Preliminary Report: The Climate and Energy Impacts of the Inflation Reduction Act of 2022 ," REPEAT Project, Princeton, NJ, August 2022. DOI: 10.5281/zenodo.6992940

Summary of Findings

- Failing to accelerate transmission expansion beyond the recent historical pace (~1%/year) increases 2030 U.S. greenhouse emissions by ~800 million tons per year, relative to estimated reductions in an unconstrained *IRA* case. Emissions are 200 million tons higher if transmission growth is limited to 1.5%/year.
- Over 80% of the potential emissions reductions delivered by IRA in 2030 are lost if transmission expansion is constrained to 1%/year, and roughly 25% are lost if growth is limited to 1.5%/year.
- To unlock the full emissions reduction potential of the *Inflation Reduction Act,* the pace of transmission expansion must more than double the rate over the last decade to reach an average of ~2.3%/year. That rate of expansion is comparable to the long-term average rate of transmission additions from 1978-2020.
- To achieve *IRA*'s full emissions reduction potential, new clean electricity must be rapidly added to both meet growing demand from electrification and reduce fossil fuel use in the power sector. Constraining transmission growth severely limits the expansion of wind and solar power.
- If electricity transmission cannot be expanded fast enough, power sector emissions and associated pollution and public health impacts could increase significantly as gas and coal-fired power plants produce more to meet growing demand from electric vehicles and other electrification spurred by IRA.
- If transmission cannot be expanded faster than recent historical rates (~1%/year), growing demand from electric vehicles and other electrification spurred by IRA results in over 110 million tons of additional coal consumption in 2030 than a No *IRA* case and roughly 250 million tons more than if transmission expansion is unconstrained.
- Expanding transmission more rapidly enables growth of wind and solar power and substantially reduces U.S. natural gas consumption, which falls 17% from 2021 levels in the unconstrained IRA case. In contrast, if transmission expansion is limited to 1%/year, natural gas use increases to 4% above 2021 levels in 2030 and remains elevated through 2035.

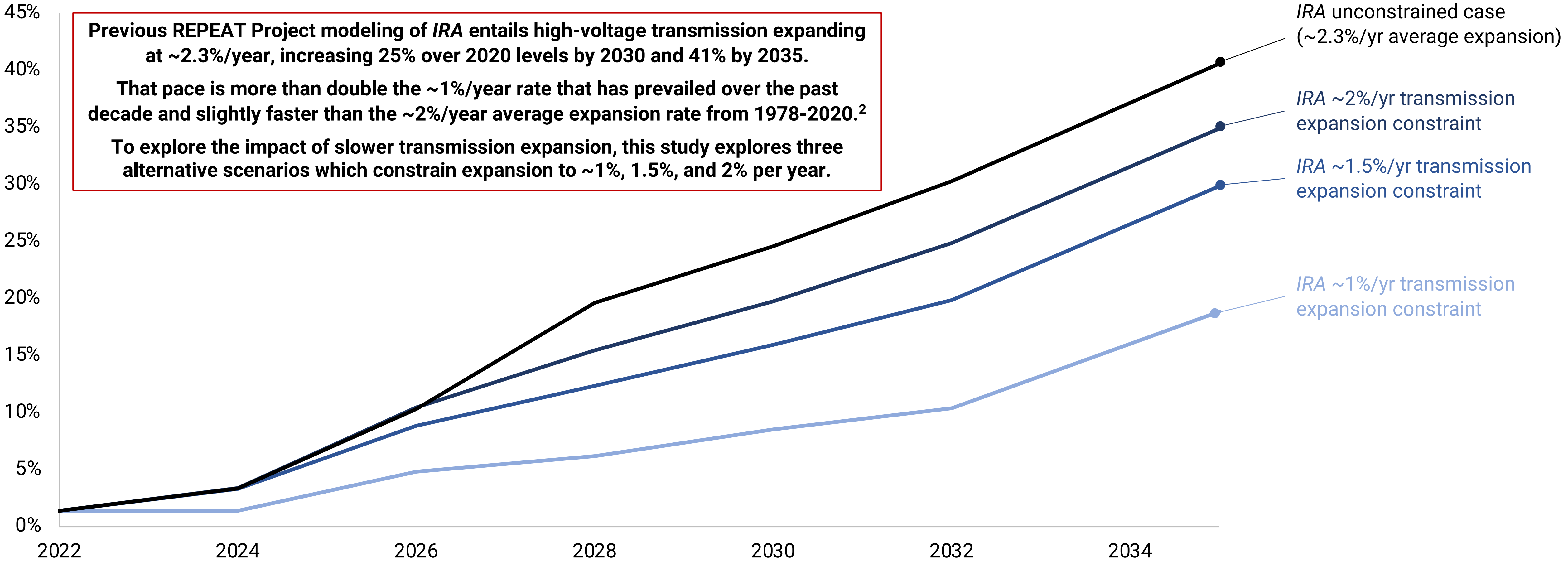
Cumulative Expansion of U.S. High-Voltage Transmission Capacity

Percent growth in GW-miles vs 2020 installed capacity[1]

Previous REPEAT Project modeling of *IRA* entails high-voltage transmission expanding at ~2.3%/year, increasing 25% over 2020 levels by 2030 and 41% by 2035.

That pace is more than double the ~1%/year rate that has prevailed over the past decade and slightly faster than the ~2%/year average expansion rate from 1978-2020.[2]

To explore the impact of slower transmission expansion, this study explores three alternative scenarios which constrain expansion to ~1%, 1.5%, and 2% per year.

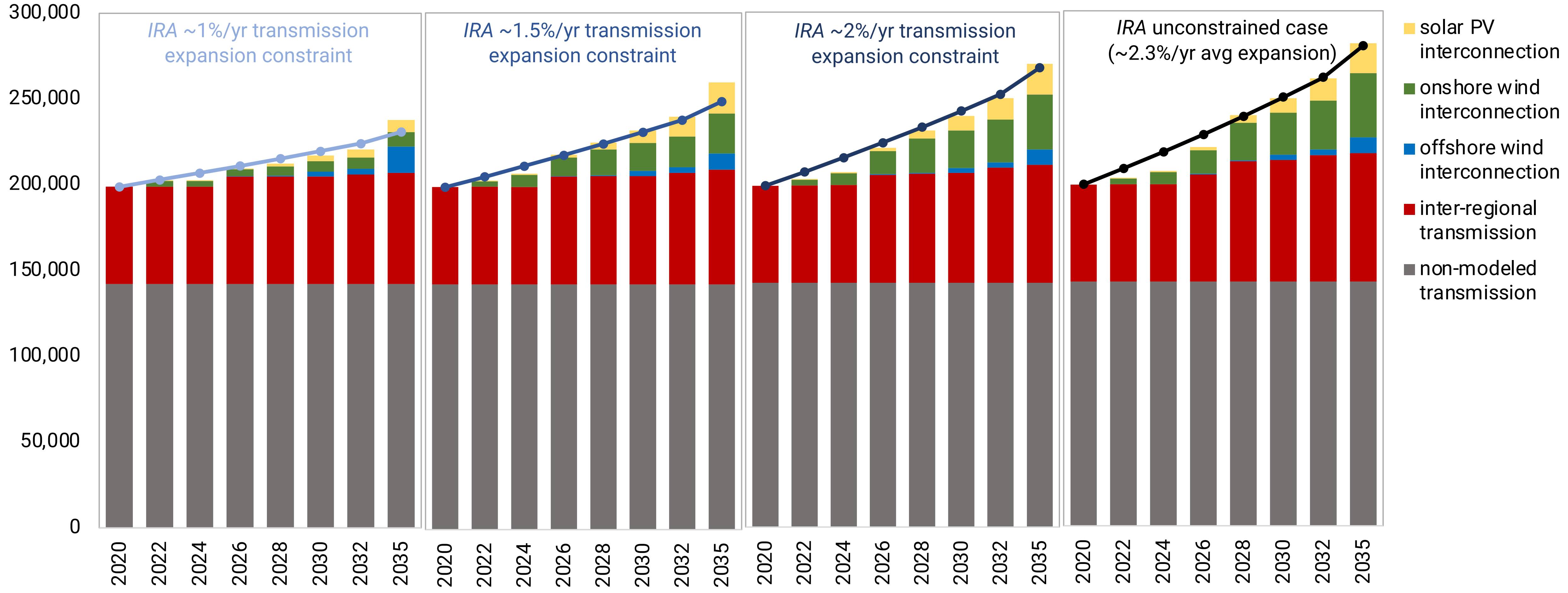


1 – Relative to approximately 200,000 GW-miles of estimated installed high voltage (200 kV and above) transmission capacity based on U.S. DOE "Annual U.S. Transmission Data Review," March 2018.

2 – Based on US DOE, UT Austin and S&P Global data sources as reported in Cembalest (2022), "Eye on the Market 12th Edition: 2022 Annual Energy Paper" p.12.

Total Modeled U.S. High-Voltage Transmission Capacity

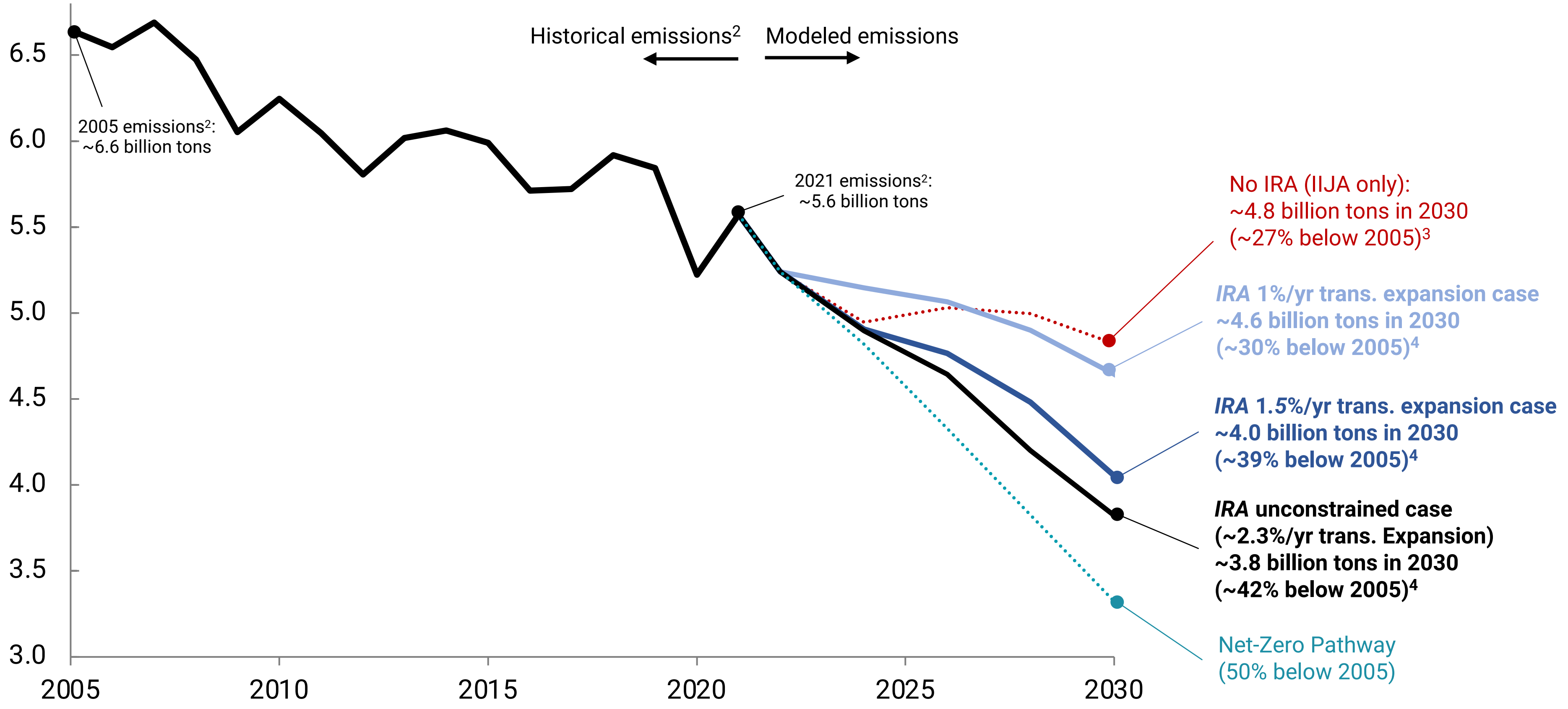
GW-miles vs 2020 installed capacity[1]



1 – Relative to approximately 200,000 GW-miles of estimated installed high voltage (200 kV and above) transmission capacity based on U.S. DOE "Annual U.S. Transmission Data Review," March 2018.

Impact of Transmission Expansion Constraints on Modeled Net U.S. Greenhouse Gas Emissions (Including Land Carbon Sinks)

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



Failing to accelerate transmission expansion beyond the recent historical pace (~1%/year) increases 2030 U.S. greenhouse emissions by ~800 million tons per year, relative to estimated reductions in an unconstrained *IRA* case.

Emissions are 200 million tons higher if transmission growth is limited to 1.5%/year.

To unlock the full emissions reduction potential of the *Inflation Reduction Act,* the pace of transmission expansion must more than double the rate over the last decade to reach an average of ~2.3%/year.

That rate of expansion is comparable to the long-term average rate of transmission additions from 1978-2020.

1 - CO_2-equivalent emissions calculations use IPCC AR4 100 year global warming potential as per EPA Inventory of Greenhouse Gas Emissions and Sinks. **All values should be regarded as approximate given uncertainty in future outcomes.**

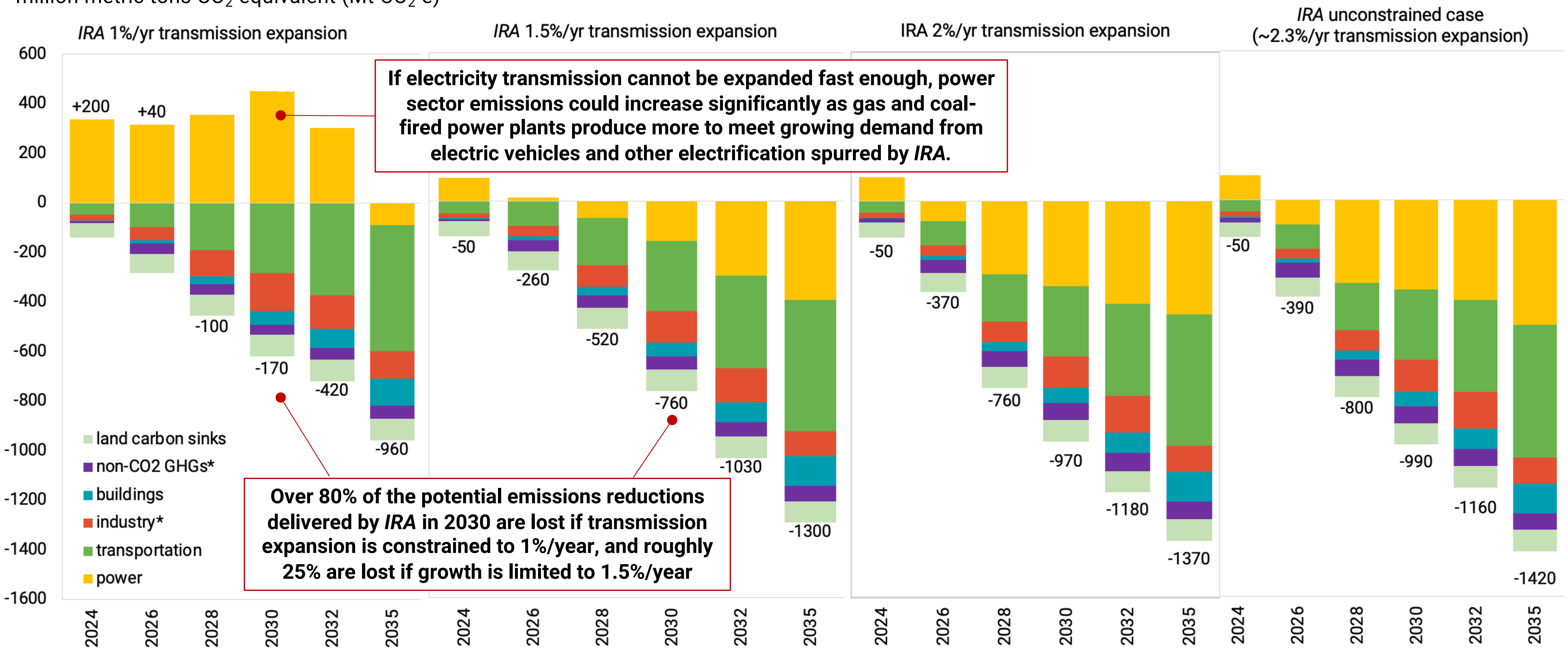
2 - Historical data from US EPA Inventory for 2005-2030; 2021 preliminary emissions estimate assumes total net emissions change in proportion to 6.7% year-on-year change in CO2 emissions from energy and industrial processes estimated by Global Carbon Monitor.

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 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.

Annual Change in Net U.S. Greenhouse Gas Emissions Relative to No IRA (Bipartisan Infrastructure Law Only)

million metric tons CO_2-equivalent (Mt CO_2-e)[1]



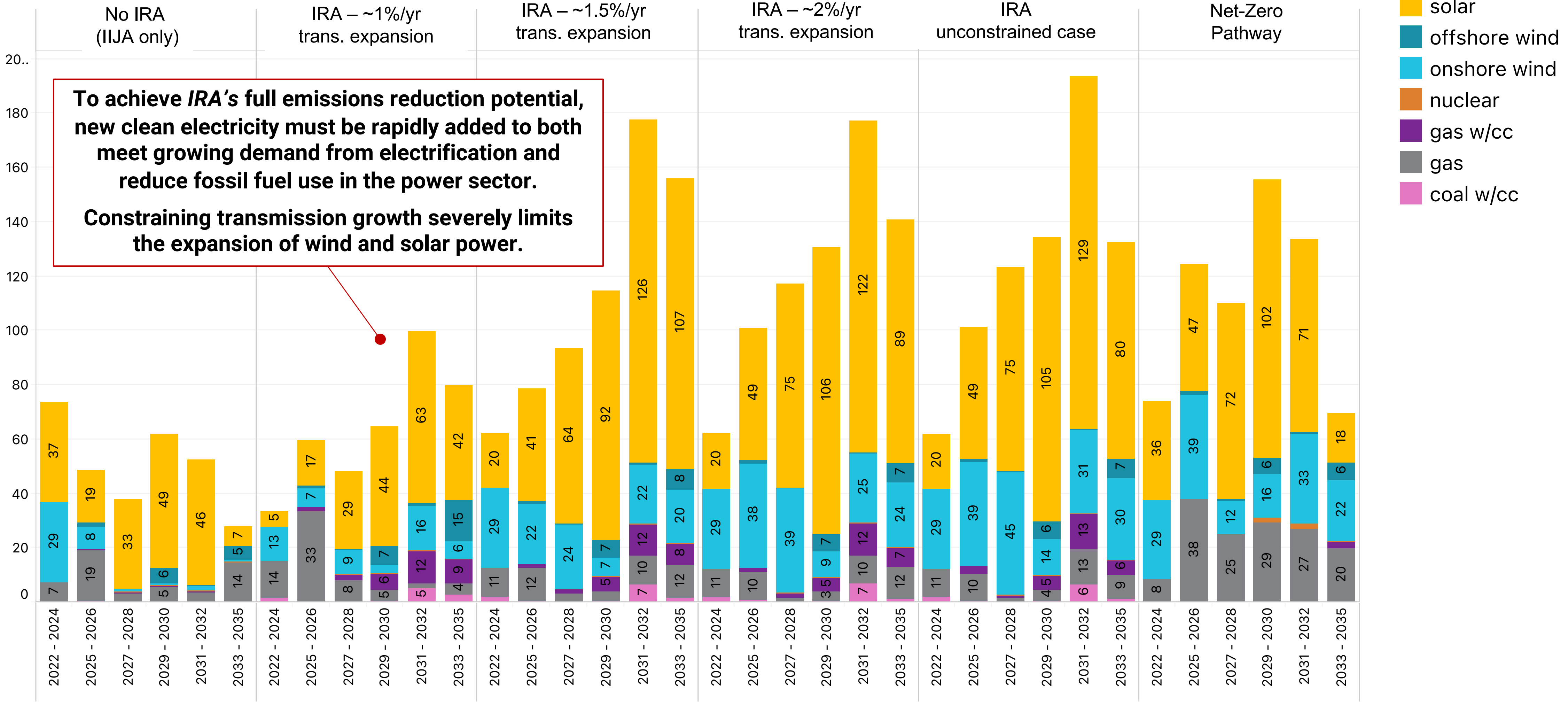
Notes:

1 - CO_2.equivalent emissions calculations use IPCC AR4 100 year global warming potential as per EPA Inventory of Greenhouse Gas Emissions and Sinks.

All values should be regarded as approximate given uncertainty in future outcomes. Results rounded to nearest 10 Mt CO2-e. See additional notes on prior page.

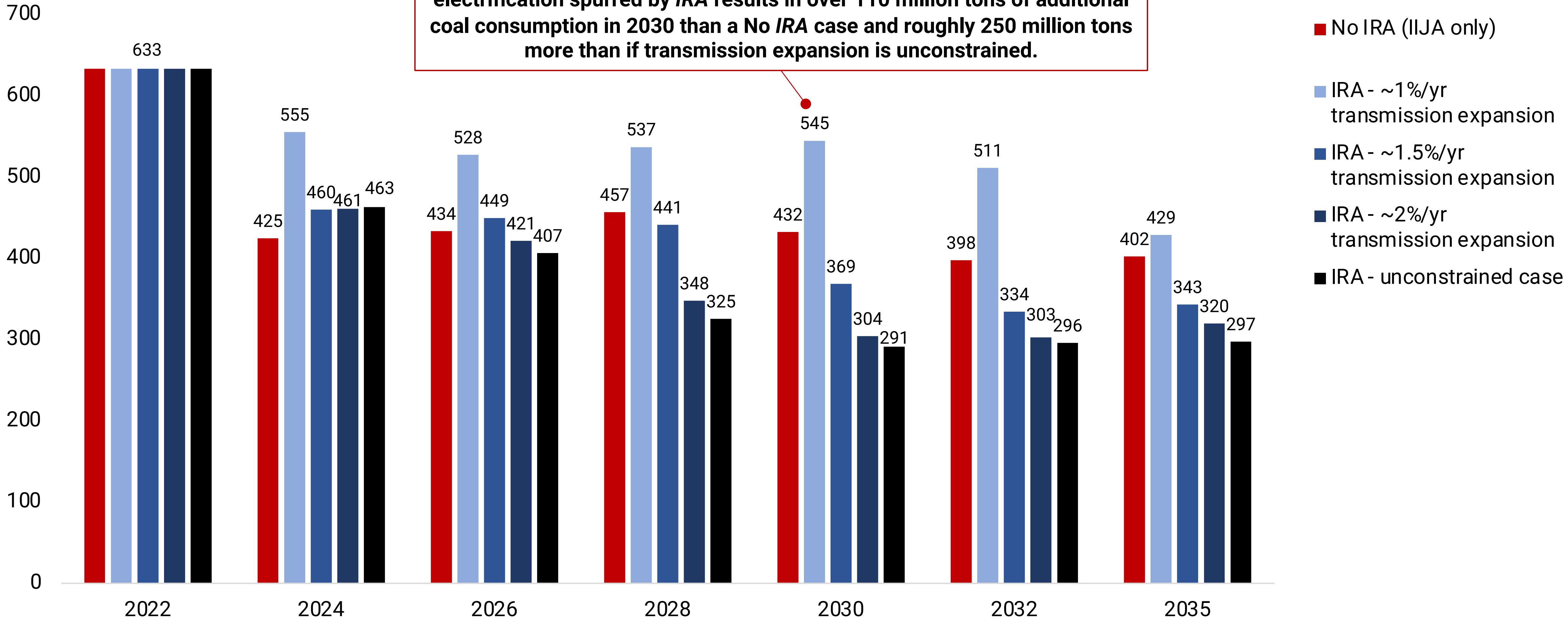
Annual Average Capacity Additions

gigawatts



U.S. Coal Consumption
million short tons per year

If transmission cannot be expanded faster than recent historical rates (~1%/year), growing demand from electric vehicles and other electrification spurred by *IRA* results in over 110 million tons of additional coal consumption in 2030 than a No *IRA* case and roughly 250 million tons more than if transmission expansion is unconstrained.

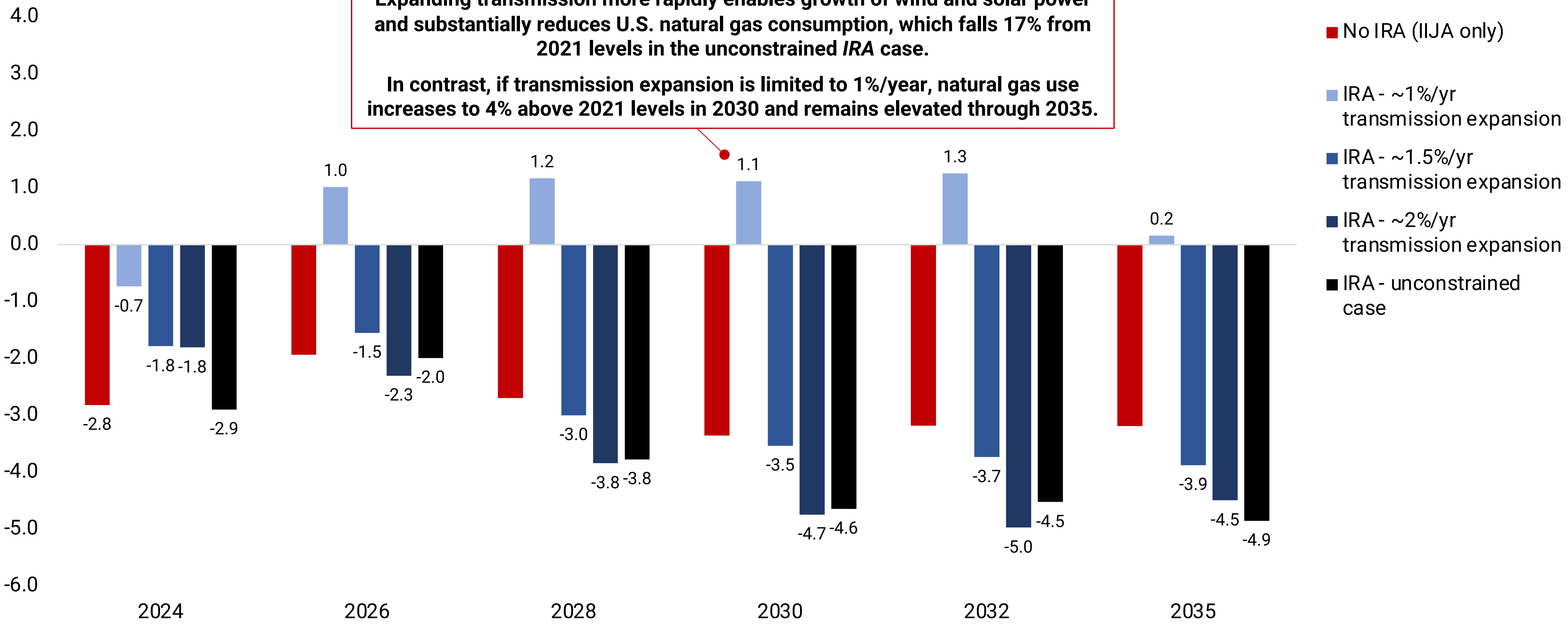


Change in U.S. Natural Gas Consumption vs 2021

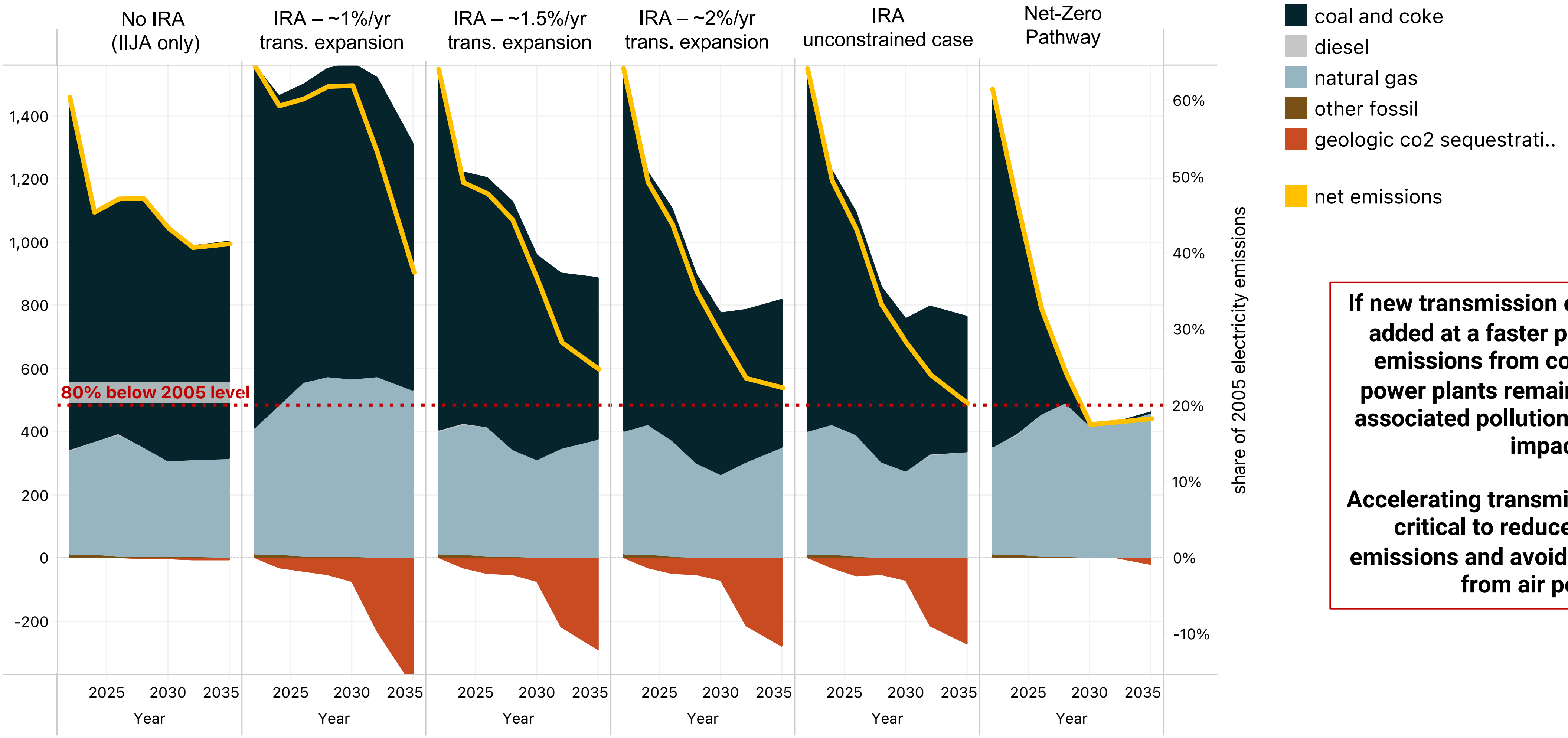
trillion cubic feet per year

Expanding transmission more rapidly enables growth of wind and solar power and substantially reduces U.S. natural gas consumption, which falls 17% from 2021 levels in the unconstrained *IRA* case.

In contrast, if transmission expansion is limited to 1%/year, natural gas use increases to 4% above 2021 levels in 2030 and remains elevated through 2035.



Power Sector Annual CO_2 Emissions
million metric tons

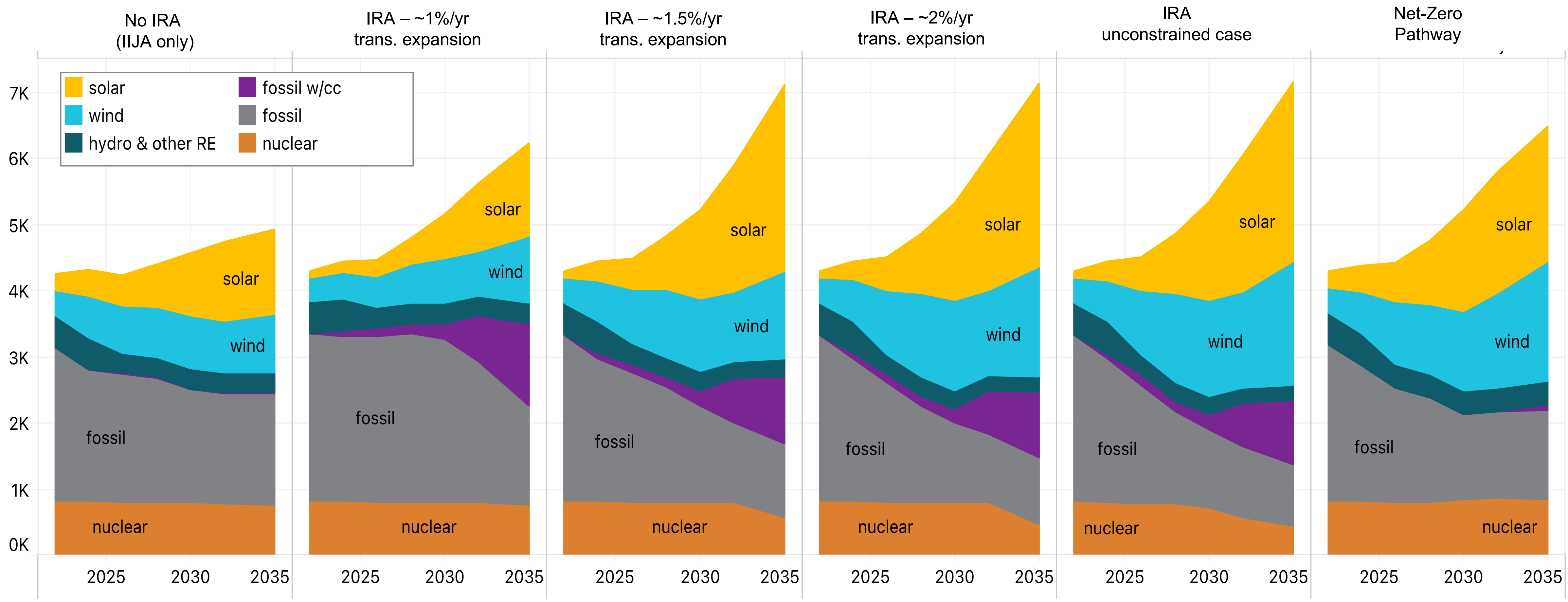


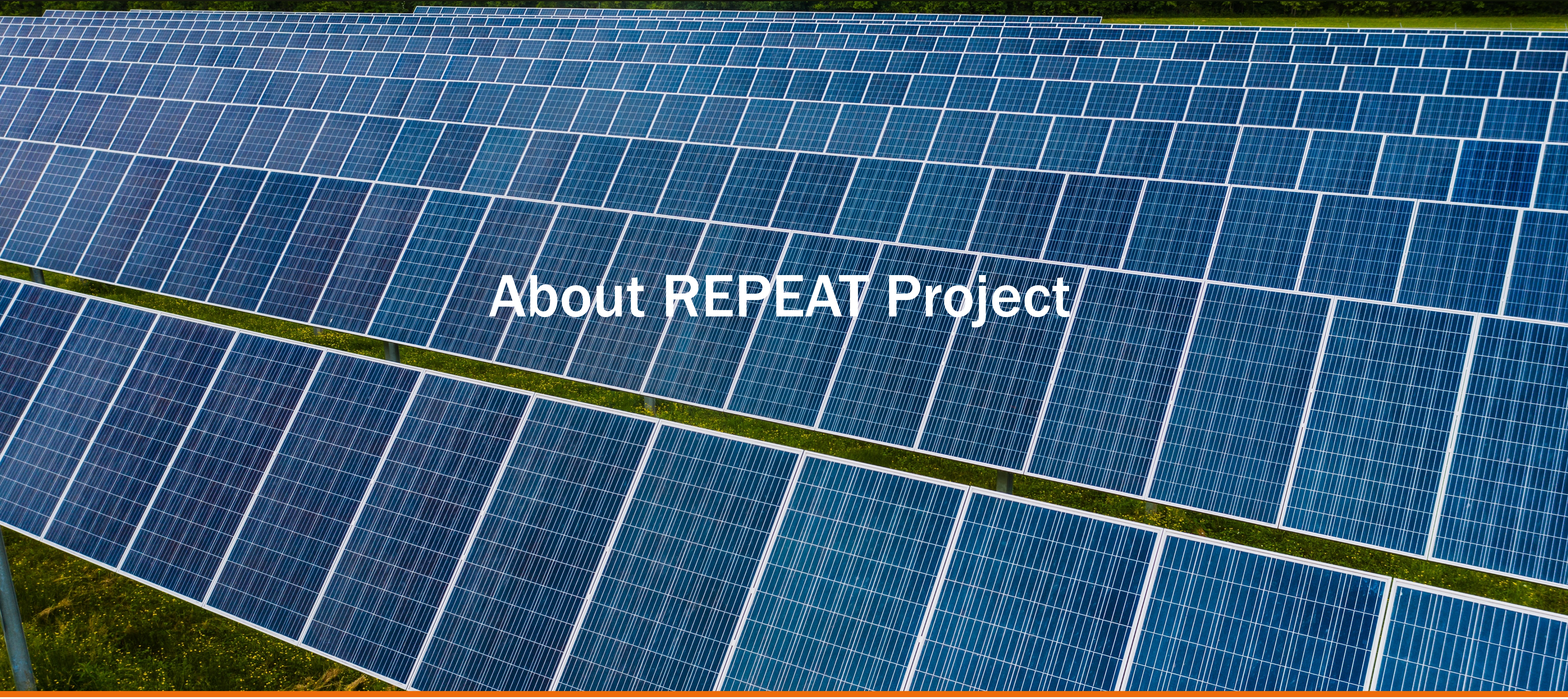
If new transmission capacity cannot be added at a faster pace, greenhouse emissions from coal and gas-fired power plants remain high, along with associated pollution and public health impacts.

Accelerating transmission expansion is critical to reduce power sector emissions and avoid premature deaths from air pollution.

Electricity Generation

terawatt-hours (TWh)





About REPEAT Project

A New Toolkit for Evaluating Energy and Climate Policy

The **REPEAT Project** provides regular, timely and independent environmental and economic evaluation of federal energy and climate policies as they're proposed and enacted, offering a detailed look at the United States' evolving energy and climate policy environment and the country's progress on the road to net-zero greenhouse gas emissions.

Approach: employ geospatial planning and analysis tools coupled with detailed macro-energy system optimization models to **rapidly evaluate federal policy and regulatory proposals at politically-relevant spatial resolutions** (e.g., state, county, and finer resolutions). A refinement of methods used in the Princeton *Net-Zero America* study.

Goal: provide independent, timely, and credible information and analysis for broad educational purposes, including as a resource available publicly for stakeholders, decision-makers, and the media.

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

The REPEAT Team

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Binghamton University: Prof. Neha Patankar;

Evolved Energy Research: Ryan Jones, Jamil Farbes (macro-energy systems modeling)

Carbon Impact Consulting: Greg Schivley (scenario inputs, transmission interconnection routing, etc.)

Montara Mountain Energy: Emily Leslie, Andrew Pascale (renewable energy candidate project areas, transmission cost surface).

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