

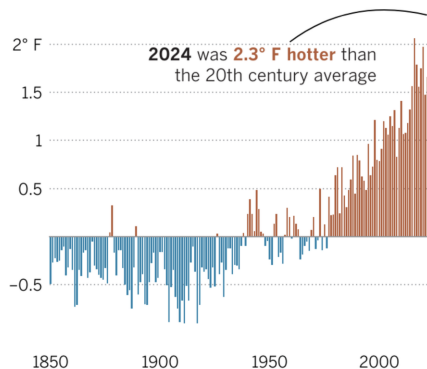
# ***THE DISTRIBUTIONAL EFFECTS OF US TAX CREDITS FOR HEAT PUMPS, SOLAR PANELS, AND ELECTRIC VEHICLES***

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*National Tax Journal*, volume 78, number 1, March 2025.

# Warmest year on record

Deviation from the 1901-2000 average



## Earth Surpasses 1.5 Degrees C in Hottest Year on Record

The year 2024 was the hottest on record and the first to top 1.5 degrees Celsius of warming. All 10 of the hottest years have been in the past decade

# Motivation

- ▶ Economists nearly universally agree that pricing greenhouse gases directly would be the most efficient approach to reduce emissions.
- ▶ Instead, the dominant approach, particularly in the United States, has been to subsidize clean energy technologies.
- ▶ This paper focuses on U.S. tax credits for heat pumps, solar panels, and electric vehicles (EVs).

# Research Questions

- ▶ Who receives U.S. clean energy tax credits?
  - ▶ What is the distribution across income levels?
  - ▶ How has this changed over time (2006-2021)?
- ▶ Have tax credits increased adoption of these technologies?

# Summary of Results

- ▶ Clean energy tax credits 2006-2021 provided \$47+ billion in subsidies to U.S. households.
- ▶ The bottom three income quintiles received 10% of all credits, while the top quintile received 60%.
- ▶ The most extreme is the tax credit for EVs, for which the top quintile received 80%+.
- ▶ The concentration among high-income filers is relatively constant over time, with a slight broadening of the EV credit since 2018.

# Related Literature

## ► Previous Studies of Clean Energy Tax Credits

(Crandall-Hollick and Sherlock, 2014; Neveu and Sherlock, 2016; Borenstein and Davis, 2016; Coyne and Globus-Harris, 2024)

## ► Distributional Effects of Environmental Policy

gas taxes (Poterba, 1991; Bento et al., 2009; Glaeser et al., 2023) carbon taxes (Metcalf, 1999; Williams et al., 2015; Goulder et al., 2019), cap-and-trade (Dinan and Rogers, 2002; Burtraw et al., 2009)

## ► Economic Incidence of Clean Energy Subsidies

(Sallee, 2011; Gulati et al., 2017; Pless and Van Benthem, 2019; Barwick et al., 2023)

## ► Distributional Effects of Other Tax Expenditures

(Poterba and Sinai, 2011; Bulman and Hoxby, 2015; Linos et al., 2022; Congressional Budget Office, 2021)

# Clean Energy Tax Credits

Tax credits available to households through the federal income tax system

In the paper, we describe the technologies that are included, eligibility requirements, maximum credit amounts, and important changes over time.

These are tax credits (not deductions) so a filer does not need to itemize, but are **nonrefundable** so require a filer to have positive tax liability

| Form 1040 (2023)       |           |                                                                                                                                                                               |           |  |  |  |  |  |  | Page <b>2</b> |  |
|------------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--|--|--|--|--|--|---------------|--|
| <b>Tax and Credits</b> | <b>16</b> | <b>Tax</b> (see instructions). Check if any from Form(s): 1 <input type="checkbox"/> 8814 2 <input type="checkbox"/> 4972 3 <input type="checkbox"/> <input type="checkbox"/> | <b>16</b> |  |  |  |  |  |  |               |  |
|                        | <b>17</b> | Amount from Schedule 2, line 3                                                                                                                                                | <b>17</b> |  |  |  |  |  |  |               |  |
|                        | <b>18</b> | Add lines 16 and 17                                                                                                                                                           | <b>18</b> |  |  |  |  |  |  |               |  |
|                        | <b>19</b> | Child tax credit or credit for other dependents from Schedule 8812                                                                                                            | <b>19</b> |  |  |  |  |  |  |               |  |
|                        | <b>20</b> | Amount from Schedule 3, line 8                                                                                                                                                | <b>20</b> |  |  |  |  |  |  |               |  |
|                        | <b>21</b> | Add lines 19 and 20                                                                                                                                                           | <b>21</b> |  |  |  |  |  |  |               |  |
|                        | <b>22</b> | Subtract line 21 from line 18. If zero or less, enter -0-                                                                                                                     | <b>22</b> |  |  |  |  |  |  |               |  |
|                        | <b>23</b> | Other taxes, including self-employment tax, from Schedule 2, line 21                                                                                                          | <b>23</b> |  |  |  |  |  |  |               |  |
|                        | <b>24</b> | Add lines 22 and 23. This is your <b>total tax</b>                                                                                                                            | <b>24</b> |  |  |  |  |  |  |               |  |

# Heat Pumps

- ▶ “Section 25C” credits include heat pumps, as well as a whole set of other energy-efficiency investments
- ▶ Qualified roofs (23%), ceiling and wall insulation (21%), energy-efficient doors (14%) and energy-efficient windows and skylights (13%)
- ▶ Most years has been a 10% credit, some variation across years; IRA increased it to 30%, with maximum credit for heat pumps increasing from \$300 to \$2000



# Residential Solar

- ▶ “Section 25D” credits include residential solar and other home renewables
- ▶ 89% for residential solar, 4% for solar water heating systems, 4% for geothermal heat pumps, 1% for small wind projects, and 1% for fuel cell property costs
- ▶ Most years has been a 30% credit, some variation across years; originally was a \$2,000 cap but this was removed in 2009; extended by IRA



# Electric Vehicles

- ▶ “Section 30D” credits for all-electric and plug-in hybrid vehicles
- ▶ Available since 2010, \$7500 for most vehicles
- ▶ Odd phase out when a manufacturer sold 200,000 vehicles
- ▶ Completely revamped by IRA with domestic content requirements and other changes



President Barack Obama and a Chevrolet Volt in 2010. PHOTO: SAUL LOEB/AGENCE FRANCE-PRESSE/GETTY IMAGES

# Data

## Internal Revenue Service

- ▶ *Statistics of Income* "Individual Income Tax Returns Complete Report (Publication 1304)", 2006-2021.
- ▶ *Statistics of Income* "Individual Income Tax Returns: Line Item Estimates (Publication 4801)", 2006-2021.

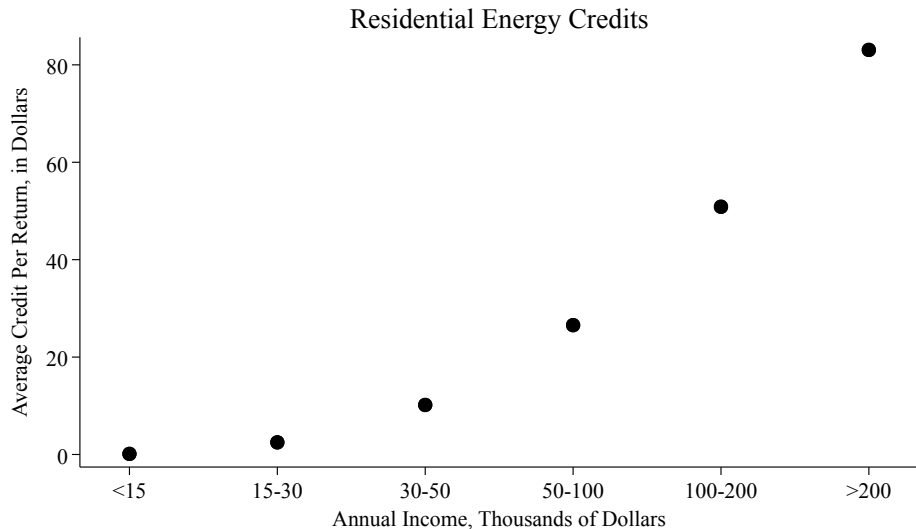
Important Caveat: These data do not reflect leases.



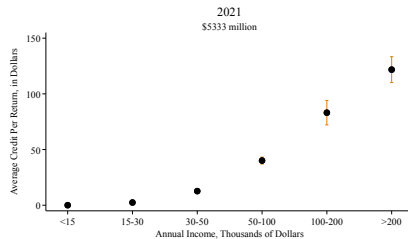
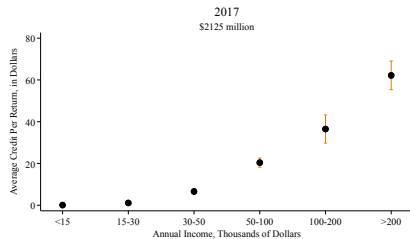
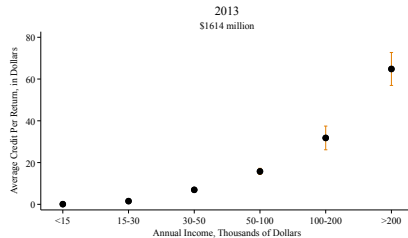
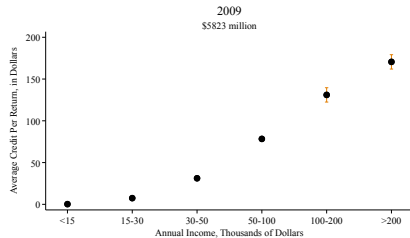
**Table:** Annual Expenditures on U.S. Clean Energy Tax Credits, in Millions

| Year         | Windows and Other<br>Energy-Efficiency<br>Investments<br>(NEPC 25C) | Residential Solar and<br>Other Residential<br>Renewables<br>(REEPC 25D) | Qualified Plug-In<br>Electric Vehicle<br>Credit<br>(PEDVC 30D) |
|--------------|---------------------------------------------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------------|
| 2005         | 0                                                                   | 0                                                                       | 0                                                              |
| 2006         | 957                                                                 | 43                                                                      | 0                                                              |
| 2007         | 938                                                                 | 69                                                                      | 0                                                              |
| 2008         | 0                                                                   | 217                                                                     | 0                                                              |
| 2009         | 5,177                                                               | 645                                                                     | 129                                                            |
| 2010         | 5,420                                                               | 754                                                                     | 1                                                              |
| 2011         | 755                                                                 | 921                                                                     | 76                                                             |
| 2012         | 449                                                                 | 818                                                                     | 139                                                            |
| 2013         | 622                                                                 | 992                                                                     | 231                                                            |
| 2014         | 518                                                                 | 1,120                                                                   | 263                                                            |
| 2015         | 517                                                                 | 1,570                                                                   | 252                                                            |
| 2016         | 513                                                                 | 1,823                                                                   | 375                                                            |
| 2017         | 248                                                                 | 1,877                                                                   | 537                                                            |
| 2018         | 0                                                                   | 2,512                                                                   | 1,541                                                          |
| 2019         | 331                                                                 | 3,176                                                                   | 643                                                            |
| 2020         | 406                                                                 | 3,469                                                                   | 313                                                            |
| 2021         | 446                                                                 | 4,886                                                                   | 1,037                                                          |
| <b>Total</b> | <b>17,297</b>                                                       | <b>24,892</b>                                                           | <b>5,537</b>                                                   |

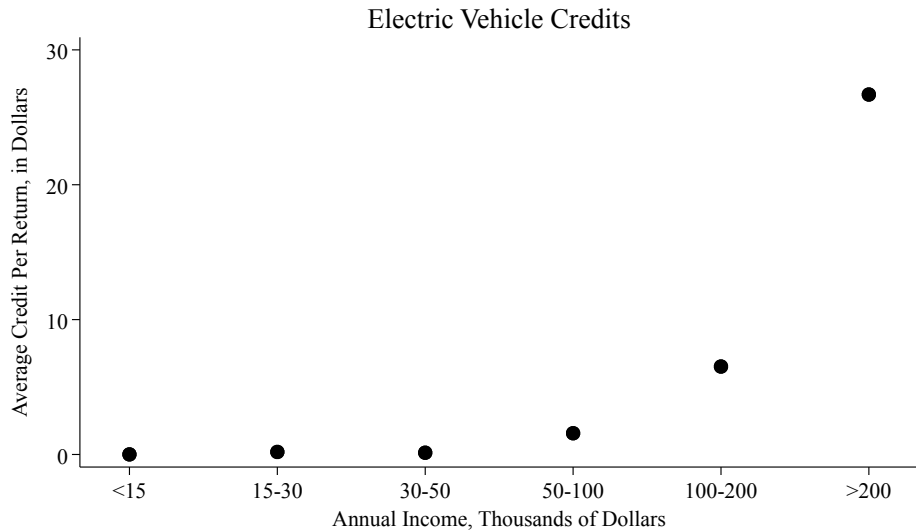
# Average Credit by AGI, 2006-2021



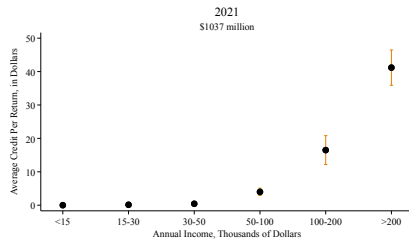
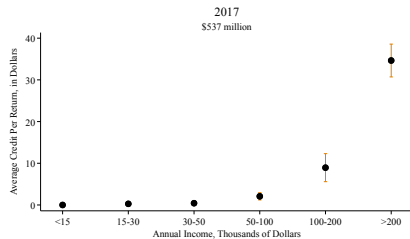
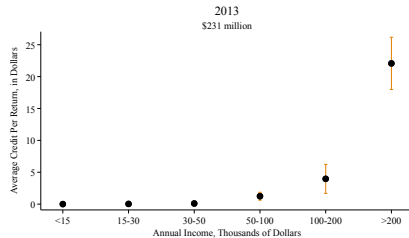
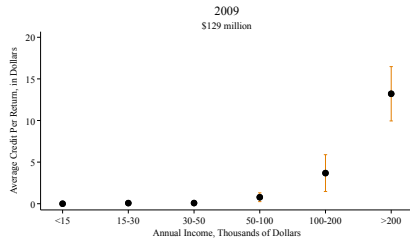
# Residential Energy Credit by AGI, Selected Years



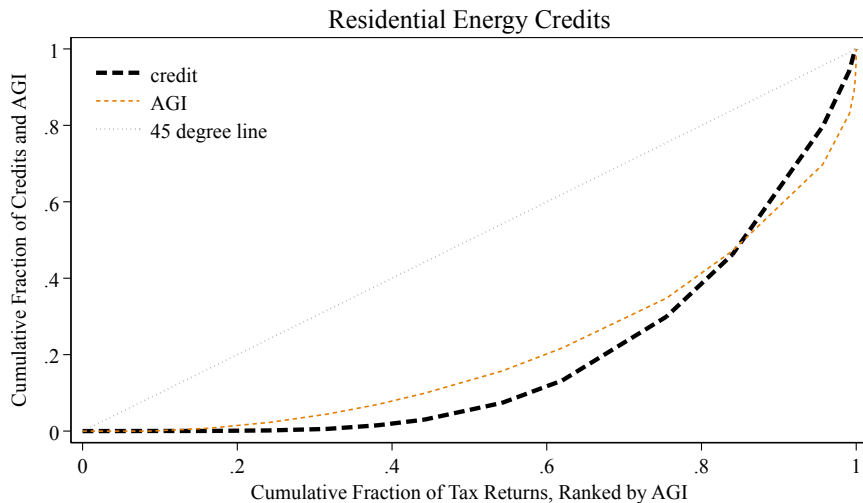
# Average Credit by AGI, 2009-2021



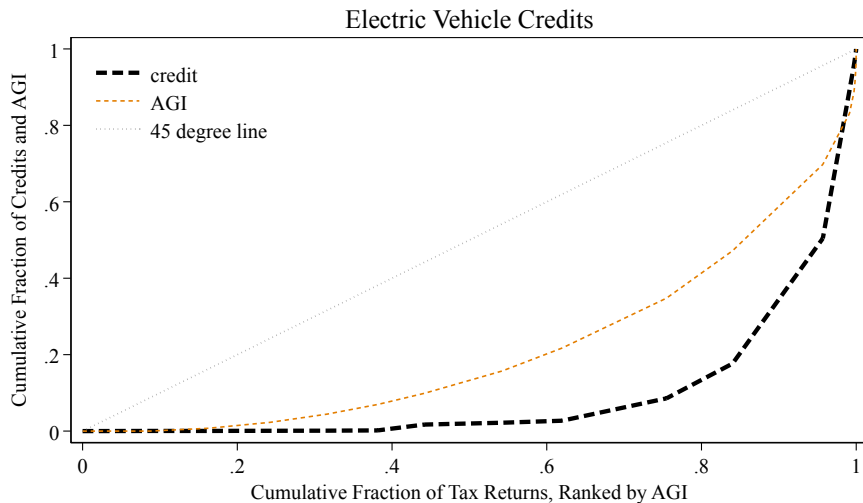
## Electric Vehicle Credit by AGI, Selected Years



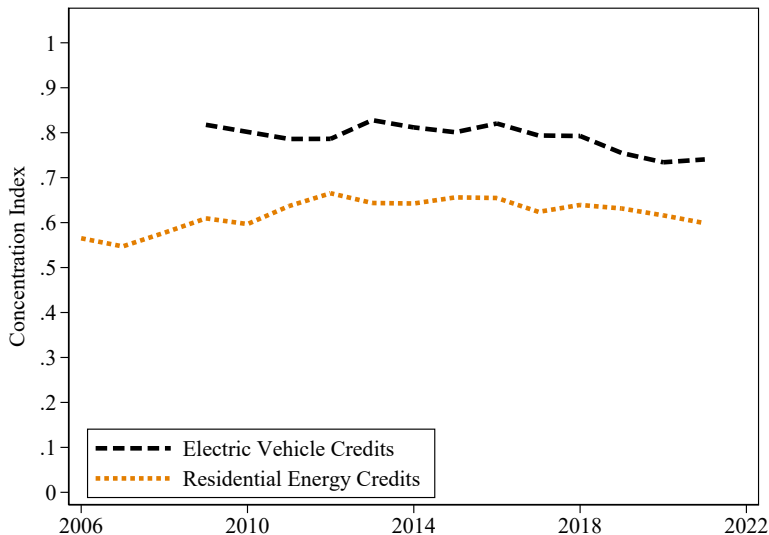
# Concentration Curves



# Concentration Curves



# Concentration Index By Year



# Wrap Up Distributional Analysis

- ▶ U.S. clean energy tax credits go predominantly to high-income households
- ▶ Little evidence that this is changing as these markets have matured
  - ▶ Part of the explanation is that all these credits are non-refundable
  - ▶ Another part of the explanation is that these credits mostly exclude renters

# Critics Have Long Been Concerned about Additionality

*“The tax credit does not motivate, but rather simply occurs at the end of the year when the fellow finds out there was a tax credit available.”*

– U.S. Congressman Bill Frenzel in 1979



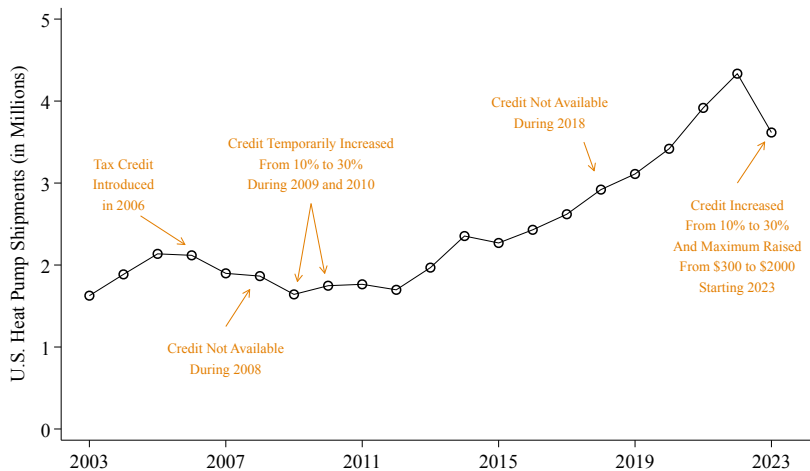
# Data

## National-Level Annual Data on Adoption

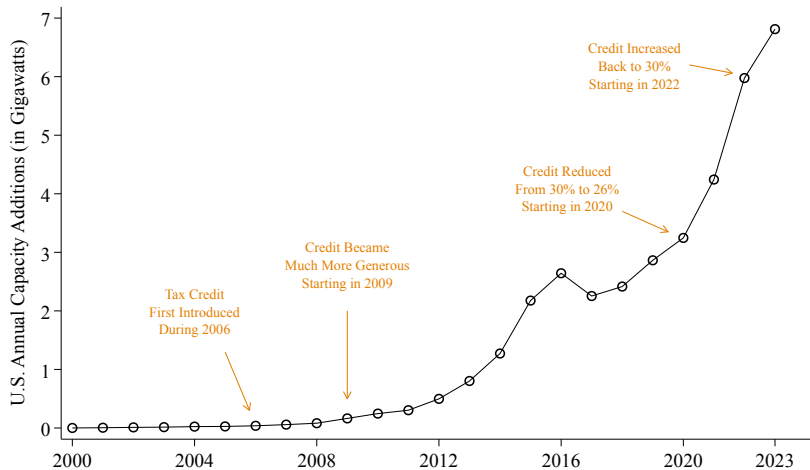
- ▶ U.S. heat pump shipments from the Air Conditioning, Heating, and Refrigeration Institute (AHRI).
- ▶ U.S. residential solar annual capacity from the Solar Energy Industries Association (SEIA), "Solar Market Insight Report".
- ▶ U.S. electric vehicle sales from Argonne National Laboratory, "Light Duty Electric Drive Vehicles Monthly Sales Updates".



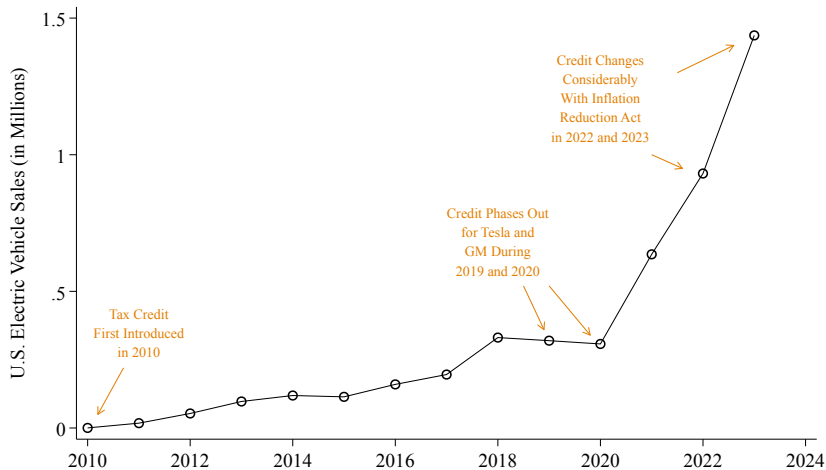
# Do Tax Credits Matter for Heat Pump Adoption?



# Do Tax Credits Matter for Residential Solar Installations?



# Do Tax Credits Matter for Electric Vehicle Sales?



# Wrap Up Additionality

- ▶ The cost effectiveness of subsidies hinges on their ability to change household behavior, yet we find little correlation overall between tax credits and adoption.
- ▶ For heat pumps, in particular, it is hard to see any discernible impact from past changes in the availability of the tax credit.
- ▶ It seems likely that many tax credit recipients would have taken these actions even in the absence of the tax credit.

# Conclusion

- ▶ It is hard not to be a bit disappointed that the U.S. is leaning so heavily into “subsidize green” rather than “tax brown”.
- ▶ This approach comes at a high cost in terms of both efficiency and equity.
- ▶ Pricing externalities directly, in contrast, would motivate a much broader range of behavioral responses while also generating revenue that could be used progressively.

# Conclusion



# Postscript

## The New York Times

### *Trump Wants to Kill the E.V. Tax Credit. Here's What to Know.*

President-elect Donald J. Trump wants Congress to repeal a \$7,500 electric vehicle tax credit. Doing so would hurt American automakers.

“They’re going to move fairly quickly, I’m told,” said Thomas J. Pyle, president of the American Energy Alliance, a conservative energy research group, of Republicans. He predicted a “monster” budget bill that will aim to cut the electric vehicle tax credits as well as subsidies for wind, solar and other clean energy in order to make way for Mr. Trump’s next round of tax cuts.

# Postscript

## The New York Times

### *The Republicans Pushing Trump to Save Biden's Clean Energy Tax Credits*

Despite President Trump's rollback of climate policy, some Republicans and business leaders say clean energy can help his "energy dominance" agenda.



By David Gelles

March 17, 2025

A growing group of Republicans and business leaders is rallying behind an unlikely cause. They want to protect Biden-era tax credits for wind, solar and other clean energy.

# Postscript

