

The Political Economy of EVs

and what that means for the EV outlook

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RSQE

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THE SALATA INSTITUTE
FOR CLIMATE AND SUSTAINABILITY
at Harvard University

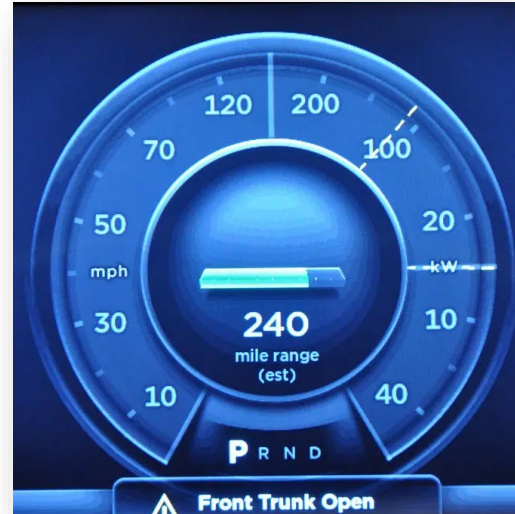
Why I'm an optimist on the EV market

Consumers are open to EVs as long as they don't have to give anything up

Similar Pricing to ICE



Long Range



Ubiquitous, Easy Charging



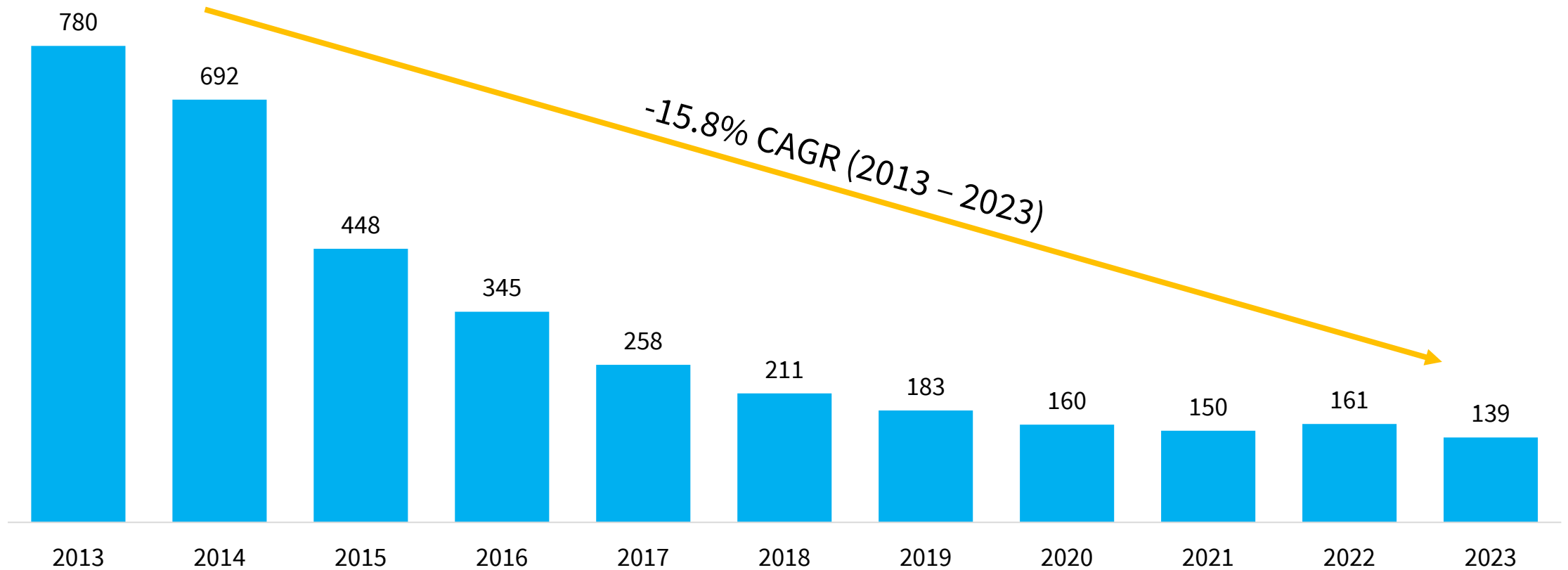
Choices of Styles, Sizes, and Shapes



And EVs are becoming closer substitutes for ICE.

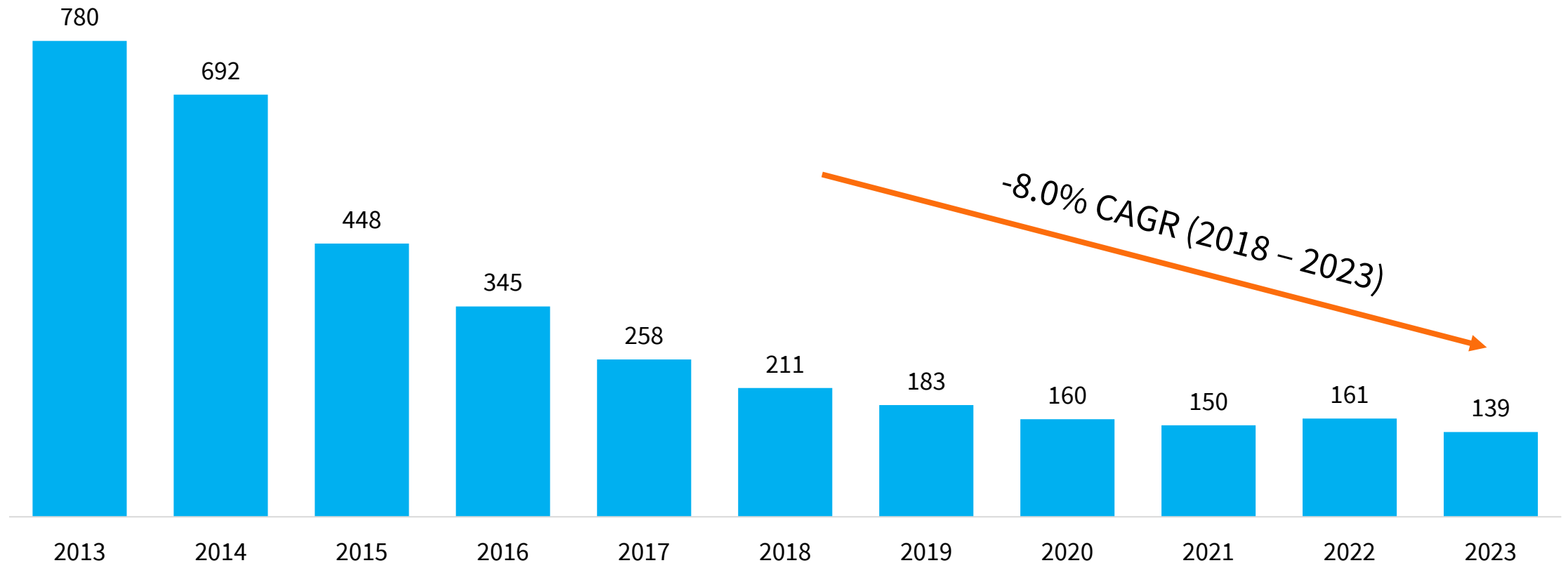
Battery costs keep falling, enabling longer range EVs and lowering price

Lithium-ion battery pack price (real 2023 \$)



Battery costs keep falling, but more slowly the last 5 years

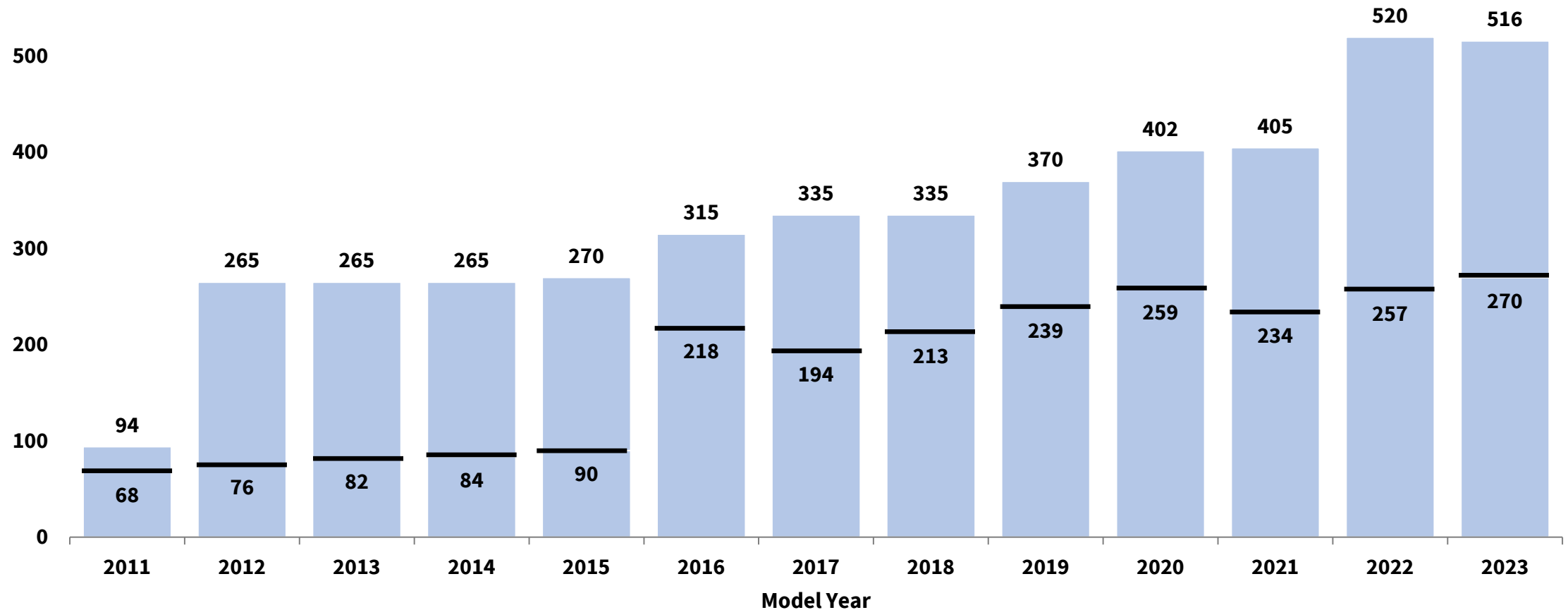
Lithium-ion battery pack price (real 2023 \$)



Range keeps improving

MY2023: Median range 270 miles, max 516 miles on a single charge

Median and Max. Range (Miles), EVs in the U.S. Market, Model Years 2011-23



EVs are fun to drive...Ask *Car and Driver*

“If you’re the type of driver who loves to push down hard on the right pedal, you’ll like driving an EV. Thanks to the nature of the electric motors—with their plentiful low-rpm torque and instant throttle response—even lower-powered electric vehicles are lively. Many mainstream EVs are muscle-car quick, and there are a host of mega-power performance EVs that will squash you into the seatback and blur your vision with their ability to pull off brutal launches.”





Charging is a problem.

J.D. Power:
Charging
worries hold
buyers back
from EVs

PERCEPTION IS REALITY

TOP REASONS SHOPPERS REJECT EVS

1 Lack Of Charging Station Availability



2^{TIE} Vehicle Purchase Price



2^{TIE} Limited Driving Distance Per Charge



4 Time Required To Charge



5 Inability To Charge At Home Or Work



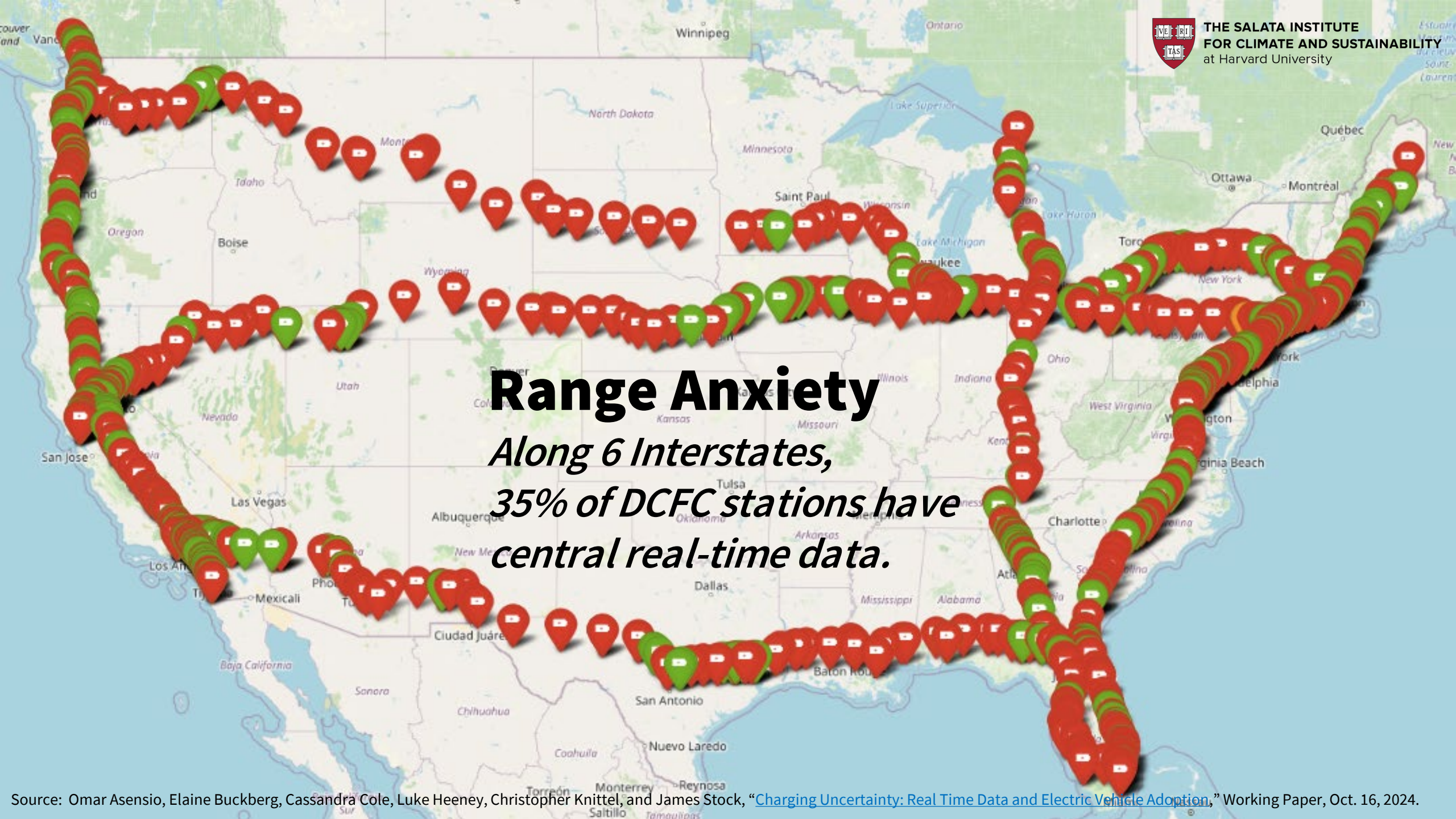
Source: J.D. Power EV Consideration (EVC) Study - August, National

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Range Anxiety
*Along 6 Interstates,
35% of DCFC stations have
central real-time data.*

What happens to EV policy?

EV manufacturing political geography is red.

Biden Administration used carrots and sticks for EV adoption

What will survive the Trump Administration?

CARROTS

IRA

Clean vehicle tax credits

Production tax credits for U.S. critical mineral processing and battery production

Grants to support transitioning auto supplier facilities from ICE to EV

Business tax credit for installing EV chargers

BIL

\$7.5B for EV charging infrastructure, both investment and operation.

STICKS

Substantial tightening of fuel economy (CAFE) and greenhouse gas (GHG) regulations

DoE to cut EVs' fuel economy equivalent rating

Higher penalties for not meeting CAFE standards

SAND IN THE WHEELS

Tariffs on imports from China:

EV imports: 100%

Lithium-ion EV batteries: 25%

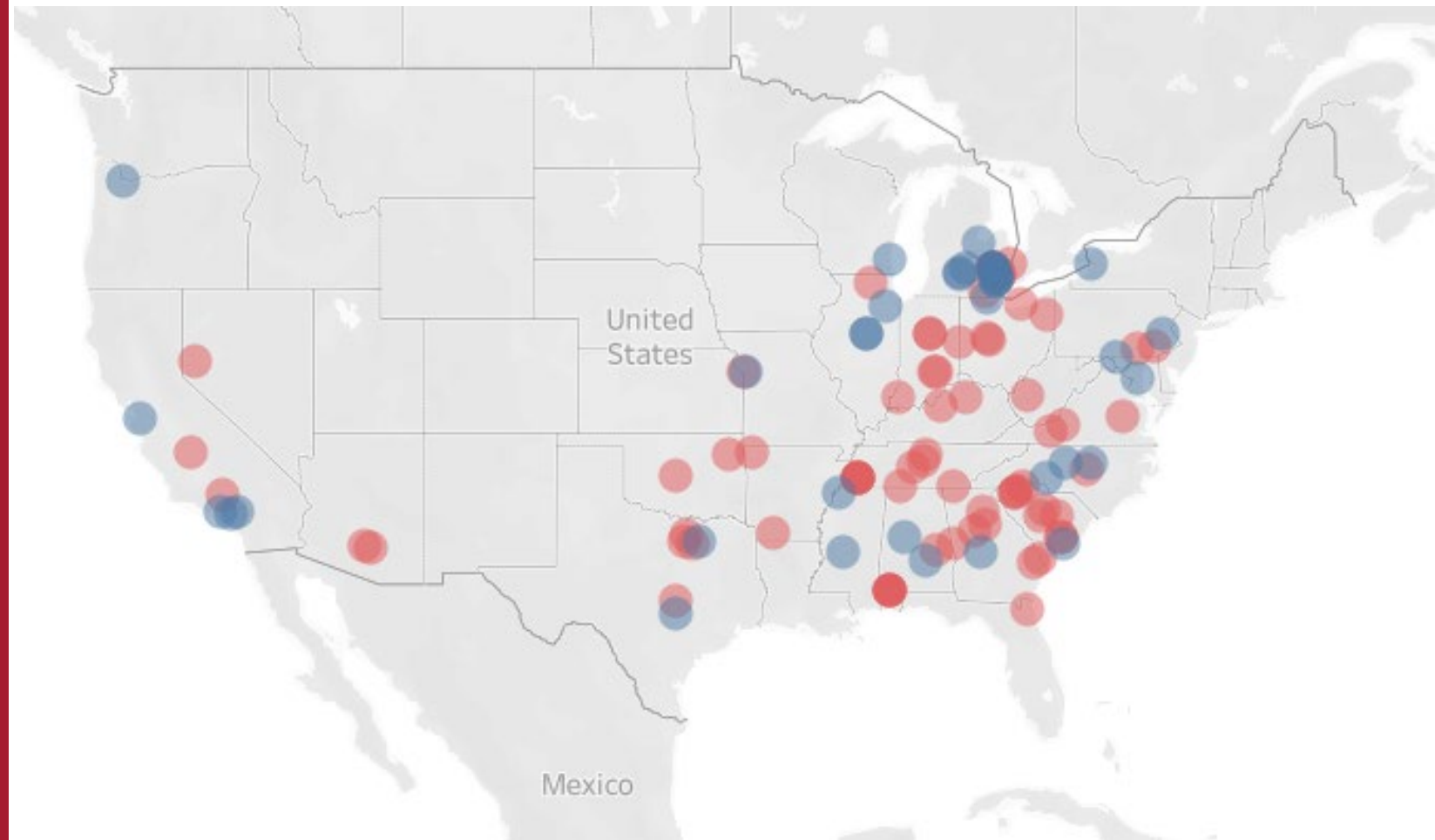
Domestic EV investment boom started pre-IRA

Announced since IRA to
10/16/24:

54 new projects

44K new jobs

\$26B in investments

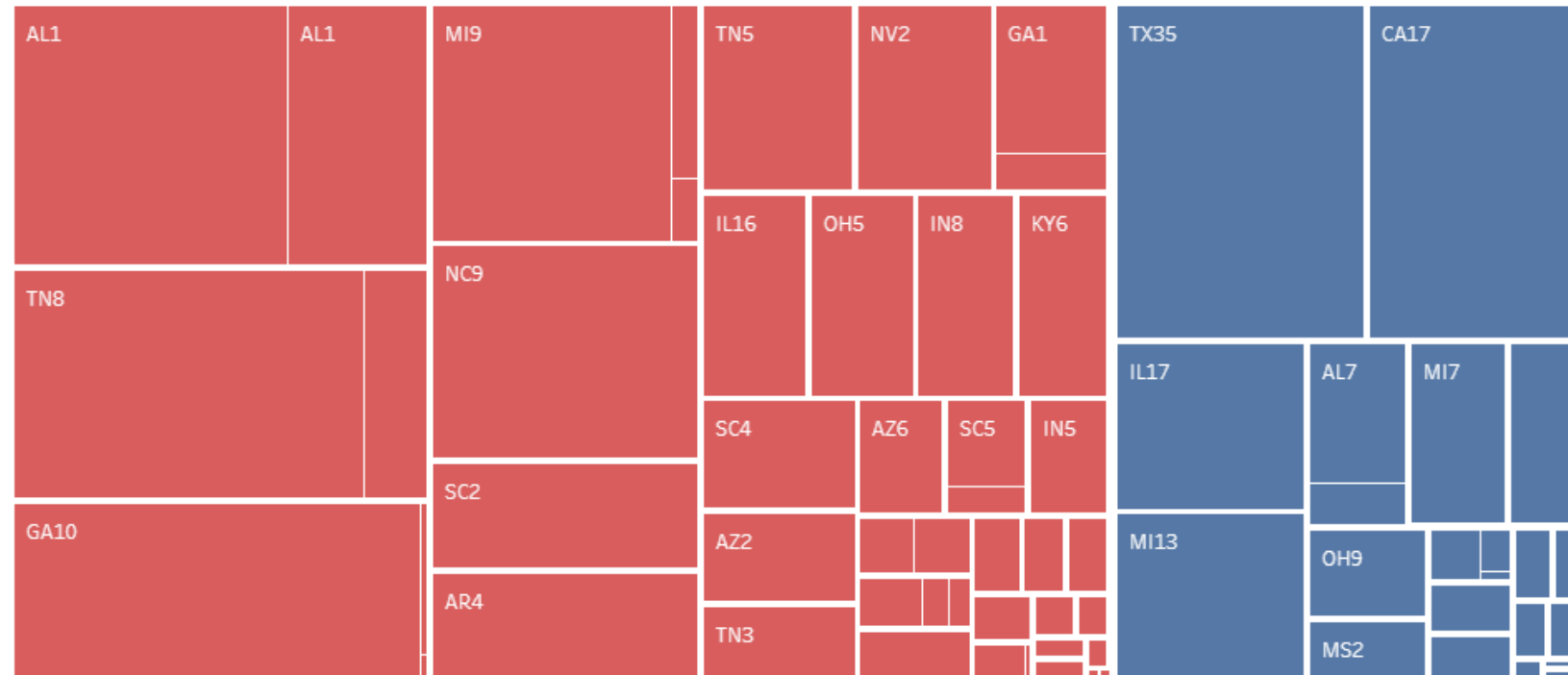


Red: Republican Rep. in Congress **Blue:** Democrat in Congress

**63% of EV investments
are in districts now
represented by
Republicans**

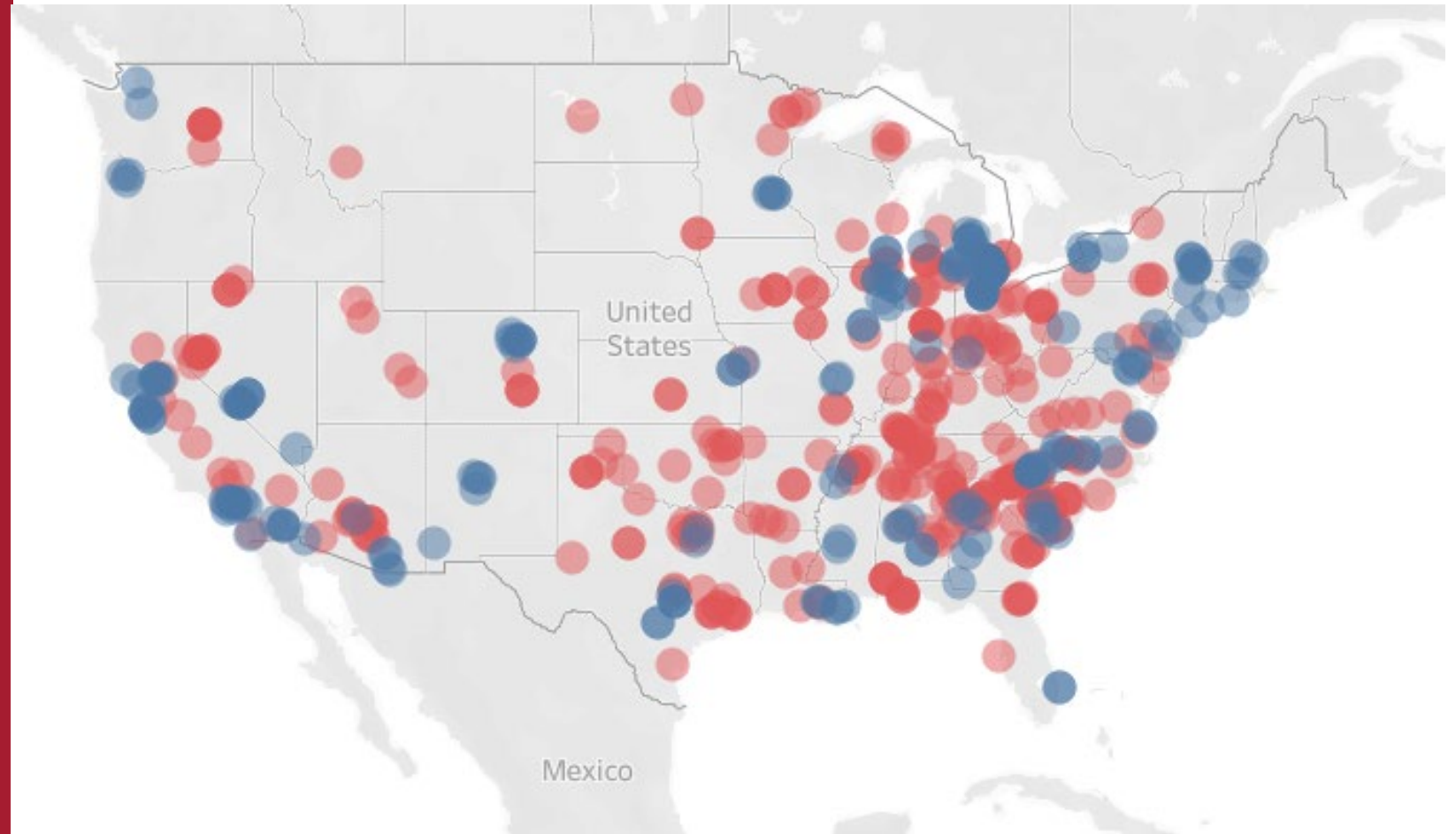
**Republican: \$36.2B
Democrat: \$21.5B**

US clean energy supply chain investments by US congressional district:



The battery boom is even larger

Announced since IRA to
10/16/24:
132 new projects
66K new jobs
\$107B in investments

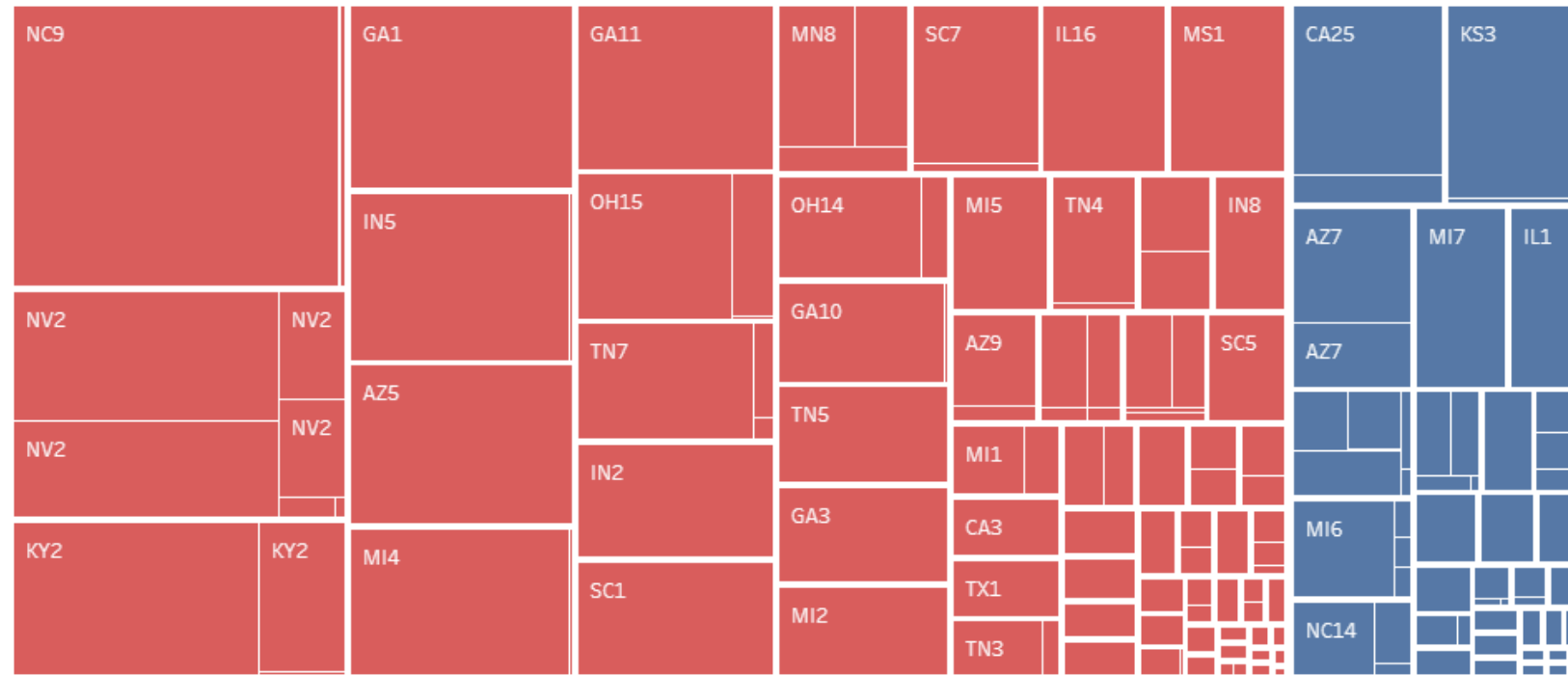


Red: Republican Rep. in Congress **Blue:** Democrat in Congress

**83% of battery
investments are in
districts now
represented by
Republicans**

**Republican: \$114.2B
Democrat: \$24.1B**

US clean energy supply chain investments by US congressional district:



What does Elon Musk want?

Model 3, X, Y all eligible for \$7,500 EV tax credit.¹

Tesla receives IRA production tax credits for U.S. battery production and is launching U.S. critical mineral processing.²

Tesla gets IRA's business tax credit for installing its stations.

Tesla has contracts with at least 10 states to install IIJA NEVI chargers.³



Sources: [Fueleconomy.gov](https://www.fueleconomy.gov); [CNN.com](https://www.cnn.com) citing [EVAdoption](https://www.electrek.com); [Tesla.com](https://www.tesla.com); New York Times (image), BBC (image).

1. Of 15 MY2024-25 BEVs eligible for the credit, Tesla has 3 of 12 getting the full \$7,500; another 3 get \$3,750. Six PHEVs get the credit, all but one getting \$3,750.
2. [Tesla.com/manufacturing](https://www.tesla.com/manufacturing): Battery production at Fremont, CA Factory, Gigafactory Nevada, Gigafactory Texas, Kato Factory. 3. 14% of total awards, as of May 2024. <https://www.tesla.com/blog/tesla-lithium-refinery-groundbreaking>

Urban Myth: Making an EV involves fewer jobs

~~**Urban Myth: Making an EV
involves fewer jobs**~~

**Making EVs takes at least as many
jobs as making ICE vehicles**

Making an EV takes comparable labor as making an ICEV: All-in, including assembly and supply chain

Myth: Because EVs have fewer parts than ICEV, they take less labor to make.

Truth:

Assembly labor is comparable because you need to consider the **complexity** of tasks, not just the number.

And you need to consider supply chain labor.

Myth: Because EVs don't have complex powertrains, they are simpler to make.

Truth:

New jobs in EV manufacturing involve battery, drive units, cooling systems, and additional electric monitoring.

These **new EV propulsion jobs offset or exceed eliminated jobs** in engine and transmission manufacturing.

BCG:

“[T]he labor requirements for assembling BEVs and ICEVs are comparable.”

University of Michigan faculty:

“...labor intensity has increased at U.S. vehicle assembly plants that have fully transitioned to assembling battery electric vehicles.”

CMU engineering faculty:

“[L]abor intensity of BEV powertrains ranges from a slight increase relative to ICEV power trains to more than double the labor intensity”

“...the very large majority ... of estimated labor hours ... are used in battery production.”

Sources: Daniel Küpper, Kristian Kuhlmann, Kazutoshi Tominaga, Aakash Agora, and Jan Schlageter, “[Shifting Gears in Auto Manufacturing](#),” September 2020.

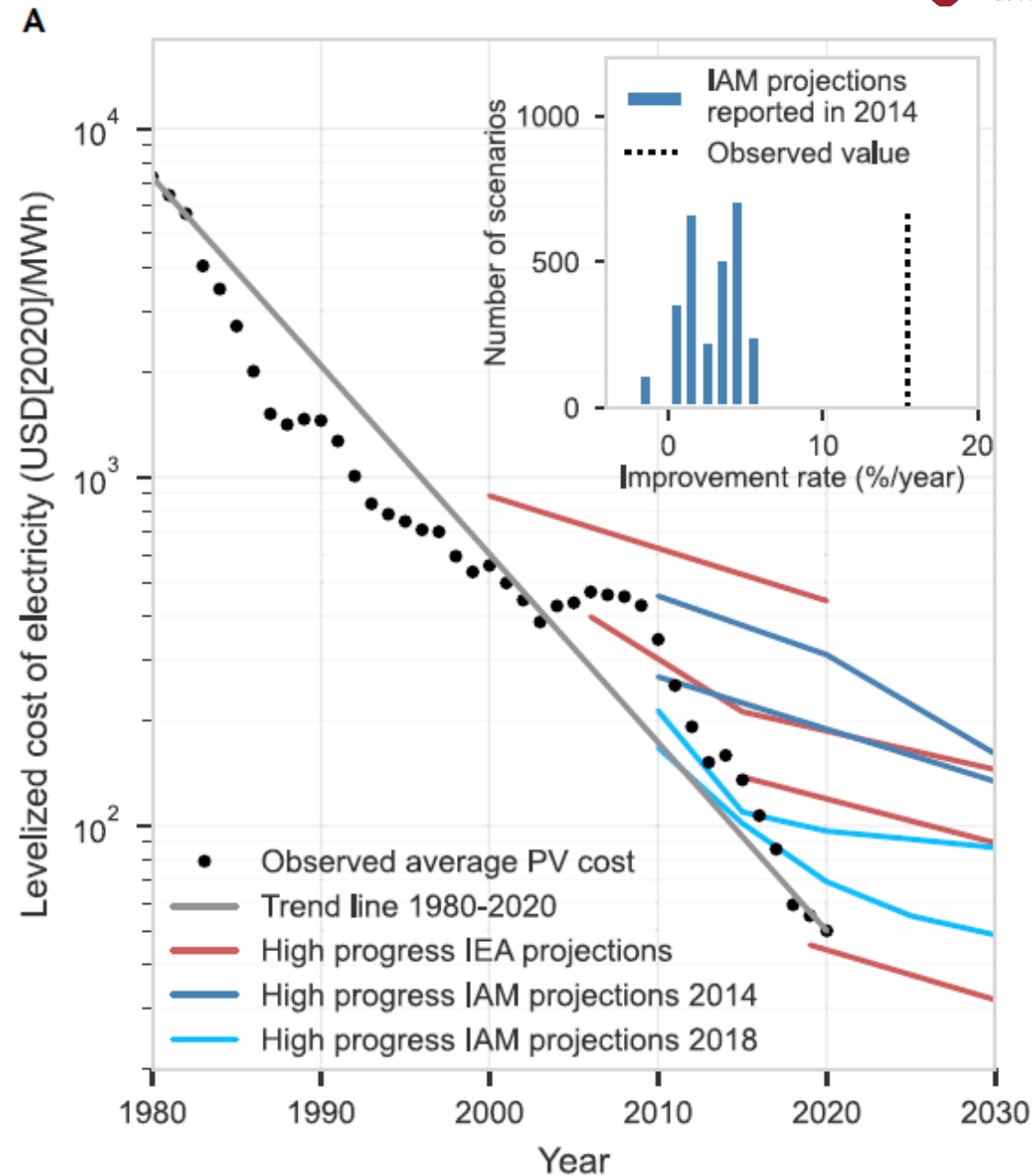
Turner Cotterman, et al., “[The transition to electrified vehicles: Evaluating the labor demand of manufacturing conventional versus battery electric vehicle powertrains](#),” working paper, March 24, 2024.

Andrew Weng, Omar Y. Ahmed, Gabriel Ehrlich, and Anna Stefanapoulou, “Higher labor intensity in US automotive assembly plants after transitioning to electric vehicles,” *Nature Communications* (2024), 15:8088, September 16, 2024.

Expect exponential progress.
Don't get hung up on current constraints.

Projections of Solar PV cost have been systematically too pessimistic

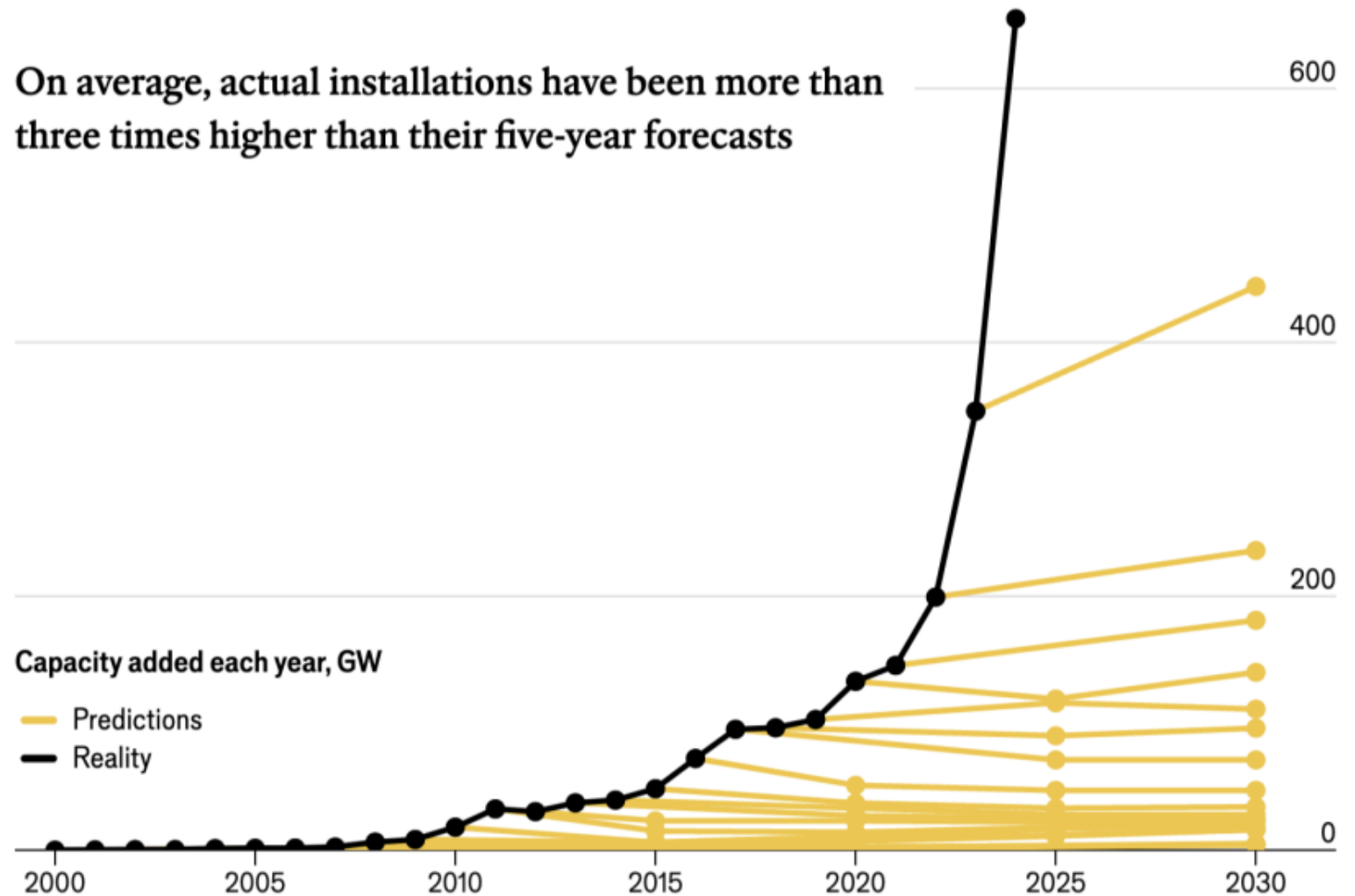
“The mean value of these projected cost reductions was 2.6%, and all were less than 6%. In stark contrast, during this period, solar PV costs actually fell by 15% per year.”



Solar deployment has been far faster than forecast

As costs fell faster than forecast, adoption beat expectations.

On average, actual installations have been more than three times higher than their five-year forecasts

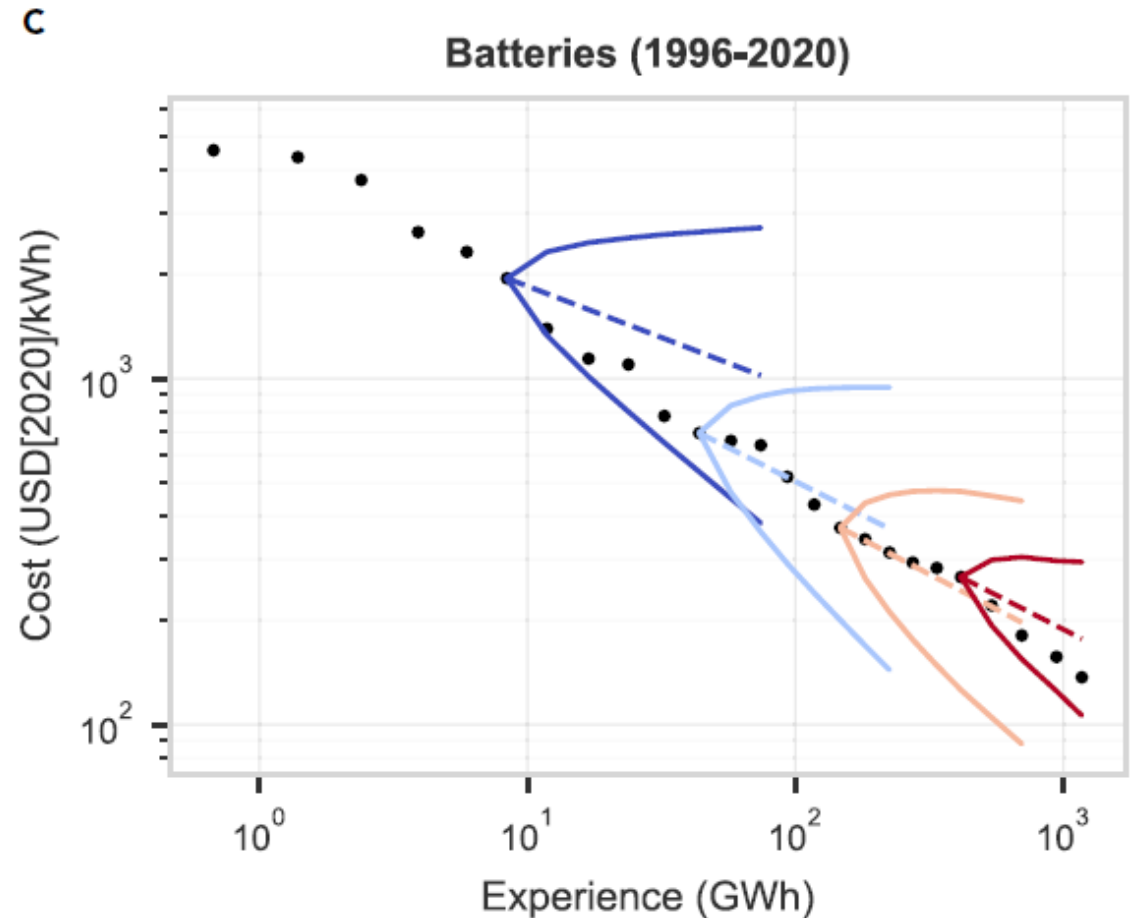
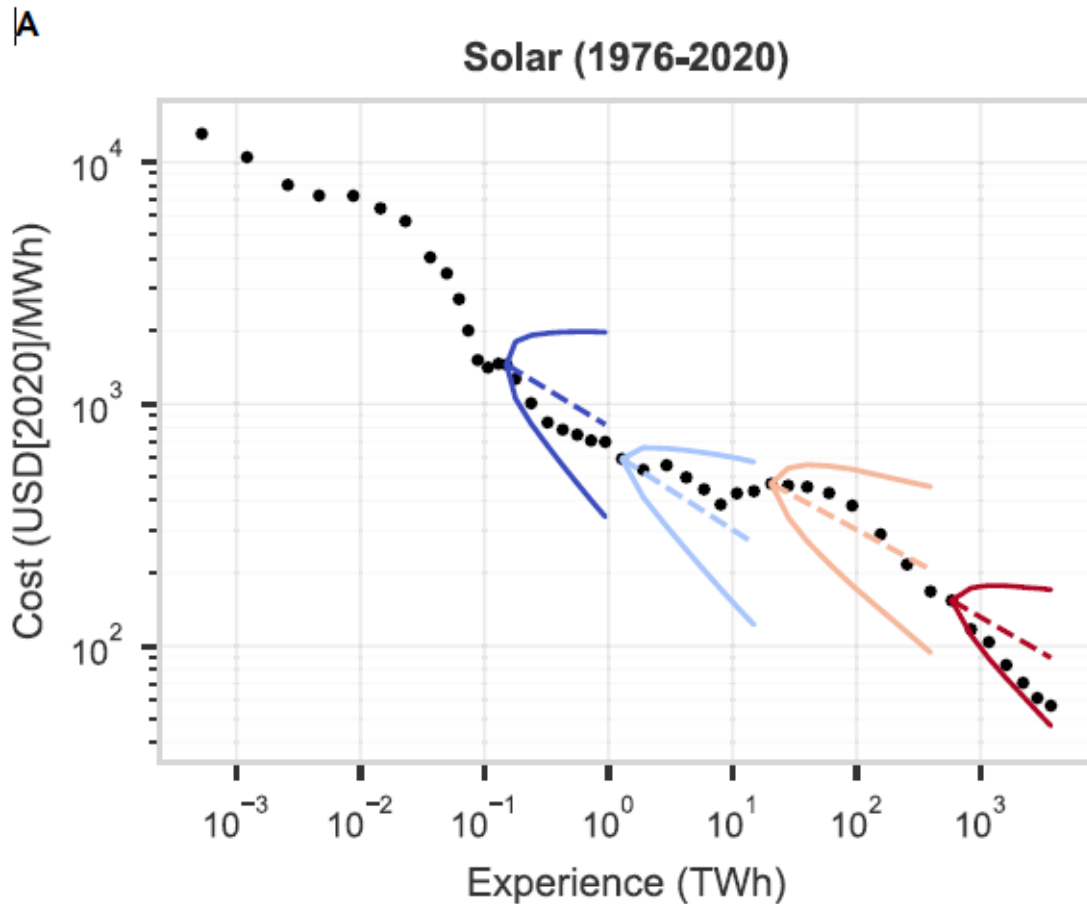


Installations for 2024 are an estimate from BloombergNEF for direct current solar capacity
 Sources: IEA; Energy Institute; BloombergNEF

Batteries are following solar down an exponential cost curve

Wright's Law: Costs drop as a power law of cumulative production

• Observed data - - - Forecast median — Forecast 95% C.I.



Thank you!

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