Congressional Budget Office
Nonpartisan Analysis for the U.S. Congress

Projected Effects of Federal Policies on the Demand for Electric Vehicles and the Supply of Charging Stations

July 5, 2023

Presentation at the 2023 Conference of the Western Economic Association International

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For information about the conference, see https://weai.org/conferences/view/13/98th-Annual-Conference.

Introduction

Two recent federal policies encourage the adoption of electric vehicles (EVs):

- The Infrastructure Investment and Jobs Act (IIJA) of 2021 provides up to $7.5 billion in subsidies for new EV charging stations.

- The 2022 reconciliation act (also known as the Inflation Reduction Act) provides tax credits of up to $7,500 per qualifying EV for qualifying buyers.

CBO’s projections show the likely effects of those policies on EV demand and EV charger supply.

Outline

- Modeling the Demand for EVs
- Modeling the Supply of EV Charging Stations
- Two Federal Policies
- Projected Policy Effects

Modeling the Demand for EVs

Factors That Influence EV Demand

Demand for EVs is modeled as reflecting an implicit consumer utility function:

$$u_{i,j,t} = \alpha_j + ln\left(p_{j,t}\right) \cdot \beta_p + ln(L2_t/TotEV_{t-1}) \cdot \beta_{L2} + ln(L3_t/HwyMiles) \cdot \beta_{L3} + \psi_t + \epsilon_{i,j,t}$$

i, j, t	Consumer i, vehicle type j (car, light truck), time period t
β	Elasticities from the literature: β_p *~N(-2, 0.25)*, $\beta_{L2} = \beta_{L3}$ *~N(0.4,0.01)*
$p_{j,t}$	Expected ownership cost of a representative new EV relative to a comparable internal combustion engine vehicle (ICEV)
$L2/TotEV_{t-1}$	Ratio of slow L2 chargers to the size of the EV fleet in the previous period
$L3/HwyMiles$	Number of rapid ("DC fast") L3 chargers per mile of highway
ψ_t	Attribute drift: a random walk capturing the demand effect of unobserved evolution in vehicle attributes and consumer preferences for EVs versus ICEVs; the model calibration parameter
$\varepsilon_{i,j,t}$	Mean-zero error term

Electric vehicles include plug-in electric and plug-in hybrid electric vehicles.

EV Market Share

Utility-maximizing behavior implies that EV market share is a logistic function of those determinants:

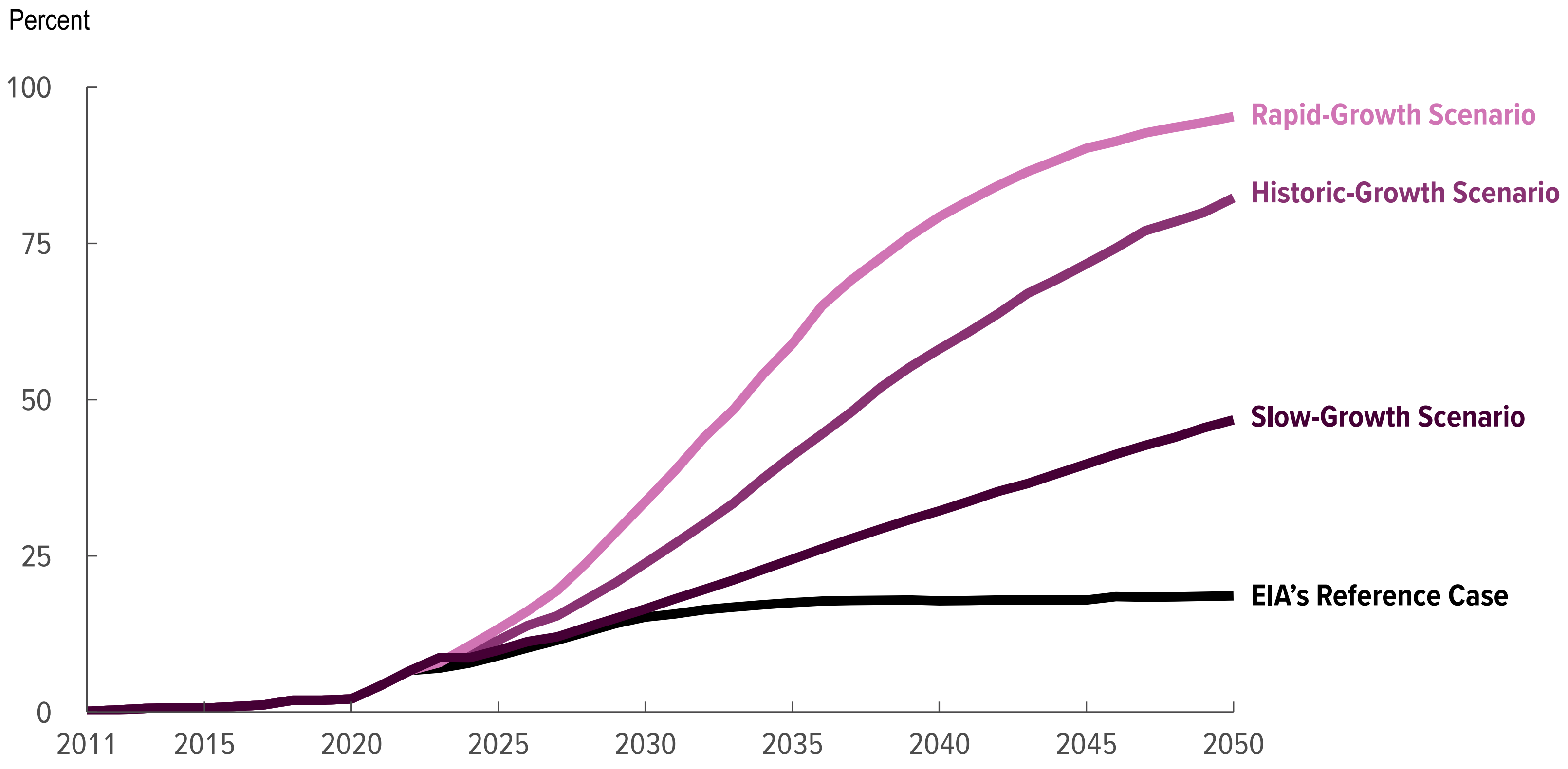
$$EVshare_{j,t} = \frac{e^{(\alpha_j + X_t \beta_j + \psi_t)}}{1 + e^{(\alpha_j + X_t \beta_j + \psi_t)}}$$

L3 chargers have about twice the effect of L2 chargers on EV sales because:

$$ln(TotEV/HwyMiles) = ln(6.7) = 1.9$$

That equation arises from how the effects of L2 and L3 charger types are modeled, given the current size of the domestic EV fleet.

Projected EV Market Shares Under Various Growth Scenarios



The model can be calibrated, via adjustments to attribute drift ψ_t, to project a range of future EV shares.

A base-case analysis uses the historic-growth scenario, which reflects a quadratic curve fit to EV shares from 2011 to 2022. The projected EV share in 2030 is 24 percent.

The slow-growth scenario, reflecting a straight line fit to EV shares from 2016 to 2022, projects an EV share of 14 percent in 2030.

The rapid-growth scenario is symmetrical to the slow-growth scenario in 2030 and projects an EV share of 34 percent in 2030.

EIA = Energy Information Administration.

Modeling the Supply of EV Charging Stations

Factors That Influence the Supply of EV Chargers

Supply is modeled as reflecting profit-maximizing behavior by suppliers,
with free entry and exit:

$$ln(L_{k,t}) = max\{\delta_k + \gamma_1 \cdot ln(EVstock_t) - \gamma_2 \cdot ln(\Delta Cost_{k,t}), \sigma_v \cdot ln(L_{k,t-1})\}$$

L_k, $k \in \{2, 3\}$	Types of chargers, L2 or L3
δ_k	Intercept terms (intersections of $ln(L_{k,t})$ with y axes)
γ_1 and γ_2	Supply elasticities with respect to the size of the EV fleet and anticipated decreases in cost
$EVstock_t$	Registered EVs in year *t:* initial EV fleet size + ($sales_t$) – ($scrappage_t$)
$\Delta Cost_{k,t}$	Expected decrease in the cost of a charger over the next year
σ_v	Average one-year survival rate of a charger of age ν

Two Federal Policies

Federal Charger Subsidies

IIJA provides up to $6.25 billion in subsidies for EV chargers built along highways and up to $1.25 billion in subsidies for community-based EV chargers.

Subsidies cover 80 percent of the private cost to build and install a new EV charger:

- An L2 charger with two ports costs $5,000, declining by 2 percent per year.
- An L3 charger with two ports costs $100,000, declining by 2 percent per year.

Federal EV Tax Credits

- New EVs qualify for up to $7,500 per vehicle in federal EV tax credits.

- The credits are available through 2032.
  - There is no limit on the total number of credits that may be claimed, but eligibility restrictions increase in stringency over time.
  - There are restrictions on the buyer’s income, the vehicle price, the location of battery assembly, and the source of the critical minerals in the batteries.

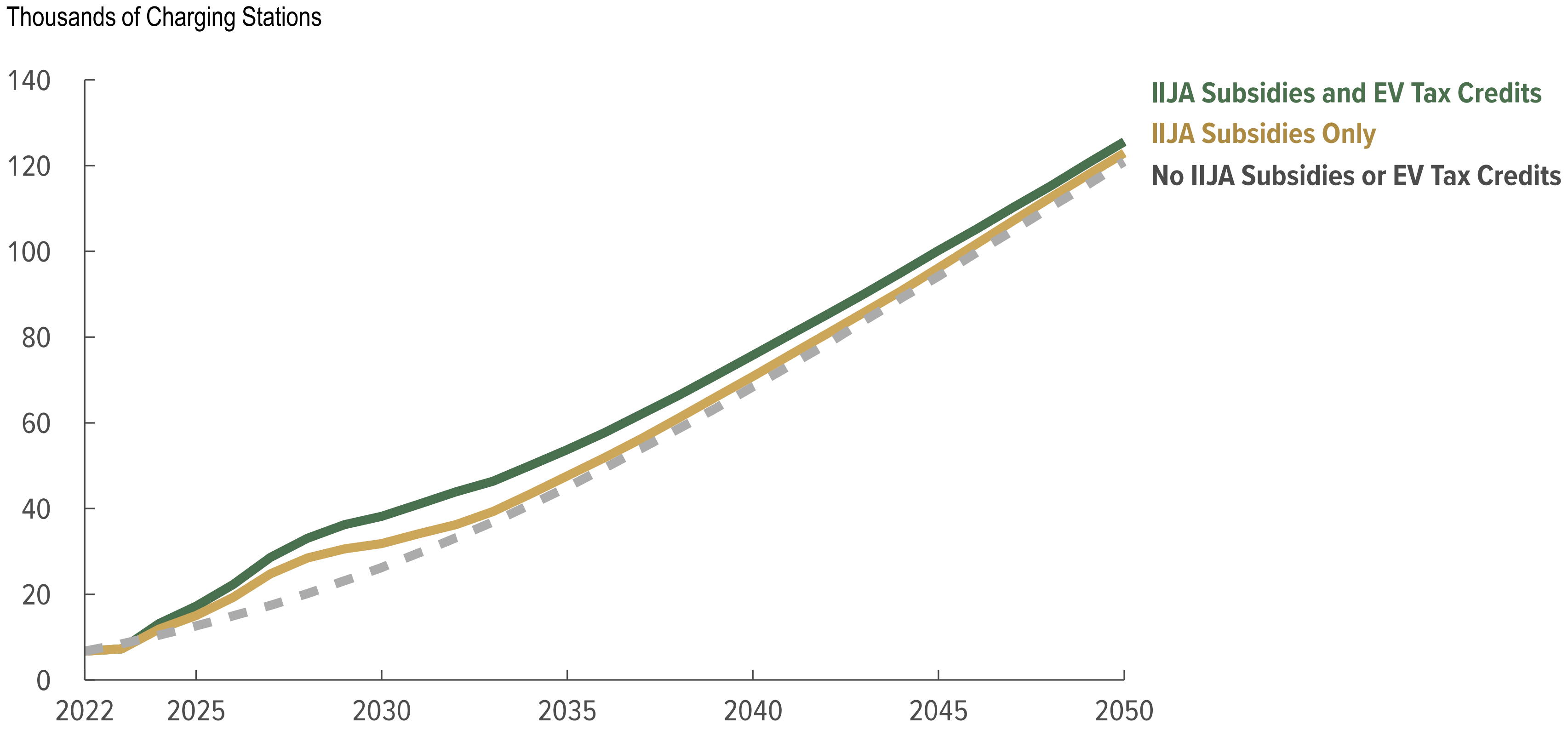
- Leasing an EV qualifies the lessor for the credit.
  - The value of those credits is modeled as being partially passed along to lessees.

- Automakers may share advanced manufacturing production (section 45X) tax credits with EV buyers.

Used EVs qualify for up to $4,000 in federal EV tax credits (not modeled).

Projected Policy Effects

Median Projected Supply of L3 ("DC Fast") Charging Stations



With the IIJA subsidies alone, the number of L3 charging stations would be projected to exceed 70,000 by 2040, versus 76,000 with both the subsidies and EV tax credits.

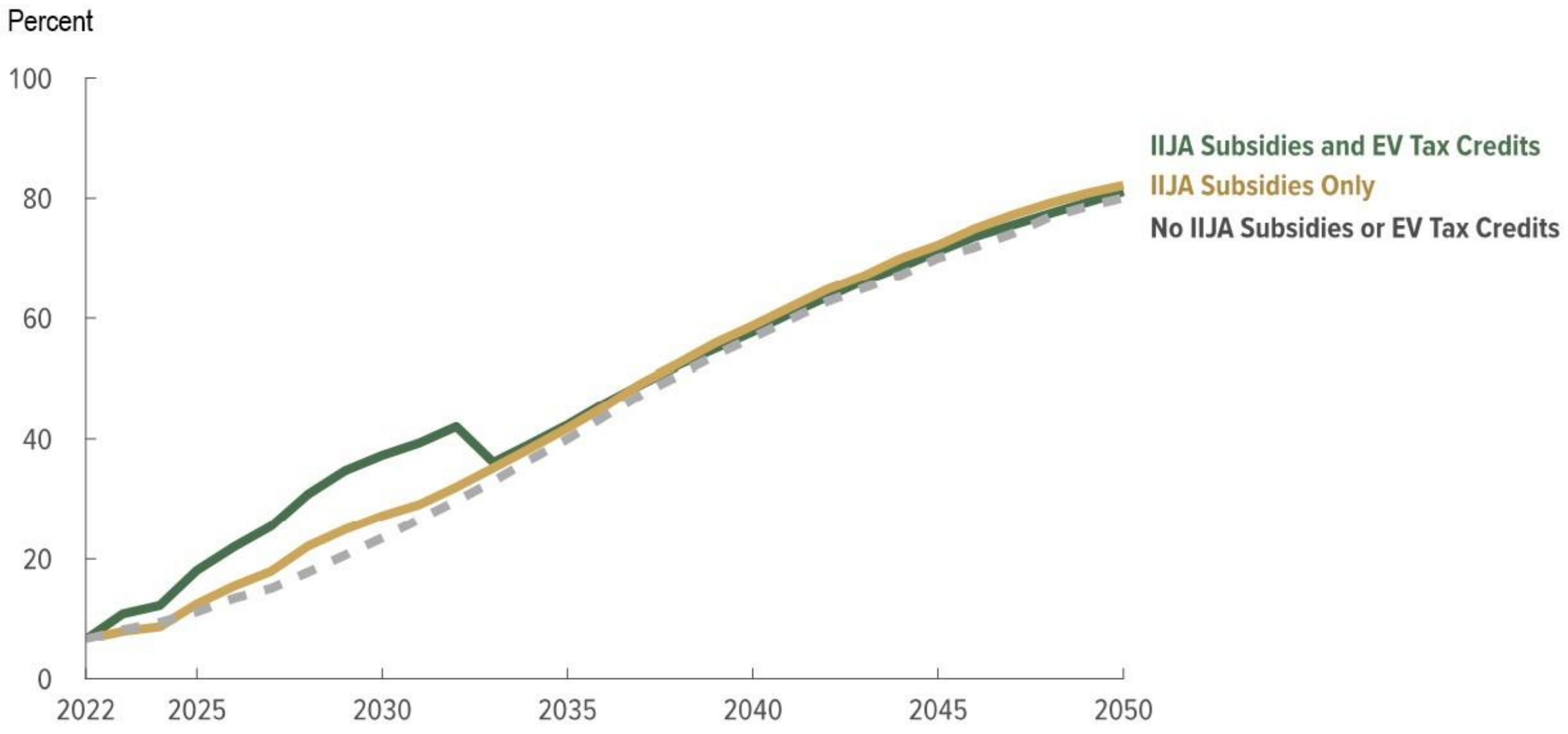
The primary effect of the IIJA subsidies is to speed up the adoption of EVs.

Growth in the EV fleet due to the EV tax credits causes a more sustained increase in the L3 charger network.

A similar, less pronounced pattern occurs with L2 chargers.

EV = electric vehicle; IIJA = Infrastructure Investment and Jobs Act.

Median Projected Market Share of New Light-Duty EVs



The median projected market share is 42 percent in 2032 with the EV tax credits and charger subsidies (falling to 36 percent in 2033 after the tax-credit program ends).

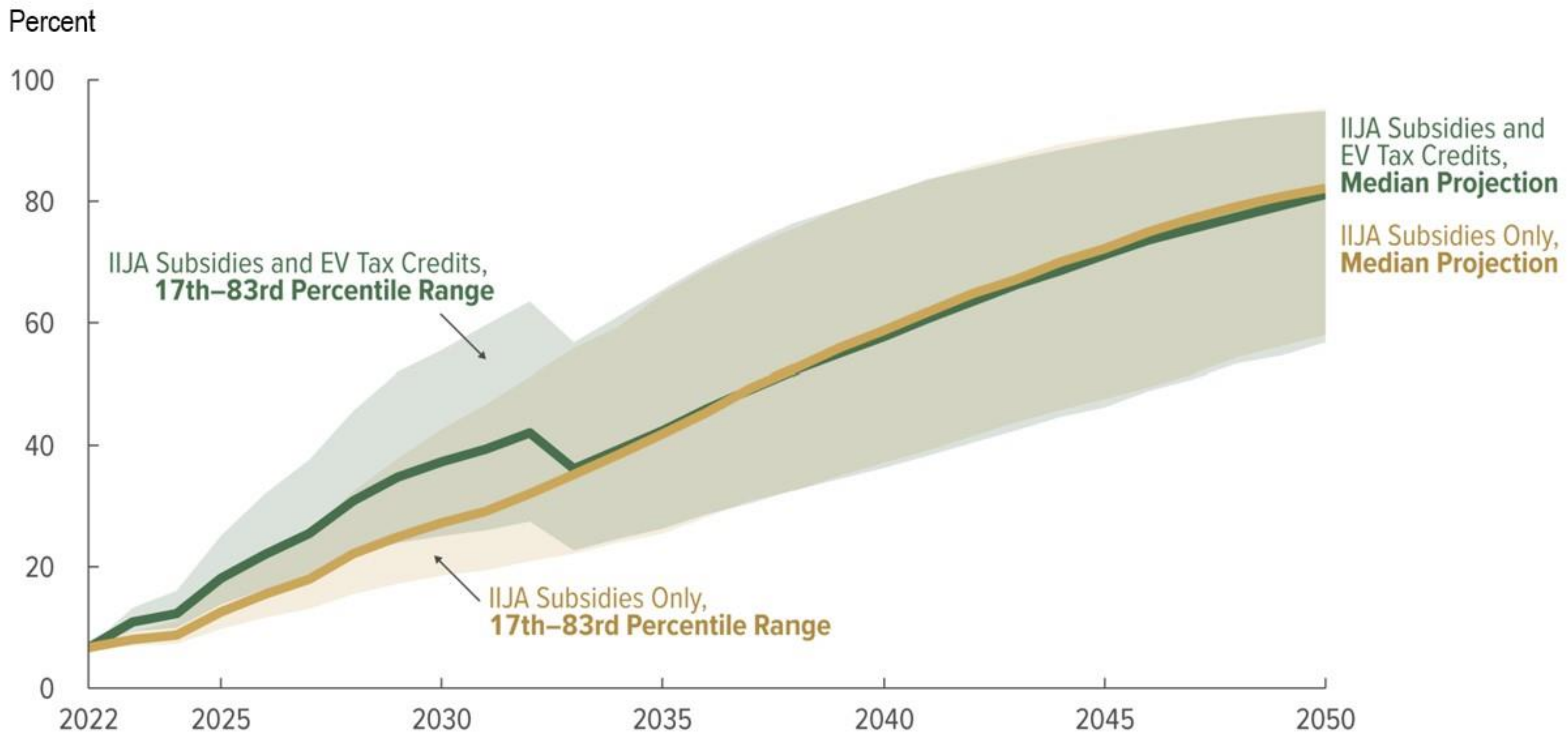
The median projected share is 30 percent in 2032 (33 percent in 2033) with neither policy in place.

The difference suggests that many inframarginal credits will be claimed, though restrictions on buyers' income and vehicle price will limit such claiming.

Some buyers who do not qualify will claim a credit by leasing EVs. (Projected results were modeled with half of such buyers leasing.)

EV = electric vehicle; IIJA = Infrastructure Investment and Jobs Act. Inframarginal credits are credits claimed by consumers who would have purchased an EV anyway.

Projected Market Shares of New EVs: Likely Range



Each simulation is repeated 5,000 times.

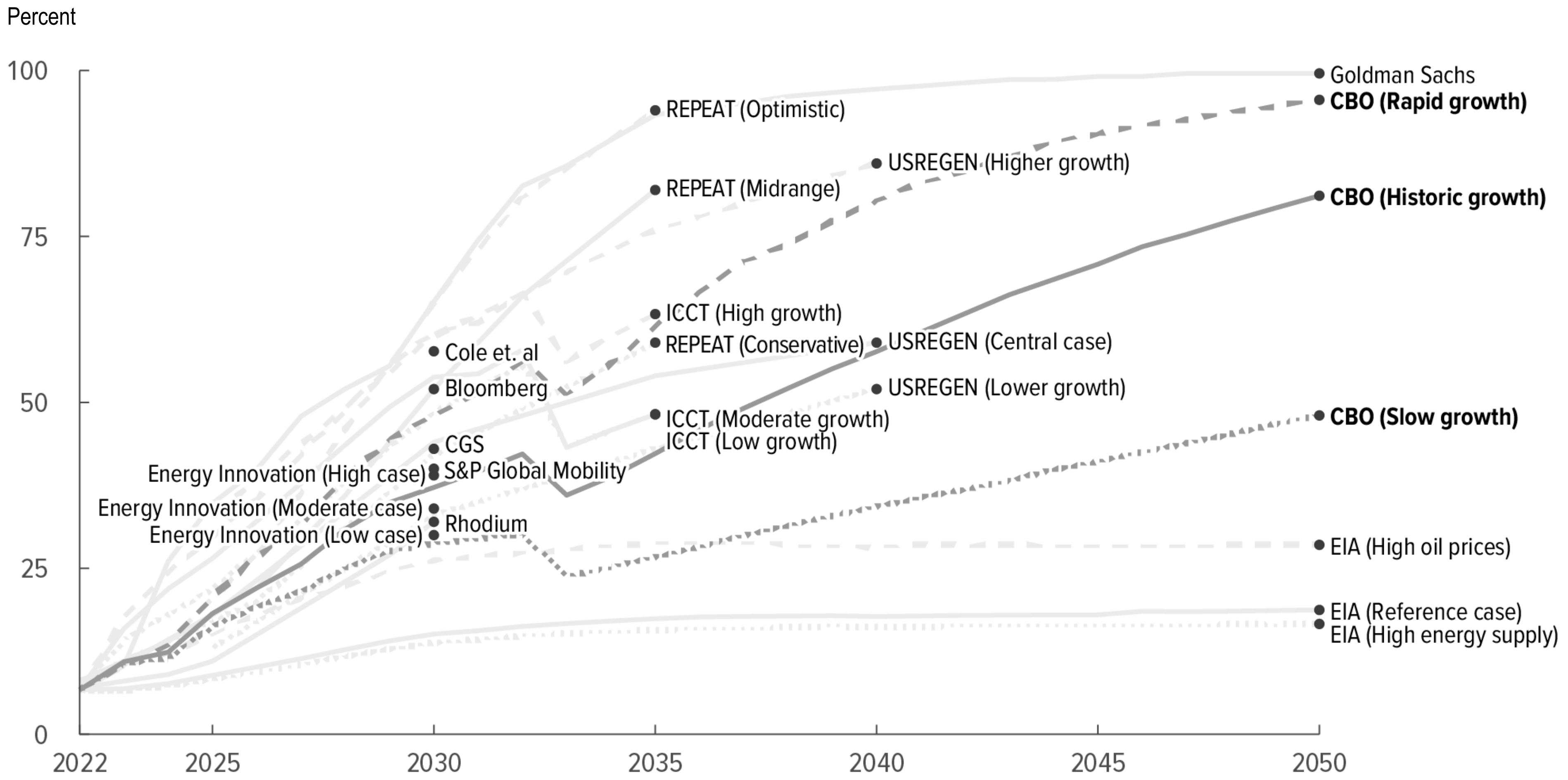
In CBO’s usage, the “likely range” of future values that the EV share could take is given by projections from the 17th percentile to the 83rd percentile.

Two-thirds of the simulated outcomes lie within the likely range.

In 2033, after the tax-credit program ends, the EV share is projected to drop.

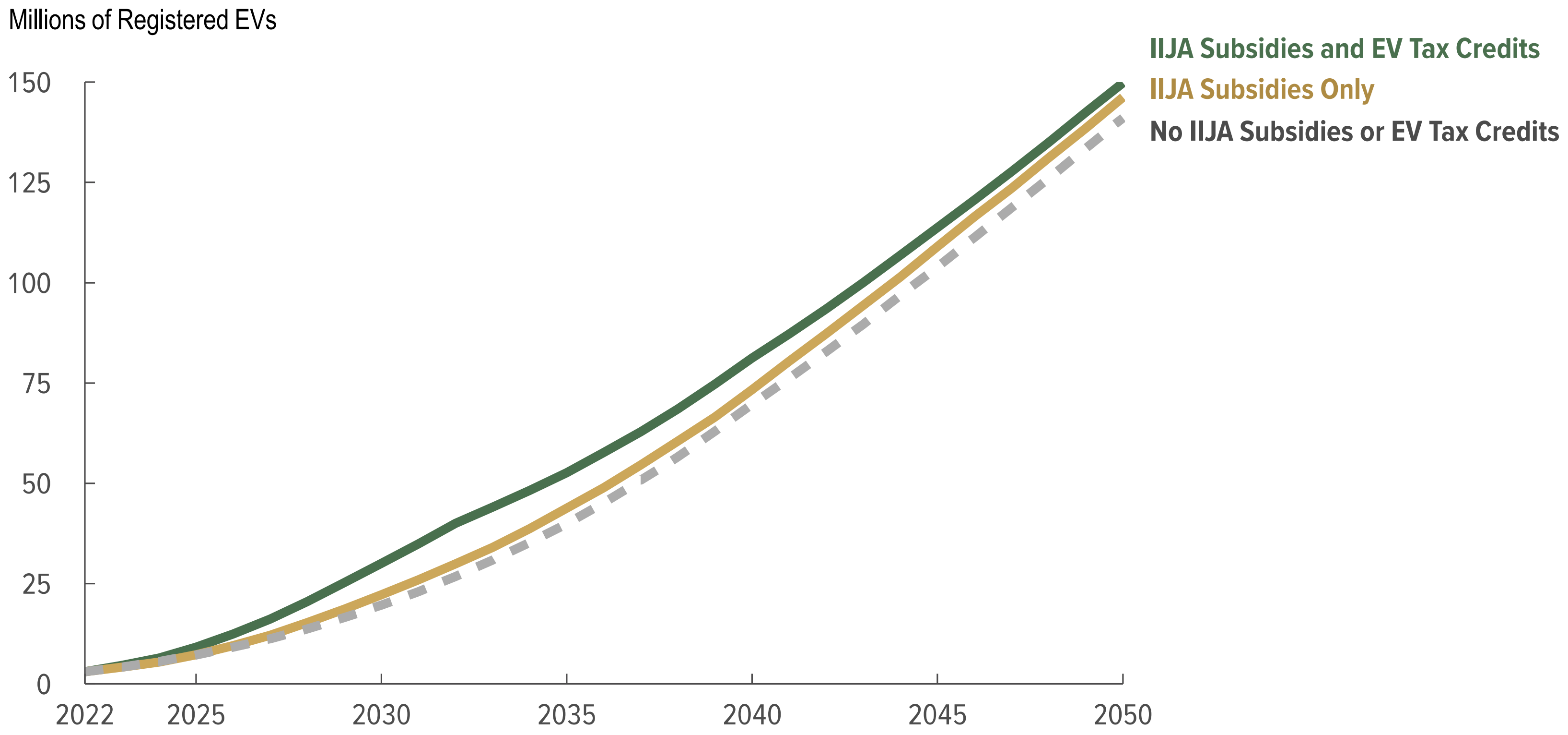
EV = electric vehicle; IIJA = Infrastructure Investment and Jobs Act.

Comparing CBO's and Other Projections of EV Market Share



For more information about the other projections, see the reference list at the end of the presentation. EV = electric vehicle.

Median Projected Size of the Domestic EV Fleet for Vehicles of All Ages



By 2032, the number of registered EVs is projected to reach 40 million under the EV tax credits and charger subsidies.

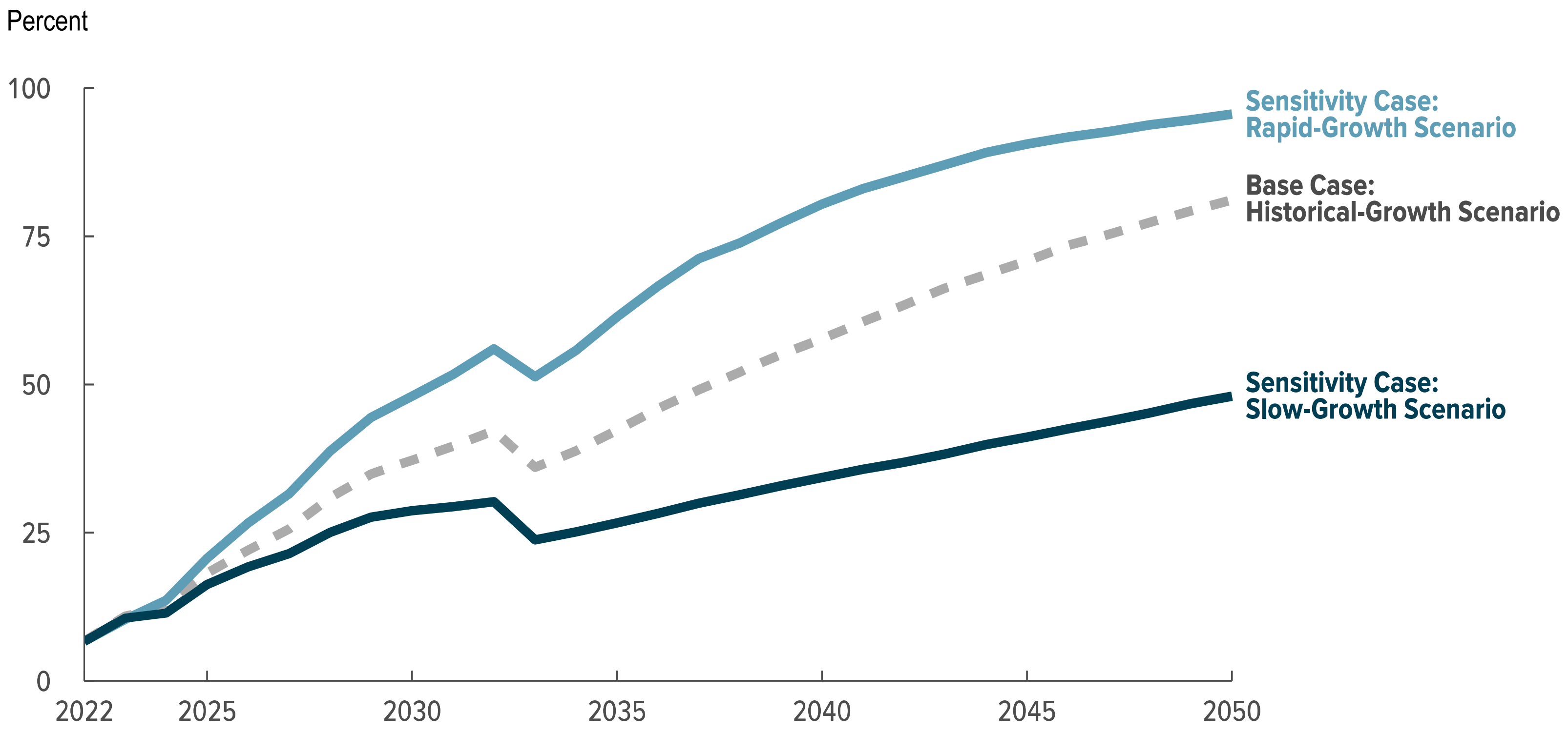
Without those policies, the EV fleet size would not reach 40 million until three years later.

The policies also have a sustained effect: The median projected EV fleet size is 150 million in 2050, one year earlier than in the no-policy projection.

Currently, there are about 300 million light-duty vehicles in the United States.

EV = electric vehicle; IIJA = Infrastructure Investment and Jobs Act.

Projected EV Market Share Is Sensitive to the Choice of Scenario



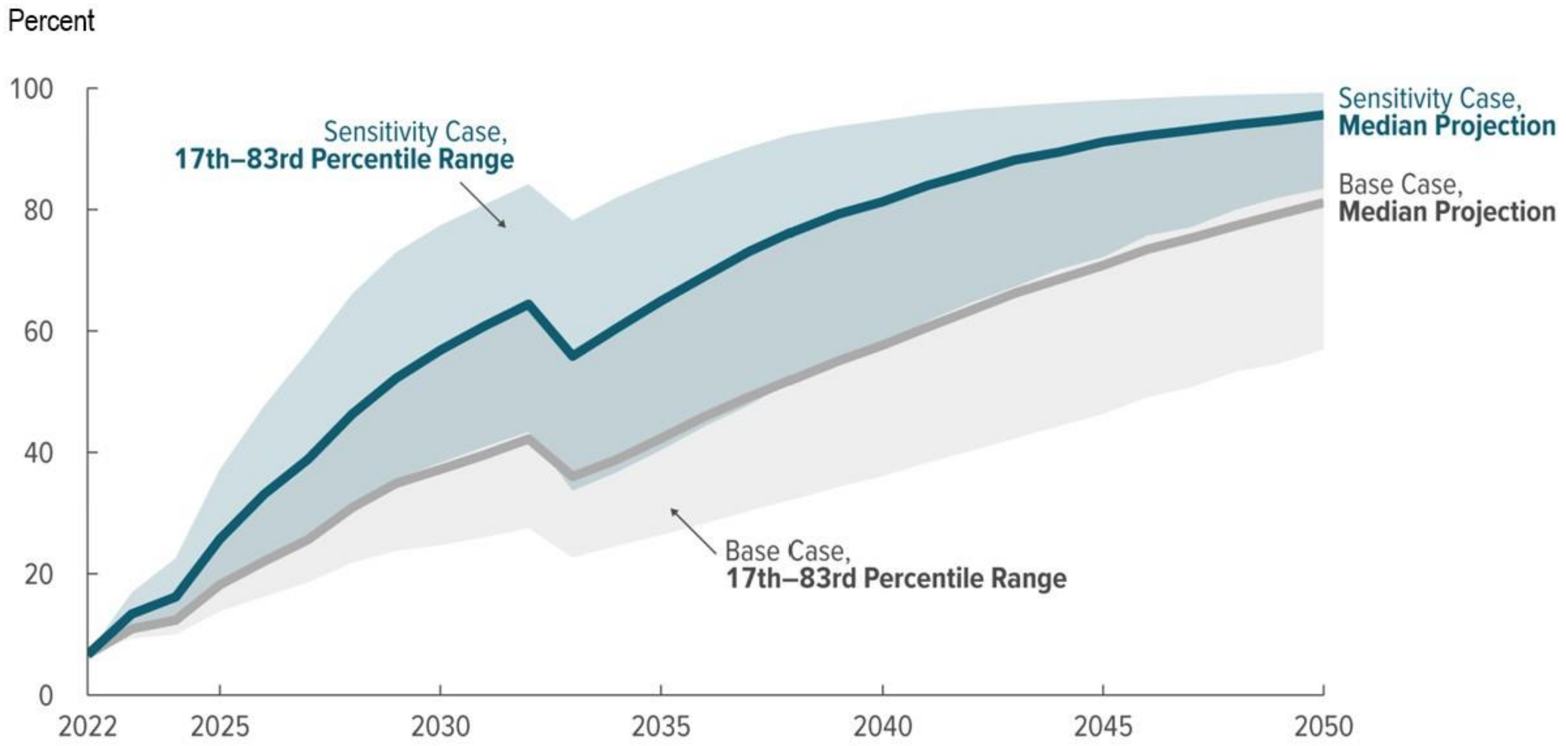
The median peak projected EV share in 2032 (when the EV tax credits are still available) depends on the scenario:

Rapid-growth scenario: 56 percent

Historic-growth scenario: 42 percent

Slow-growth scenario: 30 percent

Projected EV Market Share Is Also Sensitive to Elasticities Used

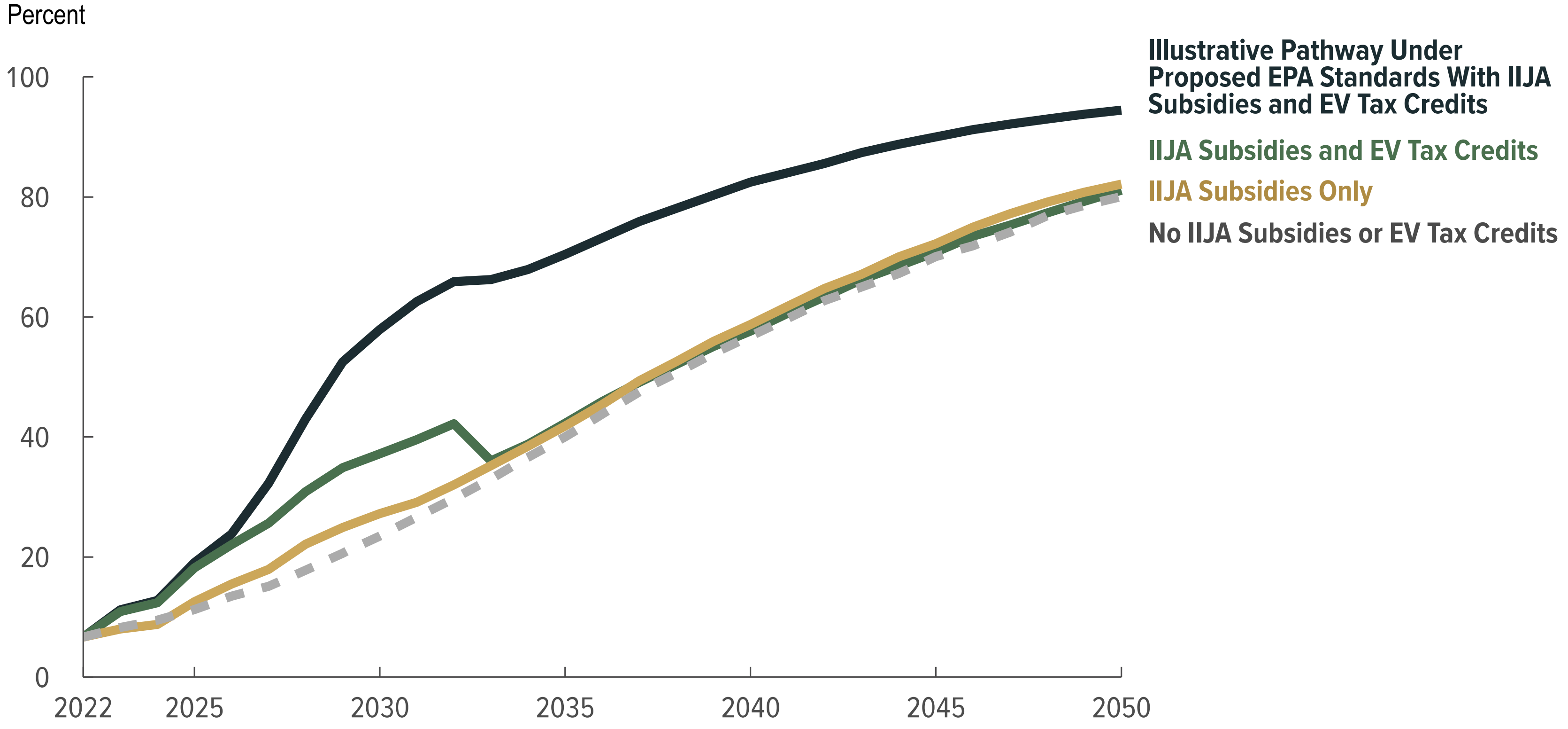


For example, for the price elasticity of demand:

Base-case simulations use an elasticity of −2 for EV demand with respect to the relative ownership costs of EVs versus ICEVs.

Sensitivity-case simulations use an elasticity of −3, so that declining EV prices have a greater effect on EV sales. In 2032, the median projected EV share is 64 percent versus 42 percent in the base case.

Illustrative Pathway of EV Market Share Under Proposed EPA Standards With IIJA Subsidies and EV Tax Credits



The Environmental Protection Agency (EPA) has proposed tailpipe emissions standards for model years 2027 to 2032.

The illustrative pathway uses EPA's estimate that automakers could comply with proposed standards for 2032 if two-thirds of their new vehicles sold were EVs.

That would be a 60 percent increase over the median projected EV share under the IIJA and EV tax-credit policies alone.

It would probably increase the number of tax credits claimed by a similar percentage.

For EPA's estimated two-thirds EV share, see https://tinyurl.com/y4cbtd2b. EV = electric vehicle; IIJA = Infrastructure Investment and Jobs Act.

Sources of Other Projections of EV Market Share

Projections from the following sources are included in the figure on slide 16:

Bloomberg: See Colin McKerracher et al., “Electric Vehicle Outlook 2023,” *BloombergNEF* (June 2023), https://about.bnef.com/electric-vehicle-outlook.

CGS: See Alicia Zhao et al., *An “All-In” Pathway to 2030: The Beyond 50 Scenario* (University of Maryland Center for Global Sustainability and America Is All In, November 2022), https://tinyurl.com/bdfa5e7w (PDF).

Cole et al.: See Cassandra Cole et al., “Policies for Electrifying the Light-Duty Vehicle Fleet in the United States,” *AEA Papers and Proceedings,* vol. 113 (American Economic Association, May 2023), pp. 316–322, https://tinyurl.com/fvhan8n5.

EIA: See Energy Information Administration, *Annual Energy Outlook 2023* (March 2023), https://www.eia.gov/outlooks/aeo.

Energy Innovation: See Sara Baldwin and Robbie Orvis, *Implementing the Inflation Reduction Act: A Roadmap for Federal and State Transportation Policy* (Energy Innovation, October 2022), https://tinyurl.com/35vn79vp (PDF).

Goldman Sachs: See Goldman Sachs, “The U.S. Is Poised for an Energy Revolution” (April 17, 2023), https://tinyurl.com/mr3bsuzh.

Sources of Other Projections of EV Market Share (Continued)

ICCT: See Peter Slowik et al., *Analyzing the Impact of the Inflation Reduction Act on Electric Vehicle Uptake in the United States* (International Council on Clean Transportation, 2023), https://tinyurl.com/3pw3erjt.

REPEAT: See Jesse D. Jenkins et al., “Preview: Final REPEAT Project Findings on the Emissions Impacts of the Inflation Reduction Act and Infrastructure Investment and Jobs Act,” REPEAT: Rapid Energy Policy Evaluation and Analysis Toolkit (Princeton University Zero Lab, April 2023), https://repeatproject.org/docs/REPEAT_2023_Preview.pdf.

Rhodium: See John Larsen et al., *A Turning Point for U.S. Climate Progress: Assessing the Climate and Clean Energy Provisions in the Inflation Reduction Act* (Rhodium Group, August 2022), https://tinyurl.com/3xn7dky6.

S&P Global Mobility: See Stephanie Brinley, “EV Chargers: How Many Do We Need?” *S&P Global Mobility* (blog entry, January 9, 2023), https://tinyurl.com/t4ku8tre.

USREGEN: See John Bistline, Neil R. Mehrotra, and Catherine Wolfram, “Economic Implications of the Climate Provisions of the Inflation Reduction Act,” *Brookings Papers on Economic Activity* (Brookings, forthcoming), https://tinyurl.com/mpdhhh7m.