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# Inflation Reduction Act – What it means for EV adoption in the U.S.

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**Executive Summary**

Today just 8% of vehicle sales are electric in the U.S.[1] The Inflation Reduction Act (IRA) is poised to change this and will be vital to accelerating electric vehicle (EV) adoption, especially across the passenger vehicle sector. The IRA provides tax credits to lower EVs' purchase price, enabling faster total cost of ownership (TCO) parity with traditional fossil fuel vehicles. This analysis considers how IRA can drive domestic demand for EVs and batteries, enabling the U.S. to achieve its climate targets and improve industrial competitiveness.

*Keywords: Policy, Passenger Car, Electric Vehicle, Cost, Demand*

## 1 Introduction

Transportation is the highest source of greenhouse gas (GHG) emissions in the U.S., accounting for 39% of total emissions (excluding non-energy related emissions).[2] Private passenger vehicles—sedans, SUVs, and light trucks—are responsible for over 58% of the U.S.'s transport emissions, nearly 21% of all U.S. energy related $CO_2$ emissions.[3] Rapid electrification of the passenger vehicle segment is needed to achieve U.S.'s climate goals. Hence, it is critical to guide the purchase decisions of private vehicle owners toward EVs.

Electric vehicle (EV) adoption can substantially reduce emissions, and the Inflation Reduction Act (IRA) can play a central role in accelerating the EV transition in the U.S. The IRA is structured as a tax credit mechanism, and credits are awarded to individuals that purchase an EV. The awarded credits can effectively lower the purchase price of the EVs, ultimately lowering the total cost of ownership (TCO) — the cost to own and operate a vehicle over its lifetime. Such credits help drive the economic competitiveness of EVs in the near term. By determining EV eligibility and quantifying the estimated credit value individuals can earn from IRA, this analysis models how IRA can enable a higher sales share of passenger EVs compared to a baseline scenario without the IRA policy intervention. By comparing the baseline to two scenarios where the IRA credits work to lower the TCO and drive EVs sales, this analysis derives the environmental and economic opportunities that can stem from the IRA over the next decade.

### 1.1 Summary of the IRA Credits

Under the IRA, passenger vehicles are eligible for the clean vehicle tax credit (30D). To qualify for the tax credit, the EV purchased must be assembled in North America, battery components and minerals cannot be sourced from a foreign entity of concern beginning in 2024 and 2025 respectively, the vehicle must be under the maximum MSRP value, and the individual must earn less than a threshold income level. While these criteria affect eligibility, they do not affect the tax credit value. The tax credit value is determined based on two criteria; one is a battery component requirement; that stipulates a particular percentage of components should be manufactured or assembled in North America beginning in 2023. The second is a critical mineral requirement that states a certain portion of critical minerals in EV batteries must be extracted or processed in the U.S. or free trade agreement (FTA) countries. The total credit is worth $7500 and is bifurcated based on these two requirements—compliance is worth $3750 per credit.

The Inflation Reduction Act's Clean Vehicle Tax Credit (30D) has strict requirements. Without aggressive investments and development in the battery supply chain, manufacturers may struggle to qualify for all, even a portion of the clean vehicle tax credit. For example, battery components shall not be produced or assembled in a foreign entity of concern (i.e. China, Russia, Iran, and North Korea); if components do originate from a foreign entity of concern, that vehicle is not eligible for any portion of the clean vehicle tax credit. Similarly, beginning in 2023, an increasing percentage of critical minerals must be sourced from the U.S. or FTA country to receive the critical mineral partial credit value.[4]

As the market stands today, most EVs in the U.S. are comprised of imported batteries, and nearly all aspects of supply chain material refining, midstream processes, and pack and cell production takes place outside of the U.S. Given these market dynamics, it may be challenging for manufacturers to meet the battery component and critical mineral requirement in the near term to fully leverage the IRA. This analysis considers these supply chain complexities and the ability of manufacturers to capture all or partial credit by modeling differing scenarios to account for variations in how manufacturers may seek to comply with the clean vehicle credit requirements.

## 2. Methodology

A cost and economics-based model was developed to analyze the impact of the IRA credits on passenger EV adoption in the U.S. The underlying condition is that IRA credits can lower the purchase price of vehicles, lowering the TCO of EVs, and encouraging more consumers to purchase EVs. The model analyzes EV adoption across the differing private passenger vehicle classes, and the logical flow and modeling steps conducted in the analysis are shown in Figure 1.

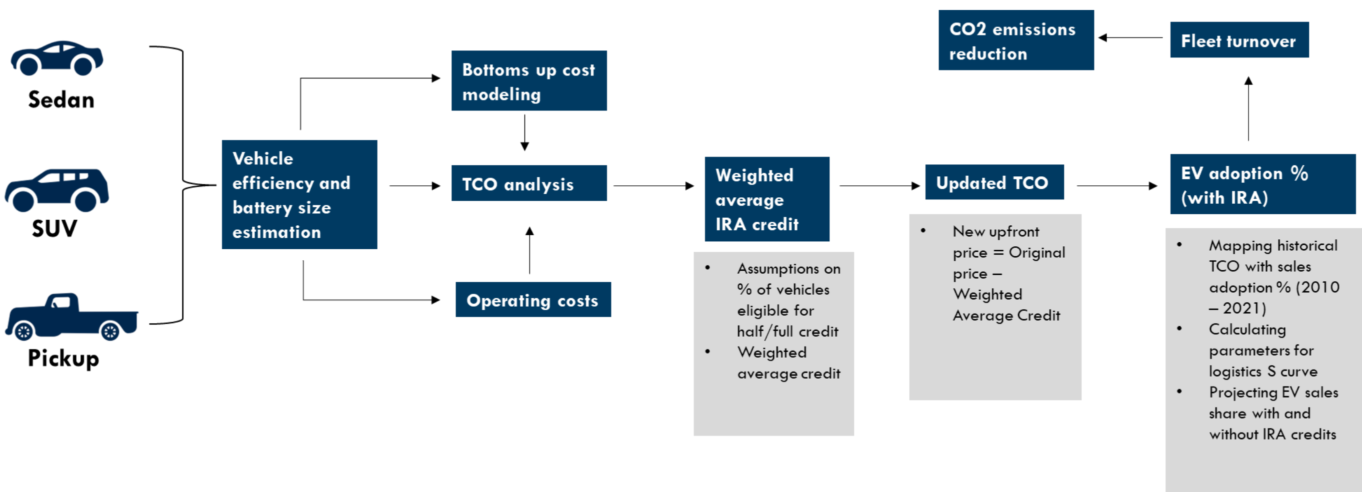


Figure 1: Logic flow of modeling exercise

### 2.1 Modeling Total Cost of Ownership (TCO)

TCO calculations include capital expenditure (CAPEX) for buying the vehicle and operating expenditure (OPEX) on fuel and maintenance for EVs and Internal Combustion Engine (ICE) vehicles. For EVs, two additional coast elements are considered – the cost of charging hardware, installation and any fixed Operating and Maintenance (O&M) expenses, and battery replacement costs.

#### 2.1.1 Bottoms up vehicle CAPEX

The vehicle purchase price was estimated using a bottom-up modeling approach. This approach considers the cost of each vehicle component, along with the associated taxes, profit margins, and R&D investments (indirect expenses). The model utilized a bottom-up vehicle cost instead of actual market prices because automakers price new technologies like EVs based on various market factors such as their ability to gain market share, the ability to avail near-term incentives, and the production of assets at economies of scale. Manufacturers also calibrate their prices against competitor pricing, leading to initial pricing volatility. Such prices are not a good proxy for the price of an asset in a stabilized, mature market.

To conduct a bottoms-up cost assessment, the first step was to determine the average vehicle efficiency per vehicle type. Vehicle efficiency was estimated by performing robust market research on all the existing EV models in the market to derive an average. Based on the average efficiency and the typical range of EV models in the U.S.—roughly 250 miles—the battery size of an EV was calculated.

Battery costs were then calculated using the estimated battery size and observed and forecasted battery prices.[5] The cost of the electric drivetrain, power electronics such as thermal management equipment, inverter, onboard charger, and vehicle chassis were added to the battery cost to get the total manufacturing costs. The cost components for ICE vehicles included the engine, drivetrain, transmission, and chassis. Lastly, a fixed markup was added to the EV and ICE manufacturing costs to account for indirect costs and to derive the total purchase price.

#### 2.1.2 Operating cost estimation

Operating costs mainly included the cost of fueling or charging and maintenance costs. Fuel costs are a function of vehicle efficiency, electricity prices for EVs, and gasoline prices ICEs. Maintenance costs for ICE vehicles were derived from literature reviews; maintenance costs for EVs were assumed to be 40% less than ICE costs.[6]

#### 2.1.3 Infrastructure capex and consideration of battery replacement

Specifically, for EVs, charging infrastructure costs and battery replacement were also considered. For charging infrastructure, a level 2 charger hardware, installation and any fixed O&M costs were incorporated, as it is expected an EV owner will buy this supporting infrastructure to charge EVs at their premises. For battery replacement, the analysis takes into account if there is a need for battery replacement over the lifetime of the vehicle depending on the battery life cycles and total distance requirement. Depending on that requirement, costs for battery replacement are also considered.

### 2.2 Inclusion of IRA credits to TCO modeling

The model then accounted for how the IRA tax credits would impact the cost of an EV. By modeling three scenarios, the model accounts for how a differing percentage of EVs may be eligible for either the full or partial IRA clean vehicle tax credit. The three modeled scenarios derived a weighted average credit value based on the IRA eligibility criteria. The three scenarios are as follows:

a. Without IRA credit scenario – This scenario serves as a baseline scenario and represents the market conditions before the inaction of the IRA; it does not consider the receipt of the IRA credits in any manner.
b. With IRA credit (Low scenario) – This scenario assumes that the critical mineral half credit is difficult to comply with through 2025, given most mineral refining and processing capacity takes place outside the U.S. or Free Trade Agreement (FTA) countries today. From 2025 to 2032, this scenario assumes that a portion of EV models gradually become eligible for critical mineral partial credit as supply chains diversify. For the battery component half credit, it is assumed that EV models sold by the likes of Tesla, Ford, and GM (automakers which have access to battery manufacturing in U.S.) are eligible for the half credit through year-end 2023, but as soon as the

foreign entity of concern rule hits, minimal EVs qualify for the half credit through 2025 as the majority of cathodes and anodes are produced in China. Post 2025, models start becoming eligible for the half credit, but the ramp-up is slow because of the significant domestic investment required to adhere to this stipulation.

c. With IRA credit (High scenario) – This scenario assumes that all EVs sold in 2032 (barring the few that would not meet the MSRP cap) would be eligible for the critical mineral and battery component credit. In the near term (through 2025), it is assumed the critical mineral credit would be hard to comply with, provided the same reasons presented in the low scenario case. For the battery component credit, it is assumed that the automakers with existing battery manufacturing capacities can divert their cathode and anode supply away from China and will be eligible for the partial credit in the near term.

Based on these assumptions, the first step is to calculate the weighted average credit amount, which is a function of percentage of EVs eligible for either half or full credit and the value of those credits.
Next, the weighted average credit is subtracted from the vehicle CAPEX to calculate the updated TCO for high and low case IRA scenarios.

## 2.3 Estimating EV sales share based on TCO outputs

Based on TCO of EVs and ICE vehicles, a logistic regression S curve was derived to estimate how the TCO will impact the sales share year over year. Other driving parameters (Alpha (a) and Beta (b)) that impact the shape of the S-curve were estimated using historical cost analysis and actual EV sales share between 2010 and 2021. The following equation was used to estimate the sales share of ICE vehicles and EVs:

$$\text{ICE (sales share)} = \text{EXP}(-a*TCO_{ICE} + b)/ (\text{EXP}(-a*TCO_{ICE} + b) + \text{EXP}(-a*TCO_{EV})) \quad (1)$$

$$\text{EV (sales share)} = 1 - \text{ICE (sales share)} \quad (2)$$

Where, a = 9, b = 1.9 and $TCO_{ICE}$ and $TCO_{EV}$ are normalized values based on TCO estimated in pervious steps. The values are normalized by dividing the TCO of each technology in the given year by TCO of an ICE vehicle in 2022.

These calculations were conducted for the Without IRA, With IRA (Low), and With IRA (High) scenarios to derive differing EV sales share figures year over year.

## 2.4 Assessing fleet turnover

Based on the percentage of year over year EV and ICE vehicle sales and the rate of vehicle retirement the fleet mix was derived—the proportion of EVs operating on the road. Total sales and total fleet projections were derived from forecasts by BloombergNEF.[7] Based on these projections, the EV and ICE fleet were derived using equations below.

$$\text{EV fleet size}_n = \text{EV fleet}_{n-1} + \text{EV sales}_n - \text{EV sales}_{n-11} \quad (3)$$

(where n is the year you want to estimate the fleet size, and assumed vehicle lifetime is 12 years.)

$$\text{ICE fleet size} = \text{Total fleet size} - \text{EV fleet size} \quad (4)$$

## 2.5 Calculating $CO_2$ emissions reduction

EVs also reduce $CO_2$ emissions and reduce the negative impact on the environment. To evaluate the $CO_2$ emission reductions from EV passenger vehicle adoption, the average emissions from producing and burning a gallon of gasoline was compared against the emissions from generating power to charge an EV. The grid emission factor (342 kgCO2/MWh) was derived from calculating EV charging emissions based on the average U.S. grid mix.[8] The model accounts for grid emissions improving over time and follows IEAs

Announced Pledges scenario.[9] Using average vehicle efficiencies based on existing EVs in the market today and calculating the average electricity used to complete the average passenger vehicle trip, the total $CO_2$ emissions from EV operations were derived. Emissions from EV usage was then compared against the tank to well $CO_2$ emissions from ICE vehicles across the three passenger vehicle segments.

# 3. Results and Discussion

## 3.1 IRA resolves economic barriers associated with EVs

The IRA helps eliminate near-term economic barriers related to EV procurement, lowering the purchasing costs and, ultimately, the TCO. The figure below depicts how partial or full credit receipt impacts the TCO of EVs by vehicle segment. The half-credit scenario is a case in which an EV model meets only one of the two credits stipulations receiving a $3500 credit. The full credit scenario is one in which the full credit value $7,500 is received. The IRA credits can help electric passenger sedans, SUVs and light-duty trucks achieve TCO parity with Internal Combustion Engine (ICE) vehicles between 2023 and 2025. Without the IRA credits, EVs would have reached TCO parity with ICE vehicles between 2024 and 2027. For example, IRA credits bring the TCO of electric SUVs to $0.4/mile today (2023). Similarly, IRA credits help bring the TCO of electric sedans to $0.3/mile today (2023). Figure 2 below depicts the TCO parity of passenger EVs by segment.

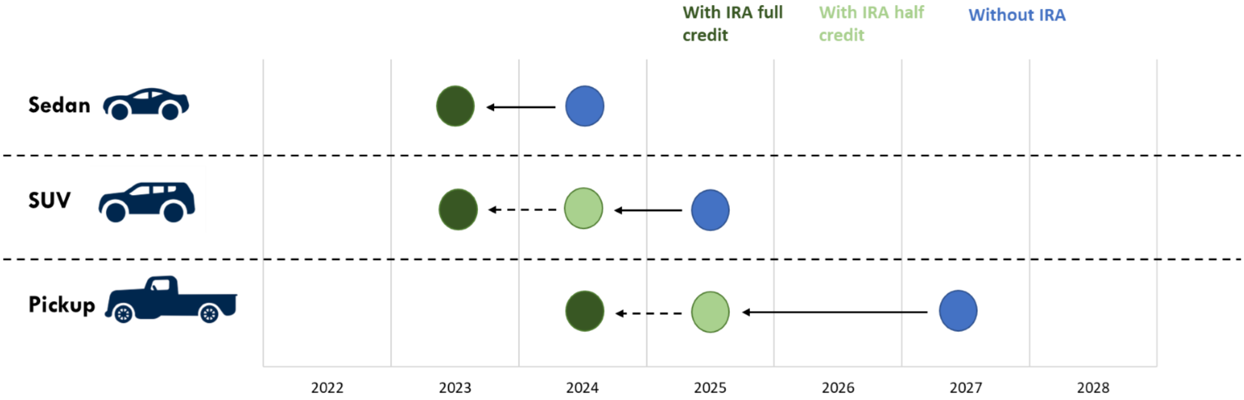


Figure 2: Impact of IRA on TCO parity

Private consumers are sensitive to purchase prices. Based on a consumer reports survey, Americans cited that purchase price was one of the most significant barriers to EV adoption.[10] Figure 3 depicts how upfront purchase price parity can be achieved between 2025 and 2031 via receipt of the full or partial clean vehicle tax credit.

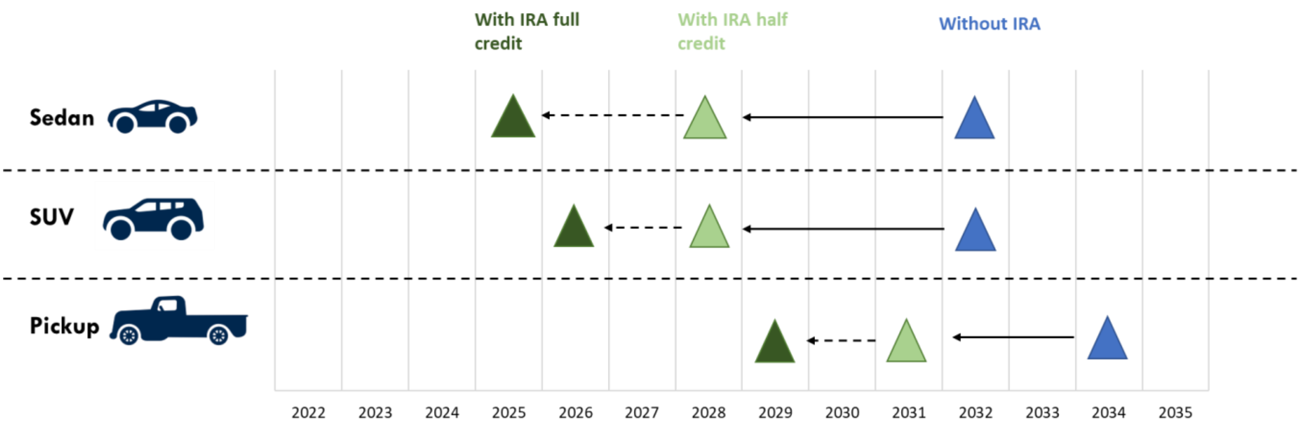

Figure 3: Impact of IRA on passenger purchase price parity

### 3.2 IRA can lead to increased EV passenger vehicle sales

The IRA-low scenario conservatively estimates that critical mineral and battery manufacturing requirements will be challenging to adhere to in the near term. The IRA-high scenario assumes industry providers will make significant investments and alterations to their current supply chains and procurement practices to leverage the IRA clean vehicle tax credit and gain a competitive advantage.

The IRA credits can enable the EV sales share to increase to 57% – 76% (the range refers to the low and high scenario) by 2032, up from 52% without the credits. This can lead to an additional cumulative sale of 4 – 25 million EVs over the next decade.

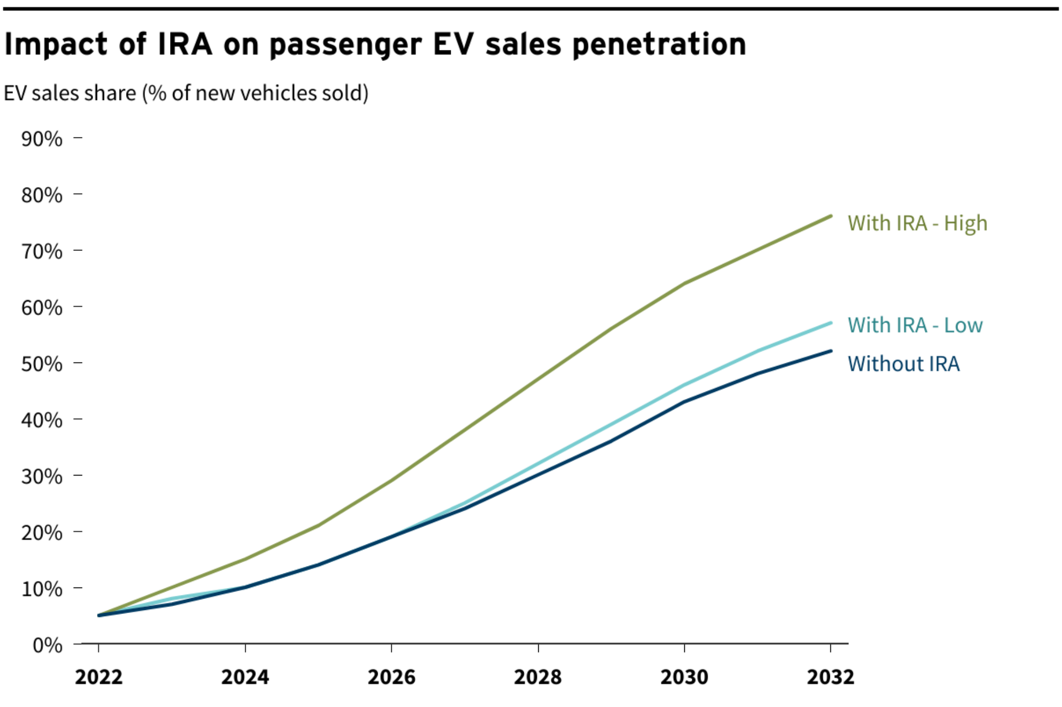

Figure 4: Passenger EV sales under IRA

### 3.3 Fleet mix to carbon reduction – why the marginal difference really matters

By assessing the current stock of passenger vehicles, this analysis models how an increased EV sales share through the implementation of the IRA can lead to a higher share of EVs on the road. Ultimately achieving a higher market share of EVs enables the market to reach a tipping point—a point in time where EVs represent 20% to 30% of the fleet mix or market share, and technology adoption can be self-sustained through market forces.[11] The figure below depicts how the enaction of the IRA can quicken the pace at which a 20% EV fleet mix is achieved. The figure below depicts how increased EV sales through IRA transpire to a higher vehicle fleet mix. Under the high IRA scenario, the share of EVs in the fleet will be roughly 30% by 2032.

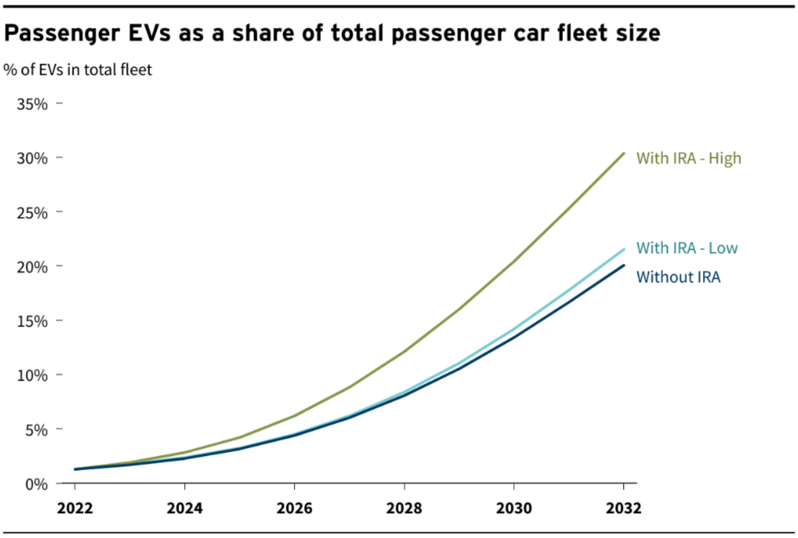


Figure 5: EV fleet mix under IRA

By achieving a high EV sales share through IRA, EVs can represent a more significant share of the fleet mix, reducing transportation emissions. By 2032 the electrification of passenger vehicles can result in a 11% reduction (88 million metric tons) in annual $CO_2$ emissions, equivalent to planting 1.5 billion tree seedlings. Cumulatively, emissions reduction between now and 2032 will amount to 340 million metric tons. Additionally, as the ICE vehicle stock reduces, emission reductions will continue post-2032. Cumulative emissions reductions from now through 2040 are estimated to be 1 giga metric tons.

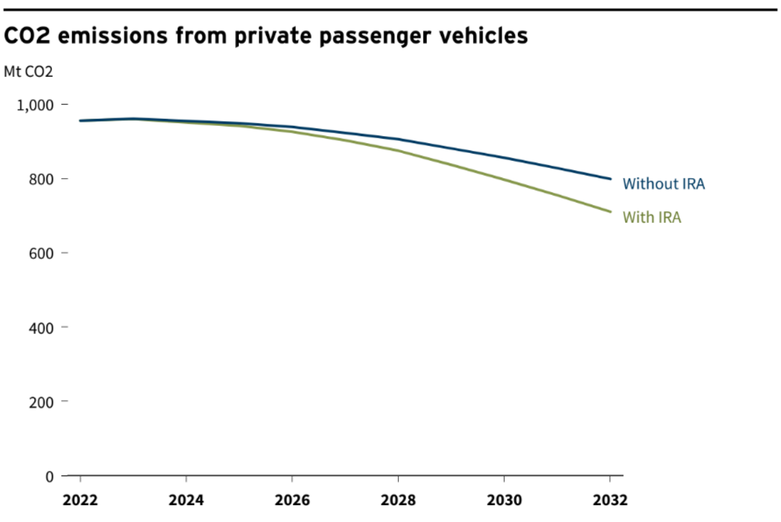


Figure 6: Passenger vehicle $CO^2$ emission reductions from IRA

### 3.4 The implications from IRA expands beyond vehicles leading battery demand growth

While this paper primarily focuses on how the IRA clean vehicle credits can lead to increased EV sales, the IRA has ramifications beyond solely the vehicle market. The IRA can also catalyze battery demand and a robust battery supply chain is needed to meet rising demand. Our analysis finds that the IRA will lead to 907 to 1205 GWH of battery demand in the passenger vehicle segment alone by 2032.

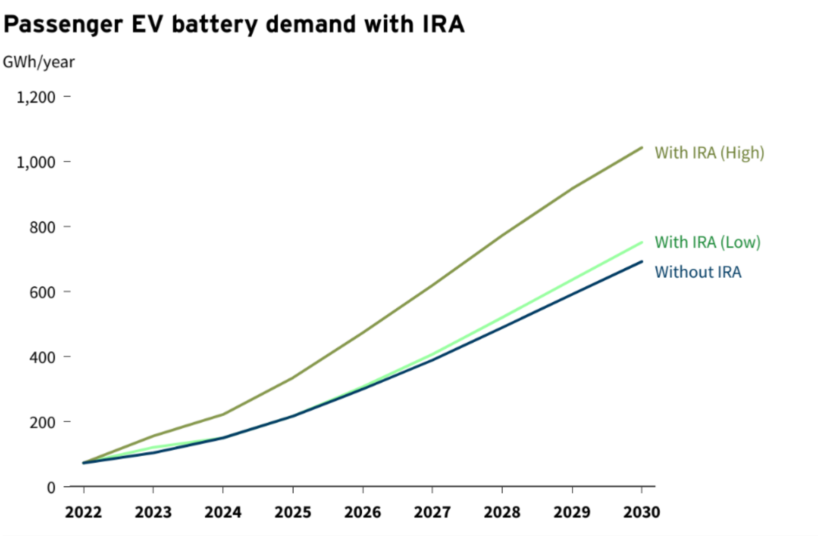


Figure 7: Increased domestic battery demand through IRA

The expected battery demand increase under the IRA is significant, and the above graph only represents the U.S. demand share in one segment, passenger vehicles. While manufacturers have pledged to install an additional 814 GWH of capacity by 2030 in response to the enaction of the IRA, these commitments are inefficient, meeting only the lower passenger EV demand threshold.[12] In addition to increased demand, the IRA will also impact how battery minerals and components are extracted, produced, and recycled. The U.S. must diversify its battery supply chain and work to strengthen relations with FTA countries to capitalize on the IRA tax credits. Adhering to the critical mineral and battery stipulations under the clean vehicle tax credit will require alterations to the current supply chain. By investing in a circular domestic battery supply chain today, the U.S. will be better positioned to meet rising battery demand, create jobs, and drive technology innovation.

## 4. Conclusion

The IRA can catalyze near term passenger vehicle adoption by providing a clear market signal, driving EV supply, and ultimately spurring uptake. Through the IRA tax credits the electrification of passenger vehicles will become more economically efficient. Under IRA, the U.S. can achieve a 76% sales penetration rate of passenger cars leading to roughly 74 million EVs on U.S. roads by 2032 (25 million additional fleet size due to IRA). This will translate to cumulative savings of 340 million metric tons of $CO_2$ emissions by 2032 and 1 giga metric tons of CO2 emissions by 2040.

## Presenter Biography

*Pranav Lakhina, Senior Associate, RMI*
Pranav Lakhina is a Senior Associate with RMI's India program. Pranav works across the areas of transport decarbonization and green hydrogen adoption. Pranav provides deep expertise in analytical modelling, policy research and analysis and interacts with industry players and policymakers to drive the agenda of clean energy transition and climate action.

*Marie McNamara, Senior Associate, RMI*
Marie McNamara is a Senior Associate with RMI's India program. In that role, Marie supports the team's efforts to provide relevant policy guidance and technical analysis to federal and state governments in India as the country transitions to a clean energy economy. Specifically, she works on electric mobility to develop freight and transportation decarbonization strategies.

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