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# California's Electrification Technology Market Outlook Panel

California Energy Commission's  
2023 Economic Outlook Workshop

January 31, 2023

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ENERGY  
INNOVATION   
POLICY & TECHNOLOGY LLC®



## NEW ANALYSIS:

# *Analyzing the Impact of the Inflation Reduction Act on Electric Vehicle Uptake in the United States*

A joint analysis by:



Just released today, 1/31/2023

## KEY RESEARCH QUESTIONS

- What impact does the Inflation Reduction Act (IRA) have on the sales shares of electric vehicles (BEVs + PHEVs) for light-duty and heavy-duty vehicle sectors, under different modeled scenarios?
  - **Baseline (Pre-IRA) + 3 IRA Scenarios:**  
Low, Moderate, and High
  - **2 Additional State Standard Scenarios for LDVs:**
    - CA-Only Adoption of ACCII
    - Increased State adoption of ACC II
  - **HDV analysis assumes existing state adoption of Advanced Clean Trucks rules**
- What do these findings imply for transportation sector emissions reductions and policy actions?

# Our Approach to Modeling the IRA Clean Vehicle Provisions

Energy Innovation modeled select IRA provisions using a customized Excel model, based on similar modeling\* done using our U.S. Energy Policy Simulator:

- Personal Tax Credits for Clean Passenger Vehicles (30D)
- Commercial Vehicle Tax Credit (45W)
- Advanced Manufacturing Production Tax Credit (45X)

We updated our original analysis using recent ICCT data:

- *Vehicle costs*
- *Battery pack estimates*
- *Efficiencies*
- *Charging behavior*
- *Future fuel prices*
- *State ACCEII adoption rates and ZEV goals*

\* Energy Innovation's original analysis of the IRA modeled the impacts of the EV Charging Infrastructure Tax Credit (30C); however, that provision is not incorporated into this modeling exercise. In addition, the used vehicle tax credit was not included in this analysis. We also do not account for the potential impacts of the recent IRS guidance on tax credit eligibility for leased passenger vehicles in this analysis.

# Modeled IRA Scenarios – Light-Duty Vehicles

IRA provision		IRA scenario		
		Low	Moderate	High
Passenger clean vehicle tax credit (30D)	Domestic battery assembly	100% of new BEVs are eligible for the full \$3,750 value		
	Critical minerals sourcing	In 2023, it is assumed that 100% of new BEVs meet the critical minerals sourcing requirements and thus are eligible for the full \$3,750.		
		For future years, the share of new vehicles that meet the requirements are as follows:		
		76% in 2025 56% in 2030 55% in 2032	79% in 2025 72% in 2030 78% in 2032	82% in 2025 89% in 2030 100% in 2032
	MSRP eligibility	87% of new BEVs qualify		
	AGI eligibility	68% of new BEVs qualify in 2023 and 77% qualify in 2030		
	Entities of concern limitation	No new BEVs qualify	50% of new BEVs qualify	100% of new BEVs qualify
	Final vehicle assembly	Sufficient North American assembly capacity to meet demand		
Average 30D incentive value 2023–2032:	\$3,400	\$5,000	\$6,150	
Advanced manufacturing production tax credit (45X)	Value of \$45/kWh battery credit passed to consumer, with phase out by 2033	0% for all years	25% in 2023 50% in 2024–2029 37.5% in 2030 25% in 2031 12.5% in 2032 0% in 2033	50% in 2023 100% in 2024–2029 75% in 2030 50% in 2031 25% in 2032 0% in 2033
	Average 45X incentive value 2023–2032:	\$0	\$1,450	\$2,900
Average incentive value of 30D and 45X combined, 2023-2032:		\$3,400	\$6,450	\$9,050

# Advanced Clean Cars (ACC II) and Advanced Clean Trucks (ACT) Assumptions

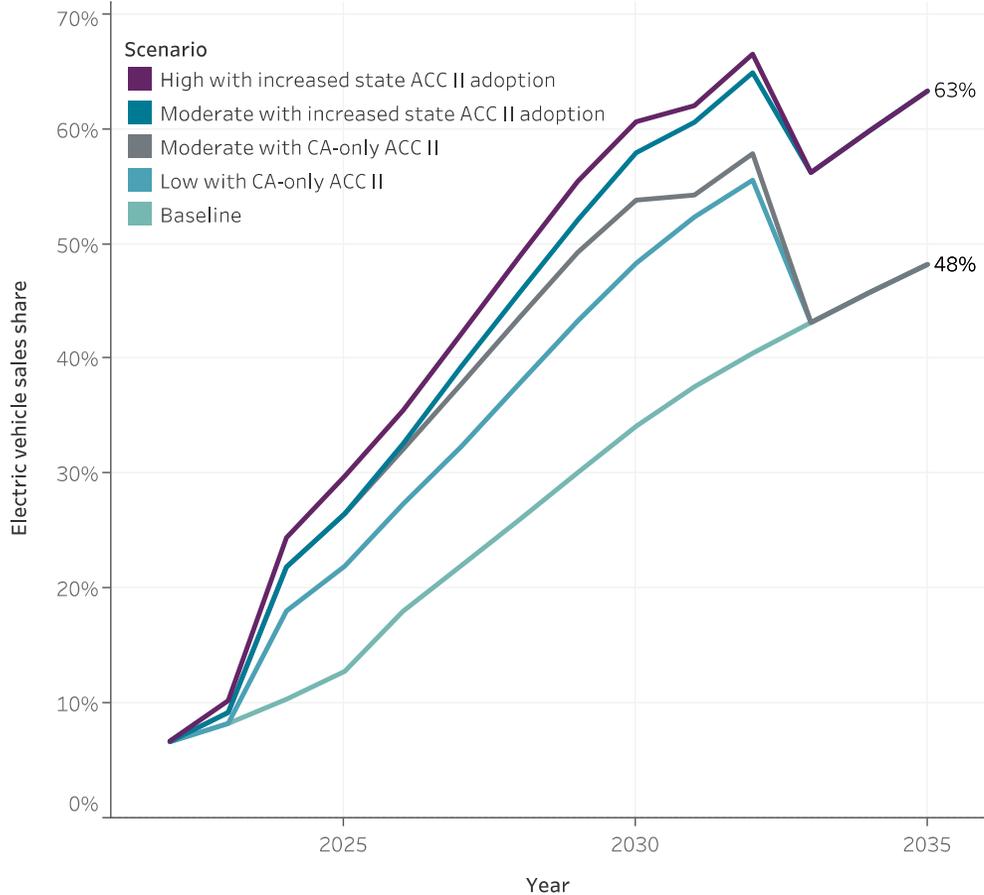
- **For Light-Duty Vehicles**, the analysis includes two scenarios evaluating state adoption of California's Advanced Clean Cars II (ACC II) rule
  - *IRA-Moderate with BAU ACC II Adoption (i.e., only California adopts ACC II)*
  - *IRA-Moderate with Increased State ACC II Adoption (i.e., all states that have adopted ACC I also adopt ACC II)*
- **For Heavy-Duty Vehicles**, for all scenarios, we assume only states that have already adopted California's Advanced Clean Trucks rule and CA ZEV targets.
  - CA targets start in 2024; all other states start in 2025
  - *Also includes additional ZEV targets from CA's Innovative Clean Transit rule for bus segments*

# Topline Research Findings

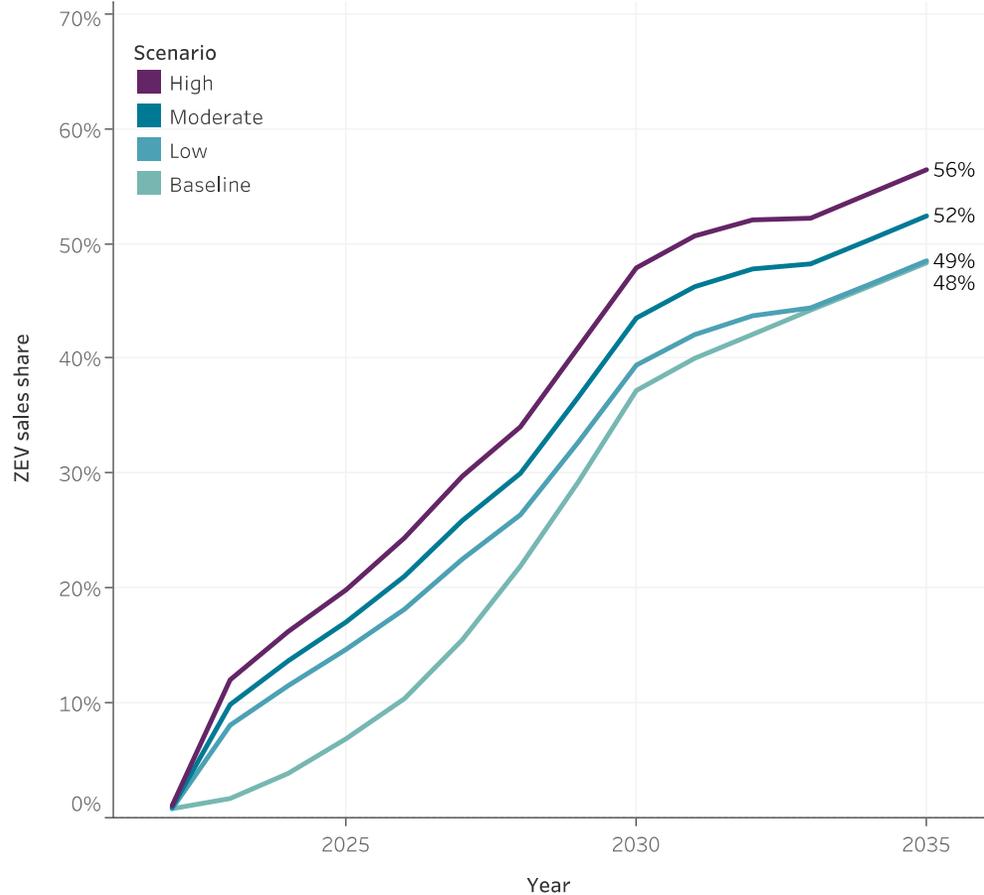


# With IRA, ZEV Sales Shares in the Light-Duty and Heavy-Duty Markets Will See Faster Growth, Relative to Baseline (pre-IRA)

Light-duty vehicles



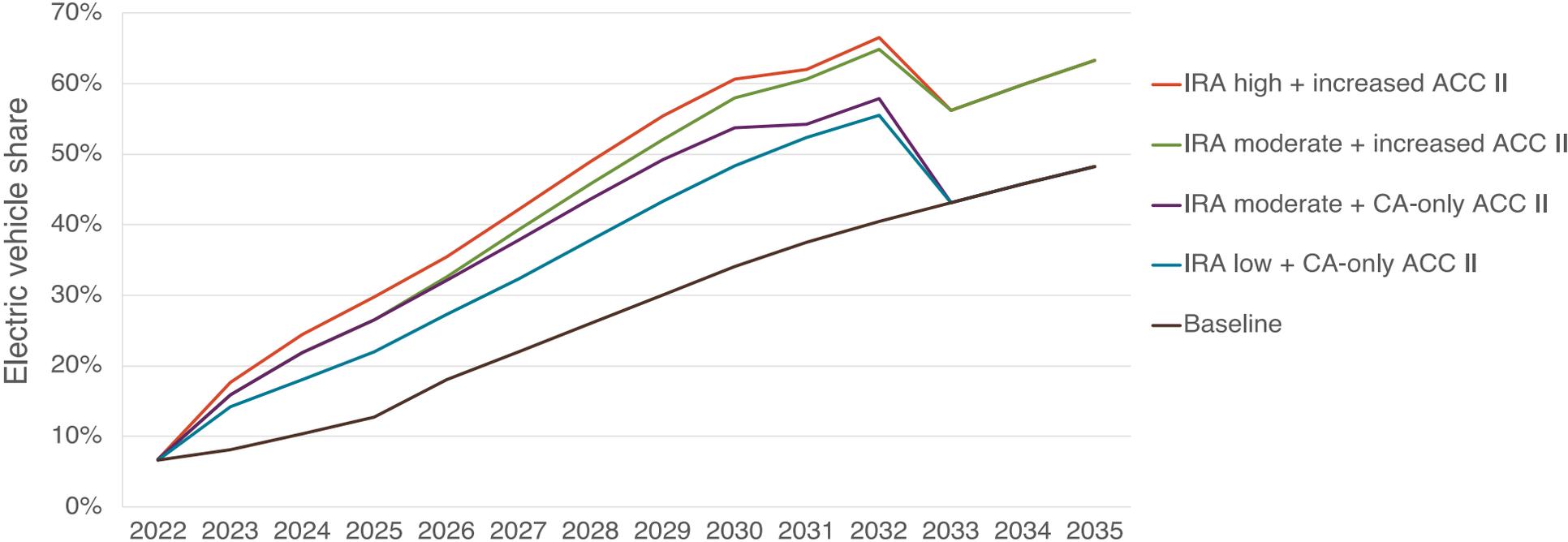
Heavy-duty vehicles



(Left graph) Baseline (pre-IRA), Low, Moderate, and High IRA Scenario projections of EV sales shares for HDVs, showing ACC II adoption in only California versus increased state adoption of ACC II. EVs include both battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).

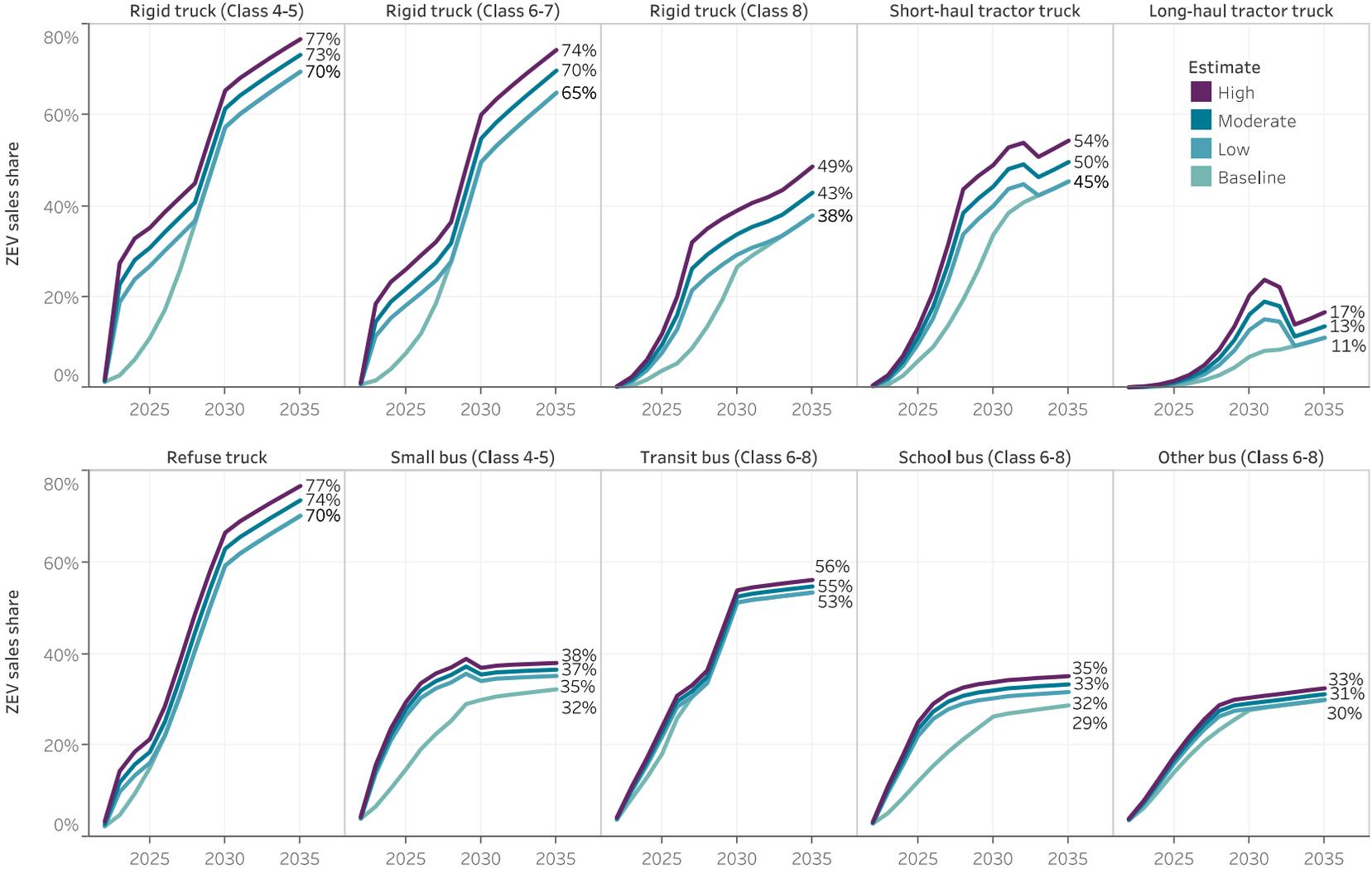
(Right graph) Baseline (pre-IRA), Low, Moderate, and High IRA Scenario projections of ZEV sales shares for HDVs. ZEVs include BEVs and hydrogen fuel cell vehicles, which make up a relatively small percentage of HDVs.

# Under the IRA Moderate Scenario + Increased State Adoption of ACC II, EVs\* could make up nearly 60% of new light-duty car sales by 2030



\* EVs includes battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs)

# The IRA will Accelerate new Sales of Commercial, Heavy-Duty ZEVs Across All Classes



\* ZEVs includes BEVs and hydrogen fuel cell electric vehicles. For all truck and bus classes, ZEV sales are projected to be dominated by BEVs. Among truck classes, FCEVs make up less than 1% of total sales in all years.

# Key Takeaways

- The IRA can potentially drive high rates of electrification over the coming decade.
- The rates of electrification achieved with the IRA fall short of what's needed to reduce on-road emissions for climate stability.
- Battery electric technology will likely play a much larger role than hydrogen in decarbonizing the road transportation sector.
- Strong federal GHG standards for light- and heavy-duty vehicles will be needed to provide a backstop for the IRA and ensure electrification continues after the tax credits expire.
- Continued state leadership is needed to amplify the benefits and impacts of the IRA.
- Additional actions from governments and industry can help overcome barriers to electrification
  - *E.g., charging infrastructure for heavy-duty vehicles, investments in the domestic supply chain, manufacturing of new vehicle technologies, etc.*



# Thank you.



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# Appendix: Modeling Methodology



# Modeling the IRA's Impact on Consumer Vehicle Choice

- We calculate an average credit value for covered vehicle classes and use a logit allocation function to estimate the impact of select incentives on *new vehicle sales*
- The logit function allocates new vehicle shares based on the discounted TCO of vehicles across different technologies
- **TCO includes:**
  - *Purchase costs*
  - *Fuel costs*
  - *Maintenance costs*
  - *Insurance costs*
  - *Parking costs*
  - *Licensing and registration*
  - *Monetized barriers (e.g., range anxiety)*
  - *Tax credits & incentives*
- **Discount rate of 15% applied, based on real-world data**
- **Shareweights prevent over-allocation to newer technologies and before supply chains are in place**



# Personal Tax Credit for Clean Passenger Vehicles (30D)

- **Weighted average tax credit value that combines all the tax credit requirements**
- **Estimate share of vehicles that can meet...**
  - *Domestic battery assembly*
  - *Critical minerals requirements*
  - *Entities of concern restrictions*
- **Reduce tax credit by share of vehicles under MSRP cap**
- **Limit credit to the lesser of BEVs assembled in North America**
- **Apply further limit based on AGI cap**
- **Transferability of this credit value results in slight reduction of credit due to transaction costs**

# Domestic Battery Assembly Credit Value Estimates

- **Compare estimated N. American battery manufacturing capacity to sales of U.S LDVs and estimated battery demand**
  - *Projected Manufacturing Capacity: 1,137 GWh/year by 2030*
  - *Existing Capacity: 56 GWh/year*
  - **Total Capacity by 2030: 1,193 GWh/year**
  - **Average battery size per new vehicle: 65.5 kWh/year per vehicle**
- **Estimated future capacity could supply more than 18 million new LDV EVs per year by 2030 (i.e., a sales share of greater than 100%)**
- **Therefore...full tax credit value (\$3,750) for meeting this requirement allocated across all three scenarios**

# Critical Mineral Credit Value Estimates

- Estimates of value of minerals in EV batteries based on average weight of different minerals across new vehicle sales and relative cost share of each mineral.
- Share of each mineral supplied domestically or by countries holding FTA with U.S.
- Estimated weighted dollar value of qualifying minerals in U.S. batteries relative to new requirements
  - *Low Scenario: 56% of new BEVs would qualify by 2032*
  - *Moderate Scenario: 78% of new BEVs qualify in 2032*
  - *High Scenario: 100% of new BEVs qualify in 2032*
- Percentages multiplied by credit value of \$3,750 to get estimates for each scenario

# Estimating Impact of New MSRP Cap

- Combine 2021 sales data by manufacturer and MSRP of EVs to develop a sales-weighted share of vehicles that qualify
- For most manufacturers, all or no EV models were below the MSRP cap except for Tesla
- Across all available manufacturers and models, the sales-weighted average share of all EVs that qualified for the incentive is 87%
- This value was applied to deflate the average incentive available to consumers



# Estimating Potential U.S. EV Manufacturing Capacity

- **ICCT report informed estimates of future N. American EV manufacturing capacity**
- **2025 North American production is 2.8 million BEVs (upper bound, high scenario)**
  - *Based on capacity from facilities: existing full electric + full electric conversion + new full electric + 1/3 of partial electric + 3% of ICE manufacturing plants + announced plants by 2025*
- **2030 North American production capacity is 5.6 million BEVs (upper bound, high scenario)**
  - *Based on capacity from 2030 commitments for 6 main U.S. manufacturers + ICCT data + Canadian plants (no data available for Mexican production facilities, excluded)*
- **Assume production-to-capacity ratio of ~77%**

# Estimating Impact of AGI Cap

- Census Bureau data aggregated by Center for Sustainable Energy on vehicle purchases by income bracket, adjusted based on historical data
- AGI caps eliminate 32% of new EV buyers in 2023 and 23% by 2030



# Estimating Impact of the Entities of Concern Limitation

- **Most significant constraint on tax credits**
- **Estimates vary substantially based on current market conditions**
- **Currently few critical mineral processing facilities are planned for N. America, and they can take 3-4 years to build**
- **Modeled Assumptions:**
  - *Low Scenario: No vehicles qualify for tax credit*
  - *Moderate Scenario: 50% of vehicles qualify (in line with upper limit from BloombergNEF)*
  - *High Scenario: 100% of vehicles will qualify for the credit*

# Modeling Battery Production Tax Credits (45X)

- **Some value of this credit (\$45/kWh) assumed to be passed onto consumers through lower battery prices and lower vehicle MSRPs**
- **Estimated impact on EV adoption**
  - *Average potential credit by vehicle type = battery pack size X credit value*
  - *Credit discounted to account for extant market factors (e.g., PTC may be used to buy down the cost differential between producing the batteries domestically and sourcing them internationally, but not reduce vehicle MSRP)*
- **We assume 50% of batteries will qualify in 2023 and 100% in 2024**
- **Other manufacturing and domestic supply chain provisions not modeled, but it is plausible they would have the effect of further reducing battery pack prices**

# Modeling Battery Production Tax Credits (45X), continued...

Modeled Assumptions, % of PTC value passed through to consumers via lower MSRP

YEAR	LOW	MODERATE	HIGH
2023	0%	25%	50%
2024	0%	50%	100%
2025 - 2029	0%	50%	100%
2030 (start of incentive phase out)	0%	37.5%	75%
2031	0%	25%	50%
2032	0%	12.5%	25%
2033+ (incentive expires)	0%	0%	0%



# Modeling State Adoption of Advanced Clean Cars II (ACC II)

- Our analysis of passenger vehicles reflect two new Scenarios, combined with IRA Scenarios
  - BAU ACC II Adoption, which includes only California ACC II
  - Increased State ACC II Adoption, which includes increased state adoption of ACC II based on all states that have adopted ACC I also adopt ACC II
- We incorporated the following data and assumptions to account for the impacts of ACC II:
  - The share of U.S. LDV sales in each year for the prospective ACC II states, by expected implementation date
  - The ZEV targets for each of the ACC II adopting states

# ACC II States: Share of 2021 US Light-Duty Vehicle Sales and Model Year for ACC II Implementation

ACC II states	Share of 2021 US LDV sales	Model year for ACC II implementation
California	11.8%	2026
Colorado	1.7%	2027
Connecticut	1.1%	2026
Delaware	0.3%	2027
Maine	0.4%	2027
Maryland	1.8%	2026
Massachusetts	2.1%	2026
Minnesota	1.4%	2027
Nevada	0.9%	2026
New Jersey	3.5%	2027
New Mexico	0.5%	2027
New York	6.2%	2026
Oregon	1.1%	2026
Rhode Island	0.3%	2027
Vermont	0.3%	2026
Virginia	2.3%	2027
Washington	1.8%	2026

Sample of State Assumptions for ACC II State ZEV Market Share (BEV, PHEV, and FCEV)

YEAR	CA	NY	OR	RI	VT	VI	WA
2026	35%	35%	35%	NA	35%	NA	35%
2027	43%	43%	43%	43%	43%	43%	43%
2028	51%	51%	51%	51%	51%	51%	51%
2029	59%	59%	59%	59%	59%	59%	59%
2030	68%	68%	68%	68%	68%	68%	68%
2031	76%	76%	76%	76%	76%	76%	76%
2032	82%	82%	82%	82%	82%	82%	82%
2033	88%	88%	88%	88%	88%	88%	88%
2034	94%	94%	94%	94%	94%	94%	94%
2035	100%	100%	100%	100%	100%	100%	100%

Source: ICCT