



CENTER FOR  
AUTOMOTIVE  
RESEARCH

# The EV Transition

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Vice President of Economic Growth and Innovation

July 2024





## WHAT WE DO

An independent nonprofit organization producing industry-driven research and fostering dialogue on critical issues facing the automotive industry and its impact on the U.S. economy and society.

### RESEARCH

CAR helps you navigate the uncertain automotive environment through thought-provoking, independent, multi-disciplinary, and unbiased research and analysis of important industry trends and changes.

### EVENTS

CAR hosts industry-driven events to disseminate key research, update stakeholders on critical issues, and foster discussions among thought leaders to share their insights and solutions to meet the challenges of an ever-evolving global automotive industry.

### PROGRAMS

CAR fosters communication and support to promote the auto industry and the issues it faces today by bringing together communities, automakers, suppliers, and technology companies.

# AGENDA

- **EV Transition**
- **Inflation Reduction Act**
- **IRA Impact**
- **EV Challenges**

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# EV Transition

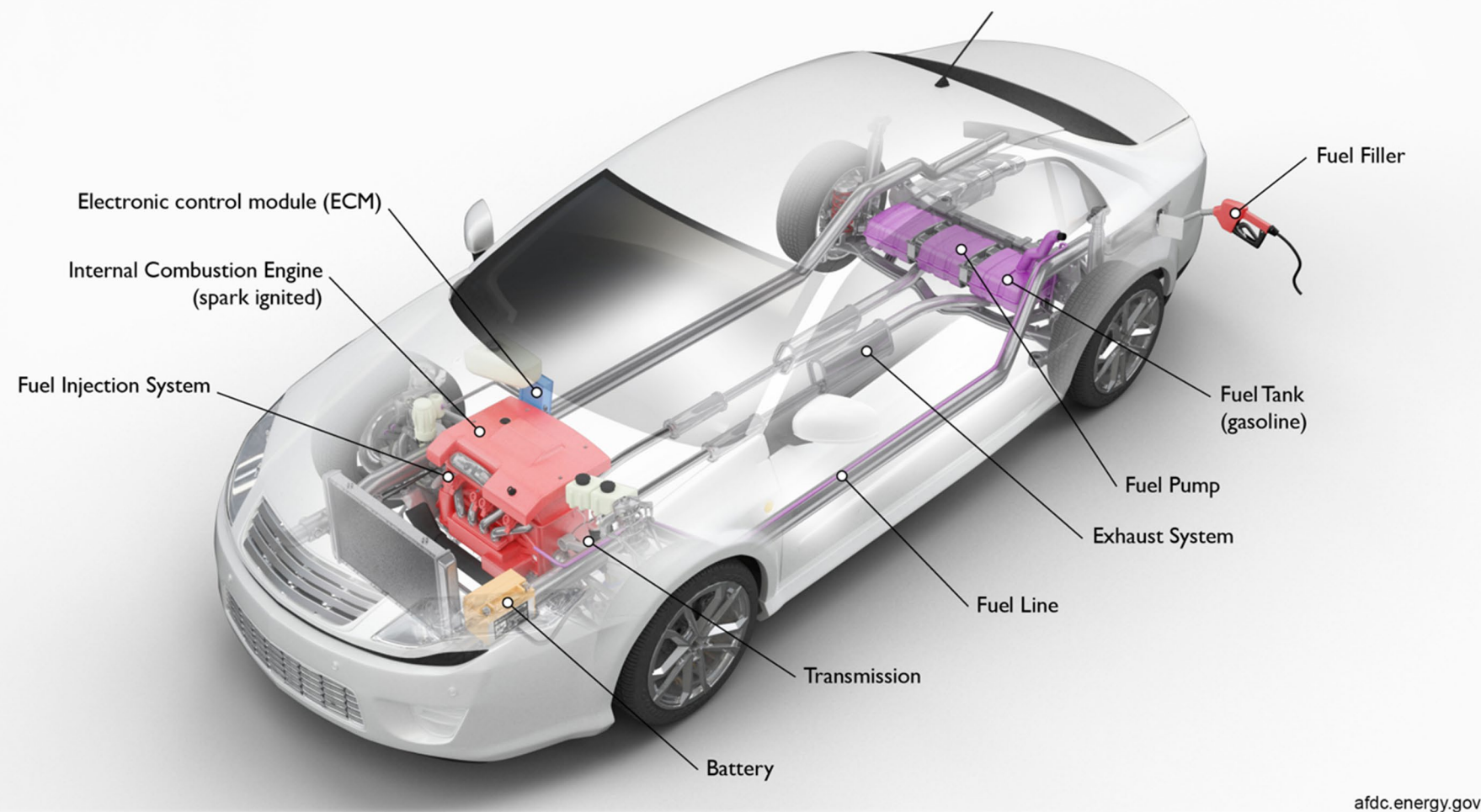
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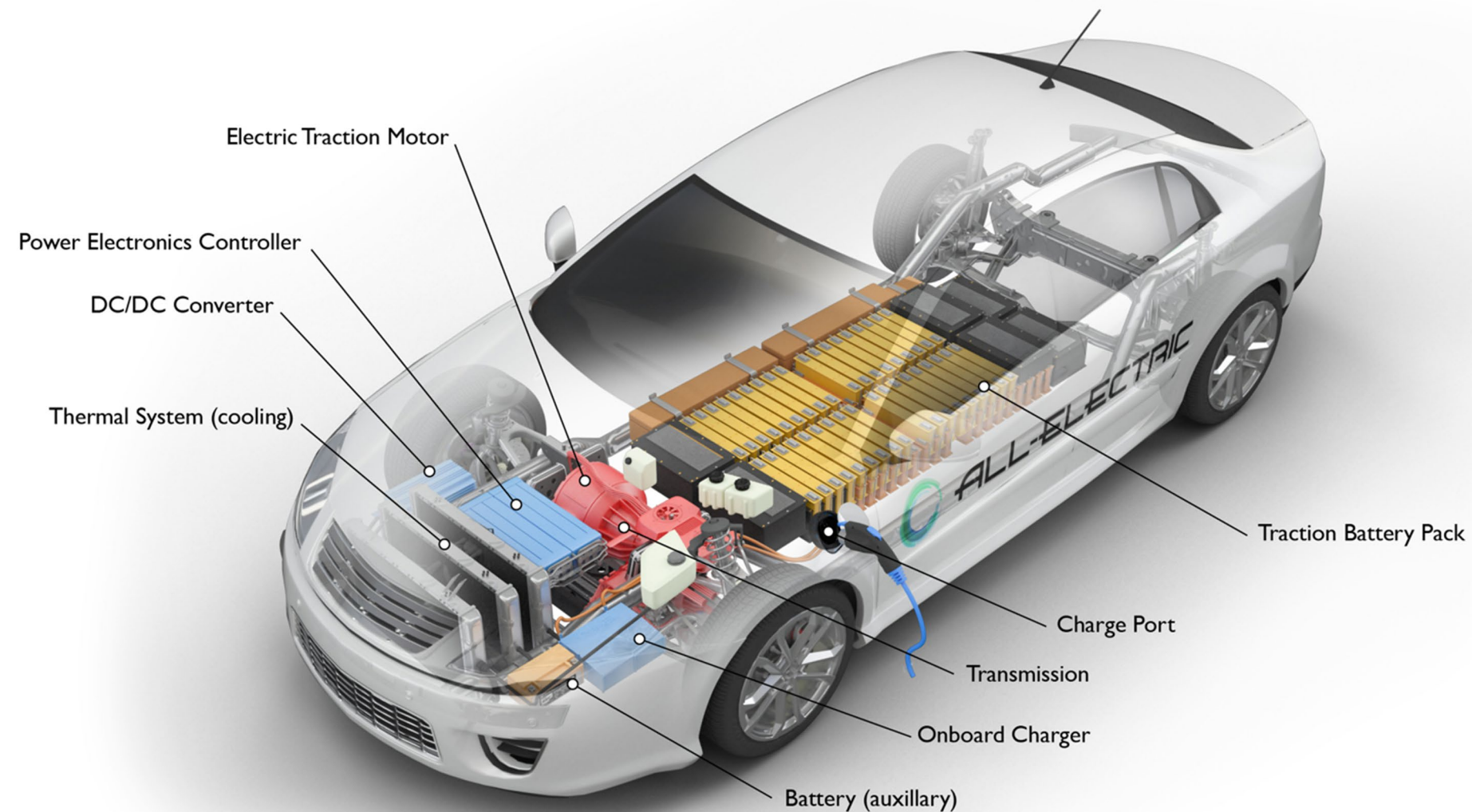


# ICE to EV: Electrified Powertrain Impact on Vehicle Components & Systems

Gasoline Vehicle



All-Electric Vehicle



- EV systems added:
- Battery
  - Electric Motor(s)
  - Power Electronics

ICE systems lost in transition:

- Engine
- Fuel Systems
- Exhaust Systems



# The Electric Vehicle Transition Implications of ICE to BEV Systems



## Major Systems Affected by Transitioning to BEV

Est. Impact On Jobs	System Difference/ Role Changes
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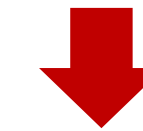
ICE Example Vehicle



✗	Fuel system (Eliminated)
✗	Exhaust system (Eliminated)
⚠	Axles, driveshafts & auxiliary components (Reduced content)
⚠	Clutches, planetary gears & torque converter replaced with electric drives
✗	Engine (Eliminated)
+	Power electronics & high-voltage electrical architecture (Added)
+	Battery pack (Added)
+	Body structures (increased content), infotainment (upgraded), safety (upgraded), Climate Ctrl. (upgraded)



Displaced Employees



Displaced Employees



DC/DC Converter + auxiliary battery



Electric Traction Motor + Transmission



Displaced Employees



Power Electric Converter



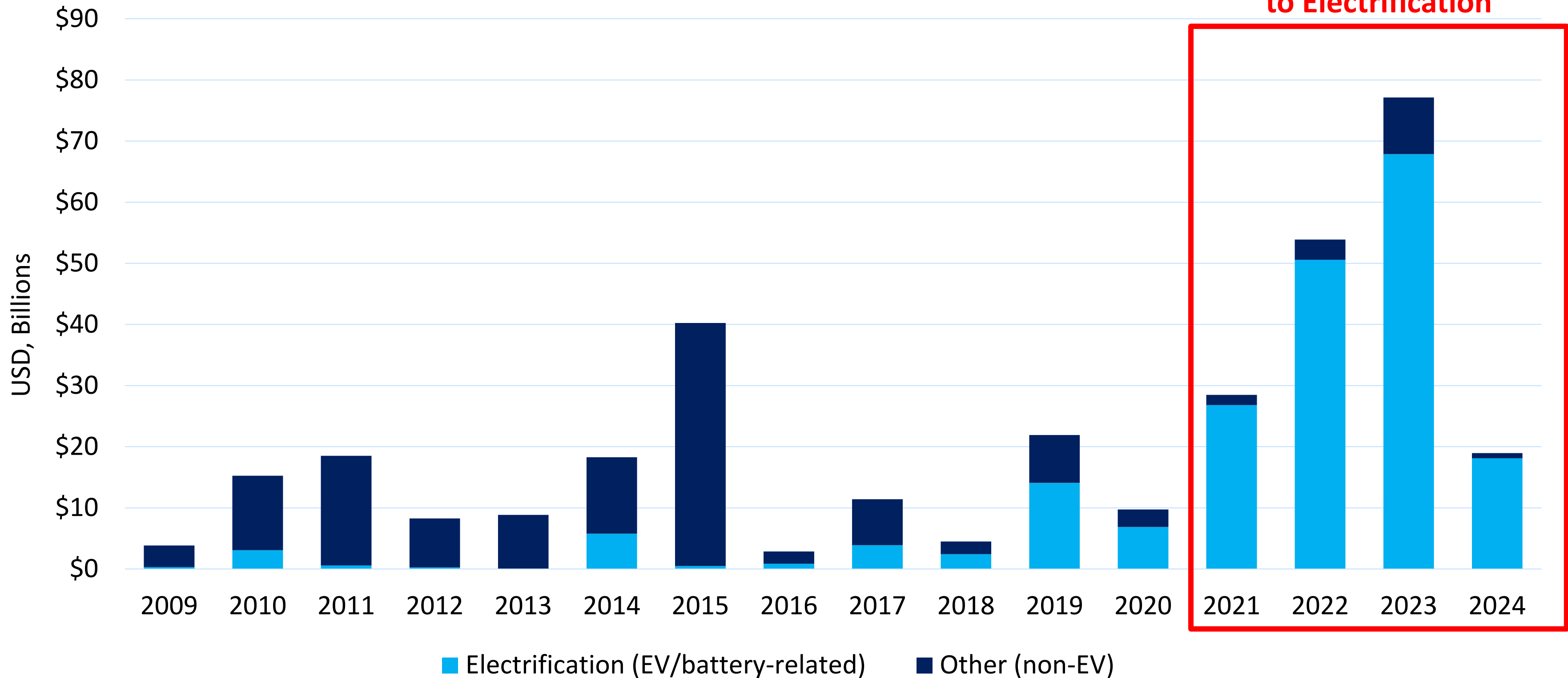
Traction Battery Pack, Charger, Charge Port



Materials, In-Cabin Electronics, Safety systems, Thermal Control



# Automaker Announced Investment North America, 2009 – June 2024



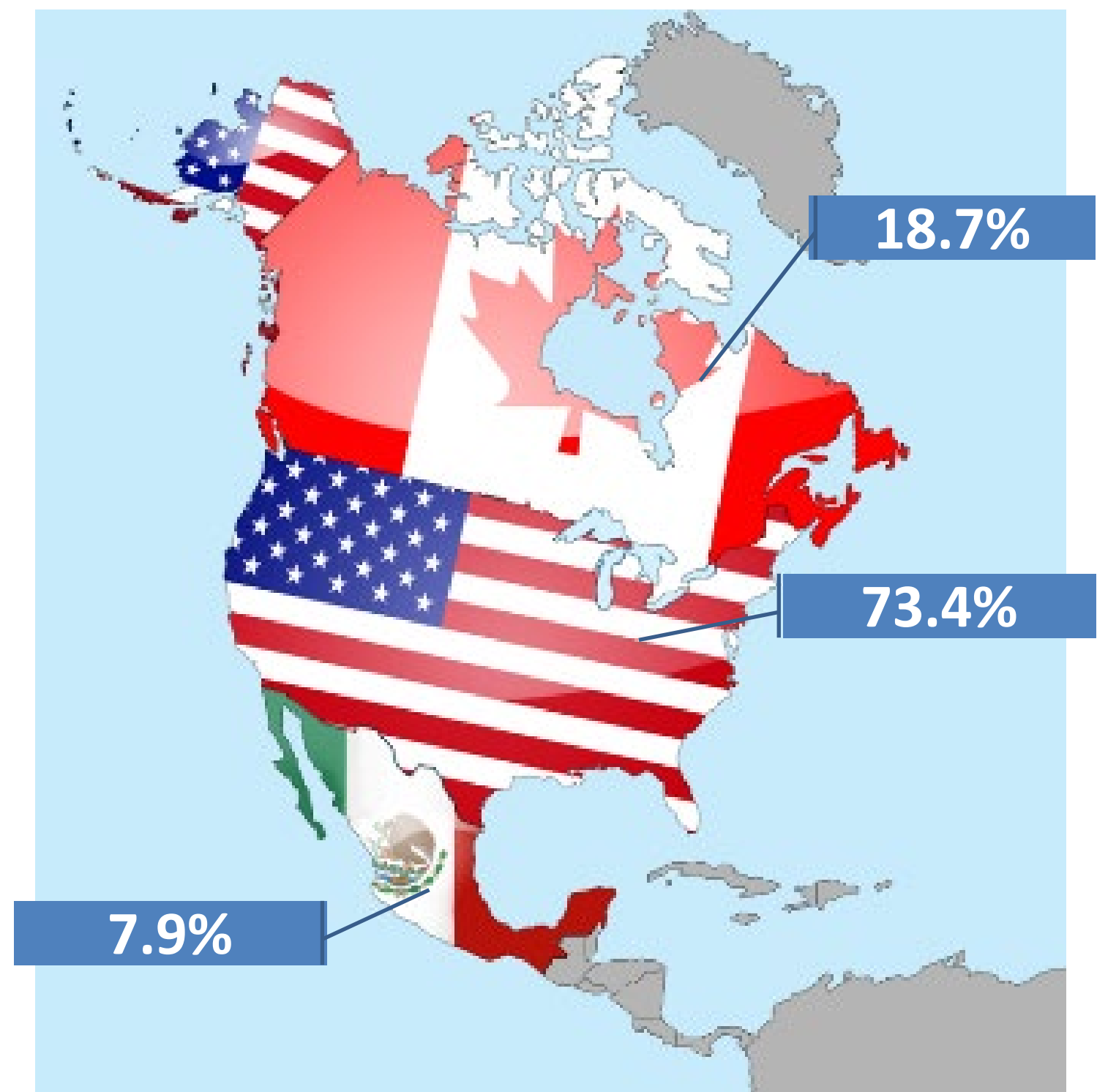
**\$163 Billion linked to Electrification**



# Automaker Announced EV/Battery-Related Investment North America, 2018 – June 2024

Region	Investment Amount (\$USD)
Canada	\$35.0B
United States	\$137.1B
<i>U.S. Great Lakes</i>	\$64.7B
<i>U.S. South</i>	\$67.1B
<i>U.S. Other</i>	\$5.3B
Mexico	\$14.7B
<b>Total</b>	<b>\$186.8B</b>

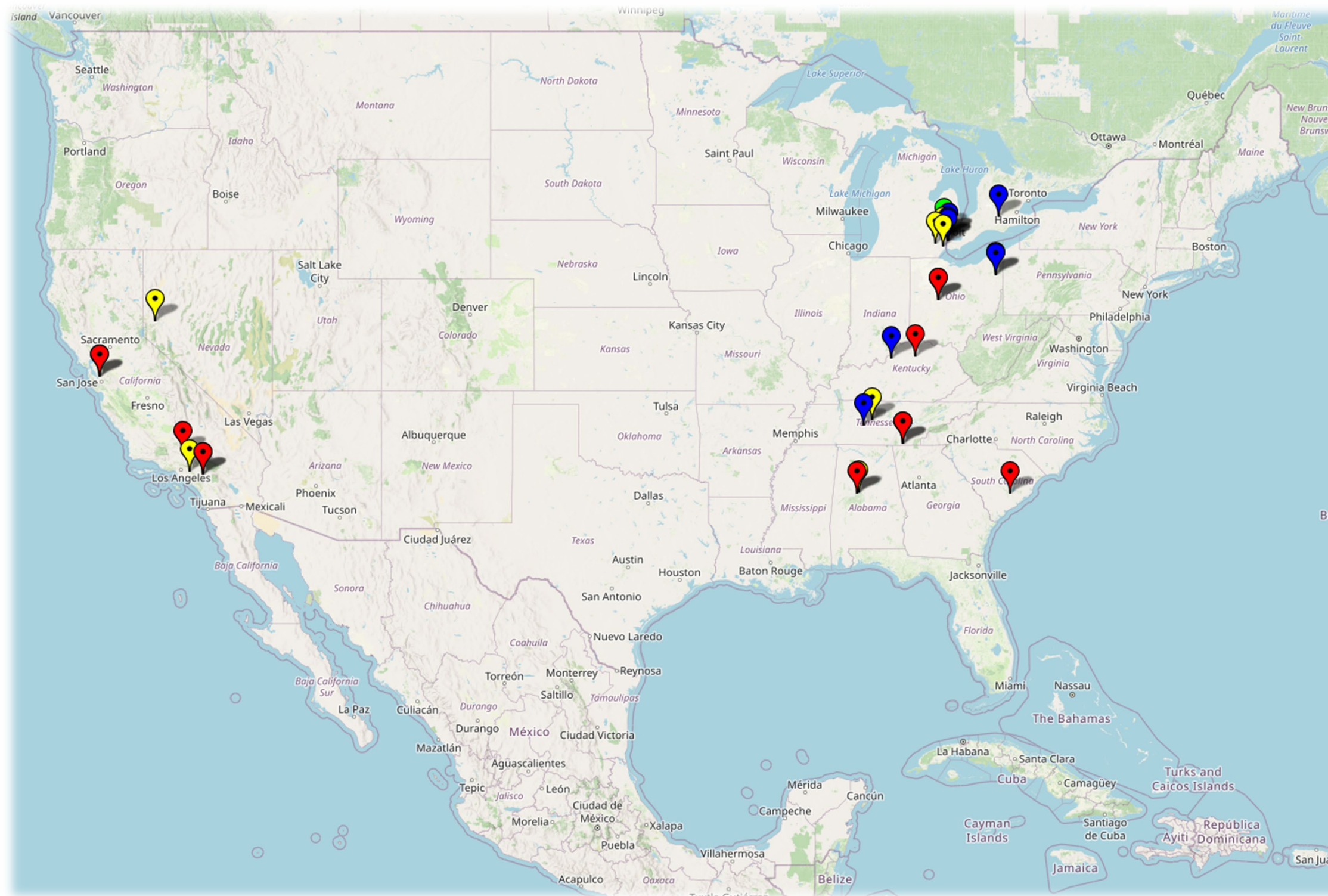
Note: U.S. Great Lakes includes: IL, IN, KY, MI, MO, and OH  
 U.S. South includes: AL, FL, GA, MS, NC, SC, TN, and TX





# Major North America EV and Battery Investment Announcements by OEMs

Base: 2019



**Investment Type**

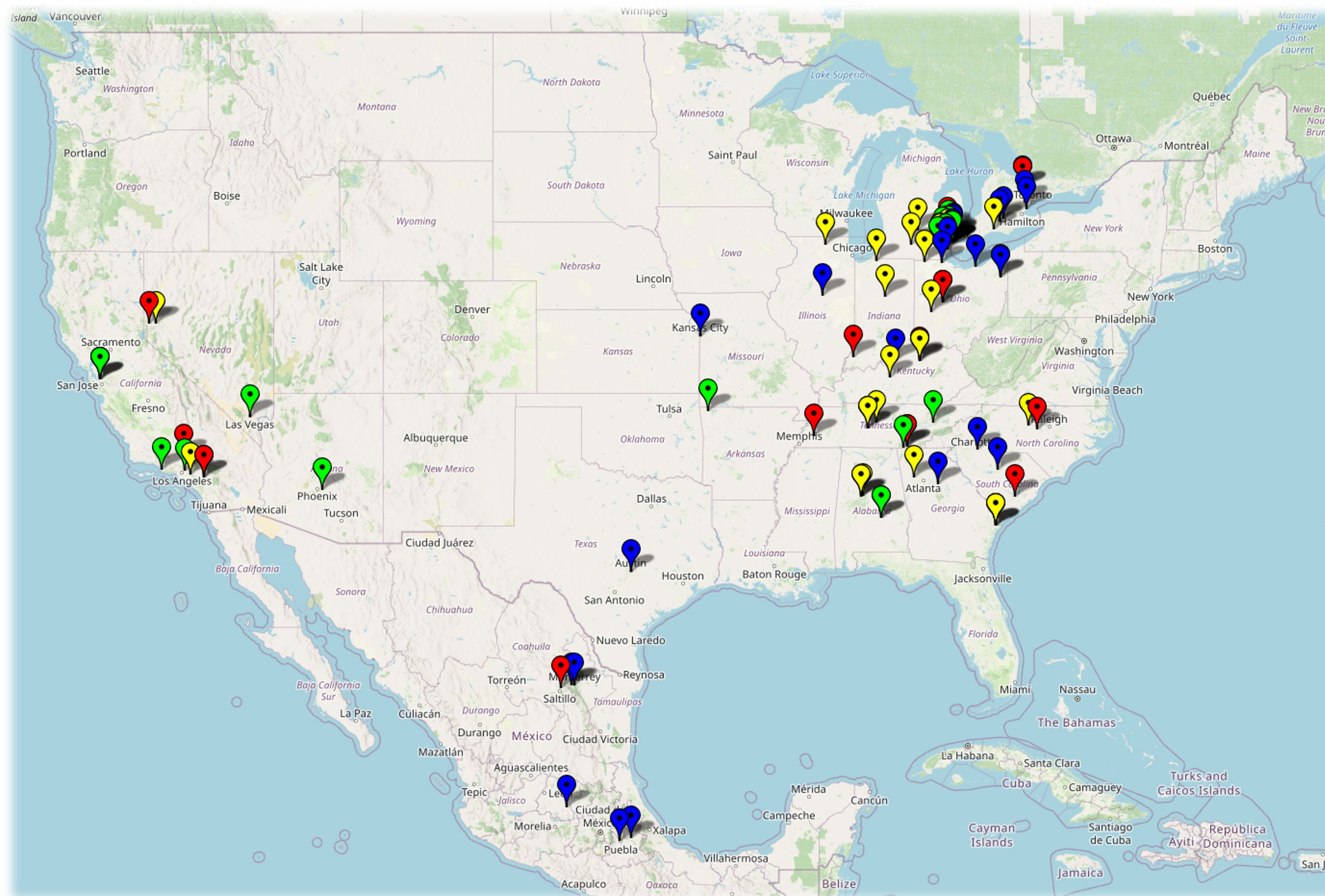
- Battery
- Electric Vehicle
- EV and Battery
- R&D

Source: CAR Book of Deals, GPS Visualizer

Note: Only Battery, Electric Vehicle, and EV and Battery announcements of over \$1.0 billion shown on map



# Major North America EV and Battery Investment Announcements by OEMs 2019 – June 2024



Investment Type	
	Battery
	Electric Vehicle
	EV and Battery
	R&D

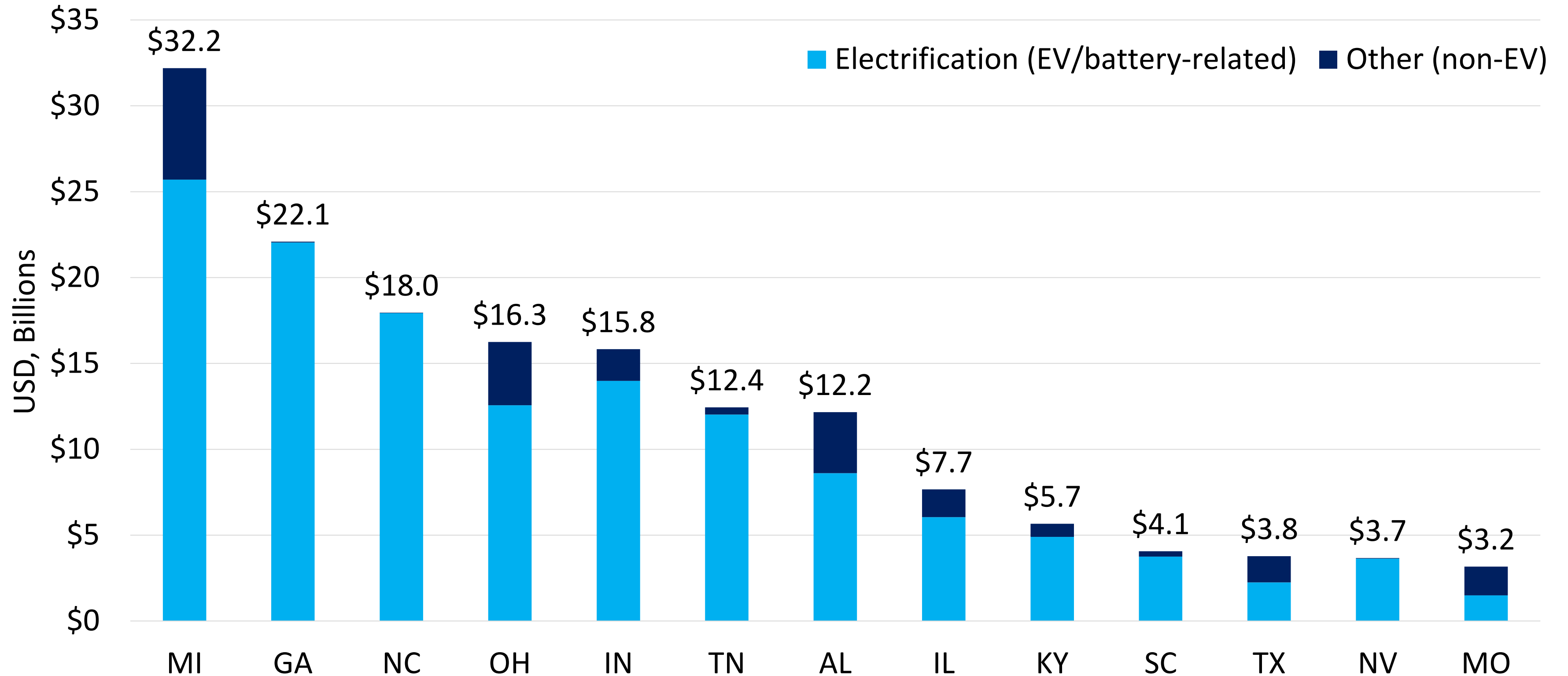
Note: Only Battery, Electric Vehicle, and EV and Battery announcements of over \$1.0 billion shown on map

Source: CAR Book of Deals, GPS Visualizer



# Automaker Announced Investment

United States\*, 2018 – 2024 YTD (June), 85% EV/battery-related



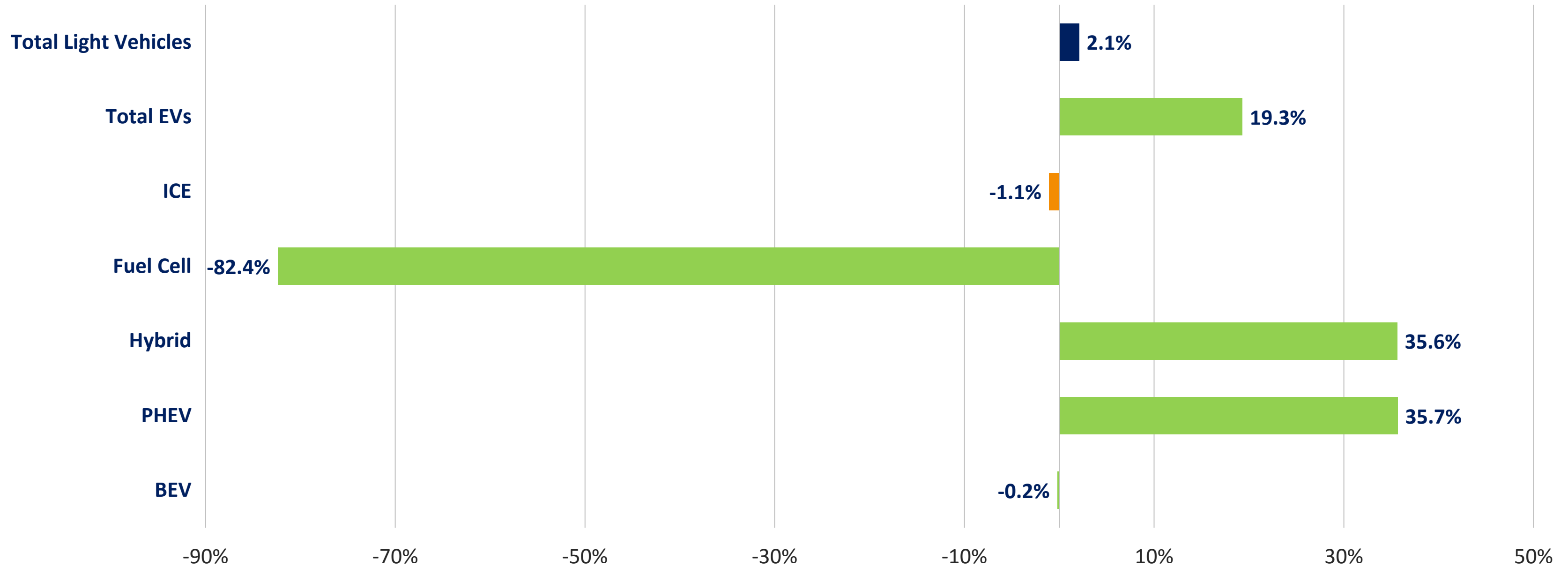
Source: CAR Book of Deals, 2024

\*States with \$1.0 or more announced investment captured



# PHEV and Hybrid sales outgrow ICEs and BEVs; FCEV sales declined sharply

**Segment Breakdown: U.S. Light Vehicles Sales Percent Change**  
2024 YTD vs. 2023 YTD through June

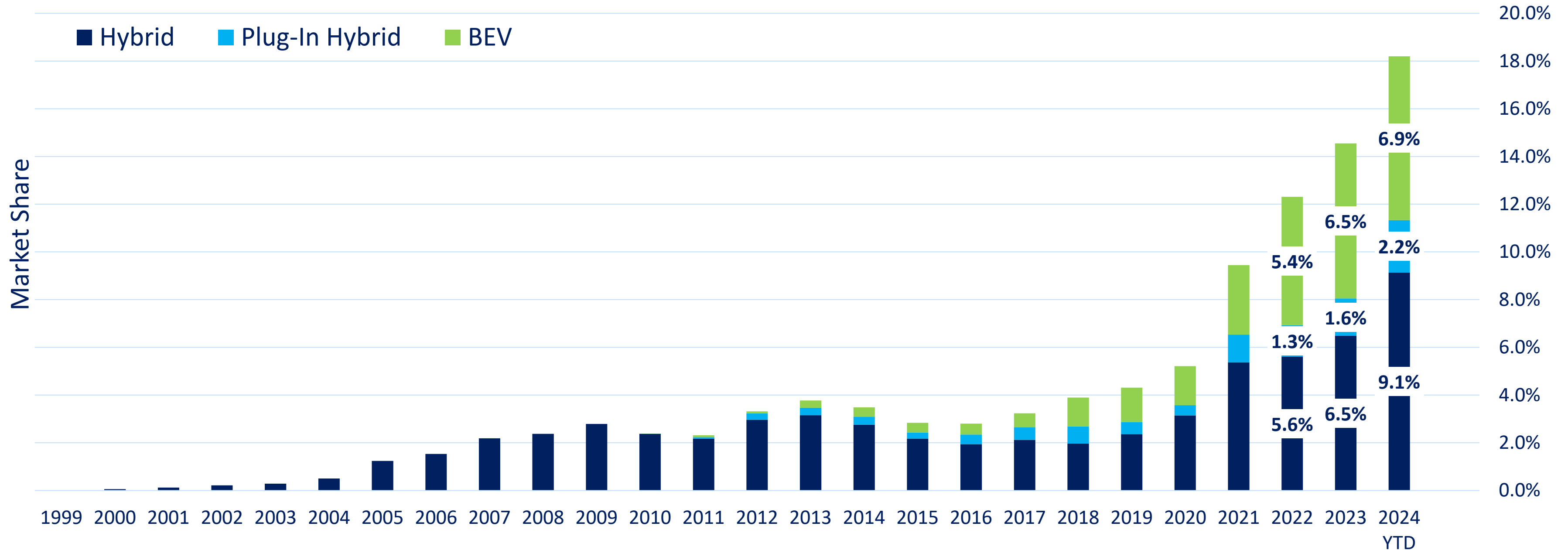


Source: Wards Intelligence Reports and CAR Research



# Hybrid, Plug-In Hybrid, and BEVs are all at historically high market shares

## U.S. Electrified Light Vehicle Sales by Propulsion Technologies 1999 – 2024 YTD



Note: Electrified vehicles consist of BEV, HEV and PHEV  
 Source: Ward's Automotive Reports (from 2010 and on), HybridCars.com and CAR Research



# Inflation Reduction Act

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# Inflation Reduction Act

- **Clean Vehicle Credit**
- **Previously-Owned Clean Vehicles**
- **Credit for Qualified Commercial Clean Vehicles**
- **Advanced Manufacturing Production Credit**

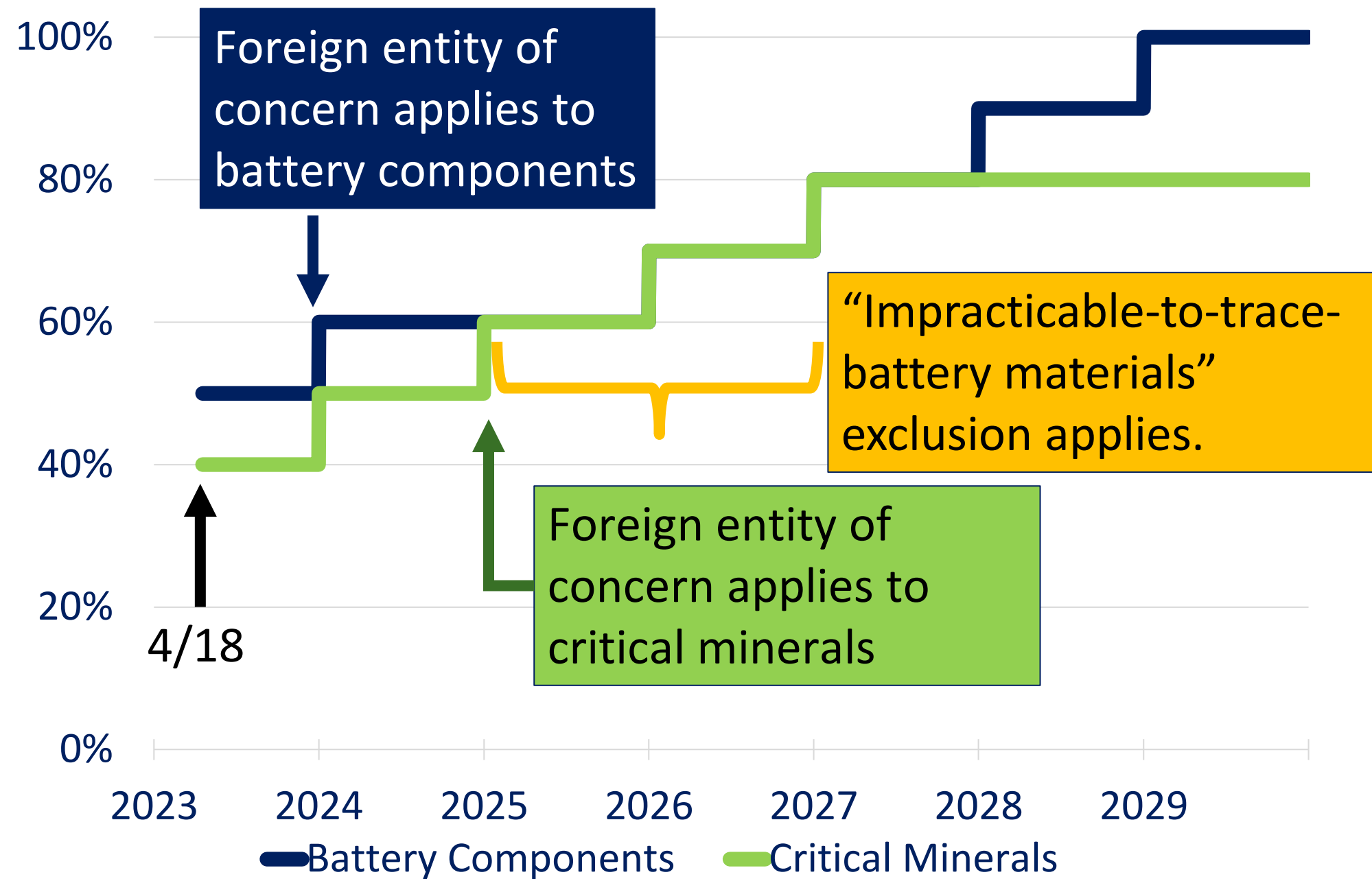
## Clean Vehicle Credit (New Vehicles)





- Must be made in North America
- Light-duty vehicle only (under 14,000 lbs.)
- Up to \$7,500 per new vehicle
- Income and MSRP provisions applied
- Critical mineral and battery component provisions applied 4/18/23
- Foreign entity of concern restriction applied (2024, 2025 and after)
- Available through 2032. No quota limit



# Clean New Vehicle Credit Sourcing and MSRP requirements

**Share of NA Value  
(NA+FTA for minerals)**



Vehicle Type	MSRP Cap
 Van	<\$80,000
 Sport Utility Vehicles	<\$80,000
 Truck	<\$80,000
 Passenger Vehicles	<\$55,000



# Inflation Reduction Act

- **Clean Vehicle Credit**
- **Previously-Owned Clean Vehicles**
- **Credit for Qualified Commercial Clean Vehicles**
- **Advanced Manufacturing Production Credit**

## Previously-Owned Clean Vehicles Credit

- Up to \$4,000 credit
- Must be purchased through a qualified auto dealer
- Income provision applied
- Vehicle price < \$25,000

## Credit for Qualified Commercial Clean Vehicles

- Light-duty vehicles up to \$7,500
- Rental and leased vehicles qualify
- No income, MSRP, battery, or critical mineral provisions
- No foreign entity of concern provision
- Vehicles made outside of NA qualify



# Inflation Reduction Act

- **Clean Vehicle Credit**
- **Previously-Owned Clean Vehicles**
- **Credit for Qualified Commercial Clean Vehicles**
- **Advanced Manufacturing Production Credit**

## Advanced Manufacturing Production Credit

- Credit is refundable
- Battery Cell – \$35 per kWh
- Battery Module – \$10 per kWh
- Battery Module not using cells – \$45 per kWh
- Electrode Active Materials – 10% of production cost



# IRA Impact

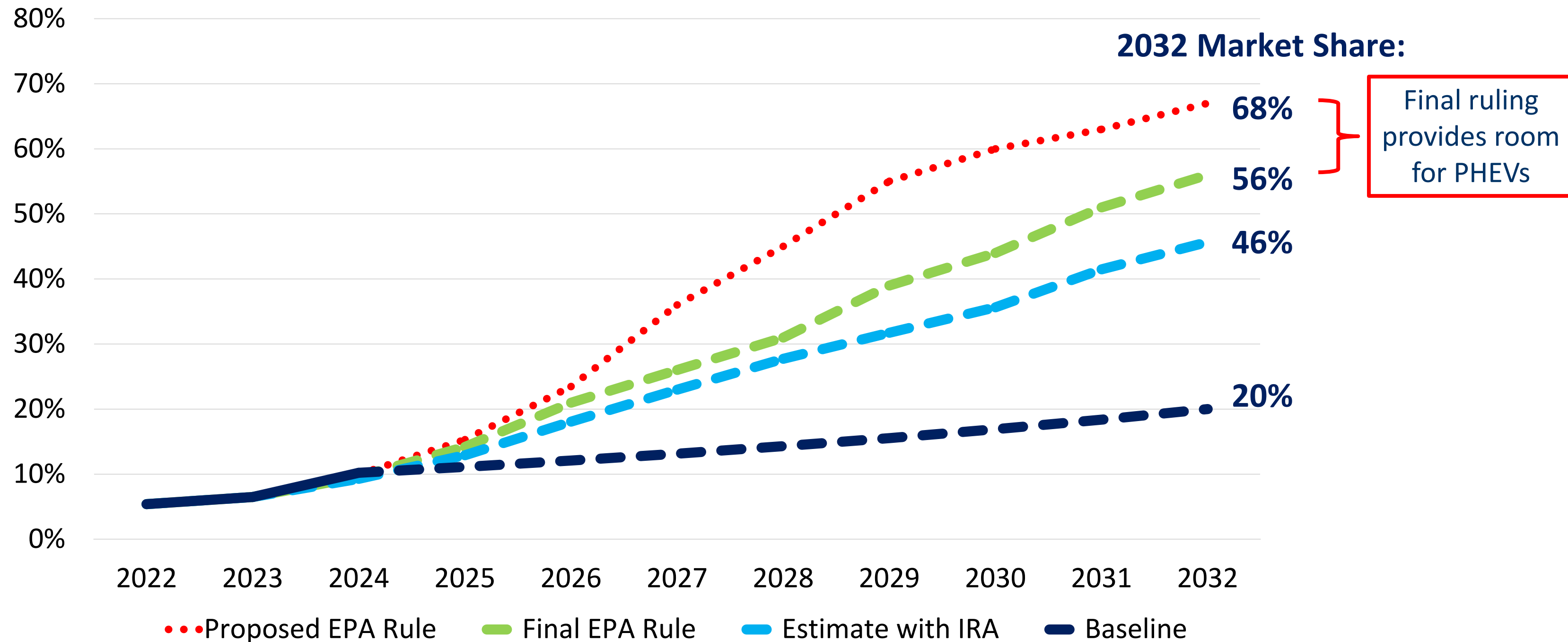
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# U.S. BEV Market Share Projections

2022-2023 Actual; 2024 – 2032 Forecast



Source: Center for Automotive Research, GlobalData, EPA



# Electrification: Labor Impact

Lost ICE jobs offset by gains in electrification

## Manufacturing Job Losses

- Engines and Engine Parts
- Transmissions
- Fuel Systems
- Assembly (fewer parts)

## Manufacturing Job Growth

- E-axles and E-motors
- Battery Packs and Modules
- Electrical Installation (EV Infrastructure)
- Increased Assembly Complexity due to Increased Electronics

**ICE manufacturing job losses can be offset by growth in electrification jobs. The number of roles may not be reduced overall but many current automotive manufacturing workers may need to be reskilled to fill new roles.**



# EV Challenges

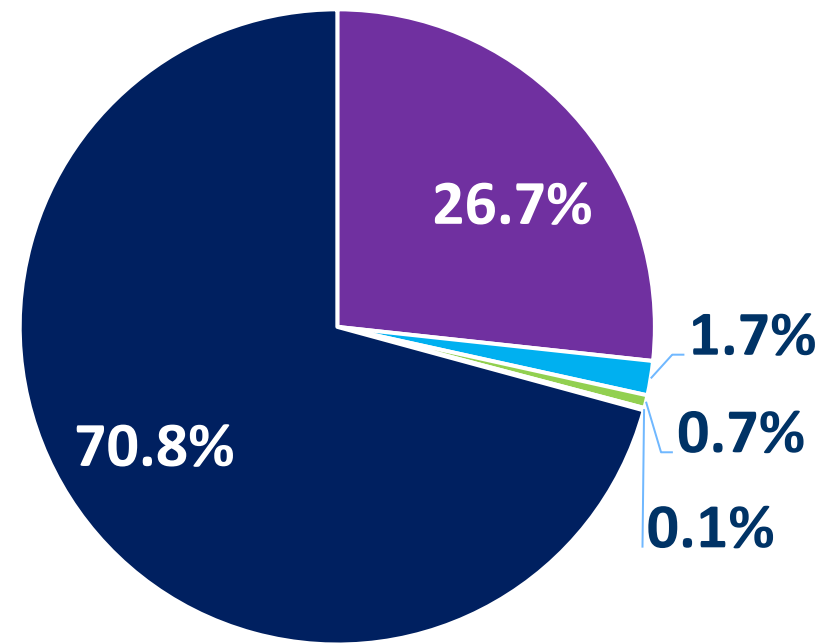
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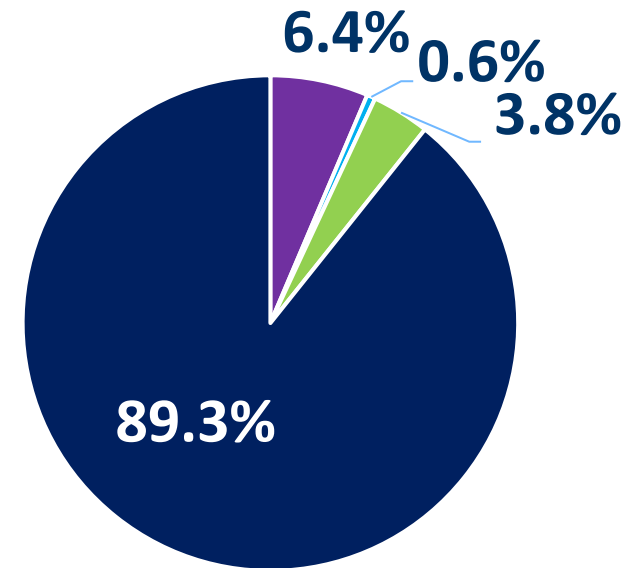
# Automaker EV Strategies: Toyota vs Detroit Three US Sales by Powertrain Type, 2023

### Toyota



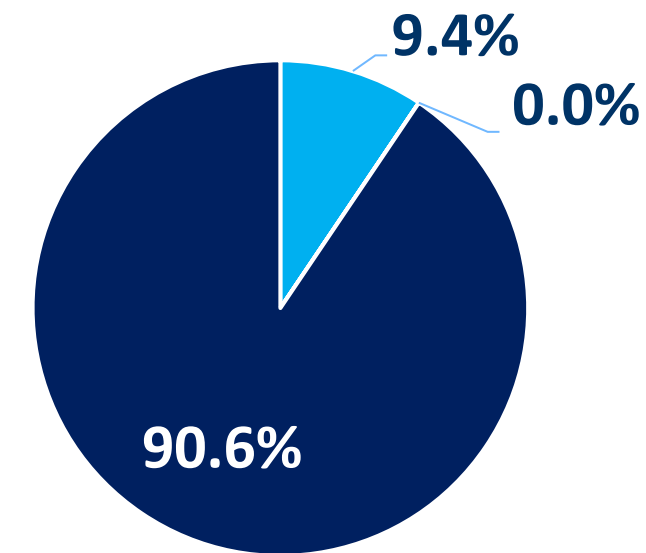
**29.2% Electrified**

### Ford



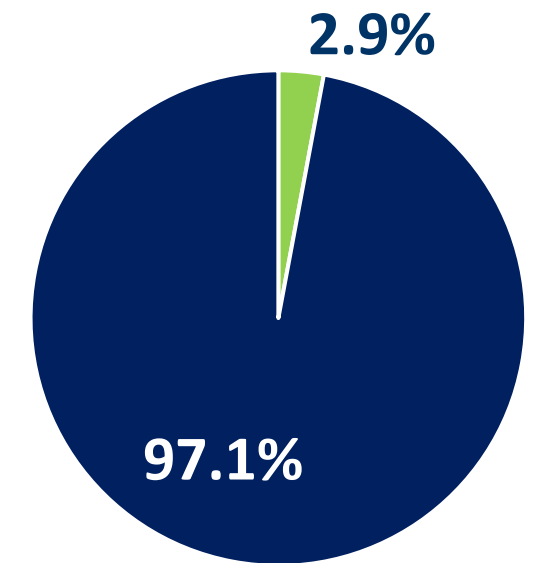
**10.7% Electrified**

### Stellantis



**9.4% Electrified**

### General Motors



**2.9% Electrified**

**Electrified**

ICE*	HEV	PHEV
BEV	FCEV	

\*Includes mild hybrids



# Resurgence of Hybrids – Automakers Rethink EV Strategies

## Automakers switch focus from BEVs to Hybrids

- GM reverses course and plans to bring back PHEVs to the US market after discontinuing in 2019
- Ford delayed BEV pickup and SUV production, plans to add hybrid models to their lineup
- Others, including Hyundai, Kia, and Aston Martin shift focus from BEV to Hybrids

## Hybrid sales see rapid growth in 2024

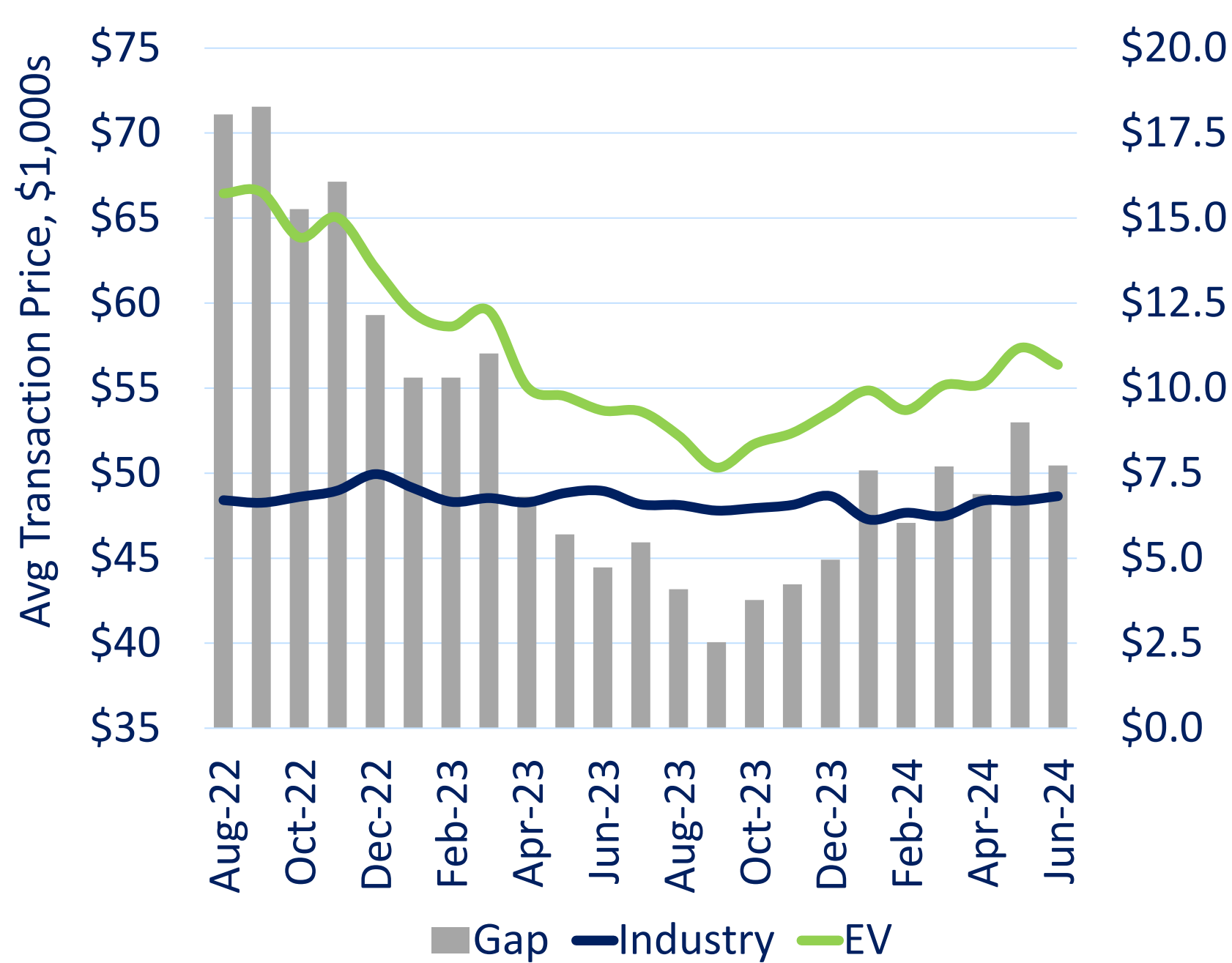
- Hybrid and PHEV sales are up 36% in the first half of 2024 compared to the first half of 2023
  - Compare to 0.2% BEV and 1.1% ICE sales decline

## Focus on low-cost EV strategy

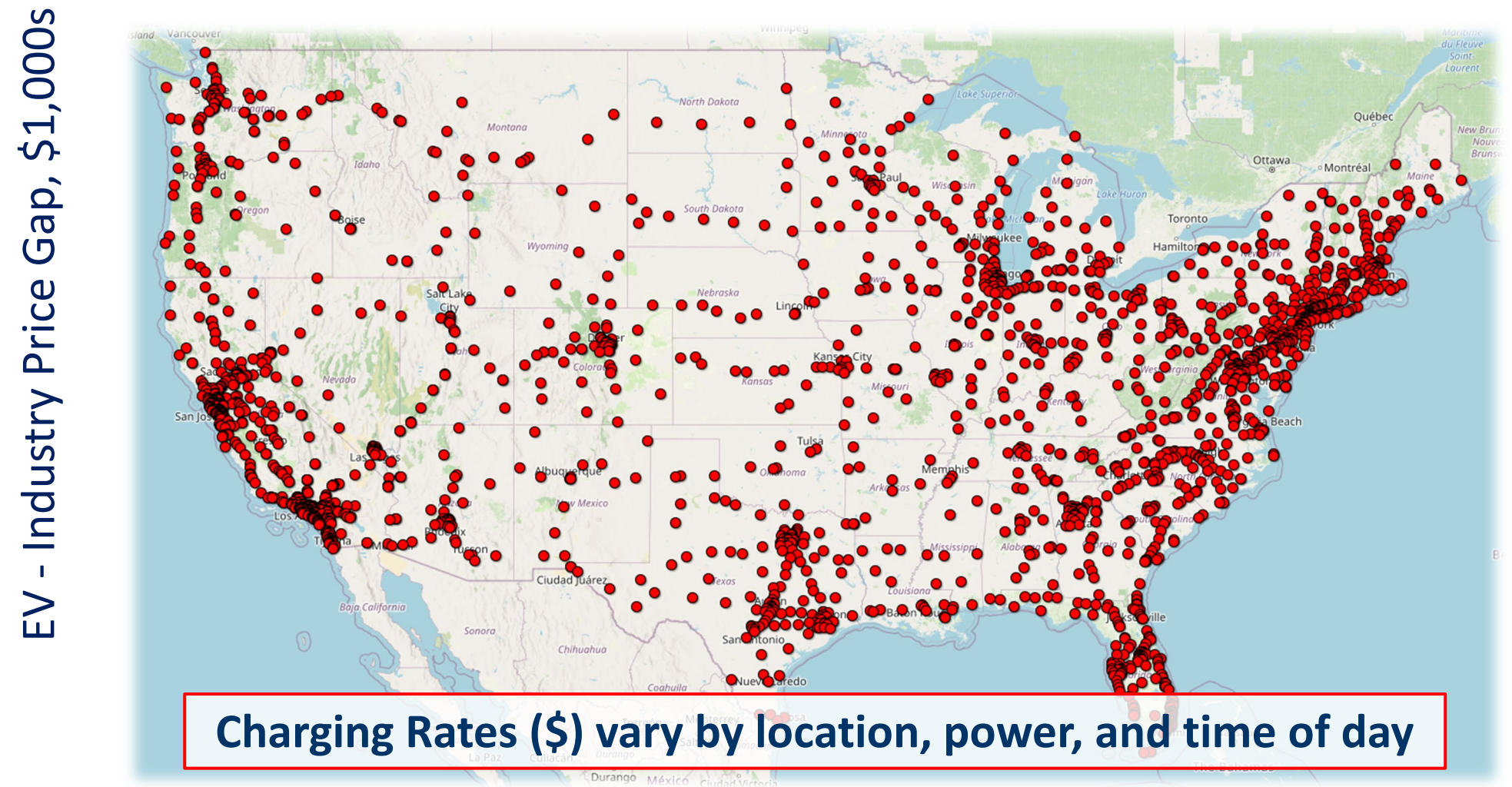


# Drivers of EV adoption – Cost and Charging Access United States

## New Vehicle Transaction Price



## Tesla Supercharger Network



“The opening of the Tesla network about **doubles the number of fast chargers** available to the general public”

- Automotive News (March 23, 2024)



# EV Challenges

## **EVs 1000-2200 lbs heavier than ICE**

- Tire composition and design
- Vehicle dynamics & chassis design
- Vehicle crash characteristics
- Lightweight materials

## **Battery repair, replacement, recycling**

- Higher system voltage, breakdown voltages
- Higher temperatures, fire retardants
- Faster charging, alternative shielding solutions

## **EV charging infrastructure build-out**

- Safe location- polymeric materials in housings
- Maintained and operational, accessible
- Defacto standard on Tesla charging interface
- \$5B federal program

## **Affordable & profitable?**

- Giga press
- Electric motors
- Component integration
- Toyota hybrid strategy, GM bringing back hybrids

# SUMMARY

- **Unprecedented investment in EV across North America 2018 -2023**
- **IRA new guidance: critical mineral and battery components**
- **EV sales forecasted to reach 46% in 2032**
- **OEMs looking for innovative solutions for reducing weight and cost**



# MBS 2024

MANAGEMENT BRIEFING SEMINARS

SAVE THE DATE

AUGUST 5-8, 2024


TRAVERSE CITY,

MICHIGAN



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