

**S&P Global**

Commodity Insights

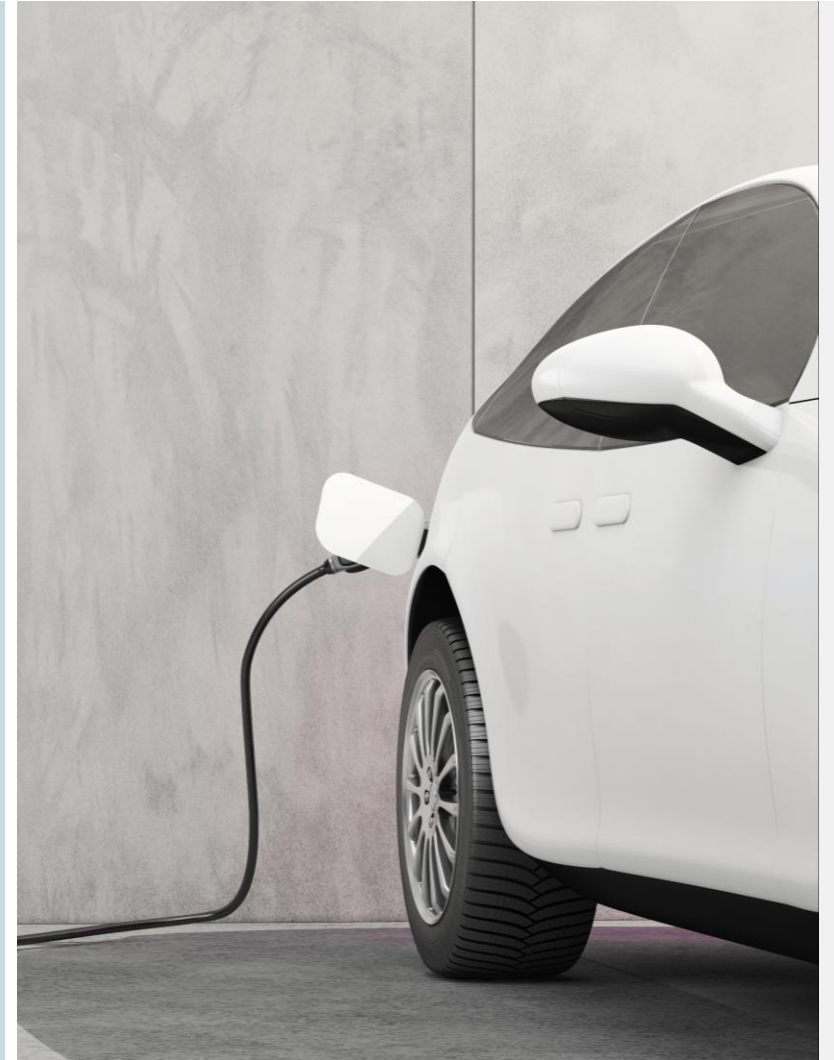
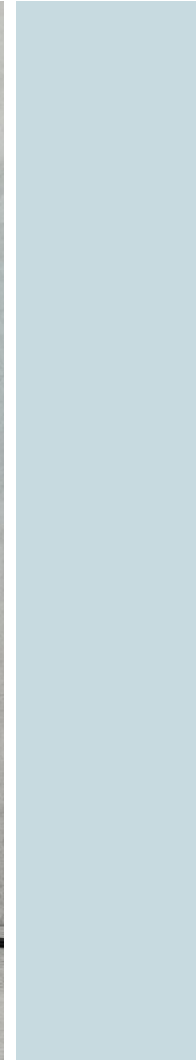
CI Consulting

# Electric Vehicle Charging Power Demand Forecast Assumptions

PJM Interconnection

Preliminary Assumptions

July 2, 2025



# Agenda

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## Summary

Overview of scenario drivers

Key modeling assumptions

Appendix

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The assumptions provided are S&P Global's initial assumptions. We acknowledge the possibility of changes based on our analysis, project work, and stakeholder feedback



### Source

Assumptions in this deck are from S&P Global's "off-the-shelf" scenarios, recent developments in regulatory and legislative arena, and last year's analysis delivered to PJM

### Adjustments

These assumptions may change over the development of the forecast due to internal forecast updates, ongoing project work, and feedback from stakeholders

### Importance

We focus only on most meaningful assumptions that could have significant impact to the outcome of our analysis



# S&P Global would like to share the following key assumptions and inputs for stakeholder review

	Type of EV vehicles	Assumptions and inputs
<b>EV forecast</b>	All	Approach to developing EV forecast: key economic inputs, policies and incentives
	Light-duty	EV national targets and performance relative to targets EPA regulations
	Medium- and heavy-duty	EV national targets and performance relative to targets by class Description of vehicle types within classes 3–8 by function
<b>Charging demand</b>	Light-duty	Miles per kWh (normal operating conditions)
		Miles driven (weekday/weekend)
		Loss in battery efficiency due to temperature
		Charging infrastructure
	Medium- and heavy-duty	Charging behavior
		Miles per kWh by class (normal operating conditions)
	Miles driven (weekday/weekend) by class	
	Loss in battery efficiency due to temperature by class	

We welcome stakeholder feedback on key assumptions to enhance accuracy and are specifically interested in comments, data, or insights regarding the following themes

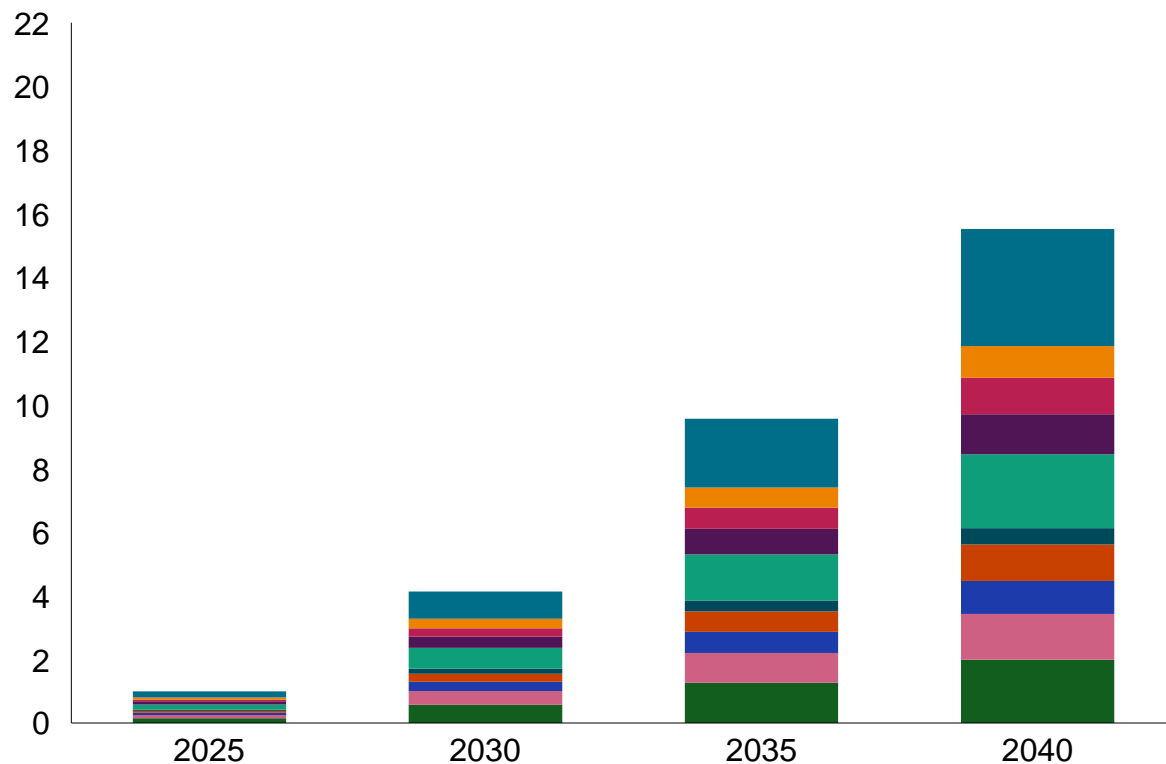
Themes	Topics
Insights or outlooks on charging infrastructure	<ul style="list-style-type: none"><li>▪ <u>Charging infrastructure adoption</u>: Trends and projections for Level 1 (L1), Level 2 (L2), and Direct Current Fast Charging (DCFC) stations, including for residential application</li><li>▪ <u>Charging infrastructure pairing with batteries</u>: Integration of stationary batteries with EV charging infrastructure for peak shaving or other applications</li><li>▪ <u>Access to homeplace/workplace chargers</u>: Availability and utilization rates of charging stations at residential and commercial locations</li><li>▪ <u>Visibility onto fleet charging for last mile delivery vehicles</u>: who owns the fleet, size of fleet, numbers of chargers and type of chargers by fleet operators</li></ul>
Insights on current EV charging behavior and policy evolution that will impact it	<ul style="list-style-type: none"><li>▪ <u>Charging patterns</u>: Current EV charging patterns</li><li>▪ <u>TOU rates</u>: Implementation trends and their influence on EV charging behaviors</li><li>▪ <u>MHDV</u>: Tariff and incentive structures that impact the operation of MHDV</li><li>▪ <u>Vehicle-to-grid (V2G)</u>: Insights on V2G applications and wide-scale adoption</li></ul>

Please direct any feedback or questions to PJM. PJM will ensure the information is appropriately conveyed to S&P Global. Note that any information or data shared with PJM and S&P Global will be treated as confidential and handled in accordance with S&P Global's data protection policies.

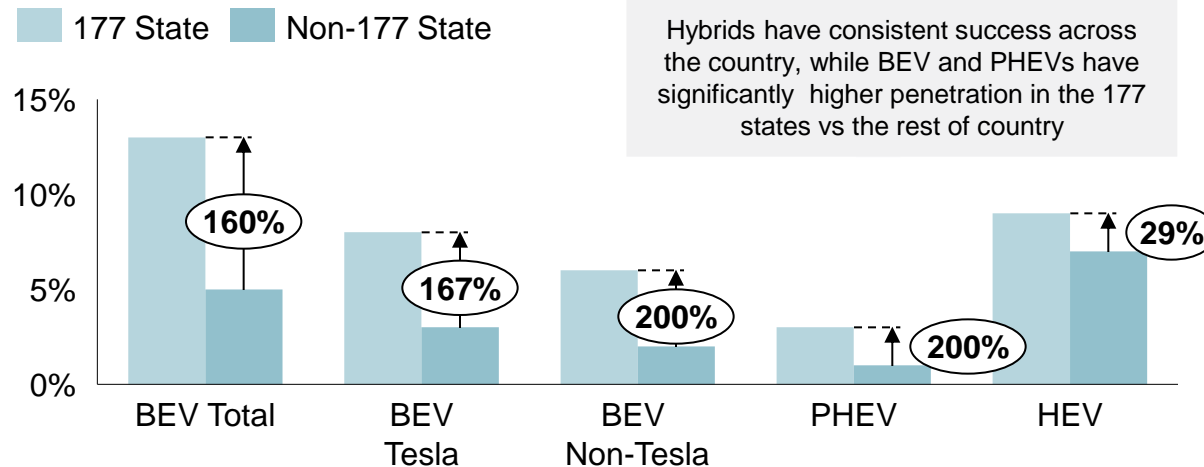
# California no longer has a waiver, ACCII goals no longer in effect and eliminates the option for section 177 states. CA to pursue ICE ban ambitions. For PJM zones, NJ likely follows.

## 2024 Analysis: Total annual light-duty EVs by PJM zone<sup>1</sup>

Million vehicles



## EV penetration by vehicle type for section 177 states and non-177 states<sup>2</sup>, %



States	ZEV Program	Aspires ICE Ban	Incentive Type – Status
NJ	Yes (ACC II ZEV)	Yes	Rebate – Yes
MD	Yes (ACC II ZEV)	No	Tax Credit – Yes
VA	Yes (ACC II ZEV)	No	Rebate – Not Funded
DE	Yes (ACC II ZEV)	No	Rebate – Yes
DC	–	–	NA – No
PA	–	–	Rebate – Yes
IL	–	–	Rebate – Yes

Values will be updated during the project. 1. From previous year's analysis; 2. 177 States are those that have adopted California's Low-Emissions Vehicle (LEV) criteria pollutant and greenhouse gas emissions regulation and Zero-Emission Vehicle (ZEV) regulations under; 3. Section 177 of the Clean Air Act. PSEG = Public Service Enterprise Group; BGE = Baltimore Gas and Electric; ATSI = American Transmission Systems, Inc.; PEPCO = Potomac Electric Power Company; ComEd = Commonwealth Edison; JCPL = Jersey Central Power & Light; AEP = American Electric Power; PECO = Philadelphia Electric Company. Source: S&P Global

# Agenda

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Summary

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Appendix

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# S&P Global maintains base-case scenario (Inflections, 2024-2050) which builds on integration of regional and sectoral analysis of energy future and will serve as foundation for this project

## Scenario description



- Inflections is the S&P Global Commodity Insights base-case scenario. It represents the integration **of regional and sector analysis** from across Commodity Insights, illustrating the pace of change in long-term global energy supply, demand and trade, based on current views and assumptions about markets, policy, consumer behavior and technology.
- This scenario illustrates the challenges and opportunities in the global energy transition. It underscores the complexities of achieving ambitious climate and energy goals in an unpredictable geopolitical landscape. Inflections highlights the critical role of national and multilateral policies, corporate strategies, and public sentiment in shaping the future of energy markets, and despite the hurdles in delivery of targets and goals, paints a picture of gradual but sustained progress. Ultimately, Inflections suggests that while radical targets may be out of reach, the direction of travel remains positive, driven by incremental changes and a pragmatic approach to global energy governance
- **Key themes of this scenario include:**
  - Through the early years, Inflections sees a period of geopolitical instability and economic uncertainty
  - Energy security, geopolitics and climate are inextricably linked
  - Through the medium term, Inflections is a multidimensional world focused on national interests. In later years, there is a rejuvenation of multilateral cooperation
  - While ambitious climate and energy transition goals set in the 2010s and early 2020s become increasingly difficult to achieve, there is incremental but sustained progress in global decarbonization and energy transition, even if climate targets are missed

1. Includes battery-electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs) and fuel-cell electric vehicles (FCEVs)  
toe: metric ton of oil equivalent; mmtoe: million metric tons of oil equivalent  
Source: S&P Global Inflections (2024)

## Key indicators (global)



		History			Inflections			
		2023	2024	2025	2030	2035	2040	2045
<b>Real GDP</b>	(Billion 2023 \$)	\$104,899	\$107,593	\$110,403	\$126,288	\$143,553	\$161,887	\$181,769
	Average annual growth	2.8%	2.8%	2.8%	2.7%	2.7%	2.6%	2.5%
		(1990–2023)	(1990–2024)	(1990–2025)	(2025–2030)	(2025–2035)	(2025–2040)	(2025–2045)
<b>Primary energy consumption</b>	(mmtoe)	15,183	15,407	15,649	16,162	16,495	16,674	16,861
	Average annual growth	1.7%	1.7%	1.7%	0.6%	0.5%	0.4%	0.4%
		(1990–2023)	(1990–2024)	(1990–2025)	(2025–2030)	(2025–2035)	(2025–2040)	(2025–2045)
<b>US light-duty EV penetration<sup>1</sup></b>	Sales	7.7%	7.9%	9.3%	24%	40%	50%	58%
	Fleet	0.8%	1.2%	1.7%	6%	13%	26%	38%
<b>Primary energy intensity of GDP</b>	(toe per million 2023 \$)	145	143	142	128	115	103	93

# US EV Market Framework Summary: industry rebalances its BEV ambitions as profitability and consumer demand remain constrained

Regulations	Incentives	OEM	Customer Readiness
<ul style="list-style-type: none"> <li>▪ <b>NHTSA</b> June 2025 CAFE statement eases viability for <b>more ZEV<sup>1</sup></b>. We are likely to see the <b>MPG goals released in coming months</b>, for this forecast a freeze on MY2028 MPG standards is expected through MY2032.</li> <li>▪ <b>EPA</b> will likely no longer be allowed to pursue a 50% reduction in GHG gases</li> <li>▪ <b>CARB: has lost rights to set their own emission/ZEV ambitions.</b> Unlikely California backs down from an ICE Ban by 2035 and will pursue other means to hit this goal. Here we expect other states to follow: <b>New Jersey</b>, Massachusetts, Washington and Vermont.</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>IRA passes</b> both houses of Congress in 2023.</li> <li>▪ <b>Big Beautiful Bill (reconciliation bill) targets the ZEV consumer incentives (30D and 45W).</b> With these being phased out no later than the end of 2026 natural demand is likely to drive the market. The manufacturer credit (45X) on battery/cell assembly is likely to survive.</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>Assumptions on BEV profitability have been re-evaluated</b> due to cost, strong price competition, and supplier volume shortfall claims</li> <li>▪ <b>Ford and GM have reduced and/or postponed EV investments</b></li> <li>▪ <b>Openness to REX (Range extenders)</b> likely to come with product development by the likes of VW, Hyundai, Ford and Stellantis</li> <li>▪ <b>Toyota, Honda</b> double on their HEV aspirations with Toyota only offering HEV for some of its best-selling models.</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>BEV growth slows down</b> under consumer affordability concerns.</li> <li>▪ <b>Consumer is stating concerns on range, charging and pricing for ZEVs.</b></li> <li>▪ <b>NACS plug</b> standardization</li> <li>▪ <b>Reduced disposable income</b> driven by inflation and high interest rates creates an economic challenge for consumers</li> <li>▪ <b>HEV gains further leadership as affordability remains key</b></li> </ul>

**Forecast consequence: More powertrain flexibility and delay of BEV trajectory by roughly 5 years**

1. The CAFE update by NHTSA signals a clear intention to ease demands for Zero Emission Vehicles, new MPG goals likely to follow.

Source: Sales-based Powertrain Forecast (May 2025)

# Agenda

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Appendix

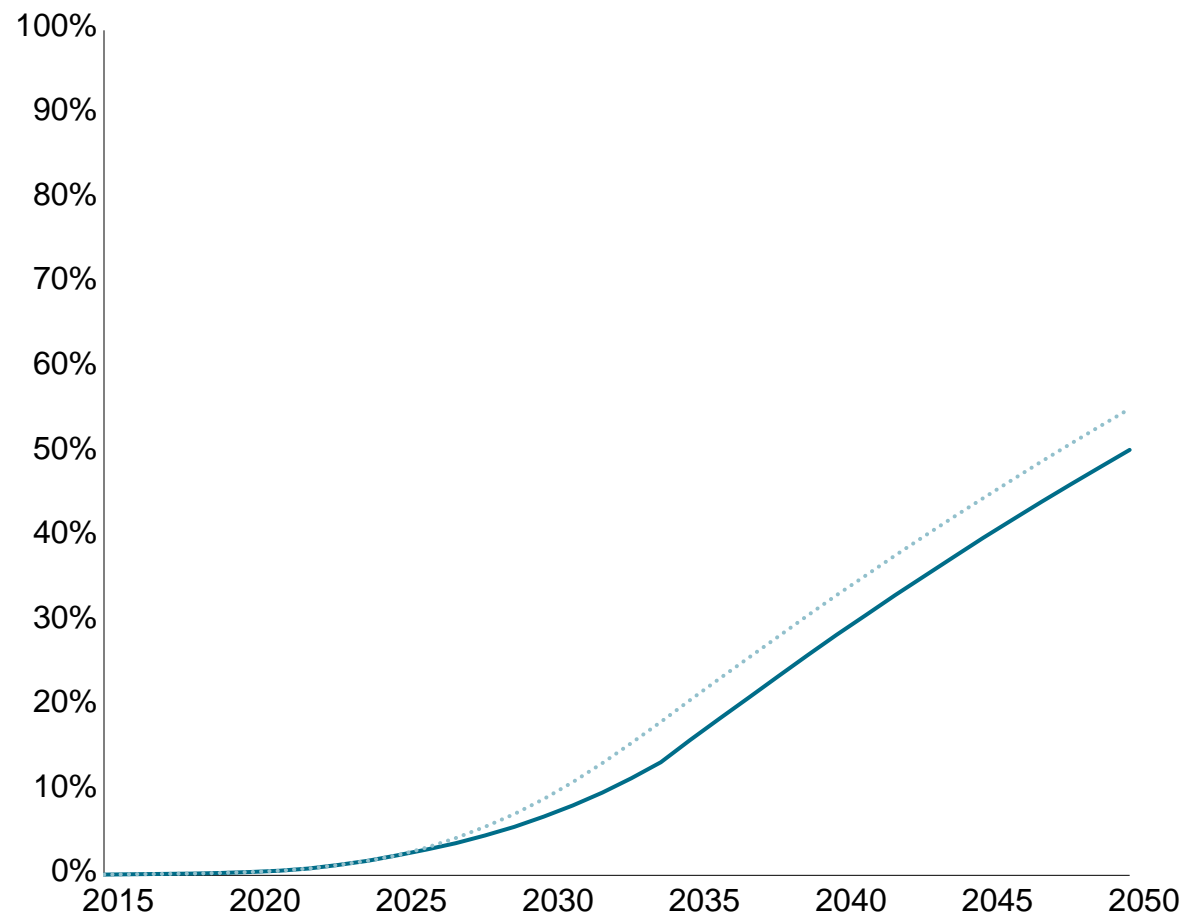
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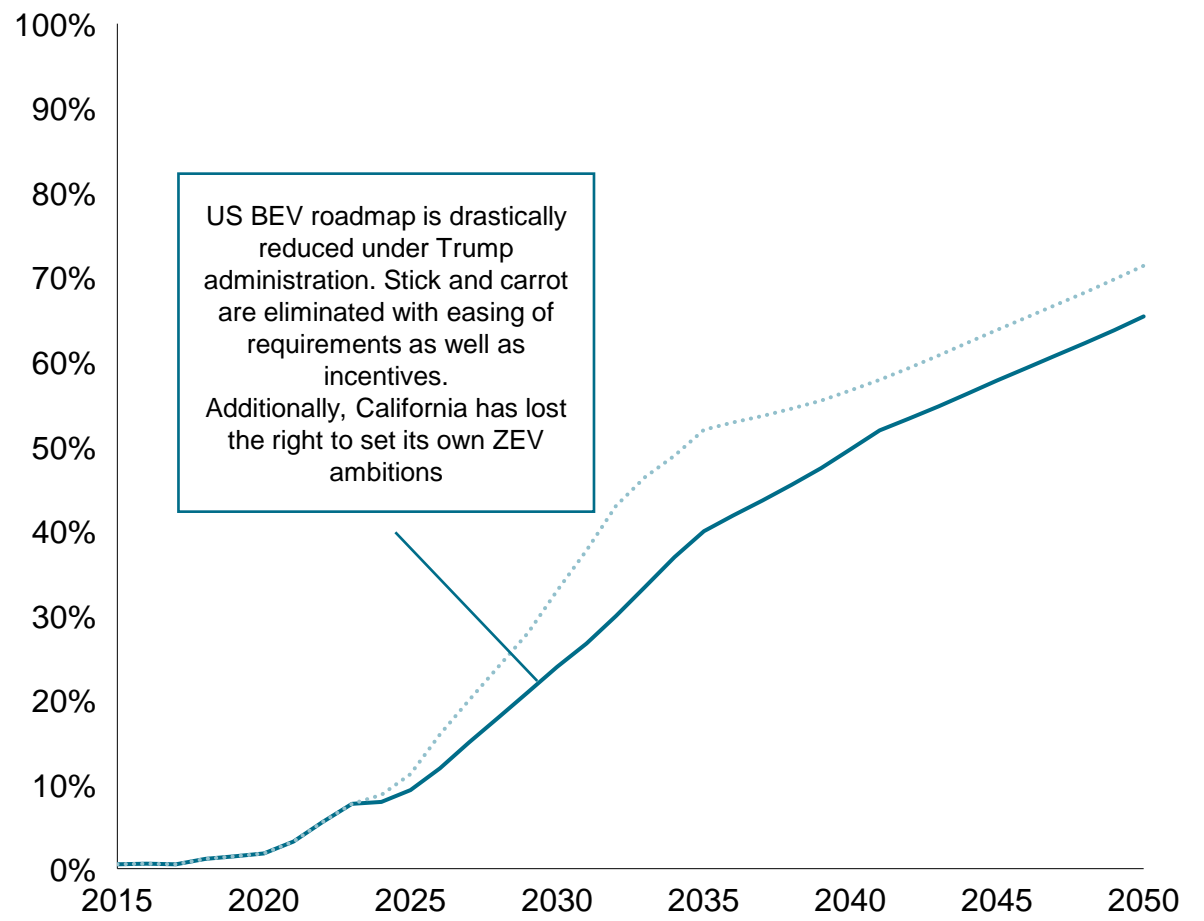


# S&P Global base case assumptions for US light vehicle sales for expected 2025 update vs 2024 and penetration metrics

## US light-duty EVs as total on-road light vehicle fleet<sup>1</sup>



## US light-duty EV sales as percent of light vehicle sales<sup>1</sup>

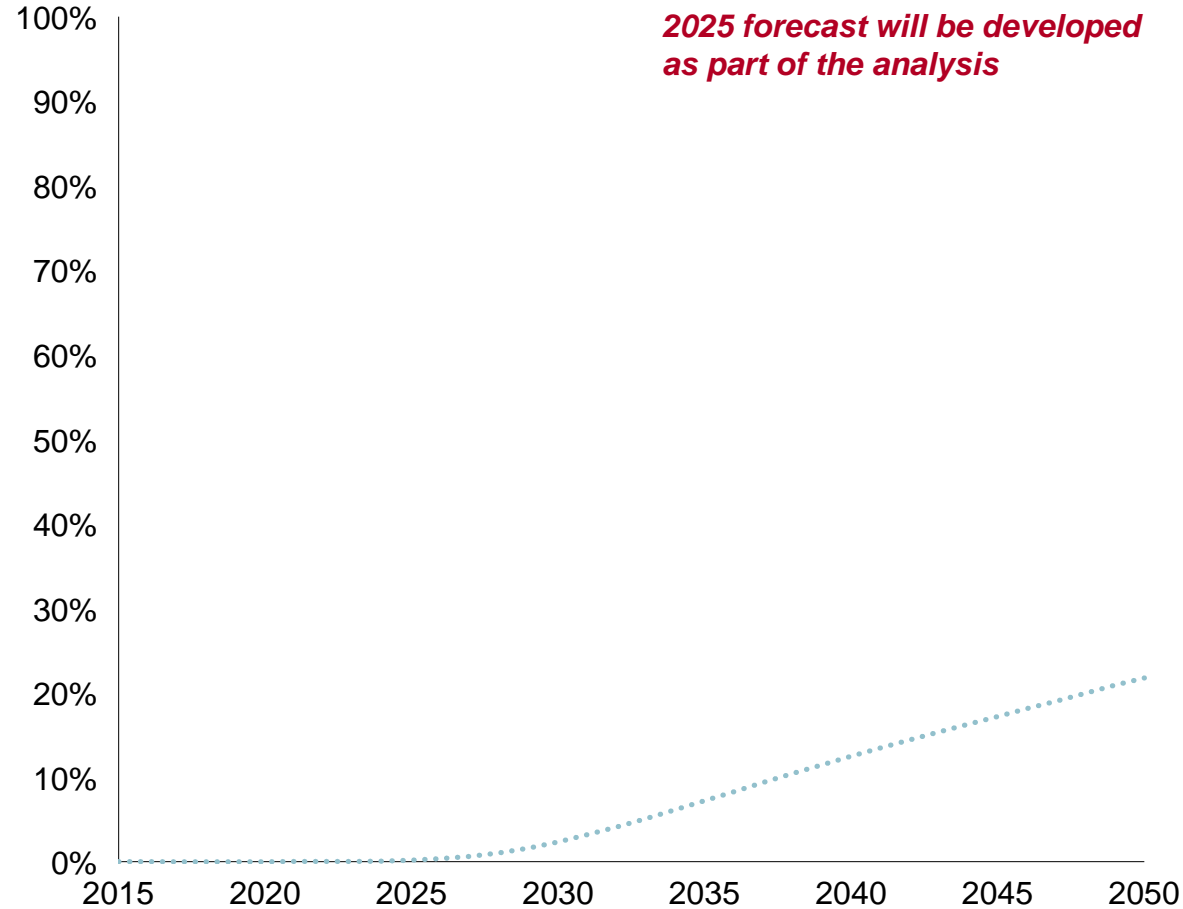


Values will be updated during the project.  
 1. Includes battery-electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).  
 Source: S&P Global Inflections (2023)  
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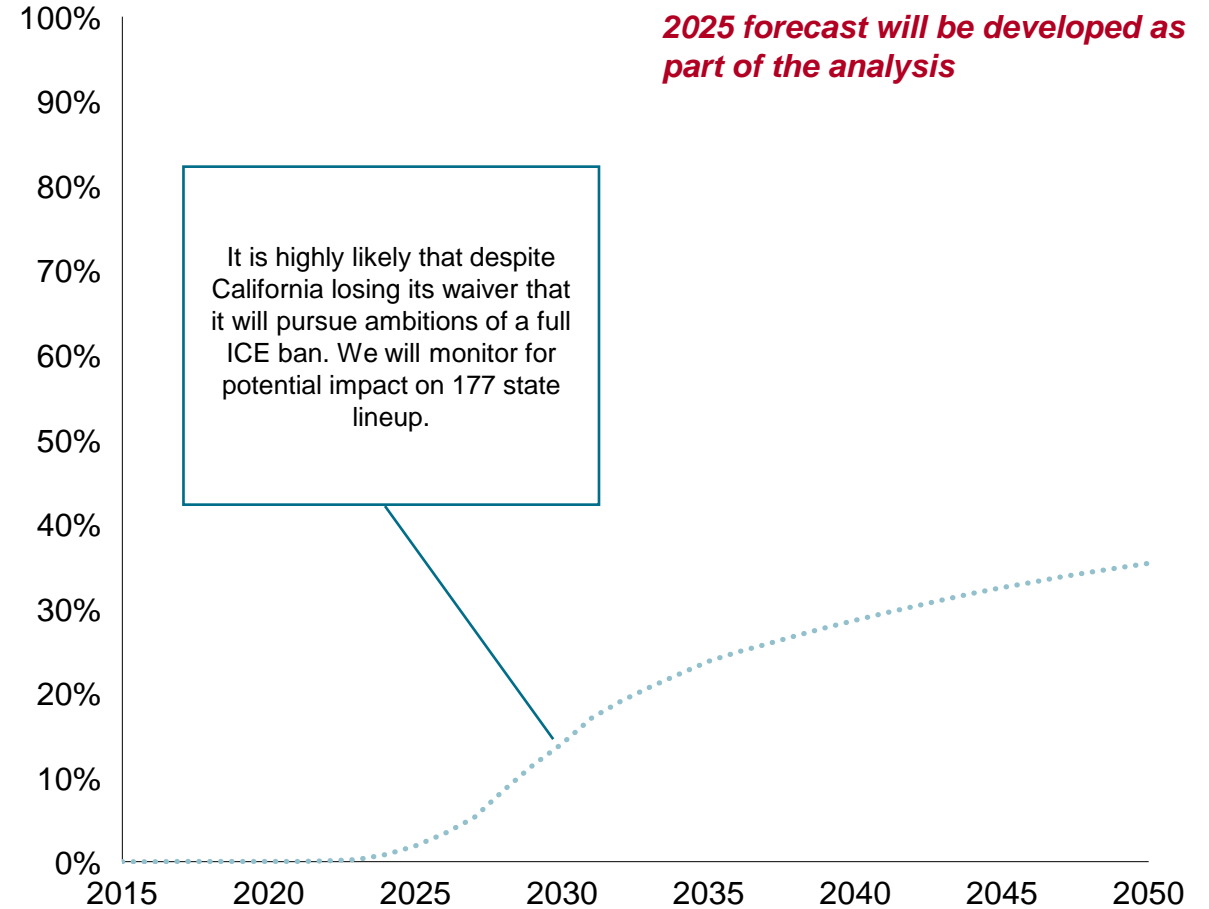


# S&P Global base case assumptions for US Medium and Heavy-duty sales and penetration metrics *(2024 numbers as the 2025 forecast is under review)*

**US Medium/Heavy duty EVs as total on-road light vehicle fleet<sup>1</sup>**



**US Medium/Heavy duty EV sales as percent of light vehicle sales<sup>1</sup>**



Values will be updated during the project.

1. Includes battery-electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs)

Source: S&P Global Inflections (2023)



# LDV and MHDV assumptions: policy and regulations

Type of vehicle applicability	Assumptions and inputs	Value	Source and notes
Light-duty	EV national ambitions abandoned, and CAFE is frozen starting MY2028	Goal: Freeze of CAFE (MPG) at MY2028 ~20% minimum BEV sales requirement S&P Global Forecast for 24% sales to be BEV in 2030	S&P Global Mobility
Light-duty	EPA regulations	Pressure removed through ~2030 but possible return to pursuit of carbon neutral by 2050	S&P Global Mobility
Medium- and heavy-duty	Sub-national “aspirational” likely to lead short term	Primarily driven by California’s ACT, roughly 75% of MH Sales. Uncertain if 177 states ask for an aspirational target. California no longer has the waiver but is highly likely to continue pursuing ZEV ambitions. MA, NJ, VT and WA likely to follow.	S&P Global Mobility
Medium- and heavy-duty	Description of vehicle types by function	Delivery van: 55% by 2035 2024 ACT Mandate School bus: 100% by 2035 2024 ACT Mandate Transit bus: 100% by 2035 2024 ACT Mandate Medium truck: 55% by 2035 2024 ACT Mandate Short haul truck: 75% ZEV by 2035 2024 ACT Mandate Long haul truck: 75% ZEV by 2035 2024 ACT Mandate	S&P Global Mobility



# LDV assumptions: EV utilization and efficiency

Type of vehicle applicability	Assumptions and inputs	Value	Source and notes
Light-duty	Miles per kWh (normal operating conditions)	2025: 2.7 miles/kWh 2045: 3.2 miles/kWh	S&P Global Mobility
Light-duty	Miles driven (weekday/weekend)	2025: 10,950 miles per year 2045: 11,571 miles per year 75% of miles are driven during weekdays	S&P Global Mobility
Light-duty	Loss in battery efficiency due to temperature fluctuations	33% additional energy at 20 Fahrenheit (heating) 3% additional energy at 80 Fahrenheit (cooling) Temperature assumed for the study is a 10-year historical average on a daily basis	S&P Global Mobility, National Oceanic and Atmospheric Administration

Based on 2024 analysis and research; Values will be updated during the project.

Source: S&P Global Commodity Insights

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# LDV assumptions: charging infrastructure

Type of vehicle applicability	Assumptions and inputs	Value	Source and notes
Light-duty	Access to home and workplace charging	2025: 75% access to home charging 2045: 50% access to home charging	S&P Global Mobility – Charging Infrastructure
Light-duty	Type of home charging (Level 2 vs Level 1)	80% Level 2 charging	S&P Global Mobility – Charging Infrastructure
Light-duty	Charging strategy (for drivers with access to home charging)	2025: 86% Immediate / 14% Delayed 2045: 50% Immediate / 50% Delayed	S&P Global Energy Transition Consulting

Based on 2024 analysis and research; Values will be updated during the project.

Source: S&P Global Commodity Insights, NREL

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# LDV assumptions: charging behavior

The light duty charging shapes are a combination of different charging strategies

Charging strategy	Home charging	Description	Preferred charging time	Type of charger
Immediate	Yes	Will choose to charge as soon as they get home, regardless of cost	Evening	Level 2: 80% Level 1: 20%
TOU – As soon as possible (ASAP)	Yes	Starts to charge as soon as the on-peak pricing ends	Late night to midnight	Level 2
TOU – As late as possible (ALAP)	Yes	Starts to charge a few hours before commuting for the day	Early morning	Level 2
Work and public charger	No	Reliant on public and workplace charging, will start charging as soon as they arrive to work	Morning through midday	Mostly Level 2 and DCFC
Ride – hailing	50%	Typically relies on public charging, will charge throughout the day	Middle of the day	Mostly Level 2 and DCFC

Based on 2024 analysis and research; Values will be updated during the project.

Source: S&P Global Commodity Insights, NREL

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# MHDV assumptions: EV utilization and efficiency

Type of vehicle applicability	Assumptions and inputs	Value	Source and notes
Medium- and heavy-duty	Miles per kWh (normal operating conditions)	Delivery van: 1.52 miles/kWh (2025) to 2.06 miles/kWh (2045) School bus: 0.87 miles/kWh (2025) to 1.12 miles/kWh (2045) Transit bus: 0.49 miles/kWh (2025) to 0.62 miles/kWh (2045) Medium truck: 0.62 miles/kWh (2025) to 0.78 miles/kWh (2045) Short-haul truck: 0.46 miles/kWh (2025) to 0.58 miles/kWh (2045) Long-haul truck: 0.46 miles/kWh (2025) to 0.58 miles/kWh (2045)	S&P Global Mobility
Medium- and heavy-duty	Miles driven (weekday/weekend)	Delivery van: 10,950 miles per year (96% of miles driven during weekdays) School bus: 11,680 miles per year (96% of miles driven during weekdays) Transit bus: 41,975 miles per year (88% of miles driven during weekdays) Medium truck: 21,535 miles per year (71% of miles driven during weekdays) Short-haul truck: 35,040 miles per year (96% of miles driven during weekdays) Long-haul truck: 85,410 miles per year (88% of miles driven during weekdays)	S&P Global Mobility
Medium- and heavy-duty	Loss in battery efficiency due to temperature fluctuations	Additional energy at 23 Fahrenheit (heating): 17% (delivery vans), 19% (transit buses), 46% (school buses), 12% (medium trucks), 24% (short-haul and long-haul trucks) Additional energy at 86 Fahrenheit (cooling): 27% (delivery vans), 11% (transit buses), 2% (school buses), 12% (medium trucks), 8% (short-haul and long-haul trucks)	S&P Global Mobility, National Renewable Energy Laboratory, CALSTART MHD EV Deployment Data

# Agenda

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**Appendix**

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# Acronyms

ACC: Advanced Clear Car

ACT: Advanced Clean Truck

BEV: Battery Electric Vehicle

CAFE: Corporate Average Fuel Economy

CARB: California Air Resources Board

DCFC: Direct Current Fast Charging

EPA: Environmental Protection Agency

EV: Electric Vehicle

GHG: Greenhouse Gas

HEV: Hybrid Electric Vehicle

ICE: Internal Combustion Engine

IRA: Inflation Reduction Act

kWh: Kilowatt Hour

LDV: Light Duty Vehicle

NACS: North American Charging Standard

NHTSA: National Highway Traffic Safety Administration

MHDV: Medium and Heavy Duty Vehicle

PHEV: Plug in Hybrid Electric Vehicle

MPG: Miles per Gallon

S-177 States: 177 states that choose to pursue California legislation as opposed to national

REX/REEV: Range Extender Electric Vehicle

TOU: Time of Use

V2G: Vehicle to Grid

ZEV: Zero Emission Vehicle

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