Projecting light-duty electric vehicle sales in the National Energy Modeling System (NEMS)

For

Second Meeting of the Georgia Joint Legislative Study Committee on the Electrification of Vehicles

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By

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Outline

- Introduction to the AEO and NEMS

- Modeling methodology for light duty vehicles in NEMS

- AEO2022 light duty vehicle results
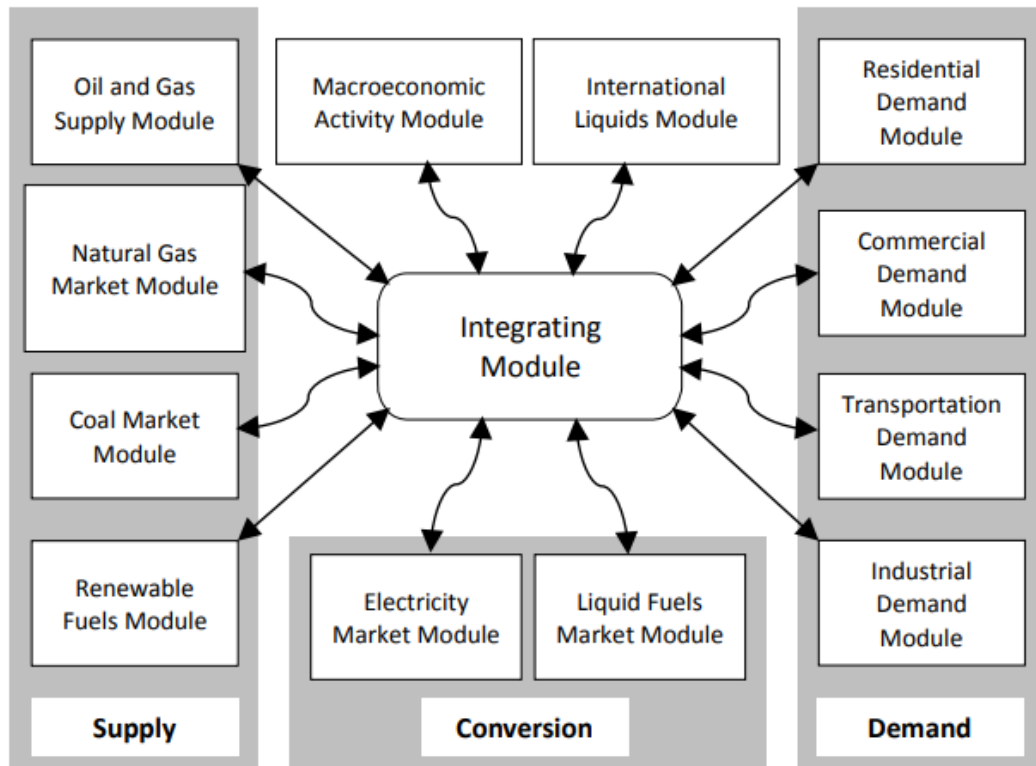
- AEO2022 assumptions

- Future uncertainties

Annual Energy Outlook (AEO)

- The AEO, developed using NEMS, is centered on the *Reference case*, which is not a prediction of what will happen, but rather a modeled projection of what might happen given certain assumptions and methodologies.

- The *Reference case* incorporates only existing law and policies, and is used as a case to which EIA can compare the relative impacts of alternate policies

- The *Reference case* typically projects technological evolutions rather than technological revolutions and therefore does not identify disruptive technologies or the timing of their availability and adoption.

- AEO2022 modeling was completed in November 2021

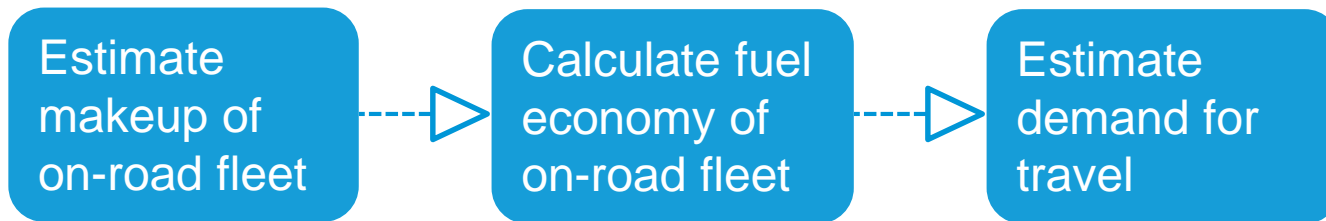# NEMS is a general equilibrium model that iterates until supply and demand converge

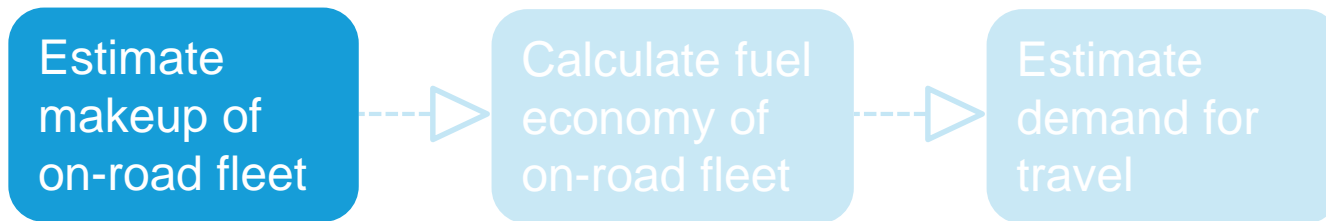# AEO2022 light duty vehicle modeling methodology

Transportation model: Light duty vehicles

Estimate makeup of on-road fleet

Calculate fuel economy of on-road fleet

Estimate demand for travel

$$Energy = \frac{Miles\ travelled}{fuel\ economy}$$

Transportation model: Light duty vehicles

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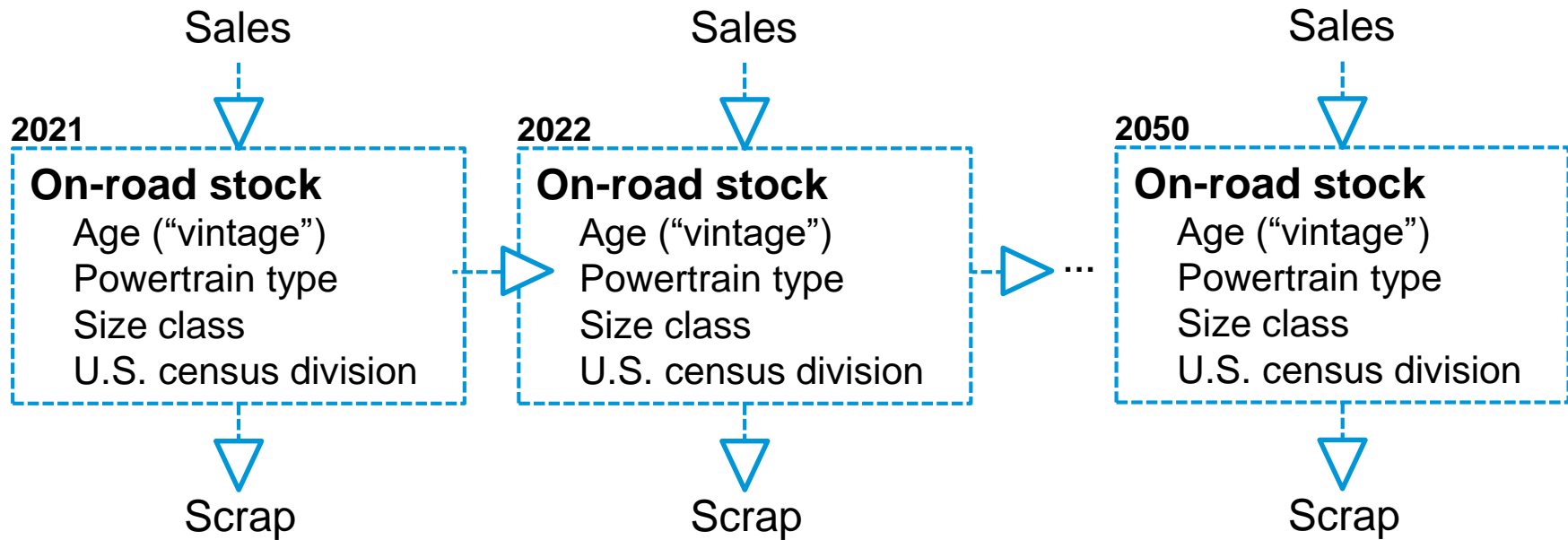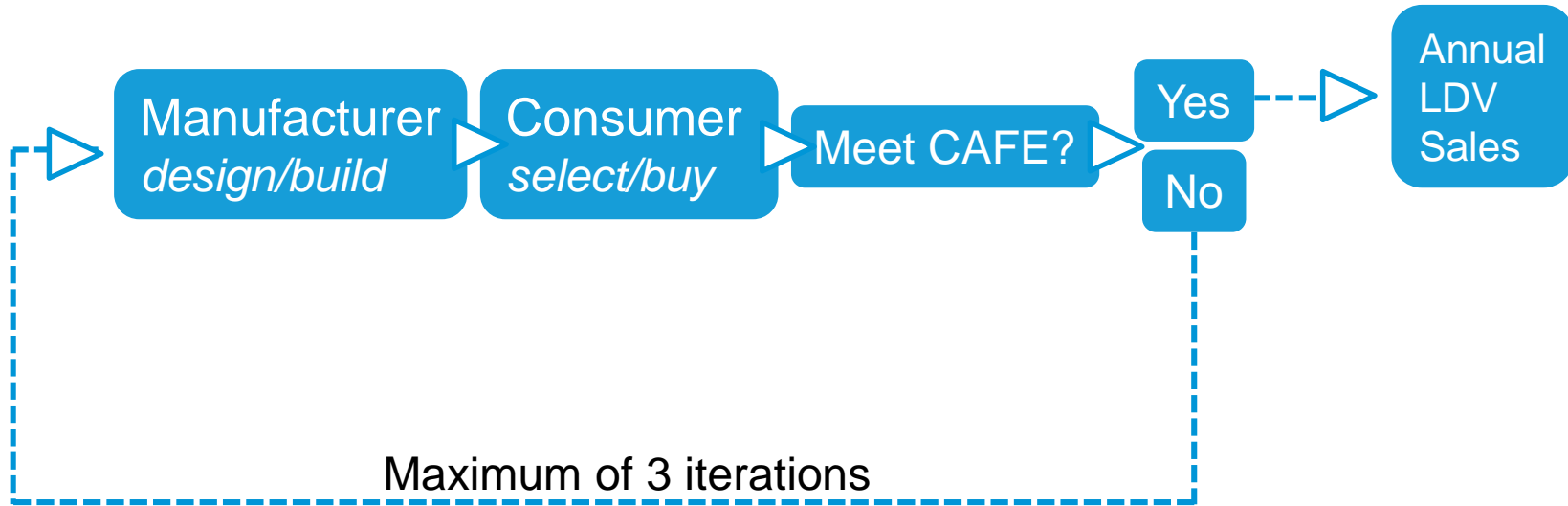
$$Energy = \frac{Miles\ travelled}{fuel\ economy}$$

Projecting changes in the U.S. light duty vehicle fleet in NEMS

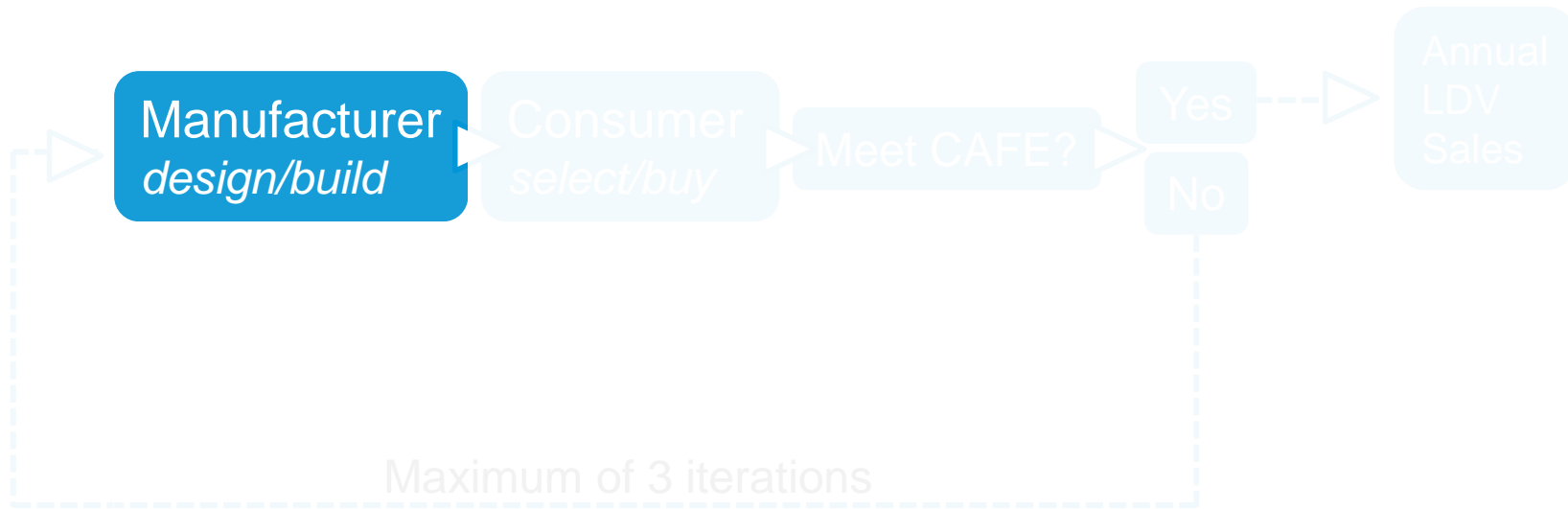# Sales projection: involves both manufacturers (building) and consumers (buying)

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┌──────────────┐    ┌──────────────┐    ┌──────────────┐    ┌──────┐         ┌──────────┐
│ Manufacturer │ ▷  │  Consumer    │ ▷  │ Meet CAFE?   │ ▷  │ Yes  │ ┄┄▷     │ Annual   │
│ design/build │    │  select/buy  │    │              │    └──────┘         │ LDV      │
└──────────────┘    └──────────────┘    └──────────────┘    ┌──────┐         │ Sales    │
      ▷                                                     │  No  │         └──────────┘
                                                            └──────┘
                      Maximum of 3 iterations
```

Maximum of 3 iterations

Sales projection: involves both manufacturers (building) and consumers (buying)

Manufacturer
design/build → Consumer
select/buy → Meet CAFE? → Yes / No → Annual LDV Sales

Maximum of 3 iterations

Manufacturers Technology Choice Component (MTCC)

Passenger Car Size Class	Light-Duty Truck Size Class
Mini	Small Pickup
Subcompact	Standard Pickup
Compact	Small SUV
Midsize	Standard SUV
Large	Small Van
2 seater	Standard Van
Small CUV	Small CUV
Large CUV	Large CUV

Vehicle powertrains	
Gasoline	Diesel Hybrid
Diesel	Gasoline Hybrid
Flex Fuel (ethanol)	Dedicated CNG
Electric—100 mile range	Dedicated LPG
Electric—200 mile range	Bi-fuel CNG
Electric—300 mile range	Bi-fuel LPG
Plug-in Hybrid Electric—20 mile	"Blank" Fuel Cell
Plug-in Hybrid Electric—50 mile	Hydrogen Fuel Cell

Within each **size class (left)**, manufacturers build a vehicle with each of the available **powertrains (right)**, with a fuel economy, vehicle price, acceleration, range, luggage space, etc.

Sales projection: involves both manufacturers (building) and consumers (buying)
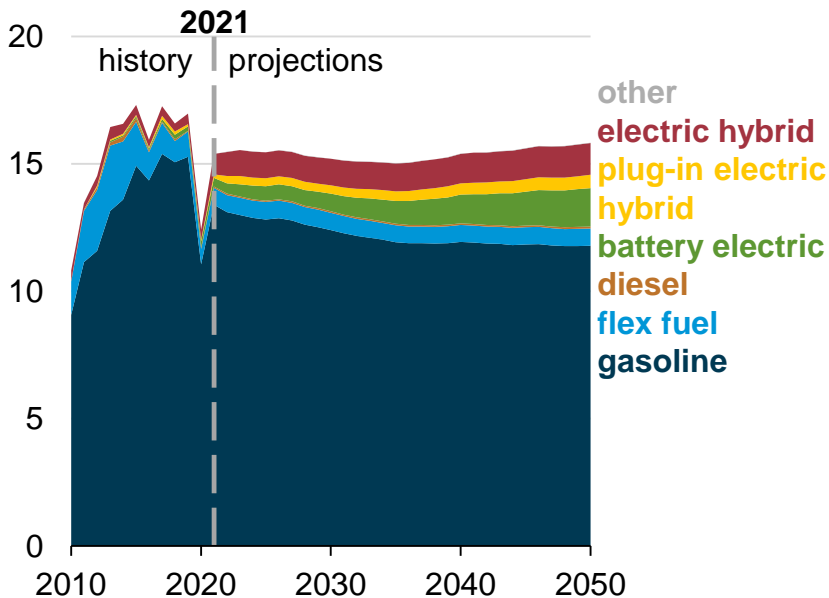
Manufacturer
design/build

Consumer
select/buy

Meet CAFE?

Yes

No

Annual LDV Sales

Maximum of 3 iterations

Based on:
- vehicle price
- fuel price
- fuel economy
- acceleration
- range

- luggage space
- maintenance cost
- fuel availability
- model availability
- home refueling
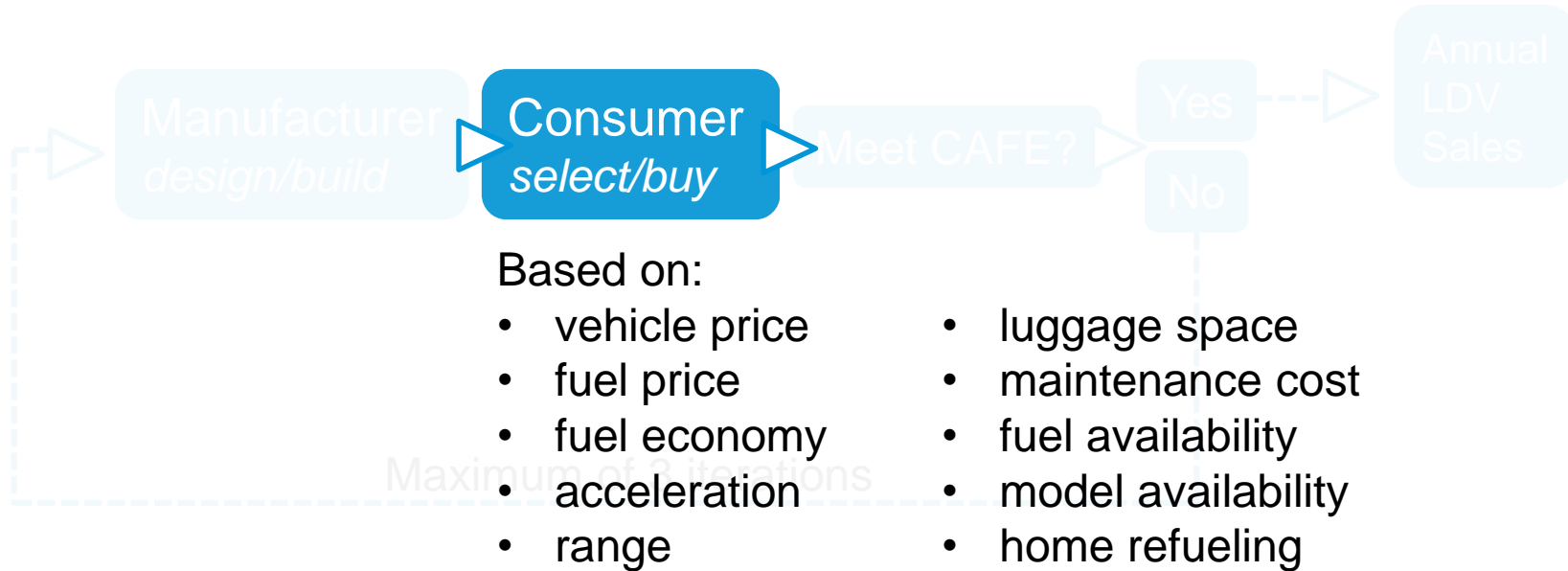
AEO2022 light duty vehicle results

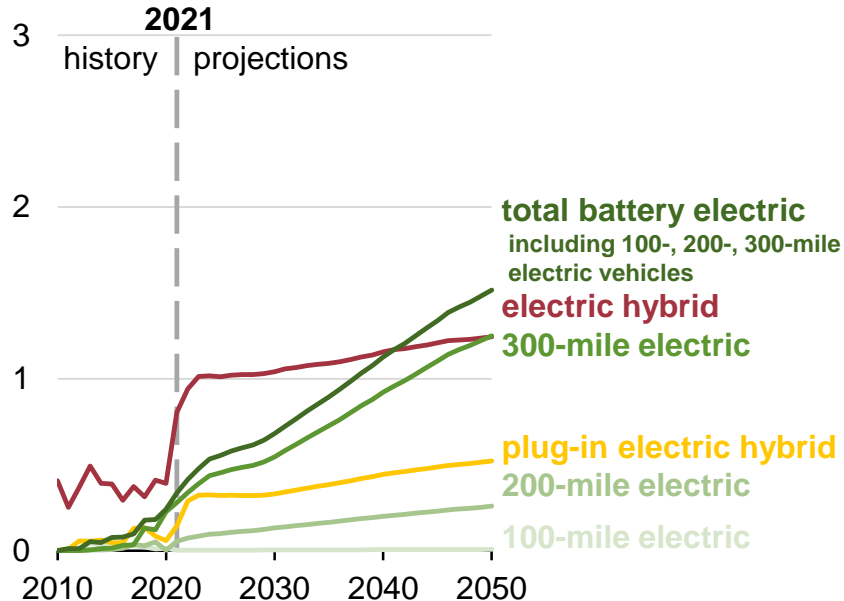# Light-duty vehicle sales by technology or fuel type

Light-duty vehicle sales by technology or fuel
**AEO2022 Reference case**
millions of vehicles

2021
history | projections

other
electric hybrid
plug-in electric
hybrid
battery electric
diesel
flex fuel
gasoline

New vehicle sales of battery-powered vehicles
AEO2022 Reference case
millions of vehicles

2021
history | projections

total battery electric
including 100-, 200-, 300-mile
electric vehicles
electric hybrid
300-mile electric

plug-in electric hybrid
200-mile electric
100-mile electric

Plug-in electric vehicle sales and stocks projection

Plug-in electric vehicle sales shares, AEO2022 Reference case
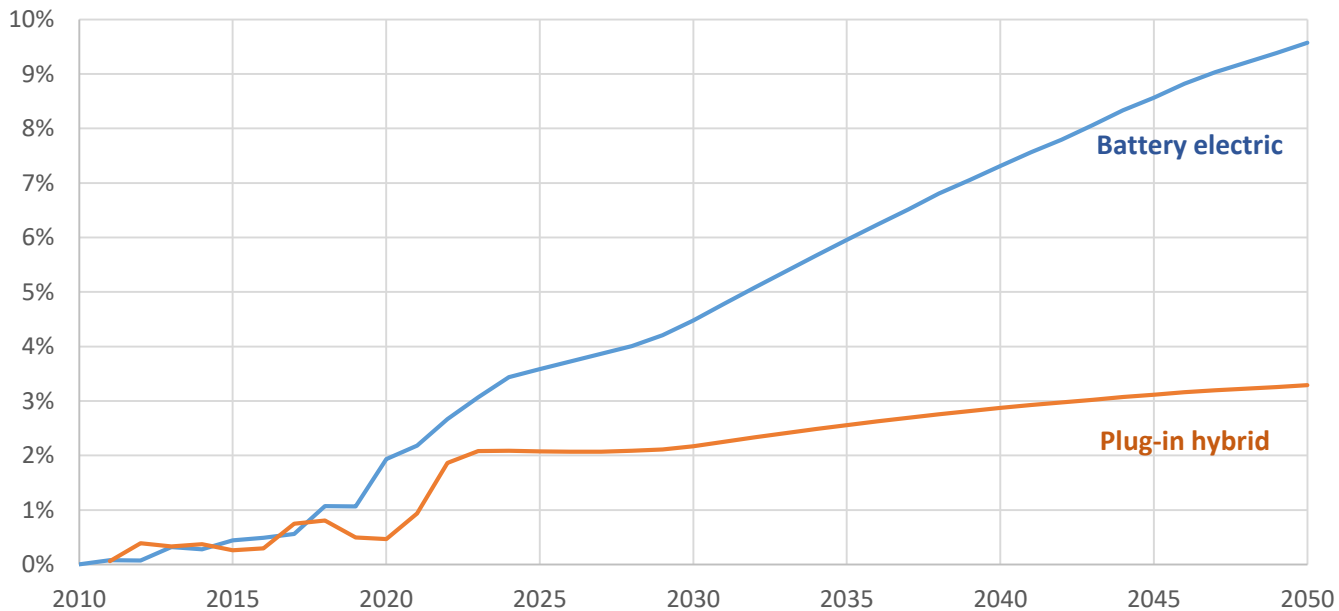
What drives EV adoption?

NOT explicitly modeled in NEMS: Manufacturer aspirations

[Statements on the Biden Administration's Steps to Strengthen American Leadership on Clean Cars and Trucks](#) regarding 40-50% EV sales in 2030:

- Ford/GM/Stellantis: "…can be achieved only with the timely deployment of the full suite of electrification policies committed to by the Administration in the Build Back Better Plan, including <u>purchase incentives</u>, a <u>comprehensive charging network of sufficient density</u> to support the millions of vehicles these targets represent, <u>investments in R&D</u>, and <u>incentives to expand the electric vehicle manufacturing and supply chains in the United States</u>."

- BMW/Ford/Honda/VW/Volvo: "…bold action from our partners in the federal government is crucial to build consumer demand for electric vehicles…includes a <u>strong nationwide greenhouse gas emissions standard</u>, <u>continued investments in charging infrastructure</u>, and <u>broad consumer incentives for all electric vehicle purchases</u>"

Source: https://www.whitehouse.gov/briefing-room/statements-releases/2021/08/05/statements-on-the-biden-administrations-steps-to-strengthen-american-leadership-on-clean-cars-and-trucks/

Conditions affecting electric vehicle sales

- Policy

- Incremental electric vehicle costs

- Fuel prices (cost to drive)

- Consumer sentiment
  - Range anxiety and recharging availability/time
  - Model availability (e.g., no EV pickups in 2021)

Conditions affecting electric vehicle sales: policy

- Federal plug in electric vehicle tax credit: up to $7500 tax credit for BEVs and PHEVs

- **2020**: Safer Affordable Fuel Efficient (SAFE) Rule – updated CAFE standards
    - Sets annual MPG improvement to 1.5% (previously around 5%)
    - Revoked California authority to set its own standard and enforce the ZEV mandate

Included in AEO2022

- **2021**: NHTSA repeals SAFE I (12/21/2021)

- **2021**: Infrastructure Investment and Jobs Act / Bipartisan infrastructure law (11/15/2021)

- **2022**: EPA reinstatement of California's CAA waiver (3/14/2022)

- **2022**: NHTSA CAFE update (3/21/2022)

- **2022**: Inflation Reduction Act (8/16/2022)

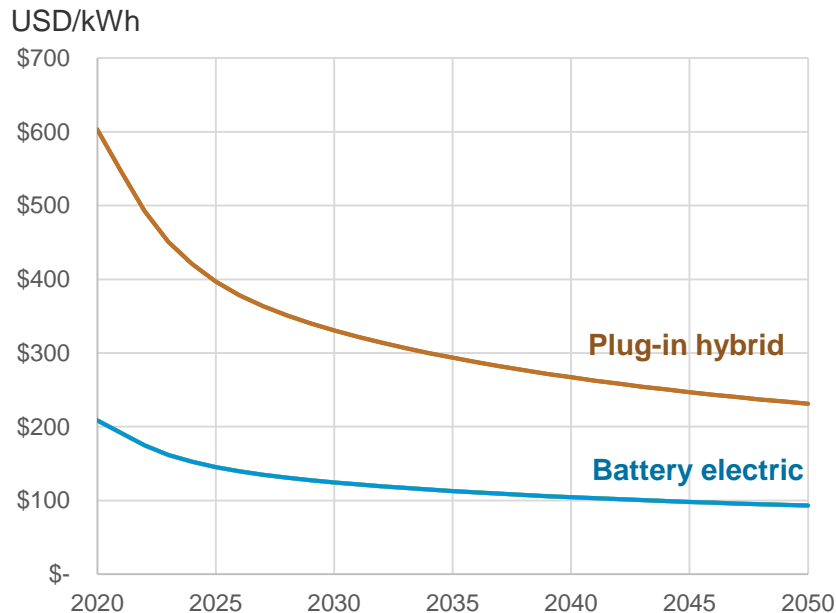- Evolving State policies (e.g. 2035 CA ICE vehicle ban)

Not included in AEO2022

Conditions affecting electric vehicle sales: purchase price

Retail price equivalent battery prices

USD/kWh

Plug-in hybrid

Battery electric

Uncertainties:

Technology breakthroughs: solid state batteries? Ultra fast charging capability?

Raw material supply chain – materials shortage looks highly likely in the mid/late-2020s, under high EV- penetration scenarios estimated by manufacturers and others

Will battery cost reductions go to range improvement or vehicle cost reduction?

Electric vehicles are priced similar to luxury vehicles

Average Passenger Vehicle Transaction Price -- Kelley Blue Book
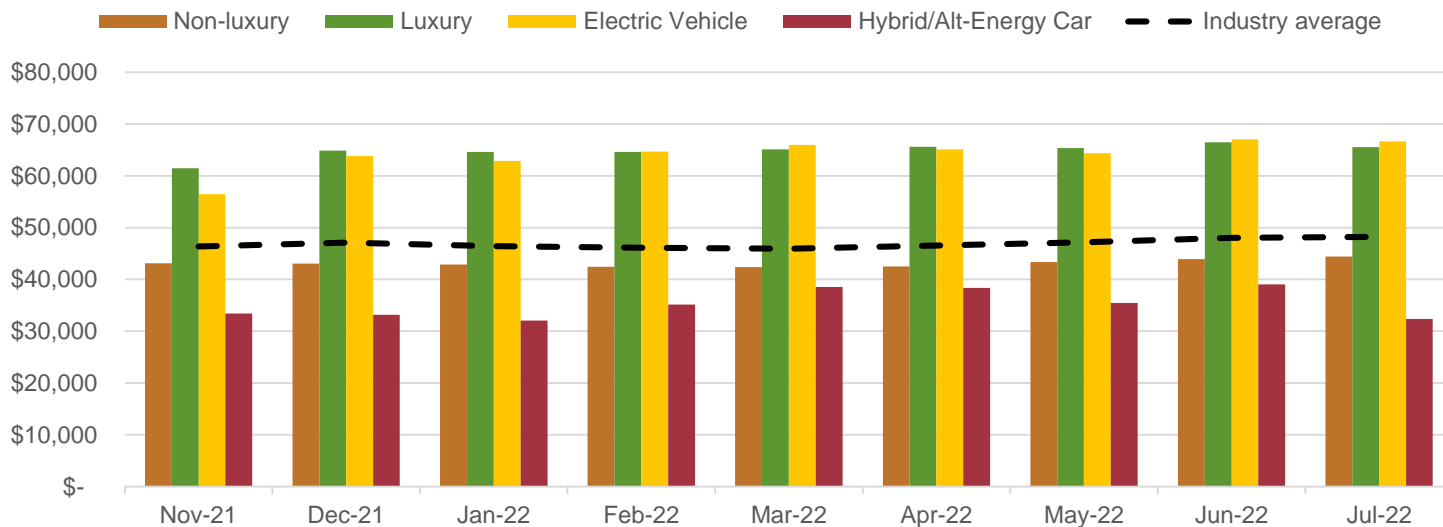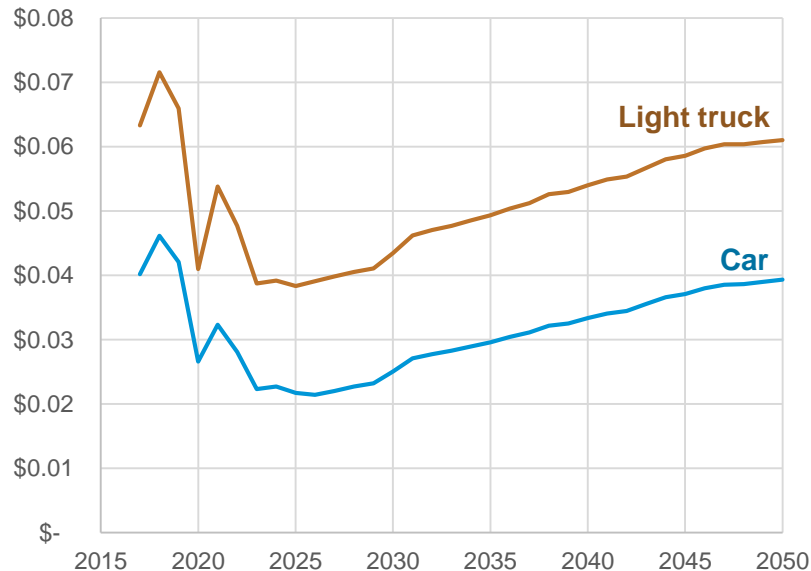
Source: Kelley Blue Book press releases

Uncertainties:

NEMS assumes home charging (residential) electricity prices, which are considerably lower than those charged for public charging (in particular public fast charging). This cost advantage would likely shrink by half, or more, if one were to assume public fast charging.

The trajectory of future fuel prices in general – both gasoline and electricity – is highly uncertain.

How much more expensive is it to drive a Gasoline ICE versus an EV300?

USD/mile

Light truck

Car

Q & A