What do greenhouse gas scenarios tell us?

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Scenario analyses explore possible futures and pathways

- What mix of technologies can achieve aggressive GHG reduction or fuel economy targets?
- How do the different projections compare with respect to 2030 and 2050 goals?
- Why do analyses on the “same” topic yield different findings?
- What should we consider as we compare and contrast scenario results?
  - Context/intent
  - Key questions
  - Scope
  - Assumptions
  - Methods and approach

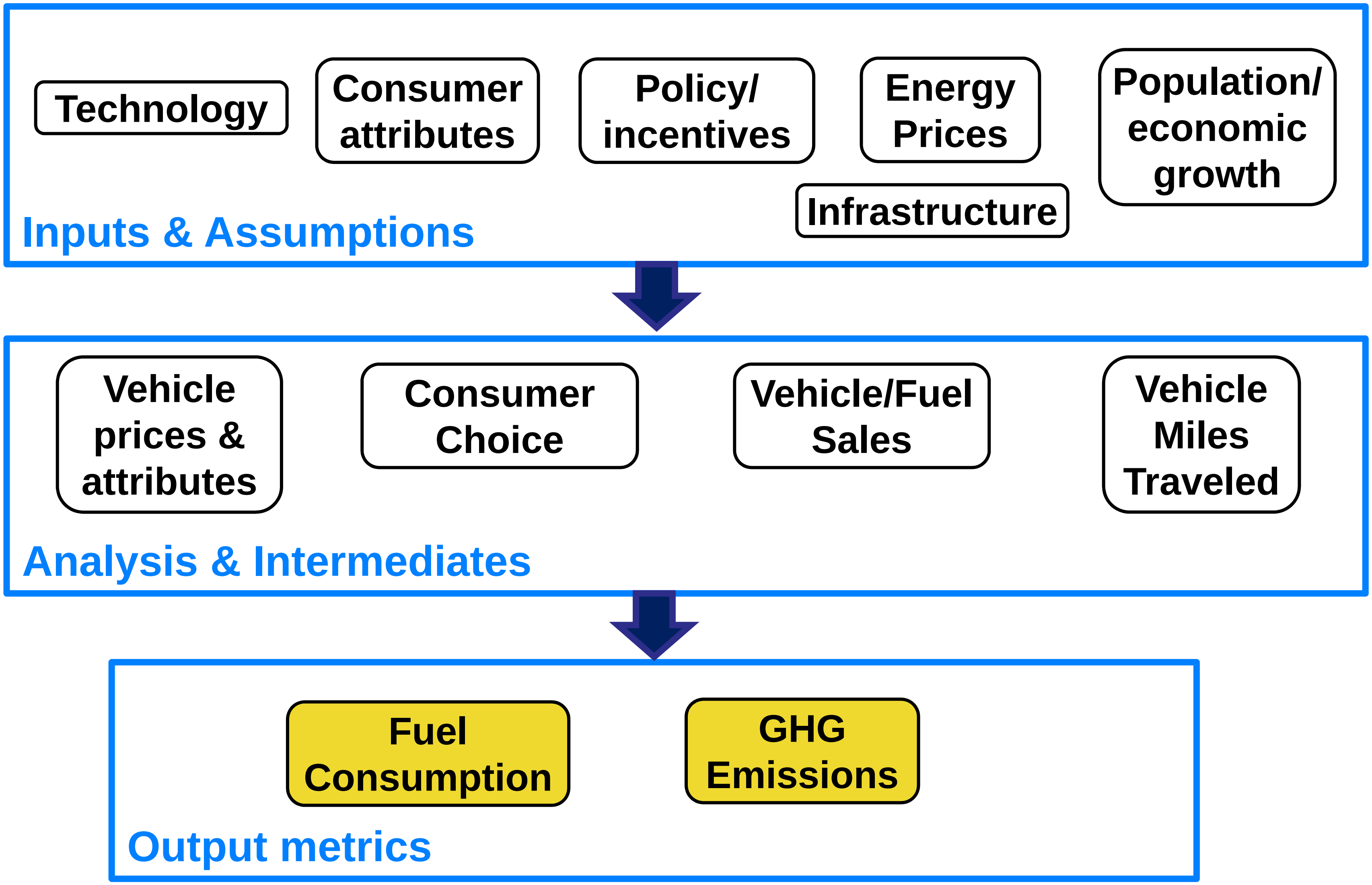
Consider context of recent studies with scenarios for GHG emissions & petroleum consumption reduction

- National Petroleum Council – Advancing Technology for America's Transportation Future
  - Request from DOE Sec. Chu to NPC. Included participation from over 300 individuals with primary leadership from oil & gas industry
- DOE EERE – Transportation Energy Futures
  - DOE study conducted by national laboratories (ANL, NREL, ORNL)
- National Resource Council – Transitions to Alternative Vehicles and Fuels
  - Convened by NRC in response to Congressional mandate in Senate FY2010 energy & water appropriations bill
- Energy Information Agency Annual Energy Outlook 2013
  - Annual best projection by EIA of key energy production, demand, and prices through 2040

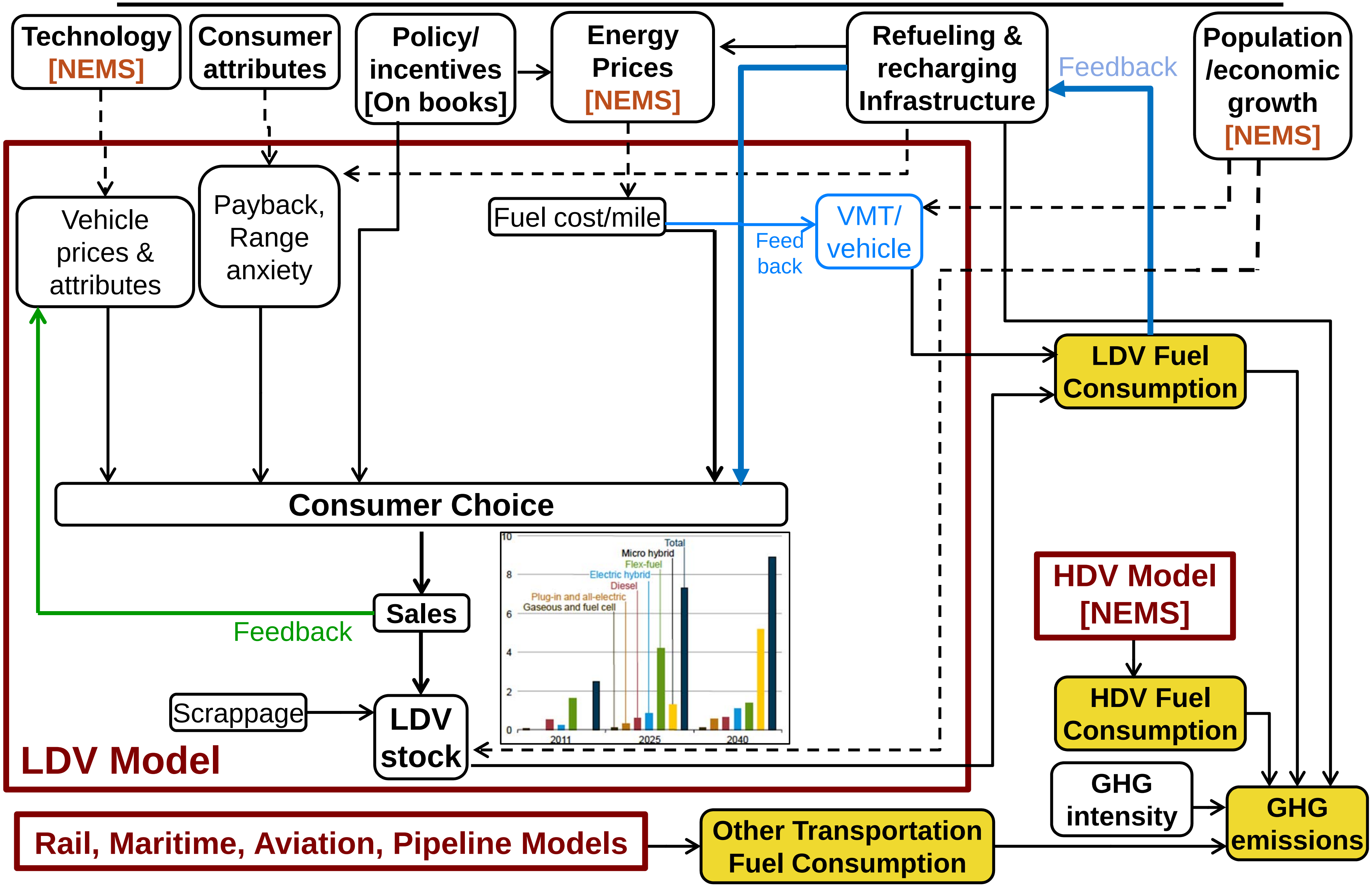
Key questions and scope for these major US studies

- NPC – entire transport sector
  - What actions can industry and government take to stimulate technological advances (alternative fuels and advanced vehicles) and market conditions to reduce lifecycle GHG by 50% relative to 2005 by 2050?
- TEF – entire transport sector with emphasis on underexplored opportunities
  - What combination of strategies could achieve deep reductions in petroleum consumption & GHG emissions?
- NRC – LDV efficiency, biofuels, electrification, H2
  - What combination of policies could achieve substantial reductions – 50% by 2030 and 80% by 2050 – in petroleum consumption & GHG emissions?
- AEO – entire energy economy
  - Where will the US energy economy likely be in 2040?

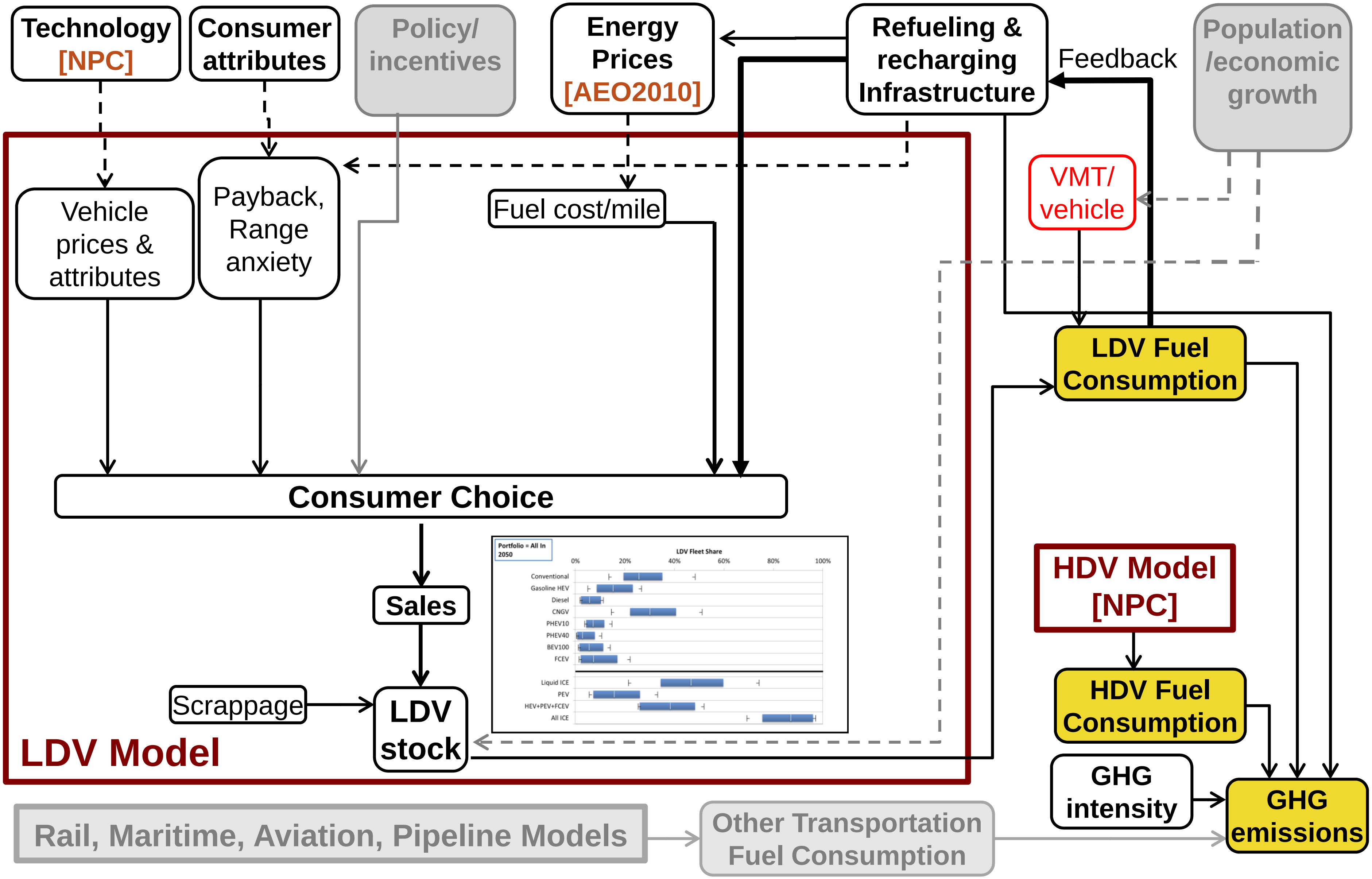
Pathways through scenarios highlight factors that influence outcomes



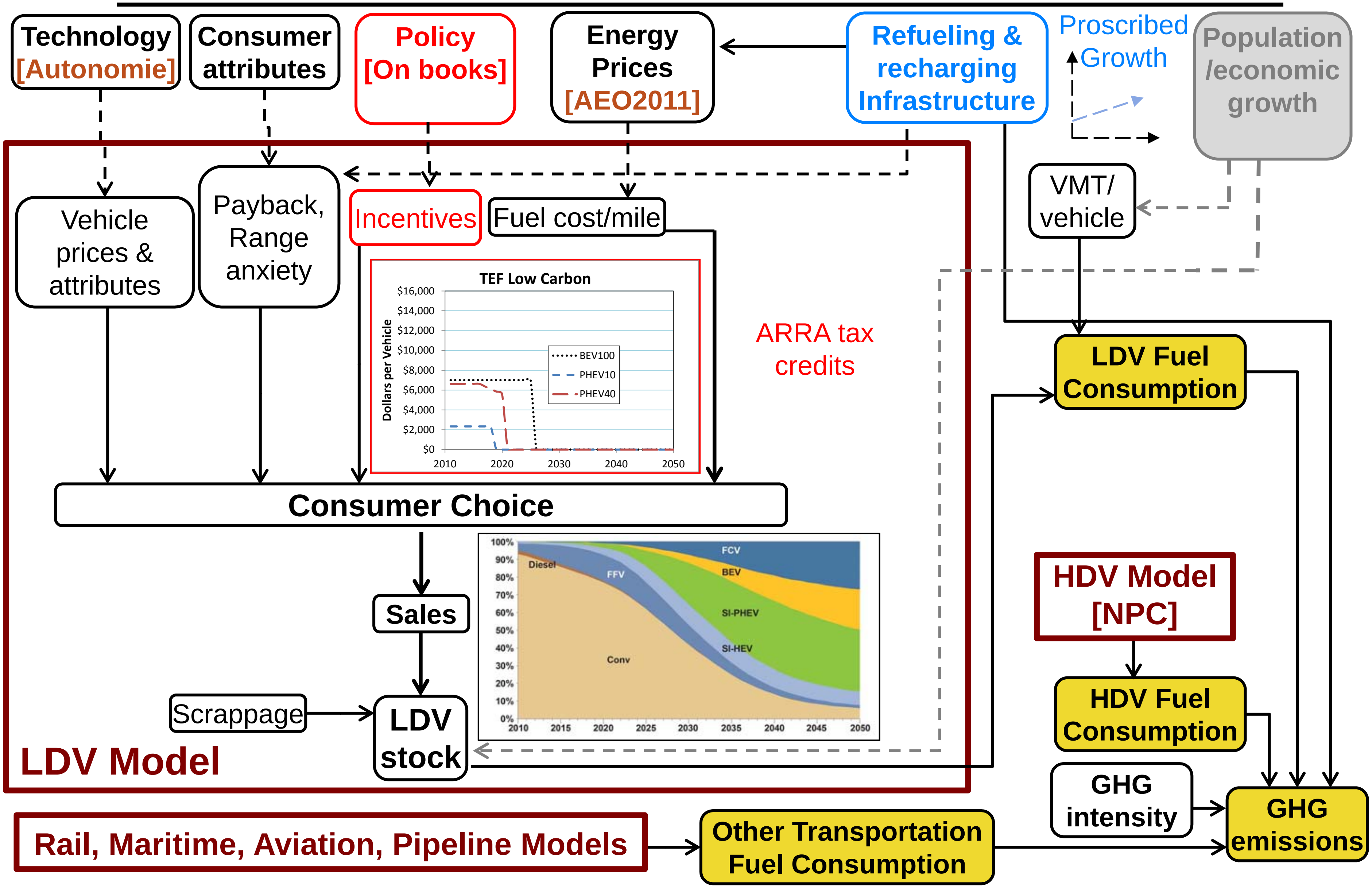
Unpacking scenarios highlights additional complexity: AEO forecasts



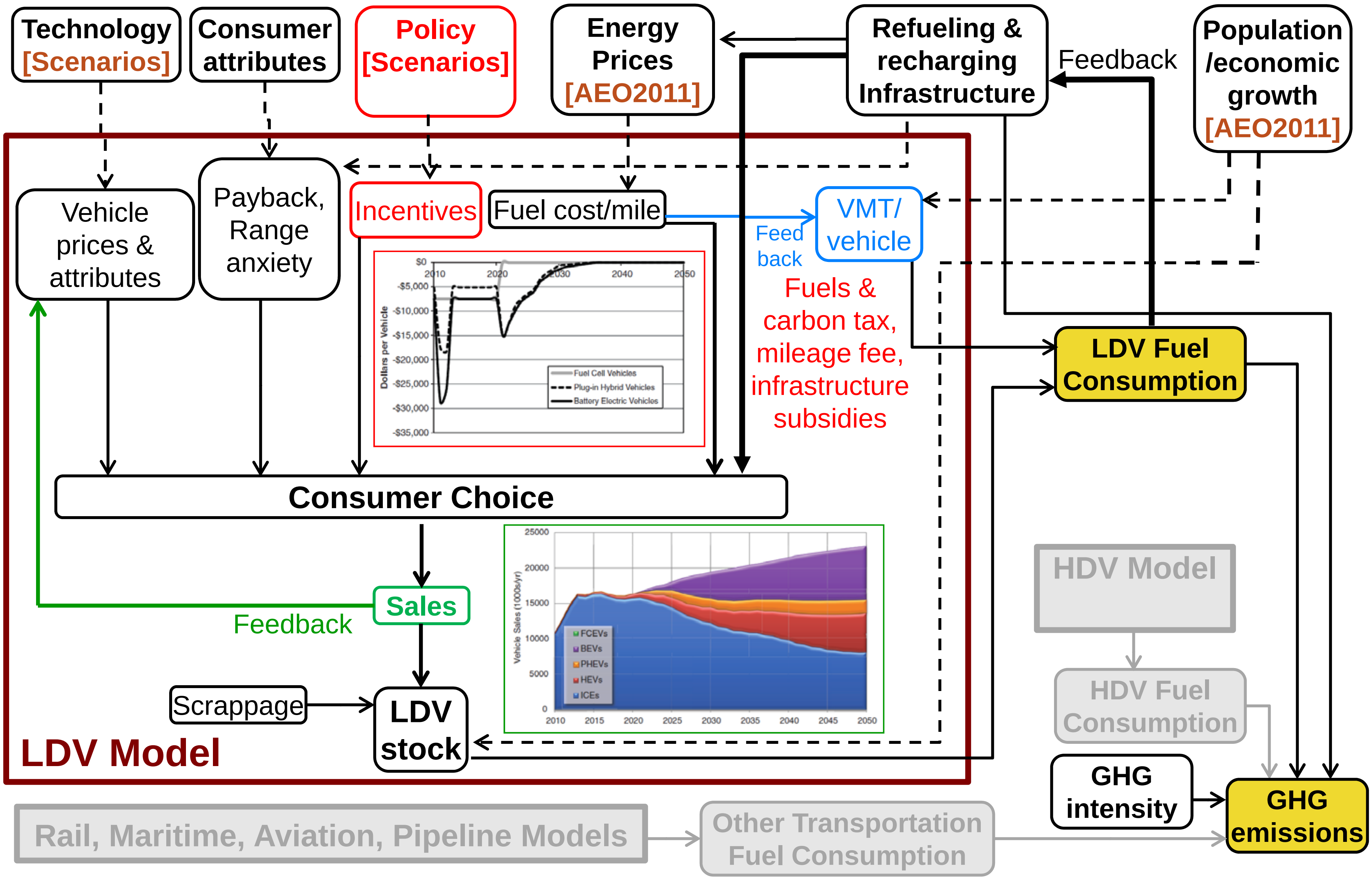
Inputs & models used to generate scenarios vary: VISION, LVChoice, fuels & infrastructure for NPC



Inputs & models used to generate scenarios vary: VISION, Autonomie, MA3T for TEF



Inputs & models and spectrum of scenarios vary: VISION, LAVE-Trans with policy for NRC



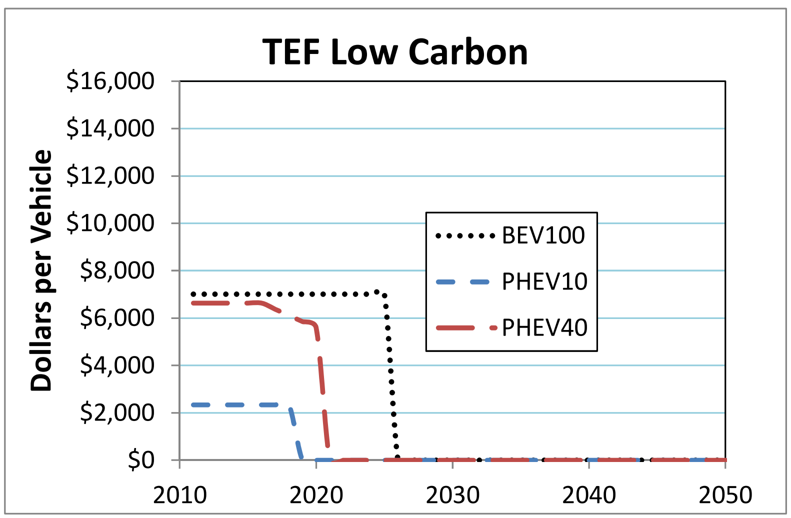
Key difference: Input policy assumptions and impacts

AEO incorporates current policies & assumes that current laws/regulations are largely unchanged (including sunset dates)

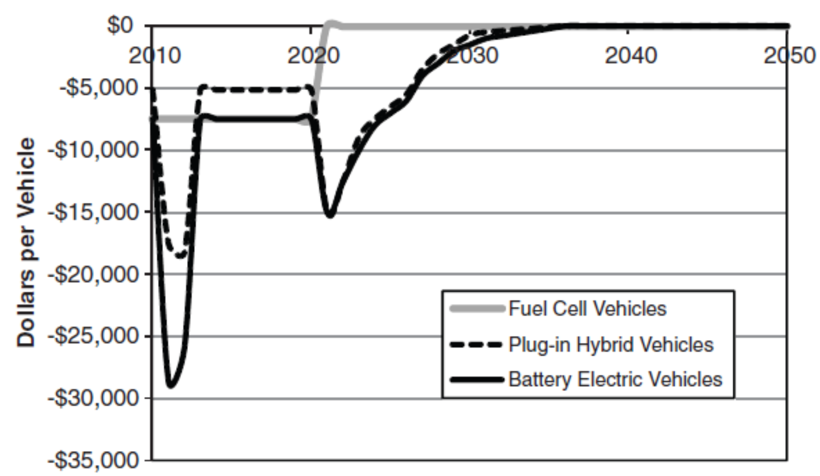
- **ARRA tax credits**
- **CAFÉ standards**
- **RFS2**
- **CA AB32, LCFS, Low Emission Vehicle Program**

NPC focused on technology rather than policy

- **Incorporated infrastructure costs in fuel price rather than subsidies**
- **Technology cost included in vehicle cost**



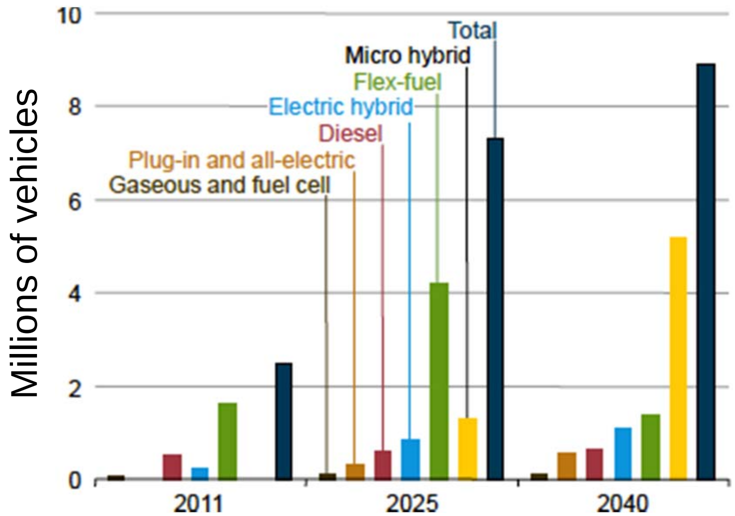
TEF: Assumed vehicle subsidies with ARRA tax credits (courtesy of Changzheng Liu, ORNL)



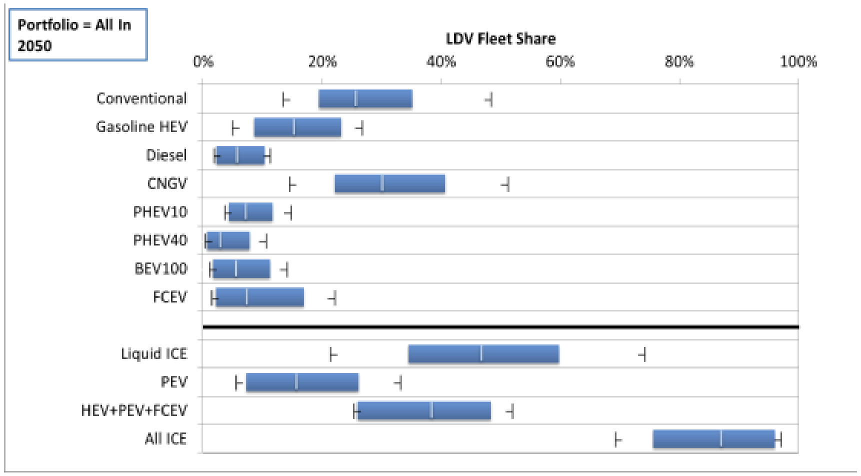
NRC Figure 5.31: Assumed BEV & PHEV subsidies in optimistic EV technology scenario

- Fuels & carbon tax, mileage fee, infrastructure subsidies

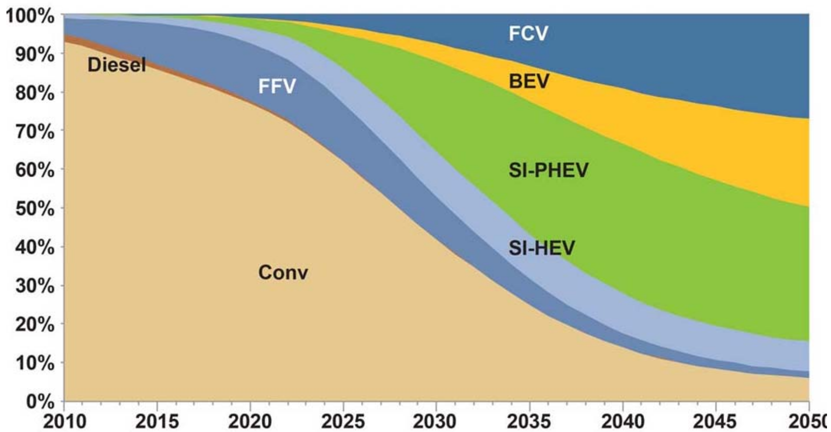
Intermediate difference: Light duty vehicle mix



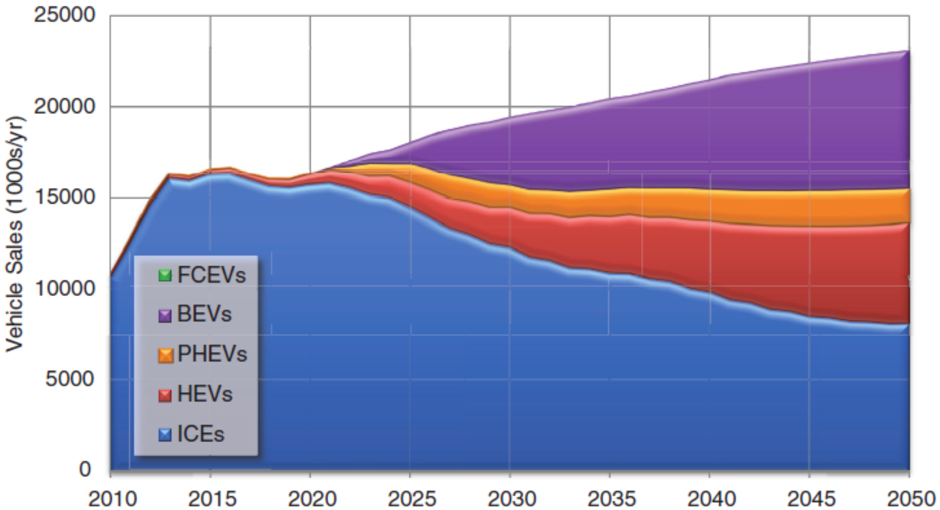
AEO Figure 73: Sales of LDV using non-gasoline technologies



NPC Figure 2-10: Ranges of 2050 LDV share in 2050 including all fuel-vehicle systems

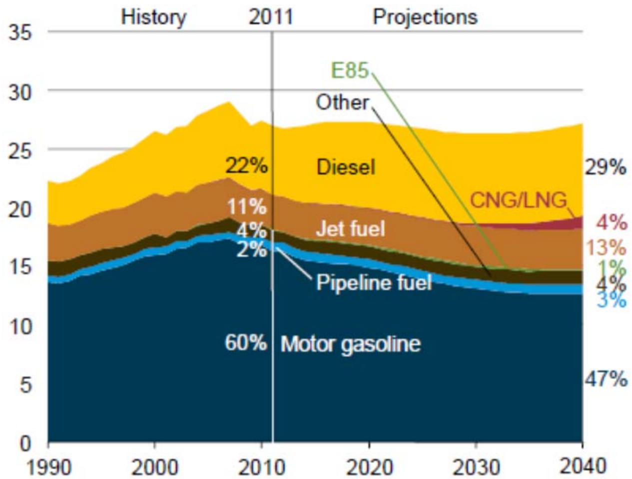


TEF Project Overview and Findings Slide 10: Advanced vehicles have the potential to dominate the LDV market by 2050

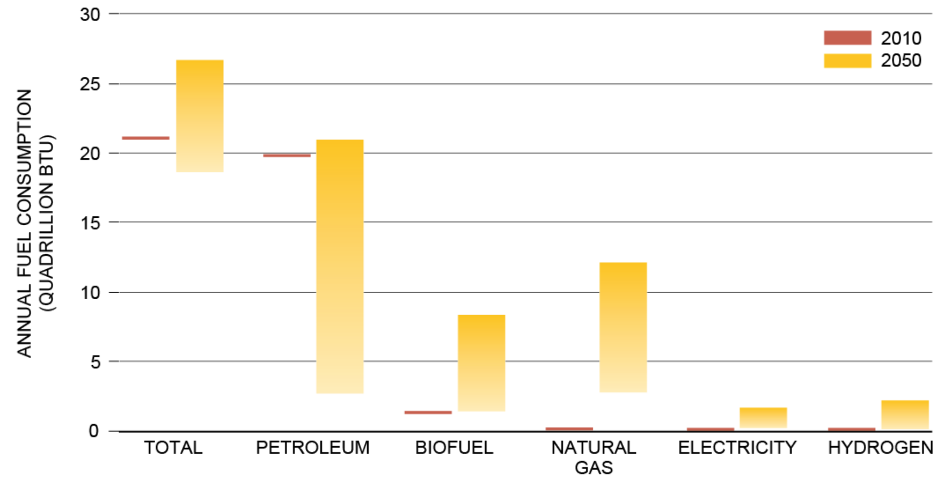


NRC Figure 5.32: LDV sales for optimistic plug-in electric vehicle scenario

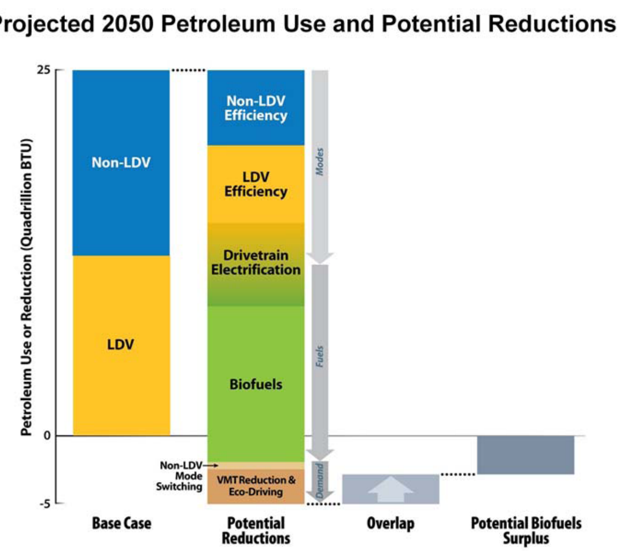
Difference in output: Fuel consumption



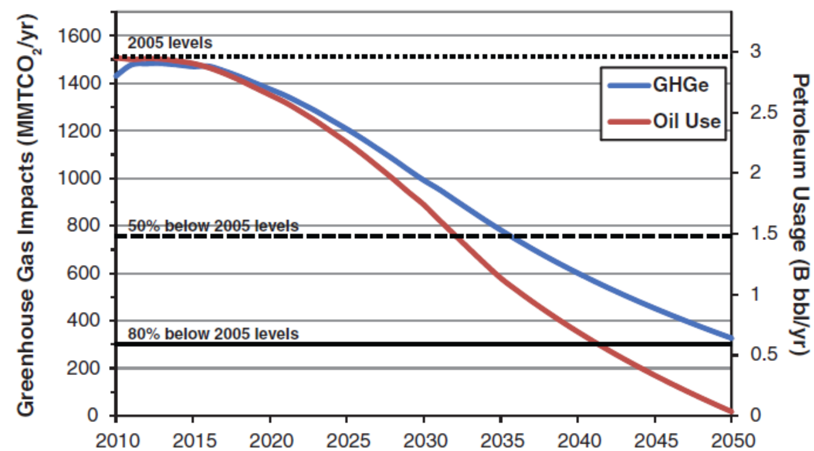
AEO Figure 6: Transportation energy consumption by fuel (quadrillion BTU)



NPC Figure ES-10: Range of 2050 on-road fuel consumption assuming all alternatives commercialized

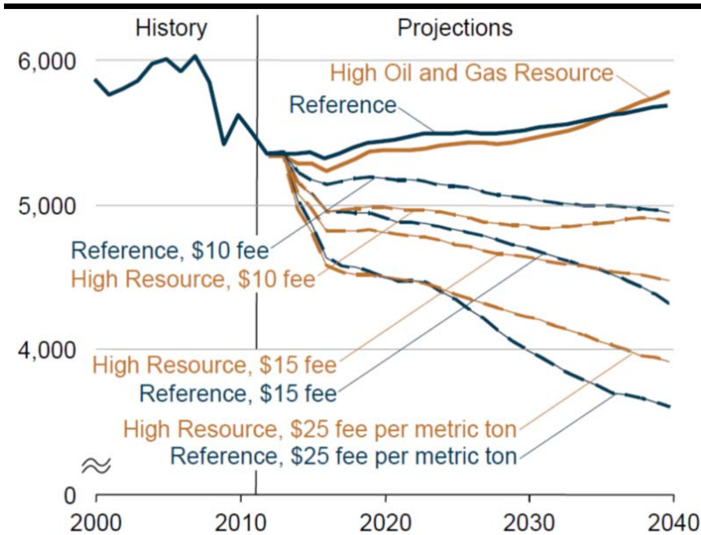


TEF Project Overview & Findings Slide 18: Projected 2050 petroleum use & potential reductions

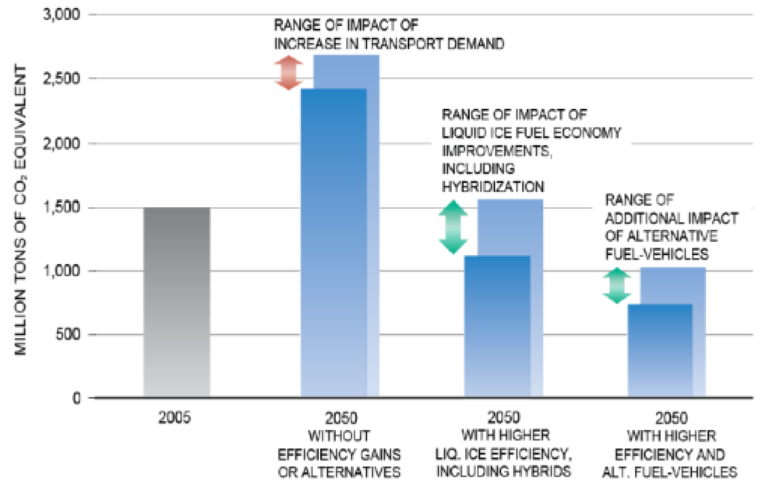


NRC Figure 5.33: Changes in petroleum use & GHG emissions versus 2005: Optimistic plug-in EV scenario

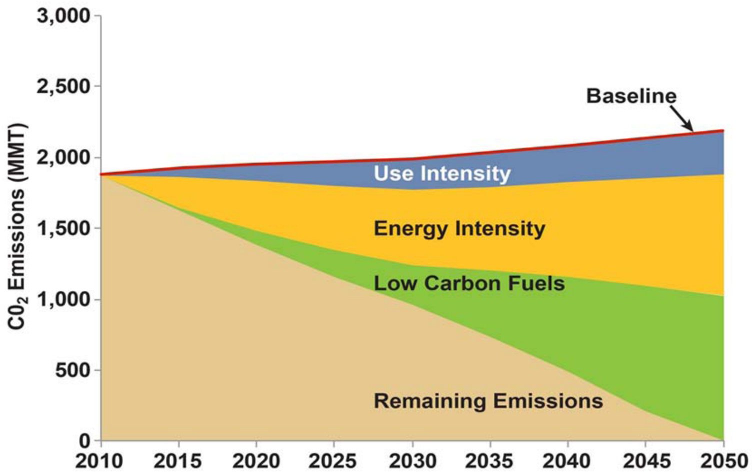
Difference in output: GHG emissions



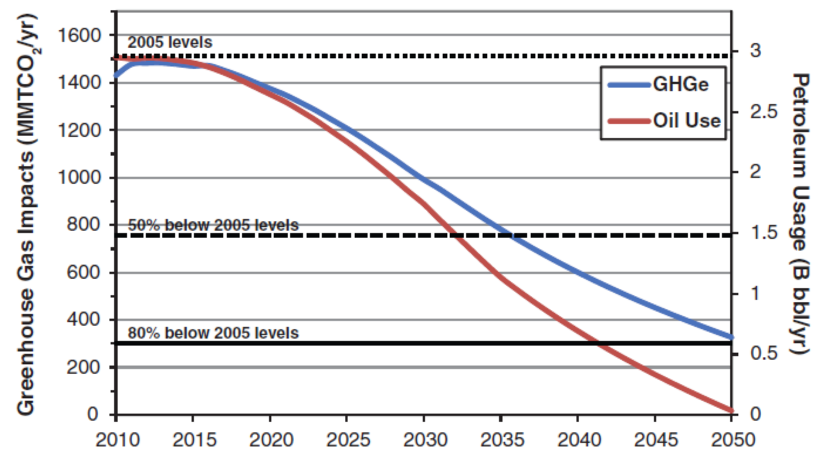
AEO Figure 111: Energy-related CO2 emissions in two cases with three levels of emissions fees (MMT)



NPC Figure ES-11: Range of impact of demand, fuel efficiency improvements, & alternative fuel-vehicle systems on 2050 LD fleet GHG emissions



TEF Project Overview & Findings Slide 19: CO2 emissions (MMT)



NRC Figure 5.33: Changes in petroleum use & GHG emissions versus 2005: Optimistic plug-in EV scenario

Observations

- Consider context, key questions, scope of scenario analyses
- Examine assumptions, inputs, intermediates
  - These can be embedded in methods/models
- Presentation of results vary
  - Side-by-side comparisons of inputs, intermediates, outputs aren’t necessarily apples-to-apples
- Scenario interpretation is complicated

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Thank you!