

# CA Truck Transition Scenarios



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# STEPS Transition Scenarios

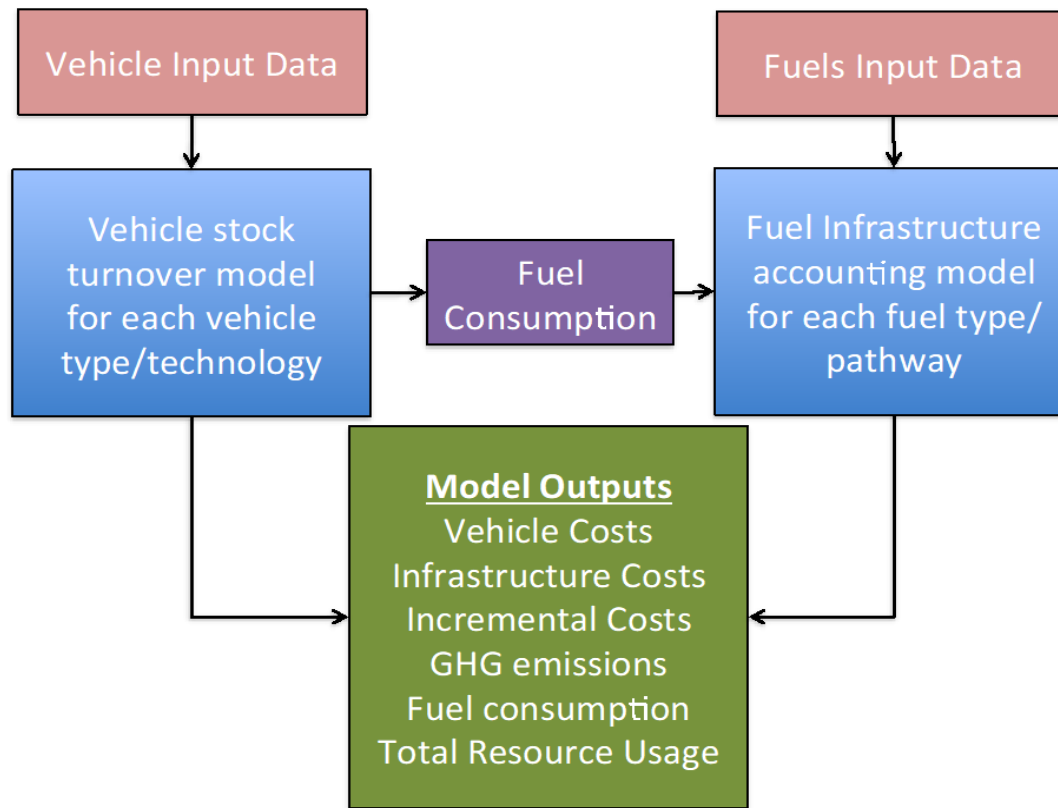
- Go for deep CO<sub>2</sub> reductions across LDVs and trucks, by 2050
- LDV scenarios based on TIMES runs, backcast
- Truck scenarios developed using a truck choice model
  - Trucks modeled across 8 truck classes
  - Track monetary costs and “generalized costs”
- Role of ZEVs vs Biofuels
- Modeled transition in fuel production, feedstocks

# Scenarios

- **Business as Usual (BAU)**
  - LDVs meet CAFE standard and ZEV mandate through 2030
  - Trucks assume no advanced technology market penetration except transit buses
- **ZEV**
  - Significant fuel cell and PEV sales (LDVS ~ 100% 2050, Trucks ~60% in 2050, Transit buses 90% in 2050)
- **ZEV + Biofuels (only trucks differ from ZEV)**
  - Roughly half the ZEV market penetration as ZEV scenario, diesel biofuels (HEFA, FT) reach 50% blend by 2050

# Transition Scenario Modeling Framework

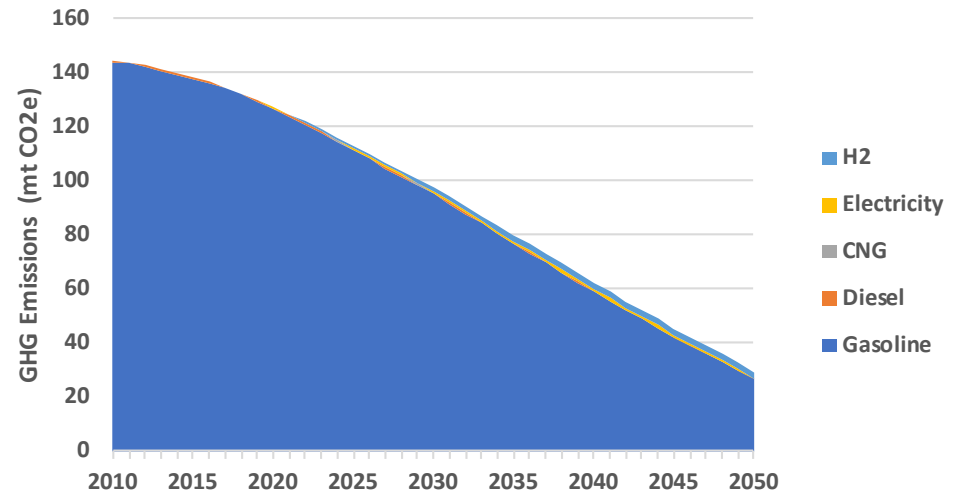
- Spreadsheet-based model
  - Specify vehicle technologies (sales mix, fuel consumption, cost)
  - Specify fuel supply (production/delivery pathways, carbon intensity, cost)



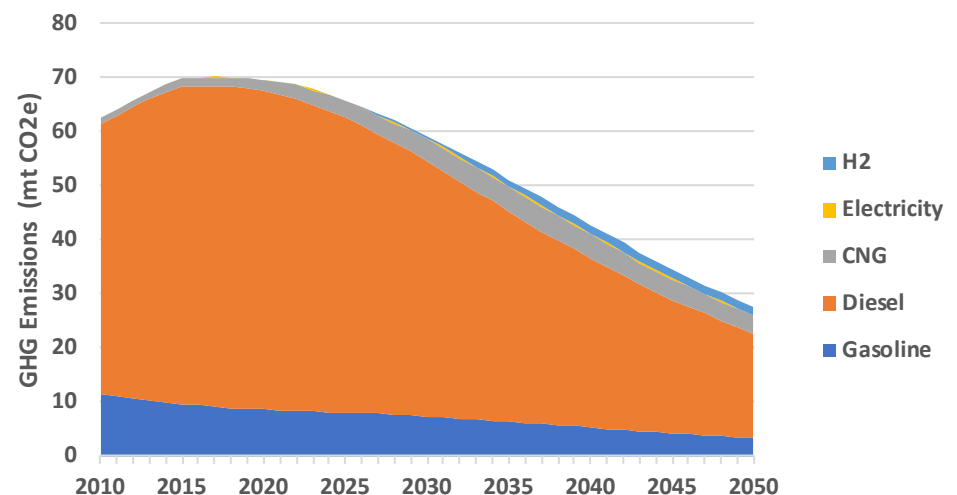
# LDV and truck CO2 emissions reductions

- Cars achieve about an 80% CO2 reduction compared to 2010
- Trucks achieve “only” about a 55% CO2 reduction compared to 2010

LDV GHG Emissions - ZEV

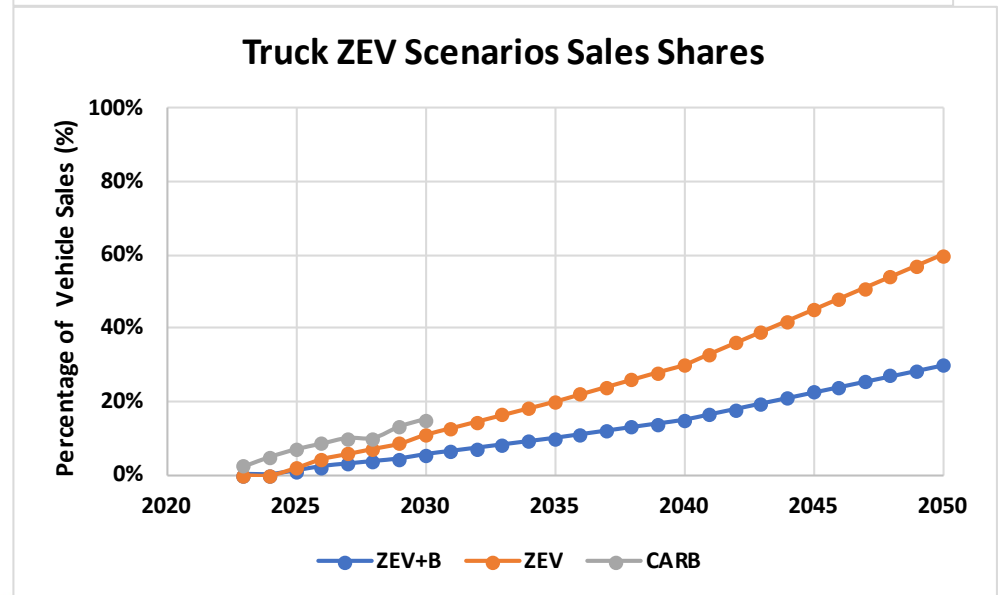
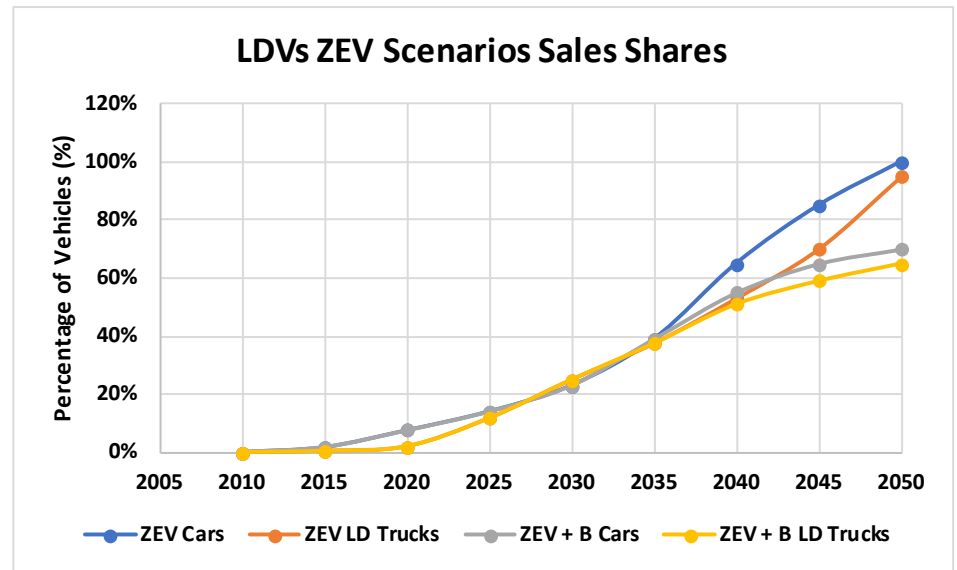


Truck GHG Emissions - ZEV



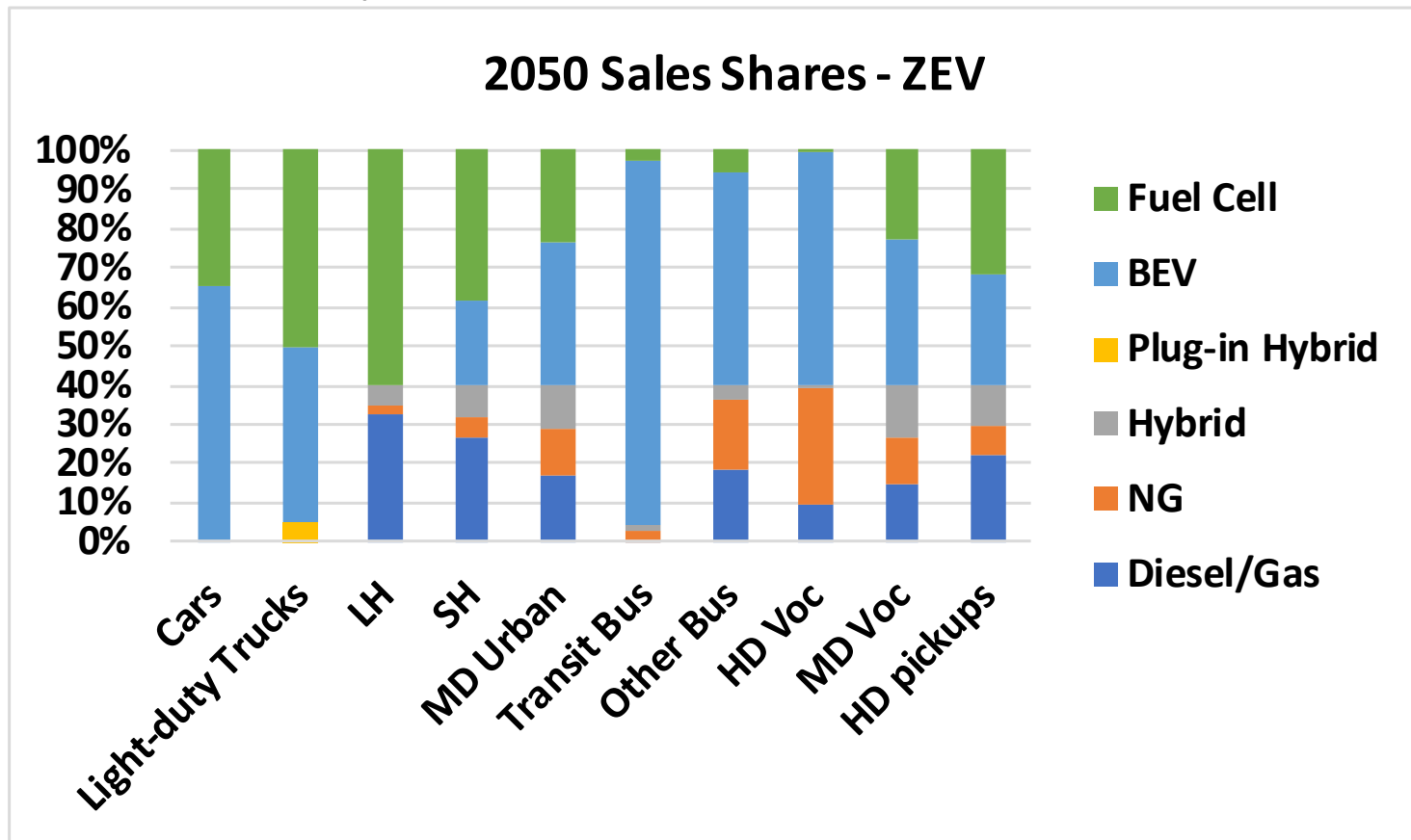
# LDV and Truck Sales Shares

- Cars achieve an 80-100% ZEV market share by 2050
- Trucks achieve “only” about a 60% ZEV market share in ZEV scenario by 2050 (10 years behind cars)
- Possible ARB ZEV truck mandate also shown

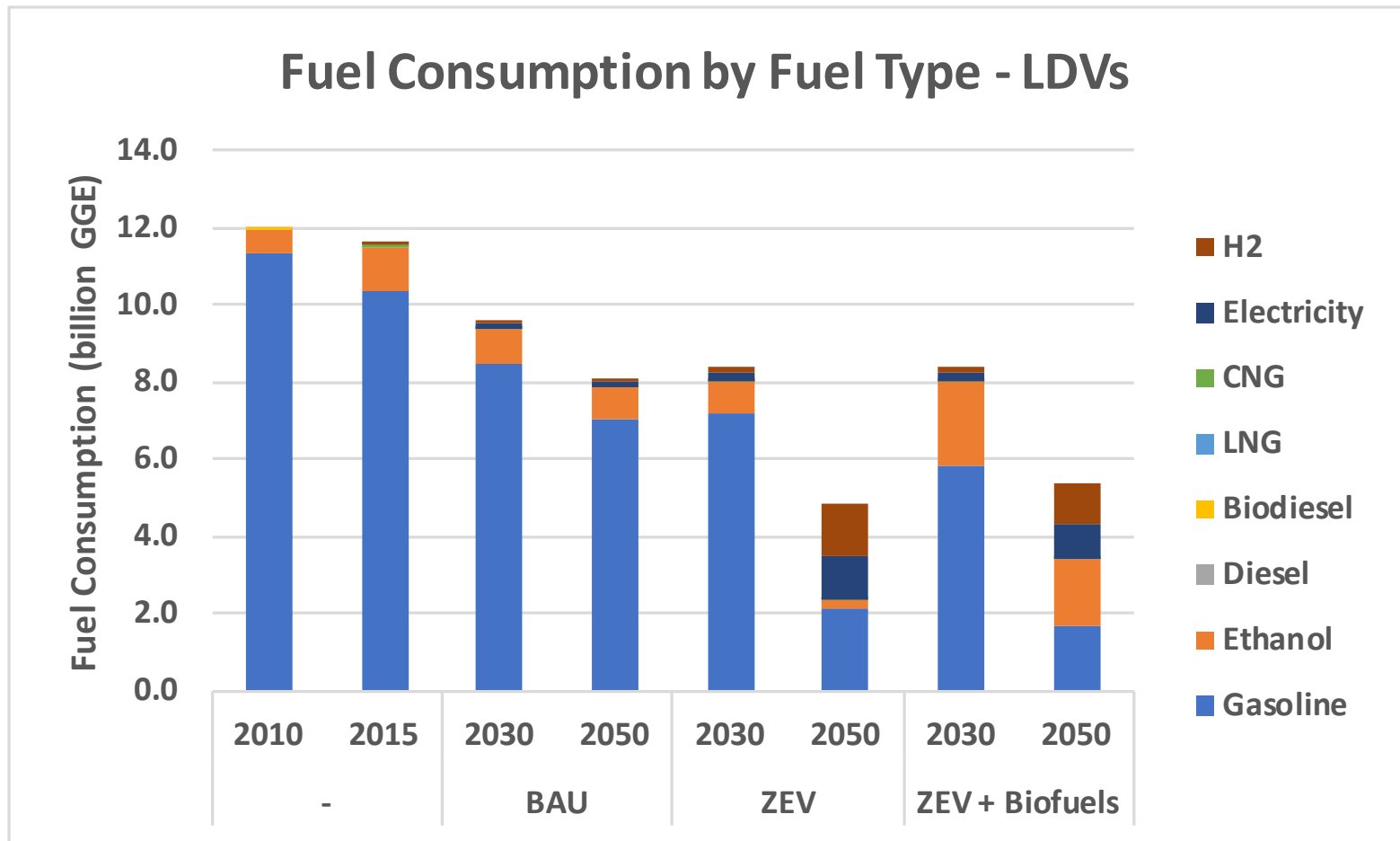


# Sales Shares, ZEV scenario

- Cars achieve nearly 100% market share of FCEV, BEV and PHEV
- Trucks achieve only 60% FCEV and BEV

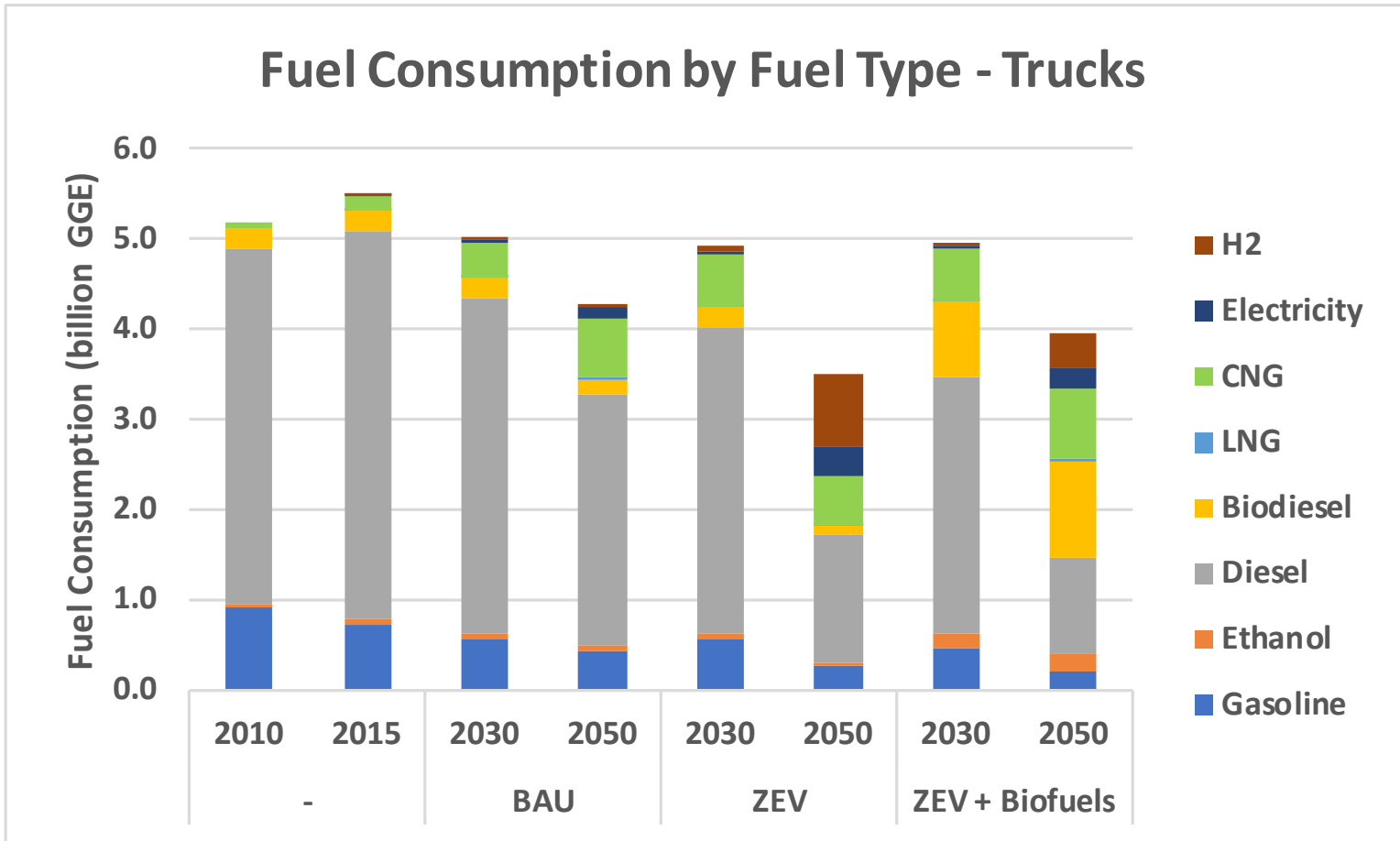


# Fuel Consumption LDVs



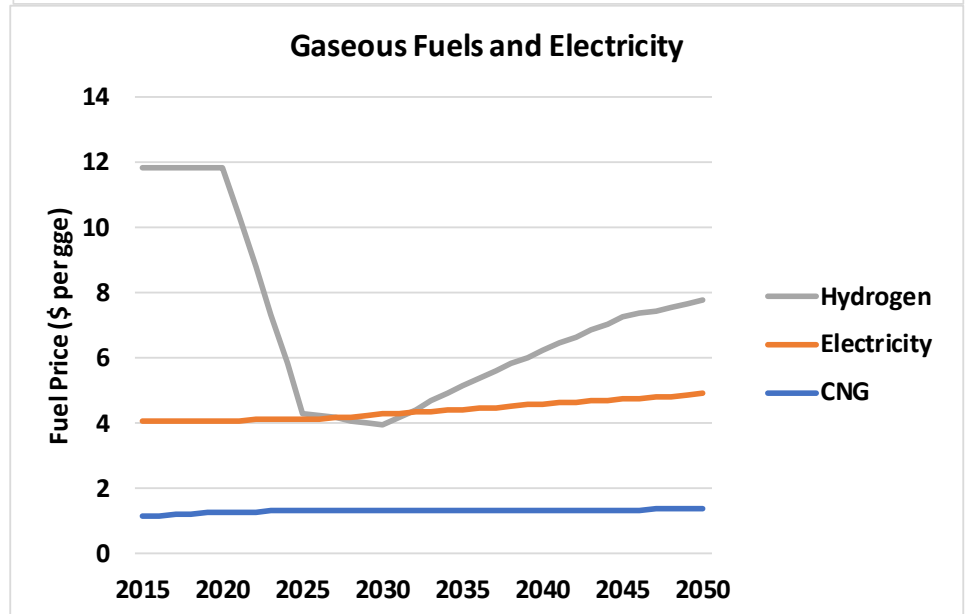
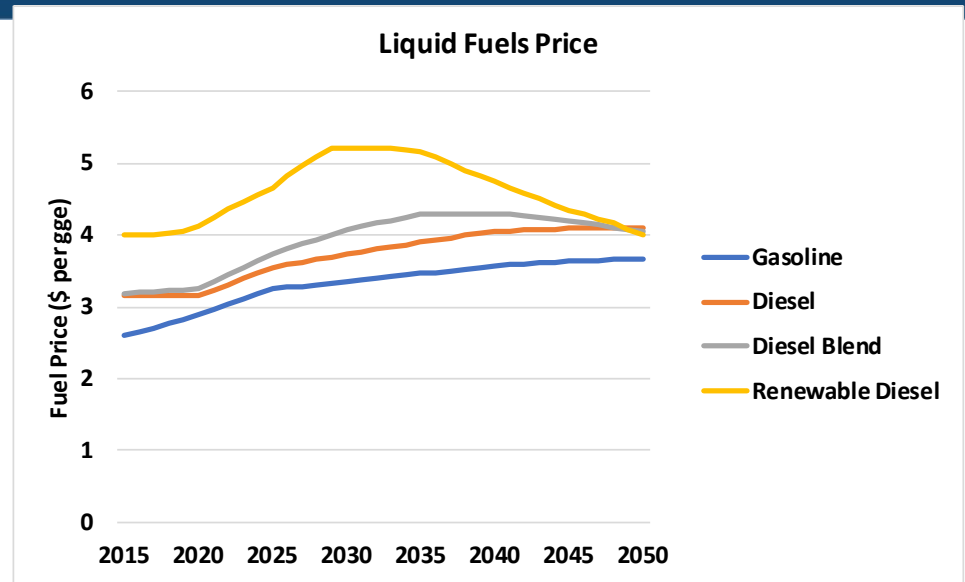


# Fuel Consumption Trucks



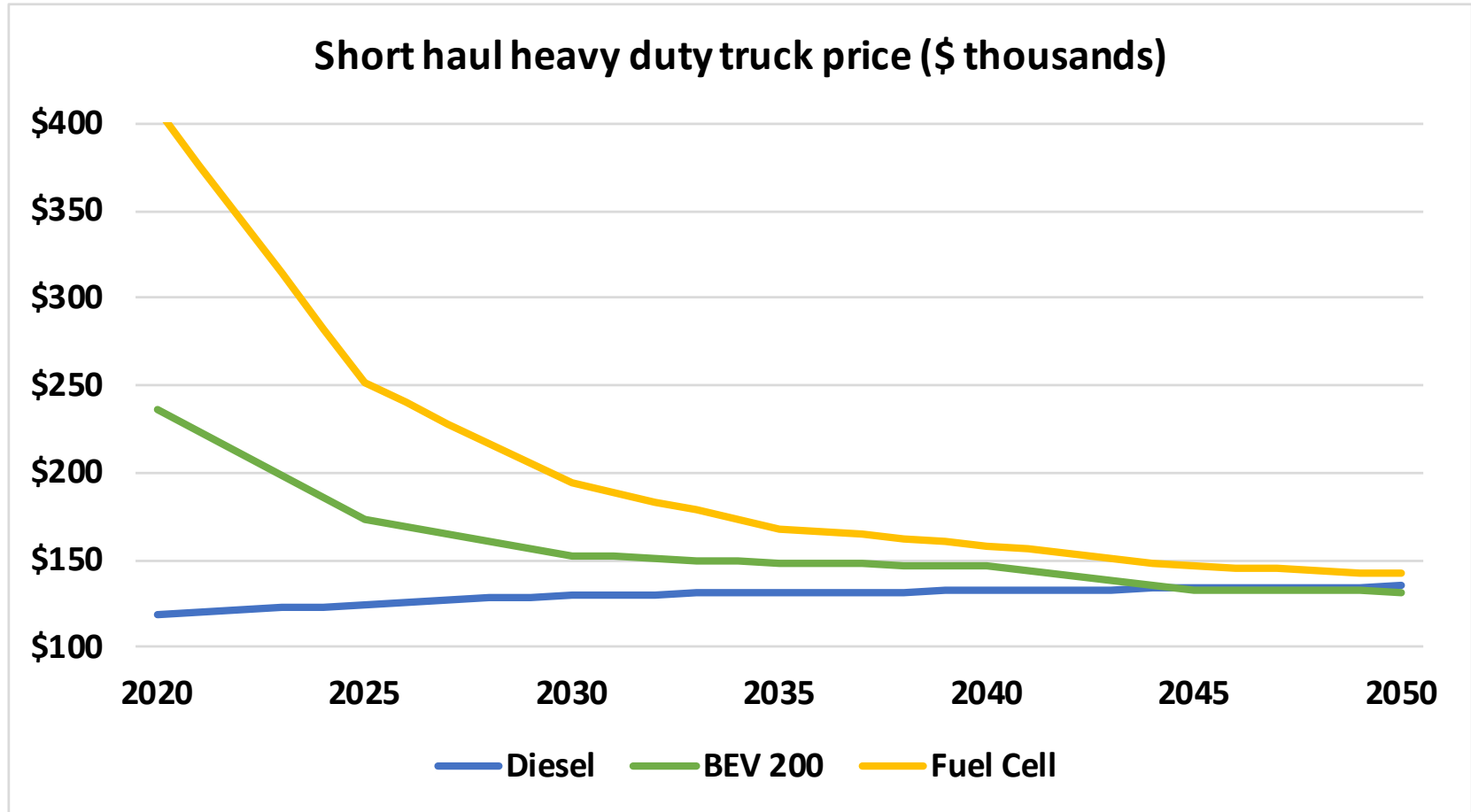
# Fuel cost

- Future renewable diesel price rises then falls as advanced RD is phased in
- Future H2 price drops then rises as electrolysis is phased in



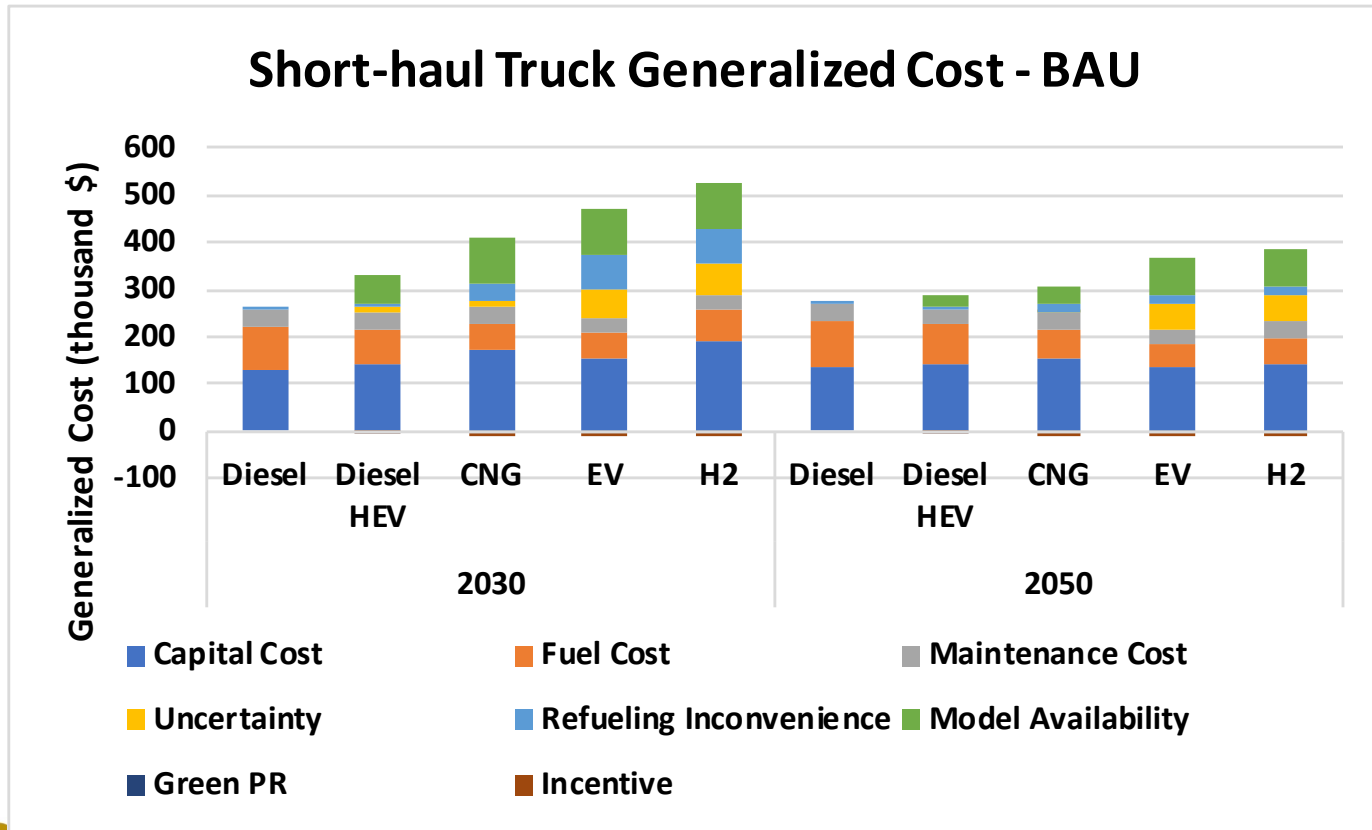
# Truck cost

- All 3 major technologies very close in price by 2040

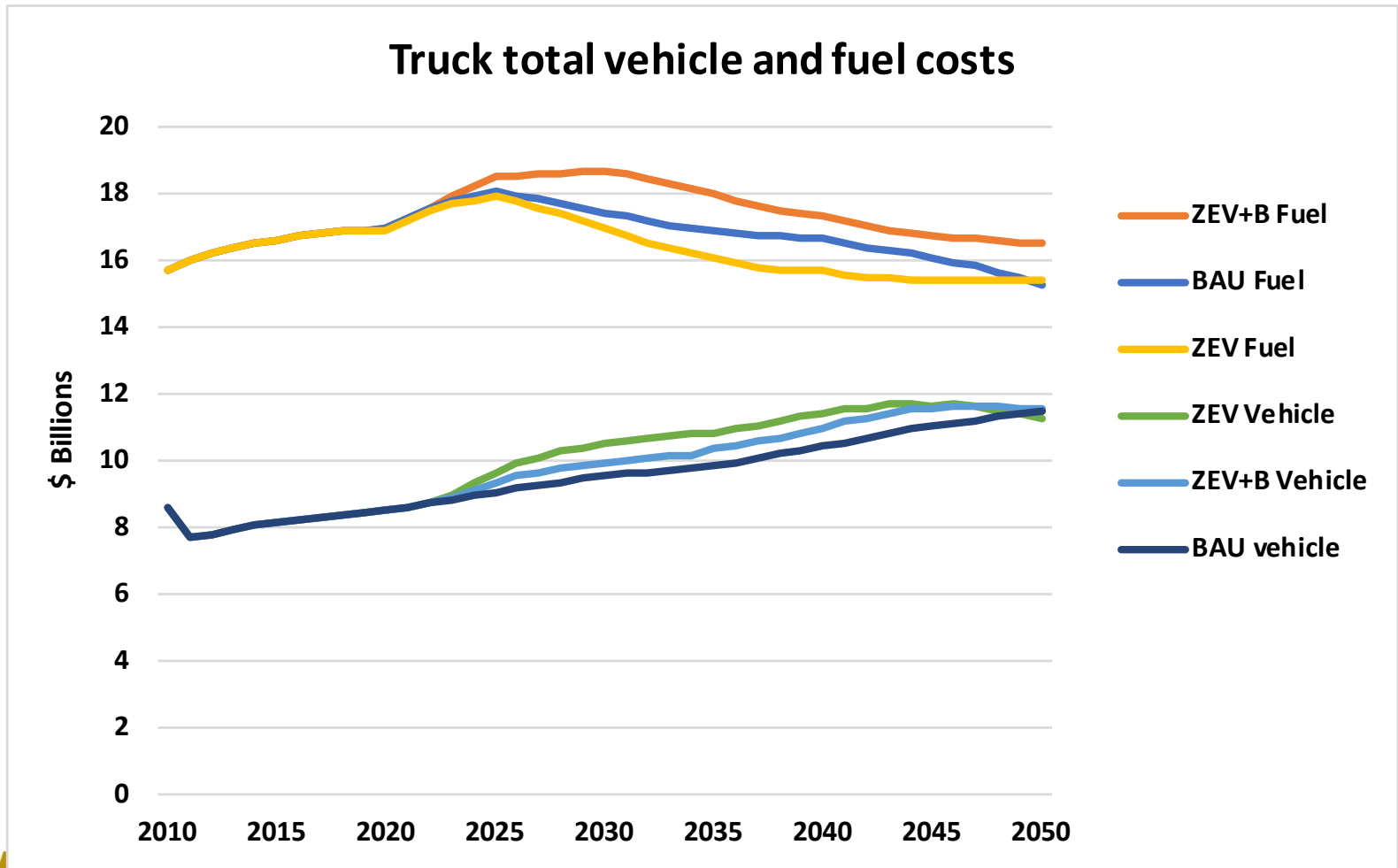


# Effect of Purchase Factors for Fleets

- Generalized cost = monetary + non-monetary factors (e.g. capital, fuel, uncertainty, model availability, etc.)
- Difference can exceed cost of new technology

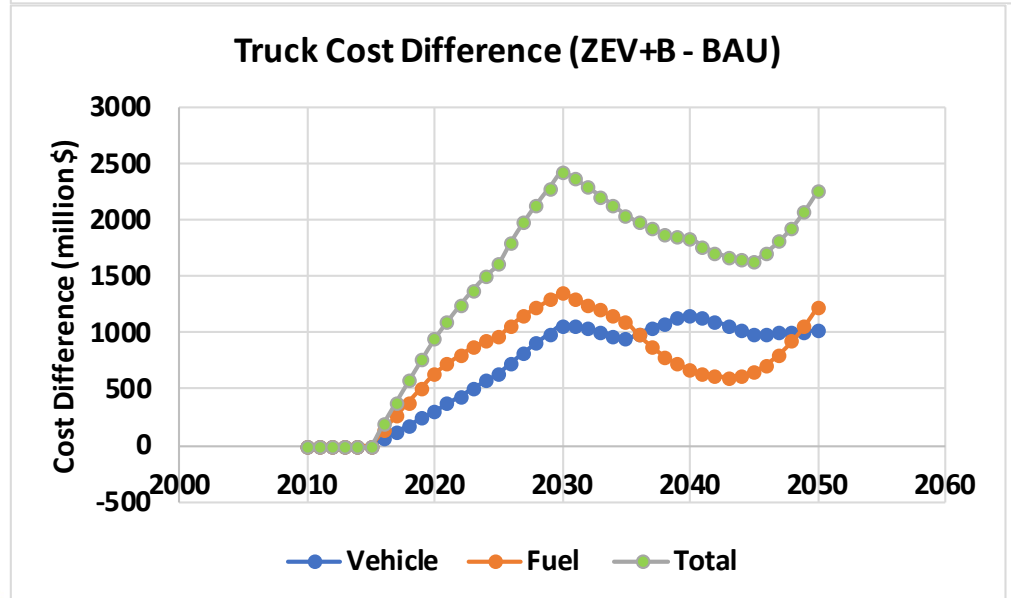
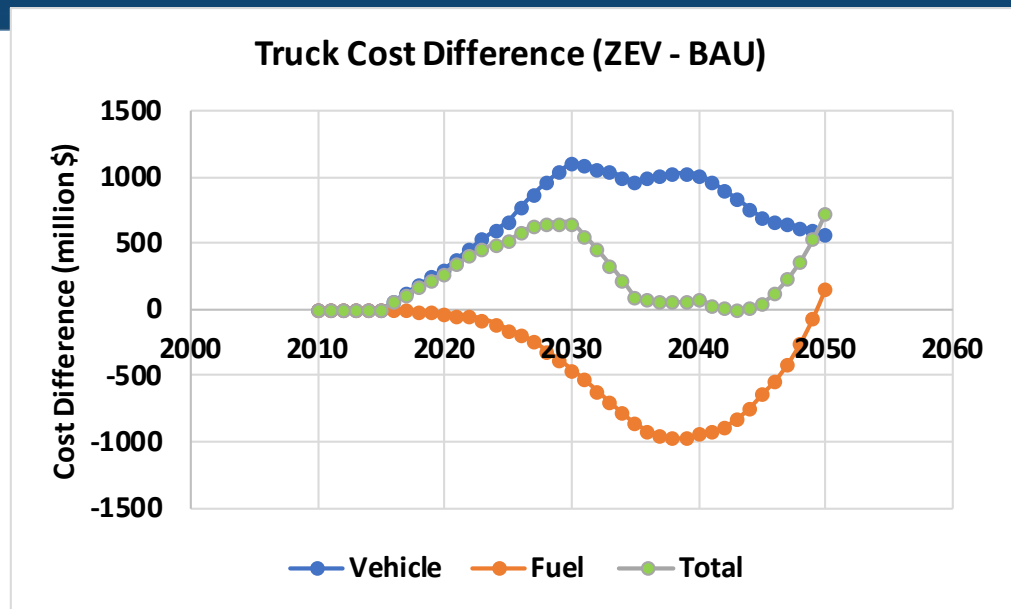


# Truck scenario total vehicle and fuel cost



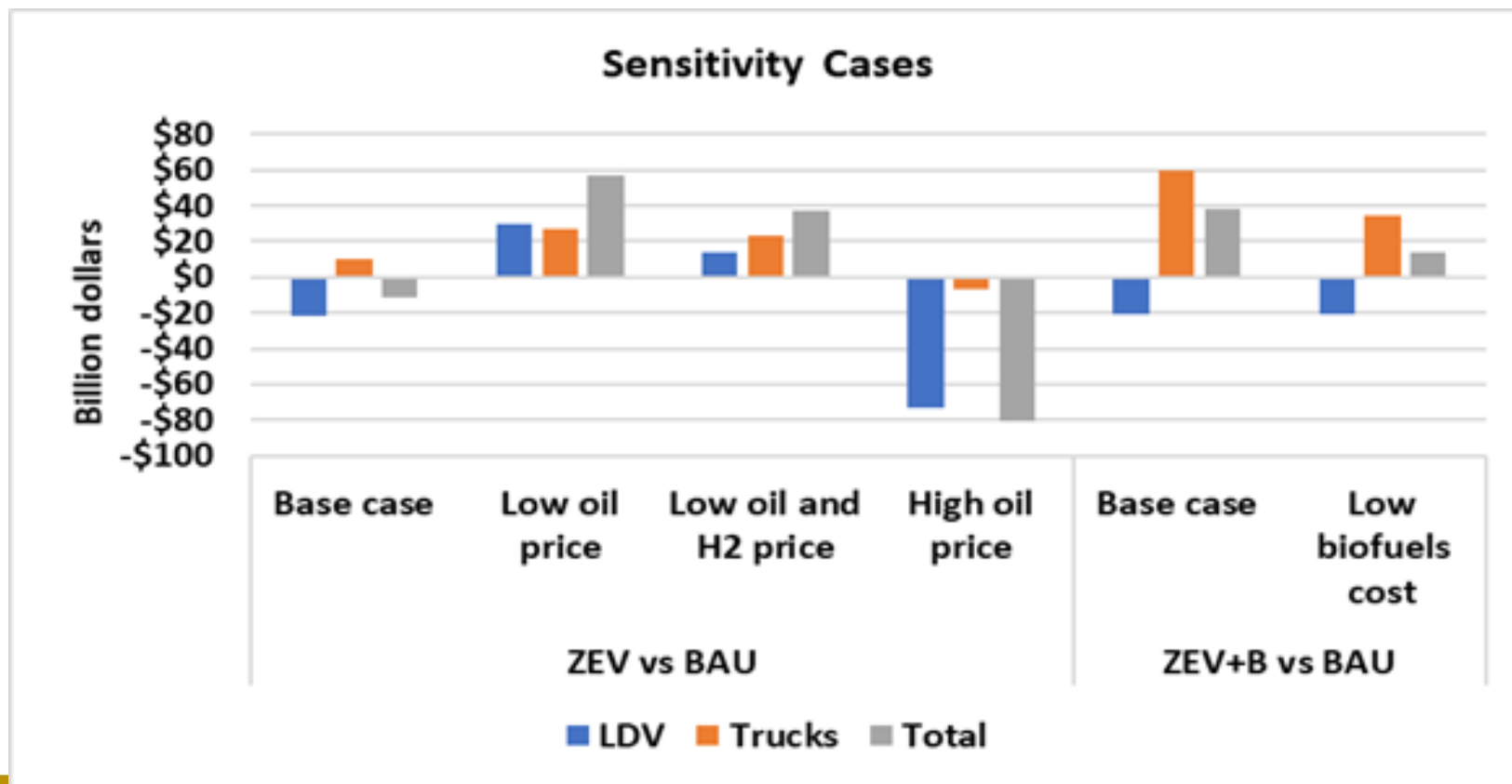
# Truck scenario vehicle and fuel costs vs BAU

- ZEV truck costs higher but plenty of energy cost savings to offset this
- ZEV+B truck costs slightly lower but fuel costs higher, net effect is a more expensive scenario



# LDV and truck cumulative cost and sensitivity cases

- We raise and lower fuel prices by 20% in the various sensitivity cases
- Total effect across cars and trucks is \$10 to 60 billion up or down, 2015-2050 cumulative
- This is relative to a base cost for all cars and trucks (vehicles + fuels) of \$4 trillion over this period. Thus under 2% change in cost.

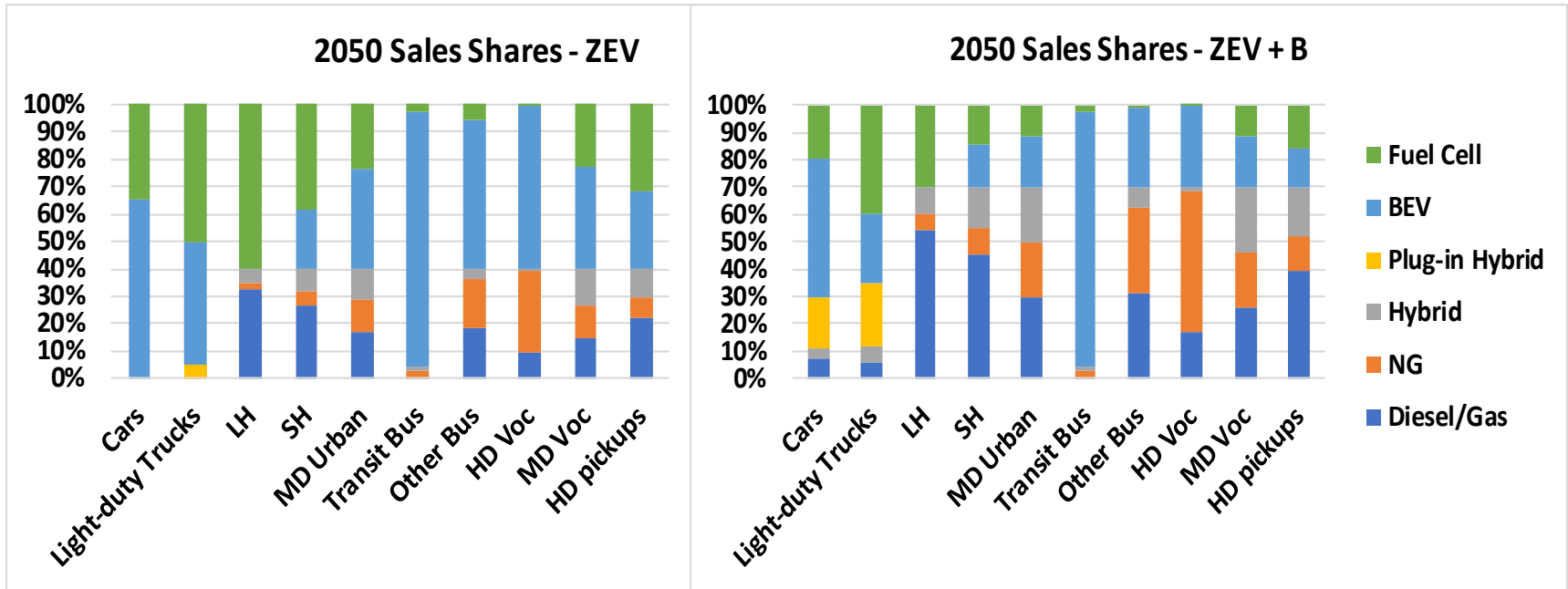




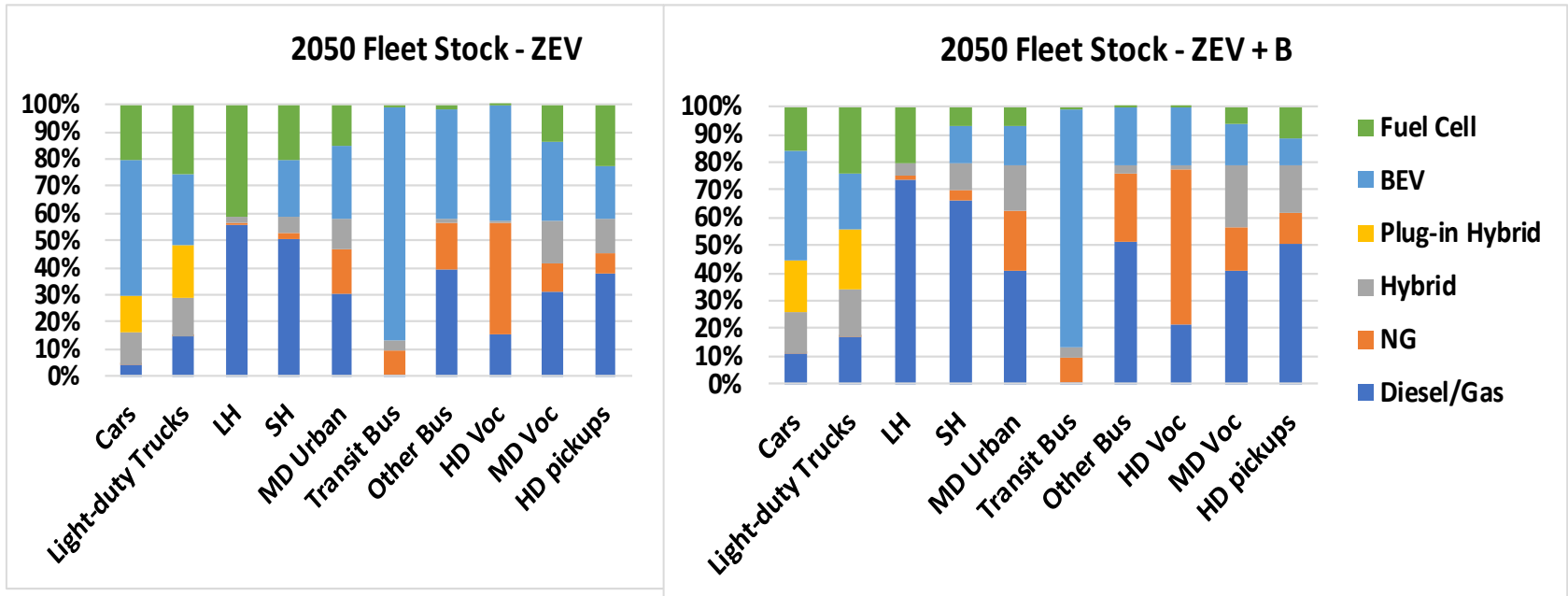
# Thank You



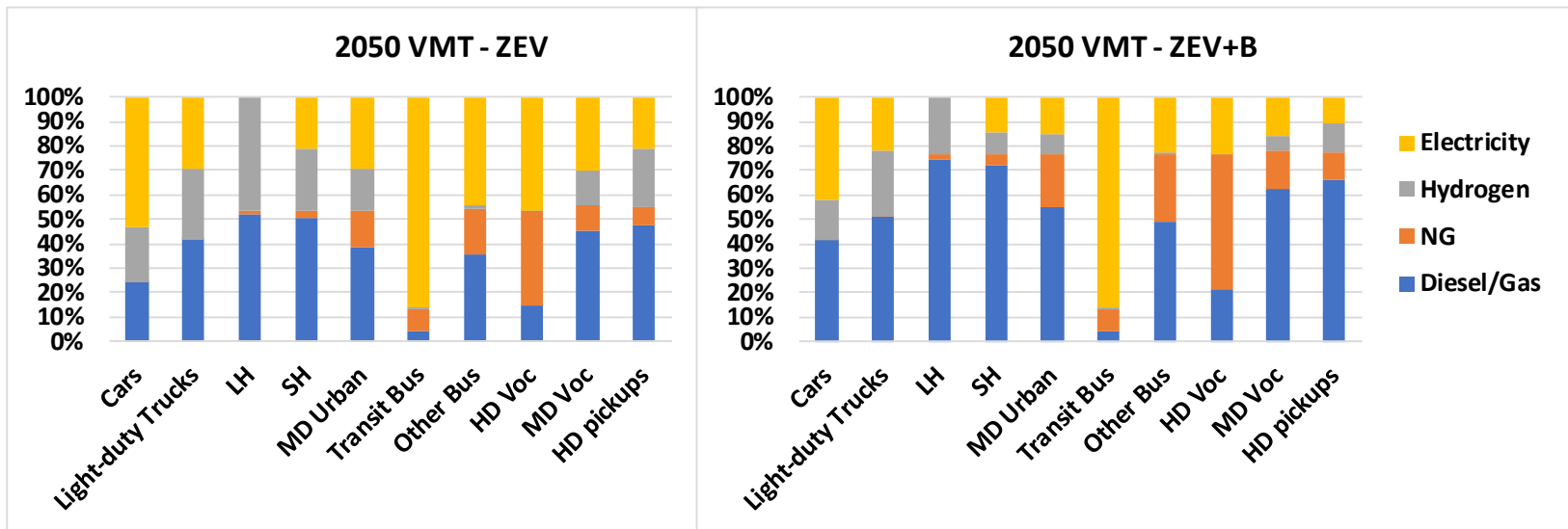
# Sales Shares, ZEV and ZEV+B scenario



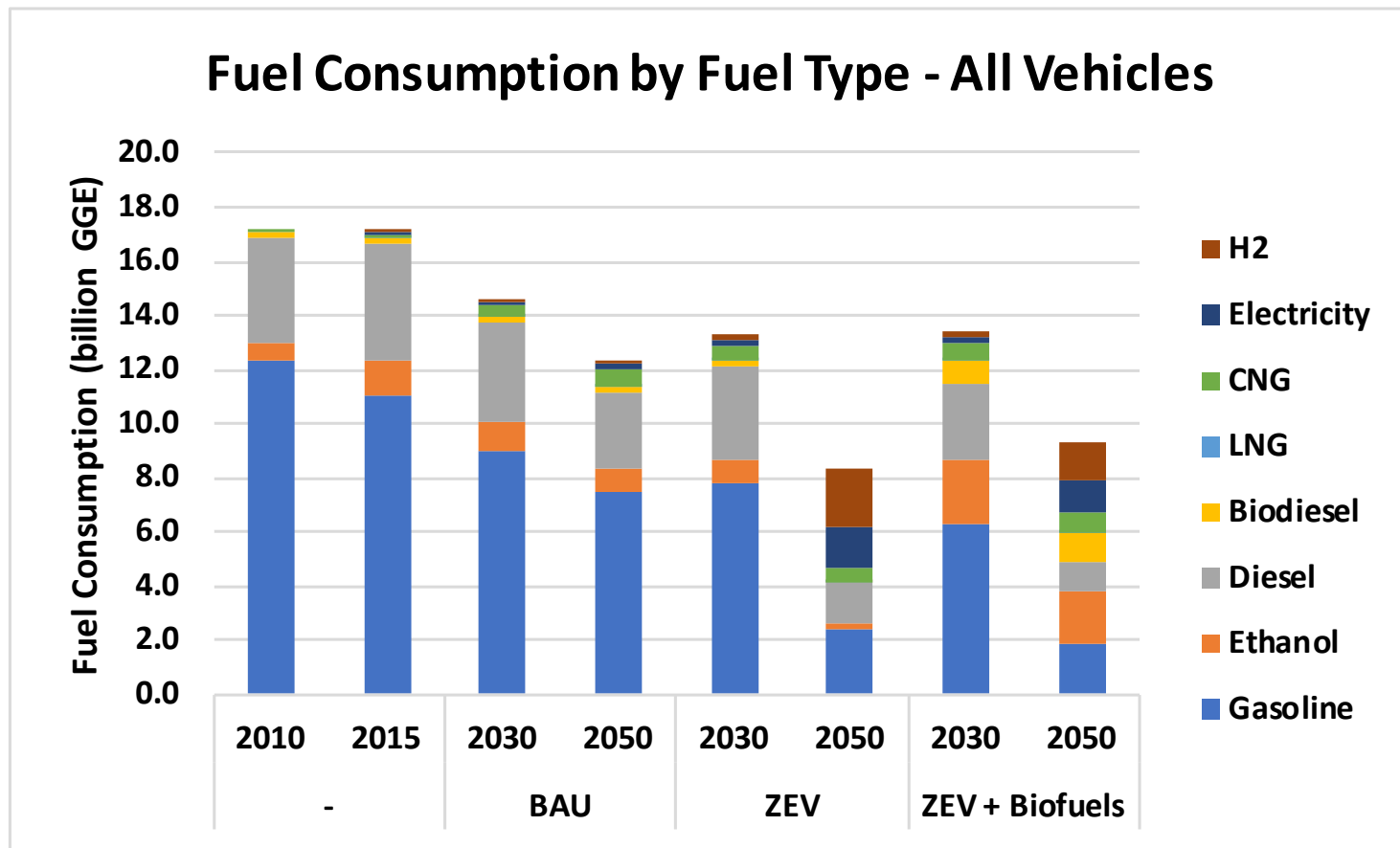
# Fleet Stock



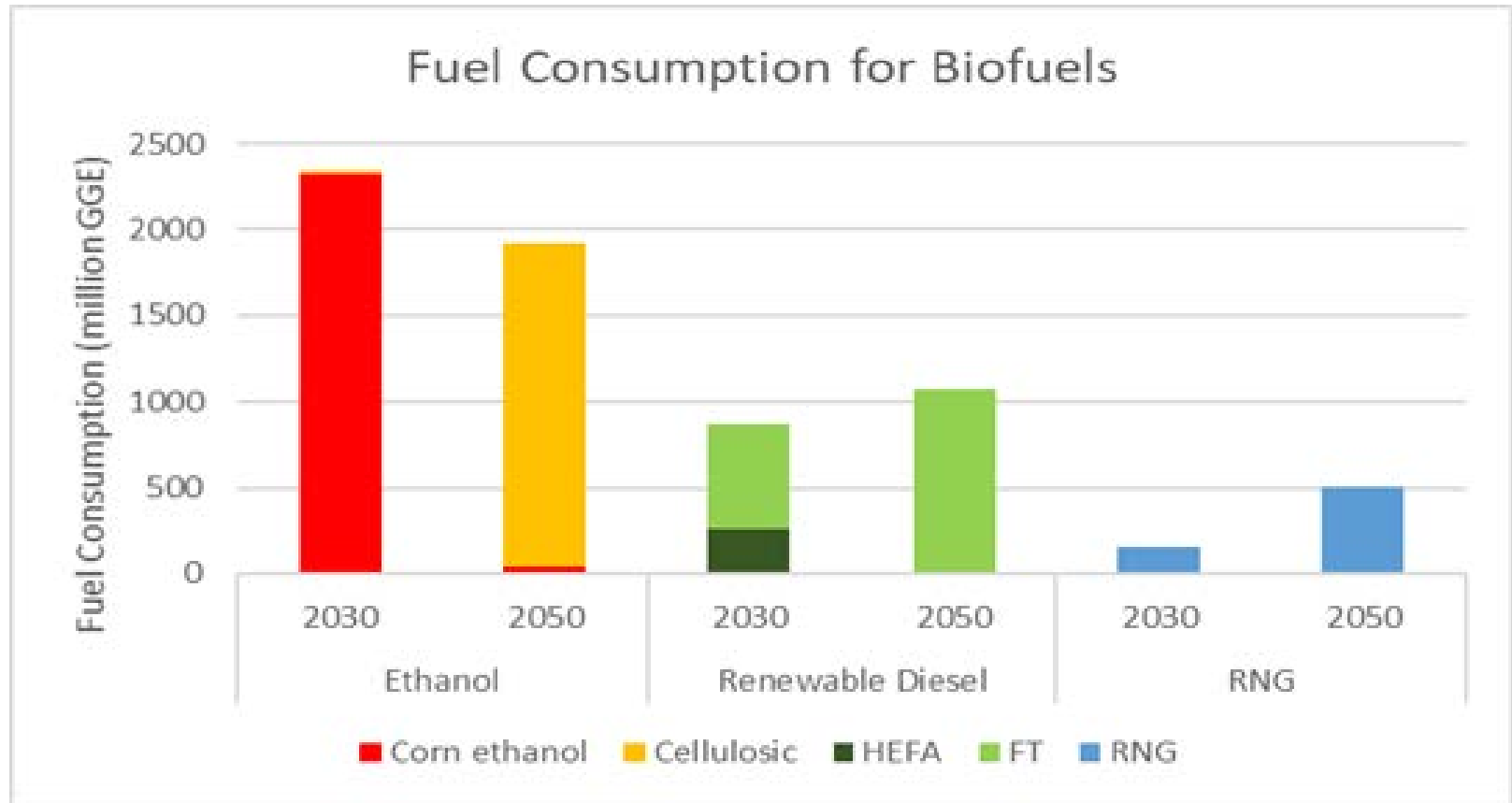
# VMT



# Fuel Consumption – All vehicles

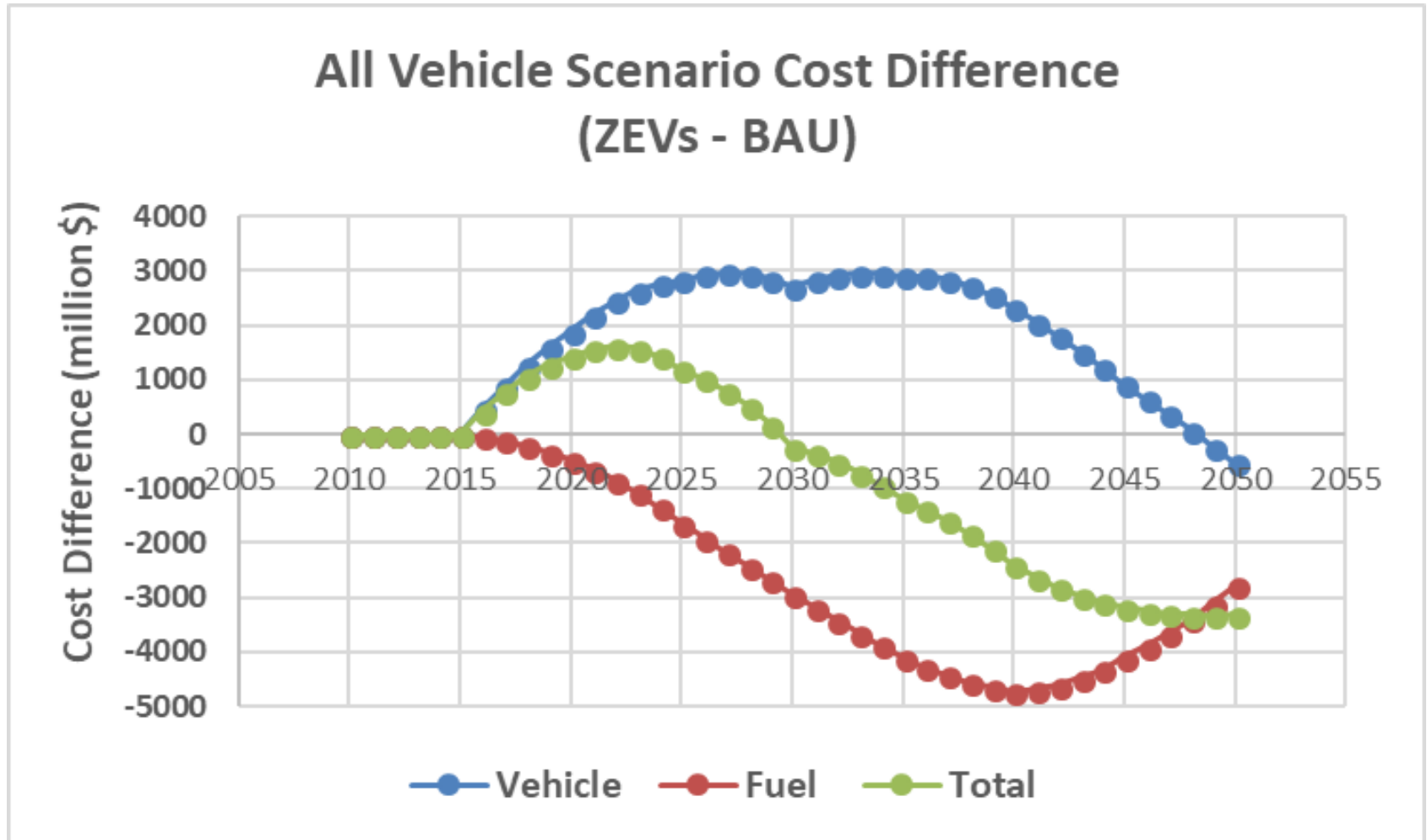


# Fuel Consumption – ZEV + Biofuels (Trucks)

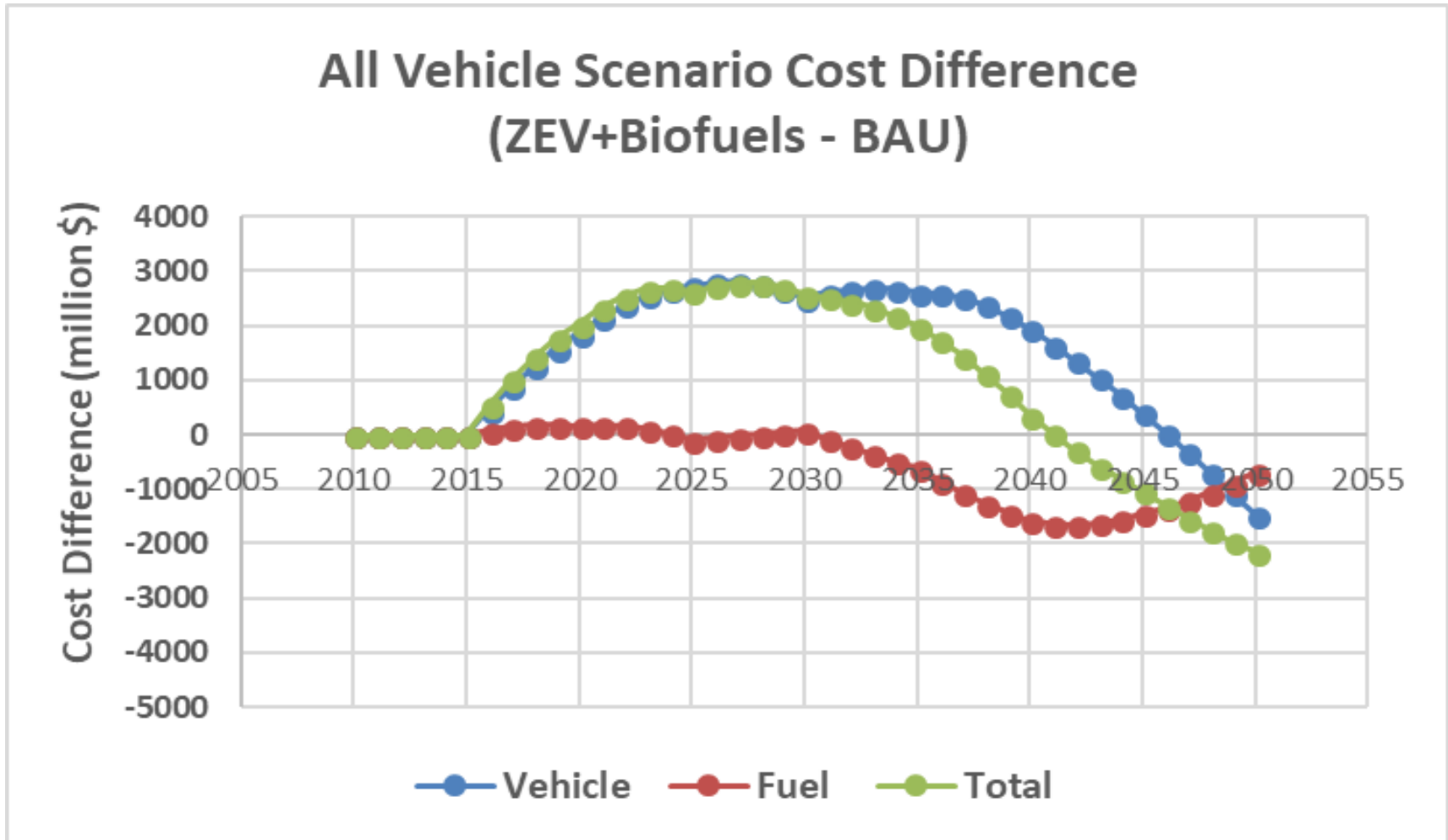


RNG content of NG increases to roughly 66% by 2050

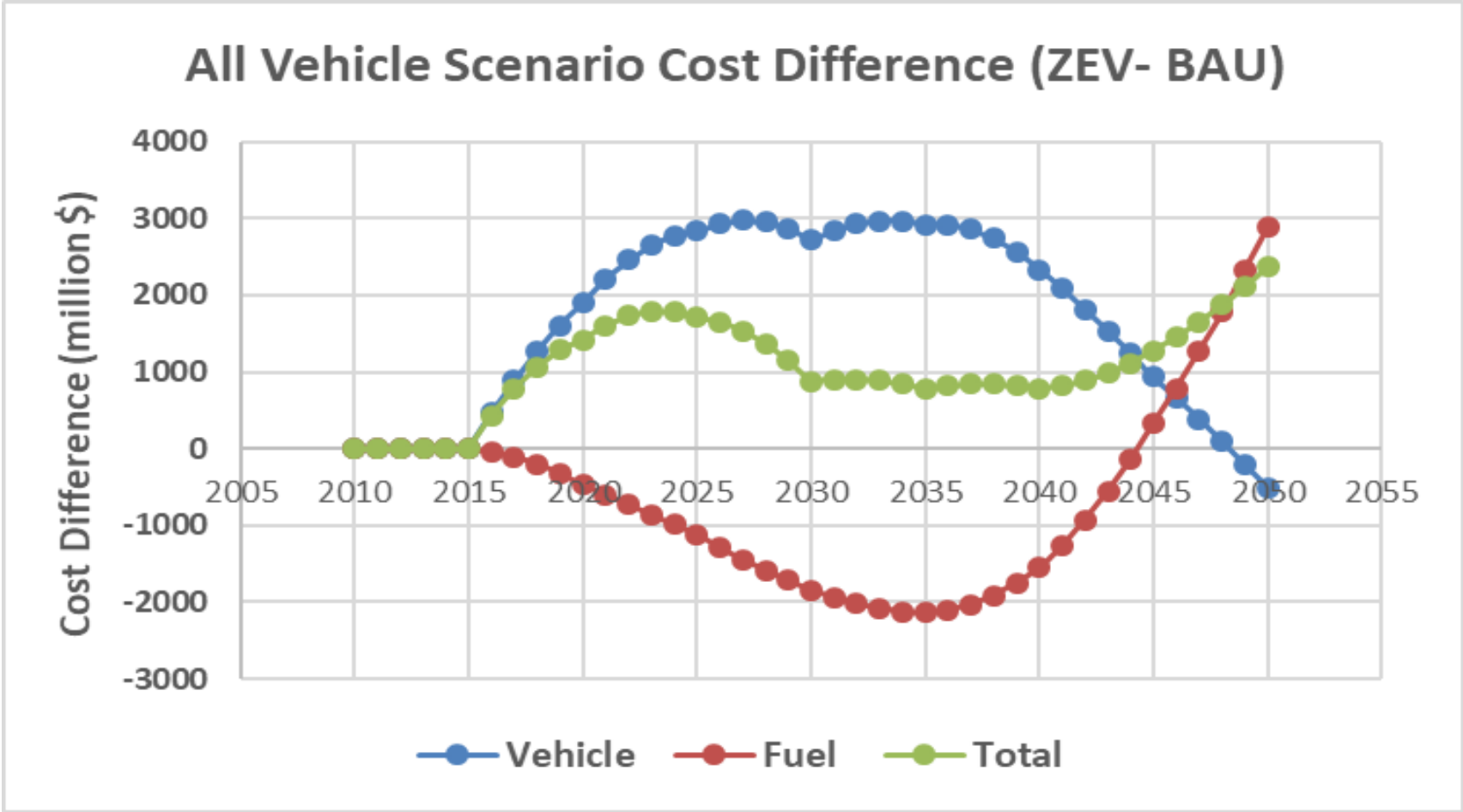
# Scenario Costs (Reference fuel price case)



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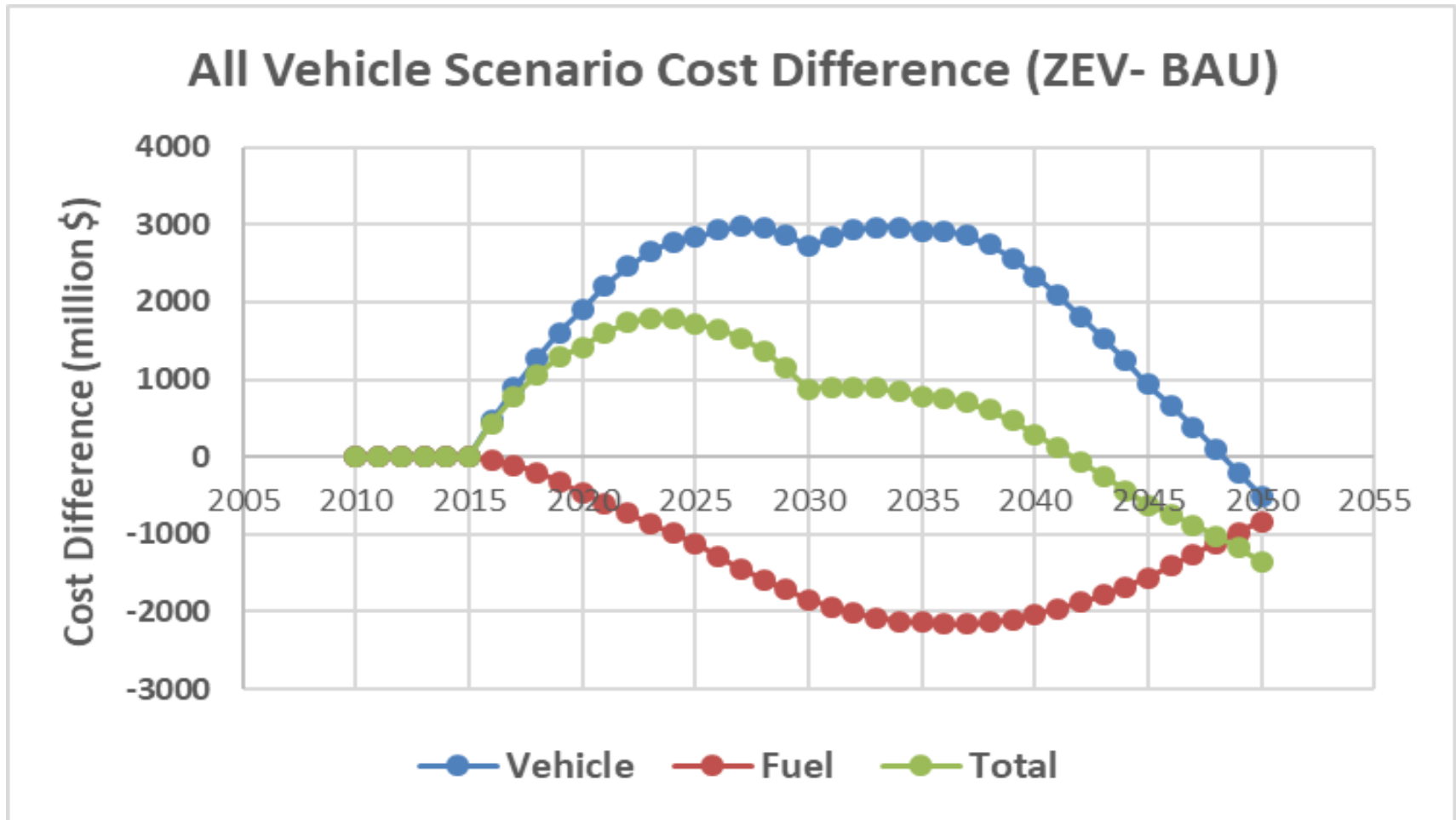
# Scenario Costs (Low fuel price case)



2050 Cost (\$/gal): Diesel = \$3.27, Gasoline = \$2.94



# Scenario Costs (Low fuel and low H2 price case)



Hydrogen Cost maximum = \$5.50 / kg