

NextSTEPS (Sustainable Transportation Energy Pathways)

STEPS Transportation Transition Scenarios for California

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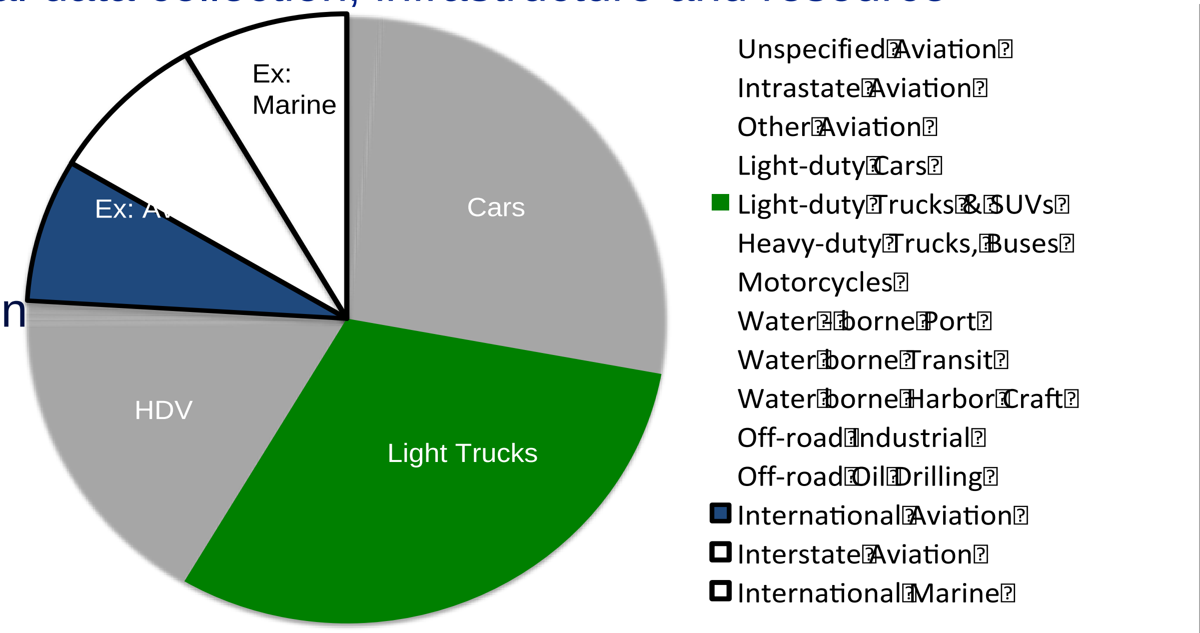
STEPS Decarbonization Scenarios for Transportation

- *Critical Transition Dynamics 2015-2030*
- Develop scenarios for transportation to analyze future vehicle mixes, fuel usage, emissions and costs
  - Integrate ongoing STEPS research on vehicles and fuels
  - Focus on the cost and emissions impacts of a transition to decarbonized transportation system (vehicles and fuels)
  - Analyze 2010-2050 with particular focus on **2015-2030**
  - Explore detailed vehicle/fuel scenarios across many transport sectors
- Project goals
  - Develop scenario modeling framework
  - Produce realistic scenarios that help contribute to meeting climate change goals in transportation
  - Assess technology/fuel/resource mix and emissions
  - Assess incremental costs (and potential subsidies required)
  - Scenarios enable "what-if" analyses and improve understanding of sensitivities of the system to inputs

Decarbonization Scenarios for Transportation

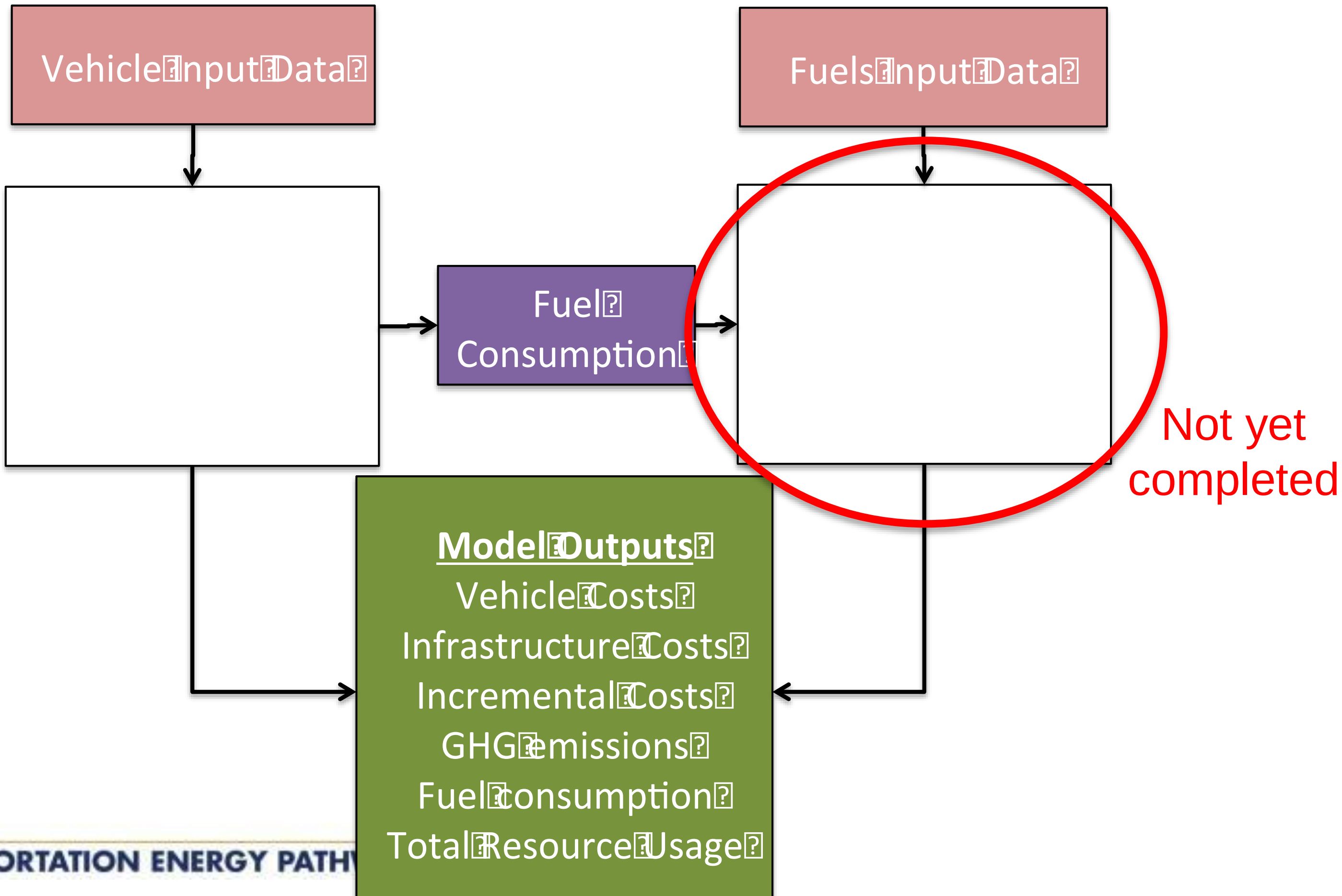
- Analyze **reference (BAU)** and **decarbonization (GHG)** scenarios
- Look across transportation sectors
  - Light-duty, medium and heavy-duty/medium-duty trucks initially
  - Additional sectors to be included later
- Start with focus on **California** to build up modeling capabilities but plan to develop US scenarios
  - Similar approach (technology specifications, modeling framework)
  - Differences (additional data collection, infrastructure and resource availability and cost)

2010 CA Transportation Emissions



Transition Scenario Modeling Framework

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



CA Scenarios Progress and Results

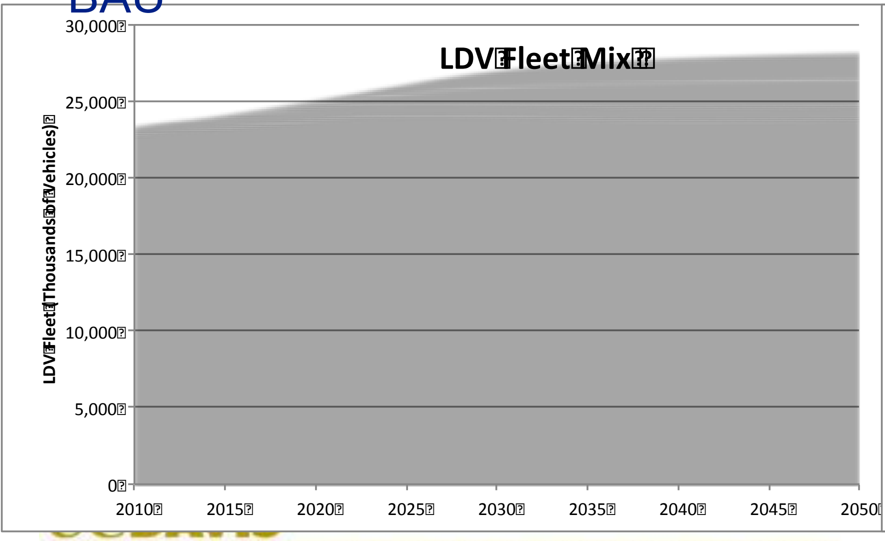
- Work is ongoing and we have completed the **light-duty vehicle** sector and **several heavy-duty and medium-duty truck** applications
  - California data and scenarios
  - Stock turnover model based upon VISION model
  - Vehicle component cost model
    - Currently assume trajectory for component costs, but will incorporate learning for batteries, fuel cells and other key components as a function of adoption
  - Simple representation of fuel pathways and fuel costs
    - More detailed infrastructure (resource supply, production, transport, refueling) representation will be developed
    - Lots of assumptions about fuel blends, carbon intensity, and costs across BAU and GHG scenarios

The results shown in the following slides are preliminary scenarios examples from this first stage scenario model

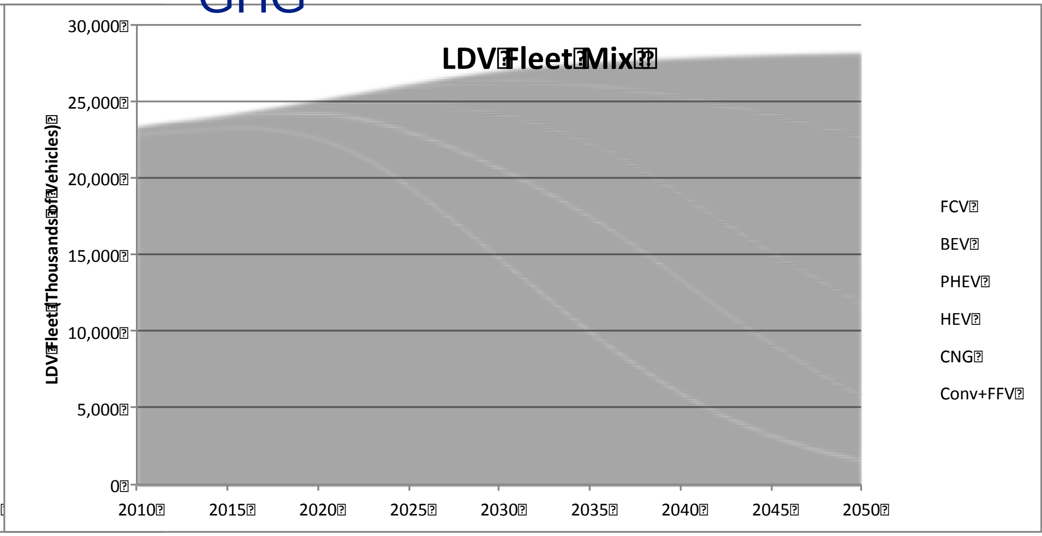
LDVs scenarios compared

- Reference scenario (BAU): ZEV compliant scenario ~16% of vehicles in 2025 are ZEVs or TZEVs
  - No additional growth in adoption after that
- Low Carbon scenario (GHG): Aggressive uptake of ZEVs by 2030: 46% of cars/light trucks sold in 2030 are EVs and PHEVs, and ~90% in 2040
  - Scenarios are identical to 2015

BAU

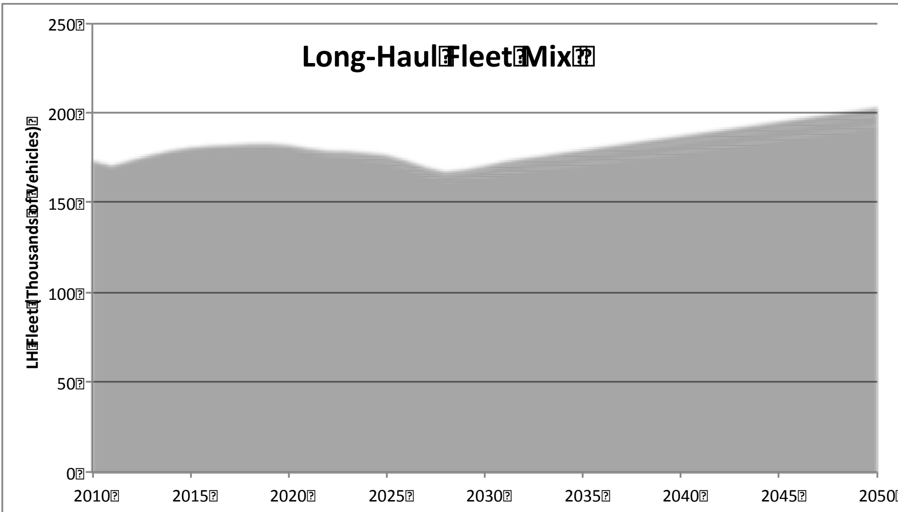


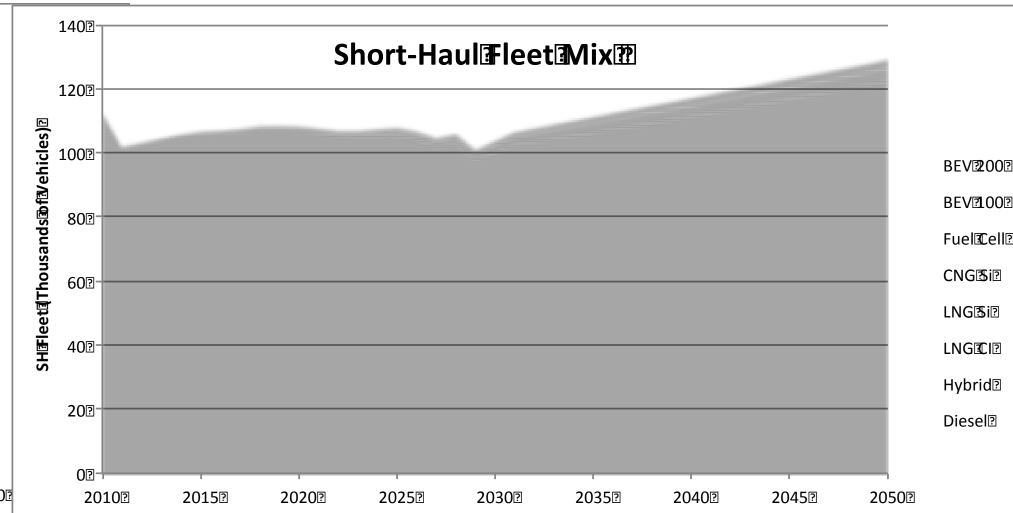
GHG

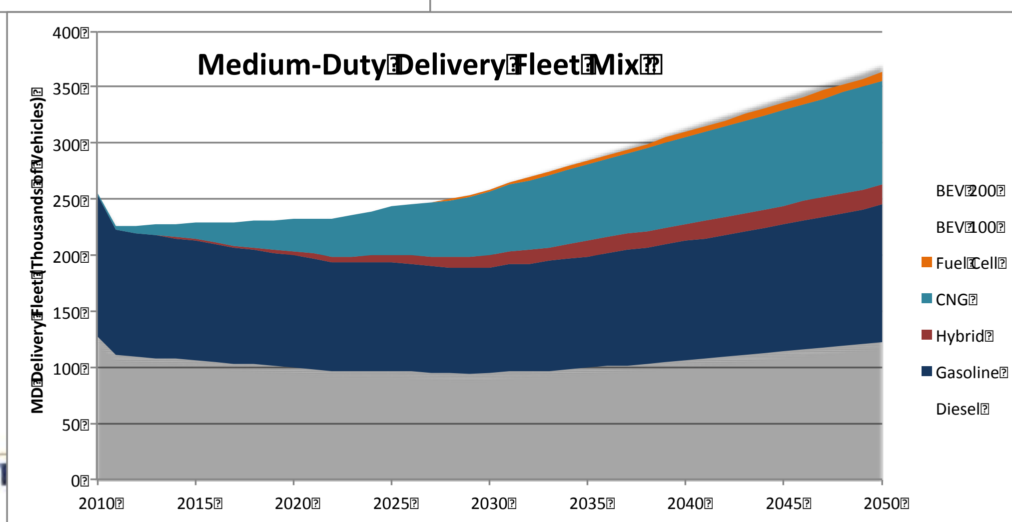


Reference (BAU) HD and MD Trucks scenarios

- Conservative adoption of alternative vehicle technologies in LH and SH.
- CNG is adopted fairly substantially in MD delivery







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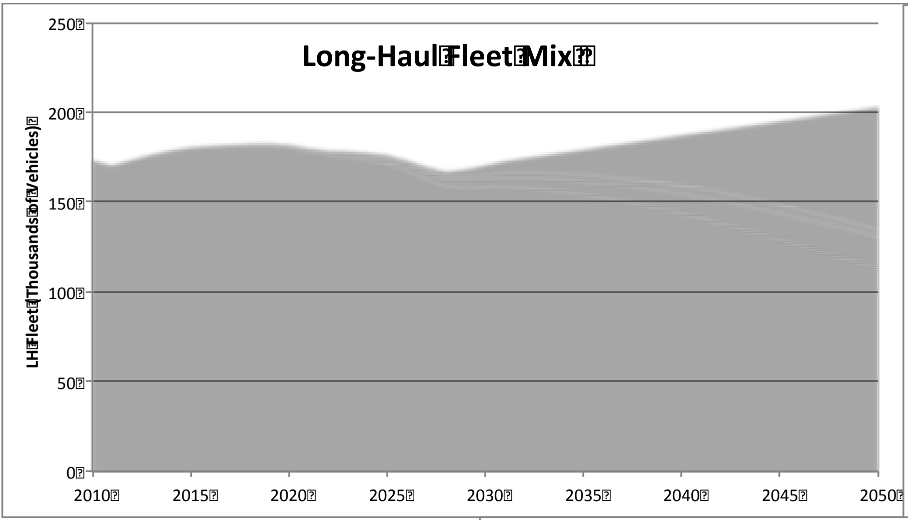
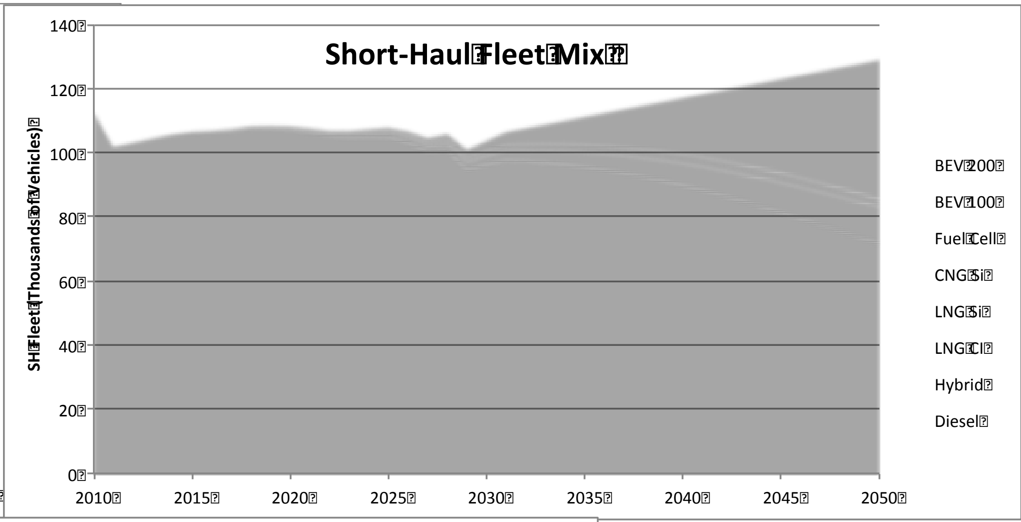
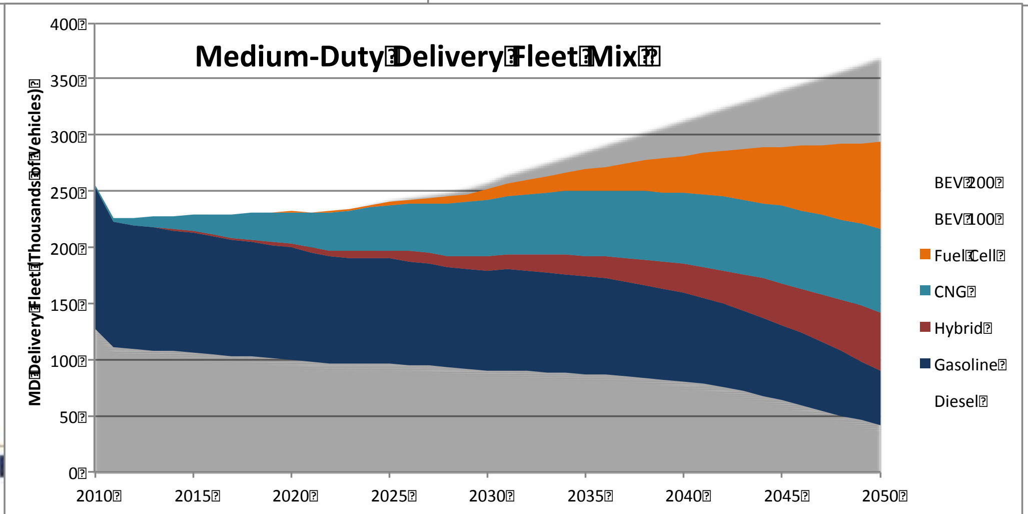
Decarbonized (GHG) HD and MD scenarios

- Sales of 50% FCVs in LH and SH by 2050. B50 Diesel blend.
- MD has substantial CNG, Fuel Cell and BEVs by 2050







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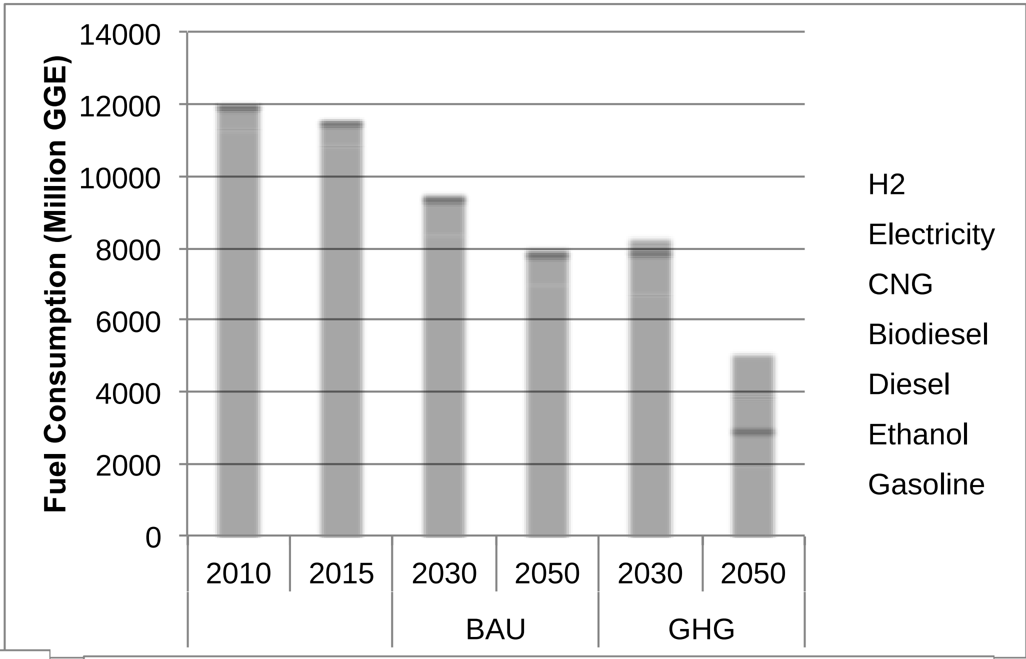
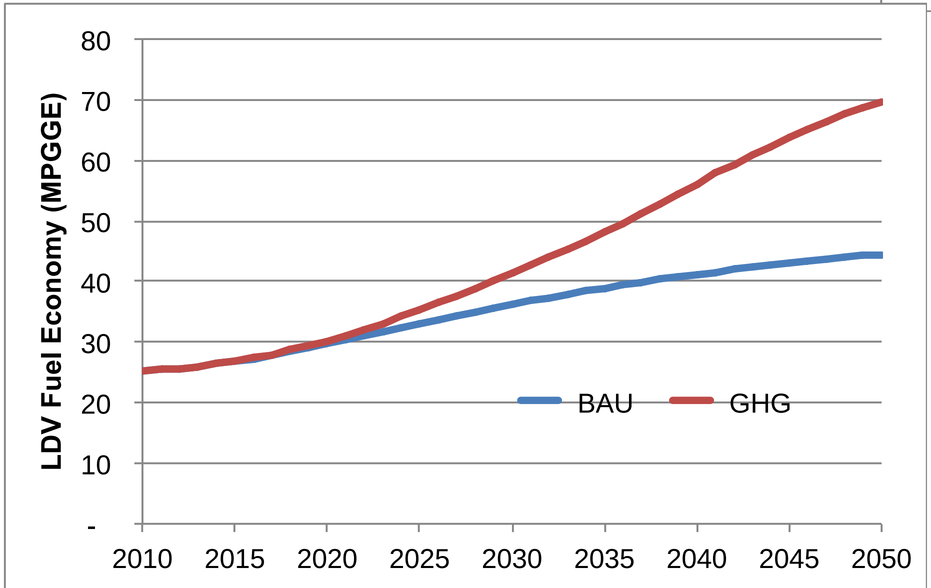
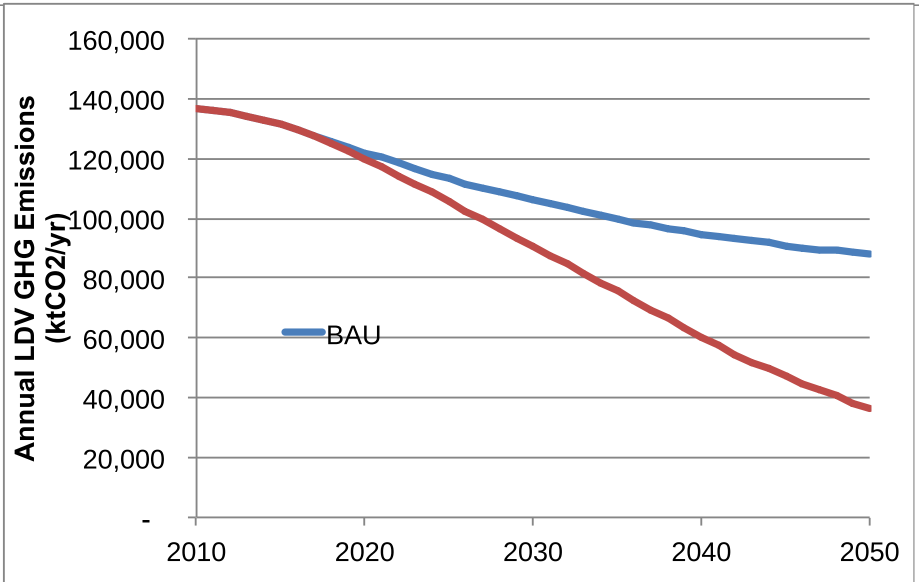
LDV Results

- BAU - has significant increase in fuel economy so fuel consumption drops by 21% (2030) and 33% (2050)
- GHG - even larger reduction in fuel consumption, 33% in 2030 and 57% in 2050

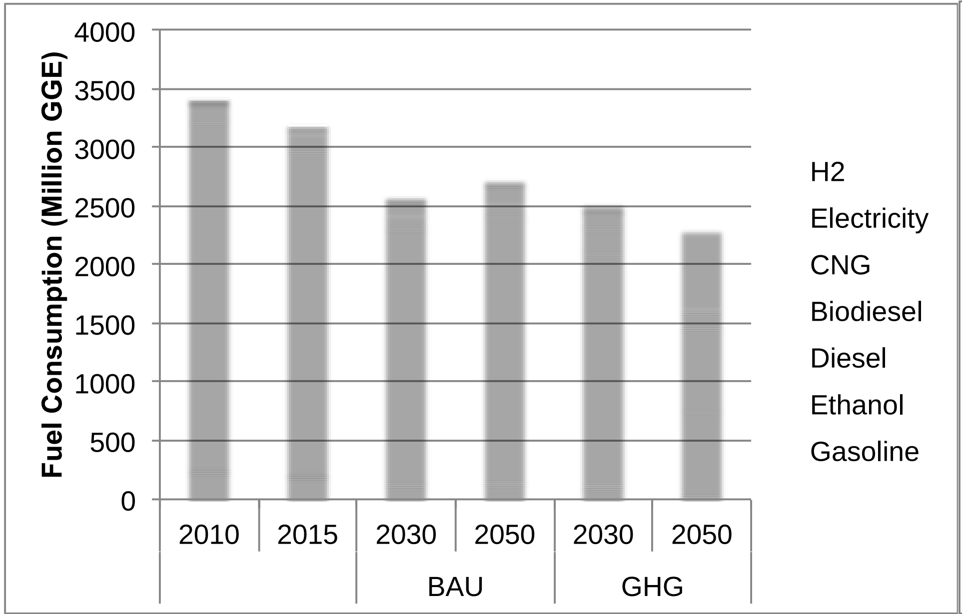


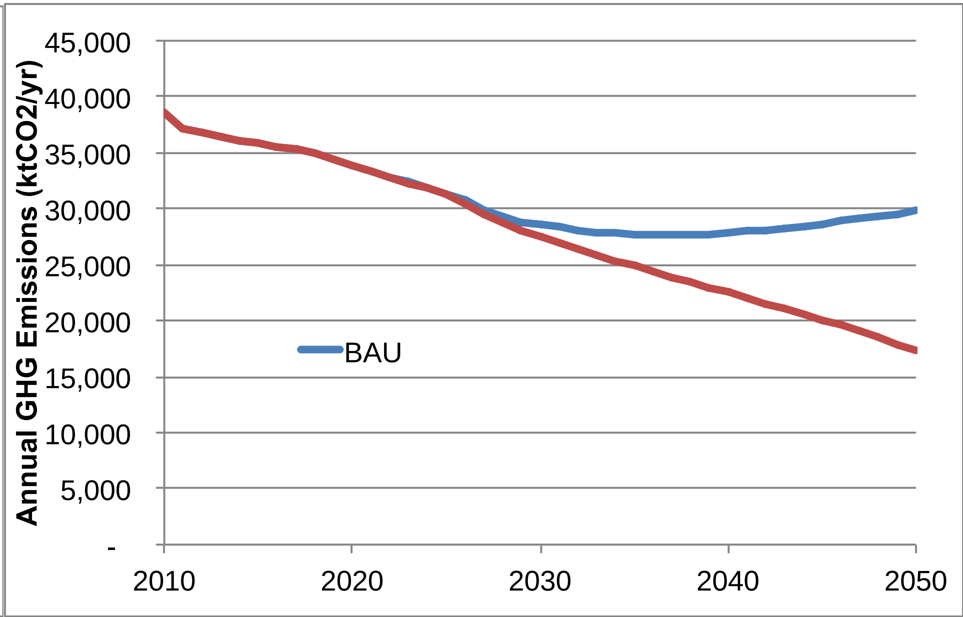




HD and MD Results

- Fuel economy improvements lead to substantial reduction in fuel consumption: 25% (2030) and 20% (2050) in BAU, 26% (2030) to 32% (2050) in GHG scenario

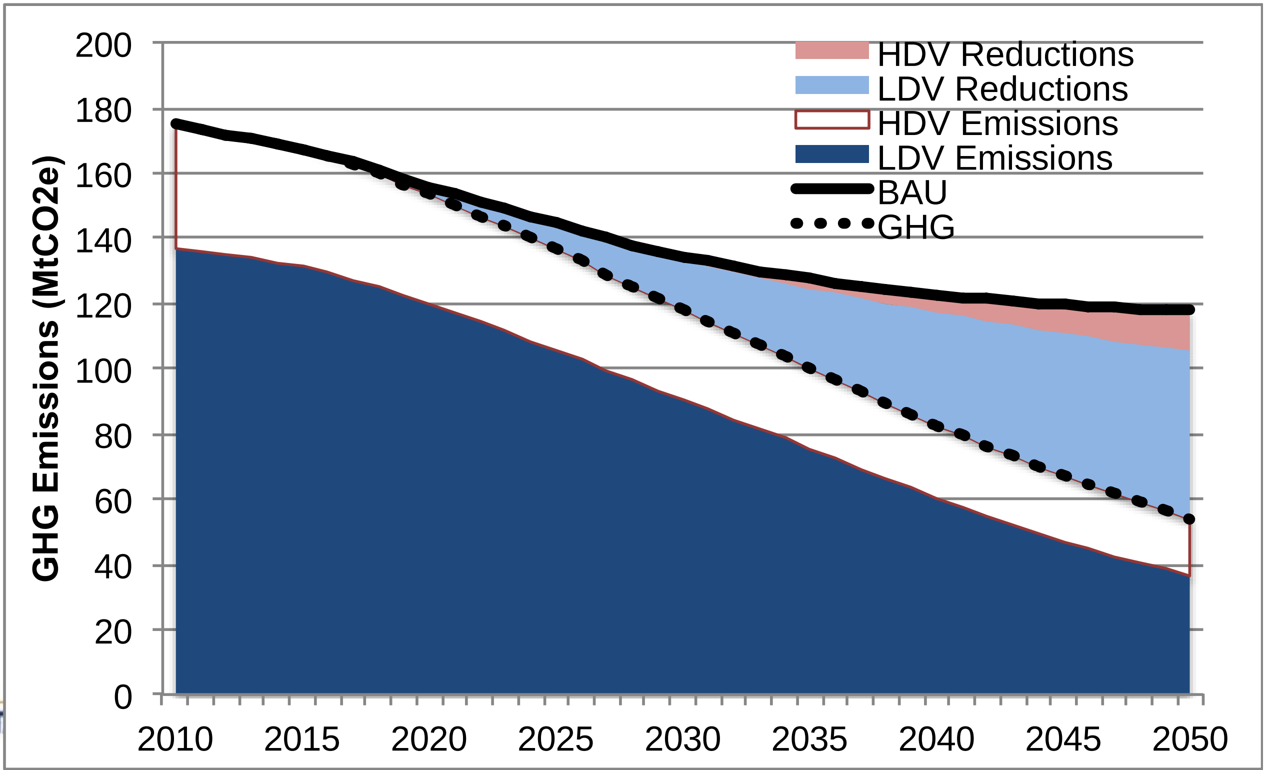




GHG emissions comparison

- Greater emissions reduction from LDVs due to greater adoption of advanced and zero-emission vehicles

		2030			2050		
		LDV	HD+MD	Total	LDV	HD+MD	Total
reduction from 2010 levels	BAU	22.4%	26.1%	23.2%	35.5%	22.6%	32.7%
	GHG	33.7%	28.7%	32.6%	73.3%	55.0%	69.3%
reduction below BAU	GHG	14.5%	3.6%	12.2%	58.6%	41.9%	54.4%



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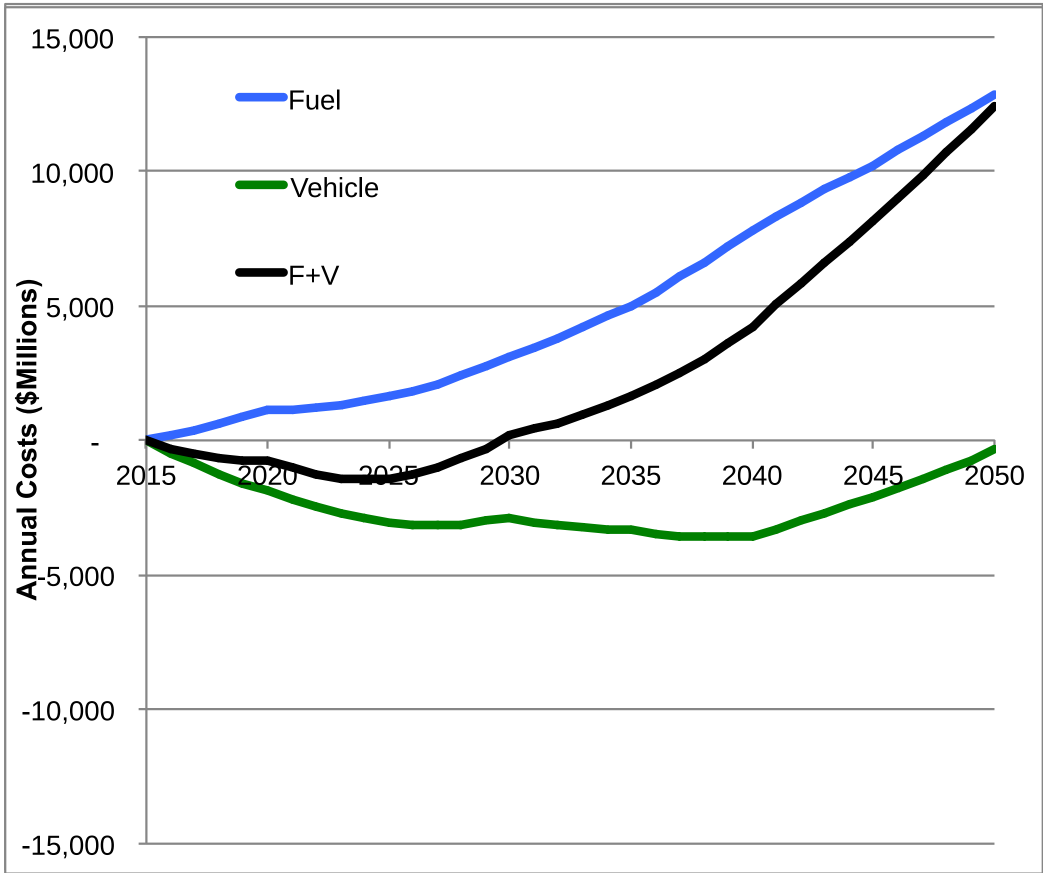
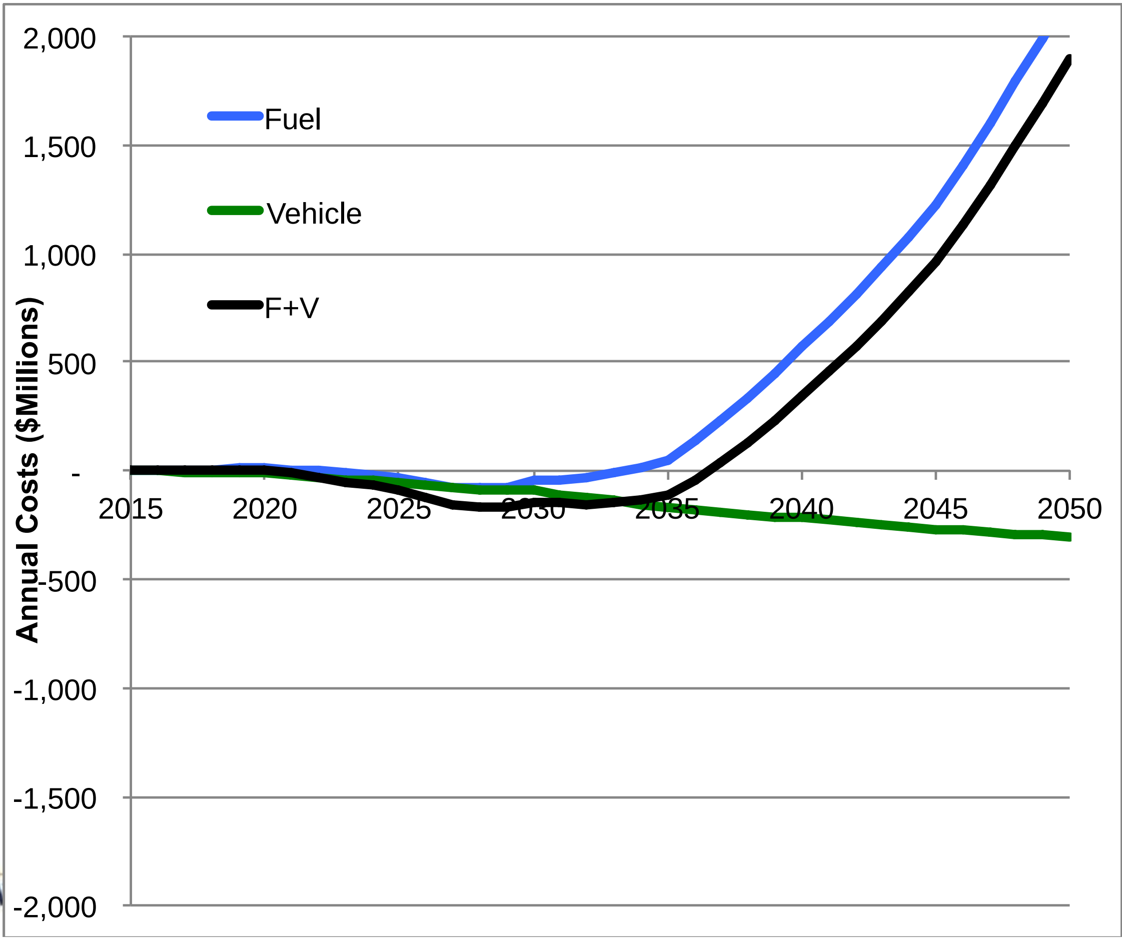
LDV Cost Comparison

- Annual expenditures- Fuel: $26 billion Vehicles: $46 billion in 2015
- Incremental vehicle cost: up to $4 billion/yr
- Fuel savings grows over time
- Fuel savings balance incremental vehicle cost in 2030
- Total incremental cost
  - to 2030: $13 billion
- Large savings after 2035



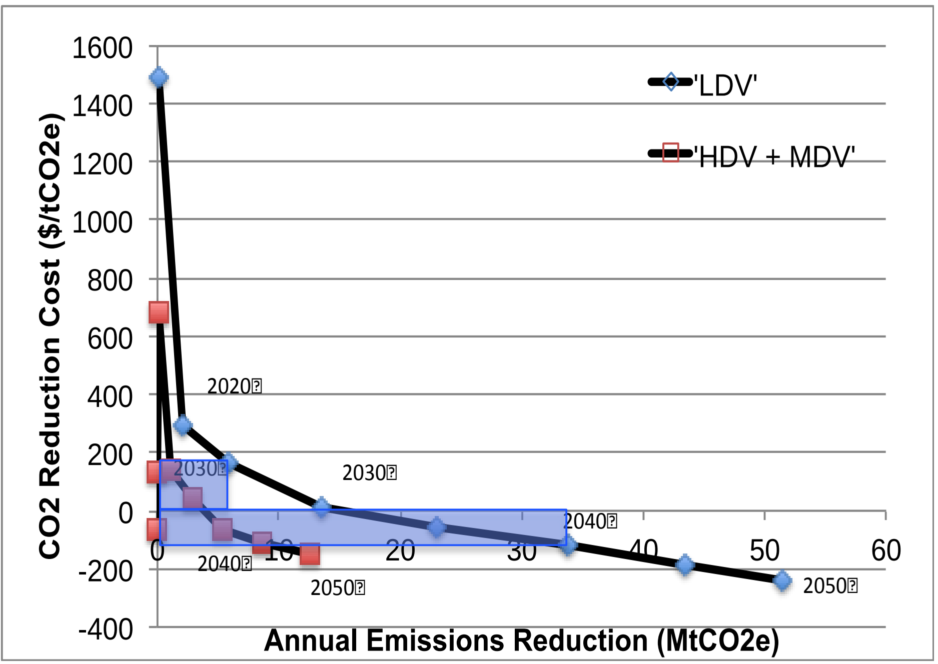
HDV + MDV Cost Comparison

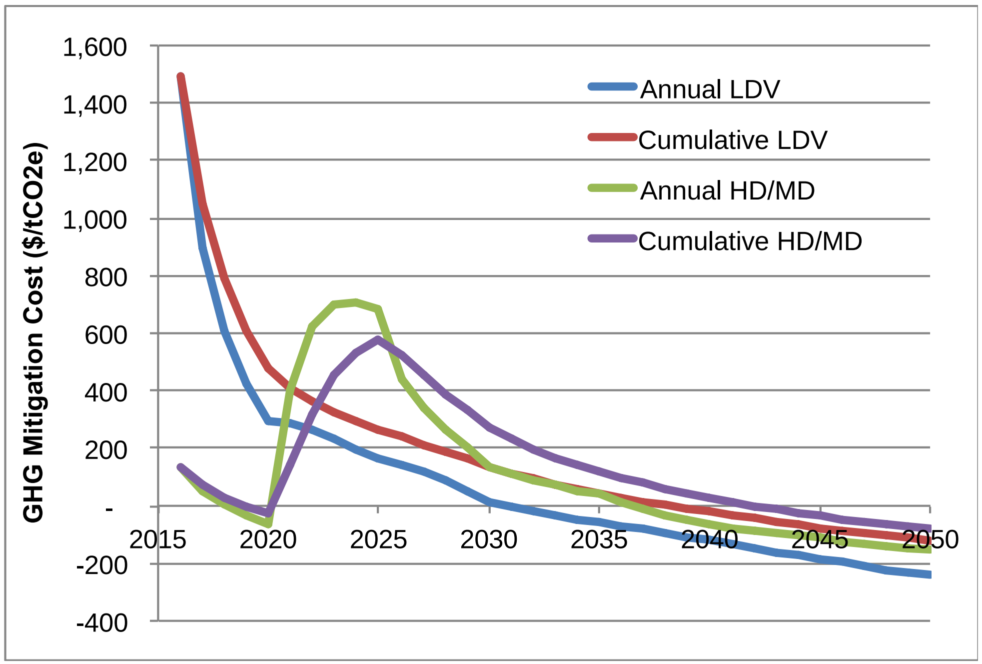
- Annual expenditures- Fuel: $7 billion Vehicles: $3 billion in 2015
- Incremental vehicle cost: up to $300 million/yr
- Fuel savings balance incremental vehicle cost in 2037
- Total incremental cost
  - to 2037: $1.7 billion
- Large savings after 2040



Abatement Cost Comparison

- The cost of CO2 reduction ($/tonne CO2) is comparable between light-duty vehicles and trucks
  - LDVs have higher emissions reduction potential
  - Greater total costs ($/tonne x tonnes reduced)





Initial Findings

- We built a spreadsheet framework for our transition scenarios modeling and incorporated largest/most important transportation sectors
  - LDVs
  - Most HDVs (Long-Haul, Short-Haul and MD Delivery)
- We developed two preliminary scenarios, a Reference and GHG reduction scenario to analyze emissions, fuel and cost impacts of the transition to a low-carbon transport system
- LDVs can achieve a 73% GHG reduction from 2010 levels by 2050, ultimately at negative cost of abatement
  - substantial incremental cost in the medium-term ($13 billion by 2030)
- HDVs and MDVs achieve 55% reduction from 2010 levels by 2050, also with negative cost of abatement.
  - Incremental cost of $1.7 billion by 2038
- Abatement costs ($/tonne CO2) are high initially (at low levels of GHG reduction), but decline substantially, becoming negative, as GHG reduction quantity increases

Next Steps

- Add additional transportation sectors/segments
  - Other truck sectors (vocational, light-heavy duty)
  - Bus, Rail, Air, Marine, Off-road
- Improve representation of fuel resource supply, production and infrastructure
- Continue to refine cost and vehicle performance assumptions
- Explore other scenarios of interest