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
• 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)
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
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.
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
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

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<tr>
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<th>2030</th>
<th>2050</th>
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<tr>
<td></td>
<td>LDV</td>
<td>HD+MD</td>
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<tr>
<td>BAU reduction from 2010 levels</td>
<td>22.4%</td>
<td>26.1%</td>
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<tr>
<td>GHG reduction from 2010 levels</td>
<td>33.7%</td>
<td>28.7%</td>
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<tr>
<td>GHG reduction below BAU</td>
<td>14.5%</td>
<td>3.6%</td>
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LDV Cost Comparison

- 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