Transportation Options Related to Climate Change

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Relevant Time Scales for Reducing Fuel Use and GHG Emissions: Developed World

By 2020: Attempt to level off transportation's petroleum consumption and GHG emissions through efficiency improvements, alternative fuels build-up, and energy conservation.

By 2035: Continue to improve mainstream technology, conserve energy, and build-up alternative propulsion systems, biofuels, and non-fossil energy sources.

By 2050: Have made substantial progress in transforming our transportation systems to a much greener cleaner state.

Technology and Fuels Improvement Potential

1. Light-duty vehicles:
   - U.S.: substantial vehicle fuel consumption, weight, size reduction potential
   - Europe: significantly less potential than U.S.
   - Biofuels, electricity, hydrogen, possibilities

2. Heavy-duty vehicles:
   - Already “cost optimized,” so more limited potential
   - Constraint: need high energy density liquid fuels

3. Passenger system:
   - Mode use shift and land use change potential
   - Conservation: reduce passenger miles travelled

4. Freight system:
   - Moderate system improvement potential
   - Constraint: key component in our economy

What it Takes to Meet CAFE

1. Limit the increase in vehicle acceleration capability (0 – 60 mph time) to less than 10% over 10 years.

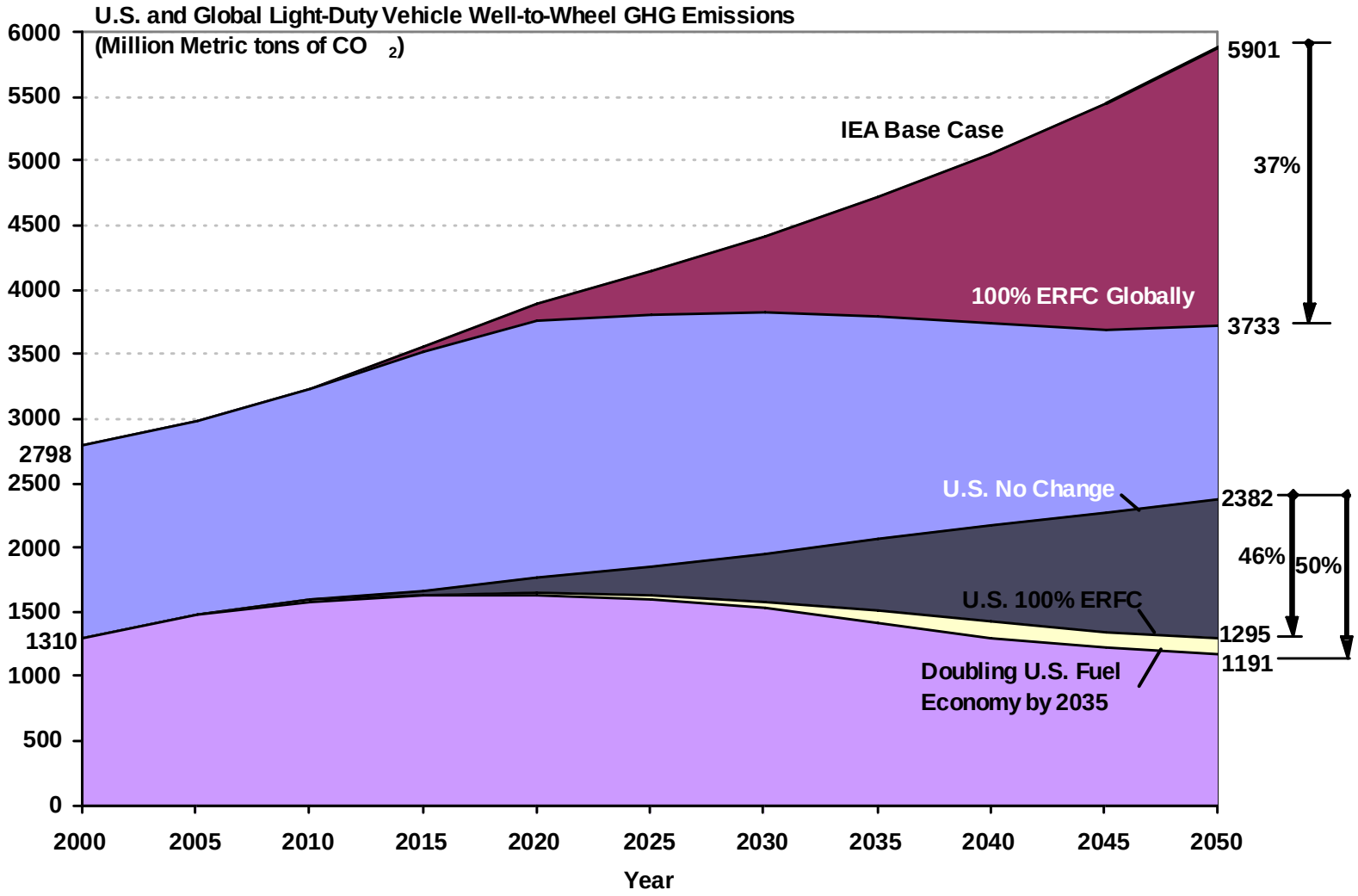
1. Reduce vehicle weight by 5-10% by 2015; and by 15-20% by 2020.

2. Powertrain mix required:

    2015: 40% turbo gasoline, diesel, hybrid
    2020: 60% turbo gasoline, diesel, hybrid

4. California, 2020: 20% weight reduction (mix shift); 70% turbo gasoline, diesel, hybrid.

U.S. and Global LDV Well-to-Wheel GHG Emissions (2000-2050)



HEV, PHEV, BEV Deployment Issues

1. Need for “prototype production” phase, with volumes in tens of thousands, which lasts 5-10 years.

2. Initial costs of these vehicles are significantly higher (e.g. currently HEV ~ $5,000, PHEV (30 mile range) ~ $10,000, BEV ~ $15,000 depending on range).

3. Long-term projections suggest these price differentials may reduce by factor of 2.

4. Impact of BEV range limitation on vehicles’ attractiveness is major uncertainty.

HEV, PHEV, BEV Deployment Issues – Cont.

5. Many pragmatic issues:
   - Availability of recharging locations
   - Recharging power requirements for “fast recharge”
   - Cumulative impact on electricity grid over time
   - Battery performance, weight, and cost issues
   - Near-term: we need to slow down and develop the technology

6. Electricity as viable longer-term energy option?
   - Systems analysis of an evolving transportation electricity supply option needed
   - GHG emissions of future electric grid, and of electricity used in transportation, a major question

Achieving a 70 - 80% Reduction in Transportation's GHG Emissions by 2050

Meeting these 2050 GHG emission targets will need:

- Major improvements in powertrain and vehicle efficiency
- Major vehicle size and weight reduction
- Stronger emphasis on fuel consumption reduction over performance and other attributes
- Substantial build-up of alternative green (low CO_2) sources of transportation energy
- Reductions in mobility impacts through mode shifts and conservation
- Extensive management of transportation infrastructure and its several modes
- Changes in urban land-use patterns
- And other "transforming" changes