SUSTAINABLE TRANSPORTATION ENERGY PATHWAYS
INSTITUTE OF TRANSPORTATION STUDIES

Transportation sector efficiency, electrification and hydrogen

Christopher Yang

Institute of Transportation Studies
University of California, Davis

ARB, CEC, CPUC Discussions
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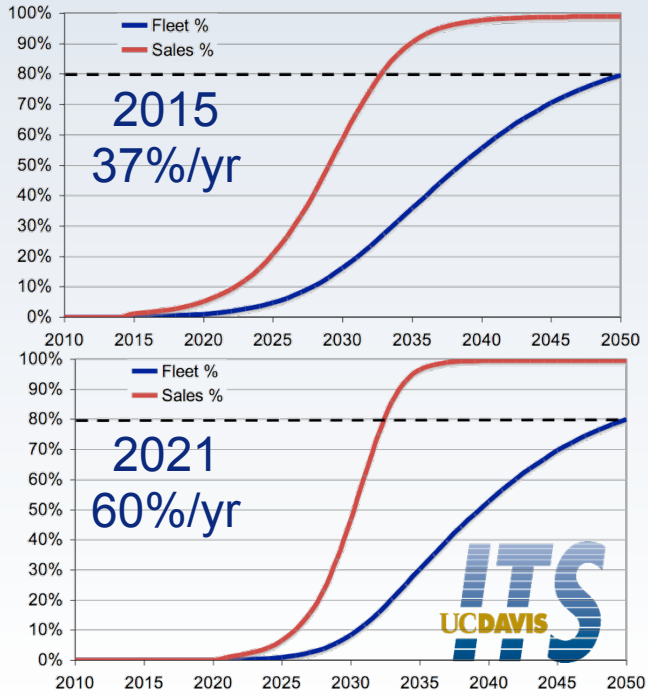
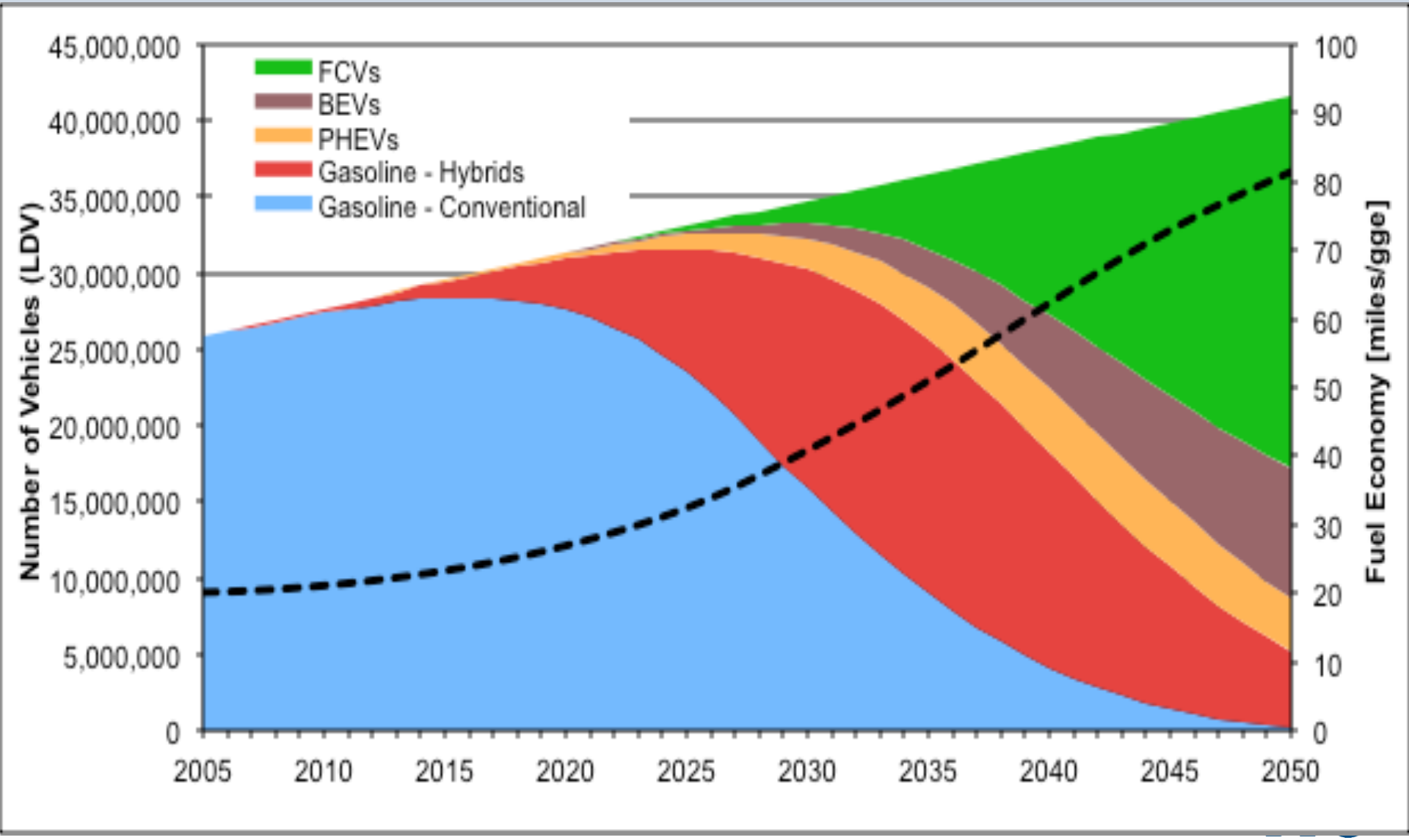
Light-duty scenarios

- Stock turnover - follow hybrid vehicle growth rates
- Slow initial growth - High vehicle costs, limited models, and consumer limitations/unfamiliarity
- Plug-in Electric Vehicles (PEVs)
  - 2050 fleet share is limited by lack of ubiquitous home charging (~60%)
  - Pricing policies are needed to overcome incremental cost
- H2 Fuel Cell Vehicles (FCVs)
  - Hydrogen infrastructure and vehicles requires subsidies
  - Infrastructure availability is an issue
  - FCVs can potentially displace more liquid fuel usage
- Remainder of vehicles are assumed to be conventional hybrids (HEVs)

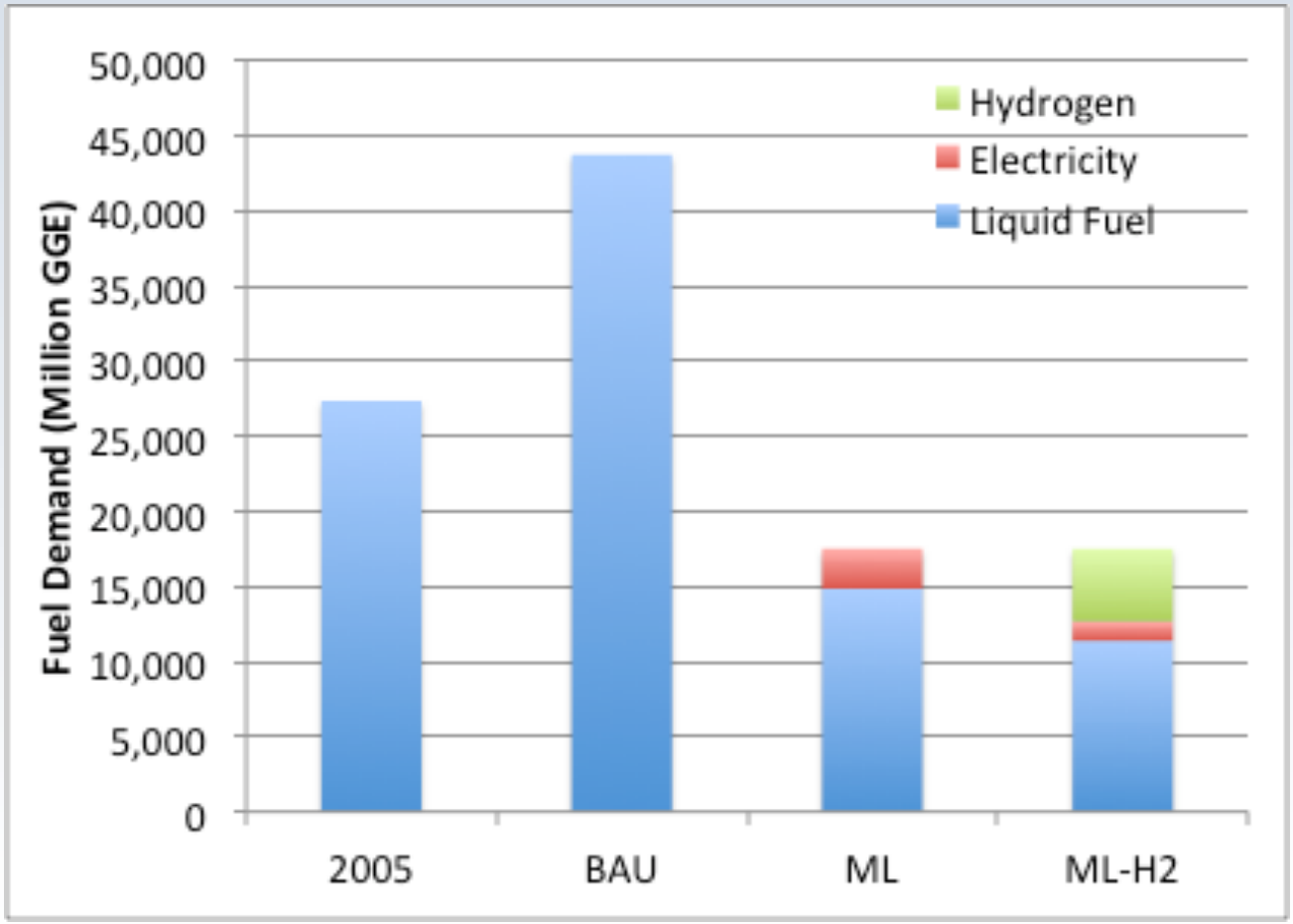


Combined PEV and FCV scenario (80%)



Fuel Demands

- Efficiency counteracts travel demand growth
- Electrification (including H2) reduces the demand for liquid fuels but there is still substantial remaining demand



Other Transportation Sectors

- Some sectors continue to rely on liquid fuels because of limited energy storage, power and weight issues
  - Heavy trucks reduce energy use through improved engines, transmissions and hybridization, cab and trailer aerodynamics, double trailers, speed reduction, routing and logistics (50% reduction in energy intensity)
  - Aviation can rely on improved jet engines, aerodynamic improvements, and operational improvements, including some more radical designs like blended wing (60% reduction in energy intensity)
  - Marine can take advantage of higher efficiency engines/propulsion systems and reductions in hydrodynamic drag and speed reduction (40% reduction in energy intensity)
  - Much of these improvements (1/3 to 1/2) are cost effective
- Electric drive can play a role for some sub-sectors
  - Buses and short-haul delivery trucks (either using H_2 or electricity)
  - Rail can also be electrified
  - Reduction in energy use per mile/seat-mile around 60%

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H2 Scenario

- Hydrogen is another decarbonized fuel
- Provides greater energy density and total range than batteries
- Barriers include vehicle costs, subsidy requirements and early infrastructure deployment
- Fuel cells and infrastructure is still maturing (Bin 1 and 2 technology)
- Identify applications where it may be successful
  - LDVs, buses, some medium duty trucks
  - Replace NG in some industrial applications
- H2 mix:
  - 10% onsite natural gas
  - 33% renewable electrolysis
  - 57% fossil with CCS
  - Carbon intensity (12-20 gCO2e/MJ, 80+% reduction in CI)
- Electricity → H2 → biofuels → fossil

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