

The Role of Technologies and Alternative Fuels

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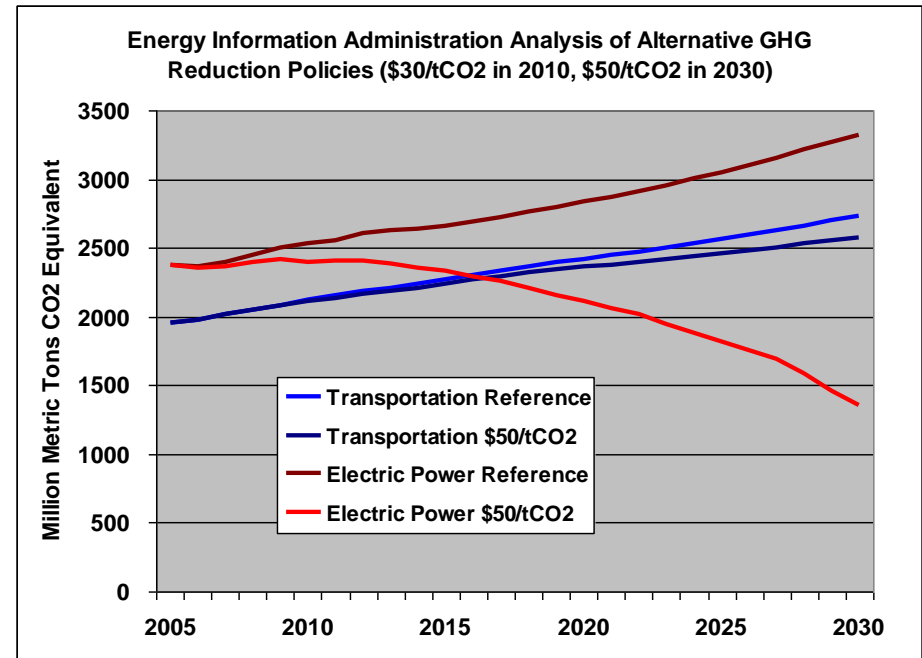
AASHTO/FHWA Climate Change Symposium

Washington, DC

August 5, 2010

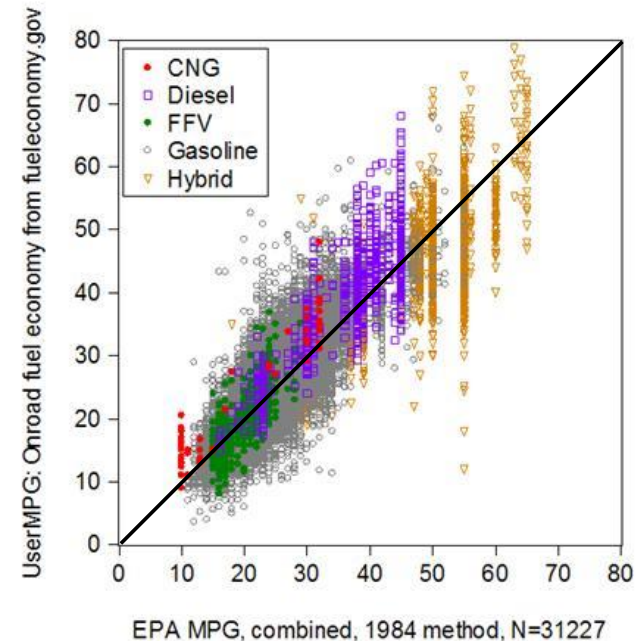
What is transportation's "fair share"?

- Wrong question?
- Equal reductions by all sectors?
- Equal marginal costs?
 - Just price carbon?
 - Adapt policies to market realities?
 - Undervaluing energy efficiency
 - External costs
 - Co-benefits
 - Land use
 - Transportation infrastructure
 - Roads as public goods
 - Unpredictable evolution of technology
 - Requires comprehensive, realistic assessment, e.g., DOT, 2010, "Transportation's Role in Reducing Greenhouse Gas Emissions".
- My guess: 50% to 80% reduction over present levels by about 2050, and energy efficiency and alternative energy will carry most of the load.

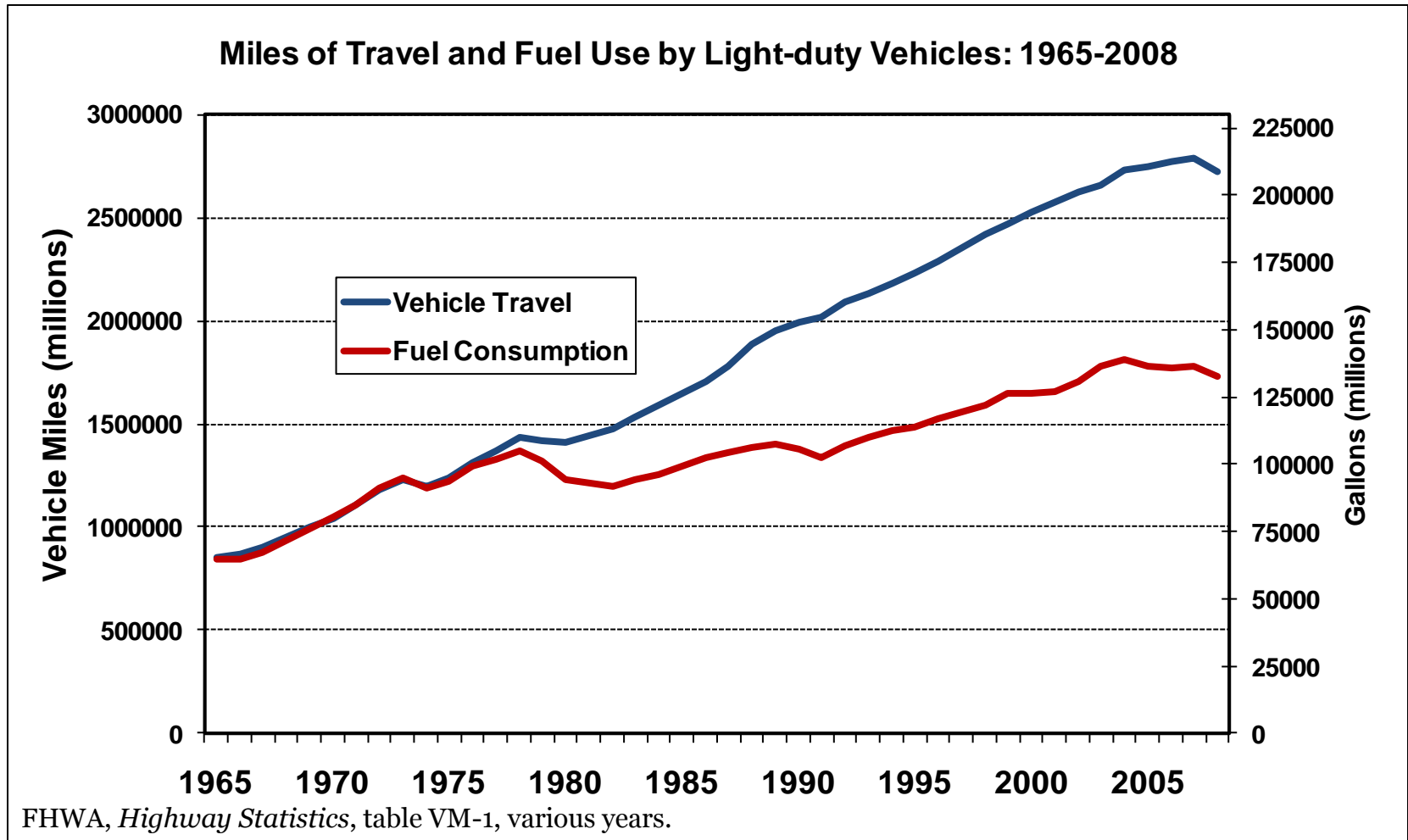


The “energy paradox”: Markets appear to undervalue future energy savings relative to *expected value*.

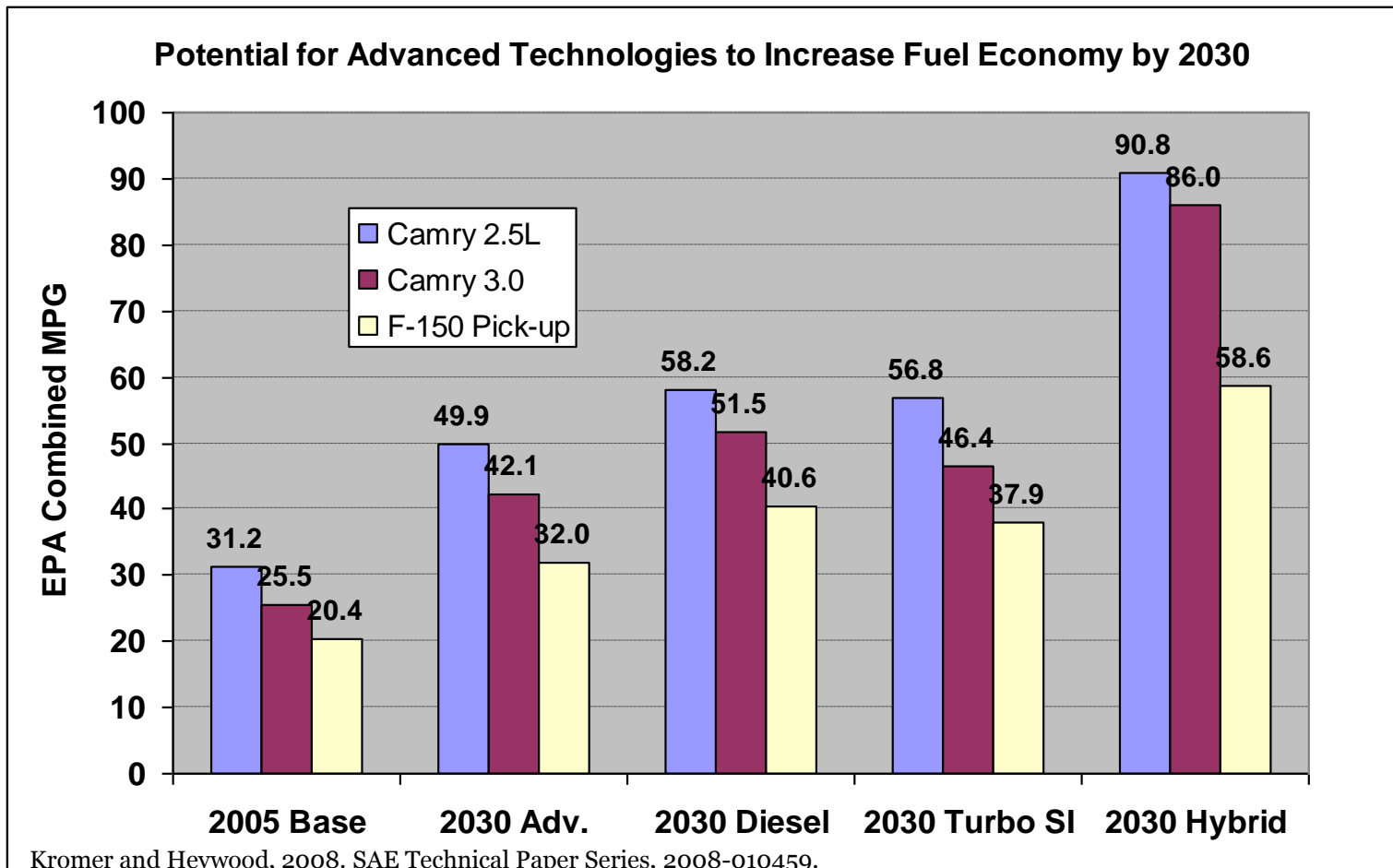
- Inadequate information?
- Bounded rationality?
- Irrationality?
- Unseen trade-offs?
- Short pay-back periods?
- Uncertainty/Loss-Aversion Bias?
 - Future fuel savings uncertain
 - Benefit is fuel savings minus cost
 - Behavioral Economics: faced with risky bet, consumers exaggerate probability of loss, count potential losses at 2-times potential gains.



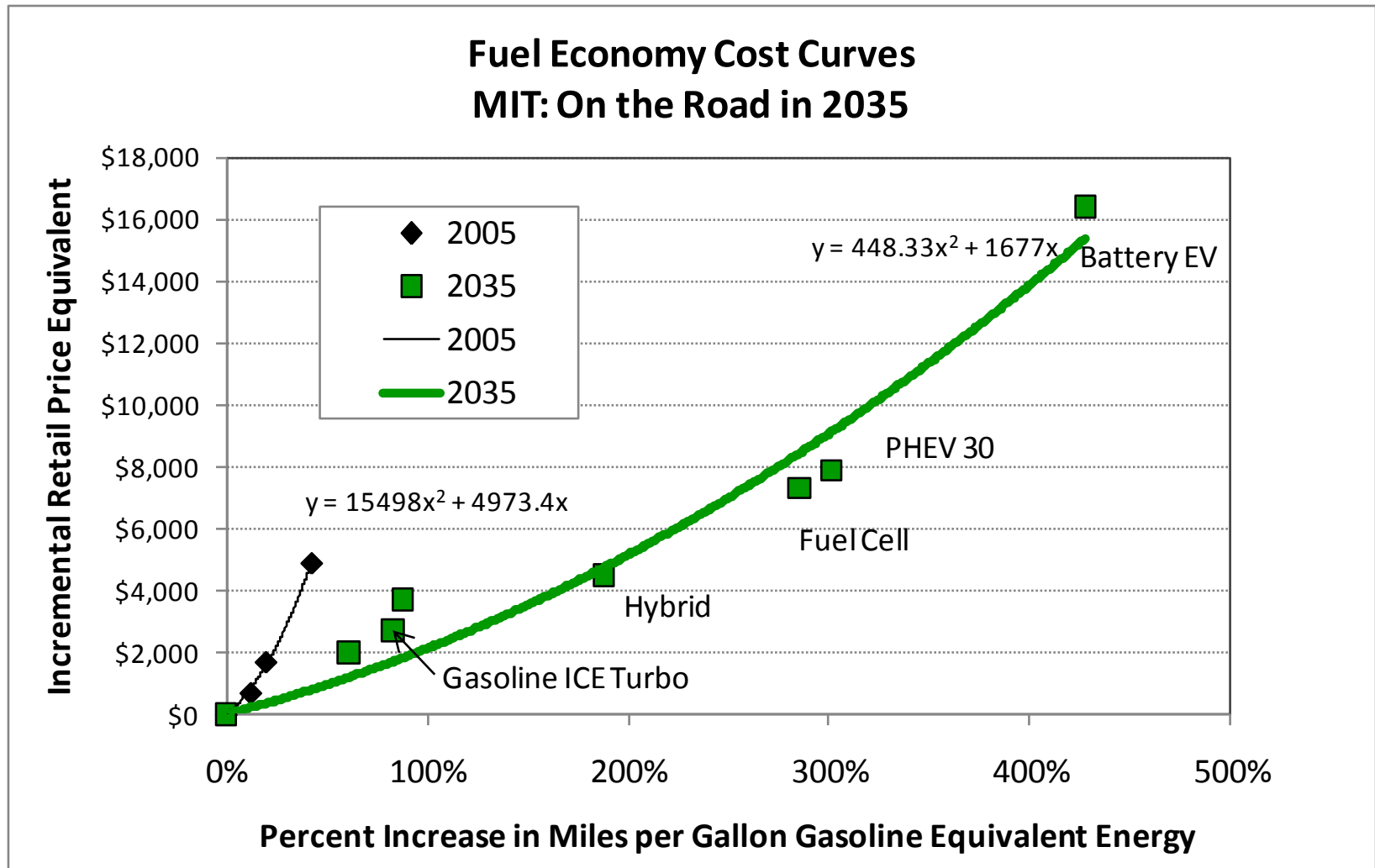
Fuel economy standards work, which is why every major auto manufacturing country has them.



IF we stop the horsepower and size race, MIT researchers foresee gains of 80-85% for gasoline passenger cars and light trucks (2-2.5%/yr.) by 2030.

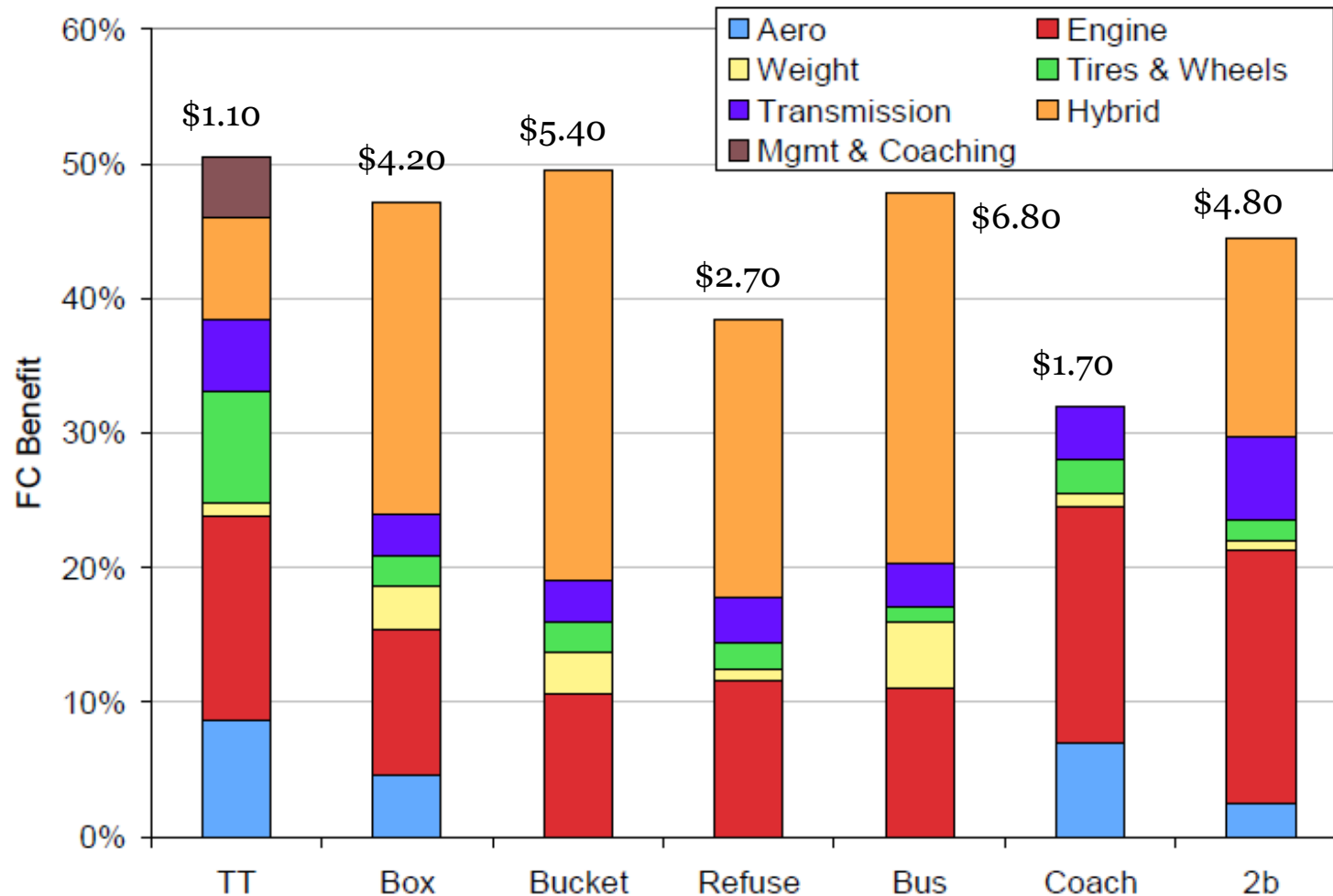


Beyond 2020: How quickly can we reduce the costs of advanced automotive technologies?

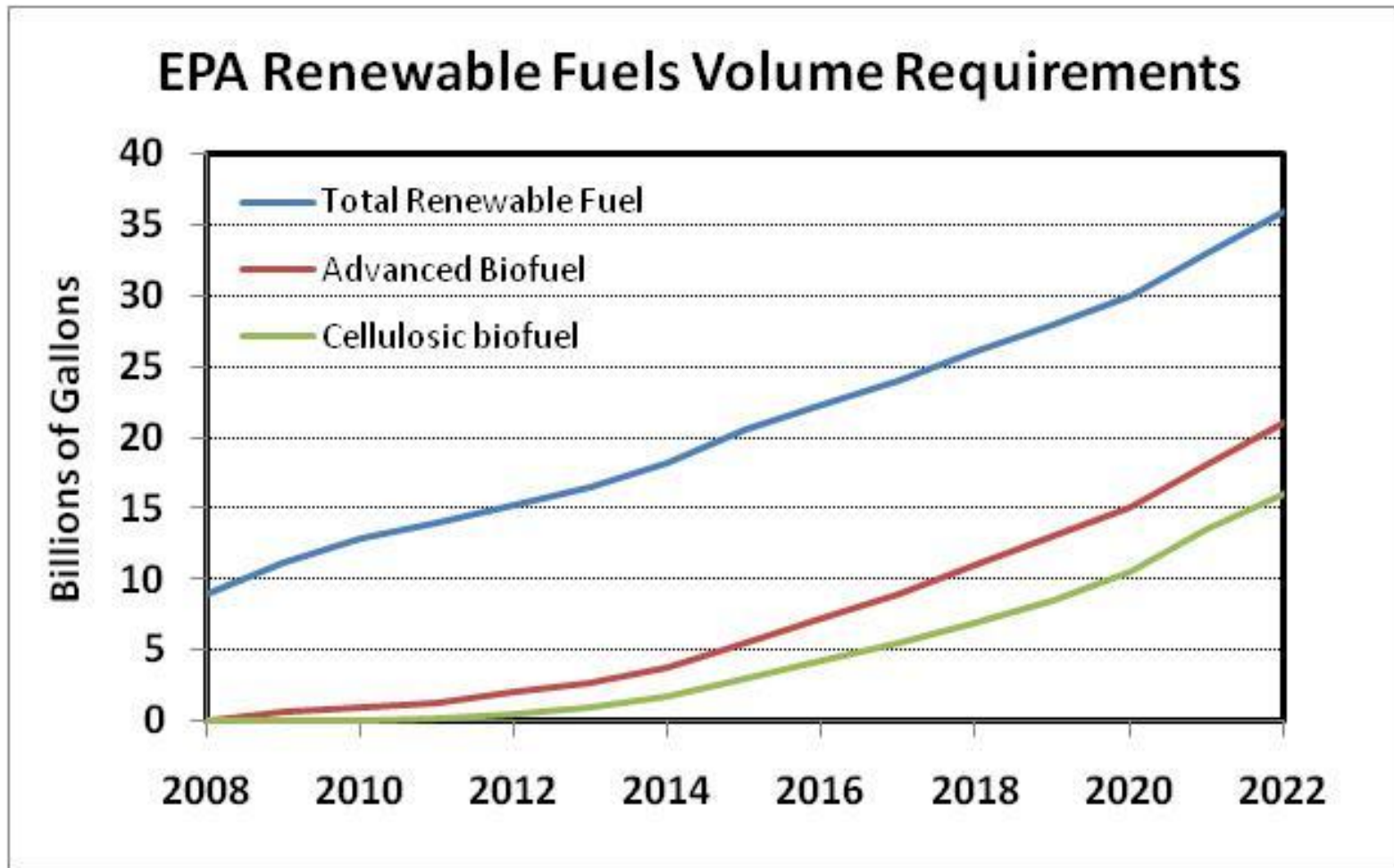


NRC Heavy Vehicle fuel economy report: 40% to 50% increase with existing technologies. Then what?

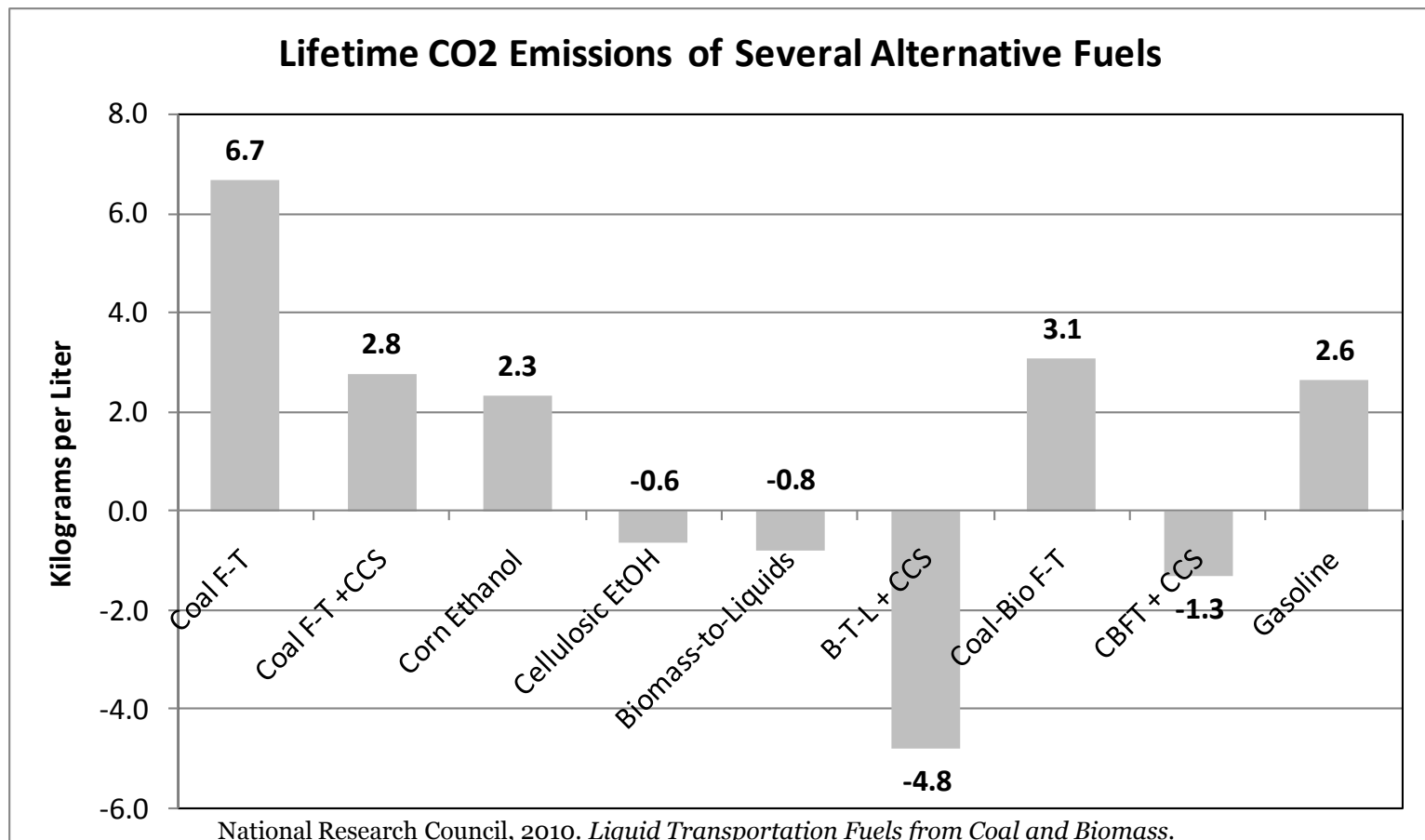
NRC, 2010, “Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles”, Figure S-1. Break-even fuel prices shown above bars.



The RFS calls for 36 billion gallons of biofuel by 2022 but the earliest cellulosic goal has already been missed. NRC considers the long-term goal feasible, but...
(NRC, *Liquid Transportation Fuels from Coal and Biomass*, 2010).



The premise of California's Low Carbon Fuel Standard is that a performance standard will lead to greater innovation than mandating or subsidizing specific fuels.

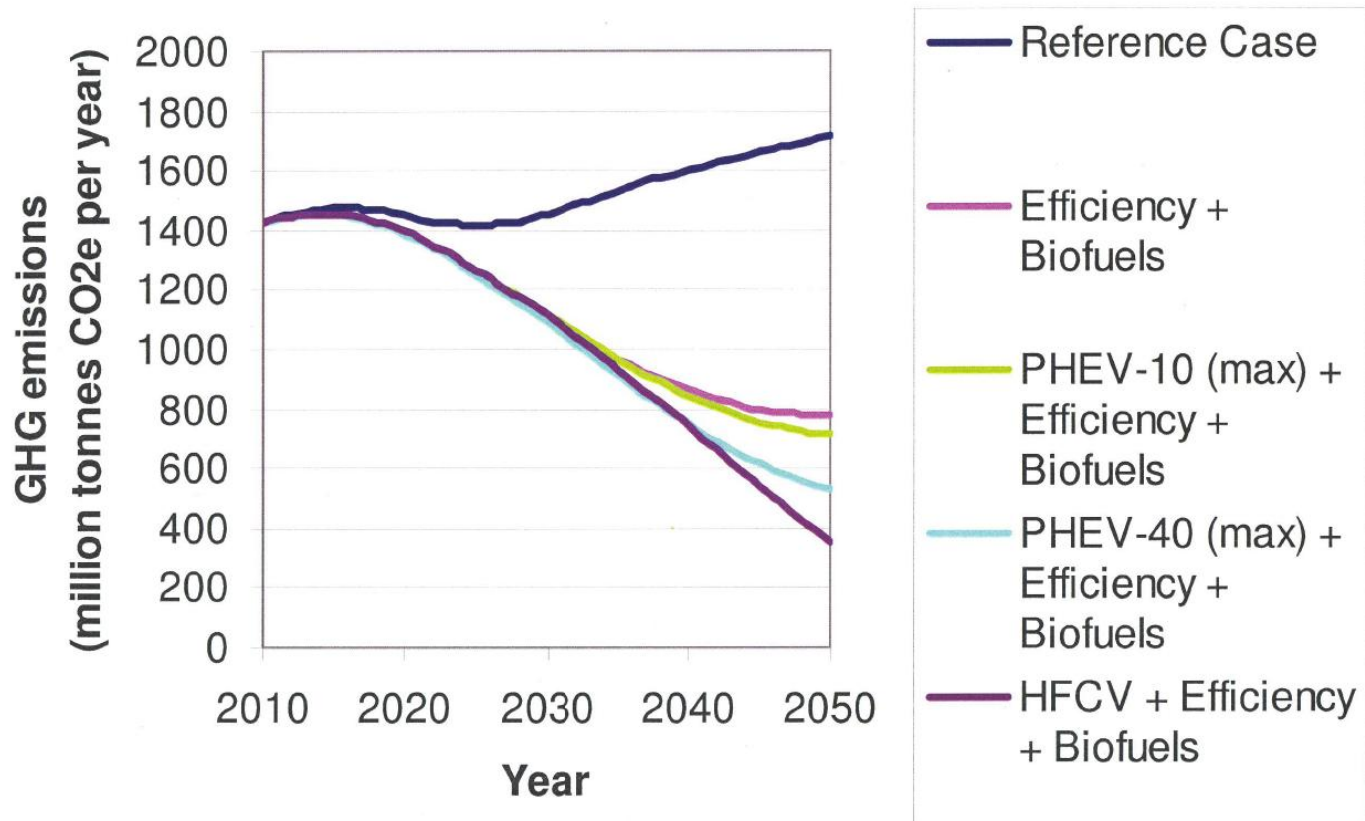


Which biofuels from which feedstocks for which uses?

- Gasify biomass to produce electricity with carbon capture and storage (CCS)?
- Make synthetic jet fuel for aircraft or diesel fuel for heavy trucks via Fischer-Tropsch synthesis?
- Make synthetic jet or diesel fuel from algae?
- Make gasoline from coal and biomass with CCS?
- Make ethanol from cellulose via enzymatic production of sugar and fermentation?
- Gasify biomass to produce hydrogen?

To achieve GHG reductions of 50% to 80% by 2050, electric vehicles will require a decarbonized utility sector and fuel cell vehicles will require low GHG hydrogen.

De-carbonized Electric Grid



And won't energy efficiency and alternative fuels decimate the motor fuel tax?

How could we finance surface transportation?

- Universal VMT tax?
- According to the laws of physics, transportation is “work”, and energy is necessary to do work.
- Universal energy tax
 - All forms of energy taxed equally
 - Indexed to average energy efficiency
 - Indexed to inflation
 - Equivalent impact on VMT to a universal VMT tax
 - In addition, encourages continued energy efficiency improvement and favors more energy efficient technologies.

What will it take?

Technology, policy, planning and public will.

- Energy Efficiency
 - Passenger car and light truck standards to 2016
 - On beyond 2016
 - Heavy-duty vehicle efficiency
- Rethinking Renewable or Low-Carbon Fuels
 - The Renewable Fuels Standard
 - California's Low-Carbon Fuels Standard
 - Future biofuels
- A Transition to Sustainable Energy
 - Electricity?
 - Hydrogen?
 - Electricity & Hydrogen?



Thank you.