Electric-Drive vs. Biofuels for Transportation

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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Vehicle Technologies Program

December 15, 2010

Overview

Biofuels compared to electric-drive vehicles: a quick look.

Areas to consider

- GHG emission reduction potential
- Lifecycle cost
- Energy density and vehicle range
- Cumulative petroleum savings potential

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Vehicle GHG emissions and energy use: 2010

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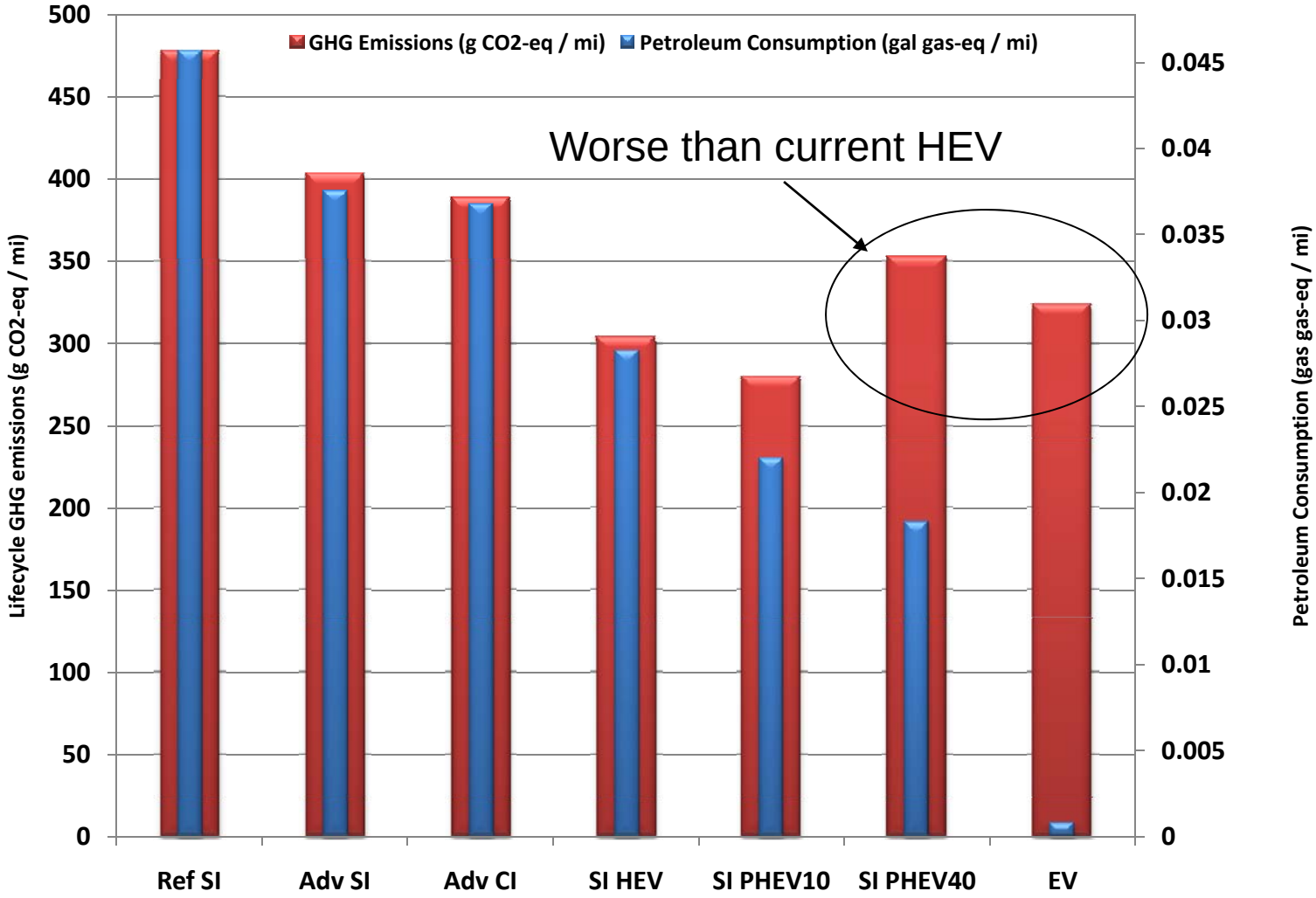
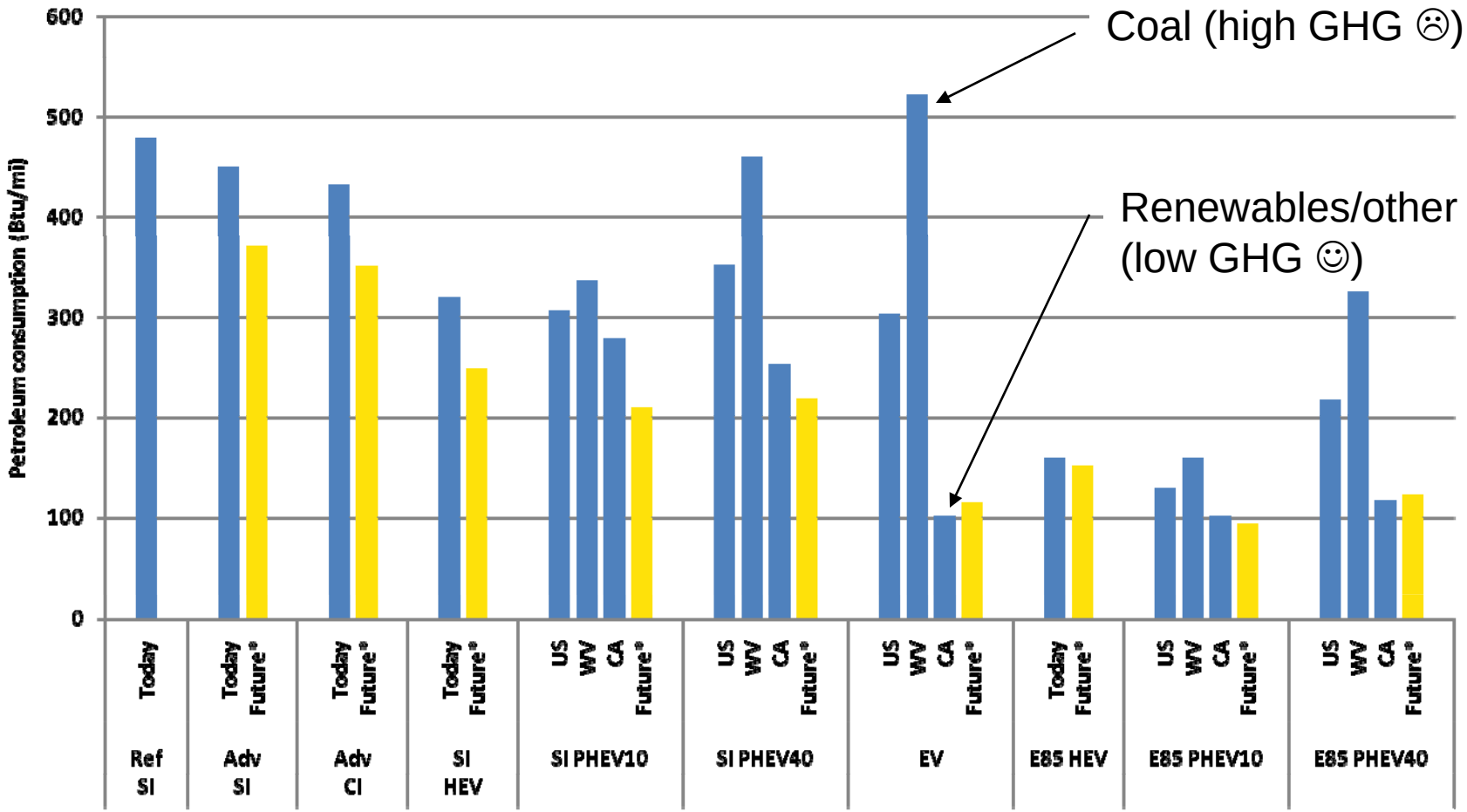
Assumptions:

Estimates based on VTP subprogram targets as inputs to PSAT and GREET modeling.



Vehicle GHG emissions depend on grid mix – WV vs. CA



Vehicle GHG emissions and energy use: 2030 (estimated)

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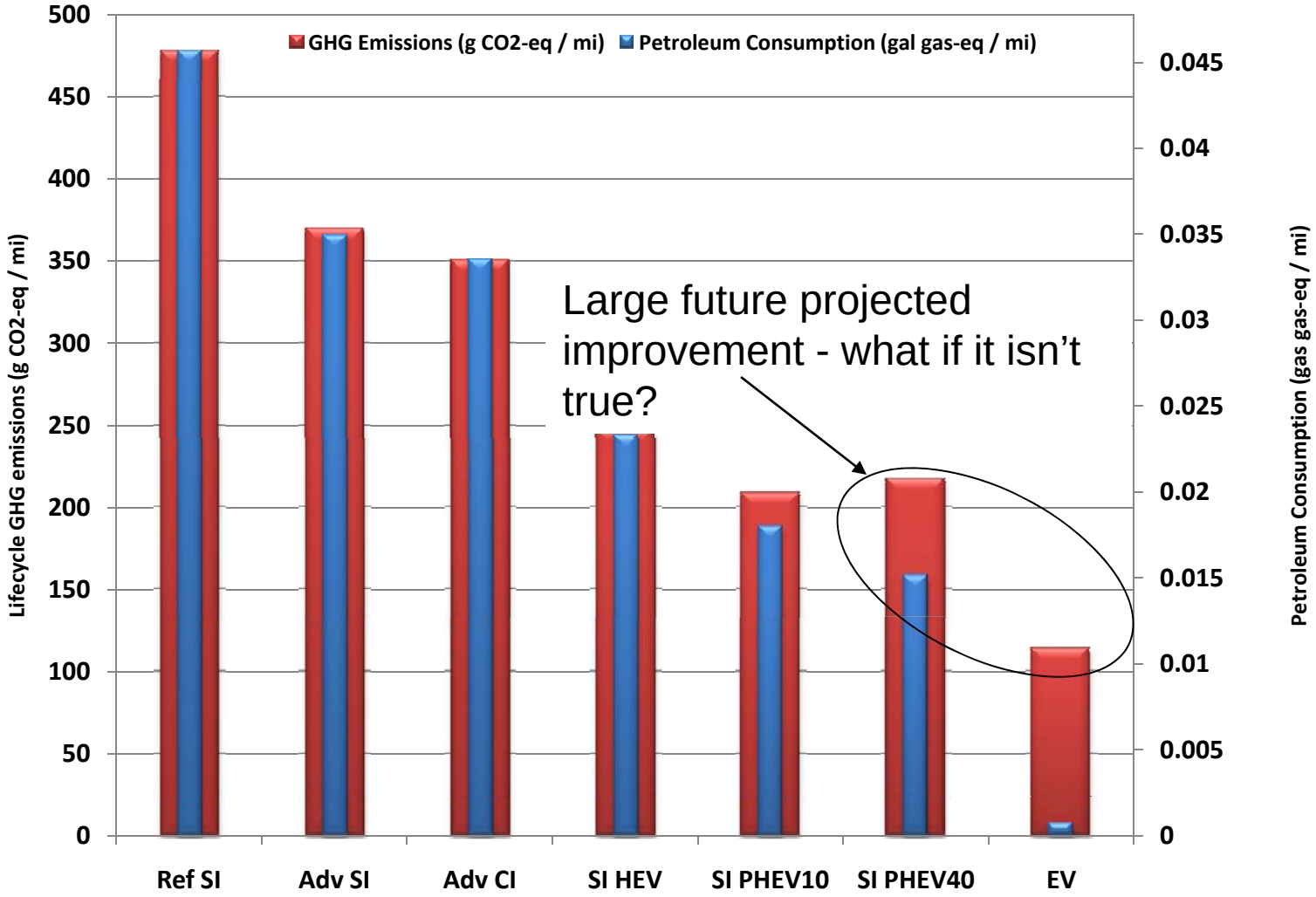
U.S. electricity grid is aggressively decarbonized by 2030 (30% renewables).



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Lifecycle Cost of Ownership: 2010 vs. 2030, by system

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Assumptions:

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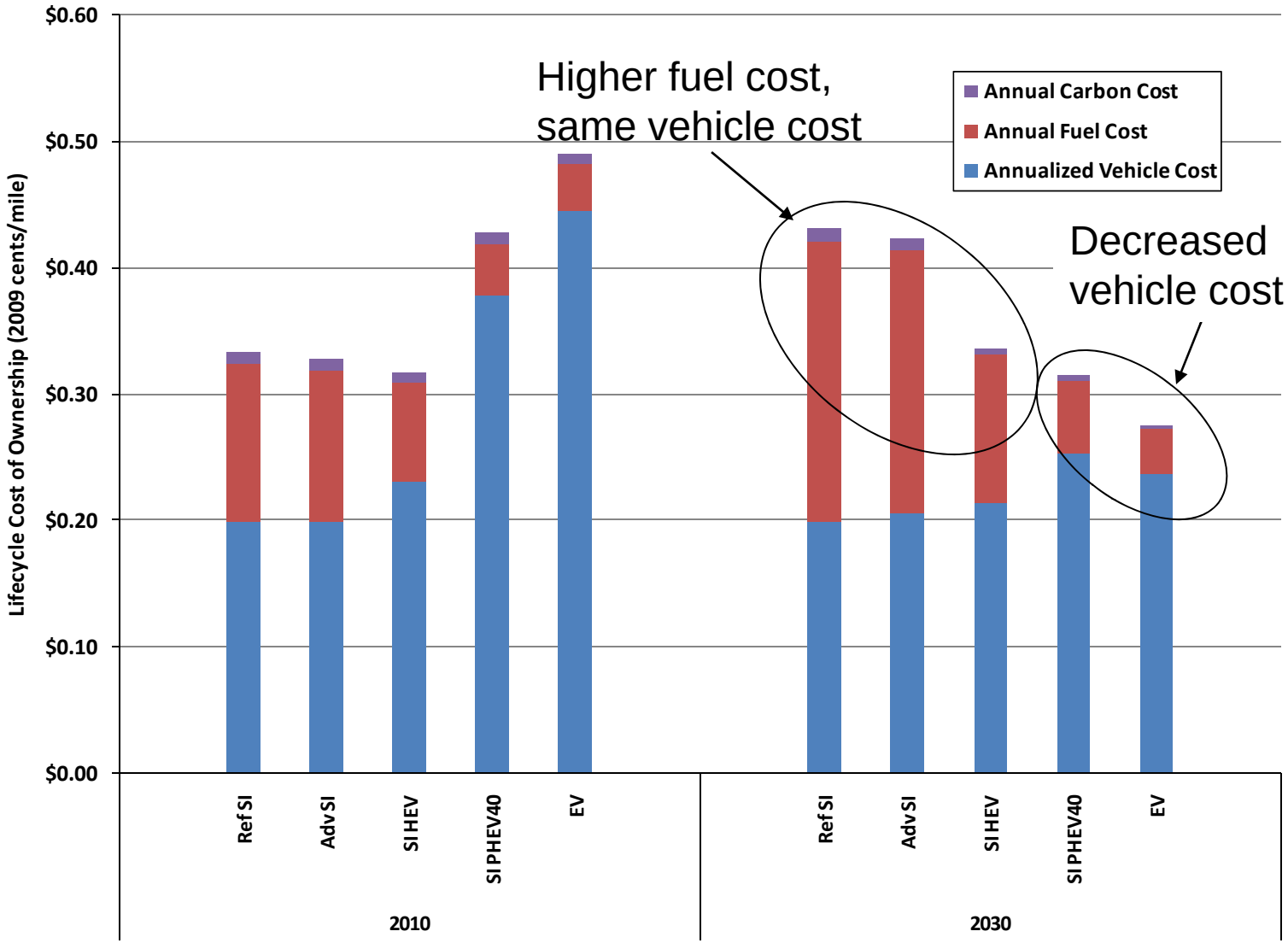
Fuel prices are AEO09 High Case (rising from $3.70 in 2010 to $5.69 in 2030).

Vehicle lifetime is 15 years, annual VMT is 10K miles, discount rate is 10% (real).

Carbon cost is assumed to be $20/ton (current dollars).



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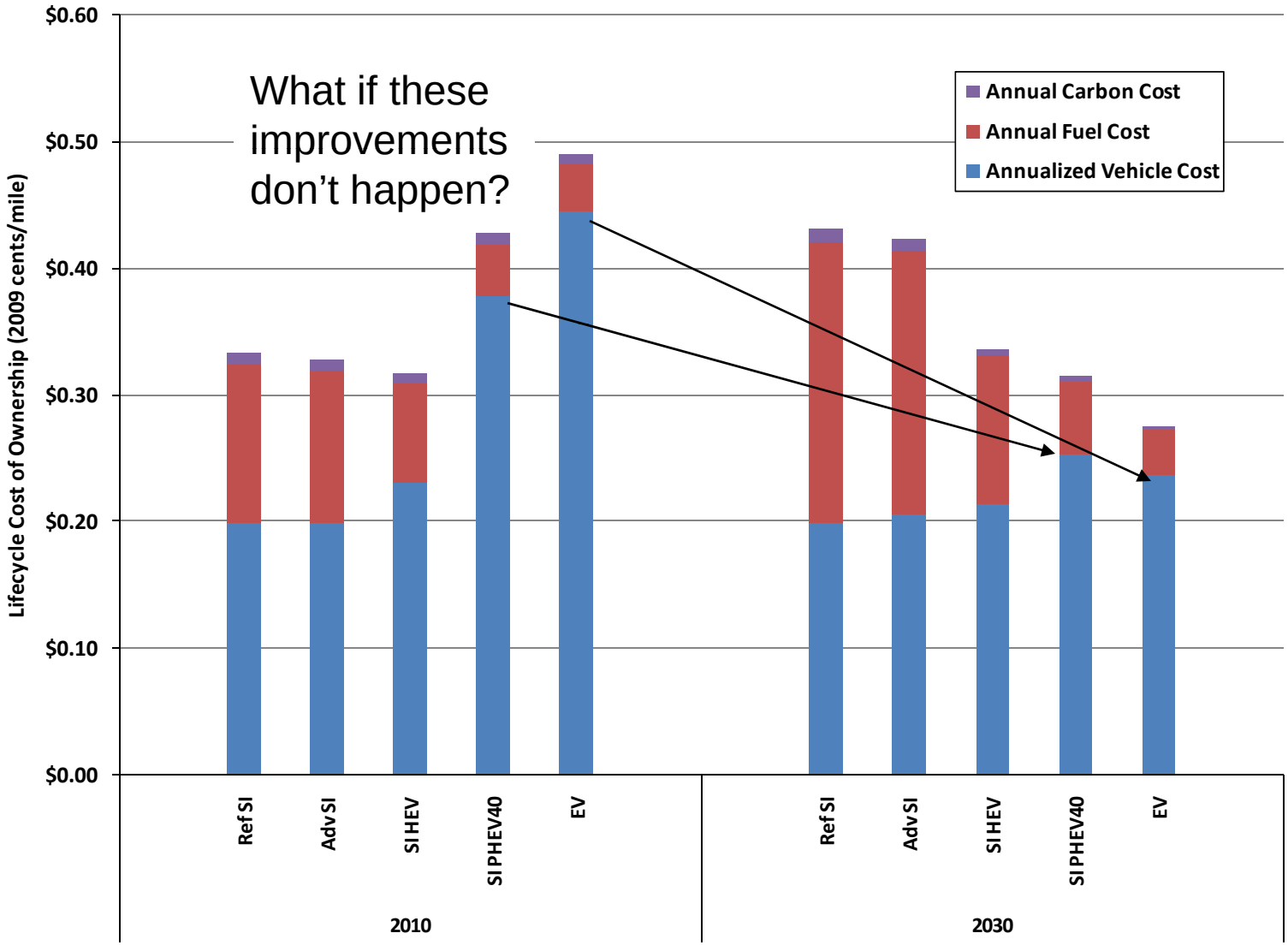

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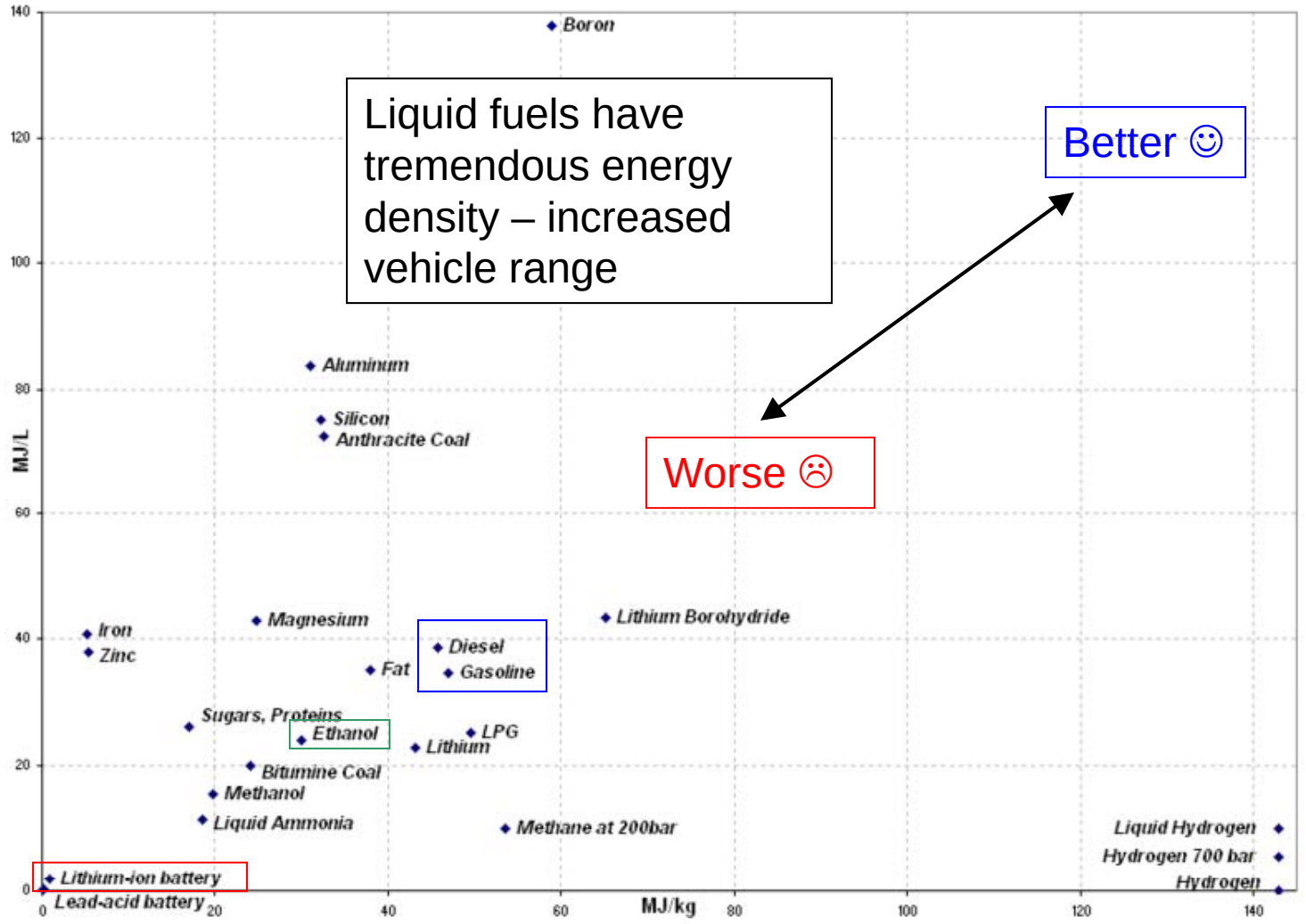
Liquid Fuels vs Battery



http://en.wikipedia.org/wiki/File:Energy_Density.PNG

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Blast from the Past-
Will History Repeat this Time?

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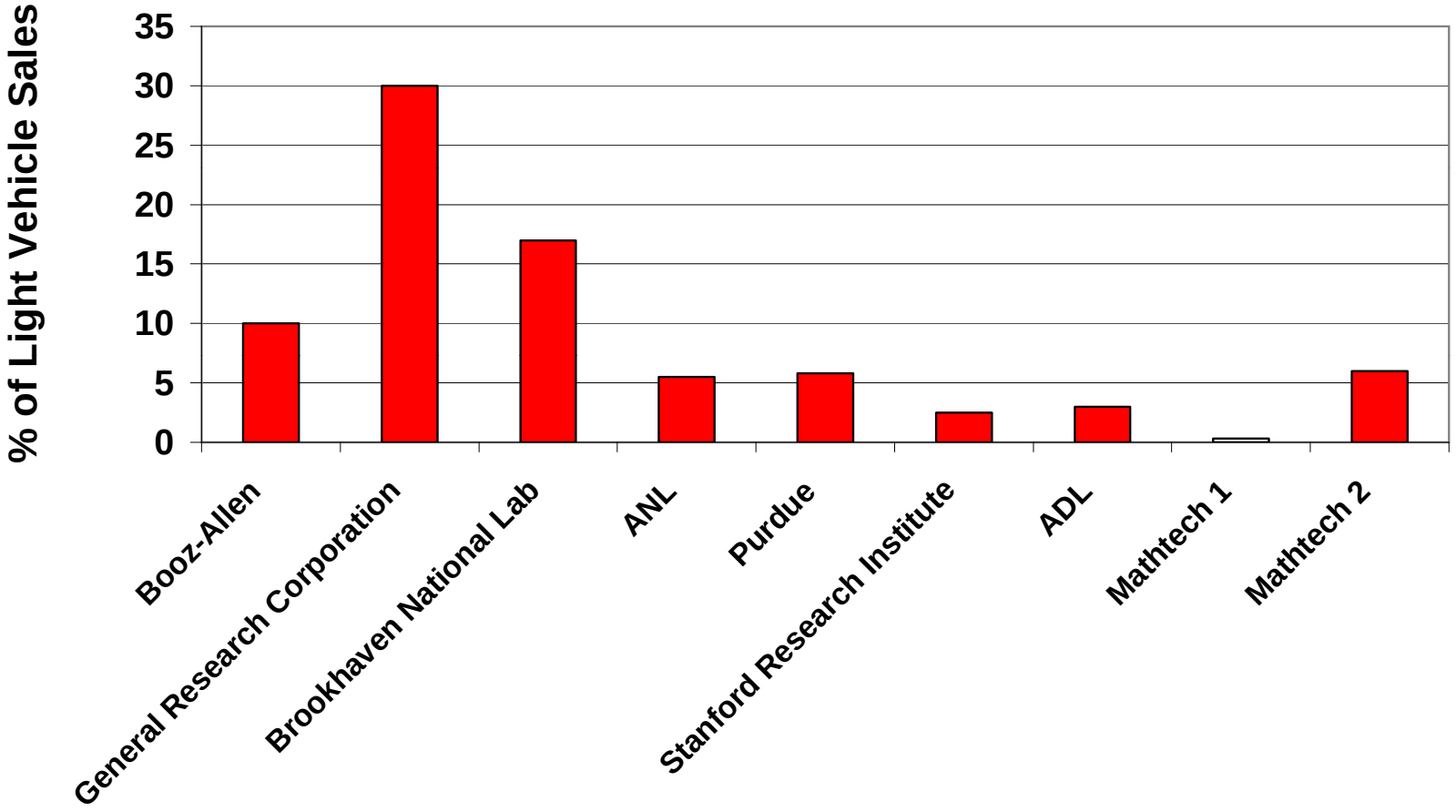
Projections in 1980 of EV Market Penetration in 2000

ORI Report for DOE, January 1980



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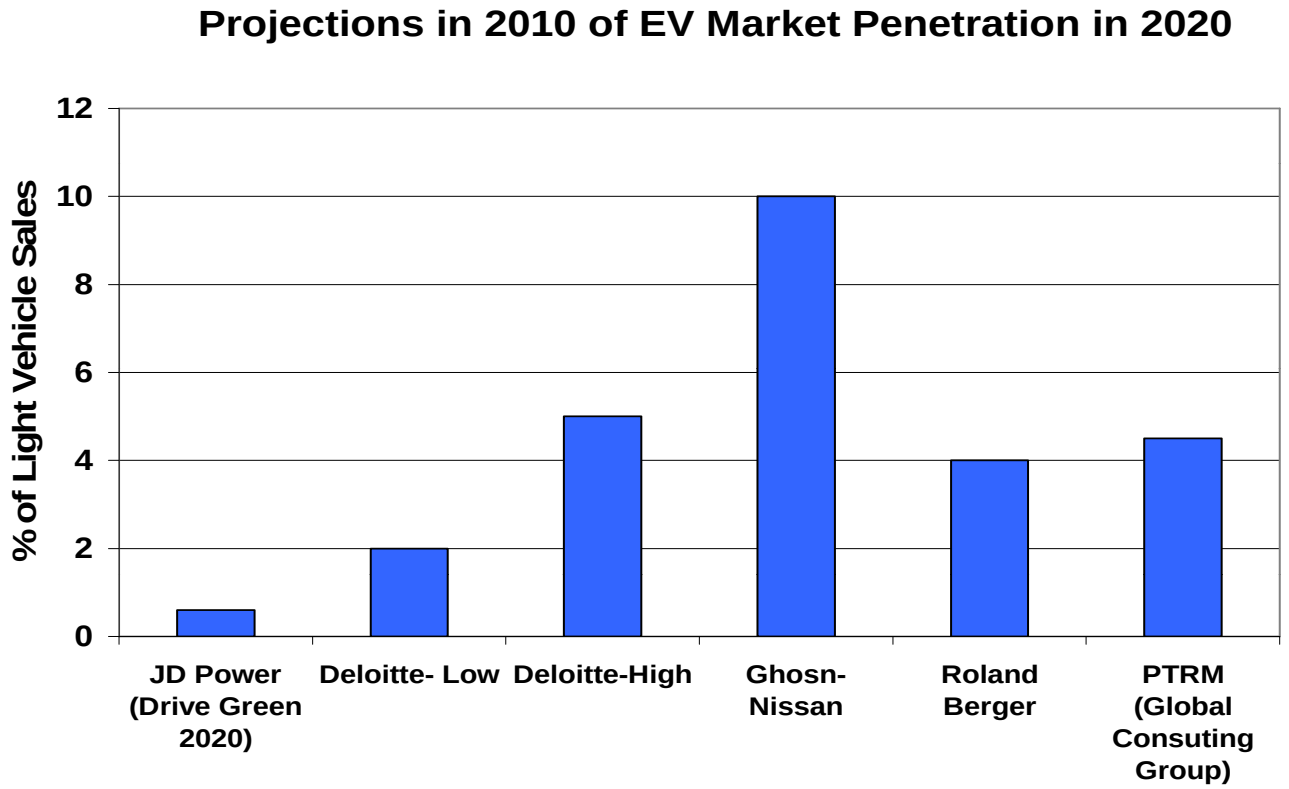

Most experts predict modest EV penetration so contribution will be limited regardless of electricity source

Another role for biofuel: heavy-duty vehicles
Forecast with heroic success in electrification…*

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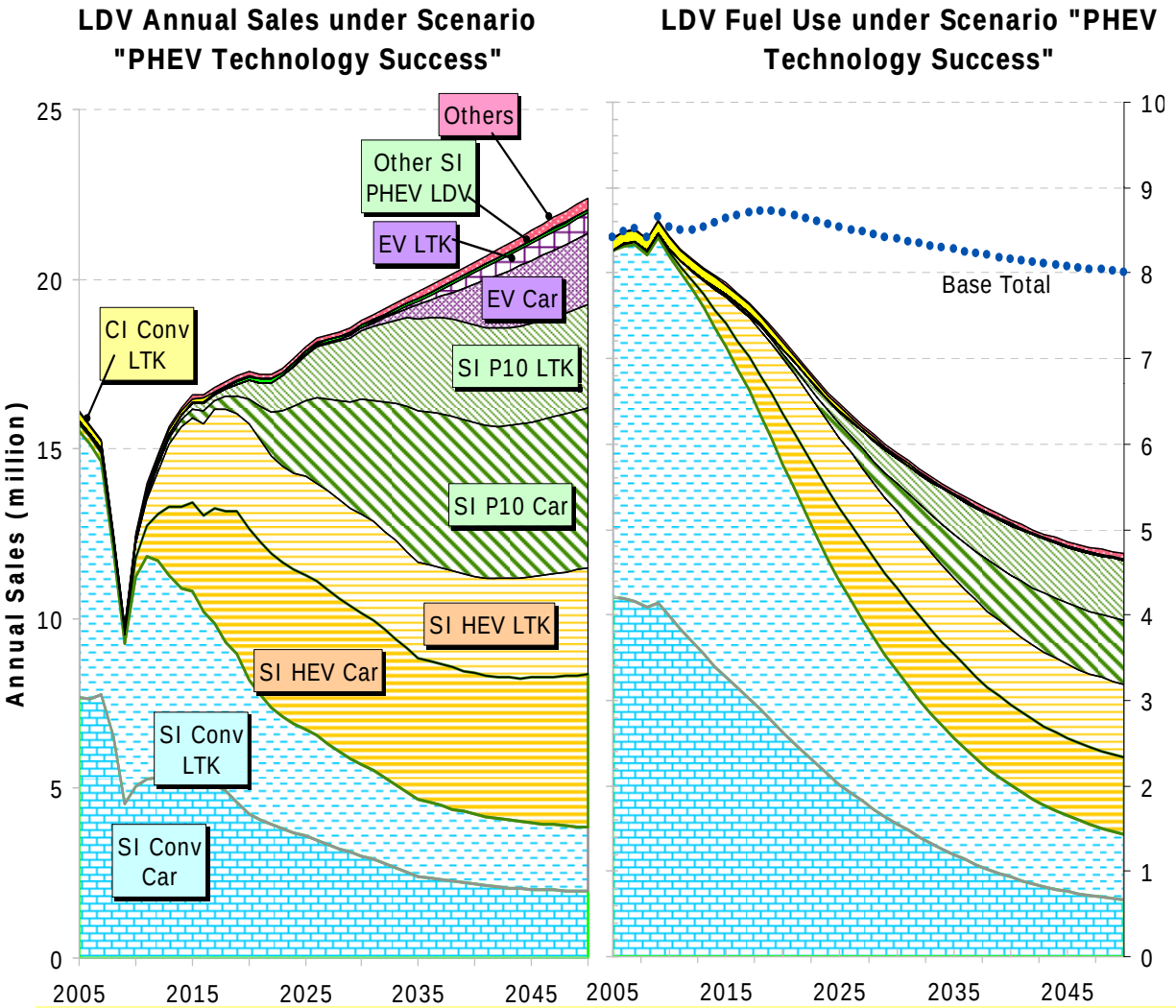
* "heroic success" ⇒ VTP targets met for battery cost and performance, electric motors, etc.

- **Major reduction in LDV liquid fuel use – but still need 5 million b/d equiv. liquid fuel**
- **EV market share visible**
- **Yet in 2050: ~90% of passenger vehicles sold – and >95% of vehicles on the road – have ICE**
- ***And what about freight and other heavy duty vehicles??***



PHEV success analysis scenario: Reaching aggressive goals in batteries and PHEV adoption has major impact on LDV energy use.

Lin and Greene, ORNL, 2010

…and freight trucks become the **largest petroleum user**, with limited technology options

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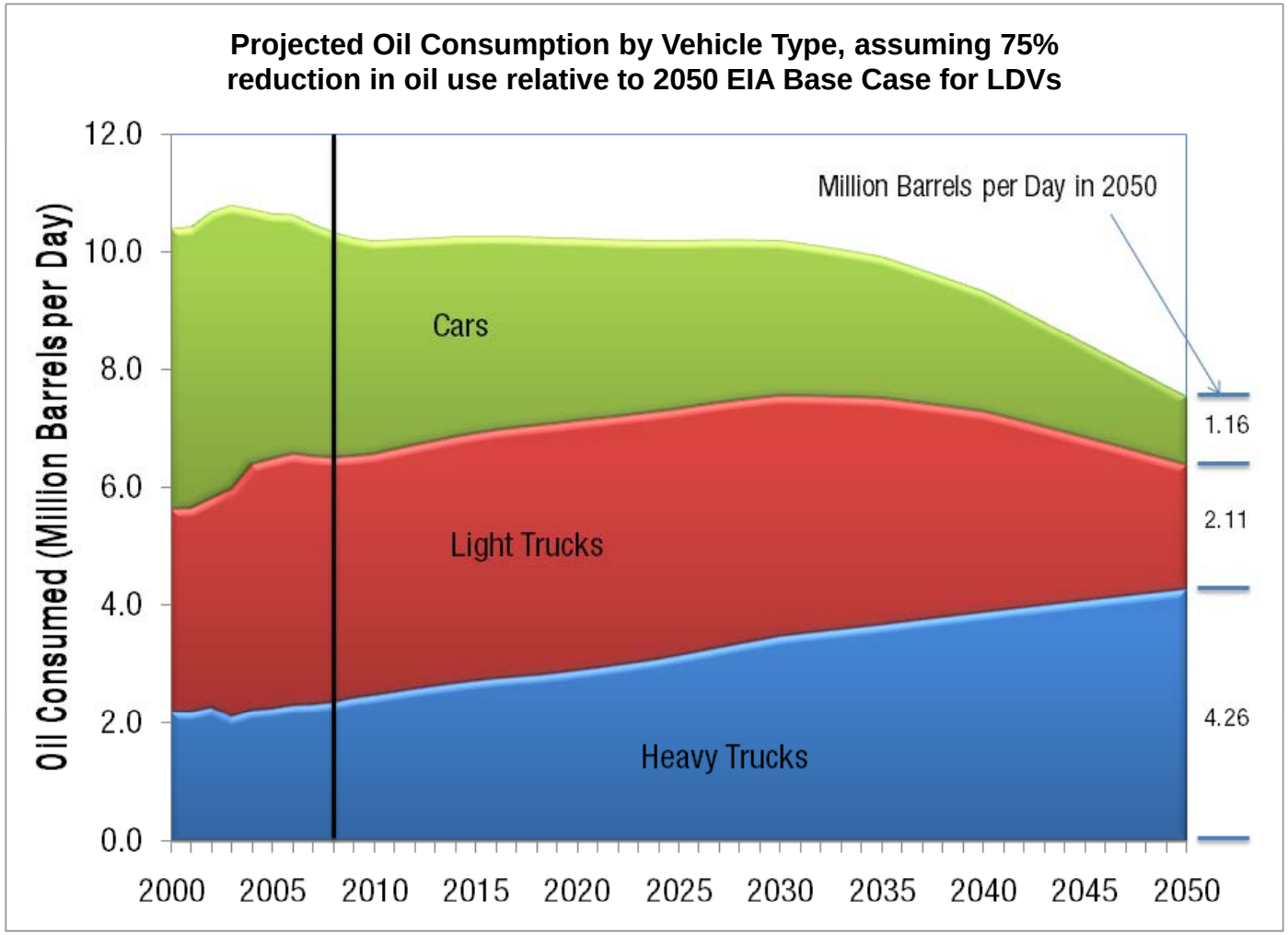
- Electrification poor HD option
- Engines remain primary power source for HD
- HD to use >½ highway petro-fuel
- Virtually all non-hwy on liquid fuel



Source: DOE Vehicle Technologies Program

Conclusion

- Liquid fuels are likely to be around for a long time and are hard to beat for energy density.
- Biofuels appear to have more potential for displacing petroleum and reducing GHGs in the near-term than using biomass for power generation for EVs.
- Long-term may be different.