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Transportation's Energy Efficiency: What's needed today and by 2050?

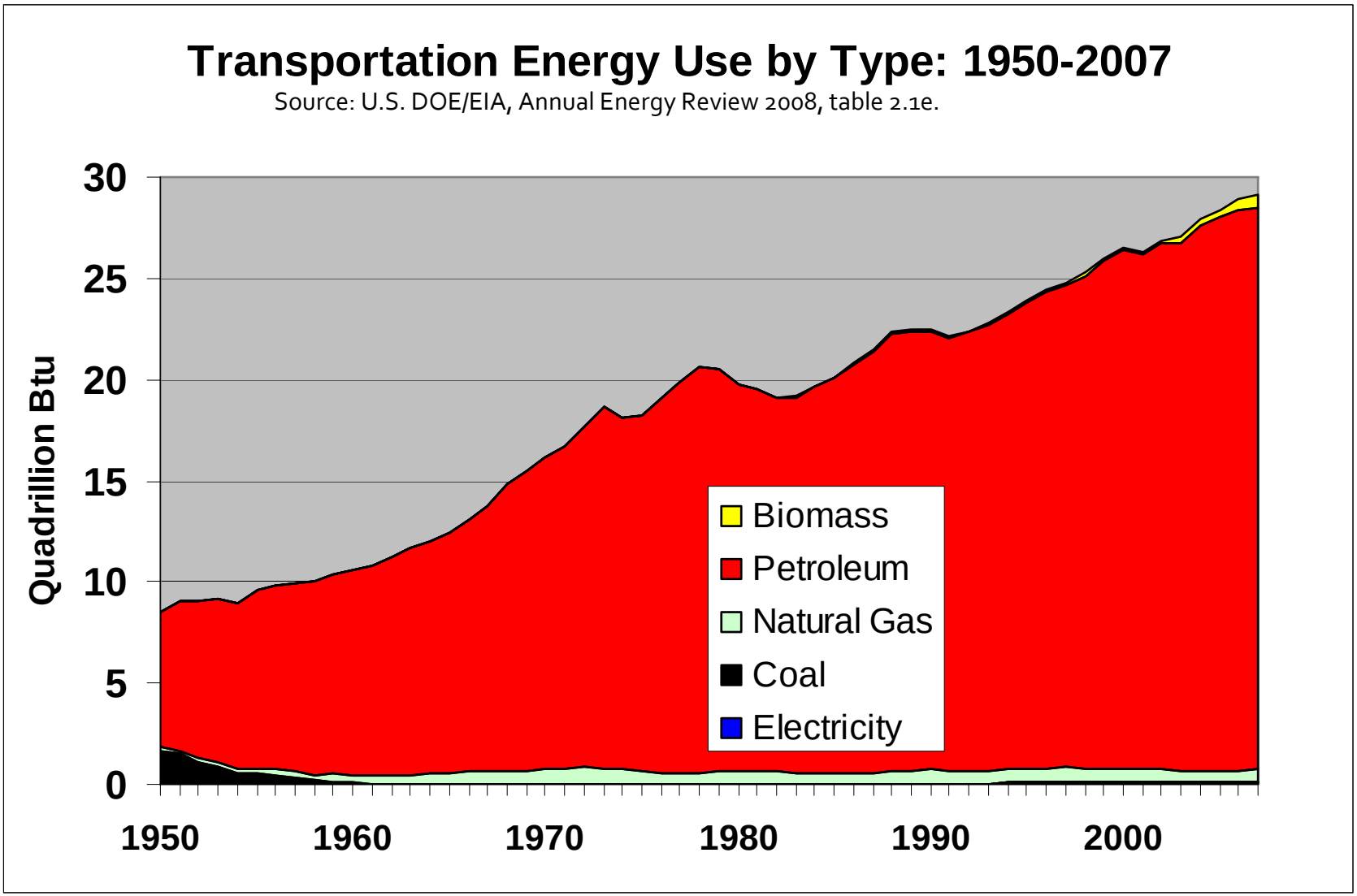
ACEEE::30 Years of Energizing Efficiency

December 7, 2010
Washington, DC

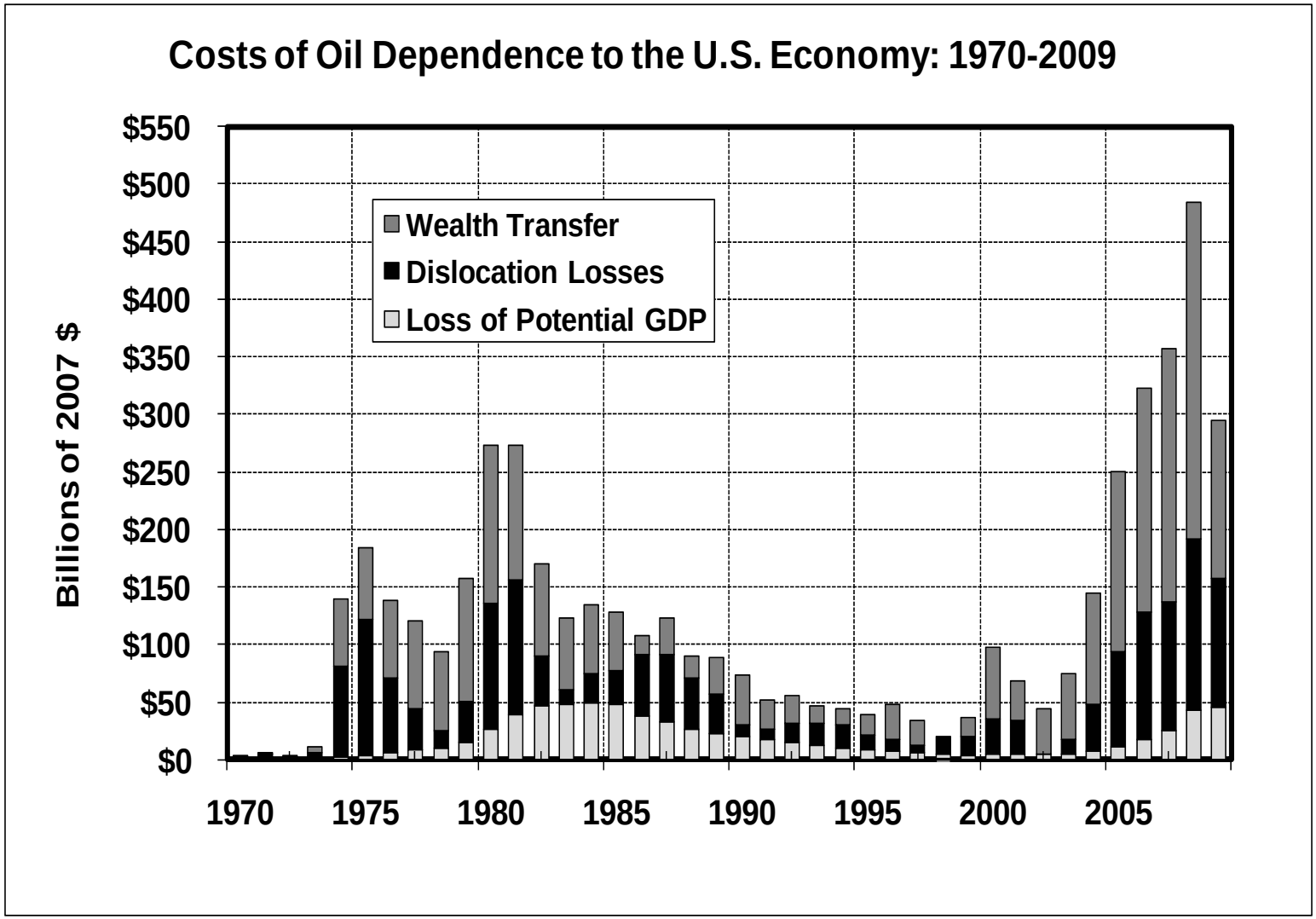
What is needed for big improvements in transportation energy efficiency?

- **Right Now:**
  - Fuel economy/GHG emissions standards
  - Incentives for advanced technology vehicles
  - Indexed ROadway User Toll on Energy
  - Research, development and demonstration
- **Future:**
  - All transport modes
  - Continued standards and revenue neutral incentives
  - Cost-neutral changes in pricing of transportation
  - Sustainable energy transition

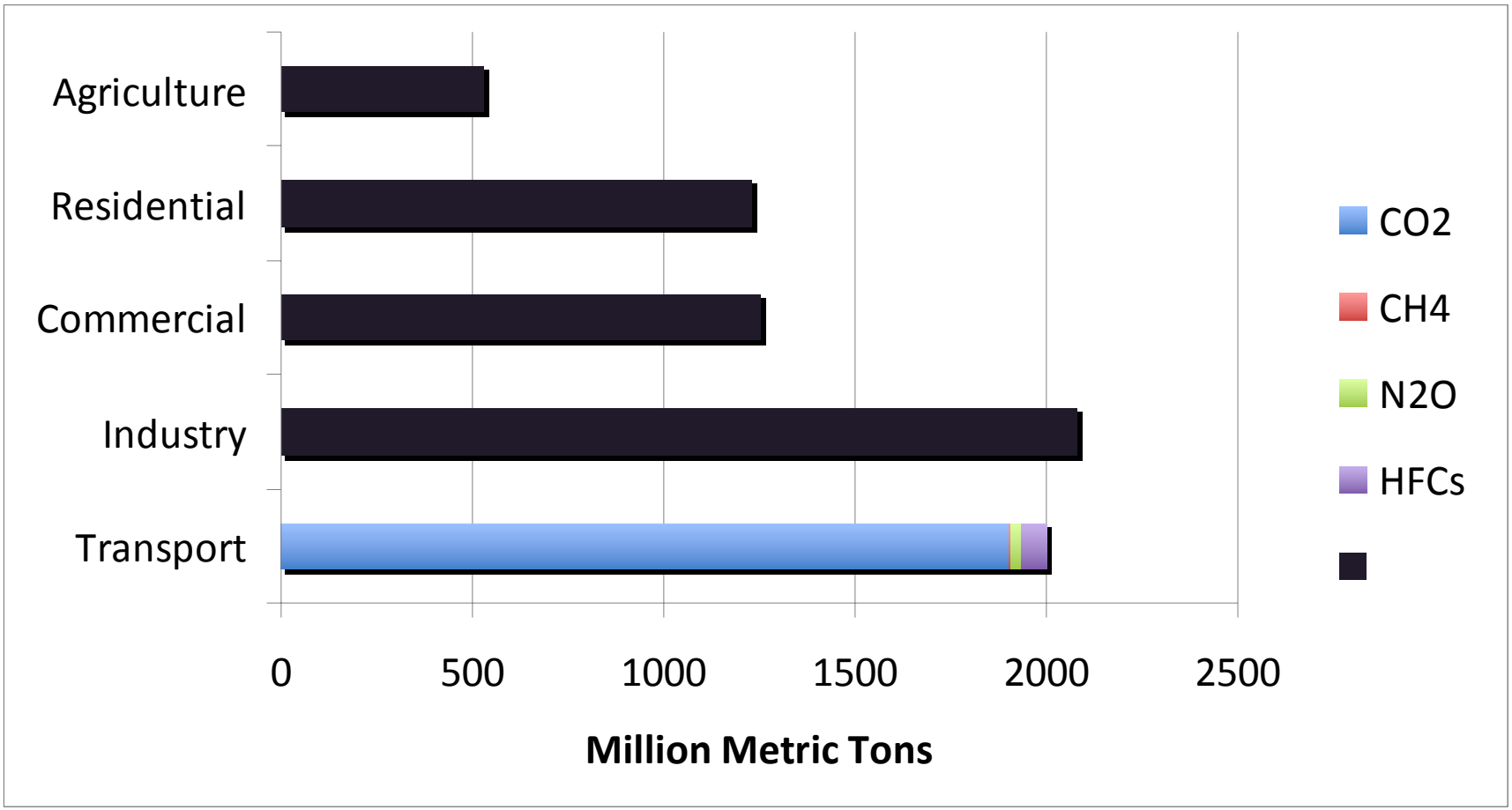
Our transportation system uses oil at the rate of over 6,300 gallons per second, more than any nation's total use. Transportation: 2/3 U.S. oil, > 4/5 of light products.



Petroleum dependence costs a lot. ($1T: 2007-9)

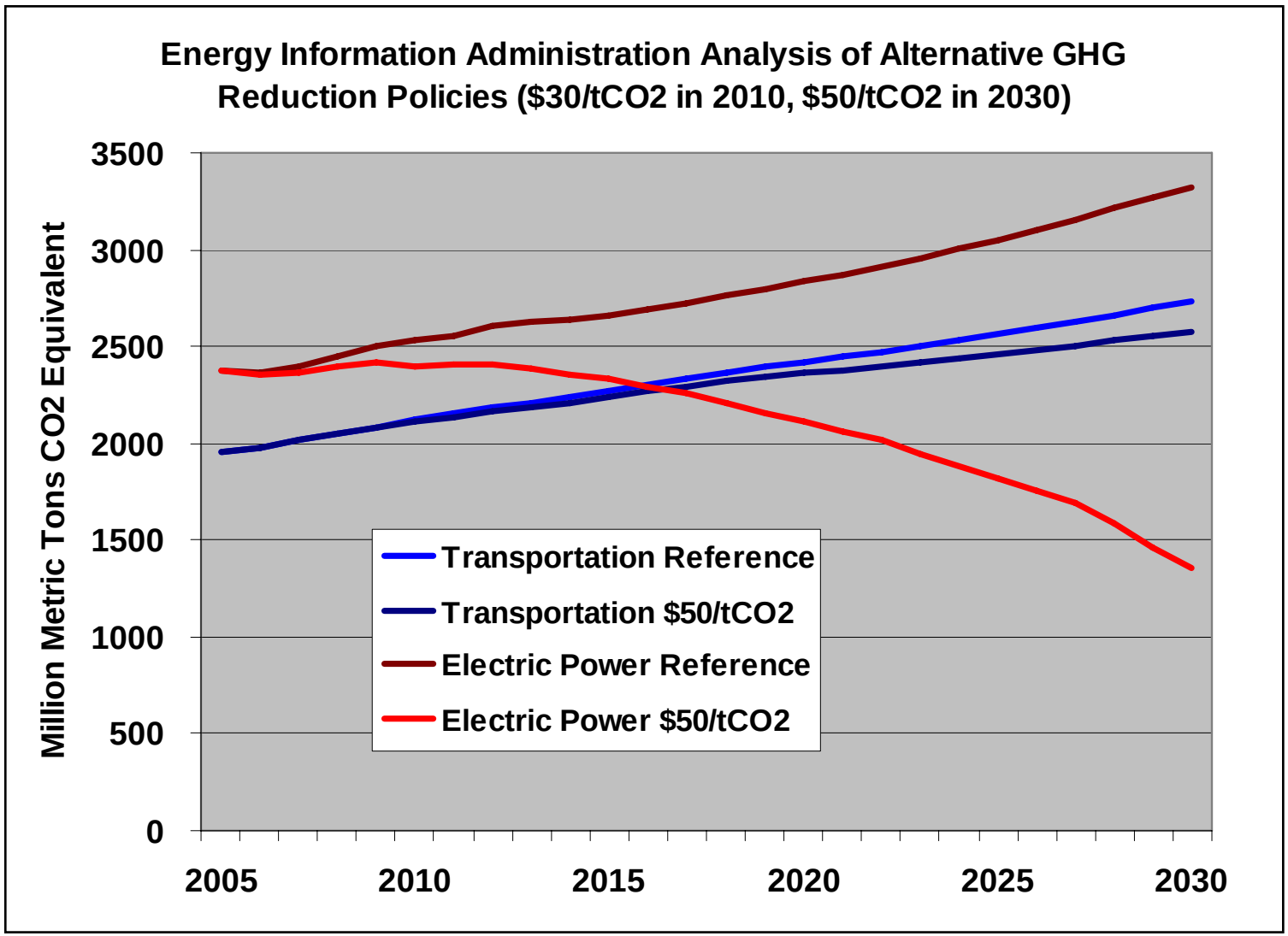


The U.S. transportation system emits more CO_2 than any country in the world except China.



What is transportation's "fair share"? Here's one answer:

A carbon price that would cut CO_2 emissions from electricity generation in half by 2030 would do little for transportation. (EIA, 2006). $50/tCO$_2$, approx. $0.50/gal.

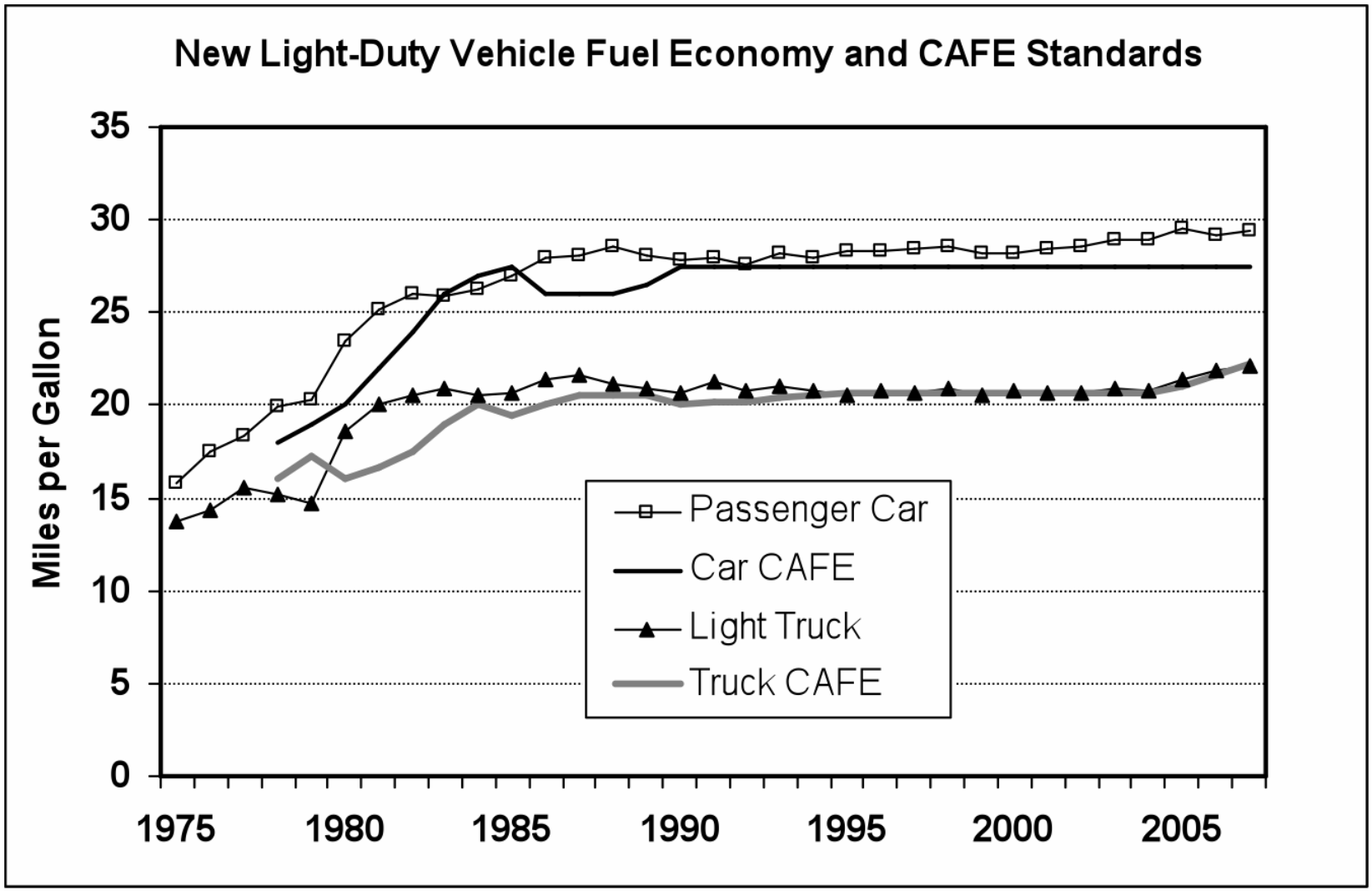


A great deal more can be accomplished by policies designed for real-world transportation markets.

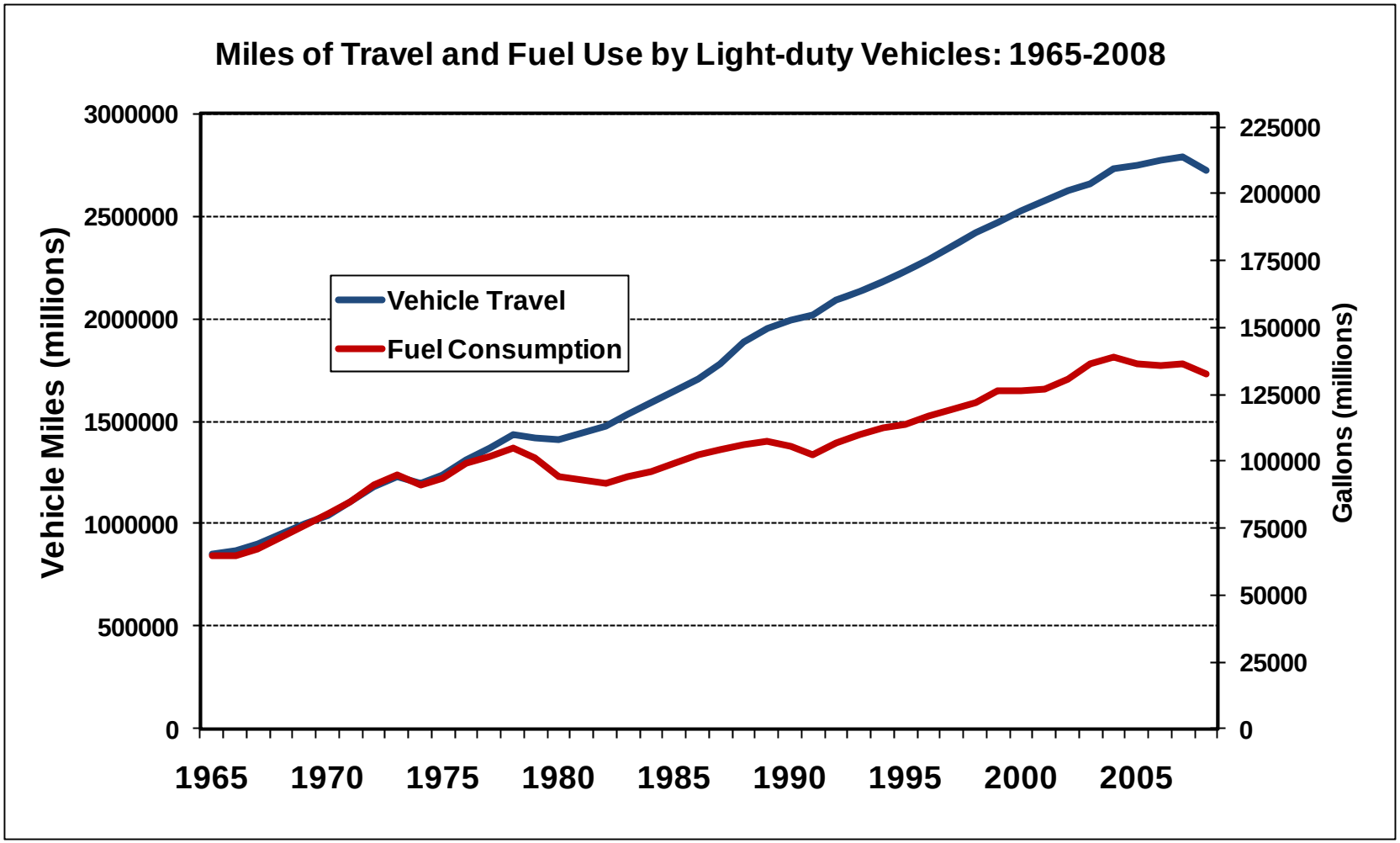
- **Undervaluing energy efficiency by half or more:**
  - (Greene, D.L., in press. "Uncertainty, Loss-Aversion and Markets for Energy Efficiency, *Energy Economics.)*
- **Importance of co-benefits and externalities (e.g., oil dependence)**
- **Interdependency with land use**
- **Interdependency with transportation infrastructure**
- **Re-pricing transportation without increasing its cost (e.g., PATP)**
- **Necessity of advanced technology and adaptable policies.**
- **Requires comprehensive, realistic assessment of mitigation potential.**
  - USDOT, 2010, "Transportation's Role in Reducing Greenhouse Gas Emissions", April.
  - Greene and Plotkin, 2010, "Reducing Greenhouse Gas Emissions from US Transportation", Pew Center on Global Climate Change, forthcoming.

#1. Keep tightening fuel economy/emissions standards.

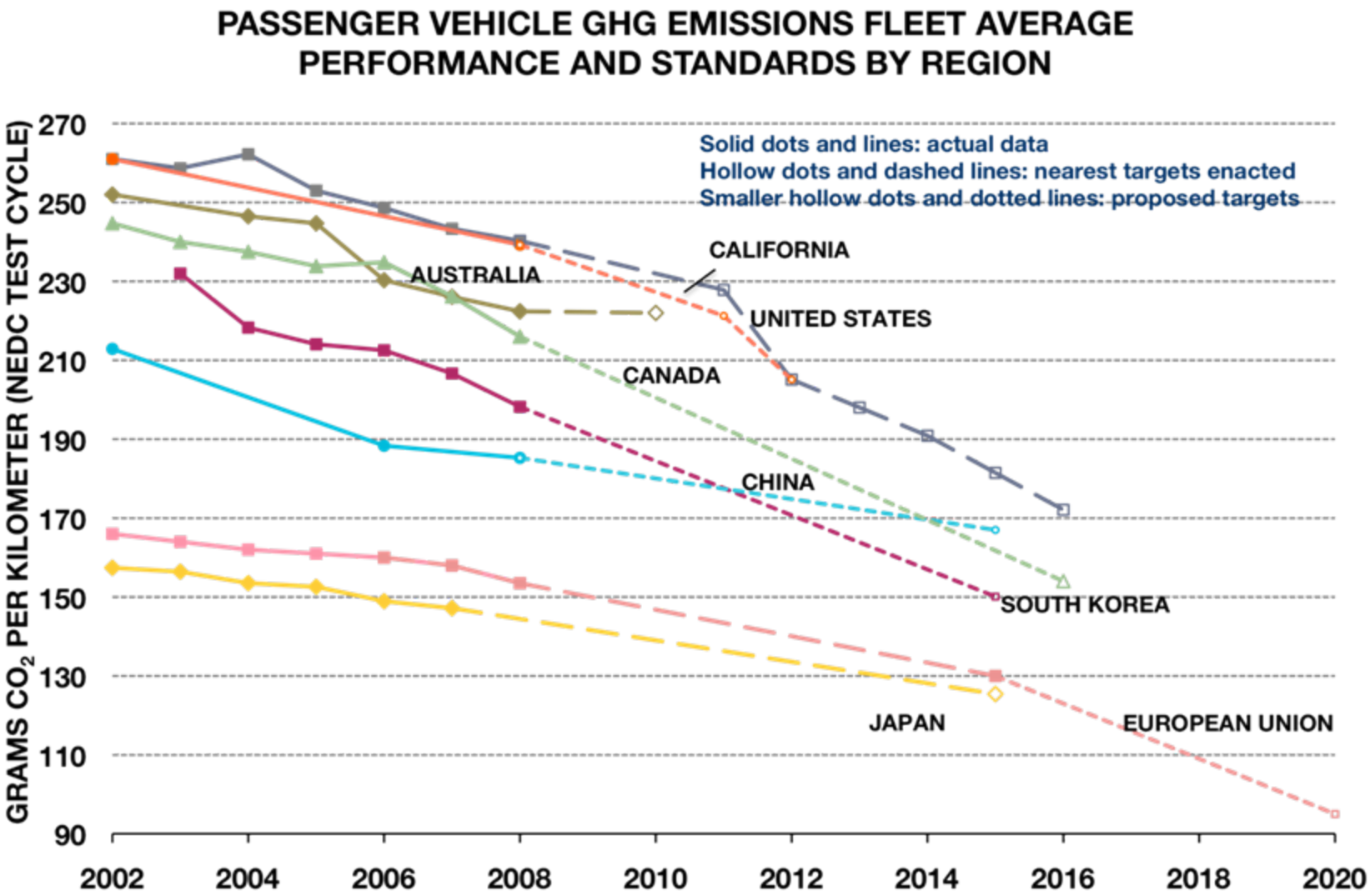
Nearly all of the fuel economy improvement in the US in the past 30 years can be credited to the Corporate Average Fuel Economy standards.



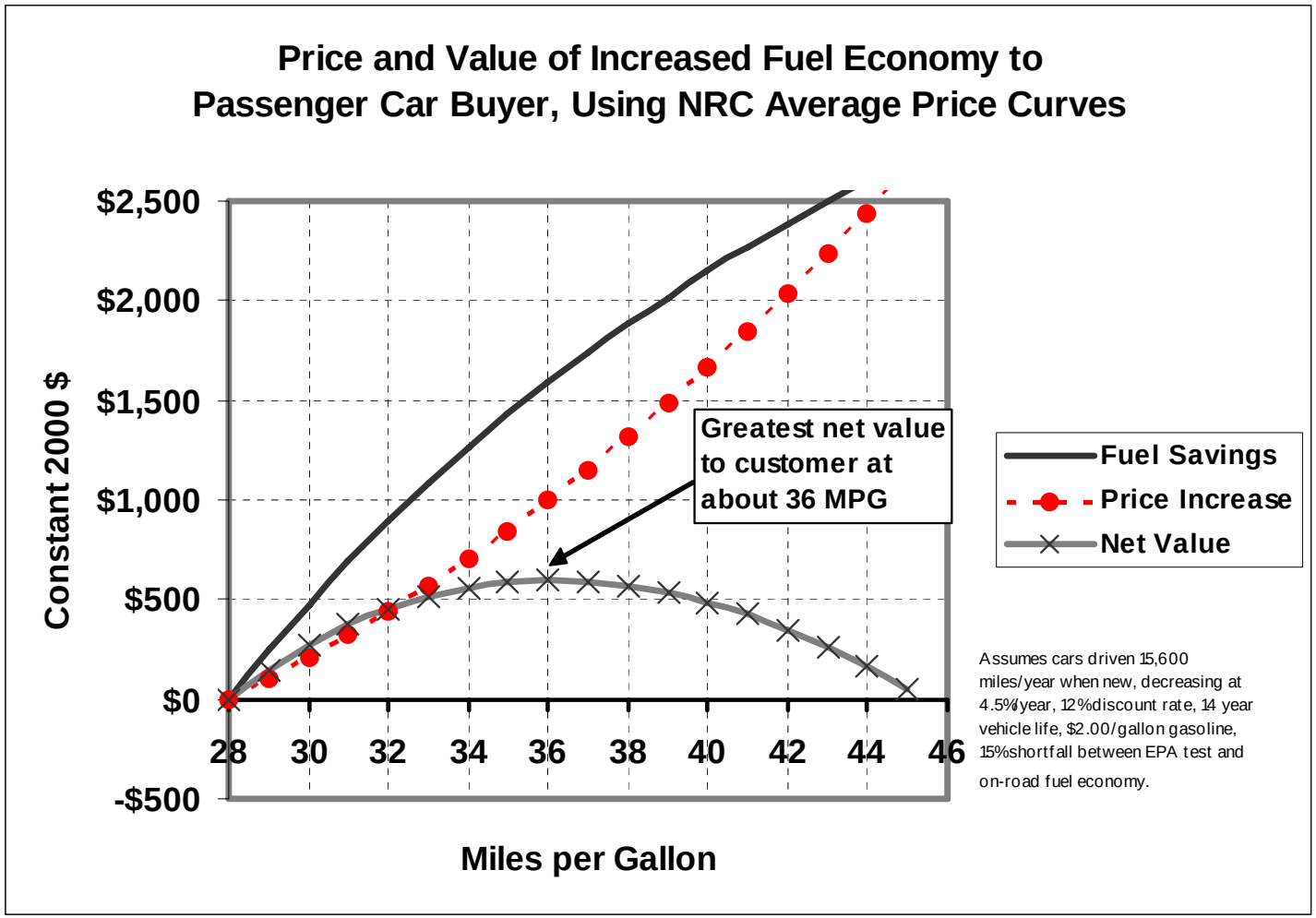
Fuel economy standards reduce petroleum dependence and GHG emissions and save money. (>60 Bgals. saved in 2008)



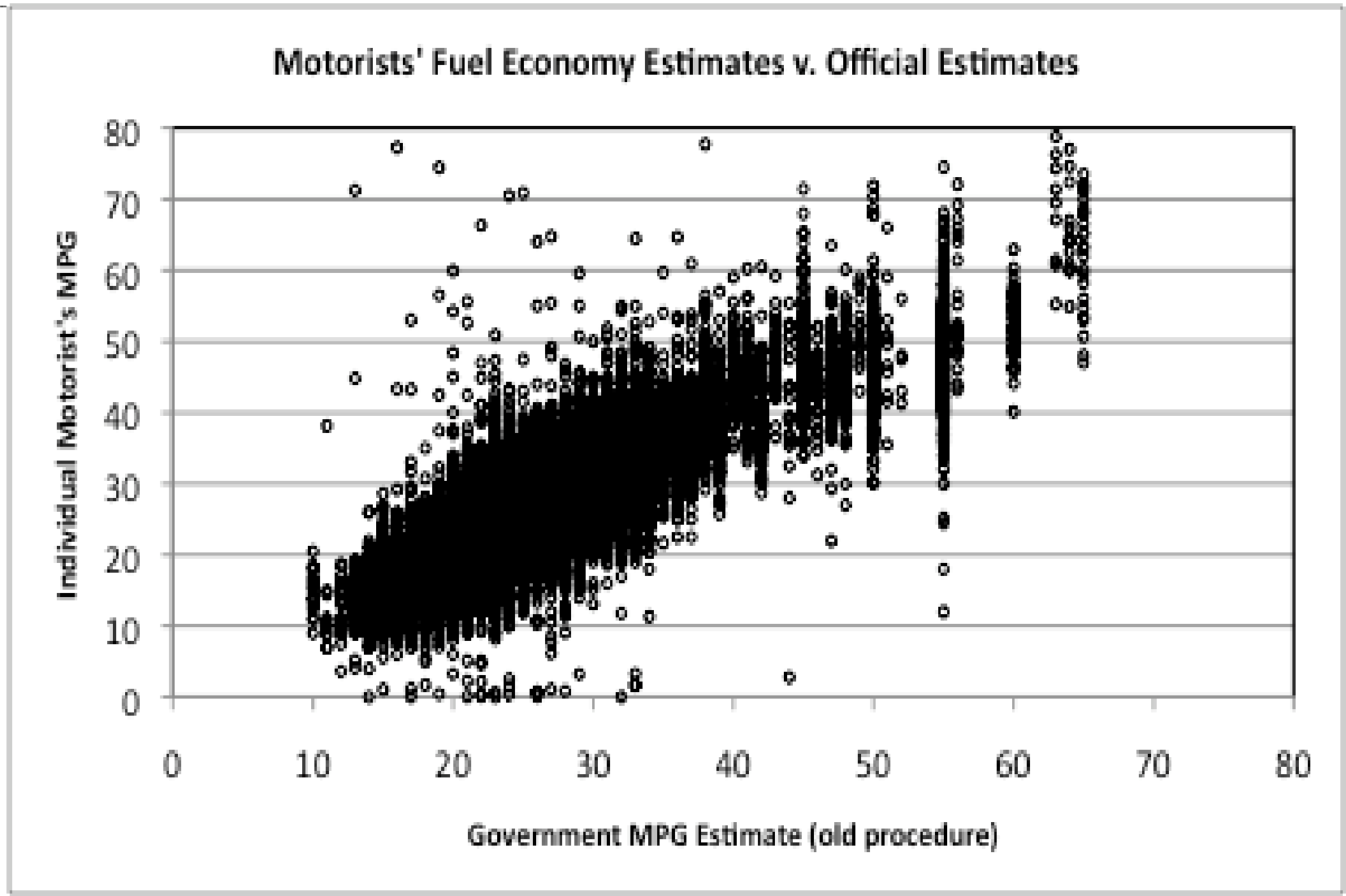
Why does every major auto manufacturing economy have fuel economy or GHG emissions standards?



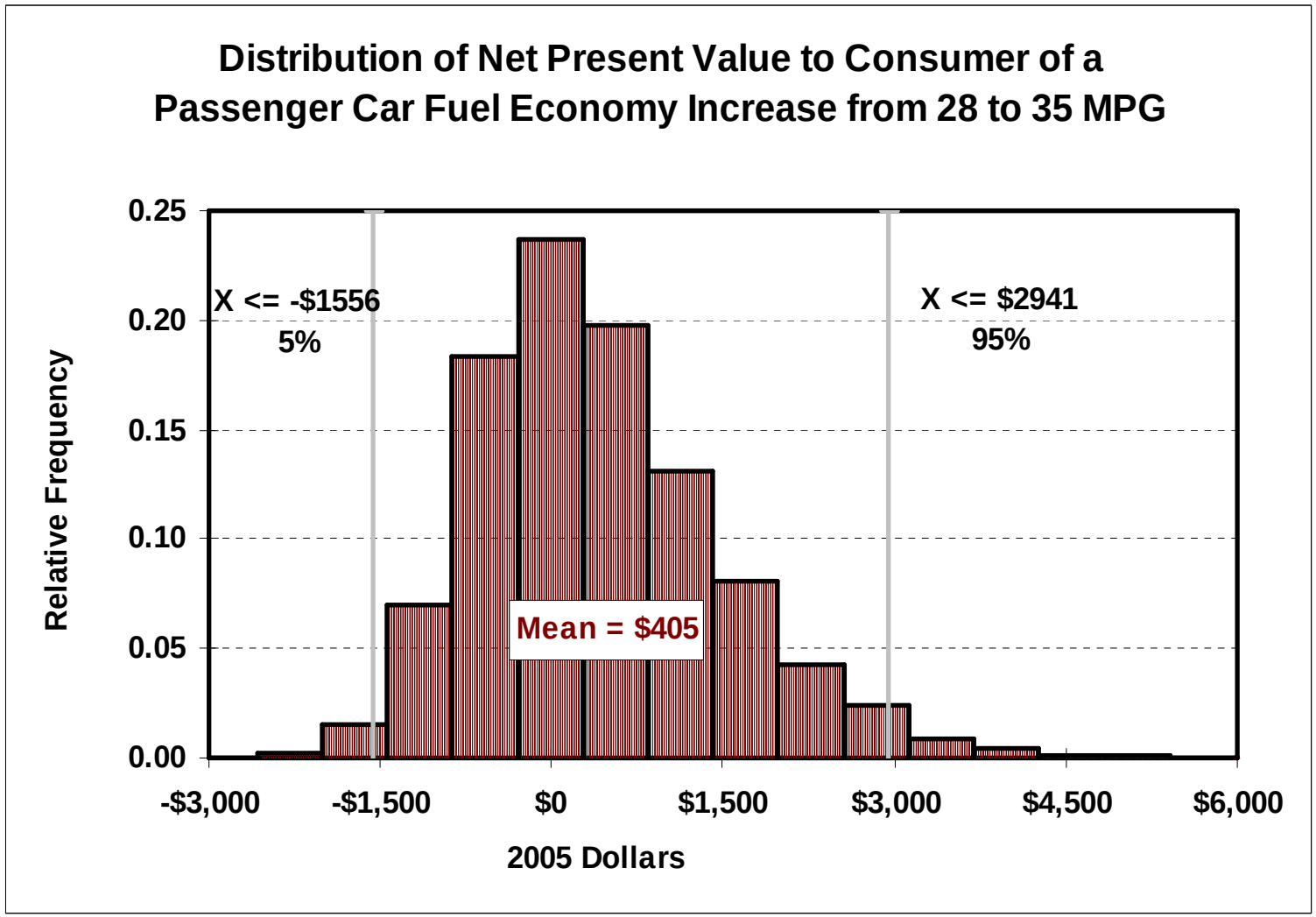
Energy Paradox: Engineering cost studies indicate unrealized, cost-effective energy efficiency potential. (US NRC, 2002)



Q: Why does the market undervalue energy efficiency?
A: Loss Aversion. (2002 Nobel Prize in Economics)

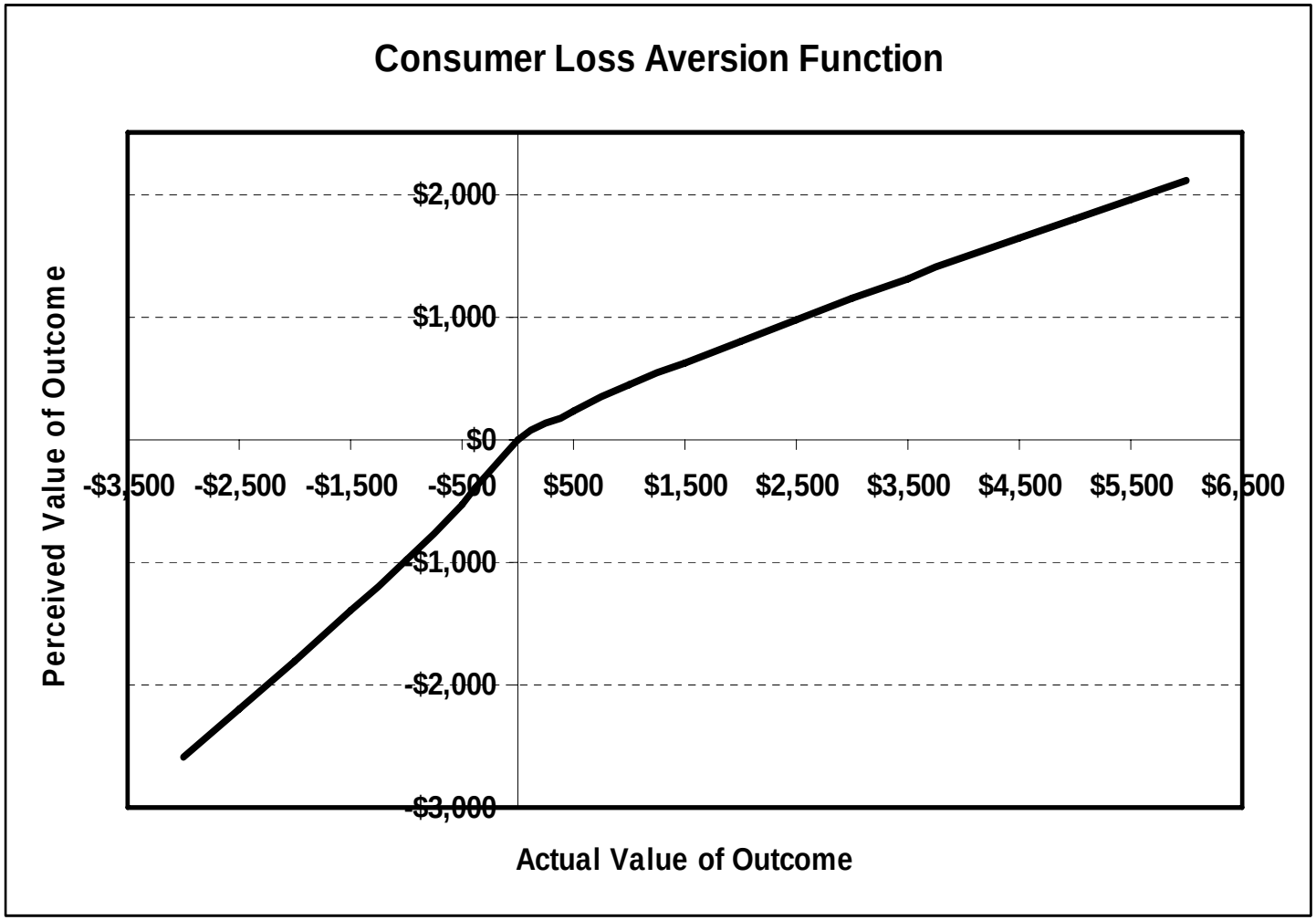


Quantifying uncertainties about fuel prices, realized fuel economy, vehicle use and vehicle life produces a *probability distribution* of Net Present Value.

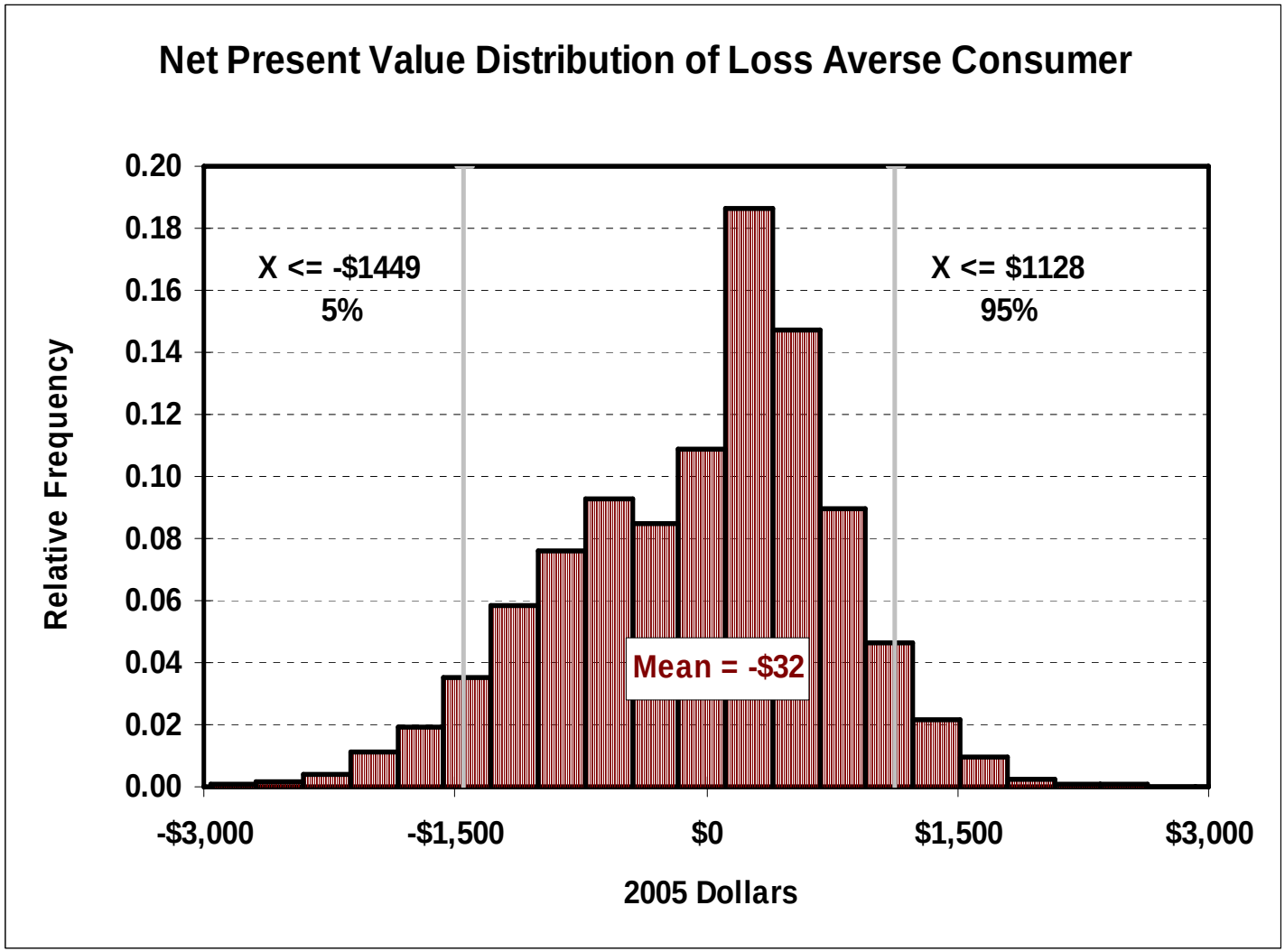


According to prospect theory, typical consumers' magnify potential losses relative to gains and exaggerate the probability of loss (Tversky & Kahnemann, 1992).

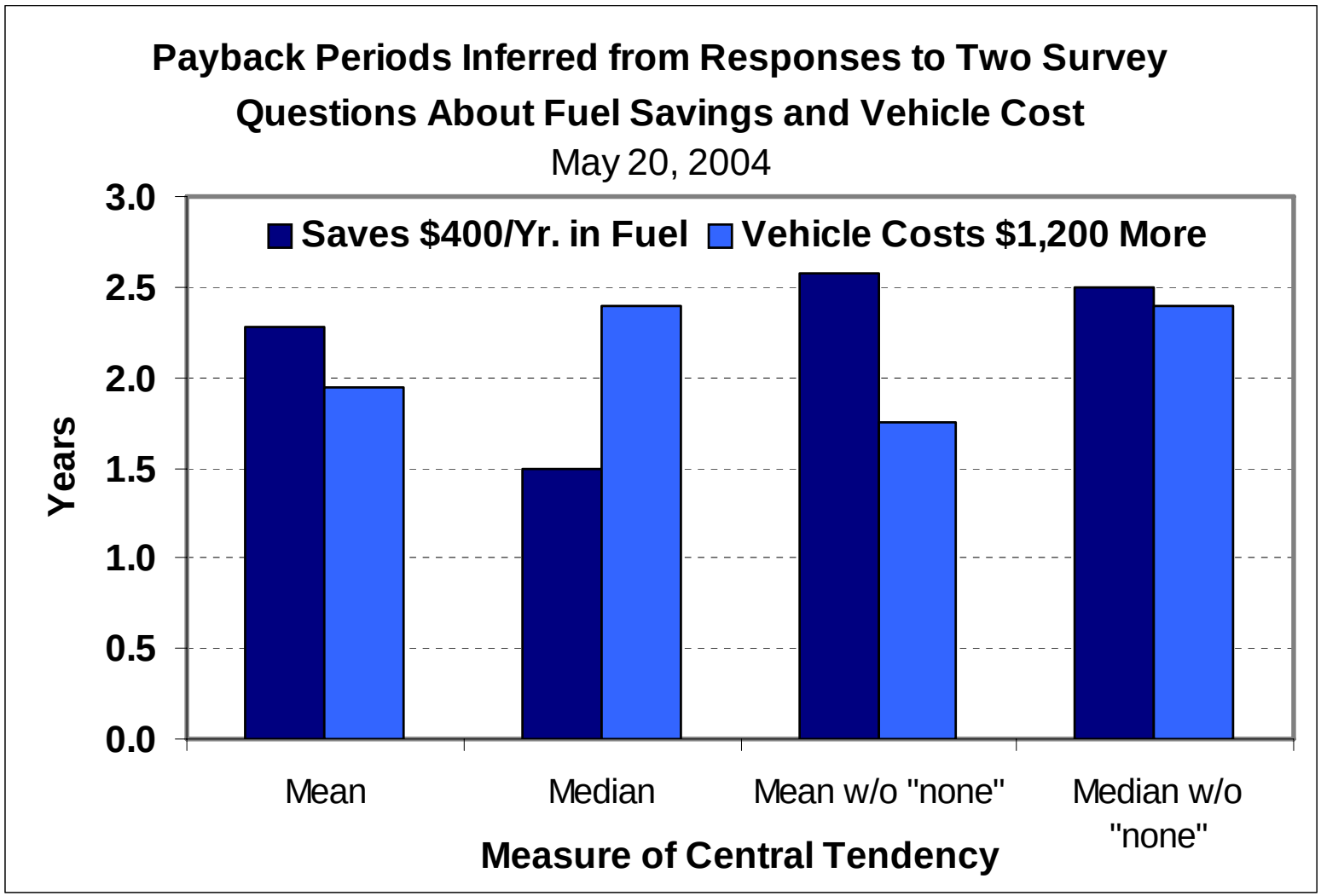
"A bird in the hand is worth two in the bush."



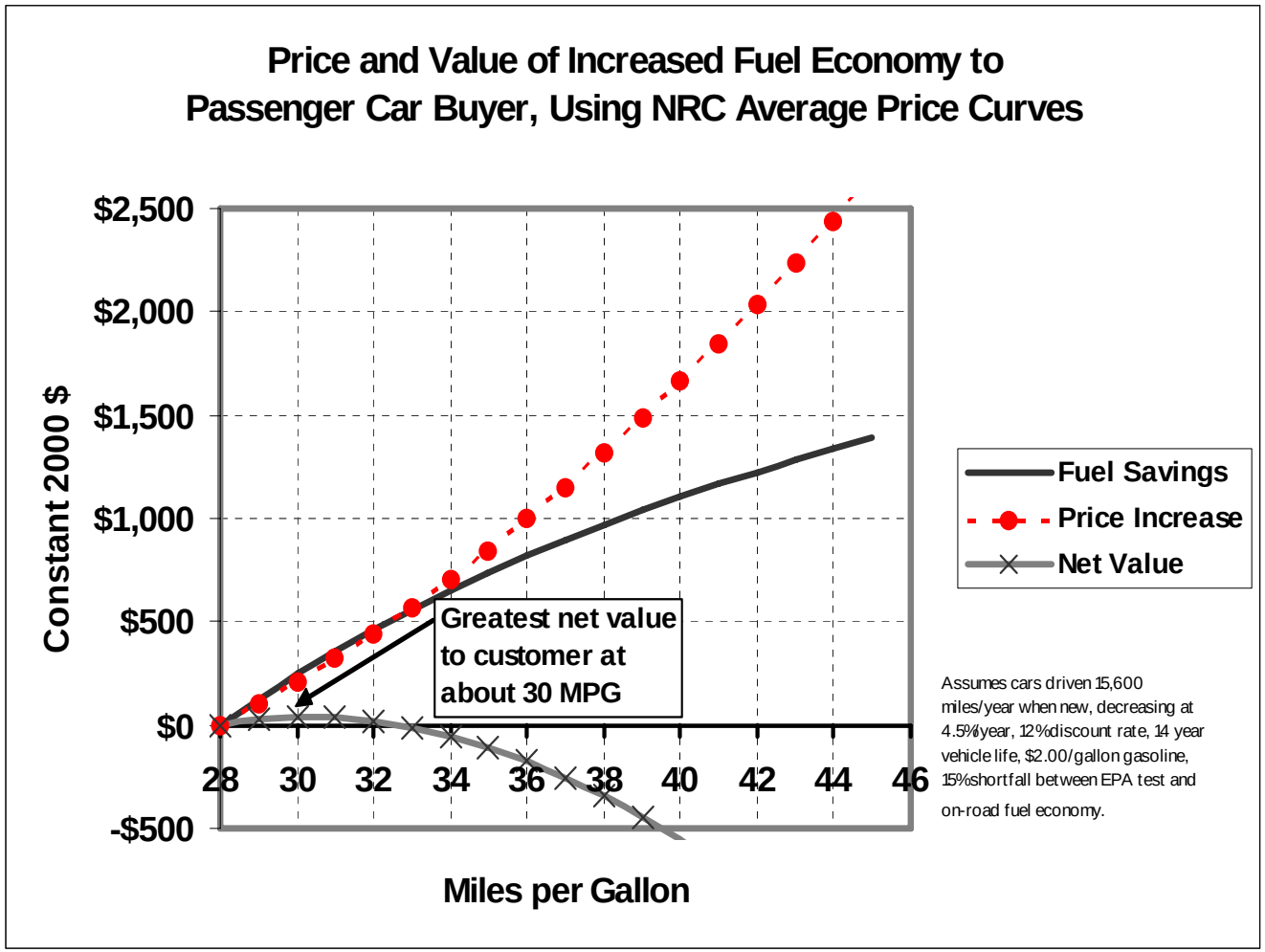
Weighting the probability distribution of NPV with the loss aversion function causes the expected benefit to evaporate. There's no "there", there.



Asked about fuel economy payback, consumers responded with short payback periods, just as carmakers expected. But few actually do any financial calculations about fuel economy as Turrentine & Kurani (*Energy Policy 2007*) demonstrated.

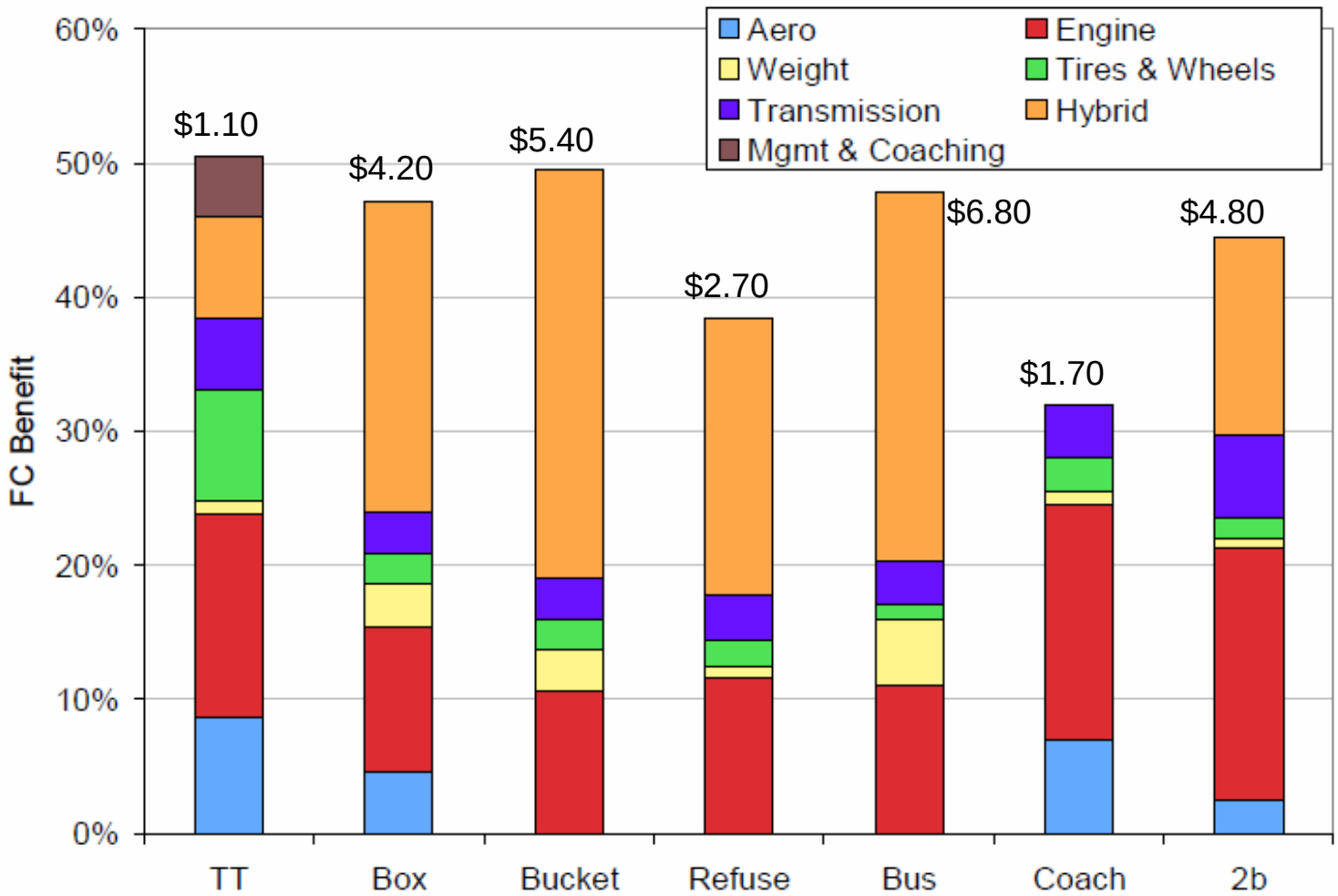


Uncertainty/loss aversion bias is also consistent with manufacturers' belief that consumers will pay for only 2-4 years of future fuel savings.

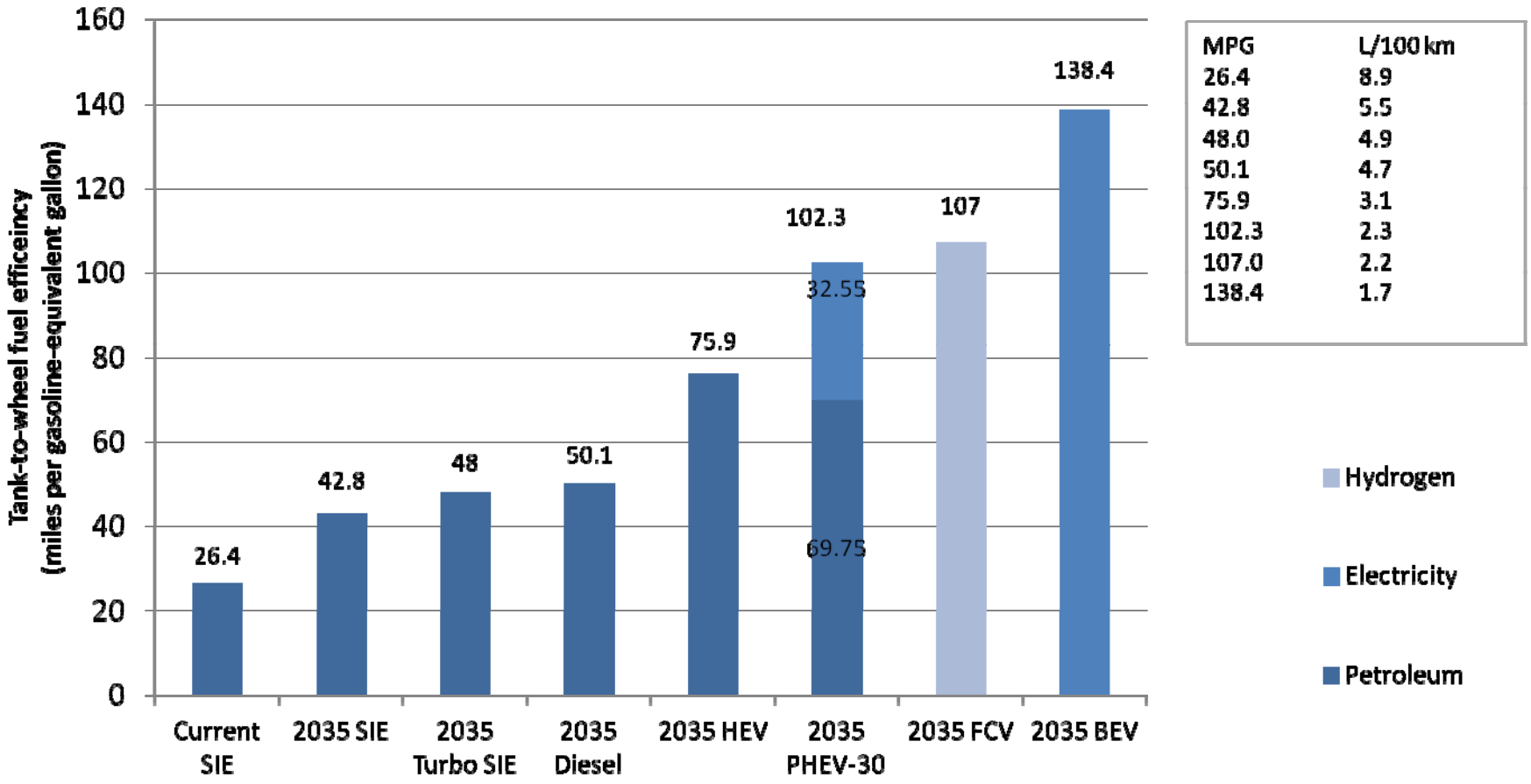


Are heavy truck buyers different?
Are their brains different?

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.

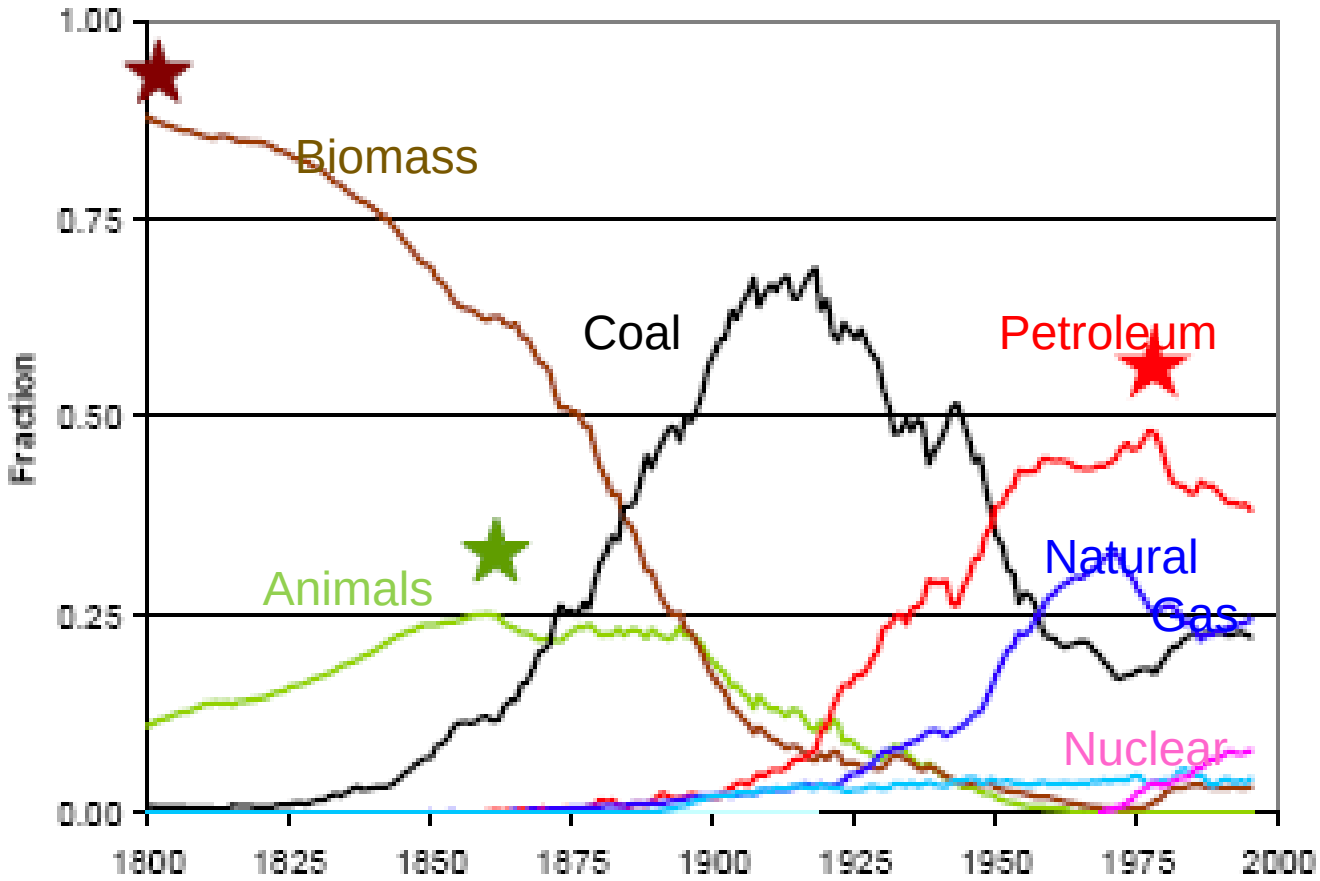


#2. Revenue neutral purchase incentives will likely be needed to realize the potential improvements of advanced technology vehicles.



Bandivadekar et al., 2008. *On the Road in 2035,* MIT Laboratory for Energy and the Environment.

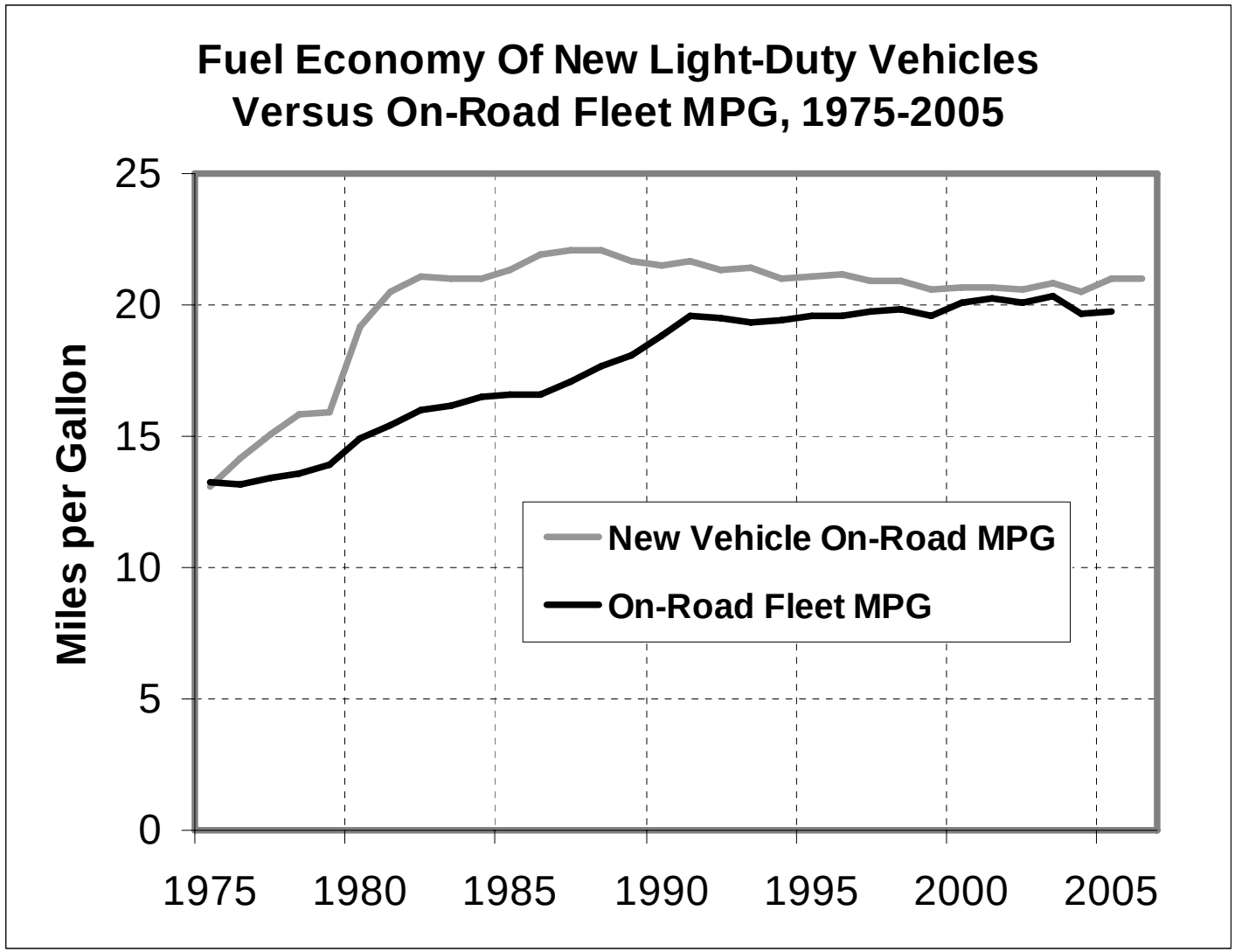
The energy transformations of the past have been driven by technology and market forces.
Can a future transition be driven by societal goals?



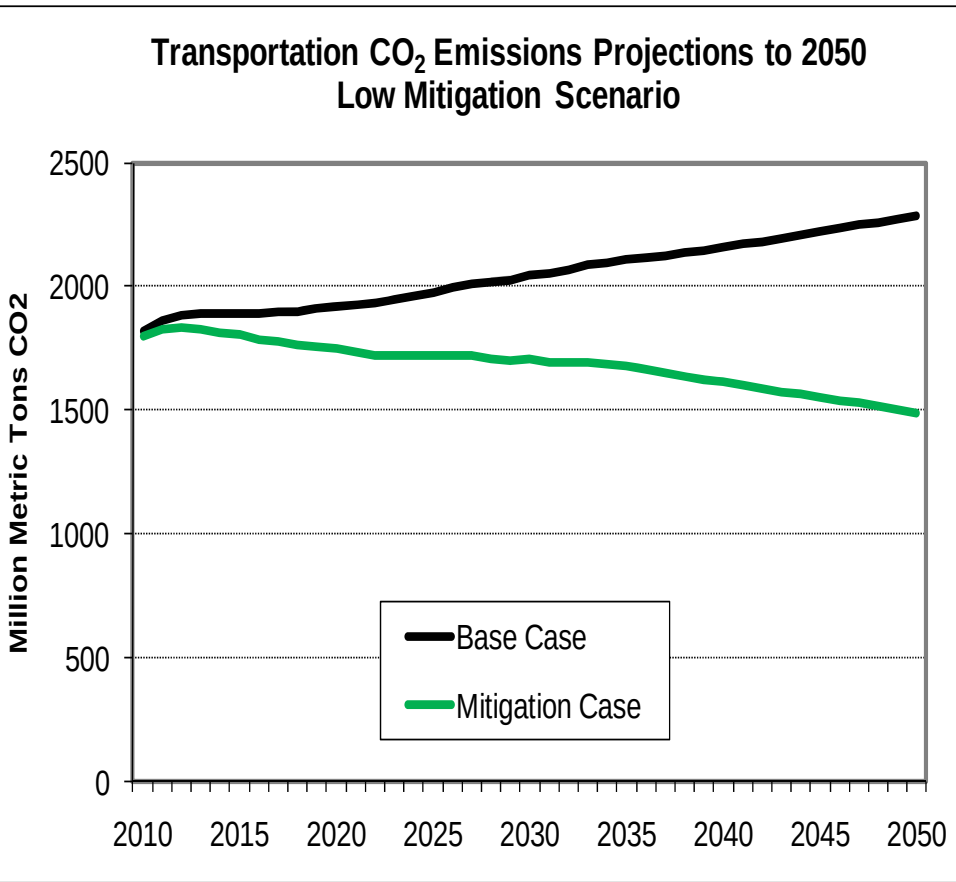
Source: A. Grubler, 2007, International Institute for Applied Systems Analysis.

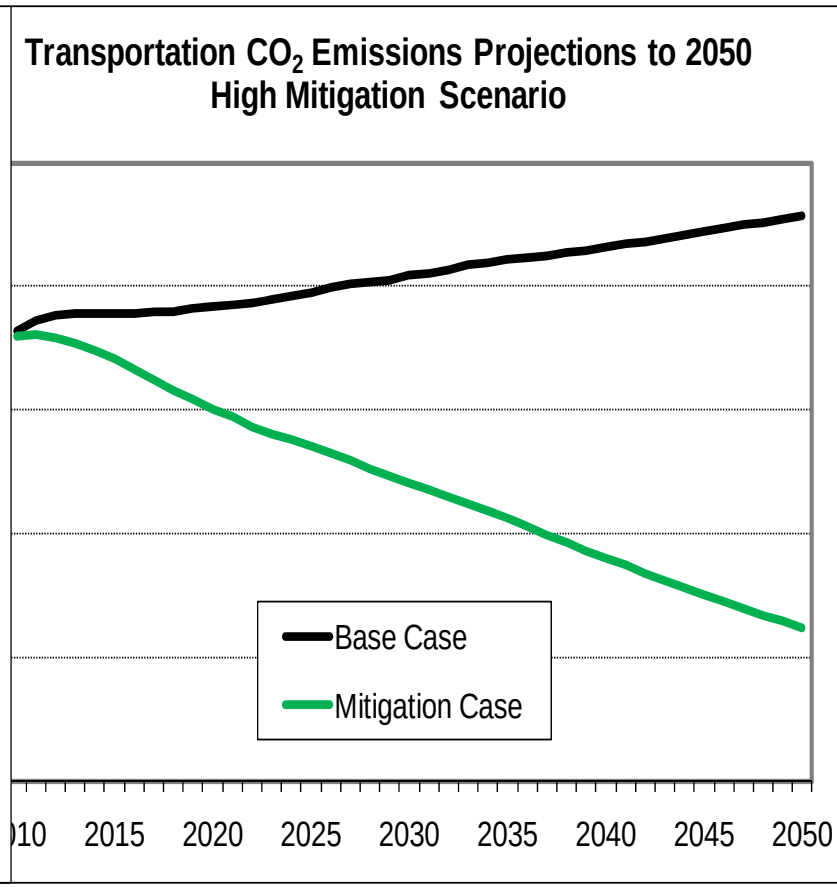
THANKYOU.

Despite early concerns, EPA test fuel economy improvements translated into real world gains.

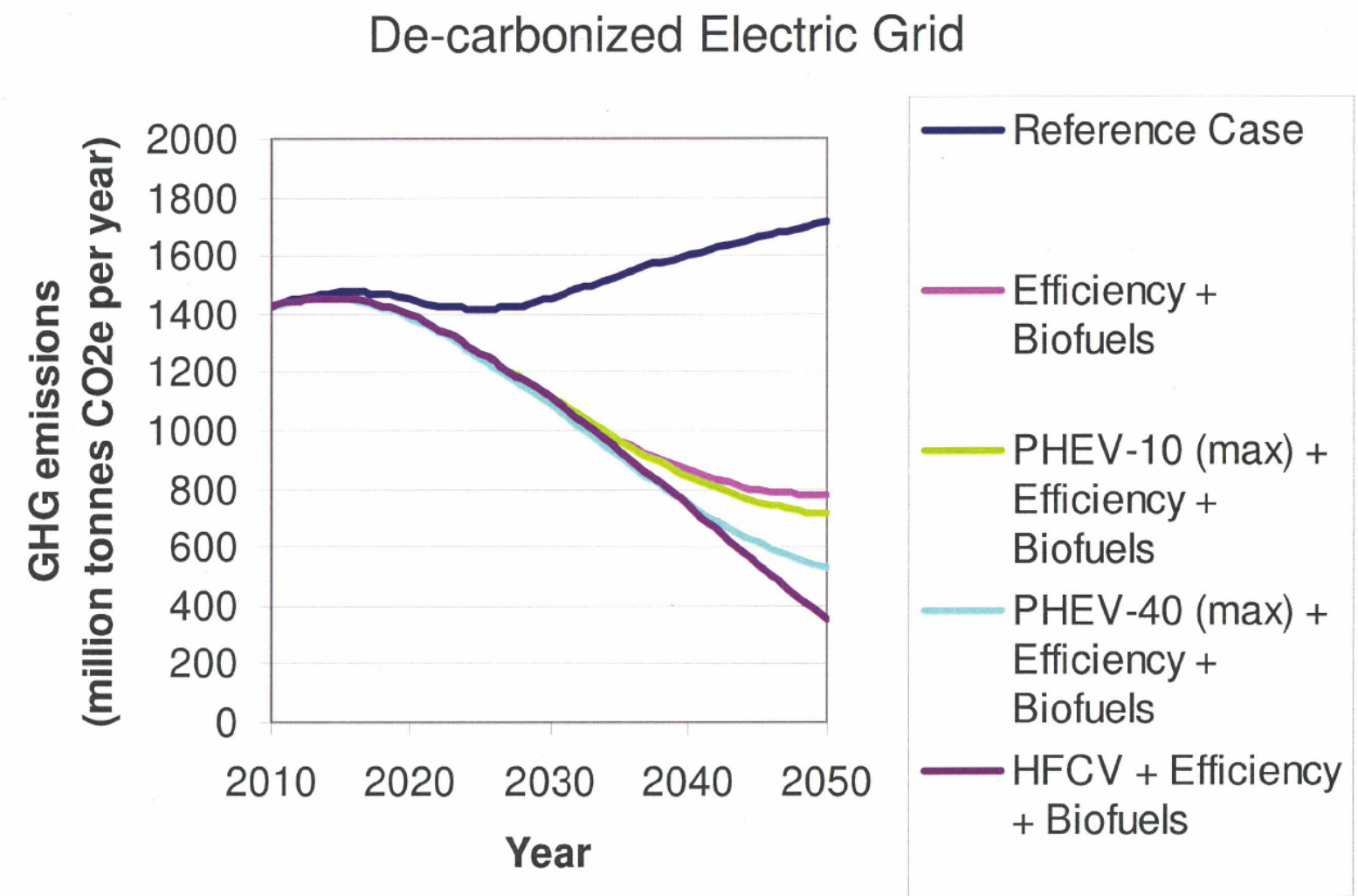


Versus 2010 levels, US transportation GHG emissions could be reduced by anywhere from 15% to 65% by 2050, depending on the stringency of policies and progress of technology. (Pew Ctr. 2010, *Reducing GHG Emissions from US Transportation*, forthcoming.)





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. Such a transition will take decades (2 or 3) and poses an unprecedented challenge for public policy.



Source: NRC, 2008. *Transitions to Alternative Energy Technologies: A Focus on Hydrogen.*

Even with fuel economy or emissions standards, the energy tax should reduce GHG emissions three times as much as a VMT tax.