

IMPROVING FUEL ECONOMY:

A WIN FOR CONSUMERS

A WIN FOR CARMAKERS

A WIN FOR THE ENVIRONMENT

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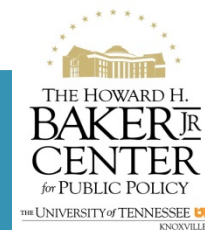
The University of Tennessee

2017 Tennessee Sustainable Transportation Awards & Forum

Navigating Toward a Livable Tennessee

May 23, 2017

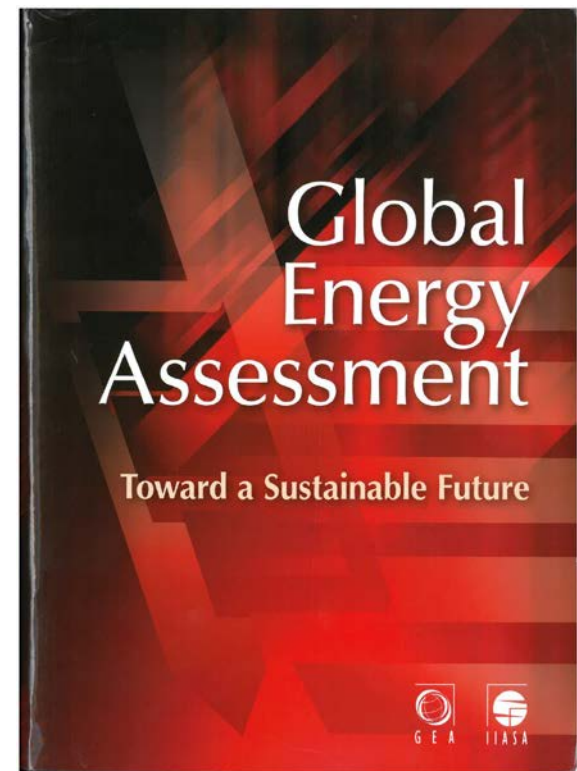
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NOTHING MOVES WITHOUT ENERGY.

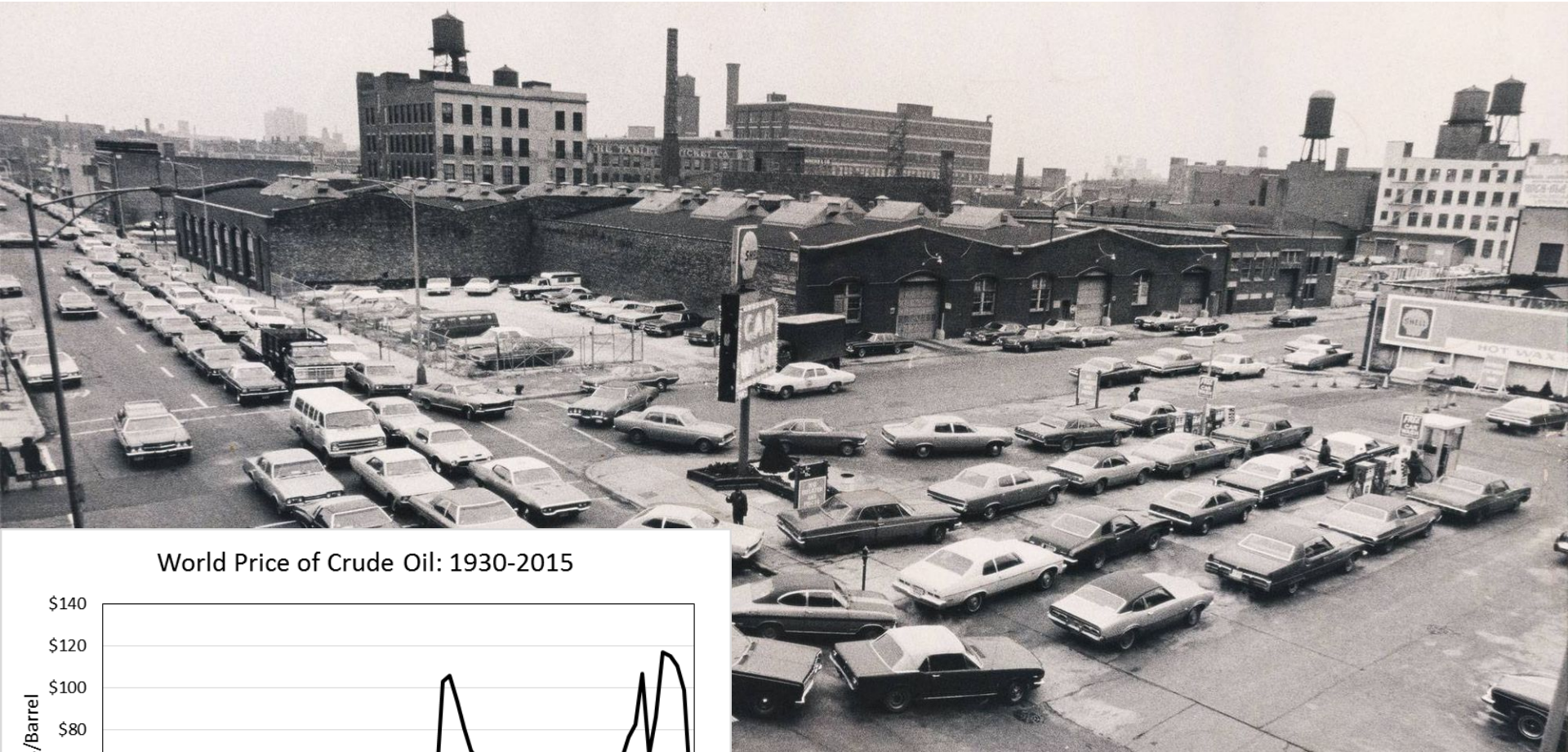
“The single most important area of action is energy efficiency improvement in all sectors.”

p. xvii (GEA, 2012: *Global Energy Assessment – Toward a Sustainable Future*, Cambridge U. Press, UK)

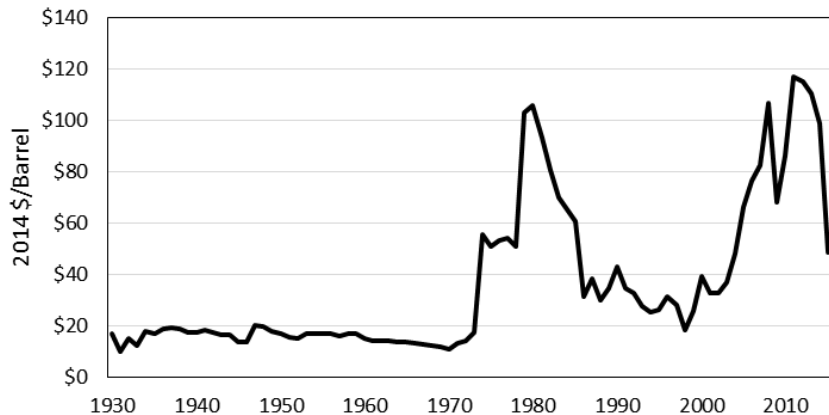


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The energy crisis of 1973-74 focused our attention on fuel economy.



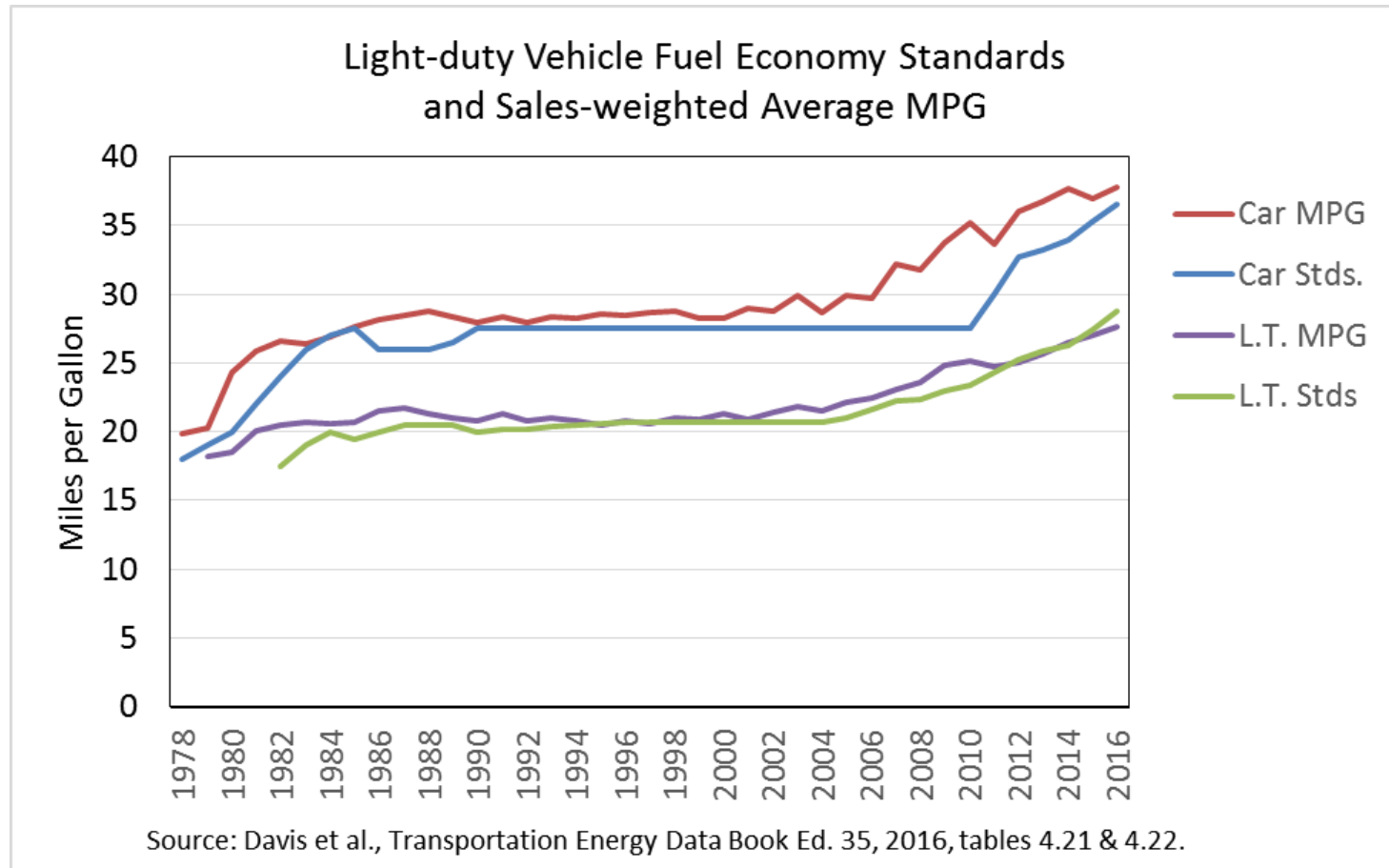
World Price of Crude Oil: 1930-2015



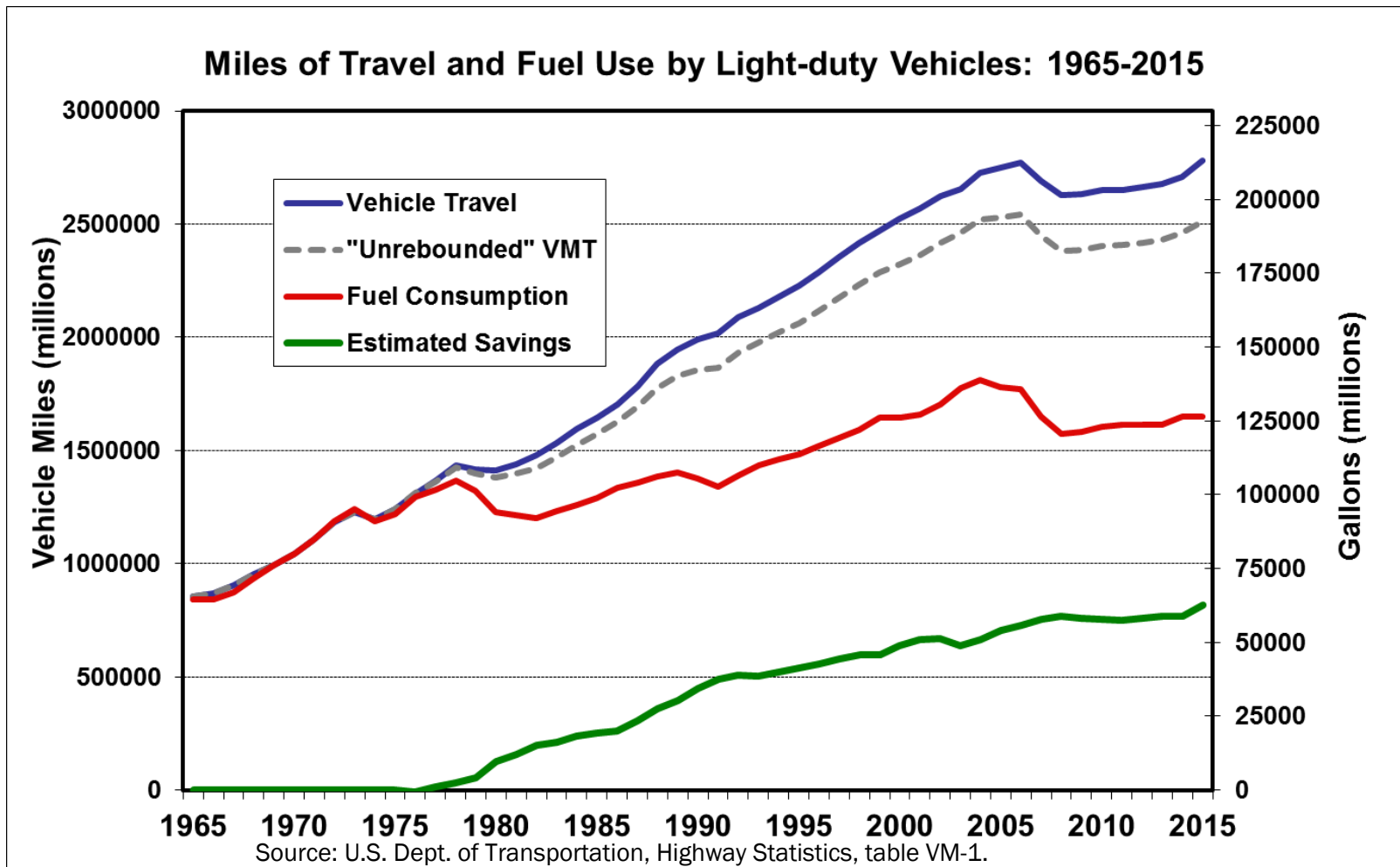
Sources: 1930-2014, BP Statistical Abstract 2016, EIA Monthly Energy Review for 2015 price.

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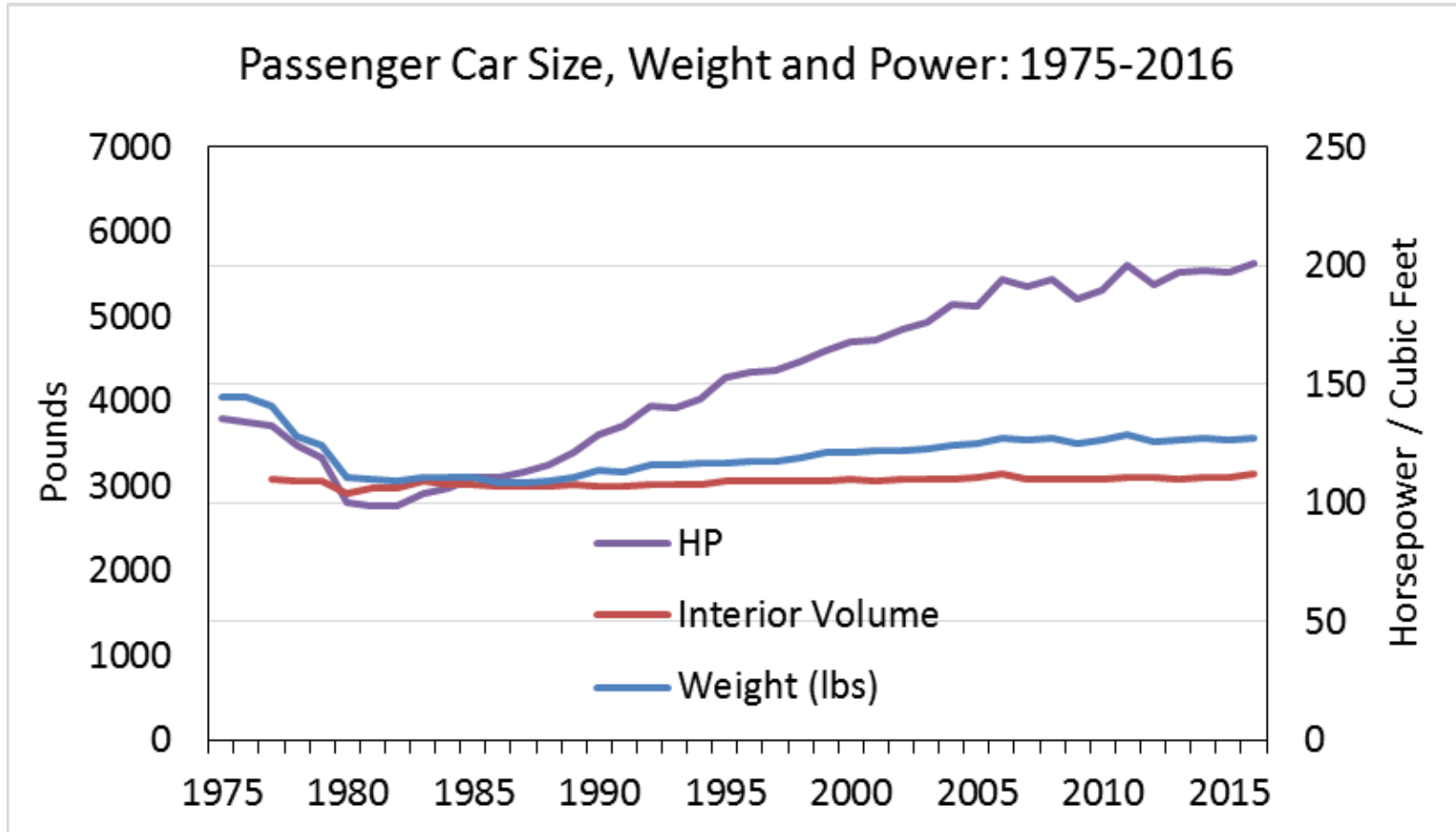
CAFE standards were not the only cause of increased MPG but probably the most important one from 1978 on.



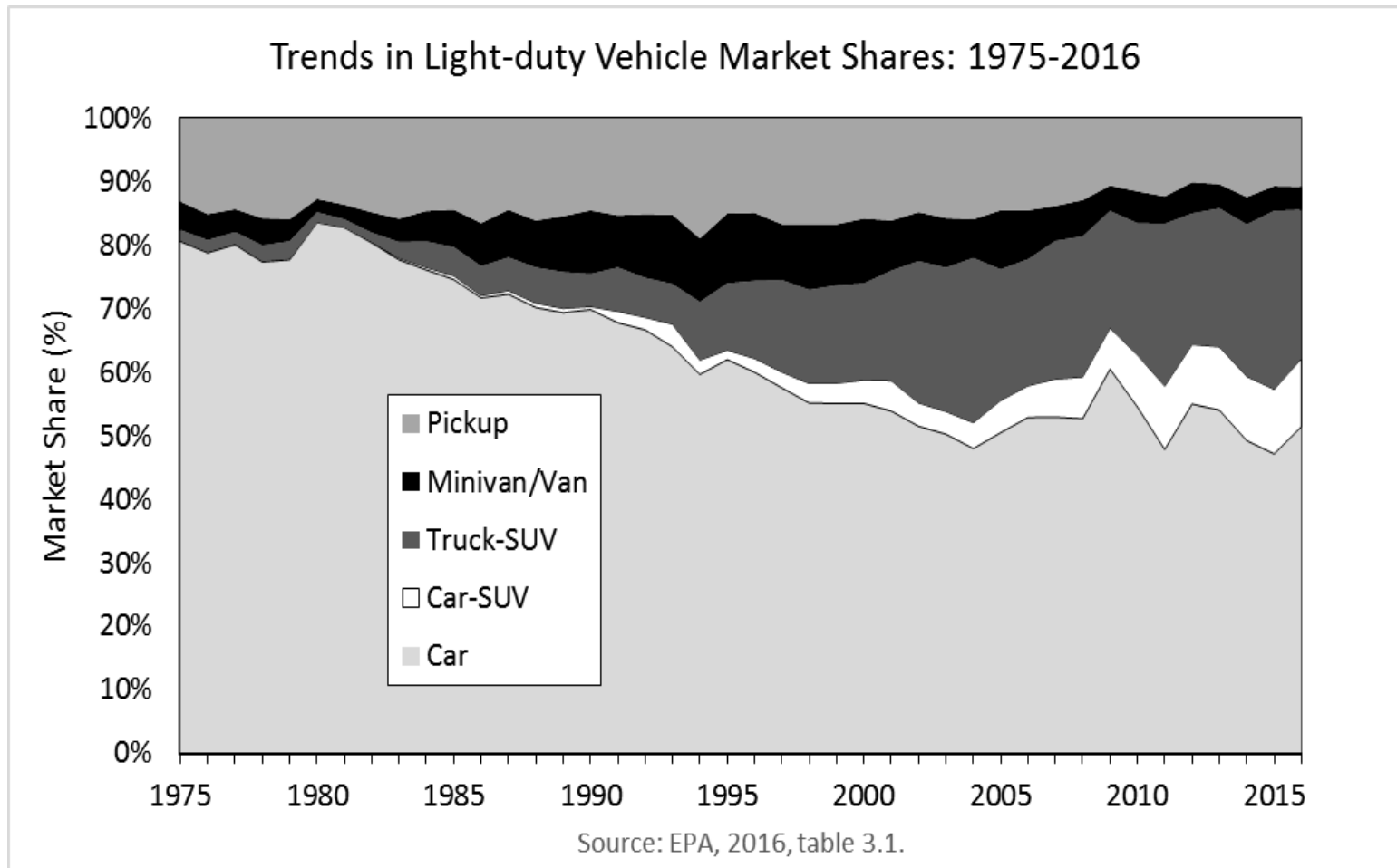
Fuel economy improvements since 1975 disconnected vehicle travel from fuel use. Saved 1.5 trillion gallons & over \$4 trillion.



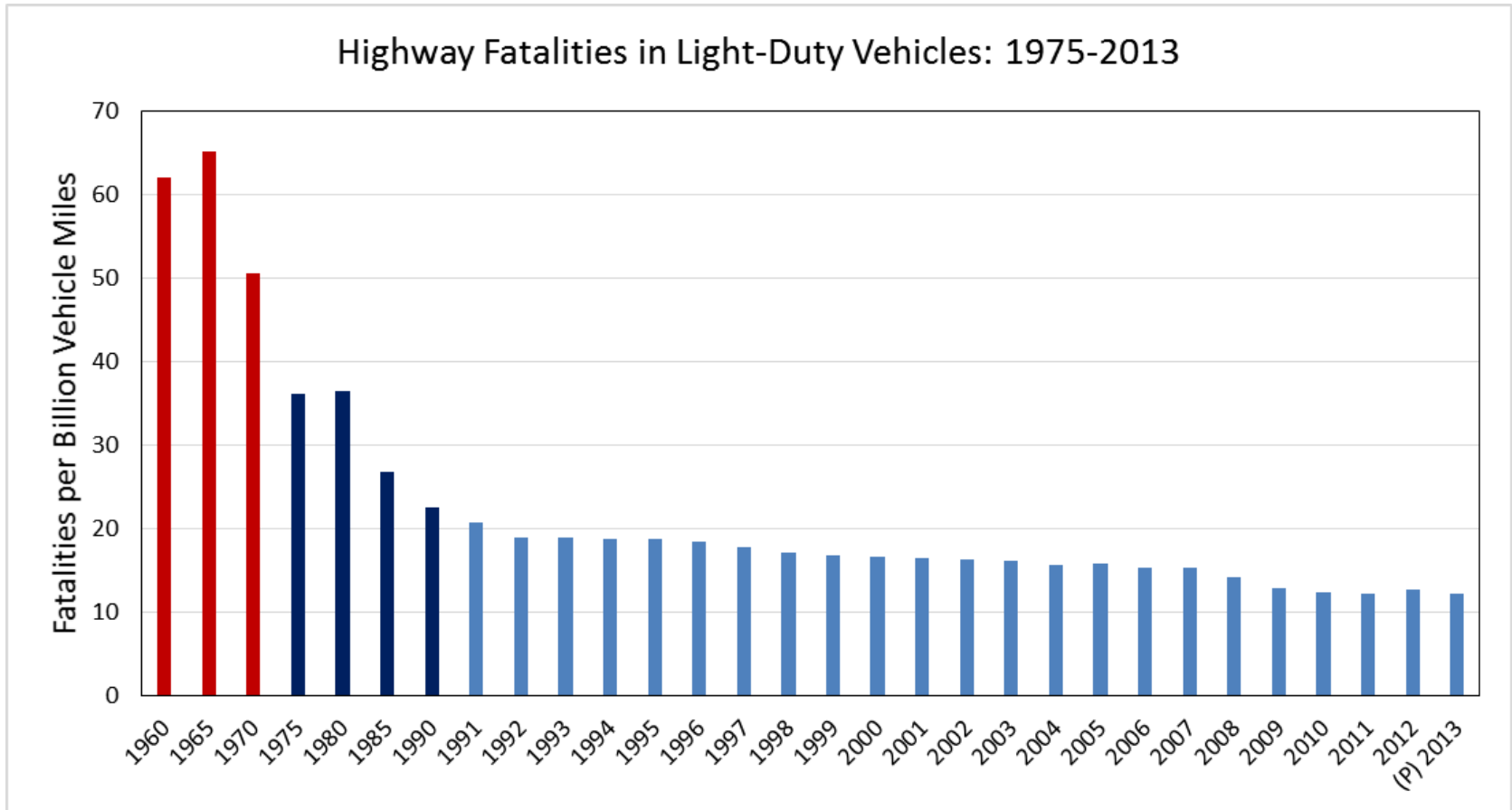
Have cars gotten smaller? Lighter? Less Powerful?



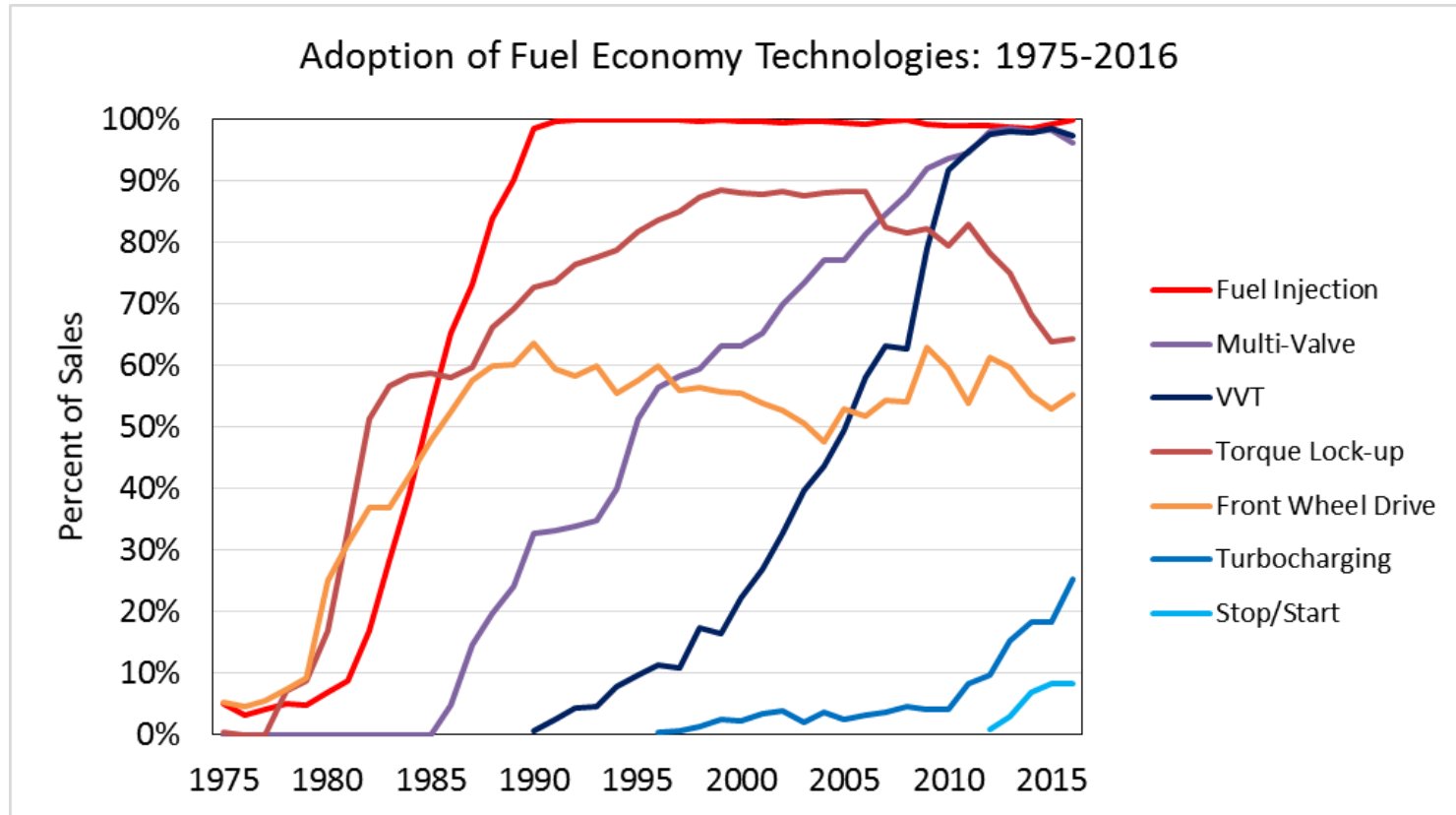
Household vehicles did not get smaller. They got larger as we substituted minivans and SUVs for cars.



The National Research Council now maintains that the best research indicates that reducing weight while maintaining vehicle size improves safety.

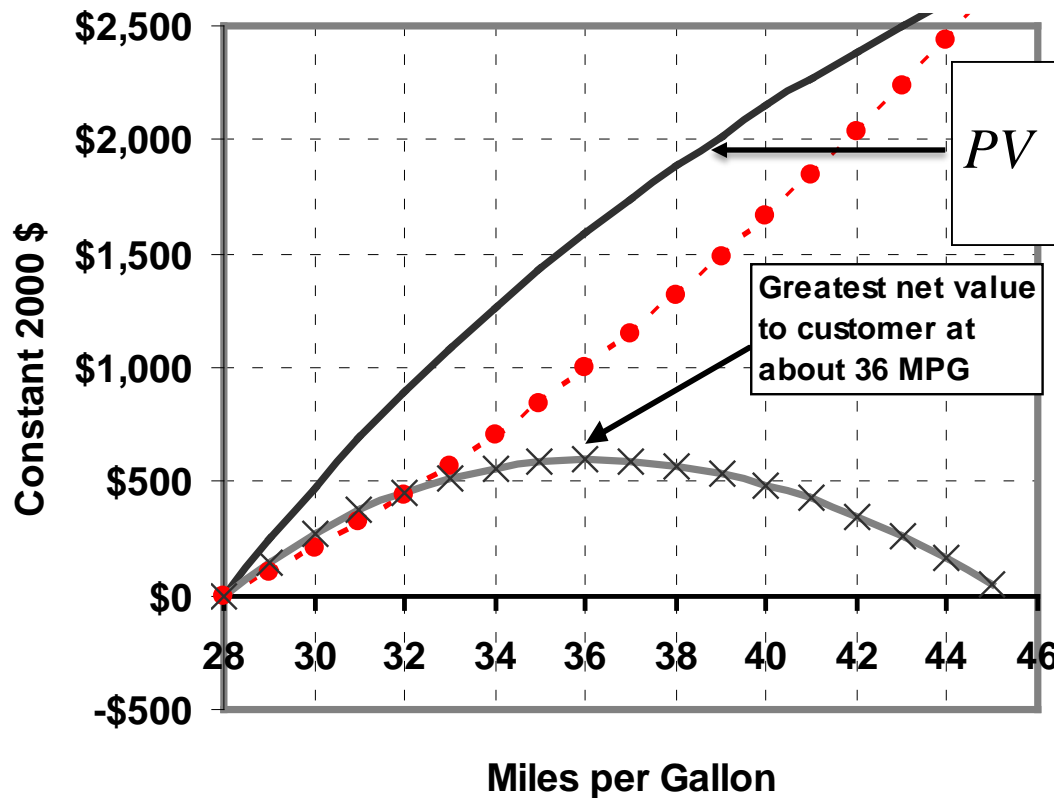


Technology, technology, technology. While engine size decreased 40%, horsepower increased 70%.



Improving fuel economy with technology is a trade-off between (present) cost and (future) fuel savings. ENERGY PARADOX?

Price and Value of Increased Fuel Economy to Passenger Car Buyer, Using NRC Average Price Curves

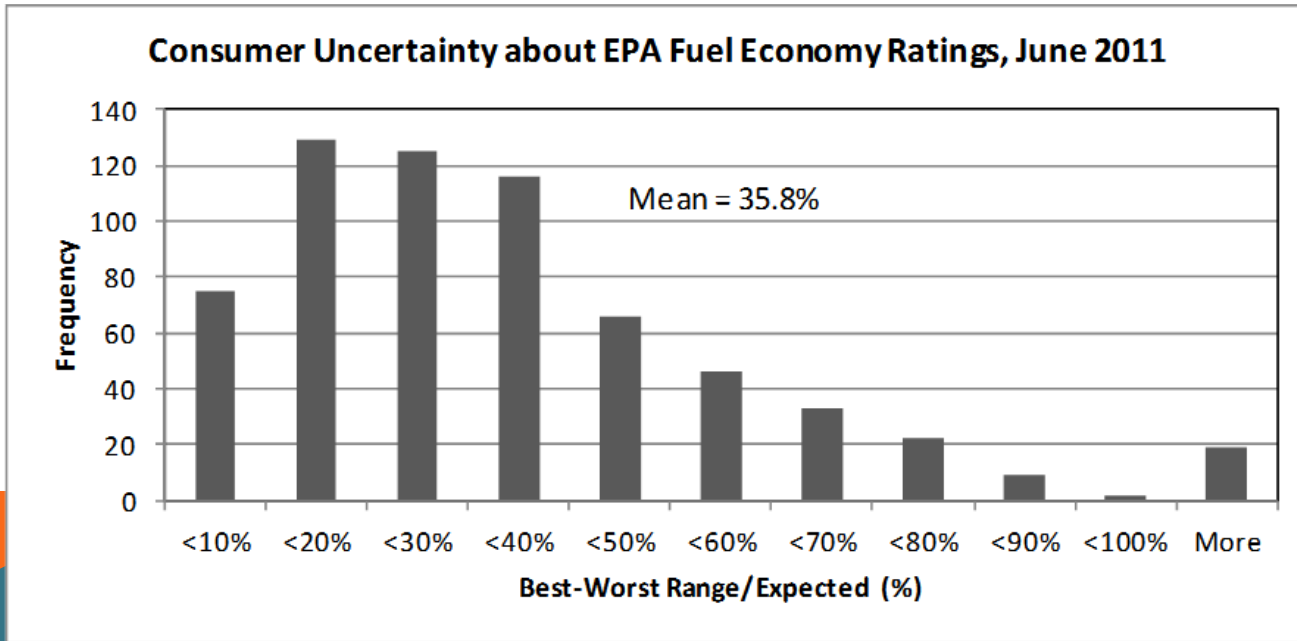
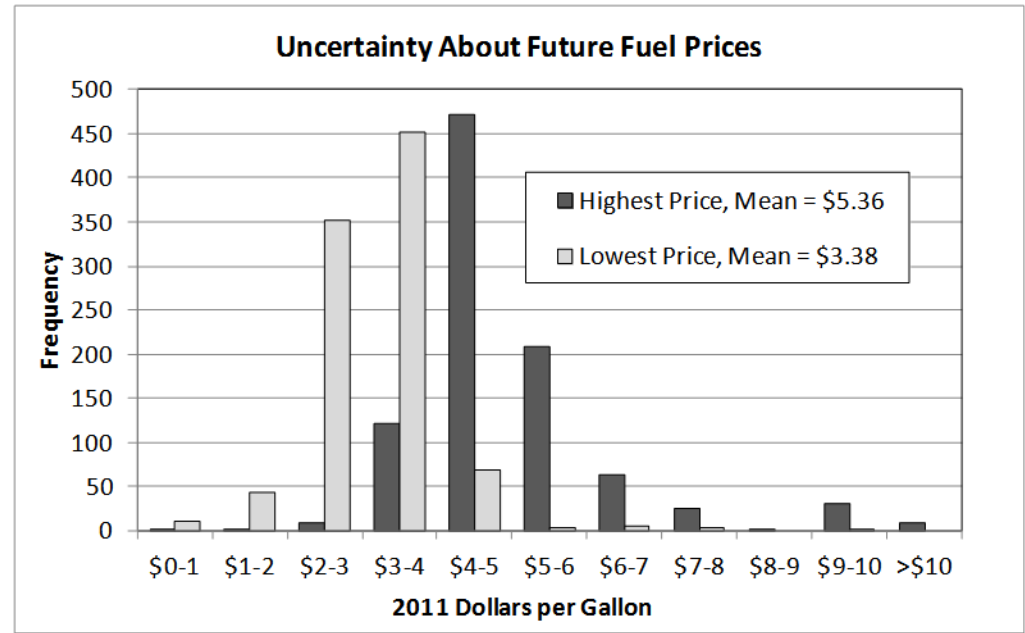


$$PV = \int_{t=0}^L P_t M_o e^{-\delta t} \left(\frac{1}{E_o} - \frac{1}{E_1} \right) e^{-rt} dt$$

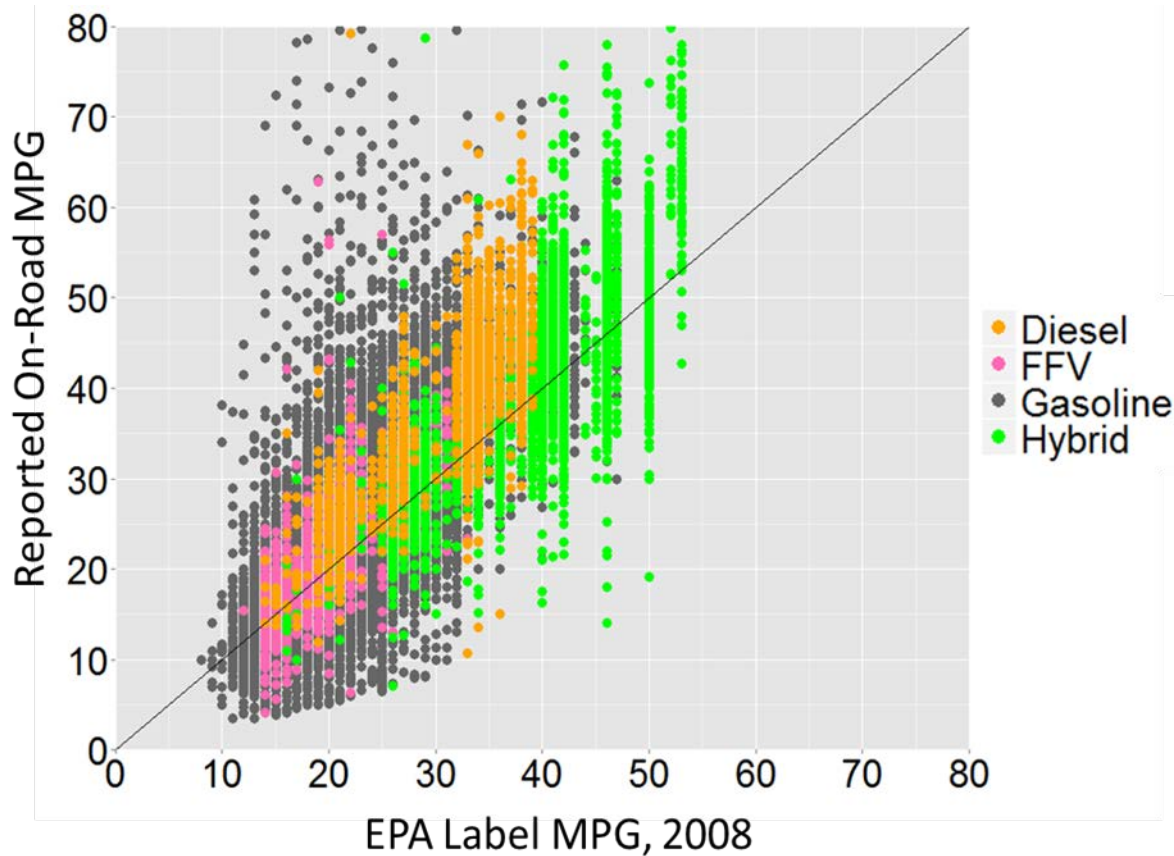
- Fuel Savings
- - - ● Price Increase
- × Net Value

Assumes cars driven 15,600 miles/year when new, decreasing at 4.5%/year, 12% discount rate, 14 year vehicle life, \$2.00/gallon gasoline, 15% shortfall between EPA test and on-road fuel economy.

In reality, consumers view paying more for technology that increases fuel economy as a *risky bet*.



Drivers' real world experiences vary greatly from the EPA label estimates.



Baker Reports 4:15

THE HOWARD H. BAKER JR. CENTER FOR PUBLIC POLICY

How Do Motorists' Own Fuel Economy Estimates Compare with Official Government Ratings? A Statistical Analysis

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The 2004 Nobel Prize in Economics went to Daniel Kahneman for his research in behavioral economics.

Consumers are “*loss averse*”

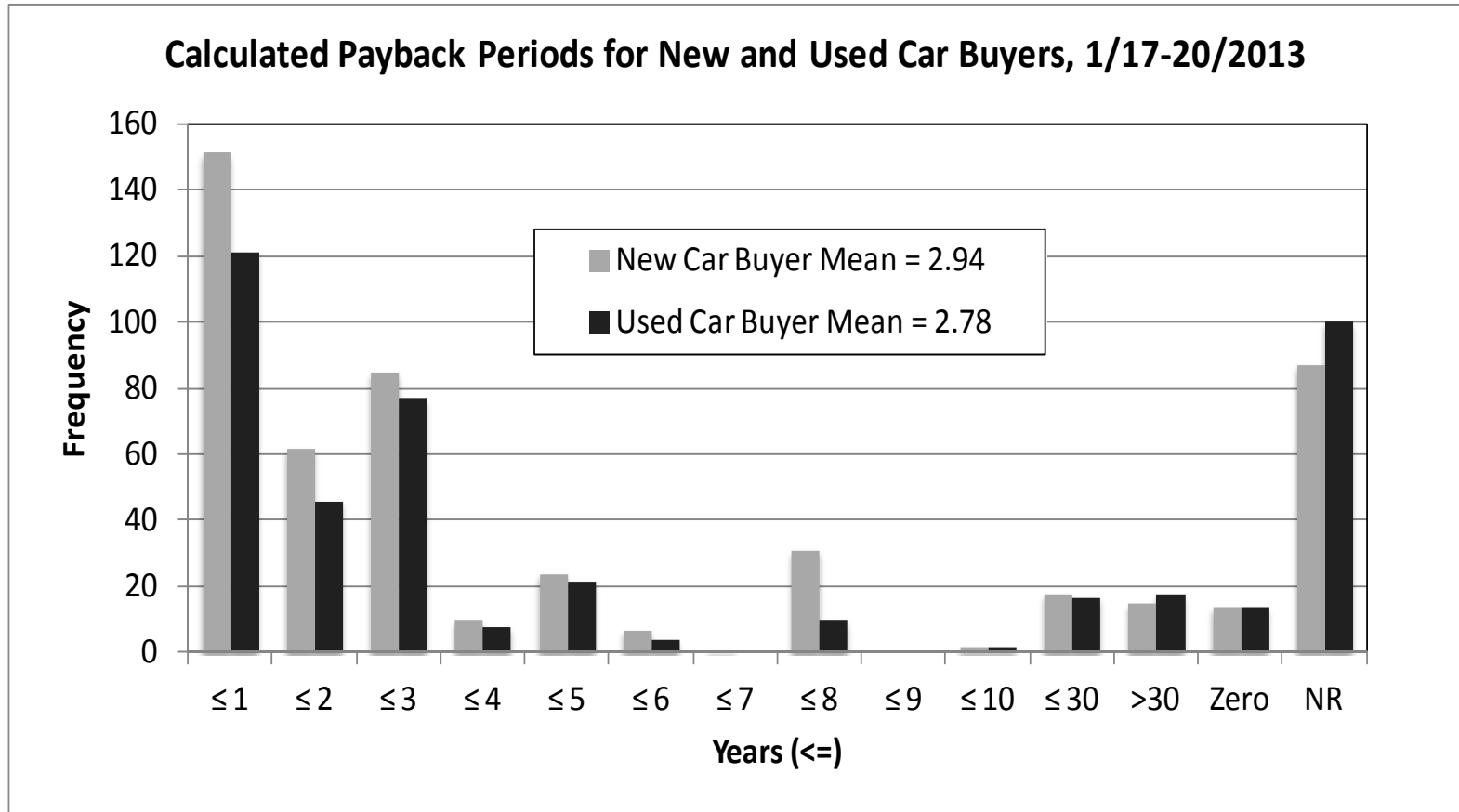
“In economics and decision theory, loss aversion refers to people's tendency to strongly prefer avoiding losses to acquiring gains. Most studies suggest that losses are twice as powerful, psychologically, as gains. Loss aversion was first demonstrated by Amos Tversky and Daniel Kahneman.”

Most attributes of a vehicle can be directly perceived.

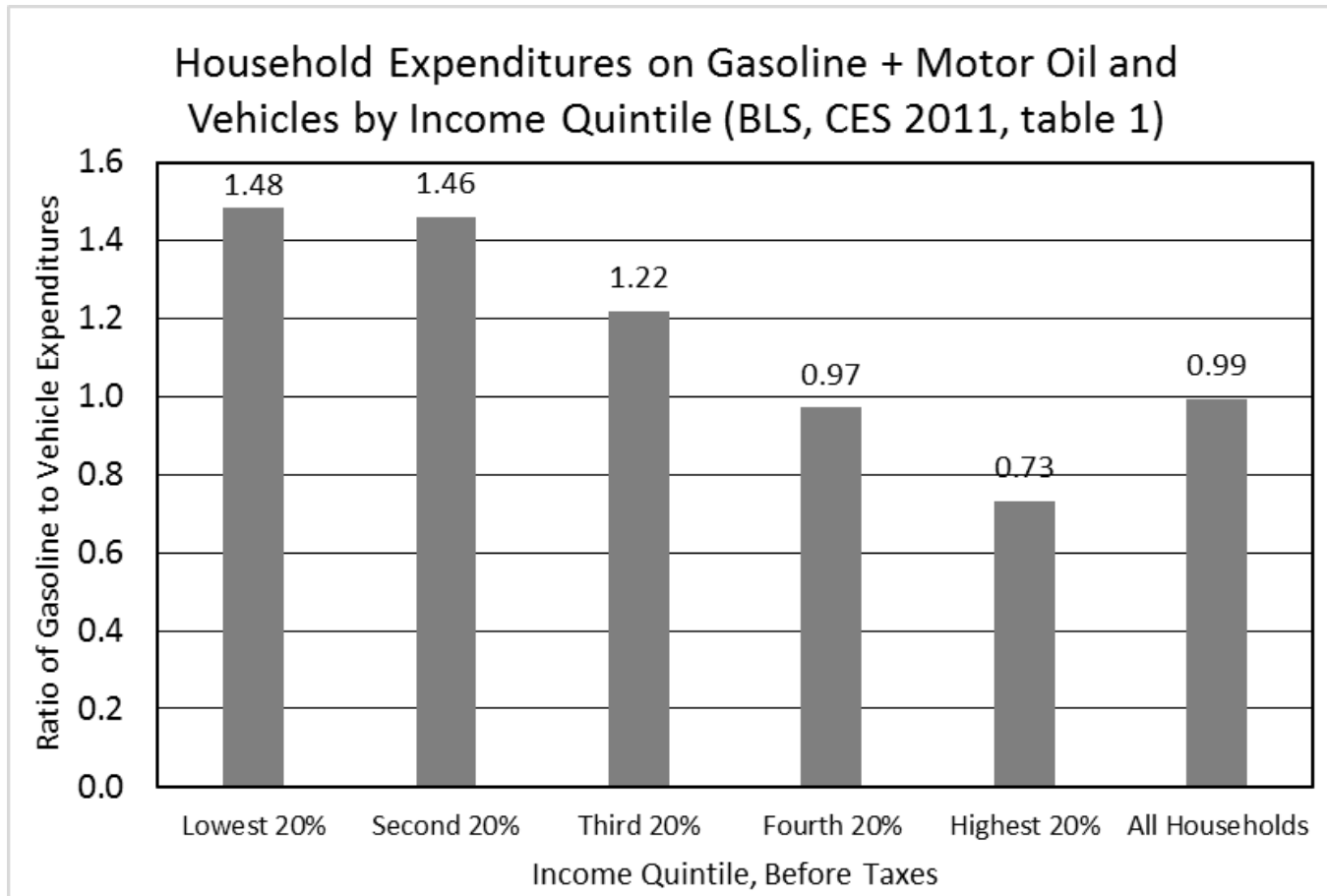
Fuel economy achieved by technology is largely invisible.

2016 Toyota Camry	2016 Toyota Camry Hybrid LE
 Gasoline Vehicle	 Hybrid Vehicle Gasoline
	
3.5 L, 6 cyl, Automatic (S6)	2.5 L, 4 cyl, Automatic (variable gear ratios)
MSRP: \$23,070 - \$31,370	MSRP: \$26,790
Regular Gasoline	Regular Gasoline
25 MPG combined city highway 4.0 gal/100mi	41 MPG combined city highway 2.4 gal/100mi

As car manufacturers told the NRC and behavioral economics predicts, consumers require a quick return to be willing to pay more for fuel economy.



The NRC's 2015 report on the CAFE standards included a graph showing that lower income households spent more annually on fuel than on vehicles.



The effects of fuel economy improvements on the distribution of income had not been measured.

Consumer expenditures on fuel from the 1980-2014 Consumer Expenditures Surveys, the official government survey used to calculate the Consumer Price Index, among other things.

Costs of fuel economy improvements were based on four National Research Council Studies for 1990-2014 and a peer-reviewed literature review for previous years.

The hypothesis:

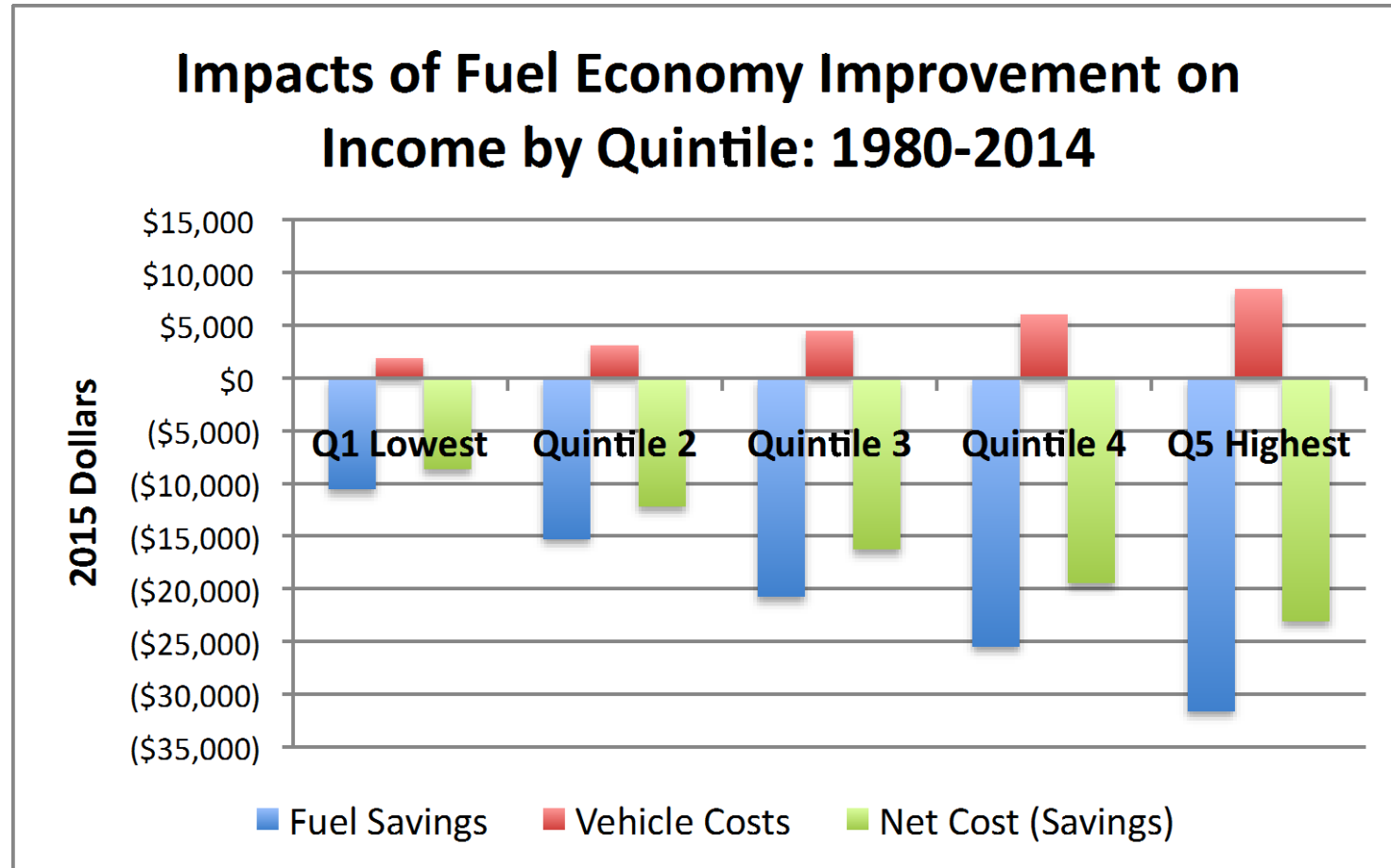
Vehicle fuel economy changes very little as vehicles age.

Vehicle prices depreciate by 10% per year, or more.

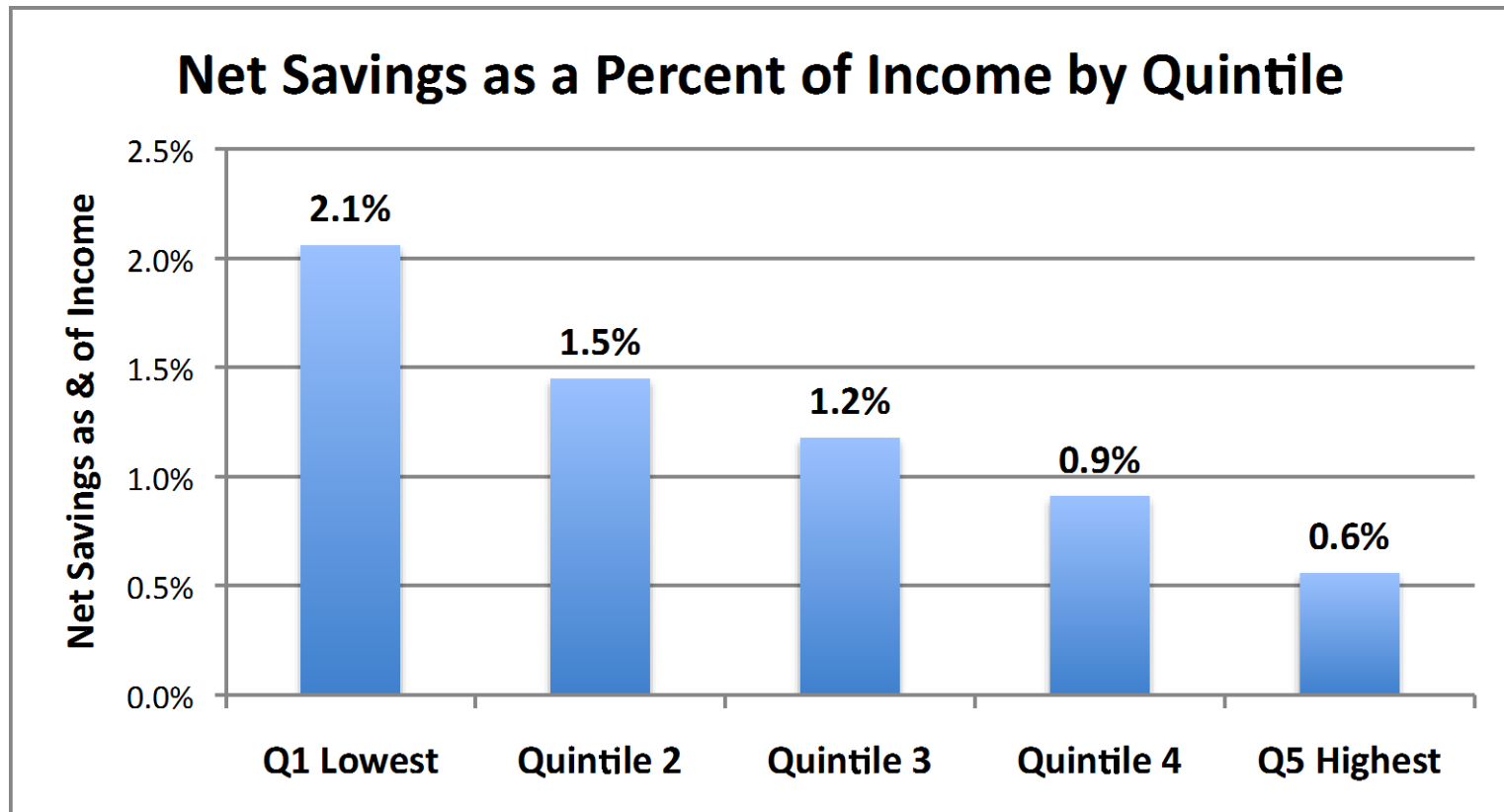
Lower income households purchase and own more older, used vehicles.

They get almost the same fuel economy as new vehicle buyers at a much lower price.

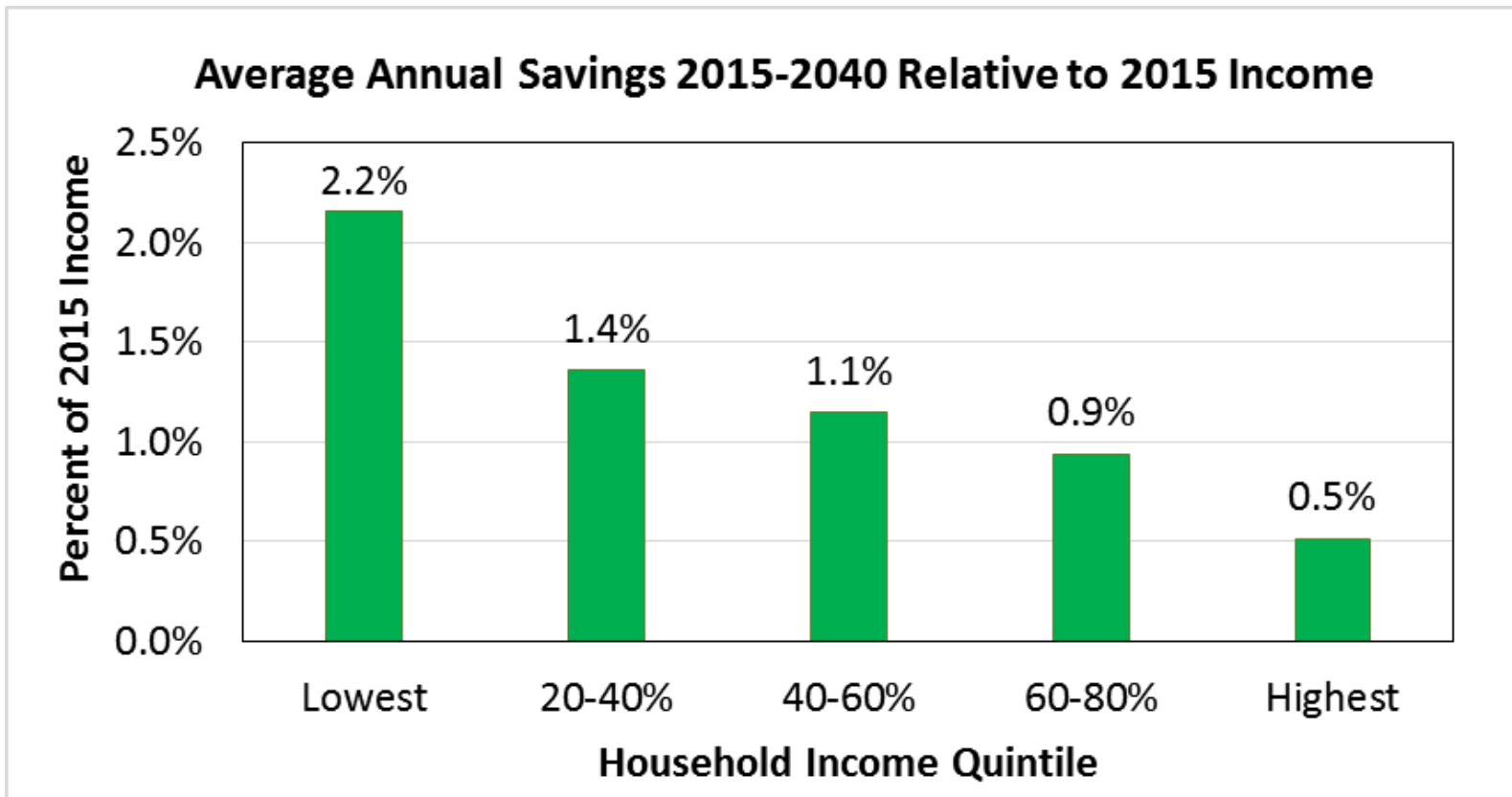
Fuel economy improvements between 1980 and 2014 saved thousands for all income groups. ***When consumers save on fuel they have more to spend on vehicles.***



As a percent of income, savings increased with decreasing income. The effects were progressive.



Our analysis of future standards also indicated that all income groups will benefit and the largest savings as a % of income will go to the lower income quintiles.

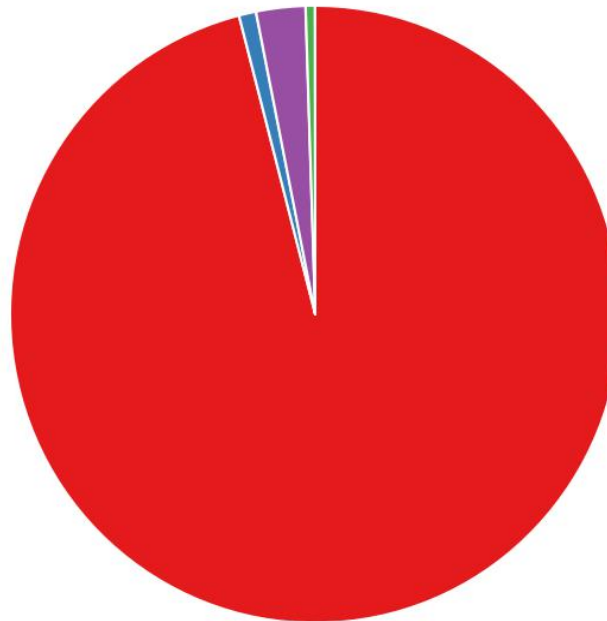


UNLIKE OTHER SECTORS, TRANSPORTATION'S GHG EMISSIONS CONSIST ALMOST ENTIRELY OF CO₂ FROM THE COMBUSTION OF PETROLEUM FUELS.

U.S. Greenhouse Gas Emissions from the Transportation Sector, 2014

(Click to hide) Emissions in million metric tons of carbon dioxide equivalents

- Fossil fuel combustion: carbon dioxide (96.0%)
- Fossil fuel combustion: other greenhouse gases (0.9%)
- Use of fluorinated gases (2.6%)
- Other transportation categories (0.5%)



Source: U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014.
<http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html>

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Improving fuel economy:

- **Saves energy and money**
 - 1.5 Trillion gallons since 1975
 - Over \$4 Trillion
 - All income groups save
 - As a % savings increase with decreasing income
- **Does not compromise quality**
 - Performance improved
 - Safety improved
 - Size maintained or increased
 - Durability increased
- **Reduces dependence on imported petroleum**
- **Is a cornerstone of sustainable transportation**

Fuel economy standards have enjoyed public support above 70% for decades.

- 1988-1997: Seven surveys found approval fuel economy standards from 72% to 95%.
- January 2005 poll found 77% support even though respondents were told "...it would cost more to buy or lease a car."
 - Democrats 83%
 - Republicans 74%
- 2006 Pew Survey: 86% favored higher standards
- 2007 Mellman Survey: also 86% support
- 2009 Gallup Poll: 80% support
- 2011 Pew: 82%; 2011 Consumer Reports 77%
- 2016 Consumer Reports: 75%

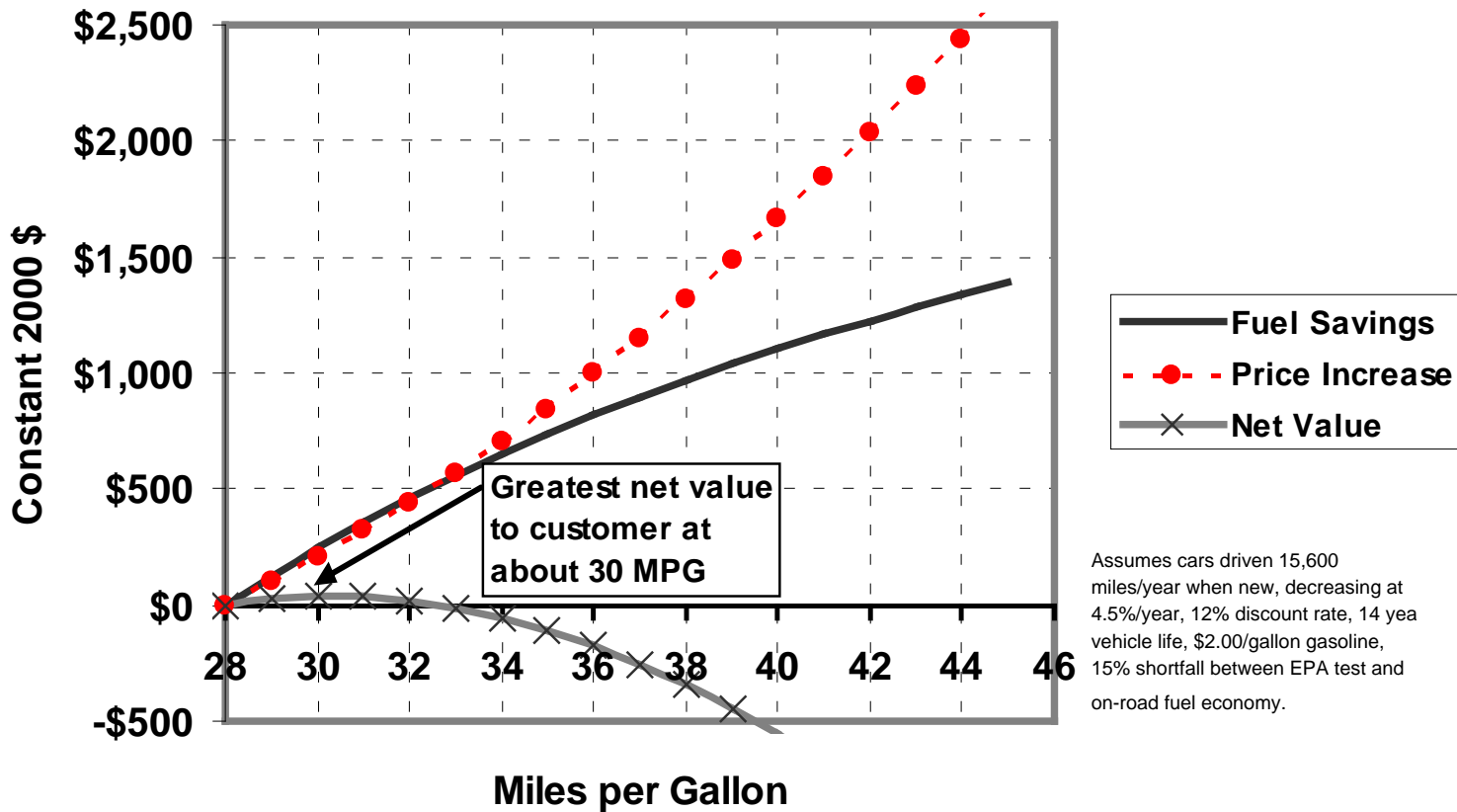
THANK YOU.

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A 3-year payback requirement would explain the market's lack of interest in the fuel economy technology the NRC identified.

Price and Value of Increased Fuel Economy to Passenger Car Buyer, Using NRC Average Price Curves



Both Tennessee Senators supported raising the fuel economy standards in 2007. The quotes below are from their websites last Monday (March 28,2016).

SENATOR CORKER:

Supporting Fuel-Efficient Vehicles:

“Senator Corker cosponsored a bipartisan amendment that was included in the 2007 CLEAN Energy Act that would reduce our gasoline consumption by making our vehicles more fuel-efficient, saving consumers money and reducing our dependence on foreign oil. While conserving gasoline, this amendment also ensured that vehicles would remain safe and cost-effective. The Senator strongly supported this particular approach because it reforms and strengthens the current fuel efficiency regulations by ensuring that all vehicles, whether small and light or large and heavy, are made to be as fuel efficient as possible. This provision was included and signed into law as part of the 2007 Energy Independence and Security Act.”

SENATOR ALEXANDER:

The CLEAN Energy Act, approved 65-27:

“When the Corporate Average Fuel Economy (CAFE) standard was created in 1975 for cars and light trucks in the aftermath of the Arab oil embargo, it resulted in a savings of 3 million barrels of oil per day. The new Senate bill would raise fuel efficiency standards beginning in 2011. In 2020, the nationwide average fleet fuel economy standard for cars and light trucks would be 35 mpg, which by 2020 would remove 206 million metric tons of carbon dioxide from the atmosphere per year and save consumers nearly \$25 billion at the pump (based on a cost per gallon of \$2.55). That represents real savings for families, a better quality of life, and a much lower vulnerability to turbulence in the Middle East.”

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WHAT ARE THE CAFE STANDARDS?

Energy Policy and Conservation Act of 1975 established Corporate Average Fuel Economy (CAFE) standards.

Every manufacturer had to meet the same MPG requirement (Sales weighted *harmonic* average).

MPG measured in laboratory on a dynamometer over “city” and “highway” test cycles (mostly by manufacturers).

2007 Energy Independence and Security Act set standards based on a vehicle’s “footprint”.

Different sizes of vehicles had different MPG targets, to remove any incentive to favor smaller vehicles.

The number of transmission gears has been increased from just over 3 in 1975 to more than 6 today. (Math QUIZ?)

