A decorative graphic consisting of a thin yellow circle on the left side. A thick black left square bracket is positioned to the left of the circle. A thick yellow right square bracket is positioned to the right of the circle. A horizontal bar with a light green-to-white gradient is overlaid across the middle of the circle and brackets.

Policy challenges in climate change and energy security

Dr. David L. Greene

Towards a Global Approach to Automotive
Fuel Economy

FIA, Paris

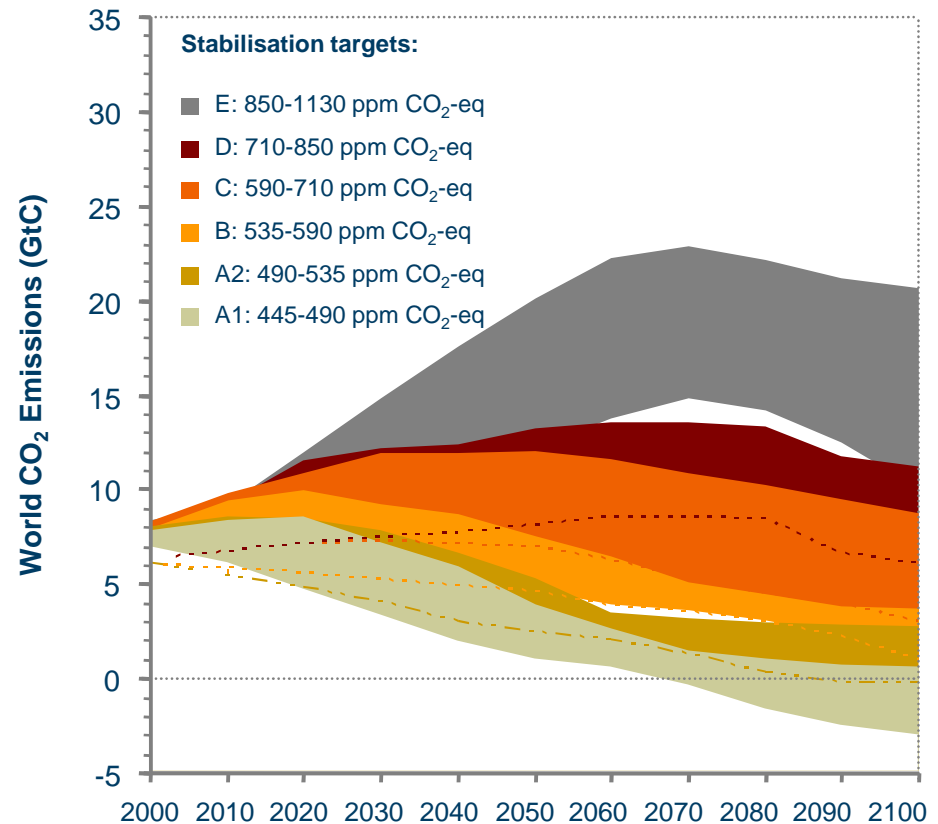
May 15, 2008

Transportation faces a triple energy challenge.

- Reducing GHG emissions
 - A public good externality market failure
- Reducing oil dependence
 - An imperfect competition market failure
- Securing sustainable energy
 - A sustainability market failure
- **Automotive fuel economy**
 - An uncertainty loss-aversion market failure

The U.S. Congress is considering legislation that would require a 70% reduction in U.S. GHG emissions over 2000 levels by 2050.

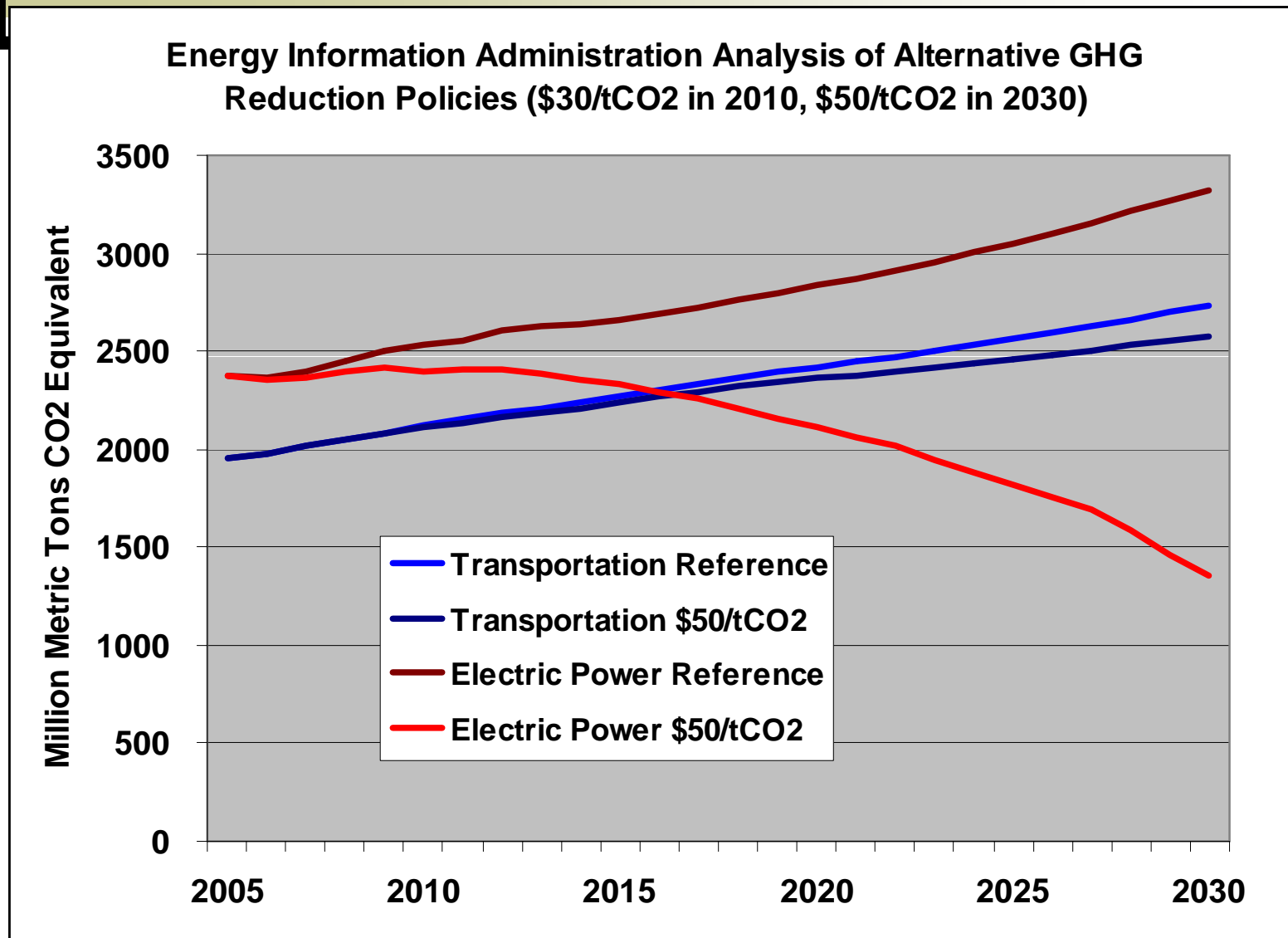
- The lower the target stabilisation level limit, the earlier global emissions have to peak.
- Limiting increase to 3.2 – 4°C requires emissions to peak within the next 55 years.
- Limiting increase to 2.8 – 3.2°C requires global emissions to peak within 25 years.
- Limiting global mean temperature increases to 2 – 2.4°C above pre-industrial levels requires global emissions to peak within 15 years and then fall to about 50 to 85% of current levels by 2050.



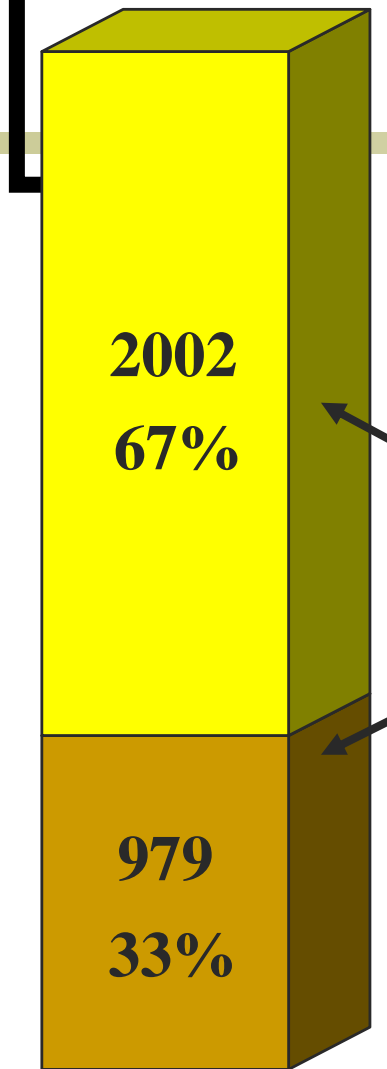
Multigas and CO₂ only studies combined

GHG mitigation: What is transportation's "fair share"?

A C-price that would cut utilities C emissions in half by 2030 would have little impact on transportation emissions. (EIA, 2006).



Where will transportation find a sustainable source of energy?



Billions of Barrels

The 2007 NPC report expects 1.1 trillion barrels of oil production over the next 25 years. More than consumed in in all of human history.

Remaining recoverable crude oil*

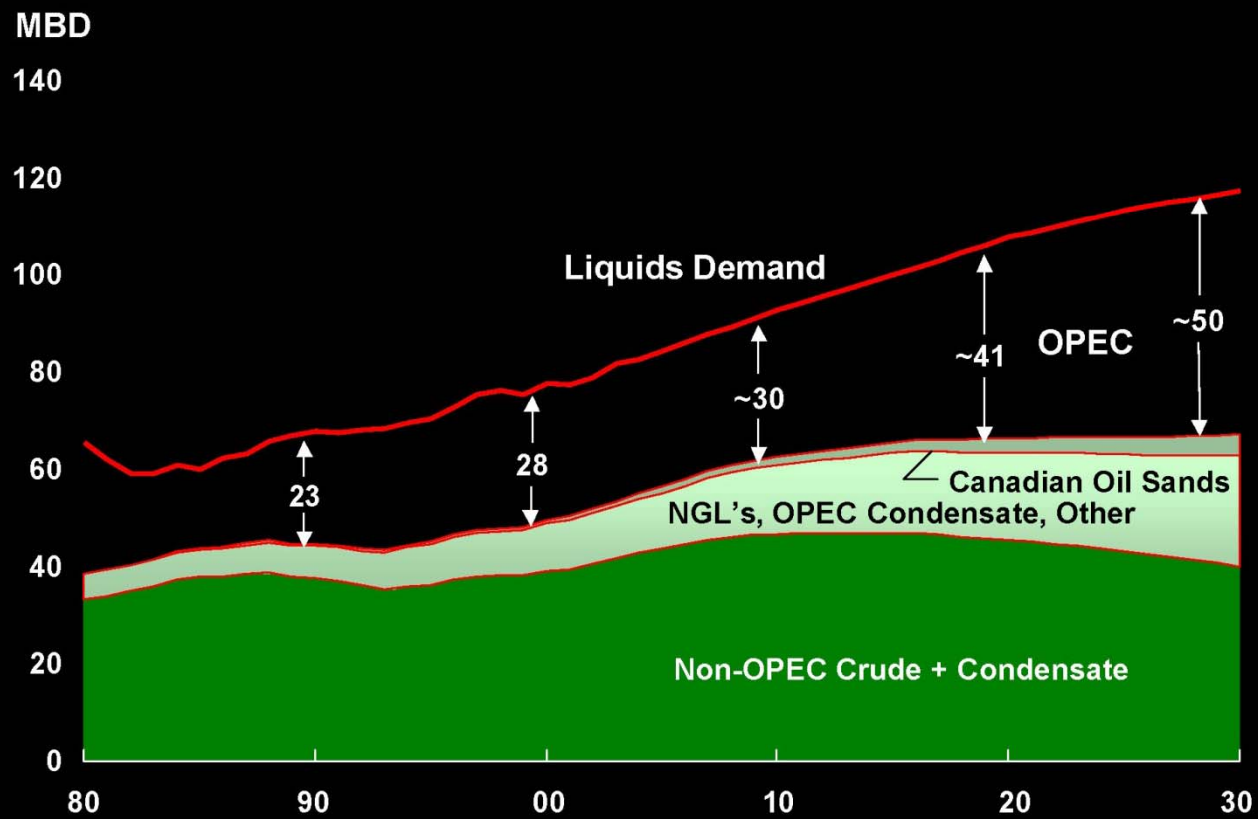
Cumulative Production to end of 2005

Cumulative Production to the end of 1995 was 710! Over 1/4 of all oil ever consumed was consumed in the last 10 years.

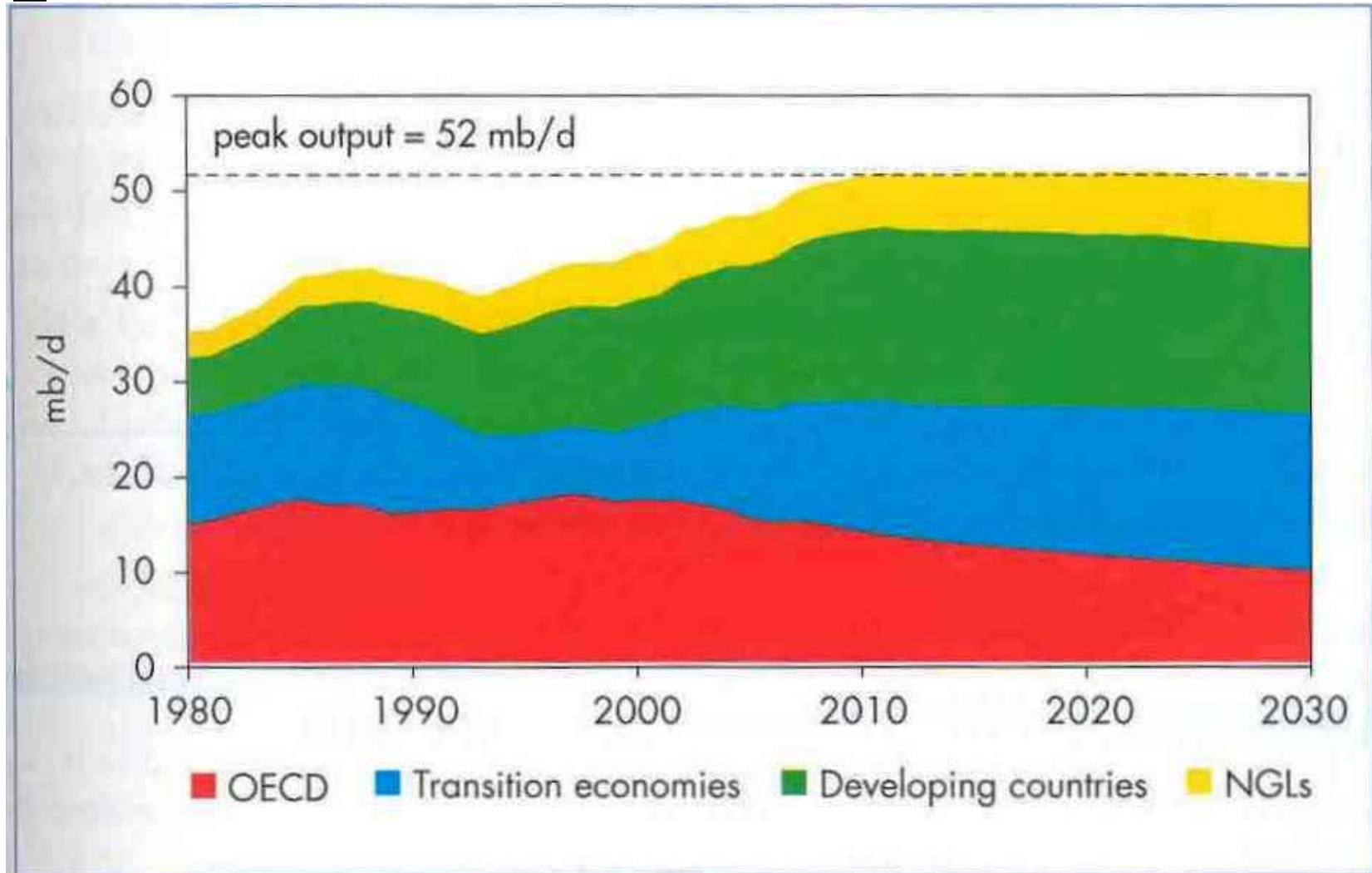
* From USGS 2000, USGS 1995, and MMS 1996

Projections of just 4 years ago expected peaking of non-OPEC supply with OPEC filling the gap. Not happening.

World Liquids Production Outlook

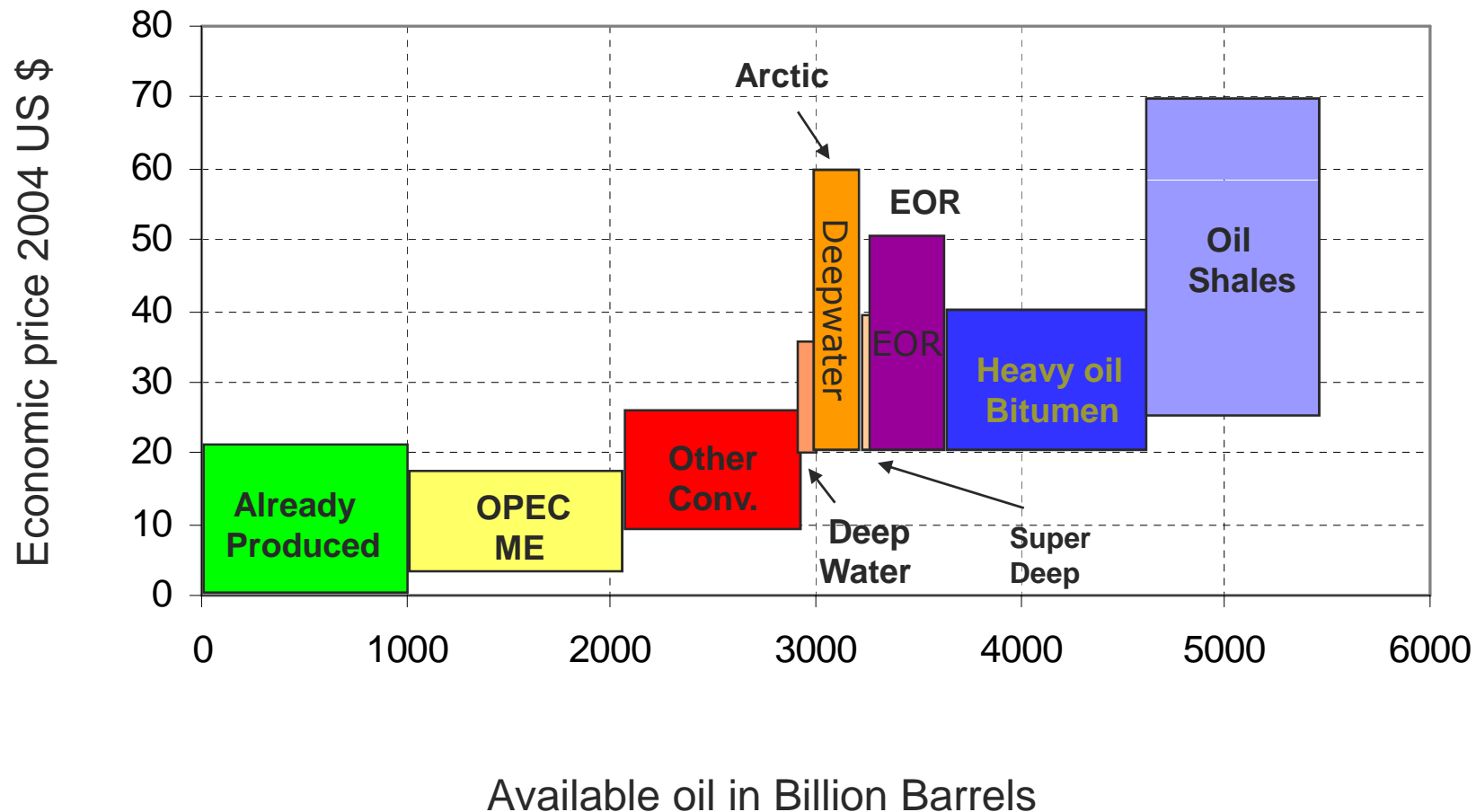


IEA's WEO 2006 foresaw a non-OPEC plateau with less OPEC supply and more unconventional resources filling the gap.

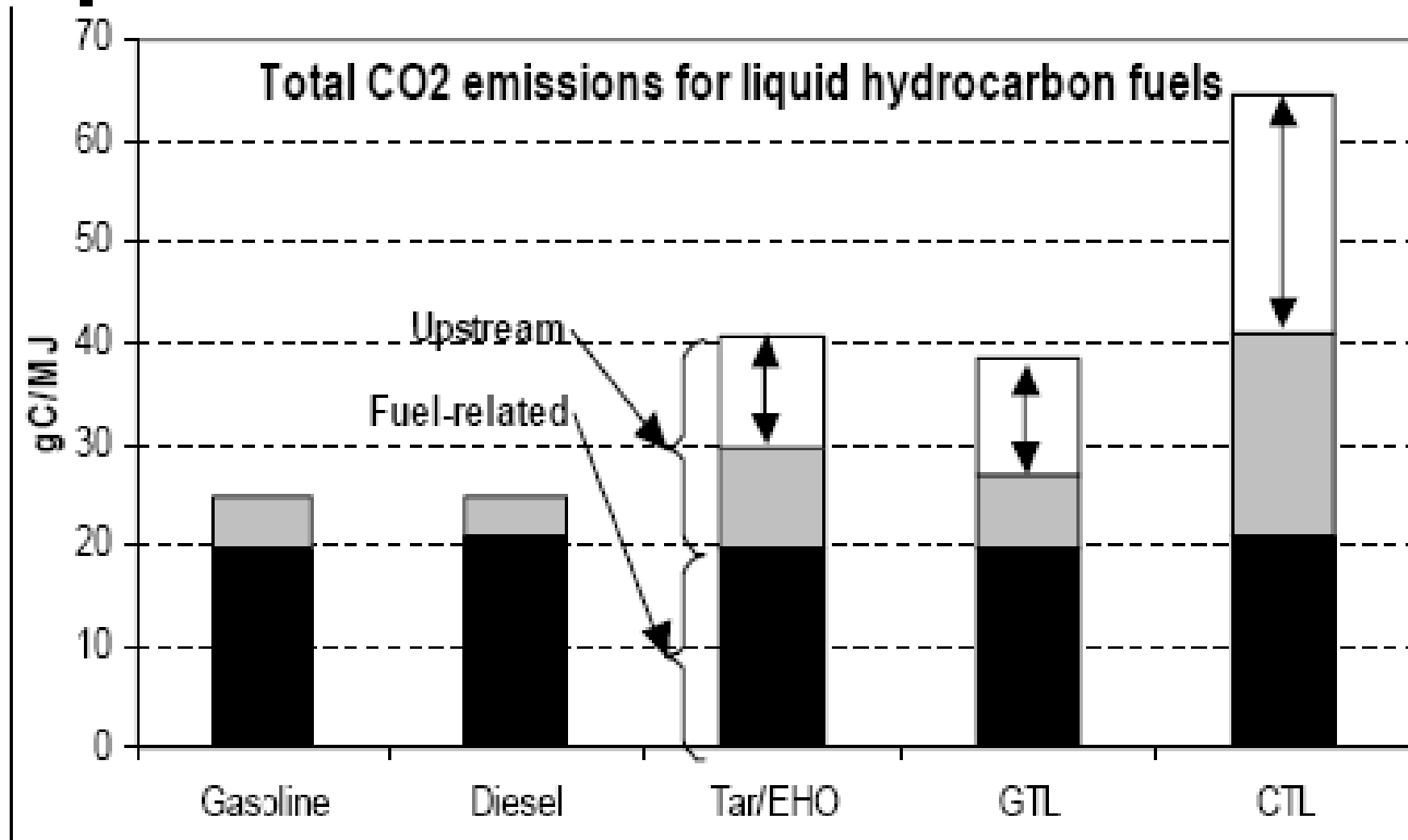


The path of least resistance? Unconventional oil resources are vast, compatible with the existing infrastructure, at prices we have shown we are willing to pay. And then there is coal. Will the investments be made without a clear, global GHG policy?

IEA "Resources to Reserves" 2005



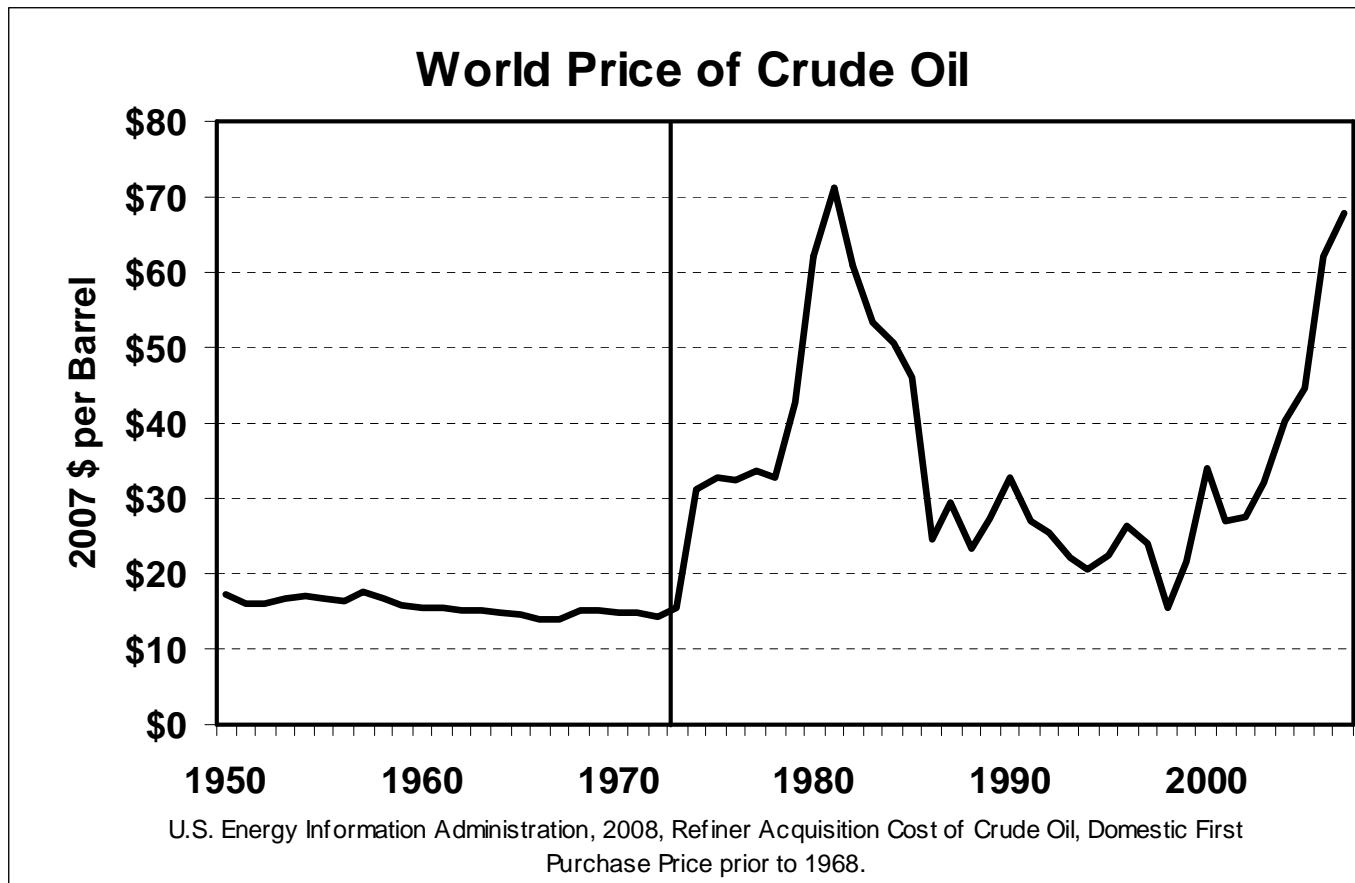
Without carbon capture and storage, unconventional oil and liquid fuels from coal will produce 20% to 100% more greenhouse gas emissions. And biofuels?



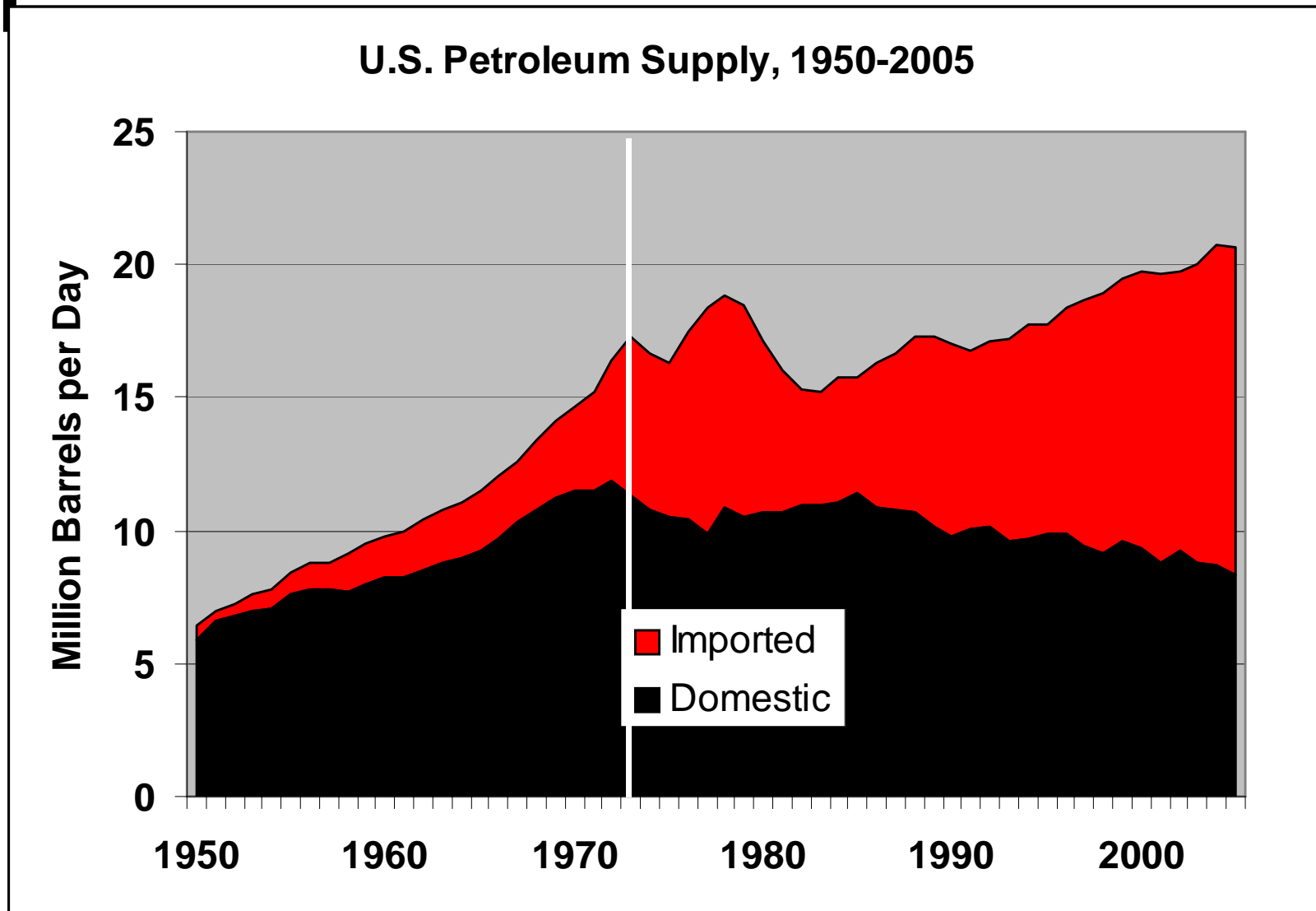
Source: Farrell, 2006.

Energy security complicates the problem a bit but is chiefly another motivation to act.

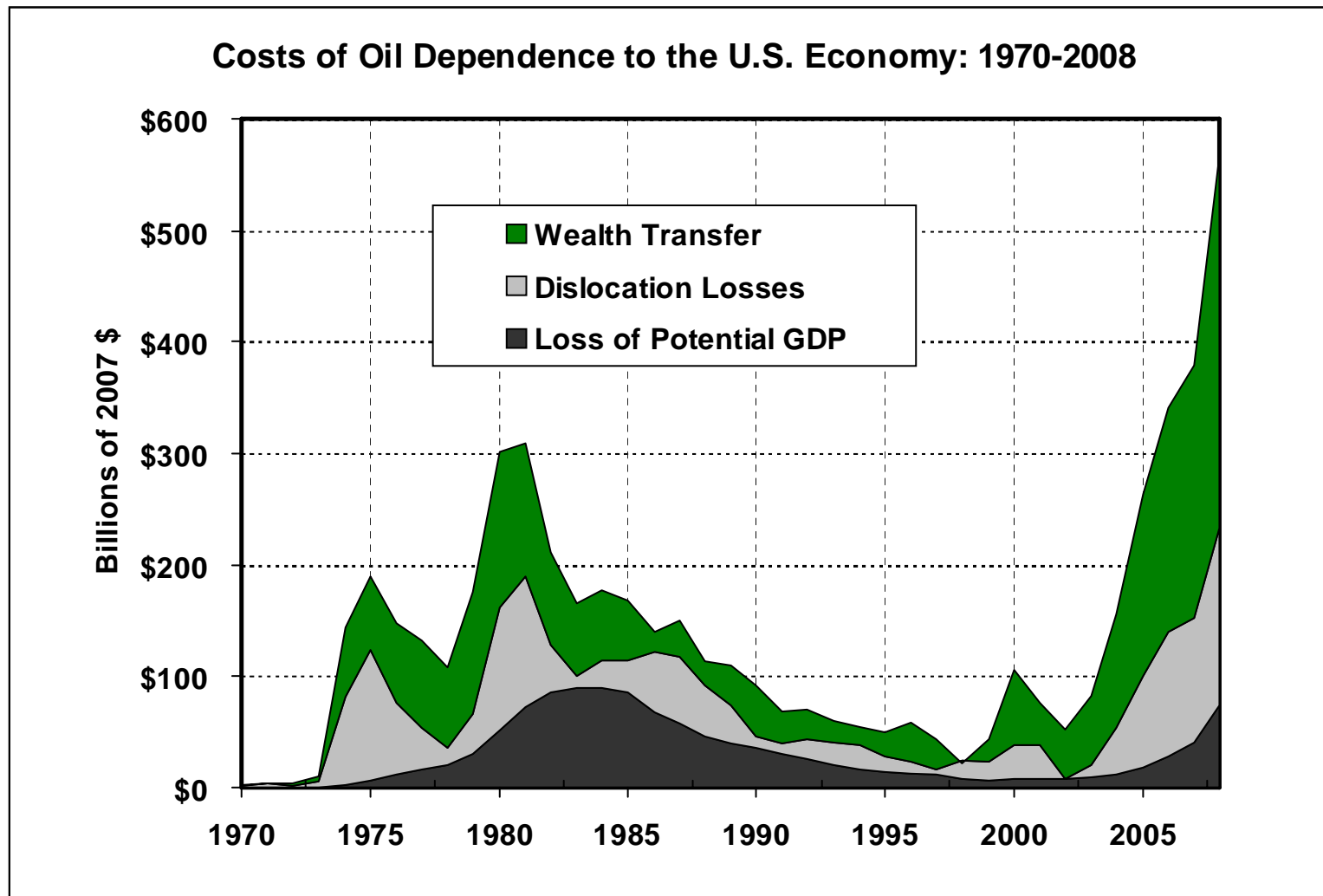
“The real problem we face over oil dates from after 1970: a strong but clumsy monopoly of mostly Middle Eastern exporters operating as OPEC.” Prof. M. Adelman, MIT, 2004.



The cartel's market power was strengthened by growing world demand, its increasing market share and the peaking of US oil production.



The direct economic costs of oil dependence are enormous. The indirect costs may be just as great.



[What is oil (energy) independence?]

- Use no oil?
- Import no oil?
- A state in which a consuming nation's decisions are not subject to restraining or directing influence by others as a consequence of its need for oil.

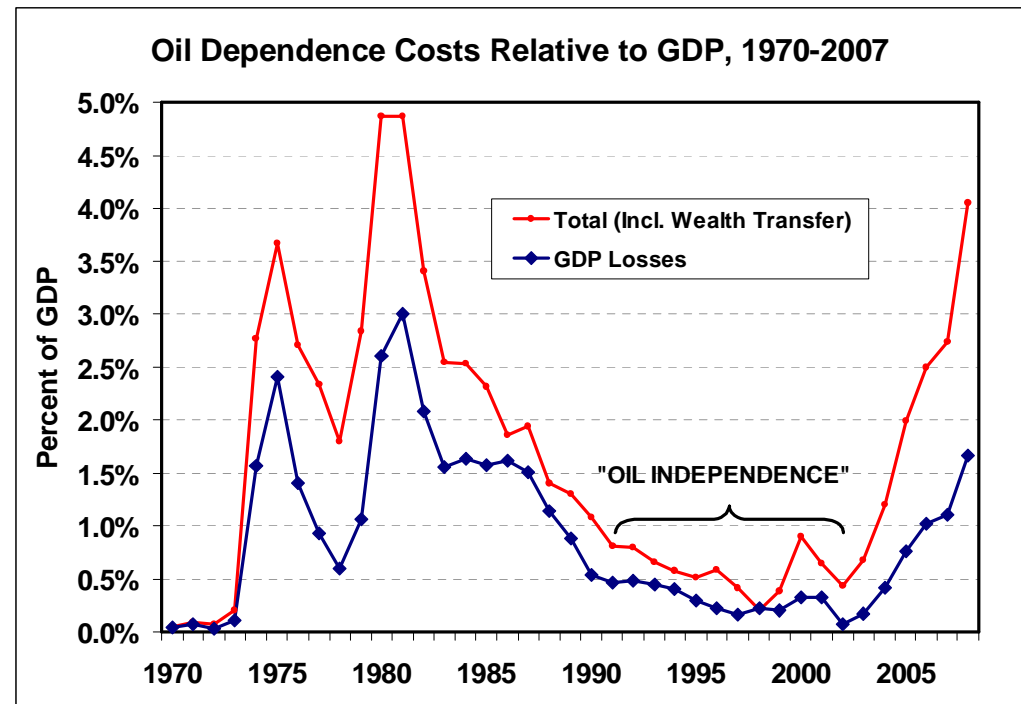
A measurable goal is needed as well as a comprehensive, sustainable policy strategy.

■ QUALITATIVE:

- For all conceivable world oil market conditions, the costs of oil dependence to the economy will be so small that they have no effect on economic, military or foreign policy.

■ QUANTITATIVE:

- The estimated total economic costs of oil dependence in any year will be less than 1% of GDP with 95% probability by 2030.

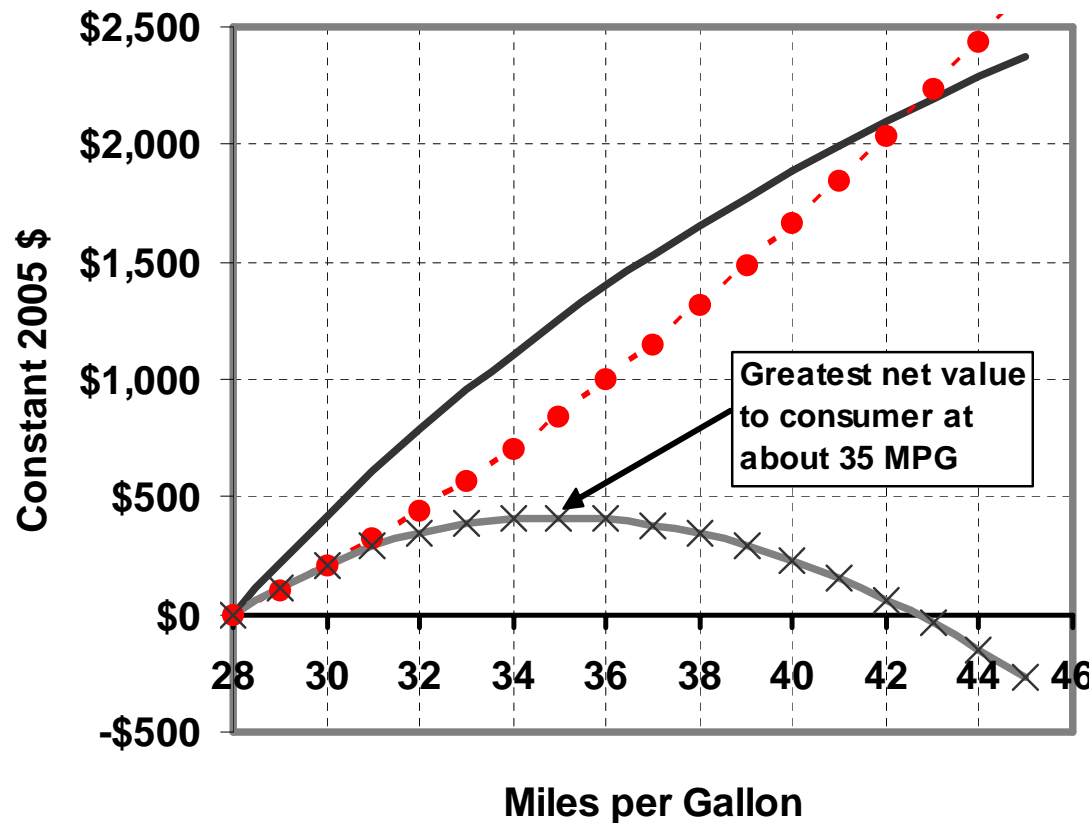


Observations on vehicle policy: What “market failure”?

- Consumers do not follow the rational economic model (Turrentine & Kurani, *Energy Policy*, 2007).
- **Uncertainty** and **loss aversion** sufficient to account for a significant energy efficiency “market failure”.
- Value of performance and weight may also involve comparative utility and externalities.
- Energy efficiency market failure may extend to all energy using markets to a greater or lesser degree.
- Affects R&D as well as adoption and application of energy efficient technology.

Rational economic model: Assuming certainty and precise preferences, a 25% increase in MPG would be optimal (& cost-efficient). But in reality the payoff is very uncertain.

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



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

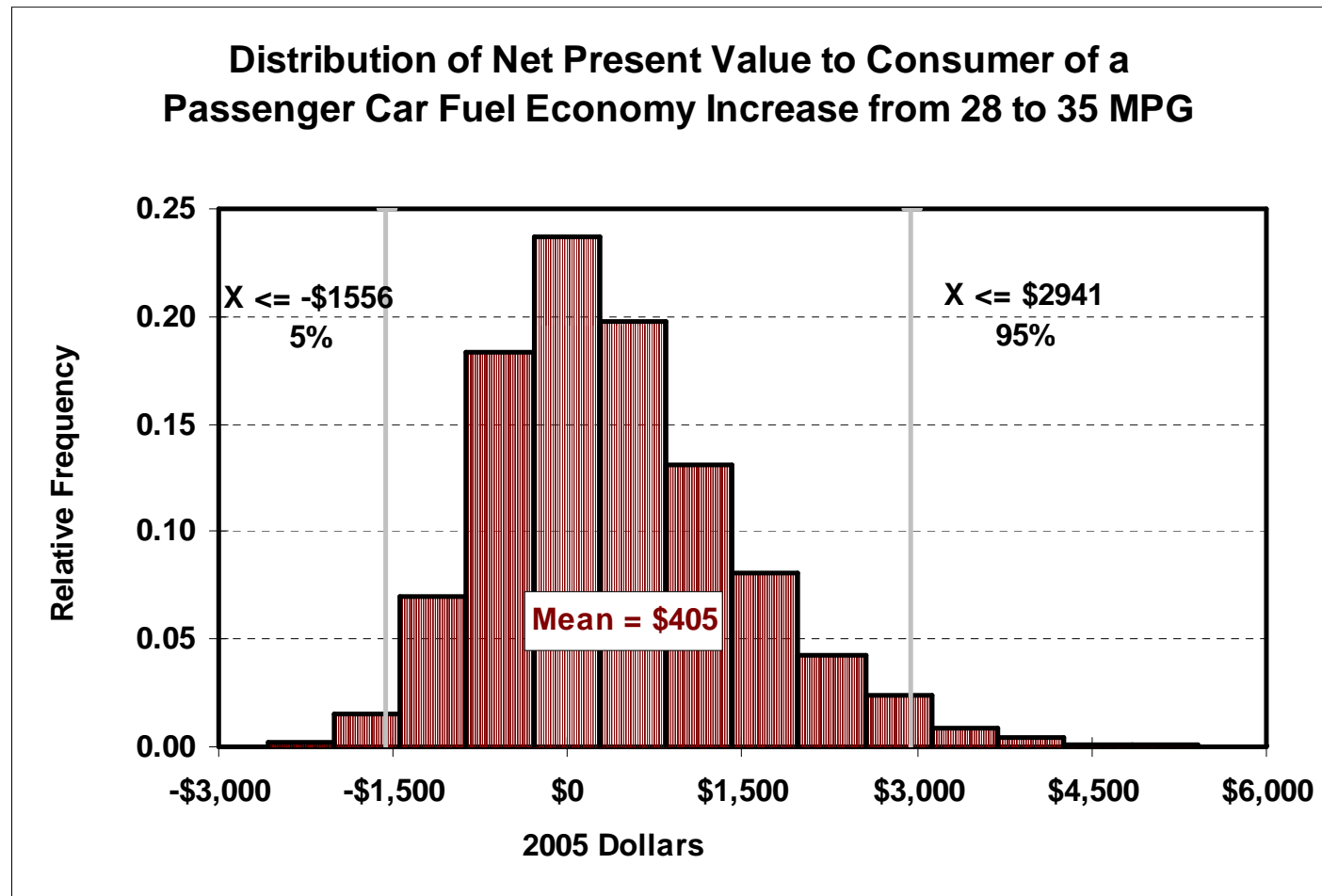
- Fuel Savings
- - - ● Price Increase
- × Net Value

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.

**Uncertainty about key factors makes
higher fuel economy a *risky bet*.**

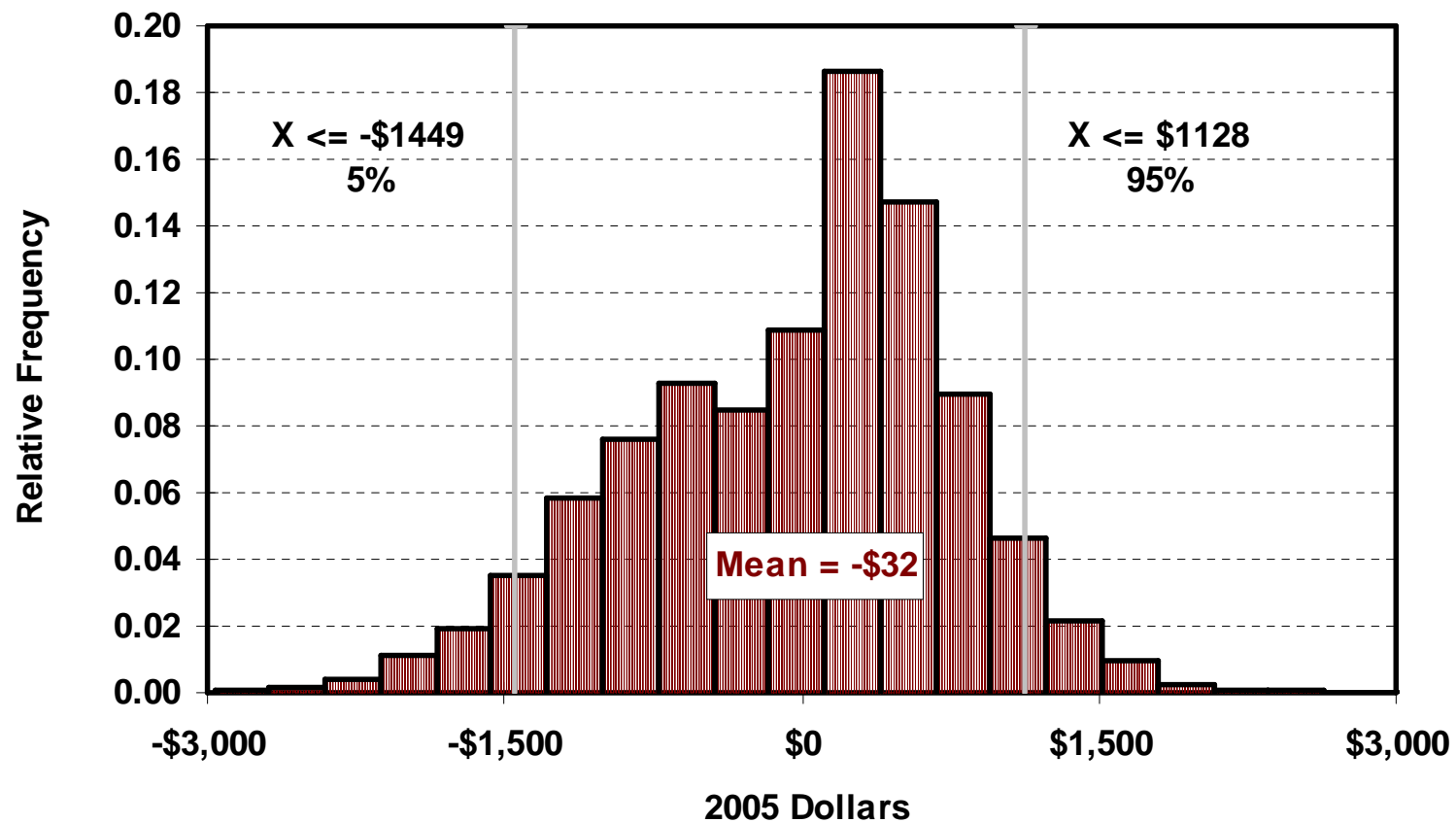
- Sure, there's a fuel economy label but what MPG will I get?
- What will gasoline cost?
- How much driving will I do?
- How long will my car last?
- (How long will I last?)
- What will I have to give up to get better fuel economy? (How much will it cost?)

A simulation reflecting these uncertain factors indicates that the fuel economy bet has an ***expected present value*** of \$405.



Introducing typical consumer **loss aversion** changes the value of the bet to **-\$32**.

Net Present Value Distribution of Loss Averse Consumer



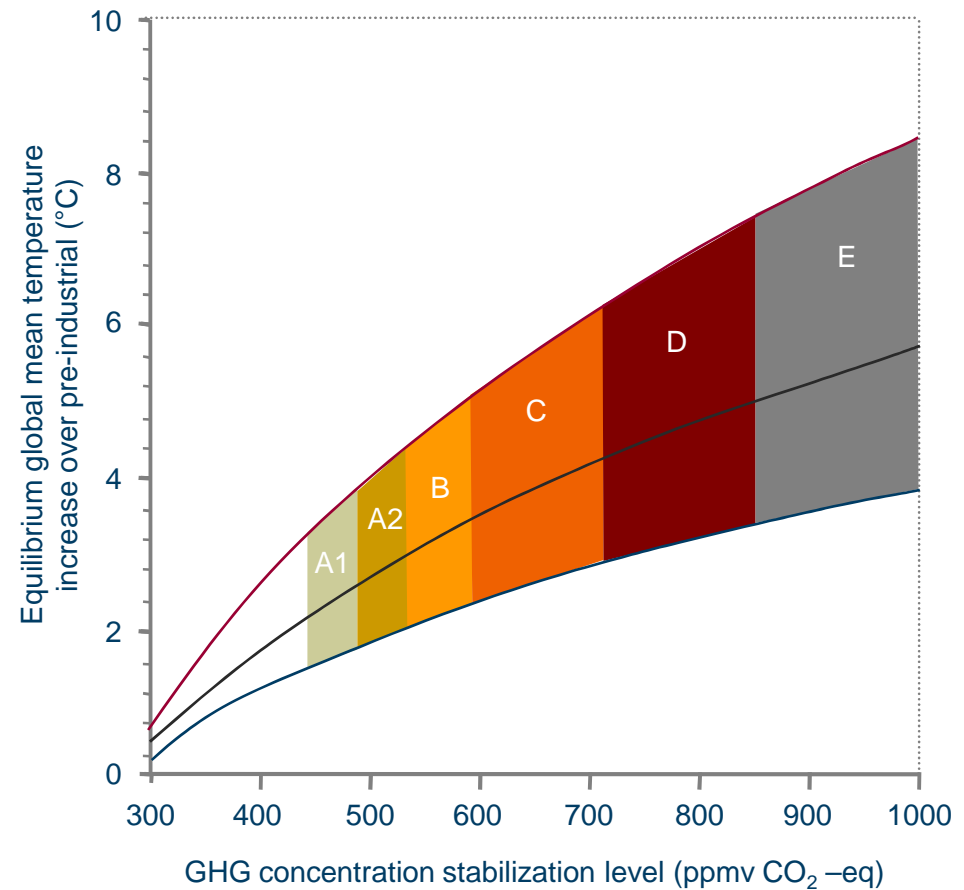
Uncertainty/loss-aversion could be a pervasive energy efficiency market failure.

- Consumers (& firms?) undervalue fuel economy.
- Other attributes (horsepower & weight) will be relatively overvalued.
- The economy will under-invest in fuel economy research and development.
- May explain why all major automotive countries adopt fuel economy standards.

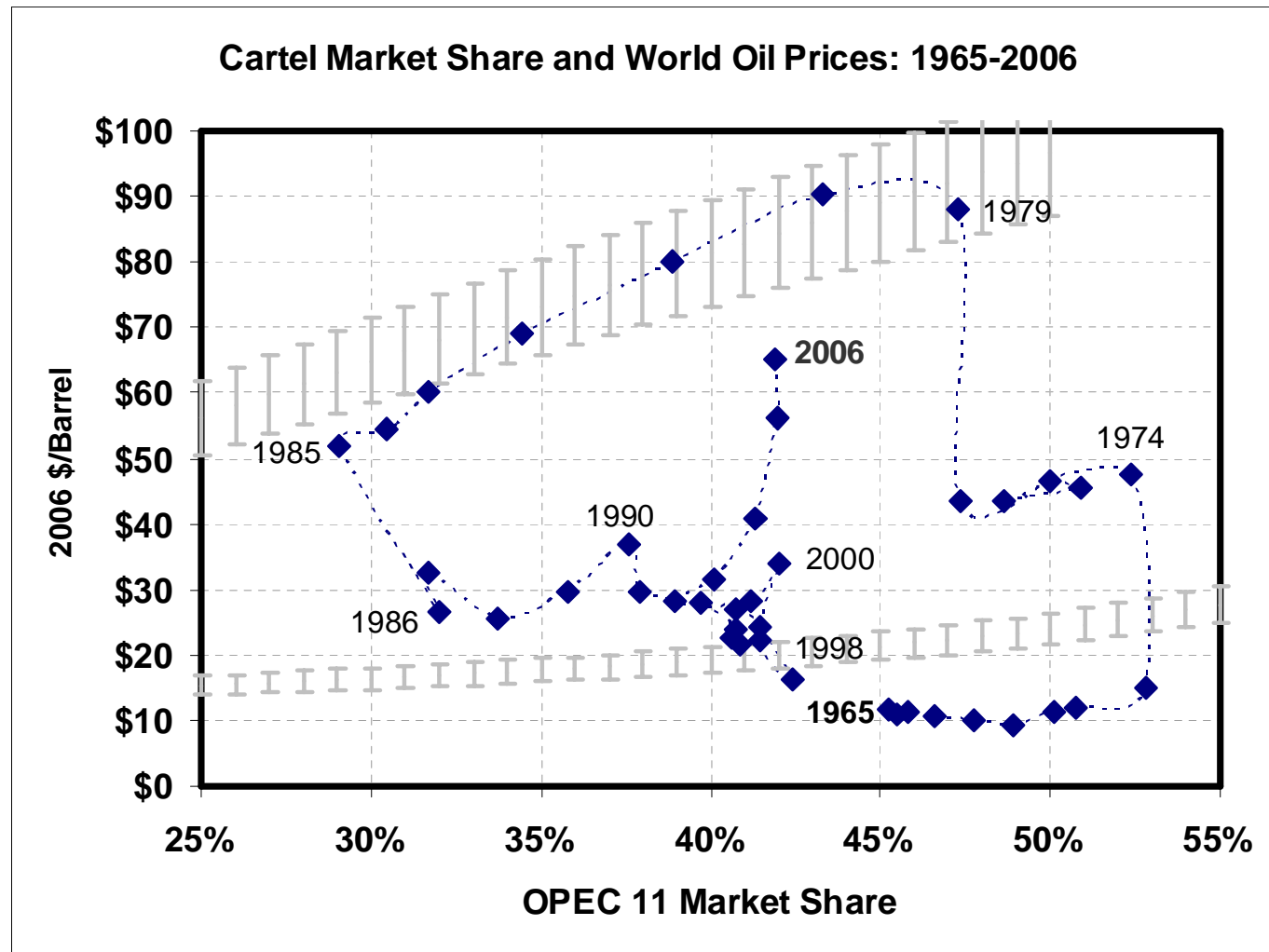
[THANK YOU. MERCI.]

Stabilising global mean temperature requires a stabilisation of greenhouse gas concentrations in the atmosphere.

The lower the aspired temperature increase, the lower the concentration stabilisation level

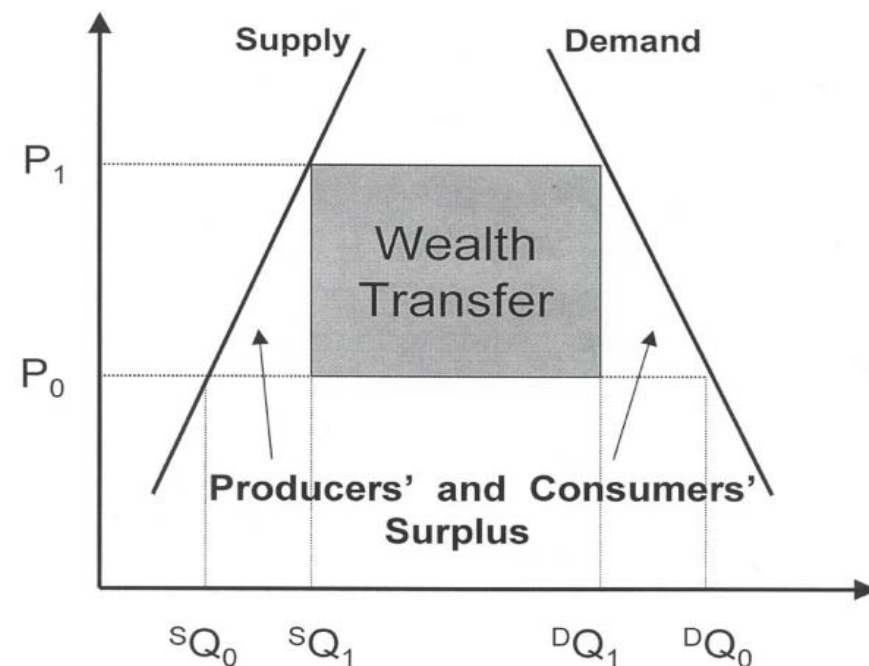


Oil market behavior since 1973 fits well into the economic theory of partial monopoly.

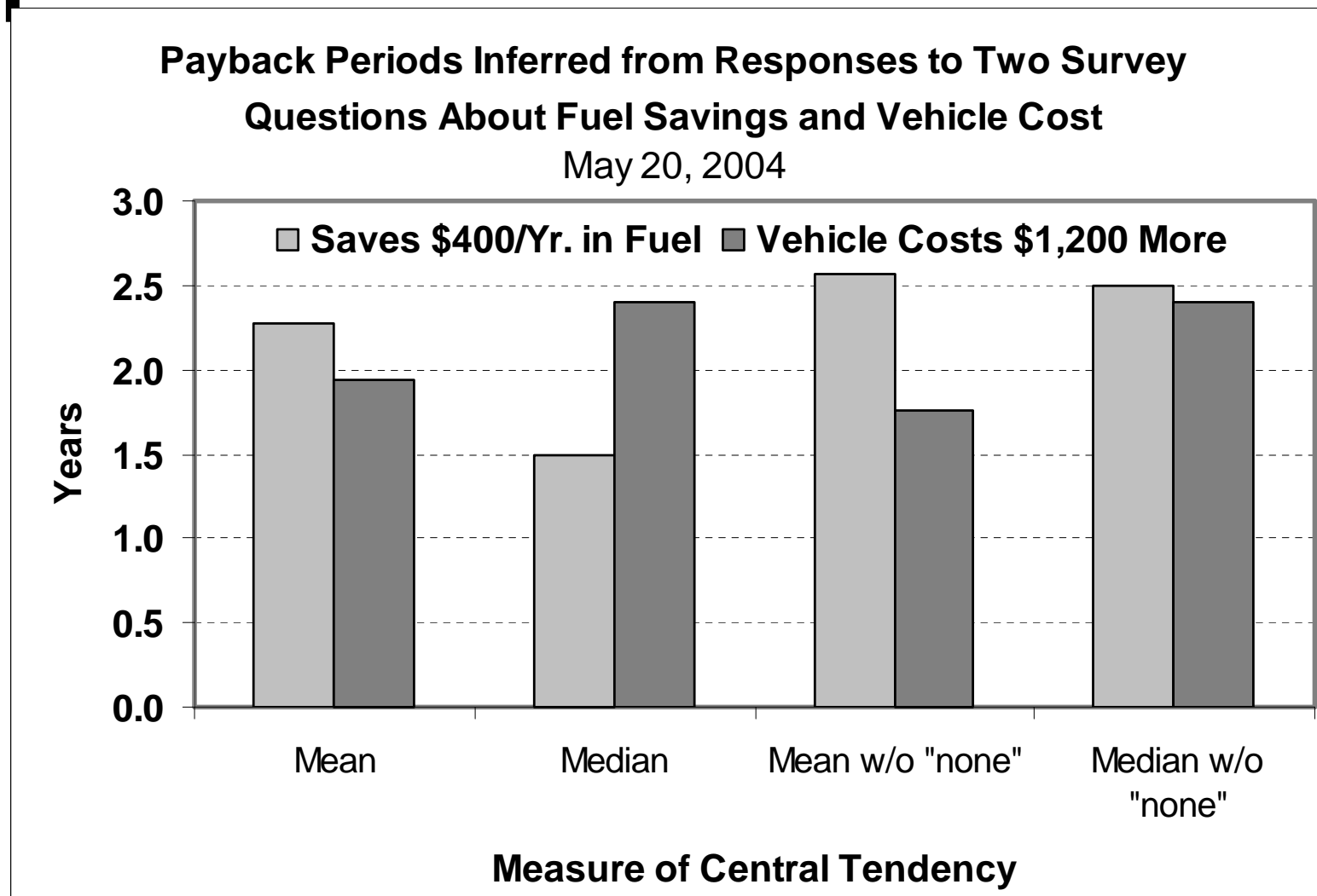


The cartelized, volatile oil market produces three direct costs to oil dependent economies.

1. Loss of potential GDP = producers' & consumers' surplus losses in oil markets (dynamic).
2. Transfer of wealth due to monopoly pricing and price shocks (requires counterfactual competitive price).
3. Dislocation losses of GDP due to oil price shocks.



Asked about fuel economy payback, consumers respond with short payback periods. But few actually think about gas mileage in financial terms (Turrentine & Kurani, 2007).



The practical effect of a 3-year payback vs. loss aversion & uncertainty are essentially the same.

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

