

Oil Security: An Economic Perspective

What is it?

Can we measure it?

Can we achieve it?

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Webcast

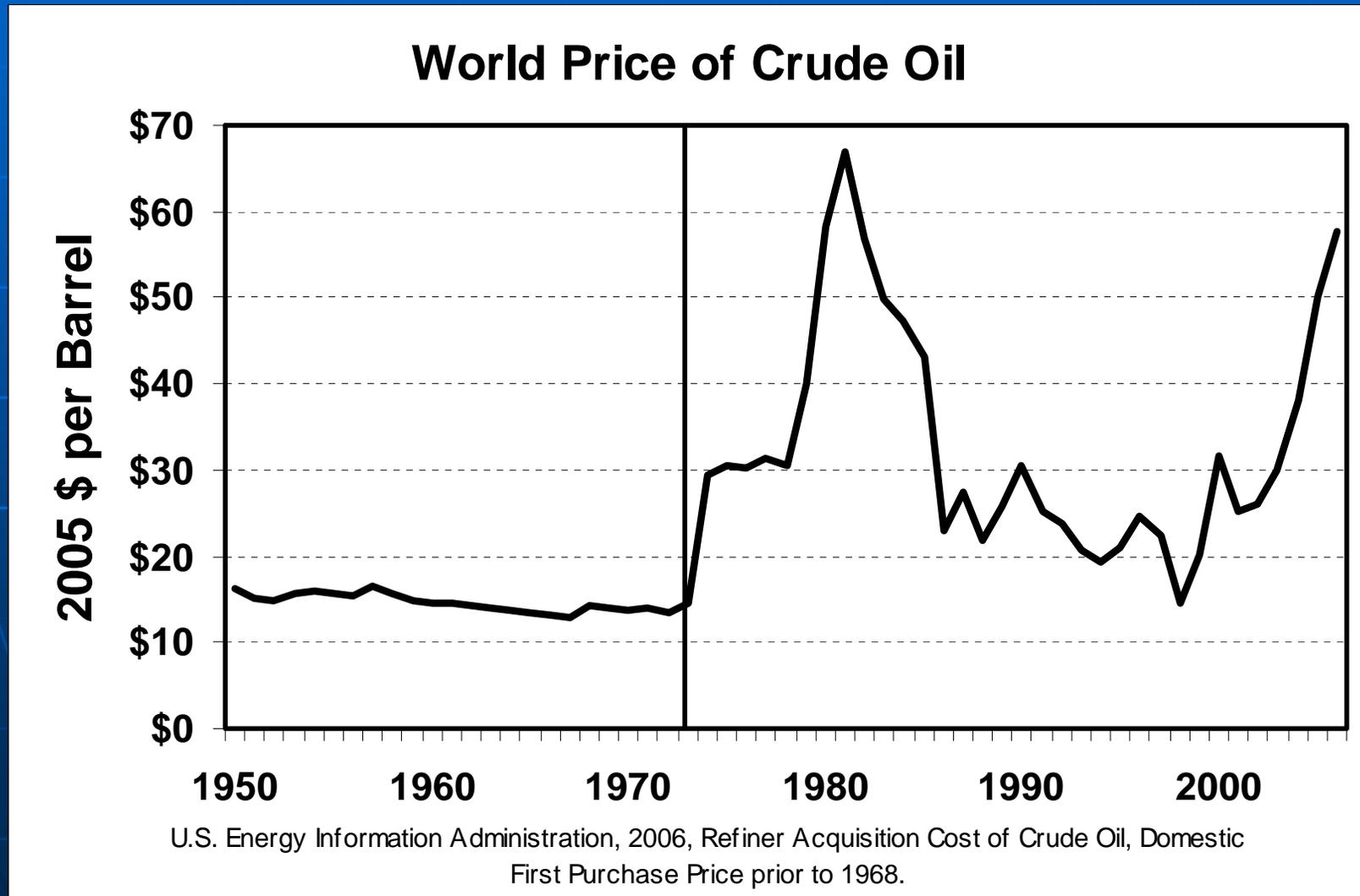
What oil security (or oil independence) isn't.

- No oil use.
- No oil imports.
- An externality.
- An unsolvable problem.
- A problem with a quick fix.

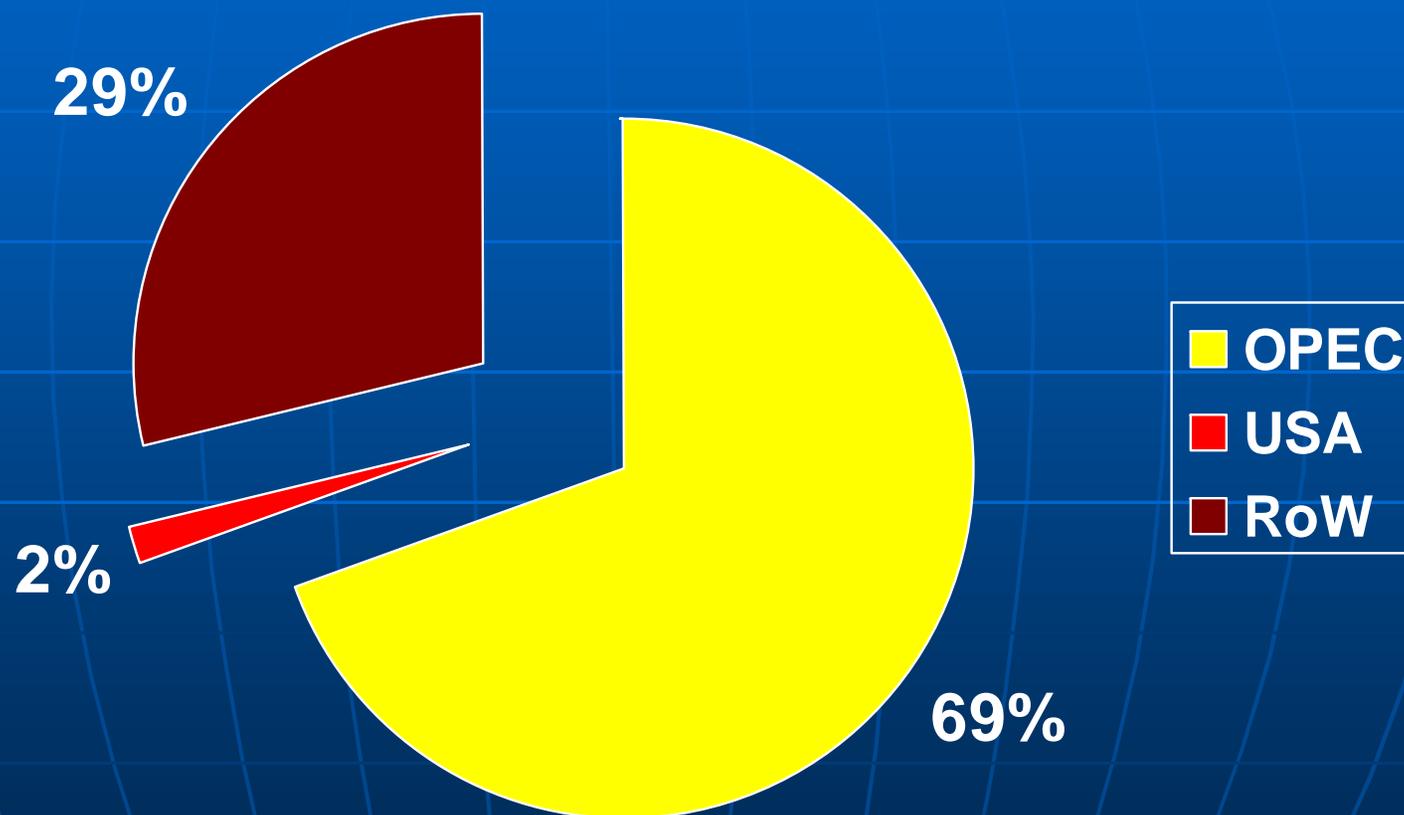
Nature of Oil Security Concerns: Three Key Phenomena

- **Oil Resources Concentrated in volatile region**
 - 60% of known reserves in Persian Gulf region
 - Unstable region
 - Unreliable source
- **Non-competitive oil supply**
 - OPEC acts as imperfect ("clumsy") cartel
 - Imposes sustained costs and can exacerbate shocks
- **Economy's exposure to oil supply/price shocks**, due to:
 - Inflexibility of demand, in short run
 - Limited substitutes (inelastic demand)
 - Importance of oil to economy
 - particularly transportation sector, growing in US and globally
 - High US oil import levels
 - Conflated Geopolitical concerns and foreign policy costs

“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.



OPEC members own 69% of the world's proven oil reserves and more than half of ultimate resources of conventional oil.



Source: U.S. Energy Information Administration, 2006.

The economic theory to understand world oil market dynamics was developed in 1954.

$$P = \frac{C}{1 + \left(\frac{1}{\beta(P)} S (\mu(P) + 1) \right)}$$

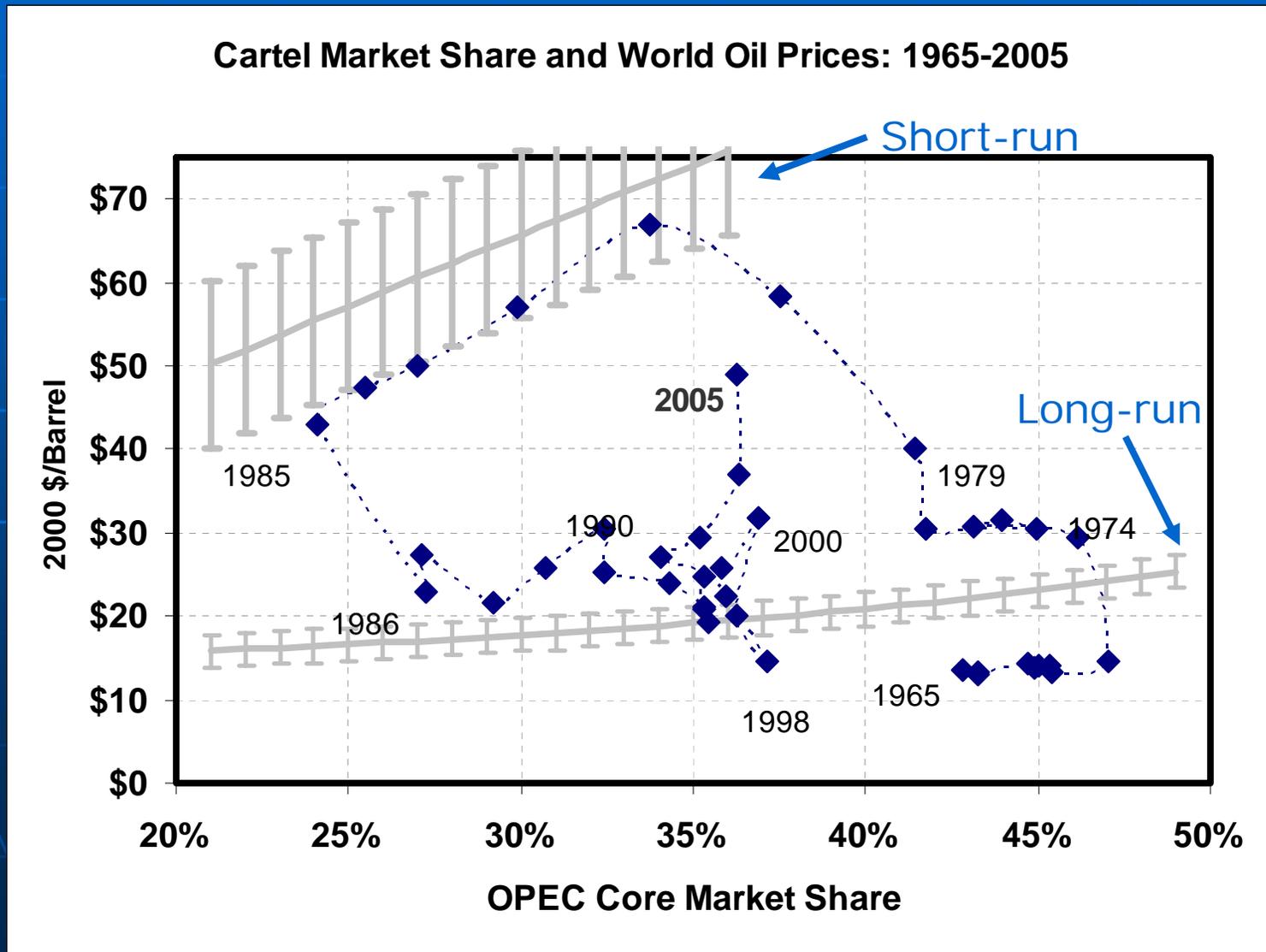
β = price elasticity of world oil demand ($\beta < 0$)

S = OPEC share of world oil market ($0 < S < 1$)

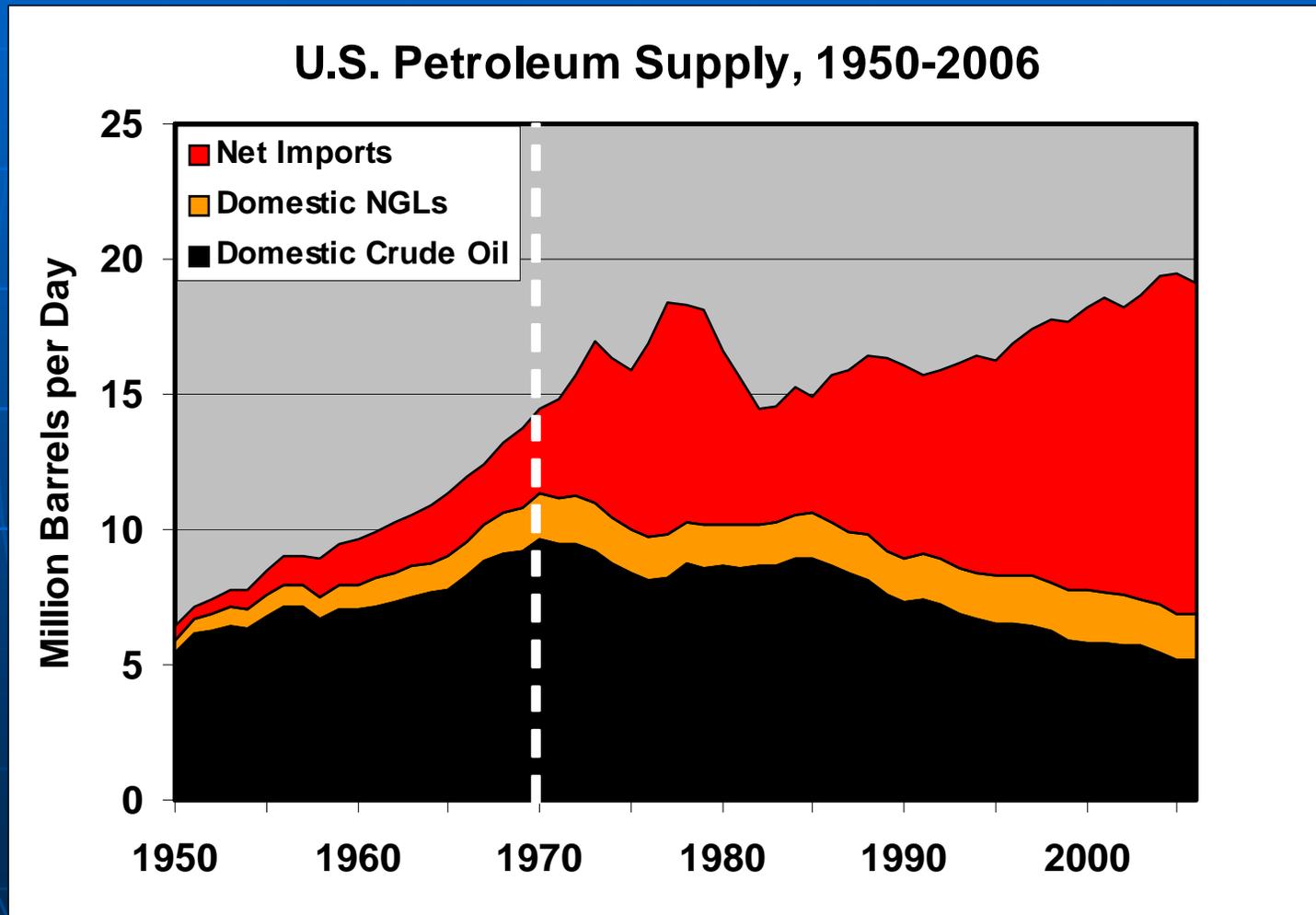
μ = non-OPEC supply response ($-1 < \mu < 0$)

Short- and long-run elasticities differ by an order of magnitude!

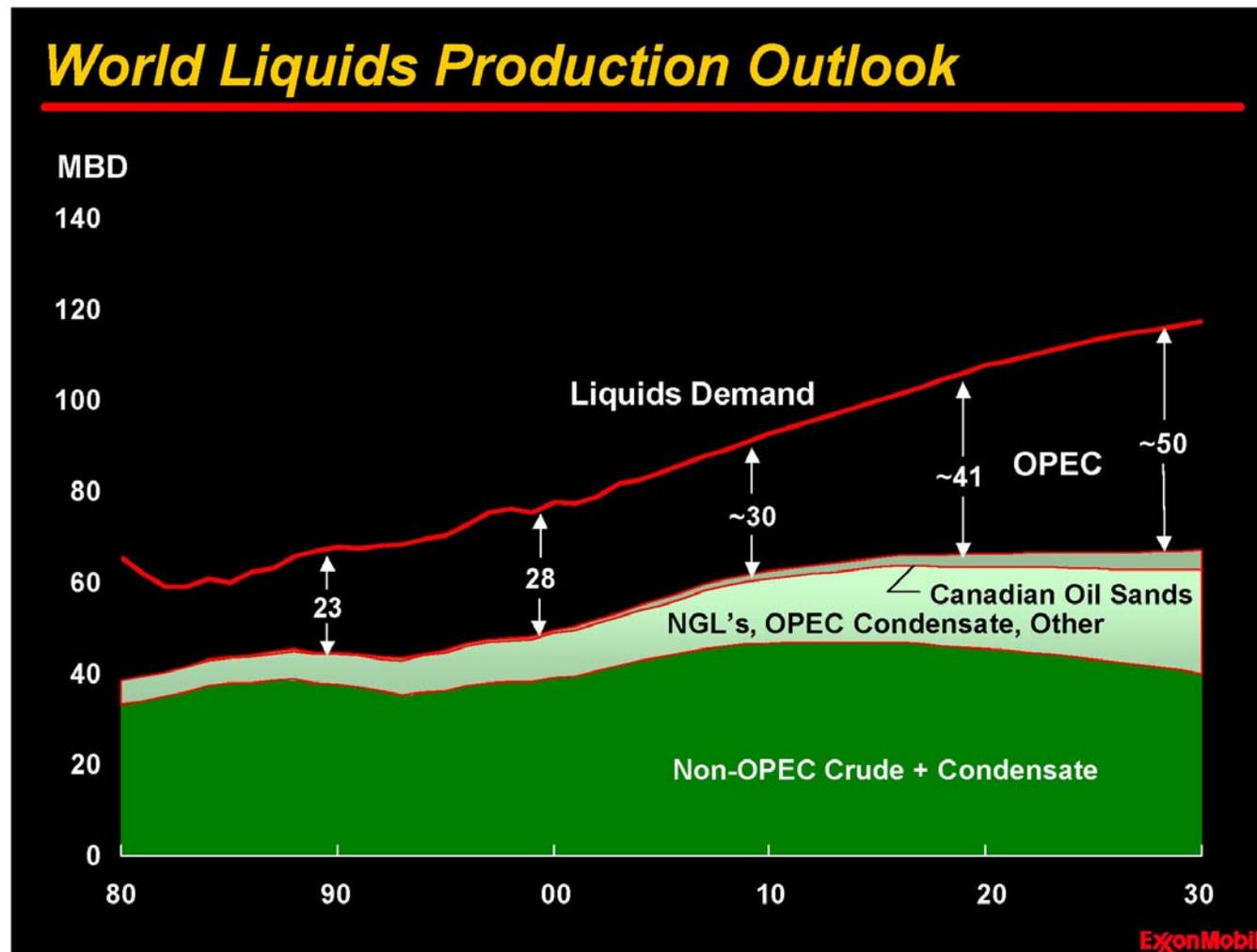
The cartel's behavior since 1973 fits well within the theoretical framework.



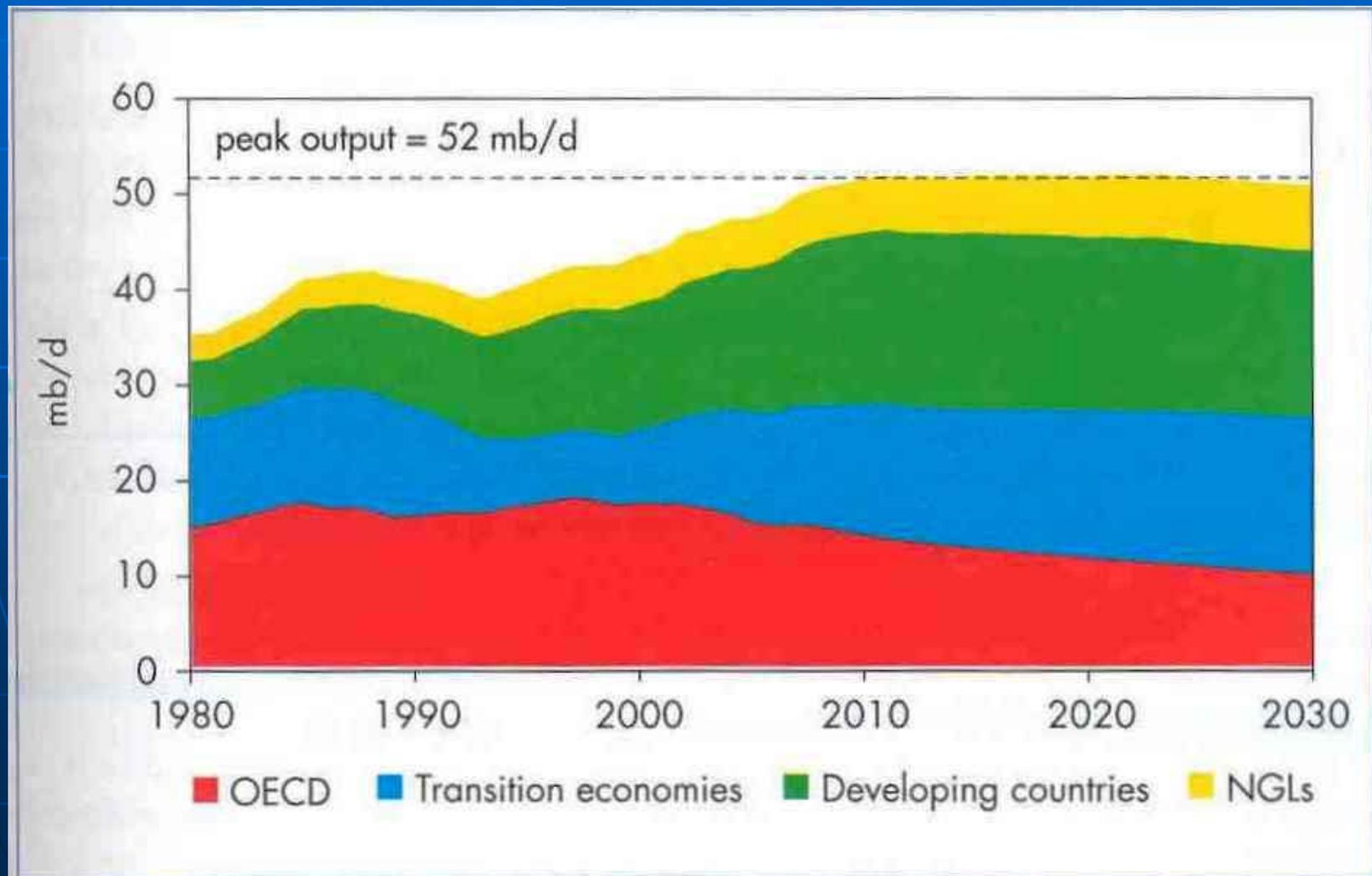
The cartel's market power was strengthened by growing world demand, its increasing market share and...the peaking of US crude oil production in 1970.



Projections of just 2 years ago expected peaking of non-OPEC supply with OPEC filling the gap. This would increase their market share and market power.



IEA's WEO 2006 foresees a non-OPEC plateau with less OPEC supply and unconventional sources filling the gap. This, too would boost OPEC's market power.



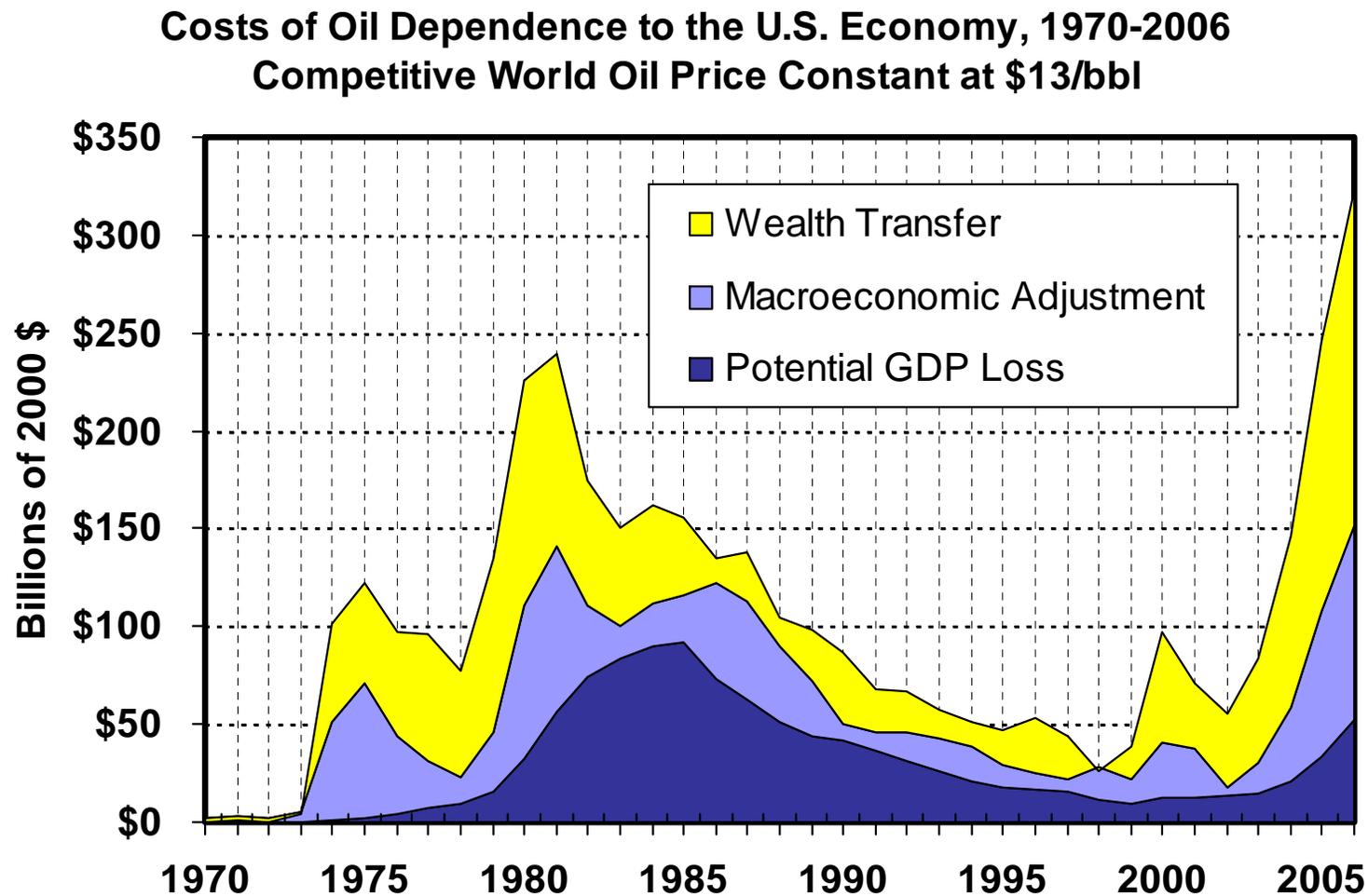
While there are important foreign policy and military costs of oil dependence, if there were no economic costs, the other costs would be far smaller.

- **Wealth transfer**
- **Long-run GDP losses**
- **Disruption costs**
- **Military costs**
- **Foreign policy costs**
- **Strategic stockpile costs (SPR)**

Our economic vulnerability doesn't depend on just one factor.

- The transfer of wealth depends directly on how much we import.
- Disruption costs depend on the oil intensity of the economy (GDP).
- Potential GDP losses depend on how much we demand and supply and on the availability of substitutes (price elasticity).

The total economic costs of oil dependence (versus a competitive oil market) amount to over \$4 trillion since 1970 (Greene & Ahmad, 2005).



What is the Oil Import Premium?

- The economics community uses the concept of the “oil import security premium” to assess the energy security risks posed by U.S. oil import dependence
- The oil import premium is:
 - The amount by which the full cost to the U.S. economy from an extra barrel of petroleum imports exceeds the market price paid by oil users
- The size of the oil import premium
 - *reflects avoidable economic costs, and*
 - *is one guideline* for how much policy intervention (i.e., encouraging investing in technology or renewable fuels) is warranted to reduce oil dependency on economic grounds

What are the Components of the Oil Security Premium?

- Two major components to oil security premium:
 - **Monopsony (Demand) Effect**
 - (recoverable) cartel rents
 - Macroeconomic **Disruption/Adjustment Costs**
- Determine *marginal* variation in these components with import level
- Generally excluded: U.S. military costs, diplomatic/geopolitical costs

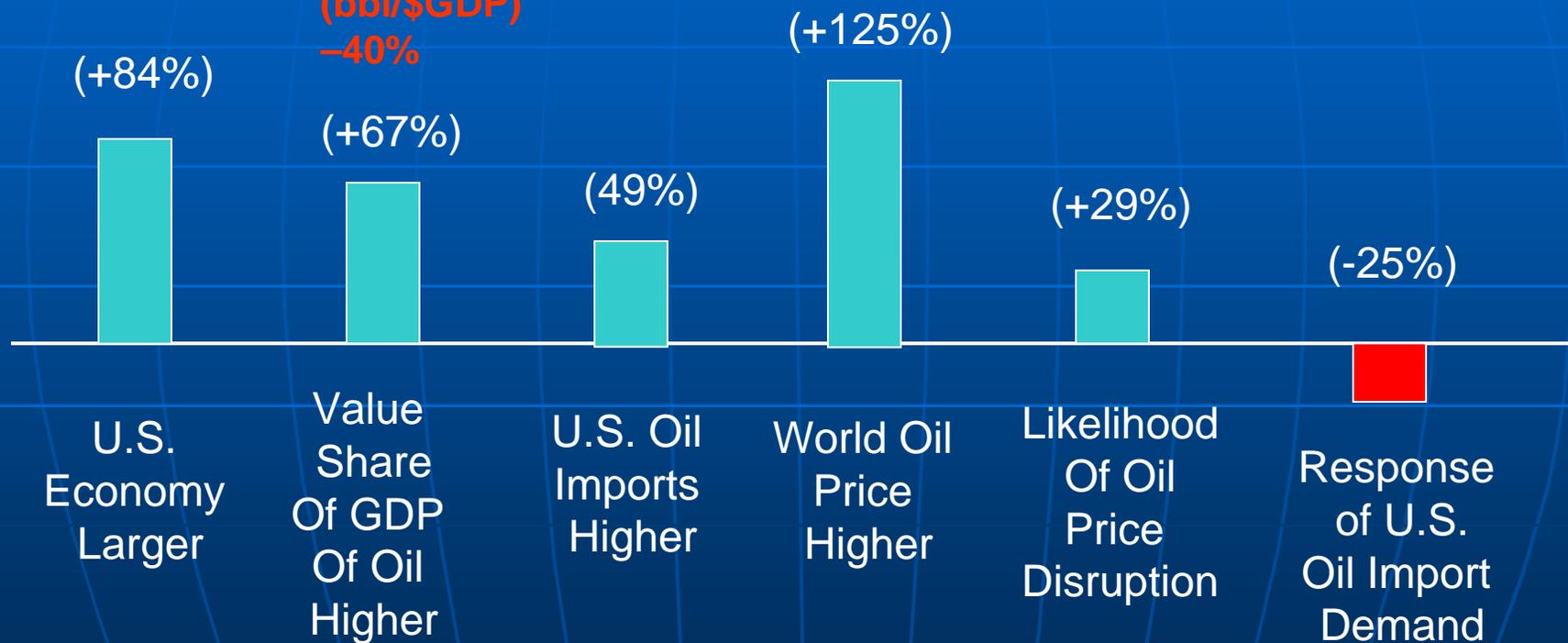
Updated estimates of the **oil import premium** indicate it is nearly 4X higher today than in 1996 (Leiby, 2007).

Effect / Study	NHTSA* (\$/barrel)	EPA Updated* (2004\$/barrel)
Monopsony	\$2.57 (\$1.54 - \$3.59)	\$8.90 (\$2.91 - \$18.40)
Macroeconomic Disruption/Adjustment Costs	\$1.03 (\$1.03 - \$2.05)	\$4.70 (\$2.18 - \$7.81)
Total Mid-point	\$3.60 (2.57 - \$5.64)	\$13.60 (\$6.71 - \$23.25)

•Results in 2004\$. 2006 column reports mean and range including 90% of results

Why has the Oil Security Premium Increased since 1996?

U.S. physical
Oil/GDP Ratio
(bbl/\$GDP)
-40%



Is “oil independence” achievable?

- “The U.S. may be addicted to oil, but many of its politicians are addicted to “energy independence” – which may be among the least realistic political slogans in American history.” J.J. Fialka, *WSJ*, 7/5/2006
- “Calls for energy independence are unrealistic, to put it mildly, for the foreseeable future; cutting oil consumption to current domestic production would severely derail an economy in which cheap and rapid transportation is taken for granted.” I.W.H. Parry and J.W. Anderson, *RFF*, 2005.
- “The voices that espouse “energy independence” are doing the nation a disservice by focusing on a goal that is unachievable over the foreseeable future and that encourages the adoption of inefficient and counterproductive policies.” Task Force of Council on Foreign Relations, 2006.
- “Energy Independence: The wrong target for policymakers”
The Washington Post, Sunday, January 21, 2007; Page B06

A measurable goal is needed.

- QUALITATIVE:

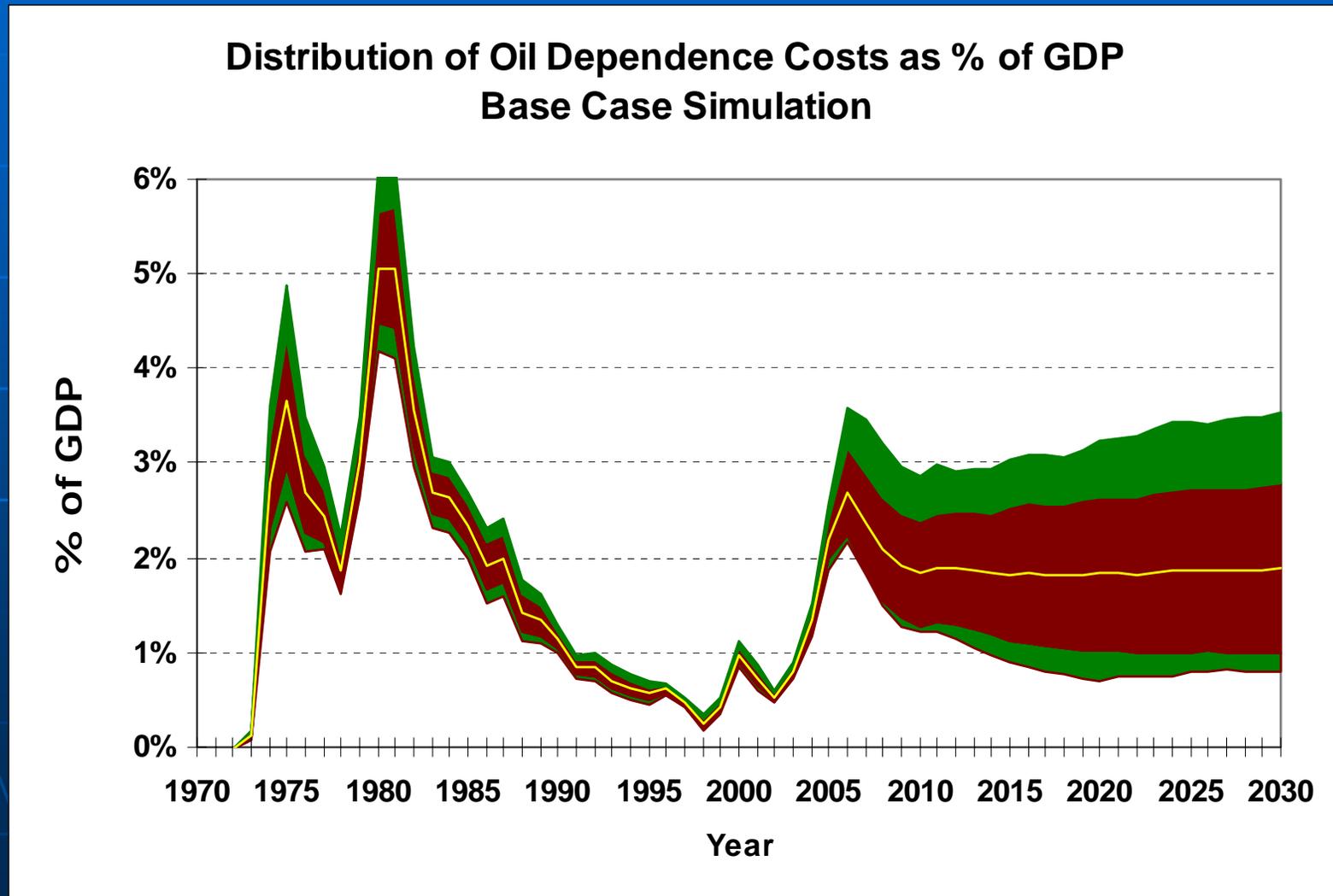
- For all conceivable world oil market conditions, the costs of oil dependence to our economy will be so small that they have no effect on our economic, military or foreign policy.

- QUANTITATIVE:

- The estimated total economic costs of oil dependence in any year will be less than 1% of GDP with 95% probability by 2030. (Greene et al., 2007).

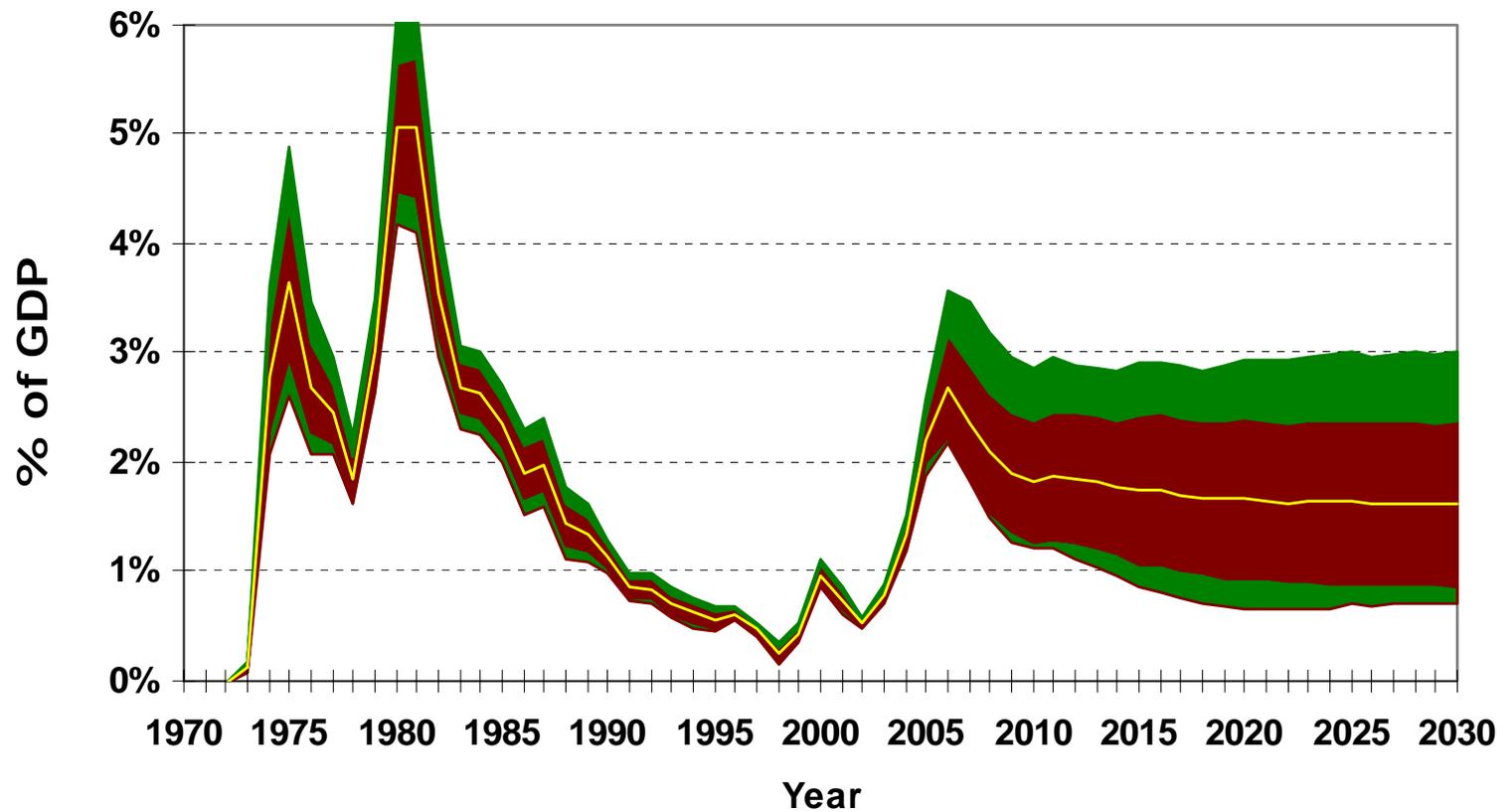
Expected oil dependence costs under BAU = 2% of GEP with a 90% C.I. of 0.8-3.5% of GDP.

(Interior interval = +/- 1 std. dev., exterior interval = 5% to 95% C.I.)



A one-time single-focus policy is insufficient: Raising LDV fuel economy to 35 MPG by 2017, then stopping, lowers the cost range to 0.5% to 3.0%.

**Distribution of Oil Dependence Costs as a % of GDP
Fuel Economy Case, OPEC Maintains Scenario Oil Price**



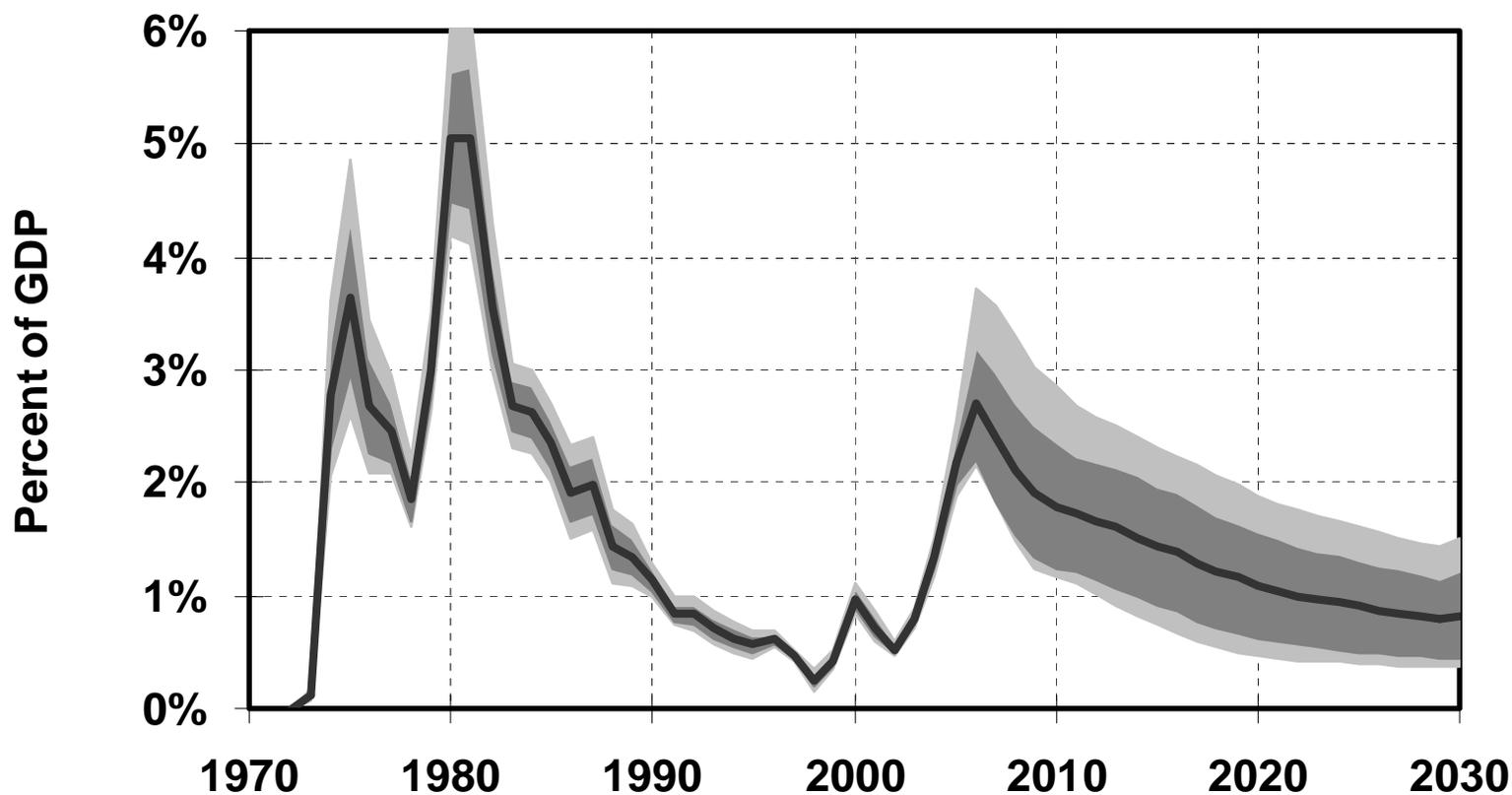
The AEO Cases represent BAU, a modified NCEP plan a comprehensive energy policy.

TABLE 1 Estimated Changes in U.S. Oil Supply and Demand in 2030 for the Modified NCEP Oil Independence Strategy (Millions of Barrels per Day)

	Oil Demand	Oil supply
Reference Case	27.57	10.42
NCEP Case Changes		
Light vehicle fuel economy	-3.50	
Heavy vehicle fuel economy	-0.53	
Rail and ship energy efficiency	-0.20	
Eliminate building heating with oil	-0.37	
Industrial efficiency, substitution	-0.62	
Coal to liquids		1.00
ANWR and Pacific Offshore		2.00
Biofuel	-2.00	
Subtotal: Decrease in Demand	-7.22	
<i>Subtotal: Increase in Supply</i>		3.00
NCEP Case Totals	20.35	13.42
Percent Change from Reference Case	-26%	29%

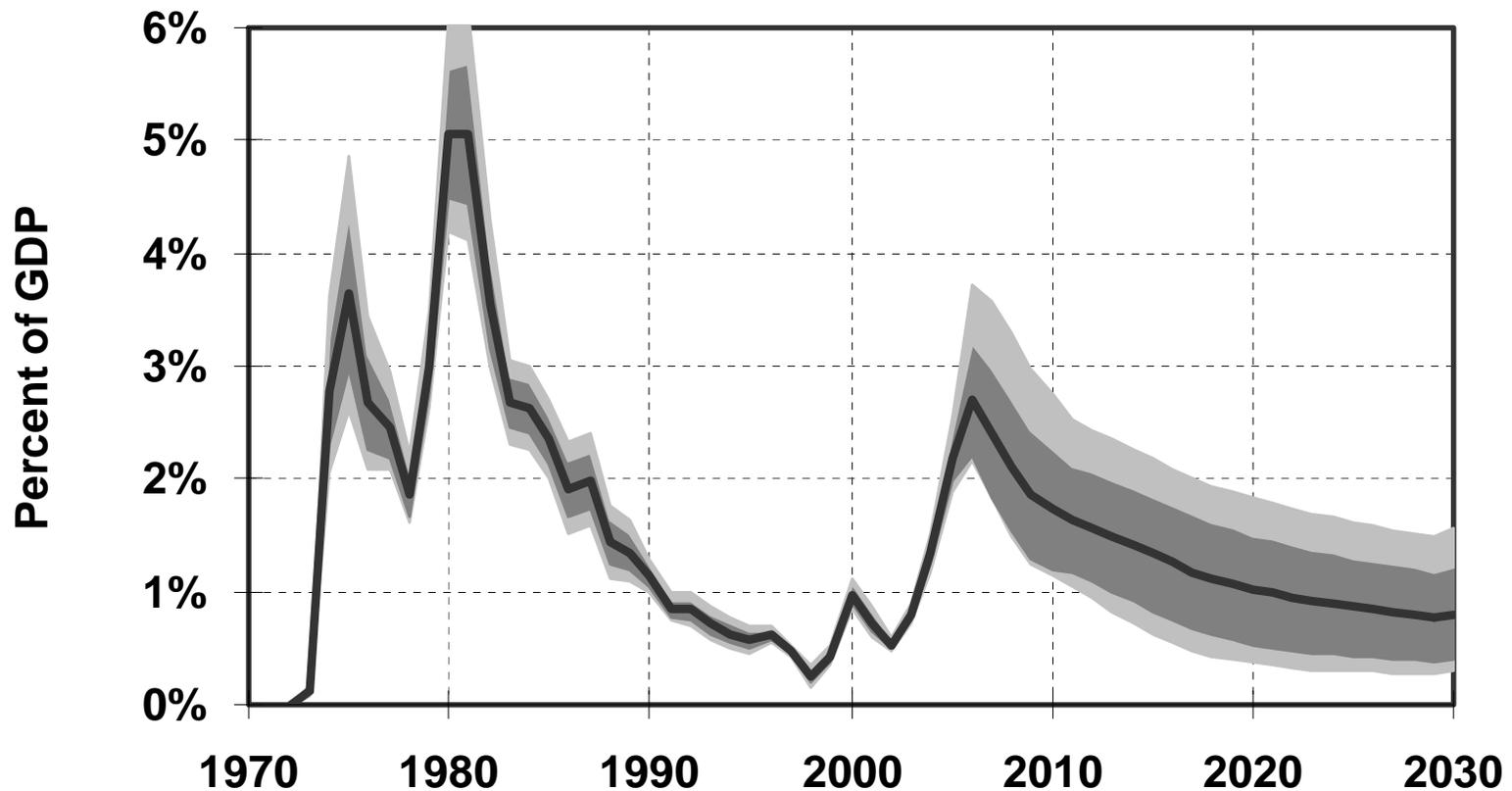
The NCEP strategy falls just short of the independence goal. More is needed, and progress must be sustained beyond 2030.

**Distribution of Oil Dependence Costs as a Percent of GDP:
NCEP Strategy Scenario, OPEC Maintains Price**



Oil independence works regardless of OPEC's response strategy.

**Distribution of Oil Dependence Costs as a Percent of GDP:
NCEP Strategy Scenario, OPEC Maintains Production**



Transportation faces other serious energy challenges.

- Achieve oil independence.
- Reduce carbon dioxide emissions.
- Undertake a transition to sustainable energy sources.
- An integrated strategy is needed.
- A measurable goal for oil independence and a means of testing proposed strategies is a necessary component.

THANK YOU.

Selected References:

- Adelman, M., "The Real Oil Problem", Regulation, Spring 2004.
- Auerswald, P.E., "The Myth of Energy Insecurity", Issues in Science and Technology, Summer 2006.
- Barsky, R.B. and L. Kilian, "Oil and the Macroeconomy Since the 1970s", Jour. Of Econ. Perspectives, vol. 18, no. 4, pp. 115-134, Fall 2004.
- Council on Foreign Relations, "National Security Consequences of U.S. Oil Dependency", N.Y., N.Y.
- Gholz, E. and D.G. Press, "Energy Alarmism: The Myths That Make Americans Worry About Oil", Policy Analysis, the Caro Institute, April 5, 2007.
- Greene, D.L., D.W. Jones and P.N. Leiby, "The Outlook for US Oil Dependence", Energy Policy, vol. 26, no. 1, pp. 55-69/
- Greene, D.L. and P.N. Leiby, "The Oil Security Metrics Model", ORNL/TM-2006/505, Oak Ridge National Laboratory, May 2006.
- Greene, D.L. and S. Ahmad, "Costs of U.S. Oil Dependence: 2005 Update", ORNL/TM-2005/45, Oak Ridge National Laboratory, January 2005.
- Greene, D.L. et al., "Oil Independence: Achievable National Goal or Empty Slogan", Transportation Research Record, forthcoming. (Summary available on Sen. Lugar's website.
- Huntington, H., "The Economic Consequences of Higher Crude Oil Prices", EMF SR 9, Energy Modeling Forum, Stanford Univ., October 3, 2005.
- Leiby, P.N. et al, "Oil Imports: An Assessment of Benefits and Costs", ORNL-6851, Oak Ridge National Laboratory, November 1, 1997.
- Lovins, A.B., "Winning the Oil Endgame", Rocky Mountain Institute, 2006, available on the www.
- Parry, I.W.H. and J. Darmstadter, "The Costs of US Oil Dependency", prepared for the National Commission on Energy Policy by Resources for the Future, Washington, D.C., November 17, 2004.
- Parry, I.W.H. and J.W. Anderson, "Energy Independence is Unrealistic", Resources, RFF, Winter 2005.