Economic Impacts of Global Petroleum Supply Shocks

Reducing Energy Intensity to Reduce Vulnerability

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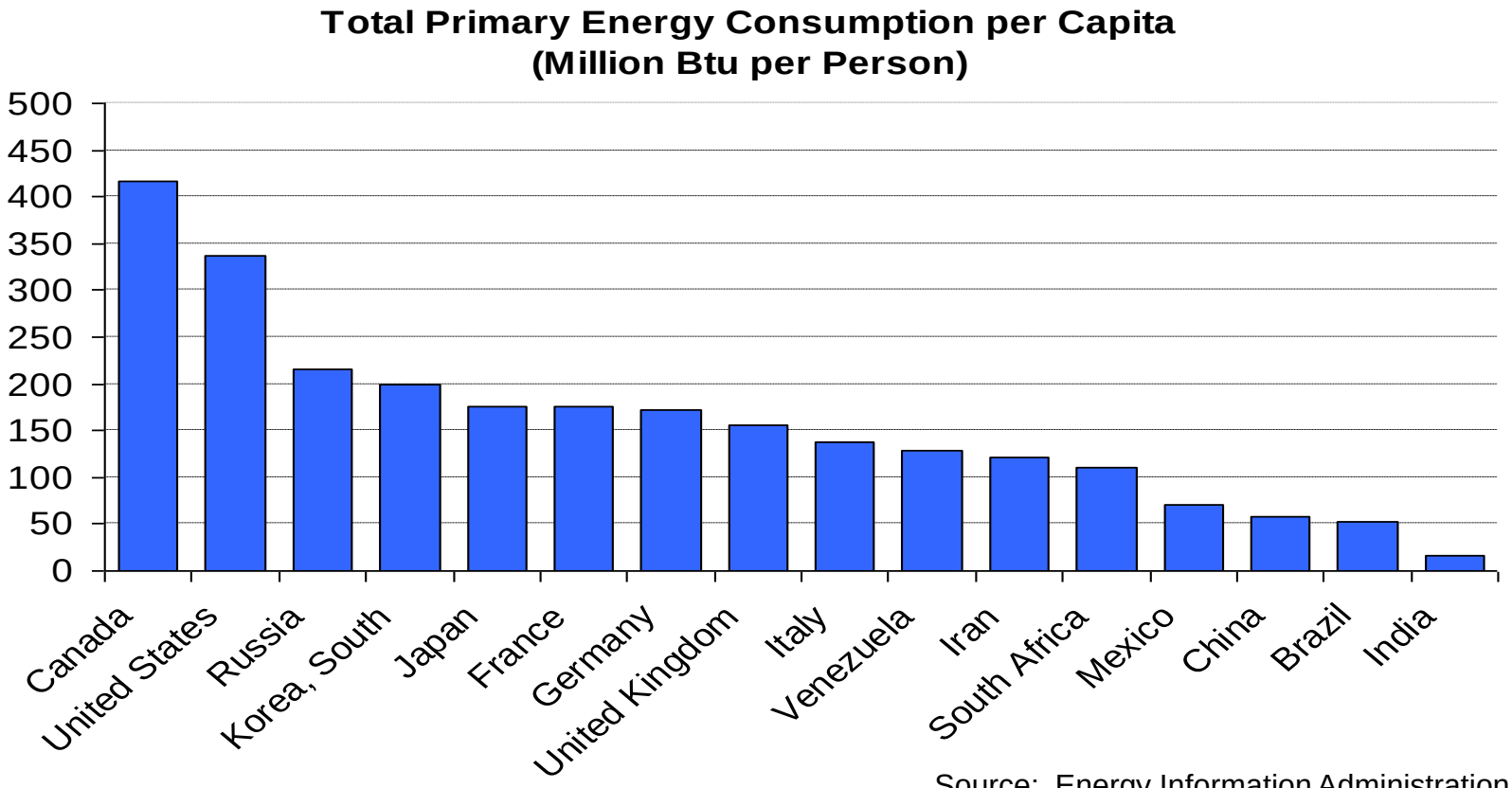
Energy Dependence and National Security

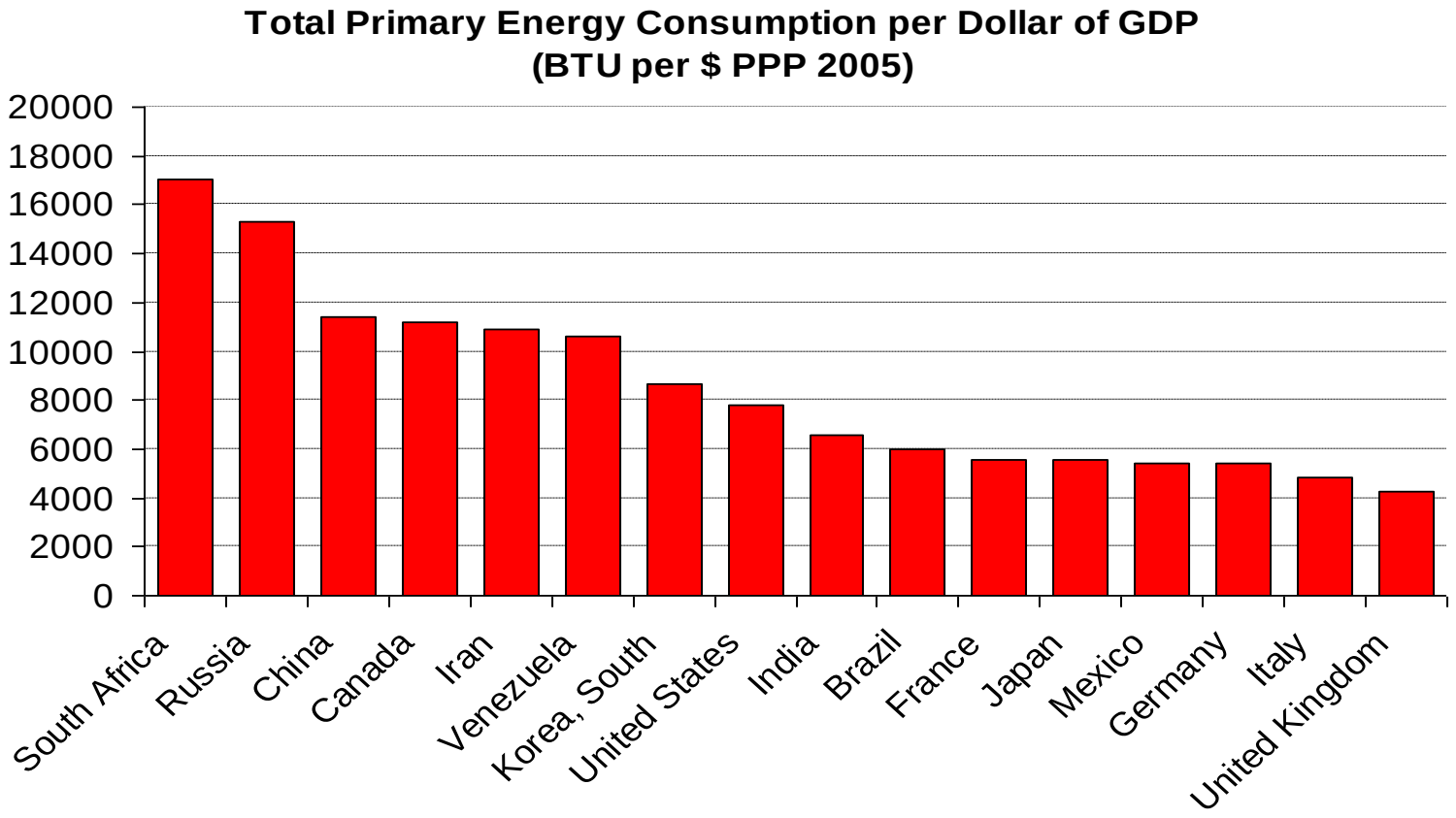
- "The U.S. 'addiction' to oil comes largely from gasoline consumption, which as a share of GDP is nearly five times that in other major industrial countries." (IMF, WEO, April 2007)



Source: Energy Information Administration, DOE

Energy Dependence and National Security

- Fuel intensity in the U.S. is 30 percent higher than EU and Japan



Source: Energy Information Administration, DOE

Economic Damage from Oil Supply Shocks: Important Factors

- Size matters: 9.6 MBD is more than twice 4.8 MBD.
- Duration: 6 months is more than twice 3 mos.
- Current supply/demand equation: Is there unused capacity?
- What is the underlying cause? Military/civil strife will tend to have a negative *psychological* impacts.
- Did the shock appear unexpectedly or were there warnings?
- Perceptions: Is price spike is temporary or permanent?

Economic Resilience

- Actions that mute the direct and indirect shocks by using remaining resources as efficiently as possible and by compressing the time-span of losses by speeding recovery.*
- Price rationing (inherent resilience) minimizes economic damage: Available energy flows to highest value activities. Large and efficient markets in energy are more resilient.
- Fuel subsidies/price controls hamper adjustment (US vs. China).
- Excess capacity, inventories and SPR. Planning and assets necessary for tapping reserves (e.g., logistics).
- Non-price demand measures (adaptive resilience) such as input substitution, and changes to economic behavior (car pooling). Planning and assets to realize these conservation measures.

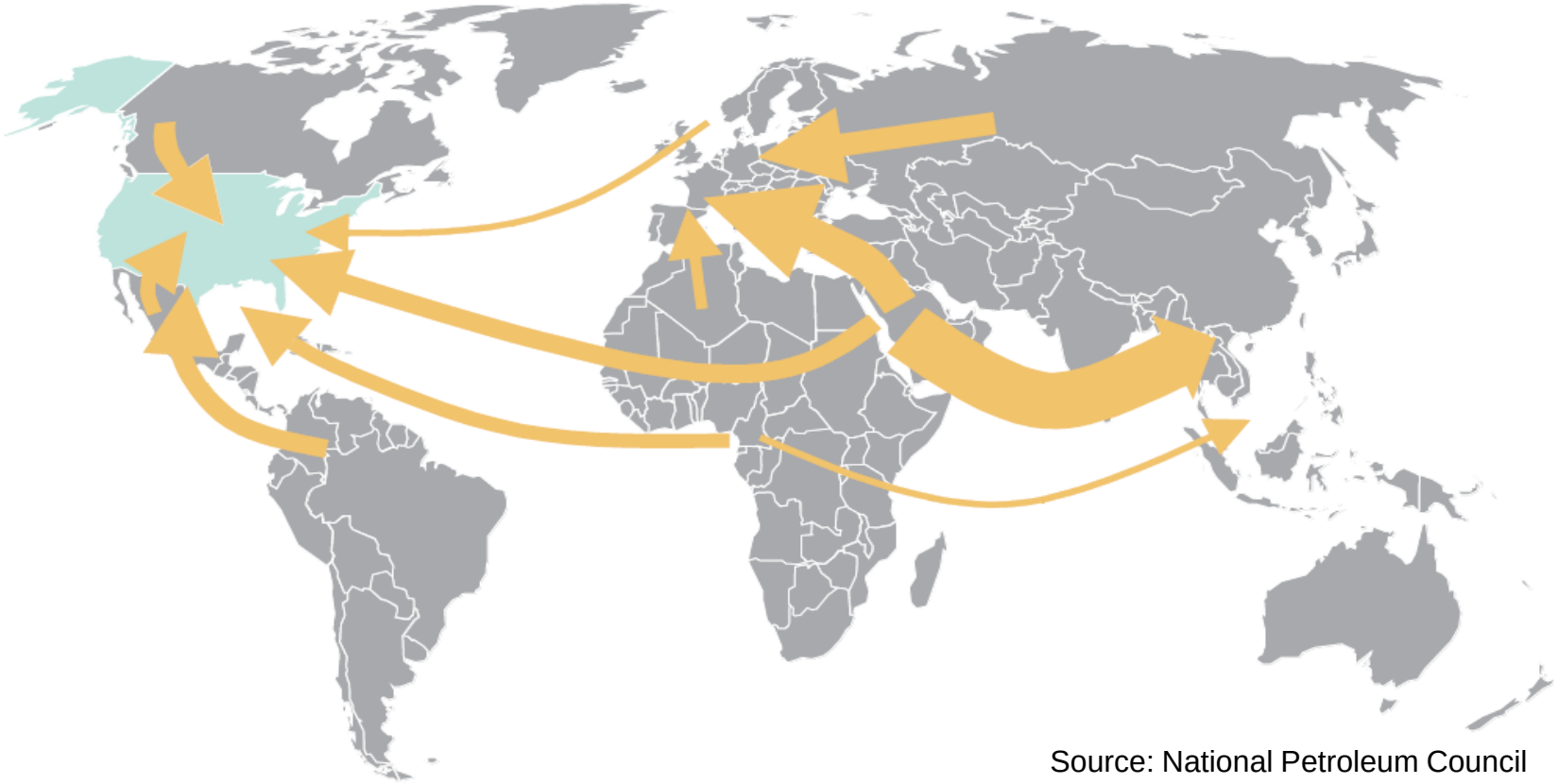
*Rose, A. 2004. "Defining and Measuring Economic Resilience to Disasters," *Disaster Prevention and Management* 13: 307-14.

Policy Considerations for a Substantial Oil Supply Shock

- Monetary policy will focus on financial market liquidity, stabilization. Given higher inflation, a direct reaction to lower growth will secondary.
- Fiscal Policy effectiveness and options would be very limited.
- Some non-price rationing might be necessary, especially with large shocks. Examples: Reducing work/school days to 4/week. Even-Odd?
- Fuel subsidies, taxes and surcharges.
- Strategic Petroleum Reserve and associated logistics.
- Distribution Decisions: High prices hit vulnerable groups. Something to think about ahead of time.
- Planning can be important. Adds to resilience.

Global Petroleum Flows

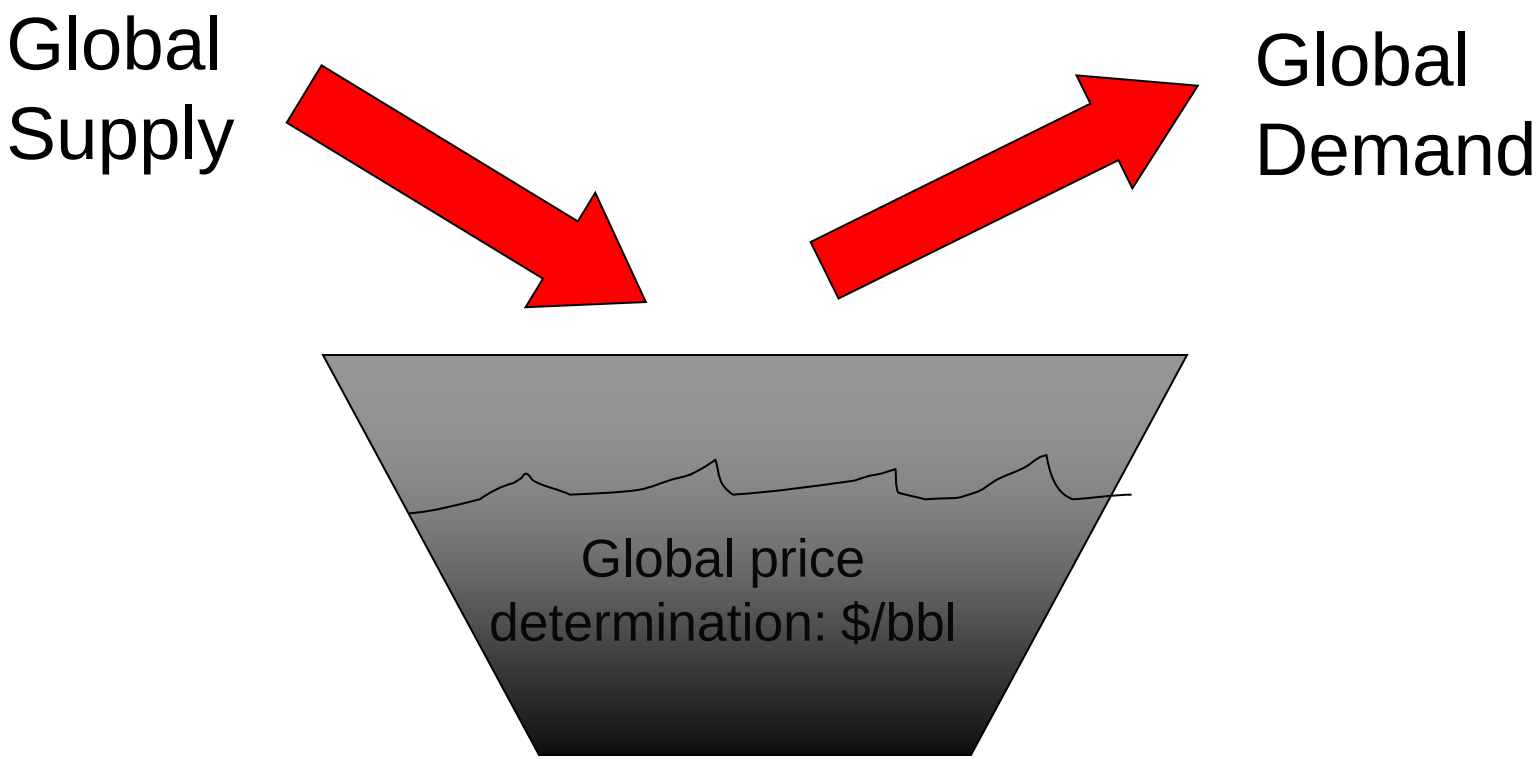
U.S. Supply sources are diversified



Source: National Petroleum Council

Petroleum Market

But “the price” is determined in a global market



Is there scope for maintaining supply through control of resources or long term contracts?

- Currently, at the margin petroleum is sold to the highest bidder.
- This market price sets prices globally, event those associated with long-term contracts or with intra-country sales.
- A 5-10% global supply interruption would probably not alter the current regime, that is, the price mechanism would apply globally.
- Larger shocks, or some altered, and plausible geopolitical situations, might alter this conclusion.

Oil Shock Simulations

Baseline:

- The economy enters 2009 growing slowly.
- End of 2008, oil prices are about $114/bbl.

Global oil supply disruption from Jan 1 to Jun 30, 2009:

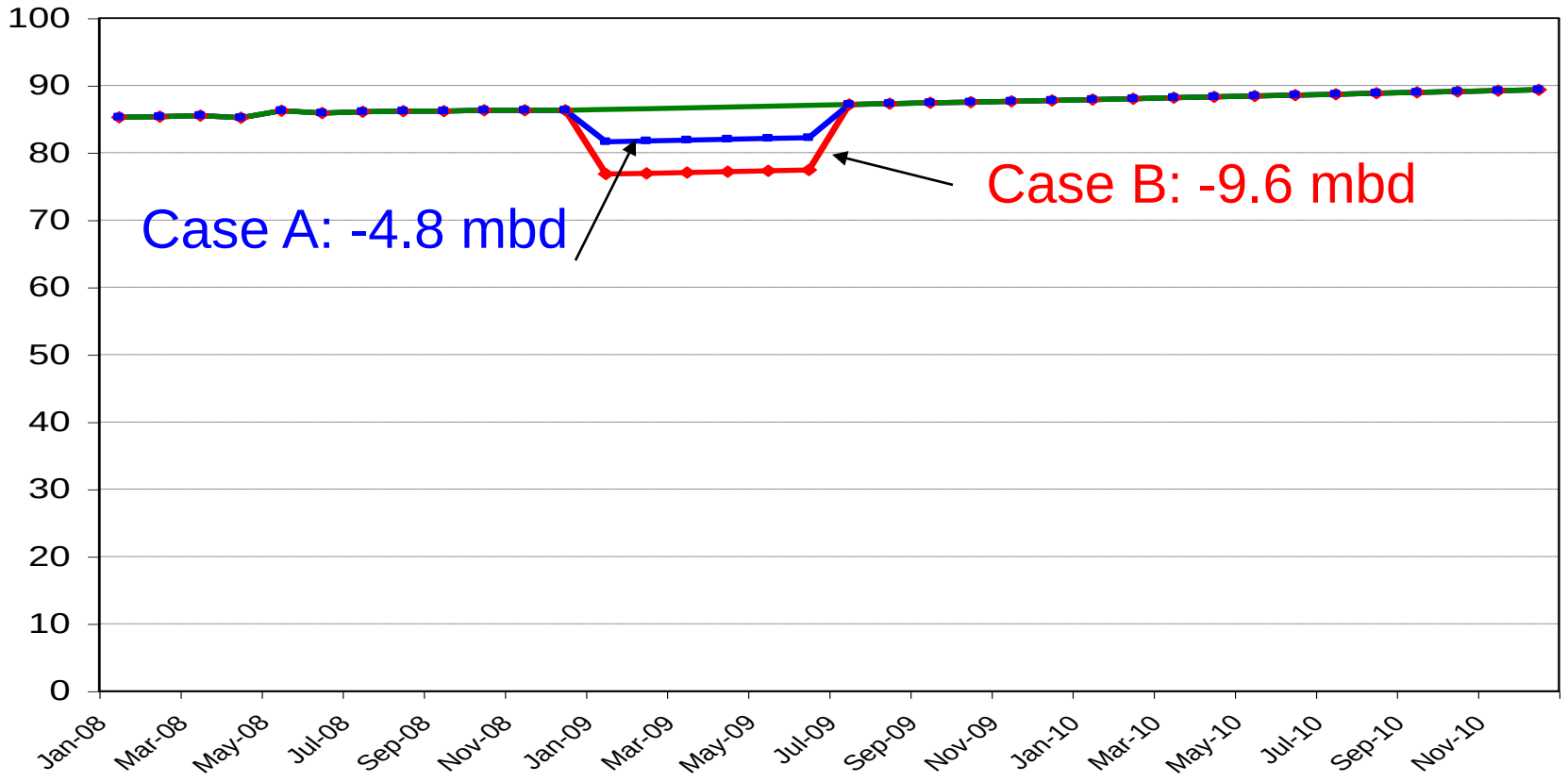
- A: 4.8 MBD (5.5%) for 6 months.
- B: 9.6 MBD (11.0%) for 6 months.
- US and other SDRs tapped.

Global price reaches:

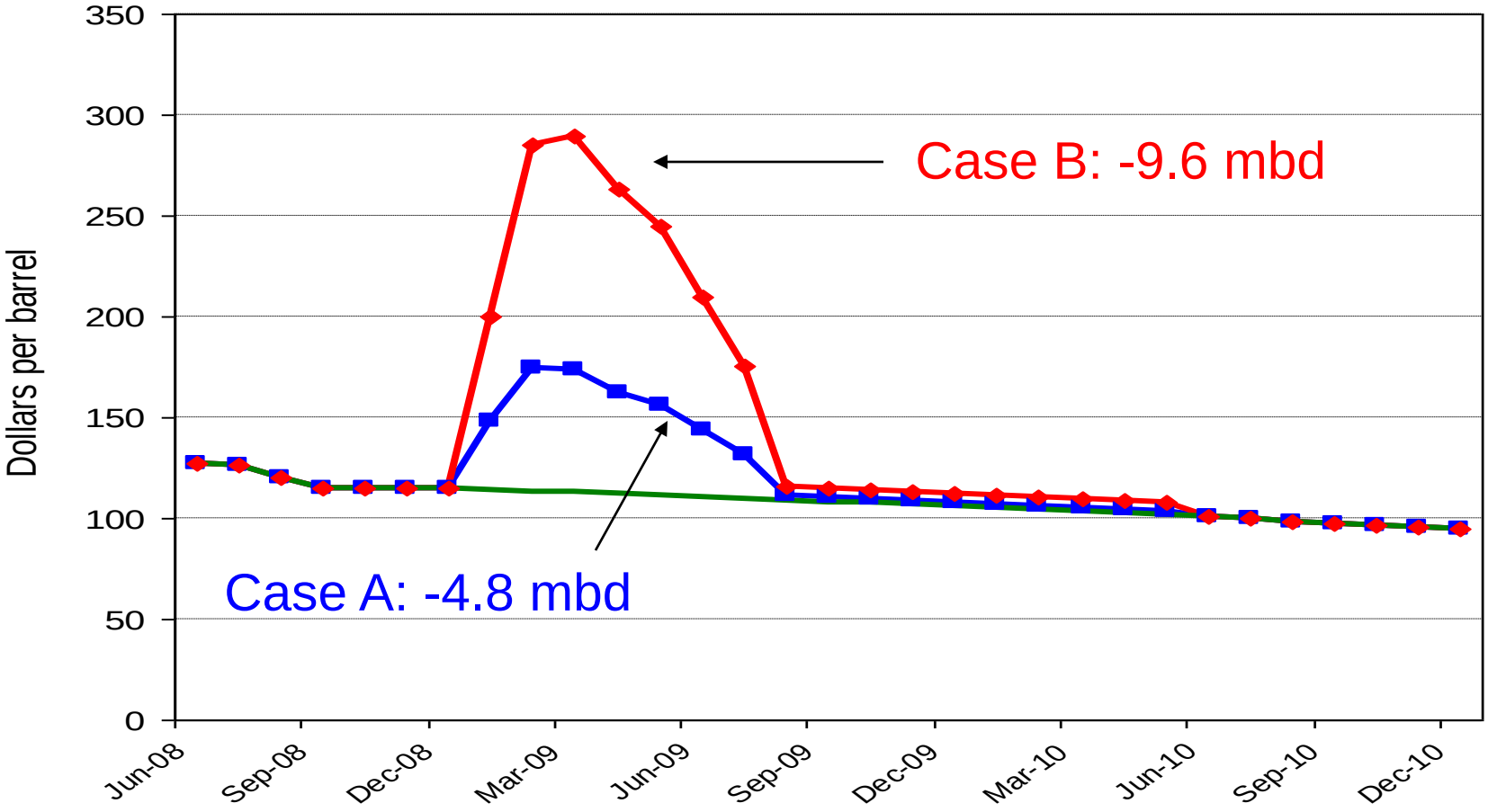
- A: $175/bbl by February, recedes slightly thereafter
- B: $289/bbl
- Uncertainty, anxiety adds to price pressure
- Some (non-Saudi) capacity and reserves relieve pressure (A: 1.25MBD; B:3.0 MBD).
- Rationing primarily through price, but significant non-price rationing occurs, especially in case B.

Global Oil Supply

Million Barrels per day



Global Oil Prices



Economic Damage of Price Shocks

1. Income/Demand Effects

Higher prices are an OPEC "tax" on consumers, firms and govt., as revenue flows abroad. Demand reduced for everything else.

2. Supply or Substitution Effects

Rising energy costs reduce profits or increase prices, especially for energy intensive items (transportation/tourism, chemicals). Demand for these reduced.

3. Policy Effects

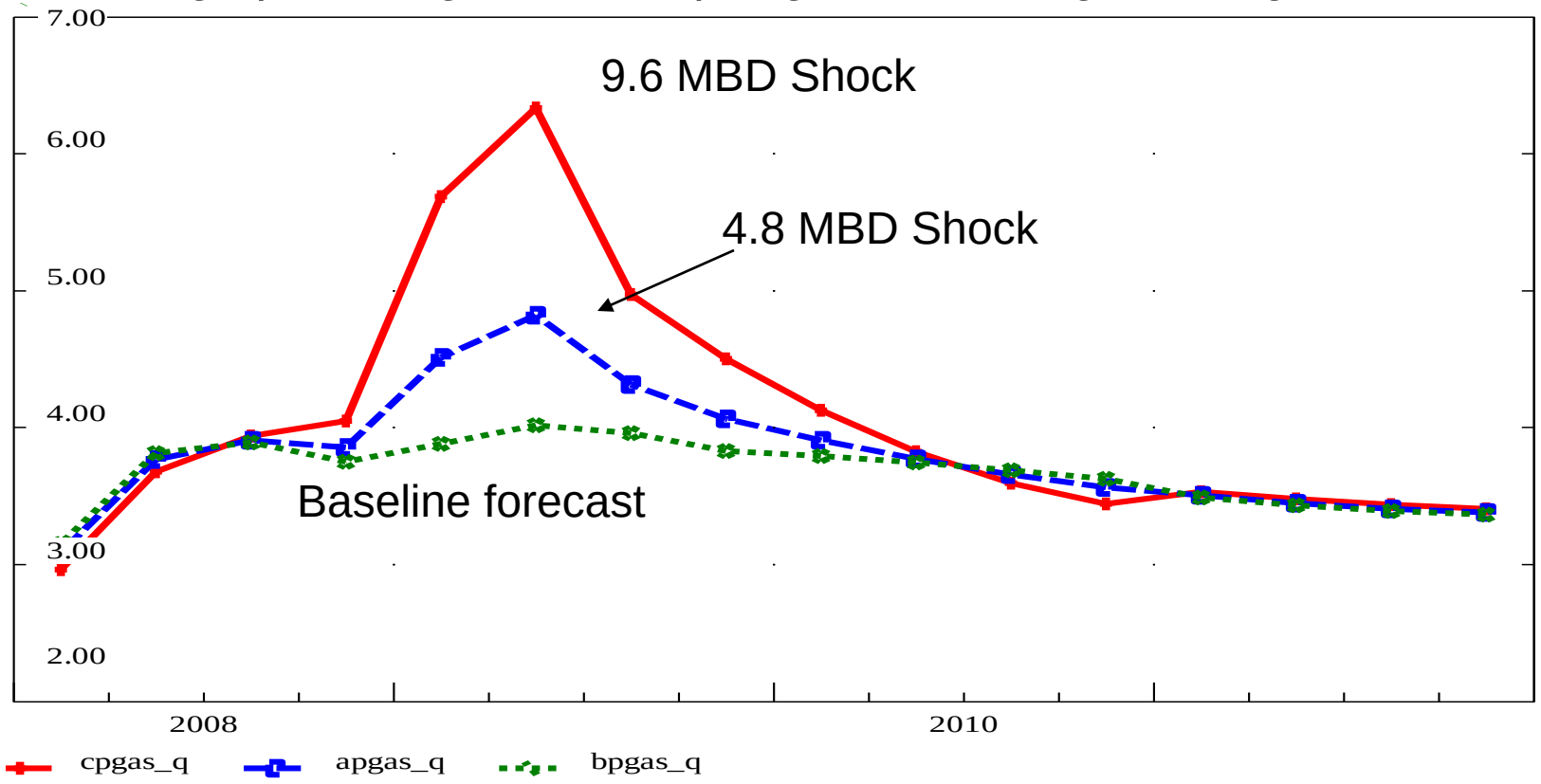
Higher energy prices spark inflationary pressure and causes monetary authorities to tighten credit conditions. Government energy bills rise substantially, crimping fiscal stimulus.

4. Effects on Confidence and Financial Market Psychology

Hurt consumer and investor confidence. As security prices, household wealth decline economy is weakened. Effects would be especially strong if cause is a major geopolitical event, such as a terrorist attack.

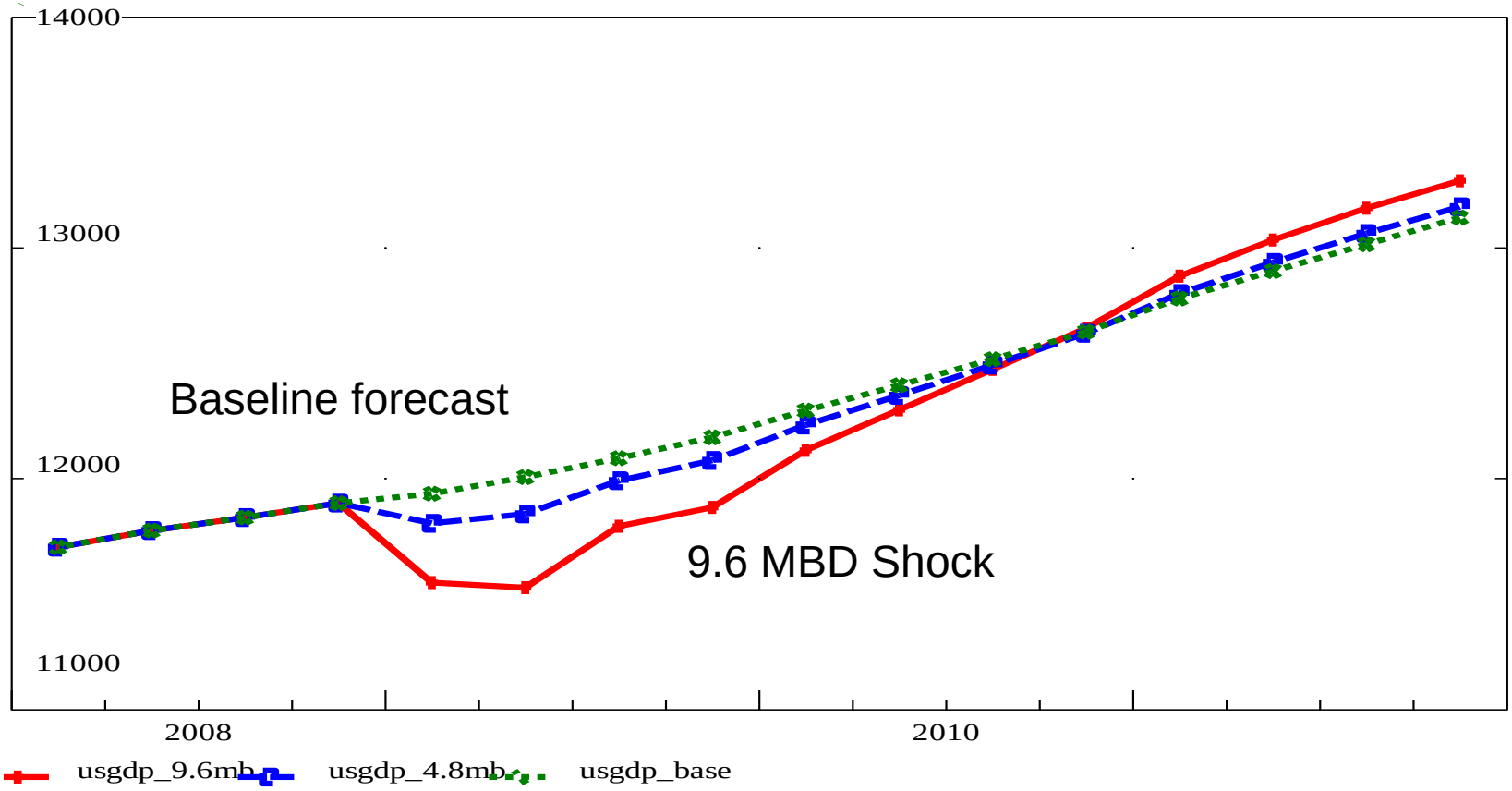
Gasoline prices rise sharply

Average price of gasoline, $ per gallon, average of all grades



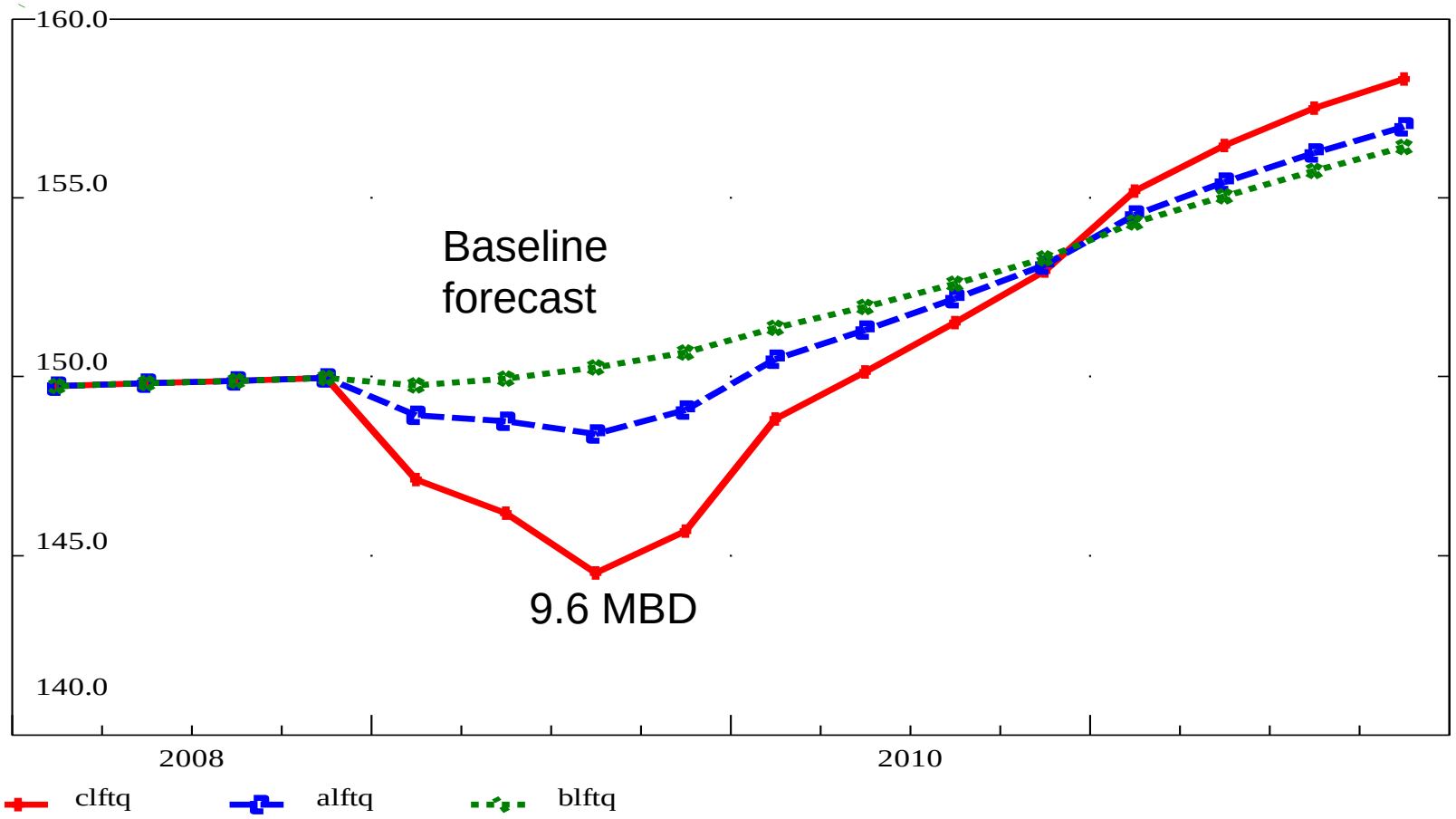
U.S. GDP Impacts: Damage is exponential. "Inherent" resilience contributes to "healing" in the intermediate term.

Real GDP in billions of 2000 dollars



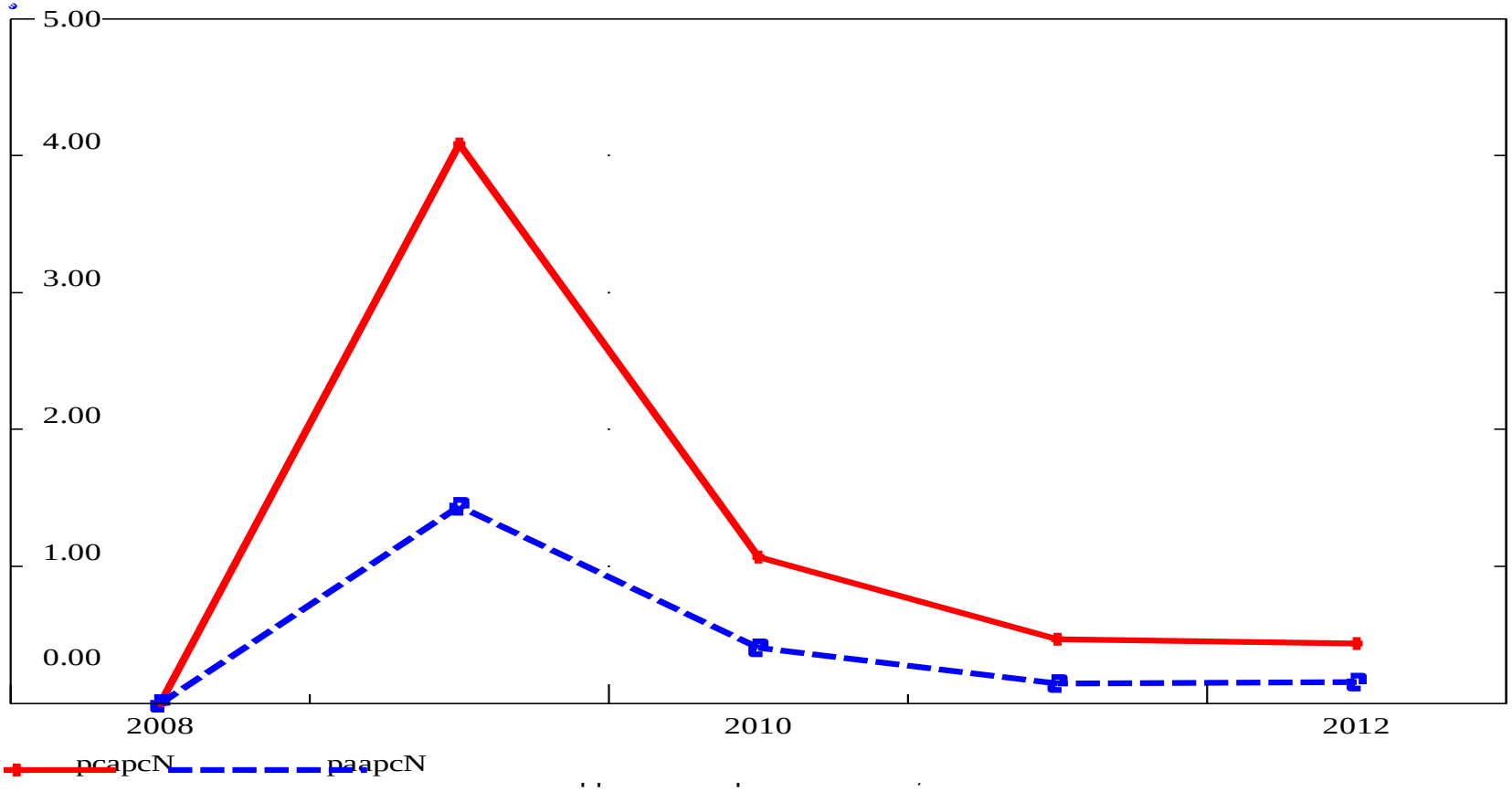
Employment is hit very hard.

U.S. Civilian employment, millions of jobs



Consumer prices: spike recedes.

Percent difference from baseline



U.S. Summary

United States	2009 Q1	2009 Q2	2009 Q3	2009 Q4	2009	2010	2011
GDP Growth baseline							
Baseline	1.4	2.4	2.8	3.1	2.1	3.4	4.0
4.8 MBD shock	-2.8	1.4	4.9	2.9	1.1	4.2	4.6
9.6 MBD shock	-11.1	-0.8	9.6	2.8	-1.0	6.0	5.7
Difference, percent of real GDP							
4.8 MBD shock	-1.1	-1.3	-0.8	-0.8	-1.0	-0.3	0.3
9.6 MBD shock	-3.2	-4.0	-2.4	-2.5	-3.0	-0.6	1.0
Difference, billions of 2008$							
4.8 MBD shock	-38.5	-48.2	-29.7	-31.3	-147.7	-40.9	46.7
9.6 MBD shock	-117.7	-146.6	-89.7	-93.5	-447.5	-93.0	166.7
Consumer price inflation (% change in prices)							
Baseline	1.9	2.4	2.2	1.9	2.6	1.7	1.2
4.8 MBD shock	8.9	4.8	-2.8	1.4	4.1	0.7	1.0
9.6 MBD shock	22.6	9.1	-10.9	0.3	6.8	-1.2	0.6
Consumer prices (% deviation from baseline)							
4.8 MBD shock	1.7	2.3	1.0	0.9	1.4	0.4	0.1
9.6 MBD shock	4.7	6.4	2.8	2.4	4.1	1.1	0.5
Unemployment rate							
Baseline	5.8	5.8	5.8	5.7	5.8	5.0	4.5
4.8 MBD shock	6.4	6.6	6.9	6.7	6.6	5.3	4.6
9.6 MBD shock	7.8	8.2	9.2	8.9	8.5	5.9	4.6

Conclusion: Energy Shocks

- Economy's dependence on fossil fuels makes it vulnerable to supply shocks. The negative impacts of shock duration and size are exponential.
- Petroleum is a global commodity and supply shocks entail global economic damage.
- Across countries, damage is associated with dependence.
- Economic resilience – inherent and adaptive – reduce the impact of shocks. Building resilience is a good idea.
- Dependence and vulnerability can be reduced in the long run.

Energy, Environment, and Economy (E3)

- Reducing energy use and carbon emissions are front-burner issue. National security issues are also salient.
- Strong and Positive Policy Leadership that stresses *economic incentives,* technology, transformation of economic structures will be fundamental. Taxes are most effective (recycled to reduce inefficient taxes on labor and capital). Not an OPEC tax.
- Gradual, but steady, transparent, and permanent policies are required.
- Several potential technology "pathways" provide strong potential.
- A long-term program of reducing fossil fuel energy dependence can make the economy less vulnerable to shocks.
- Business Roundtable: The Balancing Act: Climate Change, Energy Security and the U.S. Economy http://www.businessroundtable.org/sites/default/files/2009.06%20The%20Balancing%20Act_FINAL.pdf

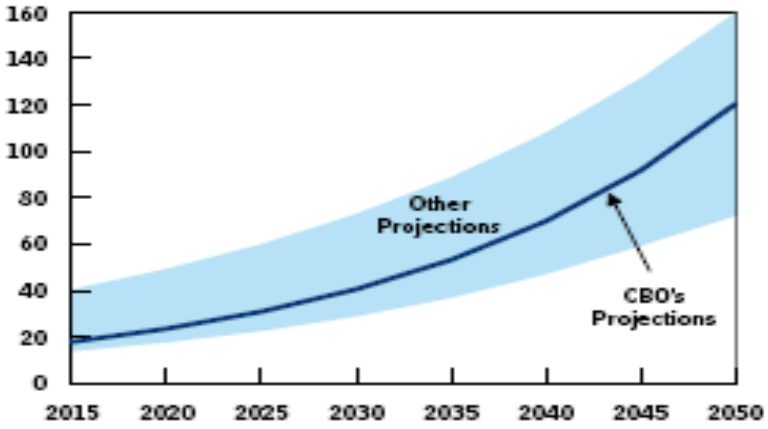
Myth: Pricing carbon would greatly harm economy

Figure 1.

Projections Under the American Clean Energy and Security Act of 2009

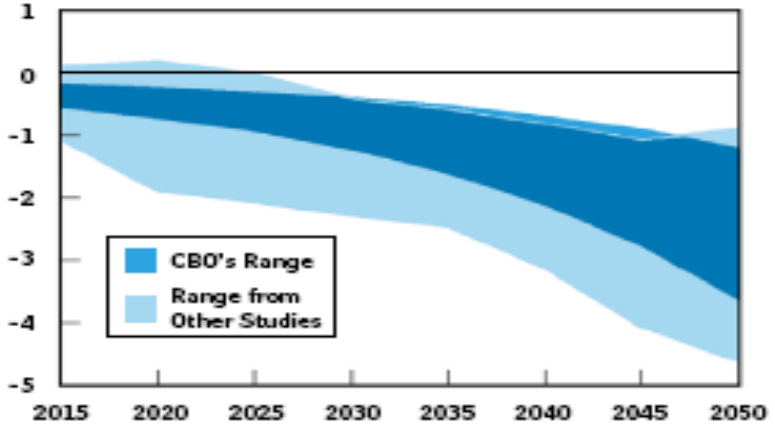
(2009 dollars per MT CO_2e)

Price Projections for Emission Allowances



(Percent)

Percentage Change in Real Gross Domestic Product



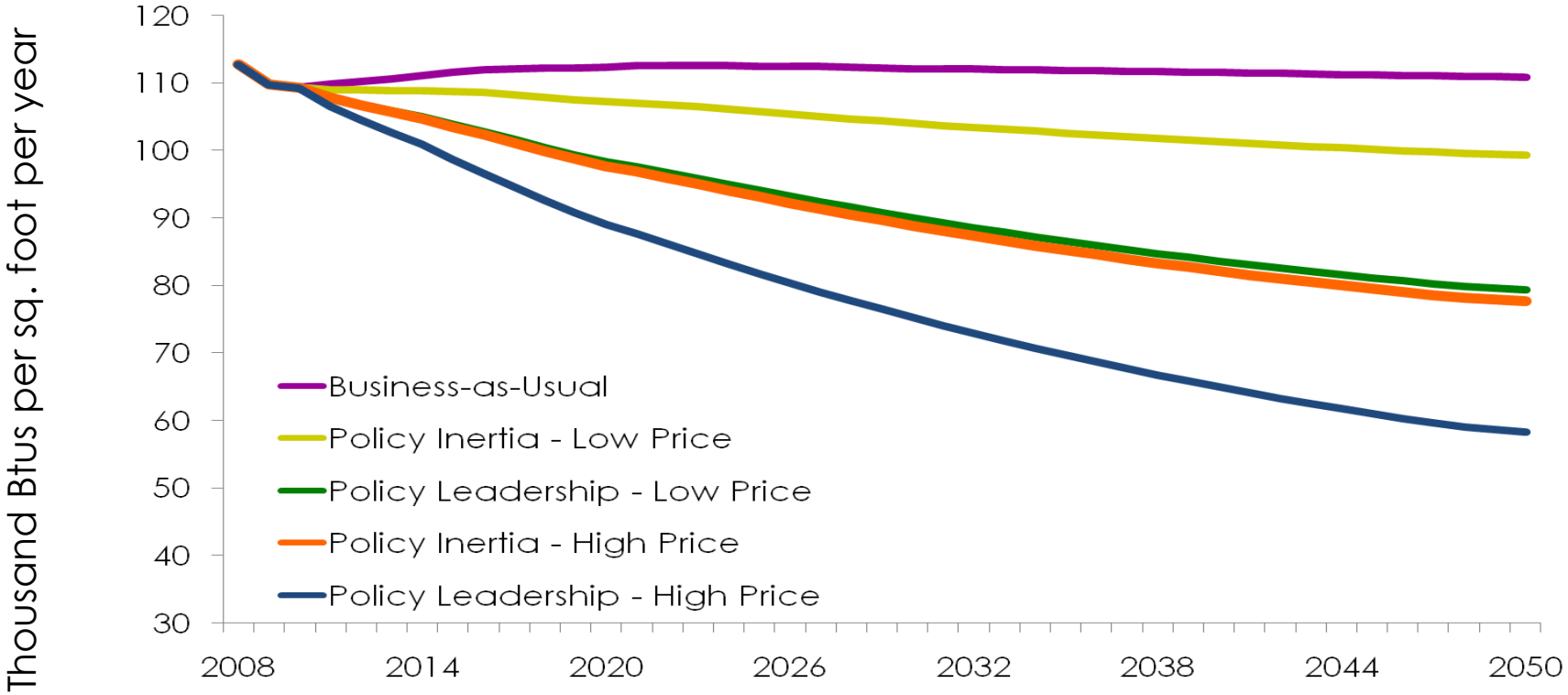
Source: Congressional Budget Office.

Notes: MT CO_2e = metric tons of carbon dioxide equivalent (or the amount of CO_2 that would cause an equivalent amount of warming).

The figures illustrate a range of estimates of the impacts of the emission reductions specified in the cap-and-trade portions of H.R. 2454, the American Clean Energy and Security Act of 2009. The estimates shown in the figure all reflect the full range of greenhouse gases covered by the bill, the banking of allowances, and the extensive use of international offsets. However, the estimates incorporate varying assumptions about economic growth, policy implementation, households' and firms' responses, the development and cost of various types of technology over time, and the availability of offsets.

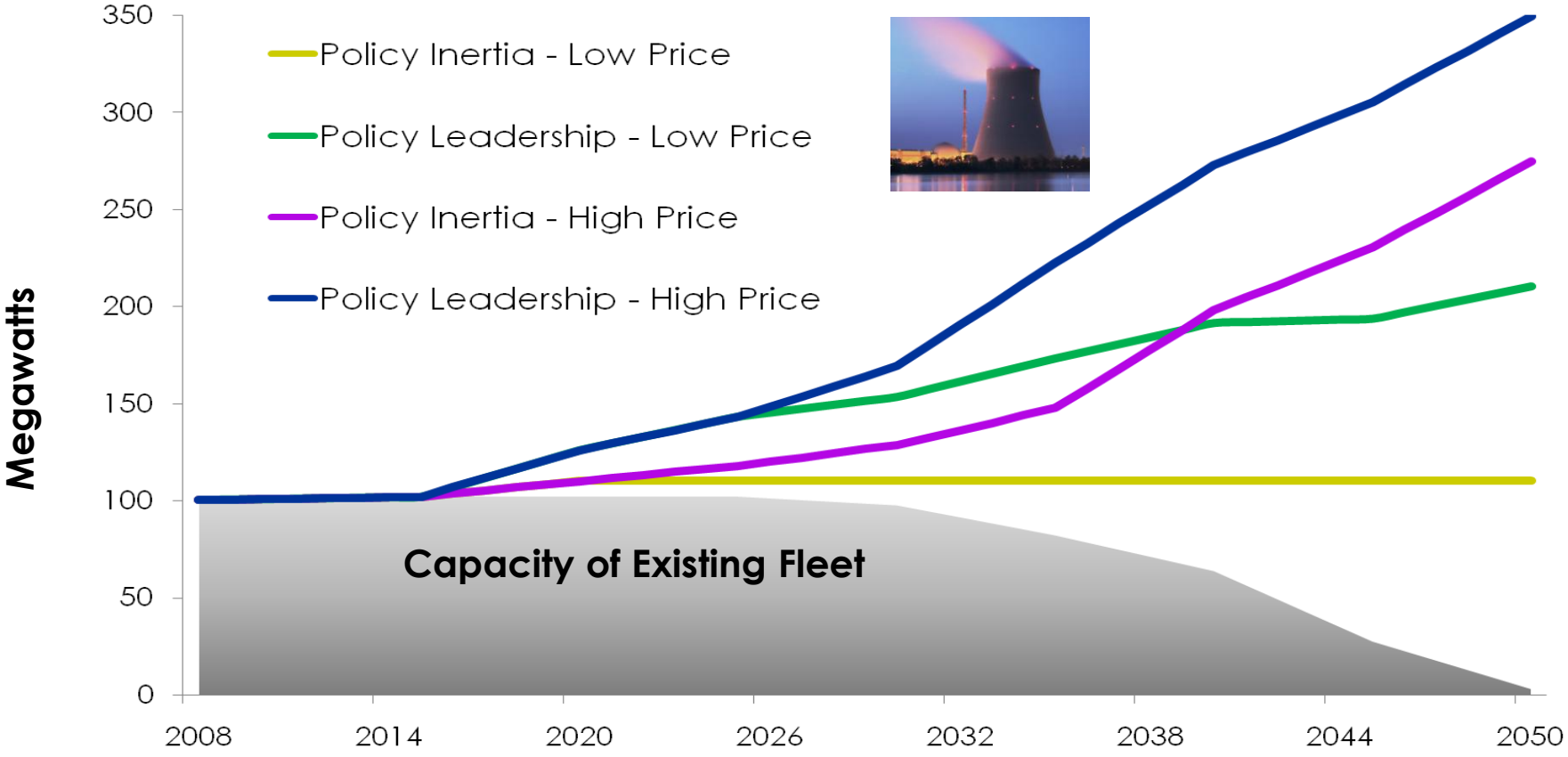
The projections displayed in the figures were produced by the Energy Information Administration, the Environmental Protection Agency, CRA International, Massachusetts Institute of Technology, the Brookings Institution, and the Congressional Budget Office.

Improvements in Commercial Building Efficiency Driven by Price and Policy



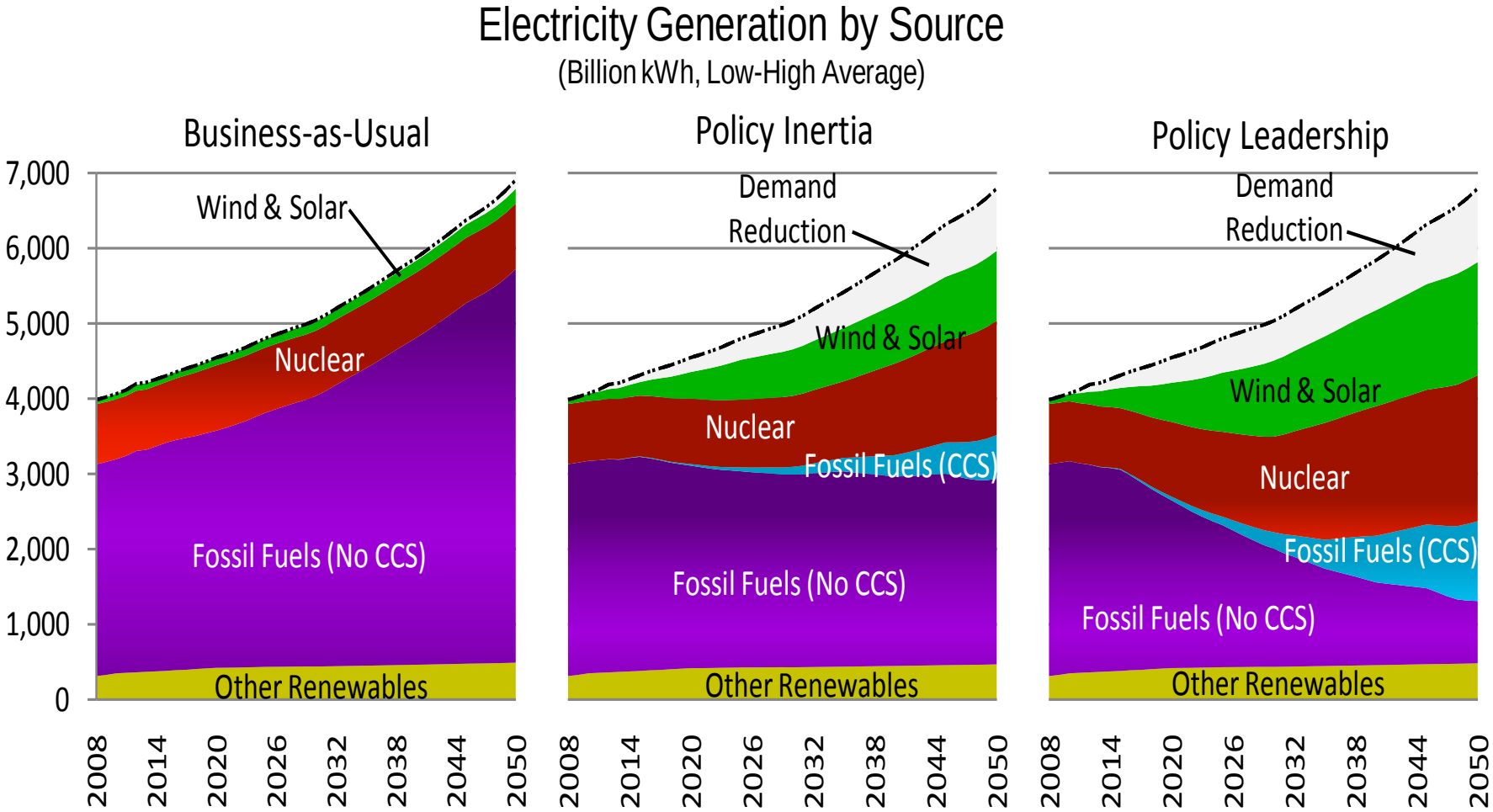
Source: Business Roundtable, *The Balancing Act, Climate Change, Energy Security and the U.S. Economy*
http://www.businessroundtable.org /sites/default/files/2009.06%20The%20Balancing%20Act_FINAL.pdf

Estimated Nuclear Power Deployment



Source: Business Roundtable, *The Balancing Act, Climate Change, Energy Security and the U.S. Economy*

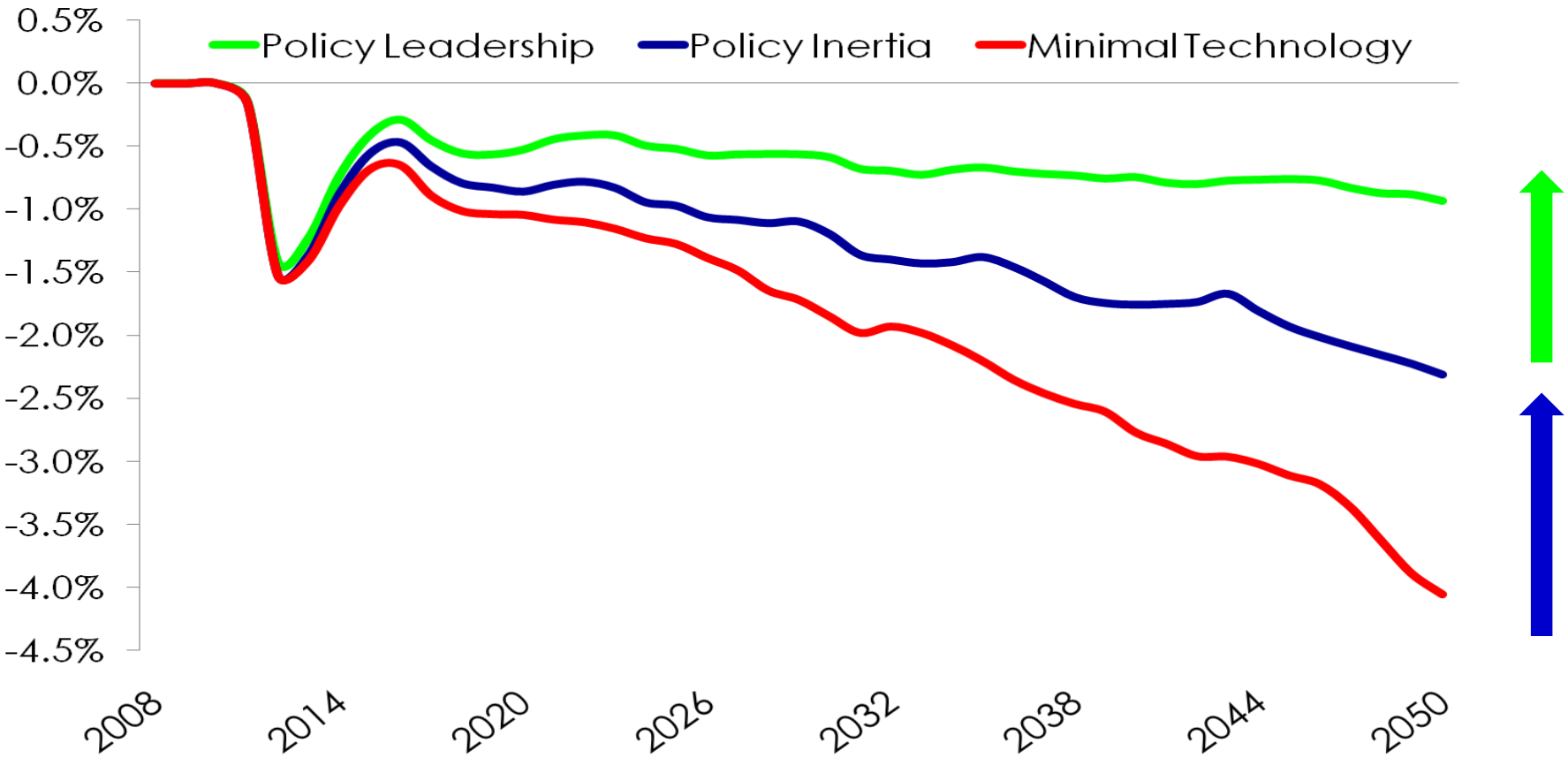
TECHNOLOGY DEPLOYMENT ESTIMATES: BALANCED PORTFOLIO SCENARIOS



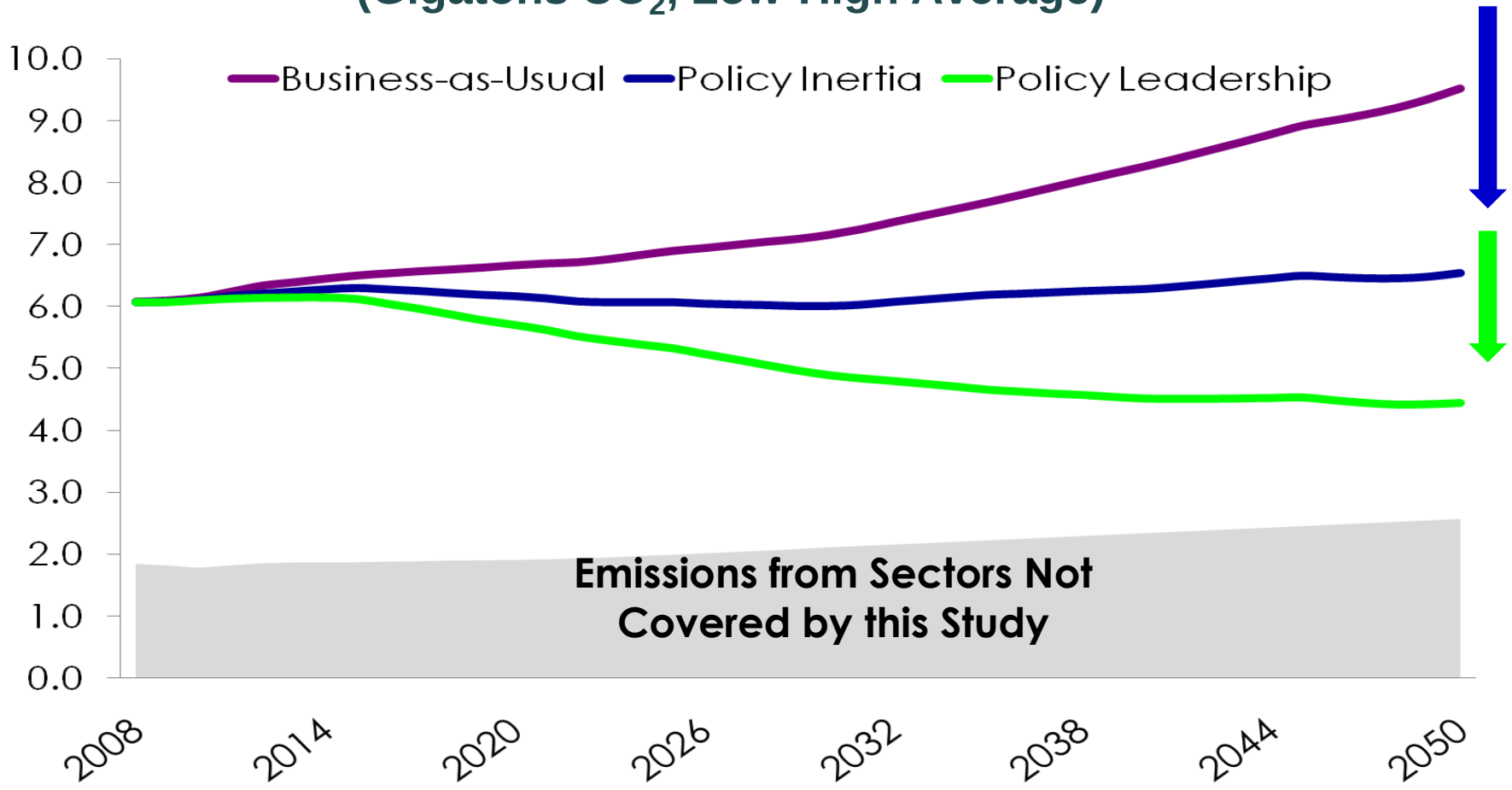
Source: Business Roundtable, *The Balancing Act, Climate Change, Energy Security and the U.S. Economy*

Distribution Statement A: Approved for public release; distribution is unlimited.

Real Gross Domestic Product
(% Change from BAU, Low-High Average)

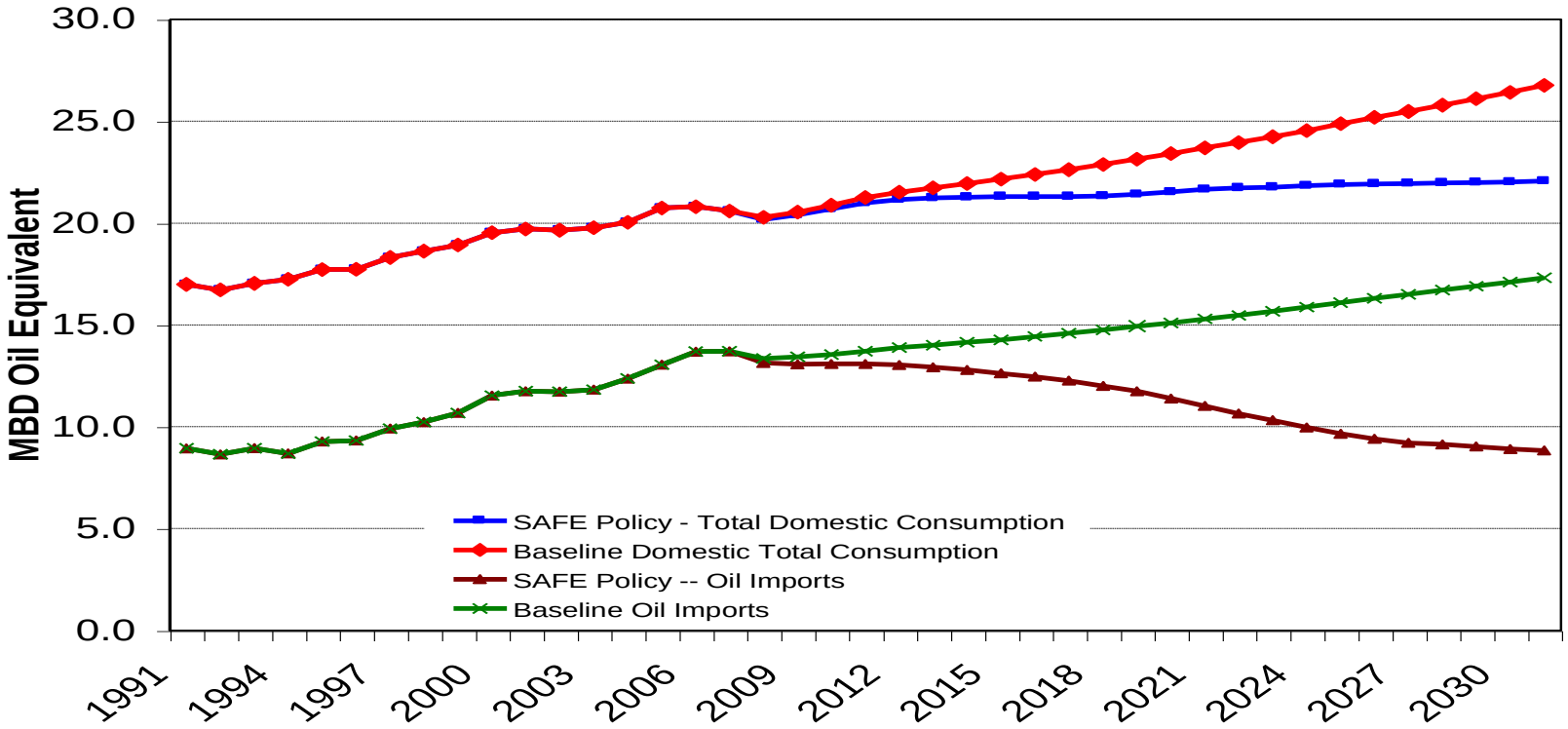


Carbon Dioxide Emissions (Gigatons CO_2, Low-High Average)



Demand Savings

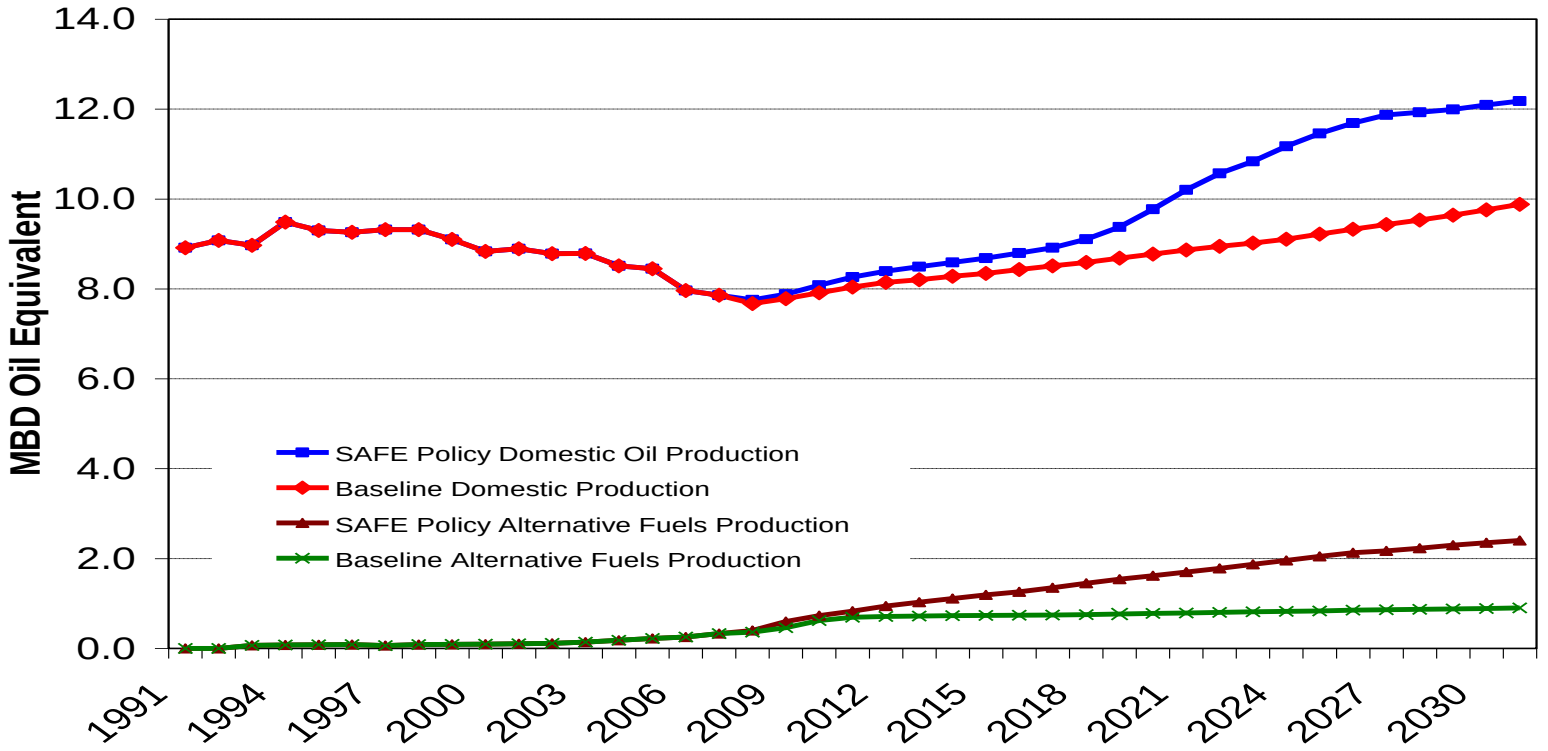
Figure 1
ESLC/SAFE Policy Impacts on Oil Consumption and Imports



Source: Securing America's Future Energy, *Summary of the Economic Impacts of Implementing "Recommendations to the Nation on Reducing U.S. Oil Dependence* (2007)

Domestic Supply Expansion

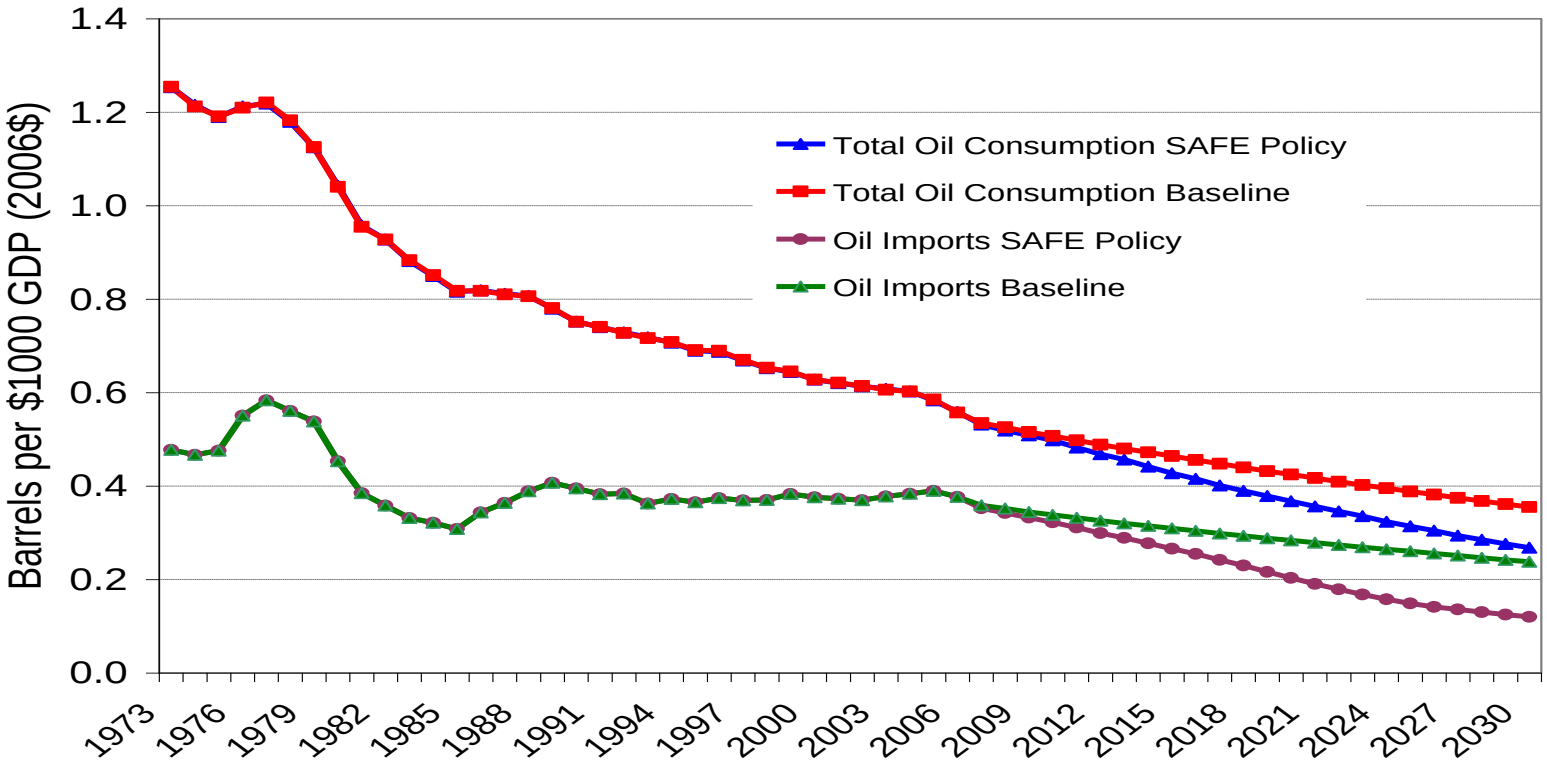
Figure 3
ESLC/SAFE Policy Impacts on Domestic Production



Source: Securing America's Future Energy, *Summary of the Economic Impacts of Implementing "Recommendations to the Nation on Reducing U.S. Oil Dependence* (2007)

Increased Energy Efficiency

Figure 4
Oil Consumption and Imports Intensity of GDP



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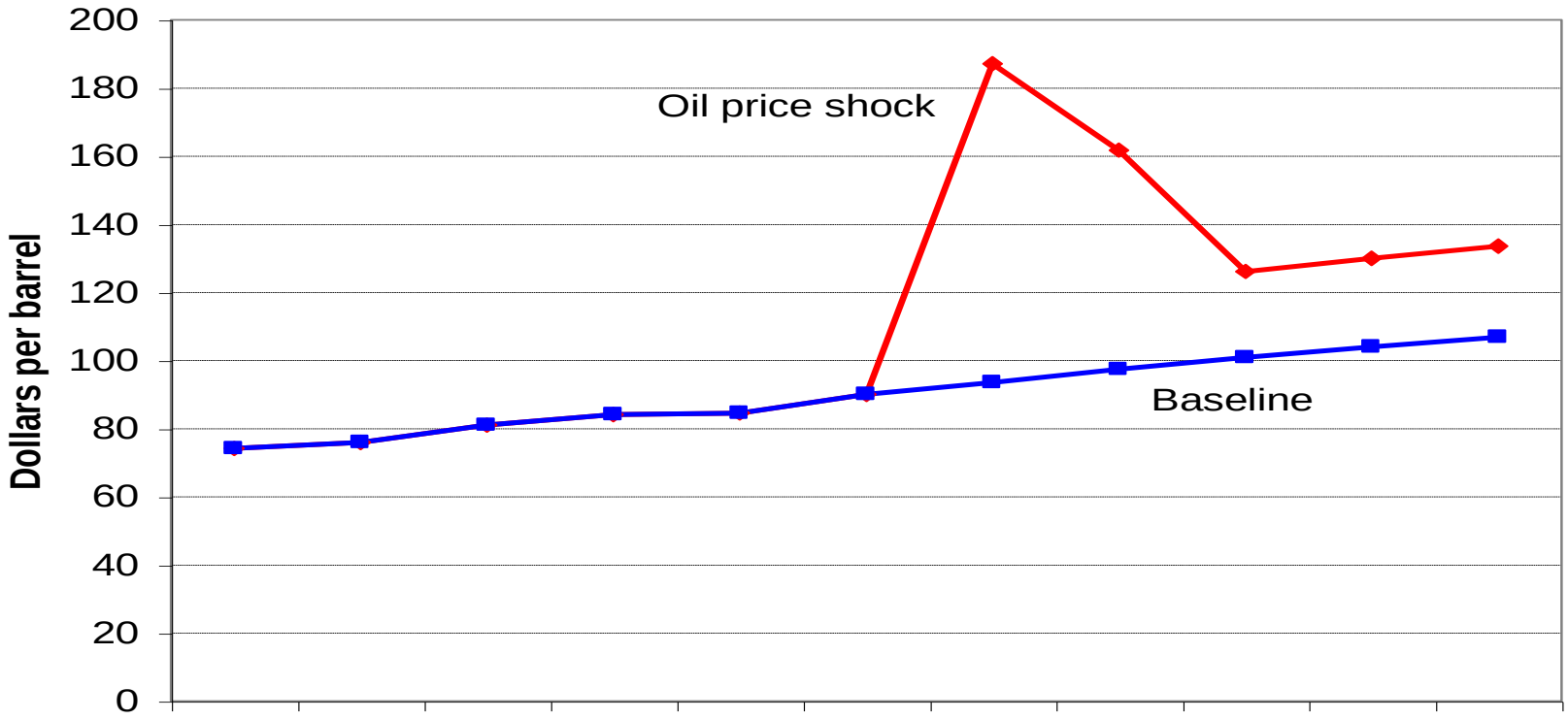
Economic Resilience to Oil Shocks

Figure 5
Oil Price Shock 2026- 2030: Nominal Price per Barrel



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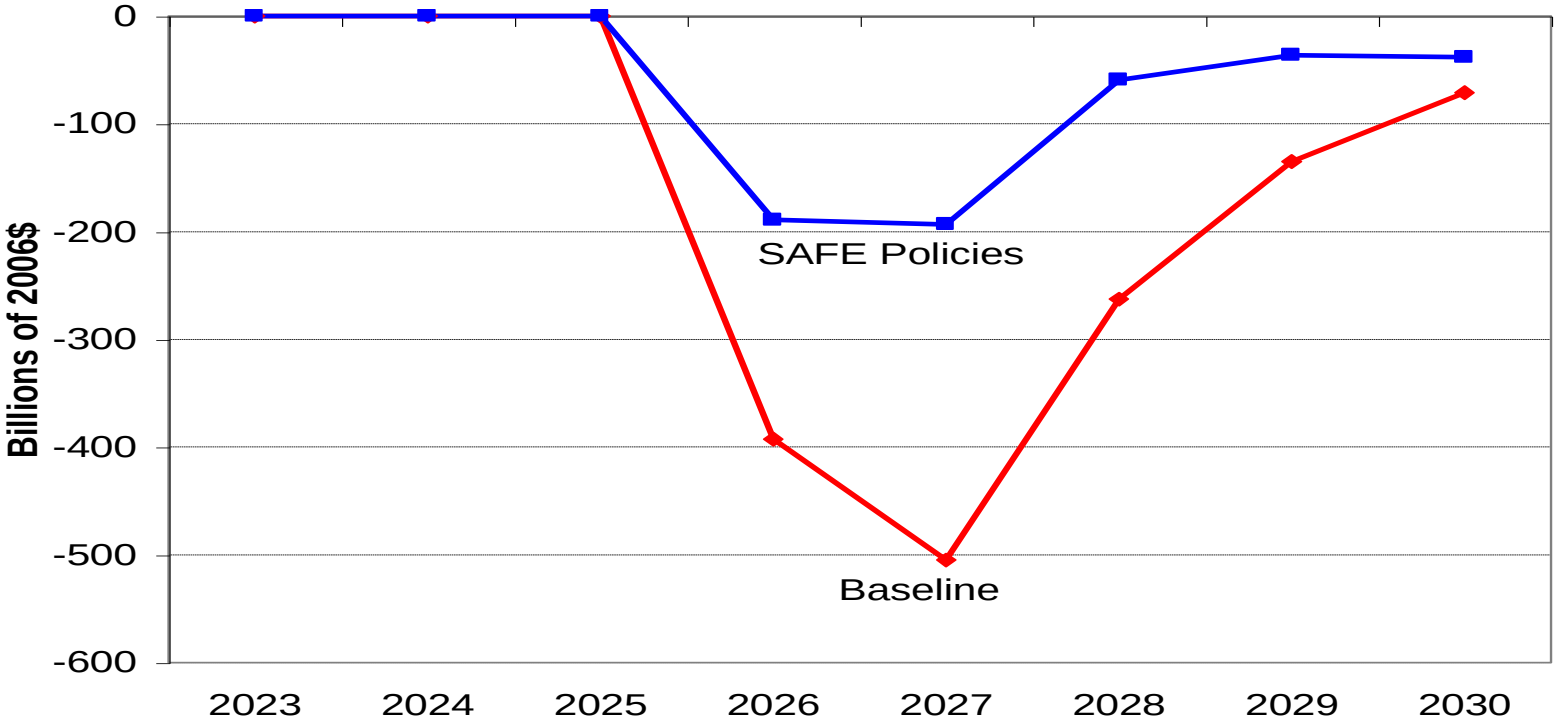
Economic Resilience to Oil Shocks

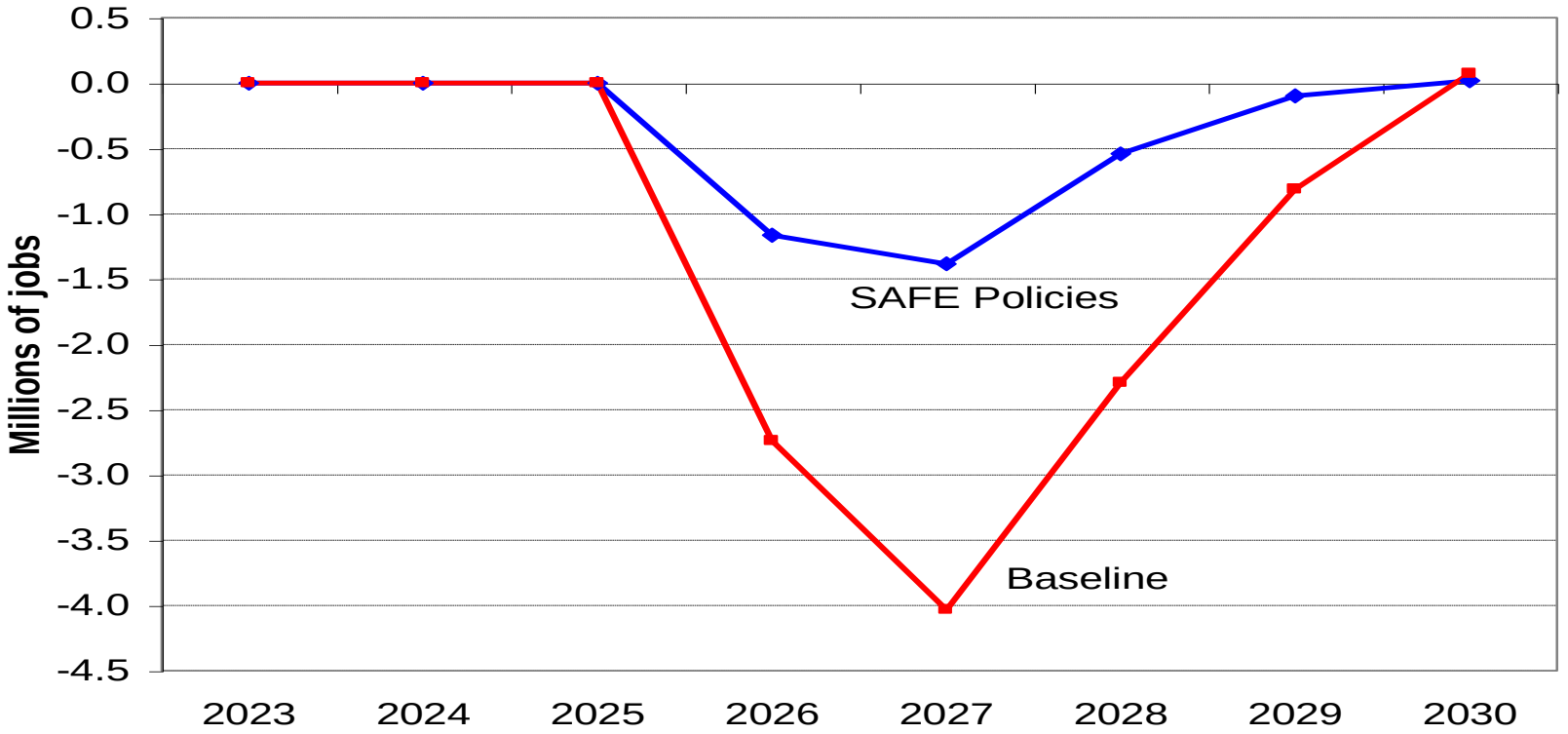
Figure 6
Oil Price Shock: Difference in Real Disposable Income



Source: Securing America's Future Energy, *Summary of the Economic Impacts of Implementing "Recommendations to the Nation on Reducing U.S. Oil Dependence* (2007)

Economic Resilience to Oil Shocks

Figure 7
Oil Price Shock: Difference in Aggregate Employment



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Conclusion: E3 and National Security

- Energy prices, climate change, Mid-East instability place E3 tradeoffs on center stage.
- Long-term program of reducing fossil fuel energy dependence can make the economy less vulnerable to shocks.
- If price rationing through markets is the best way to adapt to a shock, what is the best way to reduce long run fossil fuel dependence?
- Government mandates vs. energy taxes (recycled to reduce inefficient taxes on labor and capital). Energy taxes clearly superior.
- Well designed cap and trade schemes indirectly impose such taxes, though direct taxes are better.
- Good news: We can substantially reduce fossil fuel dependence.
- Bad news: It will take a long time to make much difference.

China

China	2009	2010	2011
GDP Growth (% per year)			
Baseline	9.1	9.1	8.2
4.8 MBD shock	8.1	10.2	8.3
9.6 MBD shock	6.4	12.1	8.5
Difference from baseline, percent of real GDP			
4.8 MBD shock	-0.9	0.1	0.2
9.6 MBD shock	-2.4	0.2	0.5
Difference from baseline, billions of 2008$			
4.8 MBD shock	-41.9	3.2	8.3
9.6 MBD shock	-109.1	12.1	27.8
Domestic product prices, difference from baseline in perce			
4.8 MBD shock	-0.5	0.5	0.5
9.6 MBD shock	-1.2	1.5	1.3
Employment, difference from base in thousands			
4.8 MBD shock	-1894	-711	171
9.6 MBD shock	-5142	-1704	717

Japan

Japan	2009	2010	2011
GDP Growth (% per year)			
Baseline	0.9	1.9	2.1
4.8 MBD shock	-0.3	3.2	2.3
9.6 MBD shock	-2.1	5.3	2.3
Difference from baseline, percent of real GDP			
4.8 MBD shock	-1.2	0.1	0.2
9.6 MBD shock	-3.0	0.3	0.4
Difference from baseline, billions of 2008$			
4.8 MBD shock	-63.1	2.9	9.2
9.6 MBD shock	-156.0	14.1	22.6
Domestic product prices, difference from baseline in perce			
4.8 MBD shock	0.4	-0.2	-0.1
9.6 MBD shock	0.6	-0.6	-0.5
Employment, difference from base in thousands			
4.8 MBD shock	-779	-126	79
9.6 MBD shock	-2153	-280	172

European Union

European Union

	2009	2010	2011
GDP Growth (% per year)			
Baseline	1.5	1.5	1.8
4.8 MBD shock	0.9	2.0	1.9
9.6 MBD shock	0.1	2.7	2.1
Difference from baseline, percent of real GDP			
4.8 MBD shock	-0.5	-0.1	0.1
9.6 MBD shock	-1.3	-0.1	0.1
Difference from baseline, billions of 2008$			
4.8 MBD shock	-105.2	-13.0	11.7
9.6 MBD shock	-259.7	-25.2	25.6
Domestic product prices, difference from baseline in perce			
4.8 MBD shock	0.6	0.4	0.3
9.6 MBD shock	1.6	1.2	1.0
Employment, difference from base in thousands			
4.8 MBD shock	-524	-428	224
9.6 MBD shock	-1184	-1008	450

Interindustry-Macroeconomic (IM) Models

- Combines industrial structure with econometric equations in a dynamic and detailed general equilibrium framework.
  - Sectoral detail.
  - Macroeconomy.
  - Useful for questions involving interactions between industries, as well as the interplay between industry and macroeconomic relationships.
- Solve for economy year by year; time path of response is important. Effects of shocks build up and decay over time. Production technology changes over time, in response to estimated trends or exogenous assumptions.
- U.S. model is Lift (Long-term interindustry forecasting tool). Under continuous development and use for over 30 years.
- International System: Bilateral trade model, IM models for all major trade partners including China.