President Bush’s Approval Ratings Were Anti-Correlated With Oil Prices Through 1/31/07
President Bush’s Approval Ratings Are Harder To Correlate With Oil Price Through 1/31/09

![Graph showing correlation between President Bush’s approval ratings and oil price from 1/1/01 to 1/31/09. The blue line represents the price of oil (WTI-Cushing $/Barrel), and the red line represents President Bush’s approval ratings (Zogby, Fox, Pew).]
Question: Who’s in charge of energy policy in the United States?

A. President
B. Secretary of Energy
C. Secretary of Defense
D. King Abdullah bin Abdul Aziz Al Saud
E. No one
The mission of the Department of Energy is not wholly dedicated to energy

- Primary national labs for energy research
  - National Energy Technology Lab (NETL)
  - National Renewable Energy Lab (NREL)

- Weapons/national labs that also conduct energy research
  - Argonne National Lab
  - Brookhaven National Laboratory
  - Idaho National Laboratory
  - Los Alamos
  - Lawrence Livermore National Laboratory
  - Pacific Northwest National Labs
  - Sandia National Labs
  - Oak Ridge National Laboratory
  - Fermi National Accelerator Laboratory
  - Others…
The U.S. has many government institutions that affect energy

- Federal
  - Department of Energy
    - EIA = Energy Information Administration
  - Department of the Interior
    - Environmental Protection Agency
    - US Geological Survey
  - US Department of Agriculture
  - Department of Defense

- States
  - Texas Railroad Commission
  - State Energy Conservation Office
  - Texas Commission on Environmental Quality

- Local: municipal utilities, etc.
There are also international Institutions

• IEA = International Energy Agency
  – just OECD countries
    • OECD = Organization for Economic Cooperation and Development
      – the fully industrialized countries
    • Does NOT include China or India
      – has petroleum reserve policies, etc.

• IAEA = International Atomic Energy Agency

• UN

• NATO
There Are Many Non-Governmental Stakeholders That Affect Energy Policy

• Industry
  – Energy industry
  – Finance industry
  – Auto, aviation, manufacturing industries

• Labor unions

• Environmental and Social Justice advocacy groups
Consequently, U.S. Energy Policy Is Incoherent

- Inputs:
  - Many actors
  - Many stakeholders
  - Geographic diversity of environmental impacts
  - Geographic diversity of energy resources

- Result: no single, robust, coherent energy policy
Actually, maybe we do have a coherent energy policy....
Executive & Legislative Branches Set Energy Policy

- President
  - Give State of the Union speeches to set priorities
  - Issue budget requests to emphasize priorities
  - Set budget directions

- Congress
  - Authorize and allocate money to be spent
  - Set rules
Major Energy Related Legislation

- **Clean Air Act (1970)**
- **Energy Policy and Conservation Act (1975)**
  - extends oil price controls into 1979
  - mandates automobile fuel economy standards,
  - authorizes creation of a strategic petroleum reserve (SPR)
- **Department of Energy Organization Act (1977)**
- **Fuel Use Act (1978):** prohibited the use of natural gas in power plants
  - Led to the creation of 80 GW of coal plants
Major Energy Related Legislation, Cont’d

- Clean Air Act Amendments (CAA1990)

Creates agencies, authorizes money, etc. Allocation of $$ is better than authorization
American policymakers have several tools to affect energy production and use

• Research and development

• Incentives
  – Tax cuts, rebates, tax credits,…
  – rebates for energy-efficient appliances, solar panels, solar water heating, etc.

• Punishments: fines, taxes, regulatory standards shame
American policymakers have several tools to affect energy production and use, cont’d

• Market mechanisms:
  – drive prices lower/higher (e.g. carbon taxes)
  – Information
    • energy guides (for appliances…)
    • “Energy Star” ratings
    • Free/cheap “energy audits” of homes…

• Access to resources: oil, gas, shale, wind, hydro, etc.

• Environmental constraints

• Strategic Petroleum Reserve (SPR)
  – market purists do not like SPR (it’s market meddling)
  – multi-country management of reserves through IEA
Energy Law Currently Includes Several Taxes or Tax Credits

- 2.1 ¢/kWh production tax credit for wind
- 45 ¢/gal ethanol tax credit (to oil companies)
- Up to $1.00/gal biodiesel tax credit (from ag sources)
- Up to 50 ¢/gal biodiesel tax credit (from grease)
- 18.4 ¢/gal gasoline excise tax
- 24.4 ¢/gal diesel excise tax
Federal Financial Incentives for Producing Power From Renewables

- Production Tax Credit (PTC)
- Investment Tax Credit (ITC)
- Cash Grant from the U.S. Treasury in lieu of ITC (New incentive)
The Production Tax Credit (PTC)

- Started with EPACT 1992:
  - A 10-yr inflation-adjusted tax credit that started at 1.5 ¢/kWh
  - Depends on how much electricity is produced

<table>
<thead>
<tr>
<th>Resource Type</th>
<th>In-Service Deadline</th>
<th>Credit Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>December 31, 2012</td>
<td>2.1¢/kWh</td>
</tr>
<tr>
<td>Closed-Loop Biomass</td>
<td>December 31, 2013</td>
<td>2.1¢/kWh</td>
</tr>
<tr>
<td>Open-Loop Biomass</td>
<td>December 31, 2013</td>
<td>1.0¢/kWh</td>
</tr>
<tr>
<td>Geothermal Energy</td>
<td>December 31, 2013</td>
<td>2.1¢/kWh</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>December 31, 2013</td>
<td>1.0¢/kWh</td>
</tr>
<tr>
<td>Municipal Solid Waste</td>
<td>December 31, 2013</td>
<td>1.0¢/kWh</td>
</tr>
<tr>
<td>Qualified Hydroelectric</td>
<td>December 31, 2013</td>
<td>1.0¢/kWh</td>
</tr>
<tr>
<td>Marine and Hydrokinetic (150 kW or larger)**</td>
<td>December 31, 2013</td>
<td>1.0¢/kWh</td>
</tr>
</tbody>
</table>

Source: NREL

Solar is not included on this list
The PTC Lowers the Cost of Production

• It does not lower the PRICE of power, it lowers the COST

• It provides an income tax credit to project owners, which supplements the project’s other two revenue streams:
  • Renewable Energy Credits due to Renewable Portfolio Standards
  • Selling the power to a utility or in the open market

• Example: Cash-rich utility owes $100M in taxes
  • Buys wind farms that generate 1 billion kWh annually
  • $21M tax credit; they now owe only $79M in taxes

  – Cash-rich, tax-burdened companies LOVE wind
  – BUT, economic crisis dissolved many tax liabilities
Production Tax Credits (PTCs) Are Big Drivers of Renewable Energy

• Allowed to expire in 2000, 2002, 2004

• Renewed at end of 2008; and extended by 2009 ARRA

• “Wind supporters say the lapses hurt the industry, even though congress eventually renewed the subsidy each time. When the tax credit expired at the end of 2003, the construction of new wind farms dropped by 75 percent the next year.”
  – Minnesota Public Radio [MPR]

Source: AWEA
Investment Tax Credit (ITC) For Commercial, Industrial, & Utility Sectors

- **Solar, fuel cells, and small wind**: 30% of qualifying costs
  - was 10% for solar prior to 2005

- **Geothermal, microturbine, and CHP**: 10% of qualifying costs

- Must be in place by the end of 2016, except geothermal (no expiration), and the solar credit reverts to 10% instead of expiring at the end of 2016 (unless it is renewed)

- Realized in the year in which the project begins commercial operations, but vests linearly over a 5-year period

- Depends on how much money is spent (in contrast with PTC)
Because Of Economic Downturn, Far Fewer Companies Have Tax Liabilities That Could Benefit From The PTC And ITC

• ARRA allows a project owner to receive cash grant instead of ITC

• Project must be in service during 2009 or 2010 or, if construction began in 2009 or 2010, before January 1, 2013.

• Not available to any governmental agency, tax-exempt entity, or rural electric cooperative
  – NOT for LCRA, Austin Energy, CPS, Pedernales Electric Coop, or Bluebonnet Electric Coop
EPACT 2005 became law on August 8, 2005

• Katrina struck land August 29, 2005
  – Removed 1.4 MMBD of oil from the market (0.225 MMBD still off today)
  – Rita struck one month later

• Congressman Joe Barton (R-Ennis), main sponsor

• John McCain referred to it as the “No Lobbyist Left Behind” bill.”
EPACT 2005 contains authorization for many tax cuts or credits

- $4.3 Billion for nuclear power
- $2.8 billion for fossil fuel production
- $2.7 billion to extend the renewable electricity production credit
- $1.6 billion in tax incentives for investments in clean coal facilities
- $1.3 billion for conservation and energy efficiency
- $1.3 billion for alternative motor vehicles and fuels (ethanol, methane, liquefied natural gas, propane)


**EPACT 2005 Changes DST in 2007**

- EPACT 2005 changed the start and end dates for Daylight Saving Time (DST) in 2007
  - not clear any energy was saved (probably not)

- Or, was it the candy companies that wanted more light on Halloween for more trick-or-treaters to drive up candy sales....?
EPACT 2005 left out some provisions

- Limited liability for producers of MTBE
- Drilling for oil in the Arctic National Wildlife Refuge (ANWR)
- Increasing vehicle efficiency standards (CAFE)
  - CAFE = corporate average fuel economy
- Requiring increased reliance on non-greenhouse gas-emitting energy sources similar to the Kyoto Protocol

• Signed into law December 19, 2007

• TITLE I: Energy Security Through Improved Vehicle Fuel Economy
  – Raises CAFE standards to 35 mpg by 2020 (Obama administration has pushed the standard to 35.5 mpg and the date up to 2016)

• TITLE II: Energy Security Through Increased Production Of Biofuels
  – Establishes renewable fuels standard (RFS) of 36 billion gallons of biofuels by 2022
    • 15 Bgal/yr from corn starch
    • 21 Bgal/yr from “advanced biofuels”
      – 16 Bgal/yr for cellulosic biofuels
      – 1 Bgal/yr of biomass-based diesel
      – 4 Bgal/yr are undetermined??
Recent Policies Have Emphasized Biofuels
Pledging to Get Off Foreign Oil Is A Bipartisan Tradition
U.S. Energy Policy Sends Mixed Foreign Policy Signals

• Bush (and other politicians) says we need to get off imported oil because it comes from countries who hate us and are unstable…
  – …like Canada and Mexico

• Bush especially calls to get off Middle East Oil
  – Says we’re going to produce our own fuels, which gives a disincentive to the Middle East to invest in new capability

• Bush demands/begs that the Middle East ramp up production
    • Presidential visit to Saudi Arabia Jan 2008 & May 2008

• Obama asks Prince Abdullah to help stabilize oil prices
  – Reuters, May 2009
Ethanol Production Has Been Actively Encouraged

• EPACT 2005 requires 7.5 billion gallons of renewable fuels by 2012
  – President Bush called for 35 gallons of renewable fuels by 2017
    • Requires 36 billion gallons of biofuels by 2022
    • 21 billion gallons must be derived from non-cornstarch products

• Candidates: 36 Bgal by 2022 (Dodd) or 65 Bgal by 2025 (Edwards)
  – “farm-grown”, “home-grown”, “produced on our farms”

• Every signal to farmers has been to
  – increase corn production by working idle land
  – switch production from other crops to corn
  – switch corn production from food/feed to fuel
EISA 2007 Uses Many Definitions for Biofuels

- RENEWABLE FUEL: all of the following
- CONVENTIONAL BIOFUEL: corn-based ethanol
- ADDITIONAL RENEWABLE FUEL: heating oil and jet fuel from renewable biomass
- ADVANCED BIOFUEL: renewable fuel with lifecycle greenhouse gas emissions 50% less than baseline (conv. gasoline and diesel in 2005)
  - Corn-based ethanol explicitly NOT included
    - Cellulosic ethanol
    - Ethanol from sugar or non-corn starches
    - Waste-derived ethanol
    - Biomass-based diesel
    - Biogas
    - Butanol
    - Other fuel derived from cellulosic biomass

§201 of EISA 2007 has definitions for fuels, etc.
EISA Calls for Aggressive Penetration of Renewable Fuels

• We exceeded early targets with corn ethanol, but now are falling behind

<table>
<thead>
<tr>
<th>Year</th>
<th>US Ethanol Production [Billion Gals]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>3.9</td>
</tr>
<tr>
<td>2006</td>
<td>4.9</td>
</tr>
<tr>
<td>2007</td>
<td>6.8</td>
</tr>
<tr>
<td>2008</td>
<td>9.0</td>
</tr>
<tr>
<td>2009</td>
<td>10.8</td>
</tr>
</tbody>
</table>

Source: §202 of EISA 2007

“Calendar year:

<table>
<thead>
<tr>
<th>Year</th>
<th>Applicable volume of renewable fuel (in billions of gallons):</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>4.0</td>
</tr>
<tr>
<td>2007</td>
<td>4.7</td>
</tr>
<tr>
<td>2008</td>
<td>9.0</td>
</tr>
<tr>
<td>2009</td>
<td>11.1</td>
</tr>
<tr>
<td>2010</td>
<td>12.95</td>
</tr>
<tr>
<td>2011</td>
<td>13.95</td>
</tr>
<tr>
<td>2012</td>
<td>15.2</td>
</tr>
<tr>
<td>2013</td>
<td>16.55</td>
</tr>
<tr>
<td>2014</td>
<td>18.15</td>
</tr>
<tr>
<td>2015</td>
<td>20.5</td>
</tr>
<tr>
<td>2016</td>
<td>22.25</td>
</tr>
<tr>
<td>2017</td>
<td>24.0</td>
</tr>
<tr>
<td>2018</td>
<td>26.0</td>
</tr>
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<td>2019</td>
<td>28.0</td>
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<tr>
<td>2020</td>
<td>30.0</td>
</tr>
<tr>
<td>2021</td>
<td>33.0</td>
</tr>
<tr>
<td>2022</td>
<td>36.0</td>
</tr>
</tbody>
</table>

Source: RFA Industry Statistics (Mar 2010)
EISA 2007 Calls for 600 Million Gallons of Advanced Biofuels Production This Year

Source: §202 of EISA 2007

<table>
<thead>
<tr>
<th>“Calendar year:”</th>
<th>Applicable volume of advanced biofuel (in billions of gallons):</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>0.6</td>
</tr>
<tr>
<td>2010</td>
<td>0.95</td>
</tr>
<tr>
<td>2011</td>
<td>1.35</td>
</tr>
<tr>
<td>2012</td>
<td>2.0</td>
</tr>
<tr>
<td>2013</td>
<td>2.75</td>
</tr>
<tr>
<td>2014</td>
<td>3.75</td>
</tr>
<tr>
<td>2015</td>
<td>5.5</td>
</tr>
<tr>
<td>2016</td>
<td>7.25</td>
</tr>
<tr>
<td>2017</td>
<td>9.0</td>
</tr>
<tr>
<td>2018</td>
<td>11.0</td>
</tr>
<tr>
<td>2019</td>
<td>13.0</td>
</tr>
<tr>
<td>2020</td>
<td>15.0</td>
</tr>
<tr>
<td>2021</td>
<td>18.0</td>
</tr>
<tr>
<td>2022</td>
<td>21.0</td>
</tr>
</tbody>
</table>

- 21 Bgal by 2022
- 16 Bgal from Cellulosic Ethanol
- 5 Bgal from unspecified sources
## EISA 2007 Calls for 100 Million Gallons of Advanced Cellulosic Biofuels by 2010

Source: §202 of EISA 2007

<table>
<thead>
<tr>
<th>Calendar year</th>
<th>Applicable volume of cellulosic biofuel (in billions of gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>0.1</td>
</tr>
<tr>
<td>2011</td>
<td>0.25</td>
</tr>
<tr>
<td>2012</td>
<td>0.5</td>
</tr>
<tr>
<td>2013</td>
<td>1.0</td>
</tr>
<tr>
<td>2014</td>
<td>1.75</td>
</tr>
<tr>
<td>2015</td>
<td>3.0</td>
</tr>
<tr>
<td>2016</td>
<td>4.25</td>
</tr>
<tr>
<td>2017</td>
<td>5.5</td>
</tr>
<tr>
<td>2018</td>
<td>7.0</td>
</tr>
<tr>
<td>2019</td>
<td>8.5</td>
</tr>
<tr>
<td>2020</td>
<td>10.5</td>
</tr>
<tr>
<td>2021</td>
<td>13.5</td>
</tr>
<tr>
<td>2022</td>
<td>16.0</td>
</tr>
</tbody>
</table>
EISA 2007 Calls for 500 Million Gallons of Advanced Biodiesel by 2009

Source: §202 of EISA 2007

<table>
<thead>
<tr>
<th>“Calendar year:”</th>
<th>Applicable volume of biomass-based diesel (in billions of gallons):</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>0.5</td>
</tr>
<tr>
<td>2010</td>
<td>0.65</td>
</tr>
<tr>
<td>2011</td>
<td>0.80</td>
</tr>
<tr>
<td>2012</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Year | US Biodiesel Production [Million Gals]
--- | -------------------------------------|
2005 | 75                                    |
2006 | 250                                   |
2007 | 450                                   |

Source: National Biodiesel Board, May 2008

• Do we need another 4 Bgal of biodiesel by 2022?
  – To be determined later by Sec’y of Energy & Agriculture
  • environmental impact, production expectations, etc.

• It’s not guaranteed existing biodiesel is “advanced”
  – existing routes: soy, palm oil, cottonseed, waste grease,…
  – 50% GHG reduction requirement for advanced biodiesel
  – some scientists calculate that palm oil & soy increase lifecycle GHG emissions due to deforestation and land use
We Have Essentially A Mandate for E10

• Today’s consumption:
  – 140 Bgal/year Gasoline
  – 40 Bgal/year Diesel

• EISA Caps Corn-Ethanol at 15 Bgal/year by 2022
  ~10% of annual consumption in 2022

“National Biofuels Action Plan,” DoE, 10/08

Source: Renewable Fuels Association for ethanol capacity; EIA AEO for gasoline consumption (140 billion gallons of motor gas/yr).
Note: E15 and E20 testing is underway; these blends are currently authorized for use.
Ethanol’s Lower Energy Density Worsens Fuel Economy

Credit: M. Webber, 1/18/10
Major Energy Related Legislation (EIEA 2008)

- Extended the PTC in-service date for certain wind and refined coal facilities until 12/31/09
- Expanded PTC to include marine and hydrokinetic renewable energy facilities placed in service on or before 12/31/011
- Extended the ITC placed-in-service sunset date for solar, fuel cell and microturbine property until December 31, 2016
- Expanded the ITC to include extended the tax credit to small wind-energy systems and geothermal heat pumps
Major Energy Related Legislation (ARRA)

The American Recovery and Reinvestment Act (ARRA) of 2009 includes more than $60 billion in clean energy investments:

- $11 B for smart grid development (40 MM smart meters).
- $5 B for low-income home weatherization projects.
- $4.5 B to green federal buildings & cut gov’t energy bill.
- $6.3 B for state & local renewable energy and energy efficiency.
- $600 M in green job training programs.
- $2 B in grants for next generation batteries/energy storage.

Source: www.whitehouse.gov
ARRA Provides New Options

• Extended the time to apply for the PTC

• Makes ITC bigger for solar and adds more generation types

• Allows project owner who is eligible for PTC to choose ITC or an equivalent cash grant instead

• Projects benefiting from subsidized energy financing couldn’t claim ITC before – now they can

• Projects get bonus depreciation of 50% if put in service in 2009
Legislation Under Consideration: Federal RPS

- Federal RPS (renewable portfolio standard) or RES (renewable electricity standard)
- Requires that a certain portion or percentage of fuel mix or capacity is renewable
- Uses REC (renewable energy credits) that you can trade to meet RPS requirements
HDTV was more urgent than CAFE

• Congress is requiring us to convert to HDTV formats for new television purchases
  – massive infrastructure changes for media production and consumer electronics
  – Expensive
  – Of little social value (maybe $10B from airwaves auction?)

• We had $1.34B for new TV coupons, but NOT for energy-efficiency, new appliances, R&D, etc.?

• Congress avoided requiring us to use less energy, despite the societal benefits
**HDTV Consumes A Lot of Energy**

*Los Angeles Times*

**Picturing a more efficient future**

Today’s flat-screen, high-definition televisions use a lot of energy. A plasma unit uses more than three times the power as a bulky cathode ray tube TV. The California Energy Commission wants to cut consumption by approving the nation’s first efficiency standards for TVs sold in the state.

**Total energy consumed per year by each type of TV technology**

<table>
<thead>
<tr>
<th>Current TV types, number of units statewide</th>
<th>Power use in watts by average-size TV</th>
<th>Energy consumption (Statewide, annually, in millions of kWh/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode ray tube</td>
<td>101</td>
<td>4,295.1</td>
</tr>
<tr>
<td>DLP* and projection</td>
<td>245</td>
<td>327.1</td>
</tr>
<tr>
<td>LCD (liquid-crystal display)</td>
<td>144</td>
<td>2,910.9</td>
</tr>
<tr>
<td>Plasma</td>
<td>361</td>
<td>1,239.2</td>
</tr>
<tr>
<td>Average</td>
<td>129.78</td>
<td>8,772.3</td>
</tr>
</tbody>
</table>

**Total** 35.4

**Energy savings and reduced costs for compliant LCD and plasma TVs — Tier 1 and Tier 2**

<table>
<thead>
<tr>
<th>Tier (year in effect)</th>
<th>Annual unit energy savings kWh/year</th>
<th>First-year savings</th>
<th>First-year statewide energy savings (in gigawatt hours per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Less strict (2011)</td>
<td>132</td>
<td>$18.48</td>
<td>528</td>
</tr>
</tbody>
</table>

* DLP is digital light processing and uses a rear projection technology
** Proposed Tier 1 standards would take effect Jan. 1, 2011; proposed Tier 2 standards would take effect Jan. 1, 2013

Source: California Energy Commission, Draft Efficiency Standards for Televisions, December 2008

**Picturing a more efficient future**

January 3, 2009
Marginal Auto Safety Is More Important Than Fuel Economy

- Safety requirements add weight
  - anti-lock brakes
  - crumple zones
  - air bags

- Weight requirements reduce fuel economy

- Marginal improvements to fatalities per million miles
R&D Is An Important Policy Lever And Indicator of A Nation’s Priorities
Energy R&D Is Much Lower Today Than Its Peak…but will increase with ARRA

Public and Private R&D Investment Has Declined from 10% to 2% of Total US R&D

Source: AAAS
Department of Energy hardly means Energy

Department of Energy R&D (in Millions of Dollars)

- **DOE Science**
- **DOE Defense**
- **DOE Energy**

<table>
<thead>
<tr>
<th>Year</th>
<th>DOE Science</th>
<th>DOE Defense</th>
<th>DOE Energy</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>$4,500.00</td>
<td>$2,000.00</td>
<td>$1,500.00</td>
<td>$8,000.00</td>
</tr>
<tr>
<td>2003</td>
<td>$4,700.00</td>
<td>$2,200.00</td>
<td>$1,300.00</td>
<td>$8,200.00</td>
</tr>
<tr>
<td>2004</td>
<td>$5,000.00</td>
<td>$2,400.00</td>
<td>$1,400.00</td>
<td>$8,800.00</td>
</tr>
<tr>
<td>2005</td>
<td>$5,200.00</td>
<td>$2,600.00</td>
<td>$1,600.00</td>
<td>$9,400.00</td>
</tr>
<tr>
<td>2006</td>
<td>$5,400.00</td>
<td>$2,800.00</td>
<td>$1,800.00</td>
<td>$9,000.00</td>
</tr>
<tr>
<td>2007</td>
<td>$5,600.00</td>
<td>$3,000.00</td>
<td>$2,000.00</td>
<td>$9,600.00</td>
</tr>
<tr>
<td>2008</td>
<td>$5,800.00</td>
<td>$3,200.00</td>
<td>$2,200.00</td>
<td>$10,200.00</td>
</tr>
</tbody>
</table>
The American Love Affair With Technology
We Believe We Can Fix Our Addiction With Technology

President Bush, State of the Union Address, January 2006: “We have a serious problem: America is addicted to oil, which is often imported from unstable parts of the world. The best way to break this addiction is through technology.”

85% of Americans say the U.S. is addicted to oil

History of Federal R&D Emphasizes New Sources of Supply and Technologies

- The U.S. has invested over $100 billion in cumulative energy-related research and development 1978 and 2006 (constant 2000$)
  - ~$40B spent in total R&D Funding FY1985-2006 from DoE

- 10-20% of total R&D at DoE was to reduce energy consumption, with the rest for new sources of supply

Sources: National Academies, Sims-Gallagher, Kammen & Nemt
Fusion is 50 years away and has been for 60 years

• An Office of Technology Assessment panel concluded in 1987 that after 40 years and $20B of fusion research, it was at least 50 years away
  – Same conclusion in 1992
  – Same conclusion in 1997
  – “No experimental reactor has even achieved break-even conditions”
• Vaclav Smil, “Energy at the Crossroads”