ENVIRONMENTAL AND ENERGY STUDY INSTITUTE

Subsidies: Historic, Current and the Skewing of Market Signals

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I. Introduction

A wide range of policy instruments provide incentives to the energy industry, including grant of access to domestic onshore and offshore resources, direct budgetary outlays for R&D and resource assessments, government ownership of energy enterprises or supporting service organizations, import/export restrictions, provision of market-related information, below-market provision of loans or loan guarantees, direct regulation of wholesale or retail energy prices, purchase requirements, regulations that alter rights and responsibilities in energy markets or provide exemptions to certain actors, provision of insurance or indemnification at below-market prices and special tax levies or exemptions for energy-related activities. These incentives are applied throughout the energy lifecycle, including the phases of research and development, extraction, transport, production, consumption and decommissioning.

Because these incentives are not applied equally to all energy sources, skewing of market signals occurs. In addition to these direct market interventions, a number of public and environmental externalities tied to energy activities incur societal costs and further skew the energy markets where external costs are not internalized. Examples of such externalities include effects on human health, crops, forests, fisheries, visibility, national security and climate. Historically and presently, the incentives to fossil and nuclear fuels greatly outweigh the incentives to renewable and energy conservation resources, as do the social costs of their externalities.

II. Magnitude and Direct Cost of US Energy Use

The United States consumed 98.9 quadrillion Btu (quad) of energy in 2000, 86% of which was fossil-derived, with an estimated expenditure of **$703.2 billion**. Consumption increased to 100.2 quad in 2004, with 86% derived from fossil sources, 8% from nuclear sources and 6% from renewable sources.

Table 1. US Total Primary Energy Consumption, 2004

Fuel Type	Consumption (Quadrillion BTU)	Consumption (Physical Units)	% imported (2003)
Oil	40.6	7,316 million barrels (2003)	56%
Coal	22.4	1,104 million short tons	n.a.
Natural Gas	23.1	22,424 billion cubic feet	17%
Nuclear	8.2	n.a.	n.a.
Renewables	6.1	n.a.	n.a.
TOTAL	**100.2**		

Source: DOE Energy Information Administration

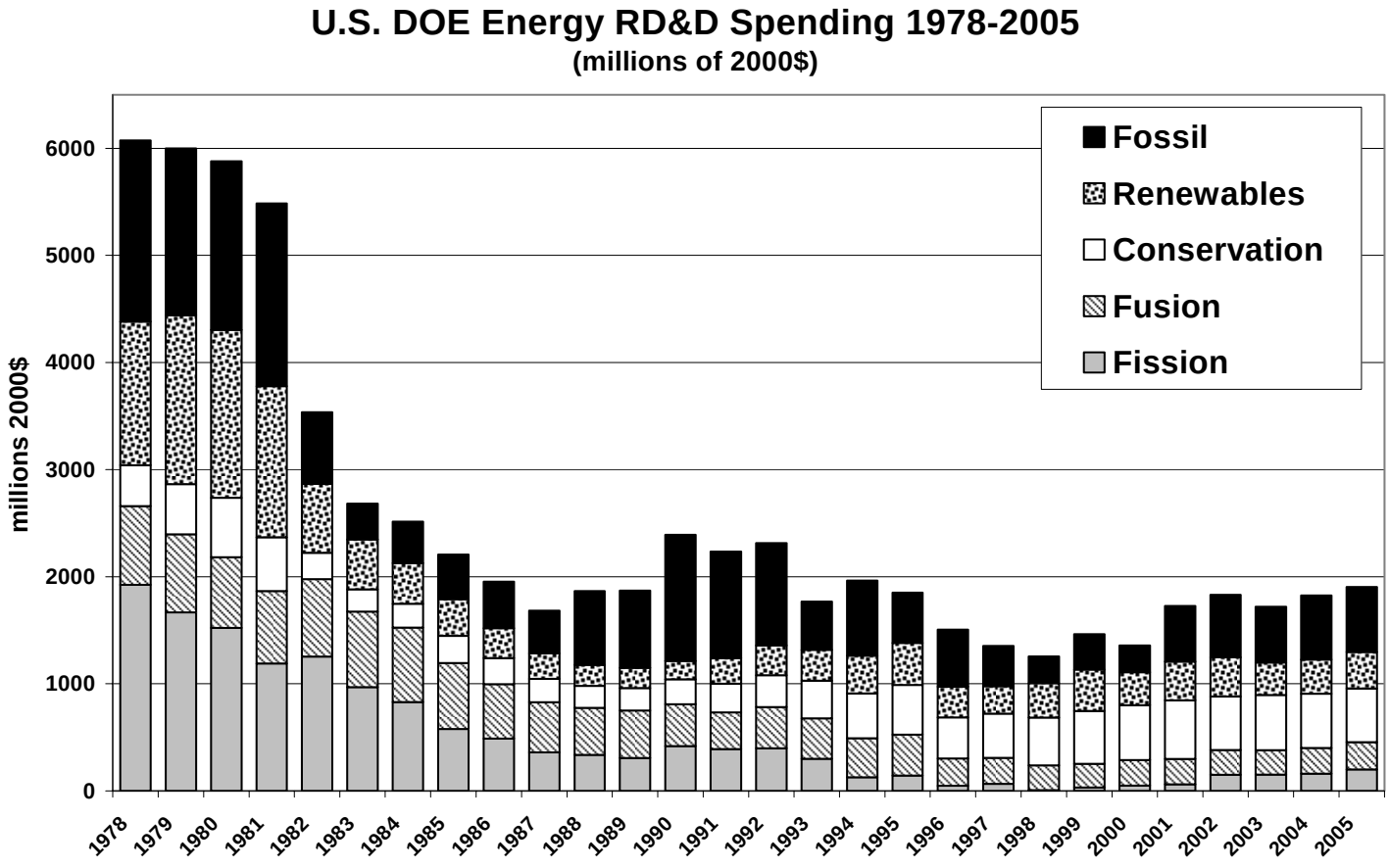
III. Federal Energy R&D and Tax Expenditures

The US Department of Energy spent **$131 billion** on energy research and development from 1948-2003, with over half going to nuclear energy and a quarter to fossil energy (see Table 2). Research funding for renewable energy and energy efficiency began with the oil crises of 1973 and 1978. As Table 3 (next page) shows, the majority of tax incentives from 1996-2009 go to fossil fuels, with 86% of the estimated **$16.1 billion** total going to fossil during 2005-2009.

Table 2. DOE Energy R&D Budgets, 1948-1972, 1973-2003, and 2004 (billion, $2003)

Energy Budget	1948-1972	1973-2003	1948-2003 cumulative	1948-2003 % share	FY 2004	FY 2004 % share
Nuclear	24.3	49.7	74.0	56%	0.667	29%
Fossil	5.5	25.4	30.9	24%	0.673	29%
Renewable		14.6	14.6	11%	0.439	19%
Conservation		11.7	11.7	9%	0.560	24%
TOTAL	29.8	101.4	131.2	100%	2.3	100%

Source: Congressional Research Service, CRS-IB10041, June 2005



Source: Gallagher, K.S., Sagar, A, Segal, D, de Sa, P, and John P. Holdren, "DOE Budget Authority for Energy Research, Development, and Demonstration Database," Energy Technology Innovation Project, John F. Kennedy School of Government, Harvard University, 2005.

Table 3. FEDERAL TAX EXPENDITURES FOR ENERGY, 1996-2009 ($ billion)

ENERGY	1996	1997	1998	1999	2000	1996-2000 cumulative	2001	2002	2003	2004	2005	2001-2005 cumulative	2005*	2006	2007	2008	2009	2005-2009 cumulative
Expensing of exploration and development costs:																		
Oil and gas	0.1	0.2	0.2	0.2	0.2	1.0	0.6	0.6	0.6	0.4	0.3	3.1	0.5	0.4	0.4	0.5	0.5	2.4
Other fuels	-	-	-	-	-	0.1	-	-	-	-	-	0.2	-	-	-	-	-	0.3
Excess of percentage over cost depletion:																		
Oil and gas	0.4	0.5	0.5	0.5	0.5	2.4	0.3	0.3	0.3	0.3	0.4	1.7	0.5	0.5	0.5	0.5	0.6	2.8
Other fuels	-	0.1	0.1	0.1	0.1	0.5	-	-	-	-	-	0.1	-	-	-	-	-	0.2
Tax credit for enhanced oil recovery costs	-	0.1	0.1	0.1	0.1	0.3	0.2	0.2	0.2	0.2	0.2	1.0	0.3	0.4	0.4	0.4	0.5	2.0
Tax credit for production of non-conventional fuels	1.0	0.9	0.9	0.9	0.8	4.5	1.5	1.6	1.0	0.6	0.6	5.3	1.2	1.4	1.6	0.6	0.1	5.1
Tax credits for alcohol fuels	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	0.1
Exclusion of interest on State and local government industrial development bonds for energy production facilities	0.3	0.3	0.3	0.3	0.3	1.1	0.1	0.1	0.1	0.1	0.1	0.7	0.2	0.2	0.2	0.2	0.3	1.0
Expensing of tertiary injectants	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-
Exclusion of energy conservation subsidies provided by public utilities	0.1	0.1	0.1	0.1	0.1	0.5	-	-	-	-	-	0.1	-	-	-	-	-	0.1
Tax credit for investments in solar and geothermal energy facilities	-	-	-	-	-	0.2	-	-	-	-	-	0.1	-	-	-	-	-	0.1
Tax credit for electricity production from wind, biomass, and poultry waste	-	-	-	-	-	0.4	0.1	0.1	0.1	0.1	0.1	0.4	0.3	0.3	0.4	0.5	0.5	2.0
Deductions and credits for clean fuel vehicles and refueling property	-	-	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL						**11.5**						**12.7**						**16.1**
Fossil					**90%**	10.3					**95%**	12.1					**86%**	13.9
Renewable and Conservation					**10%**	1.2					**5%**	0.6					**14%**	2.2

Source: Joint Committee On Taxation, Estimates Of Federal Tax Expenditures For Fiscal Years (various)
NOTE: numbers may not add due to rounding. *Year repeated, values for 2005-2009 in $2005

IV. Energy Policy Act of 2005 Provides More of the Same

- The Energy Policy Act of 2005 provides more than **$14.1 billion** in tax breaks to the energy industry over 10 years.
- The coal industry receives loan guarantees and **$2.9 billion** in tax breaks, primarily for development of "clean coal" technology.
- Oil and gas producers receive **$1.5 billion** in tax breaks as well as royalty relief for certain deep-well drilling. A **$500 million** program helps oil companies drill oil in extremely deep waters of the Gulf of Mexico. Another **$1 billion** is earmarked for coastal restoration in five states with offshore oil production.
- Benefits for the nuclear industry include "risk insurance" totaling **$2 billion** if there are permitting or regulatory delays in construction of the first six new nuclear power reactors, as well as loan guarantees for future reactors and support for constructing a **$1.25 billion** "next-generation" nuclear plant.
- The renewable energy industry receives approximately **$3 billion** in tax breaks, primarily for wind energy.
- Efficiency and conservation programs receive approximately **$1.3 billion**.

V. Additional Fossil Fuel Subsidies and Externalities

- According to Oakridge National Laboratory, the present value of the cost of US oil dependence due to transfer of wealth to exporting nations, supply disruptions and payment at above-market costs is approximately **$8 trillion** since 1970, with a reasonable range of uncertainty of **$5 to $13 trillion**. (David Greene, ORNL, 2005)
- At **$166 billion**, petroleum accounted for 25.5% of the US trade deficit of **$651 billion** in 2004. Natural gas imports accounted for an additional **$18 billion** in 2004. Due to increasing reliance on imported oil as well as increasing petroleum prices, the total trade deficit due to petroleum is increasing in 2005 and is increasing more rapidly than the overall deficit. The oil import trade deficit in the first 4 months of 2005, **$62.9 billion**, is 34.0% greater as compared to the first four months of 2004, while the overall US deficit is 20.7% greater over the same period. (EIA)
- The total annual cost of filling and administering the Strategic Petroleum Reserve (SPR) is **$950 million to $1.135 billion** in 2003 dollars, and the FY 2004 budget to maintain the SPR was **$171 million**. (CTA, 2005). Analysis by Koplow and Martin for 1995 estimated annual subsidies related to the interest costs on the original **$16 billion** spent to fill the SPR at between **$1.7 billion** and **$6.l billion**, depending on whether unpaid interest on oil inventories is compounded. (Elsevier, 2004)
- The estimated annual cost of protecting petroleum supply, not including military costs, is **$635 million**, with **$455 million** going to the Coast Guard to provide a variety of services. (CTA, 2005)
- Koplow and Martin found shortfalls in funding to plug and abandon oil wells in the United States approaching **$600 million** per year, of which approximately 75% represented insufficient bonding at wells still in operation. (Elsevier, 2004)
- According to the US Office of Surface Mining Reclamation and Enforcement, the estimated liability for high priority coal mine remediation in the United States to address public health and safety concerns is **$6.6 billion**.
- According to the International Oil Spill Conference of 1999, political and social pressures to increase environmental responsibility and the increasing complexity of response operations

and response monitoring have caused oil spill cleanup costs to increase significantly over the last 20 years, from approximately **$2,000/metric ton** (1974-1979) to approximately **$13,000/metric ton** (1995-1998).

- Climate change, driven mainly by increasing emissions from fossil fuel energy use, is expected to lead to continuing sea level rise and more intense weather extremes, such as flooding, drought, and heat waves. According to reinsurer Munich Re, annual losses are projected to be in the range of **$300 billion**, with losses of **$68 billion** in the United States alone. Innovest estimates annual costs to the United States to be even higher, on the order of **$100- to $300 billion.** (CTA)
- While the costs of defending oil shipments through the Persian Gulf are difficult to measure, estimates of annual petroleum defense and security costs range from **$6.5 billion** to **$113 billion**, with a number of estimates falling in the range of $4 to $10 per barrel imported. Table 4 below summarizes a number of these estimates.

Table 4. Estimates of US Military Spending on Middle Eastern Oil Supply Protection

Source	Total Cost ($billion/year)	Unit Cost* ($/Barrel)	Unit Cost* ($/Gallon)	Remarks
International Center for Technology Assessment (2005)	$47.6-$113.1 (2003 $)	n.a.	n.a.	Based on one third of the costs of the Iraq war plus the oil security costs in the Pentagon's annual budget
Milton R. Copulos, National Defense Council Foundation (2003)	$49.1 (2003 $)	$10.71	$0.25	Annual average calculated over multi-year period, 1993-2003
US Department of State (2003)	$38.3 (2003 $)	$9.03	$0.22	Annual average calculated over multi-year period, 1993-2003
Patricia Hu, Oak Ridge National Laboratory (1996)	$20-$40 (1996 $)	n.a.	n.a.	Based on annual costs of US military operations in the Persian Gulf in peacetime
Doug Koplow, Earth Track Inc. (2004)	$11.1-$27.4 (2003 $)	$1.65-$3.65	$0.04-$0.08	Based on one third of the costs of the military presence in the Middle East.
James A. Baker III Institute for Public Policy, Rice University (2003)	n.a.	$4-$5	$0.09-$0.12	Based on the minimum figure ($20) of the Patricia Hu estimation.
Congressional Research Service (1992)	6.4 (1992 $)	n.a.	n.a.	

*Unit cost assumes cost of oil supply protection is averaged over all imported oil, not just Middle Eastern oil.

Health and Environment

- Public responsibility for workers' health care and/or pension costs is another type of subsidy. For example, cumulative US government payments to coal miners afflicted with black lung now total over **$30 billion**. (Elsevier, 2004)
- Environmental and health externalities from fossil-fueled power plants and transportation are significant. These emissions lead to asthma, lowered IQ, cancer, heart and lung disease, reduced crop yield, forest damage and climate change, to name a few. One attempt to measure the externalities from power plant emissions estimate the cost at between **one to eight cents per kilowatt-hour**, depending on the fuel source. (See Table 5 next page.)

- **Asthma.** Air pollutants generated by fossil-fired power plants emissions have been shown to cause and exacerbate asthma in children. The cost of treating asthma in those younger than 18 years of age in the United States is estimated at **$3.2 billion** per year. (CDC) It is estimated that the annual health care cost for treating all children with asthma is nearly three times greater than for all children without asthma combined. (UCS)
- **Mercury.** High blood levels of mercury, a toxin emitted by coal-fired power plants, lead to loss of intelligence in children and lifetime diminished economic productivity. The total productivity loss of all US mercury emissions is estimated at **$8.7 billion** per year, with $**1.3 billion** attributed to power plant emissions. (Environmental Health Perspectives, 2005)
- **Diesel Emissions.** It is estimated that diesel particulate matter (PM) is responsible for 70 percent of California's risk of cancer from airborne toxics. In 2004 alone, diesel pollution will cause an estimated 3,000 premature deaths in California—greater than the estimated 2,300 annual homicides in the state--as well as an estimated 2,700 cases of chronic bronchitis and about 4,400 hospital admissions for cardiovascular and respiratory illnesses every year. The cost of these health impacts in California alone is **$21.5 billion** per year. (CARB, 2000. UCS)
- The new transportation bill, HR 3, spends 18% of its **$286.5 billion** on transit, 2 percent on safety and 80% on road-related projects.

Table 5. Cost Estimates for Health and Environmental Impacts of Power Plant SOx, NOx, Particulate and CO2 Emissions

Fuel	Externality Cost
Natural Gas	0.8 – 1.2 cents/kWh
Coal	2.8 – 6.8 cents/kWh
Oil	3.0 – 7.9 cents/kWh

Source: PACE, 1990

VI. Nuclear Power Subsidies and Externalities

- As shown in Table 2 above, nuclear energy received **$74 billion** in R&D funding from 1948-2003. Table 6 below shows that total civilian nuclear energy-related appropriations for FY 2005 are close to **$1.5 billion**.
- The Energy Policy Act of 2005 establishes a production tax credit for new nuclear power facilities. The credit amount is **1.8 cents per kilowatt-hour** for electricity produced over an 8-year period, with an estimated subsidy of **$278 million**.

Table 6. DOE Nuclear Power Budget, FY 05 Appropriations

Category	FY 05 Appropriation ($ million)
Nuclear Energy Supply R&D	$375.2
Fusion Energy Sciences	$273.9
Uranium Enrichment Decontamination and Decommissioning Fund	$495.0
Civilian Nuclear Waste Disposal	$343.2
TOTAL	**$1,487.3**

Source: Department of Energy

- The Energy Policy Act of 2005 provides **$2 billion** in risk insurance for permitting delays.
- PACE University estimates the human health externality cost of a Chernobyl-type nuclear accident in the United States as **2-3 cents per kilowatt-hour**. (PACE, 1990)

The Price Anderson Act

- The Price Anderson Act of 1957 requires that each nuclear reactor operator must carry primary liability insurance of **$200 million**. Any damage above that is assessed equally against all operators up to a limit of about **$88 million** per reactor. That generates a ceiling on potential compensation from the nuclear power industry of about **$9.5 billion**. However, it is estimated a worst-case accident could impose damages up to **$100 billion**, leaving the public liable to cover the additional cost. In 1990, Stanford and California Institute of Technology economists estimated that Price-Anderson provided an annual subsidy of **$32 million** per reactor (in 2001 dollars). Also in 1990, Dubin and Rothwell estimated a subsidy value of **$22 million** per reactor-year, or roughly half the capital costs of a nuclear reactor. In 1992 EIA determined that the total value of Price-Anderson subsidy to the nuclear power industry is **$3.05 billion** annually. After the September 2001 terrorist attacks, American Nuclear Insurers raised its premiums for the **$200 million** liability insurance by 30% as a result of increased risk.

Carbon Dioxide Emissions

- Contrary to statements by the Administration, nuclear power is not free of greenhouse gas (GHG) emissions when the entire lifecycle of nuclear energy production, including energy use in construction, mining, processing, enrichment, transport, reprocessing, waste disposal, and decommissioning are taken into account. A number of studies indicate that nuclear power may not necessarily emit less carbon dioxide (CO2) than a natural gas-fired power plant. The Institute of Science in Society estimates that a combined-cycle gas-fired power plant emits less CO2 than a equivalently sized once-through nuclear plant, particularly when uranium is derived from lower grade ores (ISIS, 2005). Electricité de France (EdF) estimates its nuclear plants emit **6 grams of CO2 per kilowatt-hour**, not accounting for uranium fuel mining and preparation (EdF, 1999). The Oeko-Institute of Germany, taking the full fuel cycle into account, calculates **34 grams of CO2 per kilowatt-hour** generated by nuclear power plants in Germany (Oeko-Institute, 1997). Finally, a recent study by J.W. Storm van Leeuwen and Philip Smith emphasizes the dependence of the nuclear CO2 lifecycle emissions on the uranium ore quality. They estimate that it takes seven to 20 years for a nuclear power plant to break even with a natural gas power plant in terms of CO2 production. According to their study, a nuclear power plant still emits **20%-35%** of the CO2 a gas-fired power plant would emit, even if very rich ore (1-10% uranium) was used. (van Leeuwen and Smith, 2005)

VII. Renewable Energy and Energy Efficiency

Research and Development

- According to the Congressional Research Service (2005), from FY1973 through FY2003, the federal government spent about **$14.6 billion** (in 2003 constant dollars) for renewable energy R&D. Renewable energy R&D funding grew from less than **$1 million** per year in the early 1970s to over **$1.4 billion** in FY1979 and FY1980, then declined steadily to **$148 million** in FY1990. By FY2003, it reached **$411 million** in 2003 constant dollars.
- This spending history can be viewed within the context of DOE spending for the three major energy supply R&D programs: nuclear, fossil, and energy efficiency R&D (see Table 2 above). Total energy R&D spending from FY1948 to FY2003, in 2003 constant dollars, was

$131.2 billion, including **$74.0 billion**, or 56%, for nuclear; **$30.9 billion**, or 24%, for fossil; **$14.6 billion**, or 11%, for renewables; and **$11.7 billion**, or 9%, for energy efficiency.

- DOE's FY2004 renewable energy R&D funding totaled **$439.4 million**, or about 19% of DOE's energy R&D appropriation. Energy conservation received **$559.7 million** (24%), fossil energy received **$672.8 million** (29%), and fission and fusion were appropriated **$667.4 million** (29%).

Tax Policy

- The Section 45 Production Tax Credit (PTC) for wind and closed-loop biomass, for eligible producers, will continue for 10 years. The PTC for geothermal, open-loop biomass, small irrigation hydropower, RE-powered fuel cells and MSW will last for 5 years. Tax credits will be awarded for renewable energy projects brought on-line between enactment and December 2008. The value of the PTC is **1.8 cents per kilowatt-hour** for wind, closed-loop biomass, and geothermal.
- In 2005 the solar PTC is dropped and a Solar Investment Tax Credit (ITC) added.
- The American Jobs Creation Act of 2004 provides an excise tax exemption of **5.2 cents/gal**. on 10% ethanol blends, a small ethanol producers credit of **10 cents/gal**., a **$1.00/gal.** agri-biodiesel credit and a **$0.50/gal.** credit for waste animal/plant oil.

State Actions

- 20 states have Renewable Portfolio Standards (RPS) [AZ, CA, CO, CT, DC, HI, IA, MA, MD, ME, MN, NJ, NM, NV, NY, PA, RI, TX, VT, WI]
- 15 states have Public Benefit Funds (PBF) for renewable energy totaling over $400 million in 2004 and expected to reach $4 billion by 2017. [CA, CT, DE, IL, ME, MA, MN, MT, NJ, NY, OH, OR, PA, RI, WI]
- 28 states have Climate Action Plans [AL, CA, CO, CT, DE, HI, IA, IL, KY, MA, MD, ME, MN, MO, MT, NC, NH, NJ, NM, NY, OR, PA, RI, TN, UT, VT, WA, WI]

Other Examples of State and Federal Policy Incentives

- The Energy Policy Act of 2005 includes a Renewable Fuels Standard (RFS) of 7.5 billion gallons by 2012.
- The Energy Title of the 2002 Farm Bill provides **$455 million** over 5 years.
- A number of state renewable energy incentives have biomass provisions: state grant programs (27 states), production incentives for renewable power generation and fuels (50 states), loan programs (21 states), property tax incentives (25 states), personal income tax incentives (14 states and PR), corporate tax incentives (16 states), sales tax incentives (14 states and PR), industrial recruitment incentives (7 states), rebate programs (19 states).
- Minnesota Governor Tim Pawlenty signed into law a statewide mandate for 20 percent ethanol use on May 10, 2005, up from the existing 10 percent requirement.
- Washington Governor Christine Gregoire signed into law SB 5101, also on May 10, 2005, to provide a 15¢ per kilowatt-hour incentive for small scale renewable energy producers using solar, wind, or anaerobic digester technology.

VIII. Conclusions

Major subsidies continue to go to mature energy industries that are highly profitable and polluting. Subsidies are embedded throughout our infrastructure at the federal, state and local level. At the same time, our use of fossil energy is responsible for most of our environmental problems, including the largest of all, climate change. What is wrong with this picture?