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Energy

NEWS...INTERPRETATION...ANALYSIS

Trillion Dollar Blunder

The war in Iraq was supposed to assure oil supplies and stabilize prices. It had the opposite effect.

Sweeping changes will be needed to wean the U.S. from oil.

Companies increase spending on exploration and production.

A Rumailah field oil well burns in 2003.

Also Inside:

...and the latest news

Founded in 1971

Support for R&D

The government spends big to develop energy technology. Here is where it puts its money.

The federal government has historically encouraged and supported the development of domestic U.S. energy resources in many diverse ways. Federal incentives for energy production have taken the form of direct subsidies, regulation, tax incentives, market support, demonstration programs, research and development funding, procurement mandates, information generation and dissemination, technology transfer, directed purchases, and other types of actions.

Of the $644 billion (2003 dollars; all estimates quoted here are in constant 2003 dollars, unless otherwise noted, and refer to actual expenditures in the relevant year) in total federal energy-related incentives provided between 1950 and 2003, research and development funding comprised about 19 percent—$121 billion. (Table 1).

The 'Big Three'

The R&D funds were not distributed evenly among technologies. Three energy technologies—nuclear energy, coal, and solar and renewable energy—have received 86 percent of all federal R&D support. These R&D programs are the subject of this analysis.

Federal involvement and intervention in energy markets has been pervasive for most of the past century, especially with respect to regulatory, price, R&D, and tax policies. Beginning in the 1950s, as a result of the Atomic Energy Act, the Federal government began to expand its energy-related R&D, particularly as it related to commercialization of nuclear energy as a source of electricity. While Federal support of energy research and development programs began during the 1950s, Federal support of energy R&D became a major national priority after the first "energy crisis" of 1973/74.

Due to the 1973 Arab oil embargo and the resulting rapid increases in oil prices, energy R&D changed from being a peripheral Federal interest to a major concern:

- In the summer of 1973, energy was a non-issue in the United States; less than a year later it was the most important issue.
- Prior to 1973, funding on energy R&D was minimal and unfocused; for many years after 1973 Federal spending for energy R&D programs and research projects grew rapidly and expanded dramatically.

Federal support for energy R&D grew exponentially after the energy shocks of 1973-74. In terms of federal R&D funding, 1976 was a watershed year, as this was the first budget year in which the new "reformed" federal energy organizations were fully in-place and the first year in which federal energy R&D funding priorities were broadly redirected.

Here we analyze federal energy research and development expenditures since 1950, with particular emphasis on the 1976–2003 period. We also estimate the cost, through 2003, of all federal incentives for energy development.

Energy R&D Priorities

Analysis of federal budget data over the past four decades shows:

- Most federal energy research and development funding, representing 86 percent of the total spent since 1950, went to three energy sources: Nuclear, coal, and renewables (excluding hydroelectricity and geothermal energy).
- Prior to 1976, the primary focus of federal research and development funding was nuclear energy. This funding concentrated on commercialization of light water reactors and development of the breeder reactors judged necessary by industry and governments around the world to assure long-term supply of nuclear fuel.
- In 1976, following the reorganization of the Atomic Energy Commission into the Nuclear Regulatory Commission and the Energy Research and Development Administration, a major change in R&D priorities and funding occurred.
- Research and development expenditures for all three energy sources expanded greatly after 1975, but this increase was especially marked for coal and renewables—between 1976 and 2003 the Federal government spent nearly five times as much on coal R&D as it had the previous quarter century, and nearly ten times as much on renewables R&D.

By Roger H. Bezdek and **Robert M. Wendling**. Bezdek and Wendling are the authors of "A Half Century of Federal Energy Incentives: Size, Distribution, and Policy Implications," published in January 2006 by Management Information Services, Inc. Washington, D.C.

Table 1
The Total Cost of Federal Incentives for Energy Development Through 2003
(Billions of 2003 Dollars)

	Nuclear	Hydro	Coal	Oil	Natural Gas	Solar	Geothermal	TOTAL	Percent
Research & Development	$60.6	$1.2	$27.3	$6.7	$5.6	$16.4	$ 2.9	$120.7	18.7
Regulation	9.9	4.1	6.2	106.1	2.9	0	0	129.2	20.1
Taxation	0	10.5	26.7	155.4	75.6	11.7	1.4	281.3	43.7
Disbursements	-8.3	1.4	6.4	2.1	0	1.5	0	3.1	0.5
Government Services	1.2	1.3	12.6	27.2	1.3	1.7	0	45.3	7.0
Market Activity	0	54.1	1.7	4.5	1.7	1.3	1.4	64.7	10.0
TOTAL	$63.4	$72.6	$80.9	$302.0	$87.1	$32.6	$5.7	$644.3	
Percent	9.8	11.3	12.6	46.9	13.5	5.1	0.9		100.0

Source: Management Information Services, Inc., 2006.

• R&D expenditures for all three technologies peaked between 1979 and 1981 and then declined dramatically and, this decline continued through the late 1990s.
• Over the past decade federal R&D priorities shifted, and by 2003 R&D expenditures for coal were one-third larger than those for renewables and nearly four times as large as those for nuclear energy. In 2003, federal R&D expenditures for renewables was nearly three times as large as those for nuclear energy.
• Most recently, major new energy R&D initiatives have been implemented and proposed that are related to climate change, fuel cells, and hydrogen. These have been primarily targeted toward renewables and coal.

There is insufficient information dating back to 1950 to derive detailed expenditure estimates for all programs, but these data are available for two current, well-developed electricity-producing technologies—light water reactors and photovoltaics:
• Between 1950 and 2003, federal R&D expenditures for the light water reactor program totaled approximately $4.69 billion.
• Over this same period federal R&D expenditures for photovoltaics totaled approximately $3.65 billion.

Since 1976, when federal energy R&D priorities were reordered, R&D spending for photovoltaics has been twice that for the light water reactor:
• Federal R&D expenditures for the light water reactor program totaled approximately $1.5 billion.
• Over this same period federal R&D expenditures for photovoltaics totaled approximately $2.9 billion.

Over the past decade, 1994-2003, R&D spending for photovoltaics exceeded LWR spending by more than 50 percent:
• Federal R&D expenditures for the light water reactor program totaled $480 million.
• Over this same period federal R&D expenditures for photovoltaics totaled $770 million.

In terms of support for electric generation technologies, cumulative R&D expenditures between 1976 and 2003 favored renewables technologies.
• In the nuclear energy program, $1.5 billion was spent on light water reactors and $2.1 billion was spent on advanced systems, for a total of $3.6 billion.
• In the coal program, $1.6 billion was spent on advanced research and technology development, $2.0 billion was spent on combustion systems, and $1.4 billion was spent on Magnetohydrodynamics, for a total of $5.0 billion.
• In the renewables program, $2.9 billion was spent on photovoltaic systems, $2.1 billion was spent on solar thermal systems, and $1.4 billion was spent on wind systems, for a total of $6.4 billion.

Support in Perspective

To place these findings in perspective, the three energy sources currently provide 71 percent of the nation's electricity and 43 percent of the nation's total energy consumption:
• Coal provides 51 percent of U.S. electricity and 32 percent of energy consumption.
• Nuclear energy provides 20 percent of U.S. electricity and 11 percent of energy consumption.
• Renewables (excluding hydroelectricity and geothermal energy) provide 0.3 percent of U.S. electricity and 0.2 percent of energy consumption.

Conclusions

The major conclusions derived here include:
• The common perception that federal R&D policies in recent decades have favored coal and nuclear energy at the expense of renewables is not correct. In fact, nearly the opposite is true.
• Over the past decade, federal R&D priorities have shifted in favor of renewables. By 2003 the renewable R&D budget was 75 percent the size of the coal R&D budget and nearly three times the size of the nuclear energy R&D budget.
• With respect to two illustrative electricity-producing technologies—photovoltaics and the light water reactor, federal R&D polices since 1976 have strongly favored the former: Over this period R&D spending for photovoltaics was double that for the LWR: $2.9 billion for photovoltaics compared to $1.5 billion for the LWR.
• Thus far, the return to the U.S. on the large sums expended on renewables R&D has been small.