"My administration will foster technologies that I'm absolutely convinced will change America for the better. We will promote innovative ways to encourage conservation.... to become less dependent on foreign sources of energy."

– President George W. Bush[1]

Energy Efficiency Research, Development, and Deployment: Why Is Federal Support Necessary?

Americans spend about $600 billion each year for energy. Investing a small fraction of this amount in energy efficiency has proven to be a cost-effective strategy for achieving important public goals, such as

- **economic prosperity**
- **environmental protection**
- **energy security**

Past federal investments in energy-efficient technology are already saving American consumers billions of dollars, while reducing air pollutant emissions and improving the security of our energy systems. Any new technology requires research, development, and deployment (RD&D) to make a difference in the marketplace. Energy efficiency technologies, because they have such strategic importance for the United States, must have sustained and expanded federal RD&D support.

American Council for an Energy-Efficient Economy

ACEEE is an independent, nonprofit research group dedicated to advancing energy efficiency as a means of protecting the environment and strengthening the economy. For more information, see our website at www.aceee.org.

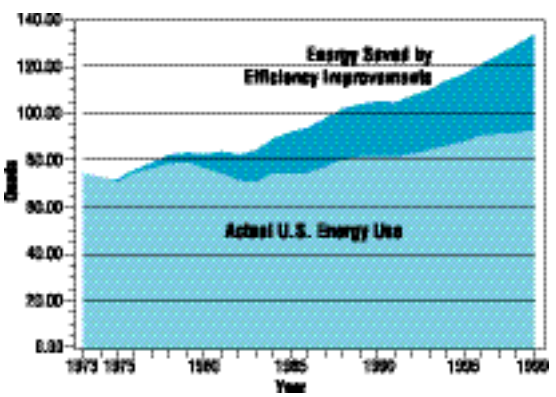
Energy Efficiency Serves Important Public Goals

Energy Efficiency Supports Economic Prosperity

The United States spends hundreds of billions of dollars a year for energy—about 6% of GDP. However, it could be worse: energy efficiency has reduced energy use per dollar of GNP by about 40% since the 1970s energy crises, slashing American energy bills by over $400 billion (see Figure 1). These savings, spent on other goods and services, created new jobs and added to U.S. economic prosperity.

Oil imports are about one-fifth of U.S. energy use, costing more than $400 for every American. Vehicle fuel economy improved from 13.1 mpg to 20.4 mpg between 1975 and 2001, and is now saving us 4 million barrels of oil per day, double what we import from the Persian Gulf. Had we not improved fuel economy, the average American vehicle would consume an extra $400 worth of fuel each year.

FIGURE 1: Impact of Energy Efficiency on U.S. Energy Use, 1973-1999[2]



While past gains in fuel economy have helped, U.S. vehicle mileage has slipped in recent years. New vehicle technologies, as well as increased fuel economy standards, are essential to reverse this trend and keep U.S. oil use from soaring.

Investing in energy efficiency also creates jobs. As a recent study showed, pursuing energy efficiency policies that stimulate investment in high-efficiency products and services would generate over 800,000 jobs by 2010, as well as almost $30 billion in new wages and $14 billion in GDP. These results are summarized in Table 1.

TABLE 1: The Impact of Energy Efficiency and Renewables Policies on Jobs and the Economy[3]

	2005	2010
net new jobs created	461,200	870,500
net new wages and salaries (billion 1996 dollars)	$14.6	$27.3
net additional GDP (billion 1996 dollars)	$8.8	$13.7

Energy Efficiency Prevents Air Pollution and Supports Public Health

Air pollution continues to be a serious public health problem in the United States. In 2000, accordingly to federal studies, air pollution caused 50,000 to 120,000 premature deaths and the health care costs related to air pollution were in the $40 billion to $50 billion range.[4]

Emissions of air pollutants like sulfur dioxide and oxides of nitrogen come primarily from energy used in power plants, motor vehicles, and industrial plants. The more energy we use, the more pollution we create. But energy-efficient technologies typically reduce energy use and pollutant emissions, producing double benefits for the economy and the environment.

For example, stationary-source emissions would be 60% higher if we had not reduced the economy's energy intensity since the 1970s.[5]

One of our most persistent ambient air quality problems—ground-level ozone or "urban smog"—stems directly from emissions of nitrogen oxide (NO_x). More than 125 million Americans—almost one in two—live in counties that exceed national air quality standards and most of those violations are for ozone. Asthma sufferers, who are disproportionately affected by ozone, experience more than 100 million days of restricted activity each year because of high ozone levels.[6]

Energy Efficiency RD&D Requires Meaningful Federal Support

Federal Investment in Efficiency RD&D Is Critical

Despite the efficiency gains achieved since the 1970s, the combination of increased levels of energy services (more cars, more computers, larger homes, etc. per person), population growth, and economic growth continue to drive increases in total U.S. energy use. The price shocks of the 1970s, which motivated large increases in efficiency, have given way to volatility in energy markets, in which prices are low much of the time but sudden spikes disrupt market equilibrium. This unpredictable price environment, coupled with an increasingly short investment timeframe for the private sector, tends to discourage investment even in

mature energy-efficient technology, let alone higher-risk RD&D.

The private sector does not take into account the value of national energy security, reduced air pollutant emissions, improved electric system reliability, or other national policy objectives when making investment decisions. Moreover, efficiency technology may not meet internal, short-range investment criteria; investment risk may be too great for an individual company; or a single company may lack the needed technical expertise. As a result, far too little private capital is flowing to the technologies needed to achieve the next wave of efficiency improvements. This makes increased federal investment in energy efficiency RD&D all the more critical.

Deployment Is Essential for Overcoming Market Barriers

Research and development of high-efficiency technologies is necessary—but not sufficient—to ensure that efficient technologies have the marketplace impact needed to support our energy security, economic prosperity, and environmental quality goals. Deployment—the vital last "D" in "RD&D"—is often essential to overcome persistent barriers in the marketplace that inhibit market penetration of high-efficiency products. Following are examples.

- Consumers don't see the full cost of energy. Nominally low retail energy prices don't reflect the environmental costs of energy use or the long-term replacement cost of fossil fuels.
- Most consumers are unaware of the efficiency and operating costs of products they buy. They are better able to judge attributes like color, size, and performance.
- Many purchasing decisions for energy-using products and systems are made by people who do not benefit directly from reduced energy use, including:
  - home builders who are more concerned about construction costs than homeowner energy bills;
  - landlords who don't invest in efficiency because they usually don't pay energy bills; and
  - procurement officers in large organizations who are bound by low-bid rules and thus have a disincentive to reduce operating costs by paying more for efficient technology.
- The buildings industry, consisting of more than 100,000 builders (mostly small businesses with limited technical staff), is ill-equipped to make informed decisions about efficient technology and building practice. Substantial education and training is needed to achieve market transformation in this industry.

DOE's and EPA's deployment programs, including ENERGY STAR®, Rebuild America, and Clean Cities, have been both effective and cost-effective in taking key energy technologies to market. By 2001, ENERGY STAR-labeled appliances had achieved a 17% national market share on an annual budget of $3 million. Rebuild America projects 2010 community savings of $2.2 billion from a 2003 budget of $20 million. Clean Cities projects 2010 savings of $389 million from a $9 million 2003 budget.

DOE Efficiency R&D Produces Outstanding Returns

In 2001, the National Research Council issued a major study of the benefits and costs of DOE's energy research programs from 1978 through 2000.[7] The study found that DOE programs overall pay back many dollars to the economy for each federal dollar spent. Part of the report evaluated the following six technologies that DOE helped bring to market:

- advanced refrigeration compressors
- electronic ballasts for fluorescent lamps
- low-e glass for windows
- advanced lost-foam casting
- oxygen-fueled glass furnaces
- advanced turbine systems

These six technologies alone have returned about $30 billion on an R&D investment of about $400 million. They have saved about 5 quads (note: one quad = one quadrillion Btus, or about 1% of current U.S. energy use) of energy and avoided millions of tons of air pollutant and greenhouse gas emissions. Even if the rest of DOE's $7 billion investment in energy R&D generated no benefits at all, the portfolio still returns more than four dollars to the economy for each federal dollar invested. Fortunately, DOE has the potential to bring exciting new technologies forward, including LED lighting, heat pump water heaters, electrochromic windows, and fuel cell and hybrid vehicles. These and other promising technologies need sustained and expanded RD&D to deliver benefits to the nation.

DOE's Portfolio Management Approach Gets Results while Managing Risk

Like any prudent investment manager, DOE spreads its investments to capture as many high-return opportunities as possible. Thus, the shortcomings of any one technology or program are not indicators of failure in the overall program, because the nature of scientific research is based on

a certain failure rate. It is the knowledge that comes from research that drives progress, even if (and often because) individual projects fail to produce expected results.

The Private Sector Actively Participates in DOE RD&D Programs

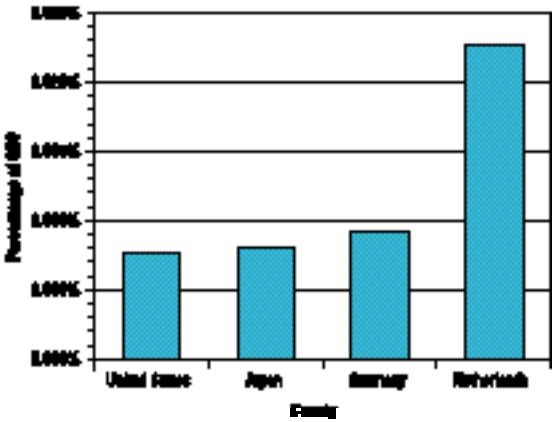
Federal energy efficiency RD&D has consistently demonstrated its value to the economy by attracting broad-based cooperation with partners from private industry, states, and other research organizations. For example, DOE's industry efficiency programs alone support about 500 RD&D initiatives involving about 2,000 partners. Similar participation patterns occur in the buildings and transportation programs.

The United States Needs to Invest in Energy-Efficient Technology to Remain Competitive

The United States lags behind its OECD partners in R&D investment in energy efficiency. We spend $.07 per thousand dollars of GDP, compared with $.08 for Japan, $.09 for Germany, and $.23 for the Netherlands. These numbers are illustrated in Figure 2.

What these numbers don't show is the share of key energy technology markets held by products made by non-American companies. High-efficiency lighting, hybrid vehicles, industrial robots, and machine tools, to say nothing of solar photovoltaics and wind systems, are examples of product markets dominated so far by non-U.S. firms. Energy-using products and equipment account for hundreds of billions of dollars in the U.S. economy, and overseas markets are much larger. Energy-efficient technology is a growing share of this market: the question is whether American manufacturers or their overseas competitors will win the larger share of these markets. U.S. RD&D is critical to keeping American companies and the U.S. economy competitive and growing in world energy technology markets.

FIGURE 2: Efficiency and Renewables R&D as a Percentage of GDP



Science Advisors Agree: DOE Efficiency R&D Should Be Doubled

The President's Committee of Advisors on Science and Technology (PCAST), a panel of research experts and private sector executives, conducted a detailed review of DOE's energy efficiency R&D programs. PCAST's review concluded that:

"R&D investments in energy efficiency are the most cost-effective way to simultaneously reduce the risks of climate change, oil import interruption, and local air pollution, and to improve the productivity of the economy."[8]

PCAST's analysis concluded that the DOE energy efficiency budget should be doubled over a 5-year period. The report projected that such an investment would produce a 40 to 1 return for the nation, including energy cost reductions of up to $45 billion annually by 2010.

PCAST's findings agree with the National Research Council's determination that energy efficiency R&D is one of the nation's best investment prospects. In light of the benefits it can create for energy security, air quality, and the economy, the case for increasing our investment in energy efficiency RD&D has never been stronger.

[1] From remarks by President George W. Bush. 2002. Whiteface Mountain Lodge. Wilmington, N.Y. April 22.
[2] Alliance to Save Energy and Doug Norland, National Renewable Energy Laboratory. 2002.
[3] Tellus Institute and Stockholm Environment Institute. 1999. *America's Global Warming Solutions.* Tellus Institute and Stockholm Environment Institute, for the World Wildlife Fund and the Energy Foundation.
[4] U.S. Public Health Service, Office of Disease Prevention and Health Promotion. 2001. *Healthy People 2000.* Washington, D.C.: U. S. Public Health Service, Office of Disease Prevention and Health Promotion.
[5] M. Bernstein, R. Lempert, D. Loughran, and D. Ortiz. 2000. *The Public Benefit of California's Investment in Energy Efficiency.* Santa Monica, Calif.: Rand Corporation.
[6] Ibid.
[7] National Research Council. 2001. *Energy Research at DOE: Was It Worth It?* Washington, D.C.: National Academy Press.
[8] President's Committee of Advisors on Science and Technology. 1997. *Federal Energy Research and Development for the Challenges of the Twenty-First Century.* Washington, D.C.: President's Committee of Advisors on Science and Technology.

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