THE ENERGY FOUNDATION | ANNUAL REPORT 2002

BUILDING THE CASE FOR NEW ENERGY TECHNOLOGY

MISSION STATEMENT

The Energy Foundation is a partnership of major foundations interested in promoting sustainable energy.

The John D. and Catherine T. MacArthur Foundation, the Pew Charitable Trusts, and the Rockefeller Foundation launched the Energy Foundation in January 1991. In 1997, the Mertz-Gilmore Foundation joined as a funding partner; in 1998, the McKnight Foundation added support for clean energy work in the Upper Midwest. In 1999, The David and Lucile Packard Foundation joined to support two programs: The U.S. Clean Energy Program and the China Sustainable Energy Program. In 2001, The William and Flora Hewlett Foundation joined the Energy Foundation.

The Energy Foundation's mission is to assist in a transition to a sustainable energy future by promoting energy efficiency and renewable energy.

The Energy Foundation has a dual character: it functions primarily as a grantmaker, but when it determines there is an unmet need in the field, it may convene workshops, commission papers, or take other direct initiatives. The foundation has programs in the United States and in China.

BUILDING THE CASE FOR NEW ENERGY TECHNOLOGY

Case: CO2-003
Subject: Opening Remarks

"You can never plan the future by the past."

< EDMUND BURKE >

Energy is the lifeblood of the modern economy. In a nation infused with technological optimism, it's astounding how stubbornly we cling to old energy technologies and old policies. The production of our electricity is dominated by Eisenhower-era coal power plants. Our best selling automobiles—trucks and SUVs—are based on 50-year-old truck frames and 20-year-old engine designs. Our homes are predominately lit by bulbs designed more than 100 years ago.

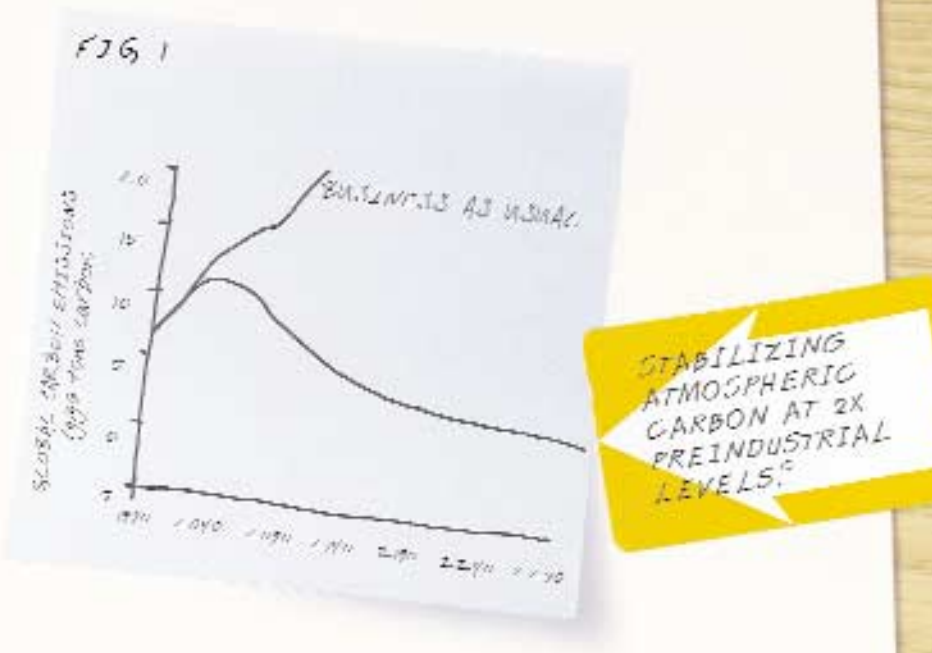
Given our nation's technological prowess, why are we such laggards in energy technology? The answer is simple: cheap energy supplies have afforded us the luxury of laziness for the past three decades. We have not seriously addressed our energy policy since the energy crisis of the early 1970s.

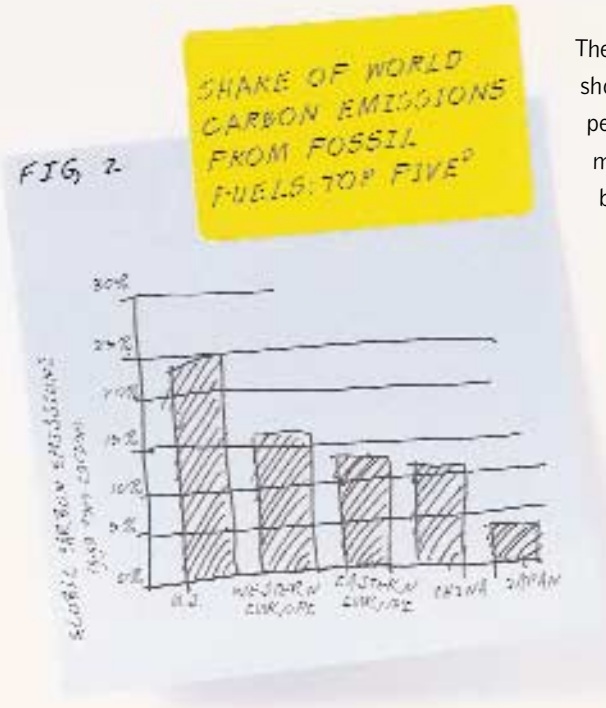
This will change. Our conflict with Iraq—a country perched near some of the world's largest oil reserves—brings into sharp focus the international security and economic dangers arising from dependence on oil. As I write this, oil prices have reached a 12-year high—at a time when our economy can ill afford the extra expense.

In the decades ahead, conflicts such as the one in Iraq will pale in comparison to the economic and environmental disruption caused by global warming. Driven by the world's massive fossil fuel consumption and consequent heat-trapping emissions, leading climate scientists project that global temperatures will rise by 2 to 10 degrees Fahrenheit by 2100, a rate of warming "without precedent during at least the last 10,000 years."[A]

It is dawning on leaders worldwide that drastic cuts in carbon emissions from the burning of fossil fuels are necessary to stabilize the climate. Prime Minister Tony Blair recently announced a British goal to cut greenhouse gases by 60 percent by 2050. An agreement between New England Governors and Eastern Canadian Premiers calls for significant cuts in greenhouse gases to stabilize the climate, adding that "current science suggests this will require reductions of 75 to 85 percent below current levels."[B]

The question is no longer whether we should reduce emissions, but whether we can reduce them fast enough. As Figure 1 shows, the world economy faces a Herculean challenge. We have to transform our energy economy, decoupling economic well-being from carbon growth. And we have to do it fast. The longer we stay on business-as-usual trajectories, the higher the ultimate concentrations of greenhouse gases. Scientists debate whether we should avoid doubling atmospheric concentrations from pre-industrial levels—unfortunately, we're on track to more than triple them.





The U.S. is at the heart of the problem, for good and bad. As Figure 2 shows, we are the largest emitter of greenhouse gases, contributing 24 percent of the world's total. We are also the largest producer of—and market for—new energy technologies. Yet the latest forecasts, from both the government and the energy industry, predict business as usual for the next 25 years.

One fact is certain: Business as usual cannot meet our energy needs. Solving tomorrow's challenges with yesterday's technologies flies in the face of America's technological prowess and its entrepreneurial spirit.

Some politicians argue that we dare not challenge the status quo because it will hurt the economy. But the evidence refutes this claim: The nation's top scientists and energy experts tell us we can have economic prosperity and a low-carbon economy. Existing technologies—from hybrid automobiles to advanced wind power—can meet the nation's and the world's energy needs with a fraction of the emissions.

On the pages that follow, we offer the evidence to show how better technology can radically cut U.S. carbon emissions. Progress in five areas could start the United States down a low-carbon trajectory:

- **Cars** New designs for conventional vehicles and rapid deployment of gasoline/electric hybrids and fuel cells can transform the auto fleet;
- **Coal** Antiquated coal power plants can be replaced by efficiency, renewables, and super-efficient natural gas power;
- **Buildings** Better designs and more efficient appliances put dollars in consumer pockets and reduce emissions;
- **Renewables** Wind power and fuels from biomass offer new revenues for American farmers while decreasing oil imports and reducing emissions;
- **Research & Development** U.S. technology innovation and leadership requires significantly greater R&D investments.

Taken together, this evidence makes the case that our country can and should lead the technological revolution toward a low-carbon economy.

We have the technology today. We know the policies necessary to spur its deployment. We see the economic benefits for American farmers, consumers, and businesses. Now it's time to allow American innovation and persistence to take us there.

Eric Heitz
President

PROOF:

ADVANCED VEHICLE TECHNOLOGIES REDUCE OIL DEPENDENCE AND CUT POLLUTION

KEY FINDINGS

Motor vehicles consume nearly three-quarters of the oil we use, and produce roughly one-third of our nation's global warming emissions. Currently we import 55 percent of our oil—more than at any other time in history—and consequently expose our nation to price shocks and political instability. The ramifications are troublesome today but are shocking when we look to the future. Recent Department of Energy forecasts show U.S. oil consumption and motor vehicle carbon emissions up 35 percent by 2020.

PROMISING DEVELOPMENTS

Technology can transform today's inefficient vehicle designs and dramatically lower our carbon emissions. In fact, the technological transformation of our nation's—and the world's—auto fleet is already beginning. The Toyota Prius Hybrid and Honda Civic Hybrid approach 50 mpg. Ford, Toyota, and GM have announced hybrid SUVs expected to get nearly 40 mpg, due out in 2004 and 2005. Hydrogen-powered fuel cell cars, which produce nothing but clean water as exhaust, offer the promise of super-clean transportation. In December 2002, Honda and Toyota put customer-ready fuel cell test cars on the road in California—the first in the United States. Even improvements to conventional technologies can, according to the National Academy of Sciences, raise fleet-average fuel economy to 37 mpg and save consumers money.[1]

Frustrated with inaction on automobile global warming emissions at the federal level, states are beginning to move. The most promising development is the attempt by California and New York to speed commercialization of climate friendly automobiles. The two states—which represent 15 percent of national auto sales—are creating emission standards for global warming pollution. Other states may follow, increasing the pressure on automakers to bring the best new technologies to market.

WHAT THE EVIDENCE PROVES

We cannot solve global warming without fixing the automobile. The United States should lead the world as a producer and exporter of advanced vehicle technologies and vastly reduce carbon emissions.

IDENCE

DESCRIPTION: AUTOMOBILES: WE CAN'T SOLVE GLOBAL WARMING WITHOUT FIXING THEM CASE NUMBER: CO2-003

PROOF:

NEW TECHNOLOGIES MUST REPLACE OLD COAL POWER

KEY FINDINGS

Over half of this nation's electric power is generated from coal-fired power plants. Many of these plants were built when Eisenhower was president and, because of a loophole in the Clean Air Act, have not been updated since. These old plants emit twice as much carbon per unit of electricity as newer plants. Power production is responsible for 39 percent of our country's carbon emissions, 80 percent of acid rain emissions, 33 percent of nitrogen oxides (a precursor to smog), and is the largest single source for mercury. The U.S. Department of Energy's forecast predicts a 46 percent increase in coal-fired generation by 2025[3] leading to a net increase in carbon dioxide (CO_2) emissions of 636 million metric tons per year.[4] This increase alone matches the total carbon dioxide emissions of India, Germany, and the United Kingdom combined.

PROMISING DEVELOPMENTS

Modern natural gas power plants, derived from airplane jet engines, are up to 100 times cleaner than old coal technologies and twice as efficient. If coupled with aggressive efficiency programs to flatten load growth and new renewable energy investments to generate zero-carbon electric power, natural gas plants could replace old coal technology.

In the absence of federal leadership to speed the transition away from old coal, states are acting on their own. Massachusetts and New Hampshire are requiring their utilities to reduce CO_2. New Jersey is on track to meet its goal of a 3.5 percent reduction in greenhouse gas (GHG) emissions from 1990 levels by 2005, and is about to launch a mandatory CO_2 reporting program. Oregon requires new gas-fired power plants to offset a portion of their CO_2, and Washington is considering adoption of this standard. New York is considering CO_2 controls for power plants. New England has set a region-wide GHG reduction goal. From a carbon perspective, these actions are in no way trivial: The economies of California and New York together are larger than that of Germany.

WHAT THE EVIDENCE PROVES

The United States cannot solve its global warming problem without cleaning up coal. Old coal power technologies destroy our nation's prospects for a low-carbon economy. New natural gas technologies, fast-growing renewables, and aggressive efficiency offer a low-carbon path.


CARBON DIOXIDE EMISSIONS FROM POWER PLANTS[5]
MILLION METRIC TONS CO2
3000
2400
1800
1200
600
0
1990
1995
2000
2005
2010
2015
2020
YEAR
BUSINESS AS USUAL
IF U.S. BANKS EMERGY EFFICIENT, RENEWABLES, & SUPER-EFFICIENT NATURAL GAS POWER
DENCE
DESCRIPTION: COAL: OUR MOST SERIOUS AIR POLLUTION PROBLEM
CASE NUMBER: CO2-003

PROOF:

BETTER BUILDING TECHNOLOGIES SAVE MONEY AND REDUCE POLLUTION

KEY FINDINGS

The average home produces more carbon emissions than the car in its driveway. Powering our homes and businesses results in 38 percent of the nation's carbon emissions. The Department of Energy forecasts 27 percent residential growth over the next 25 years, driven by new construction and by new equipment such as computers, printers, TVs, and air conditioners. New buildings last 50 to 100 years, so today's design choices have long-term carbon emissions consequences.

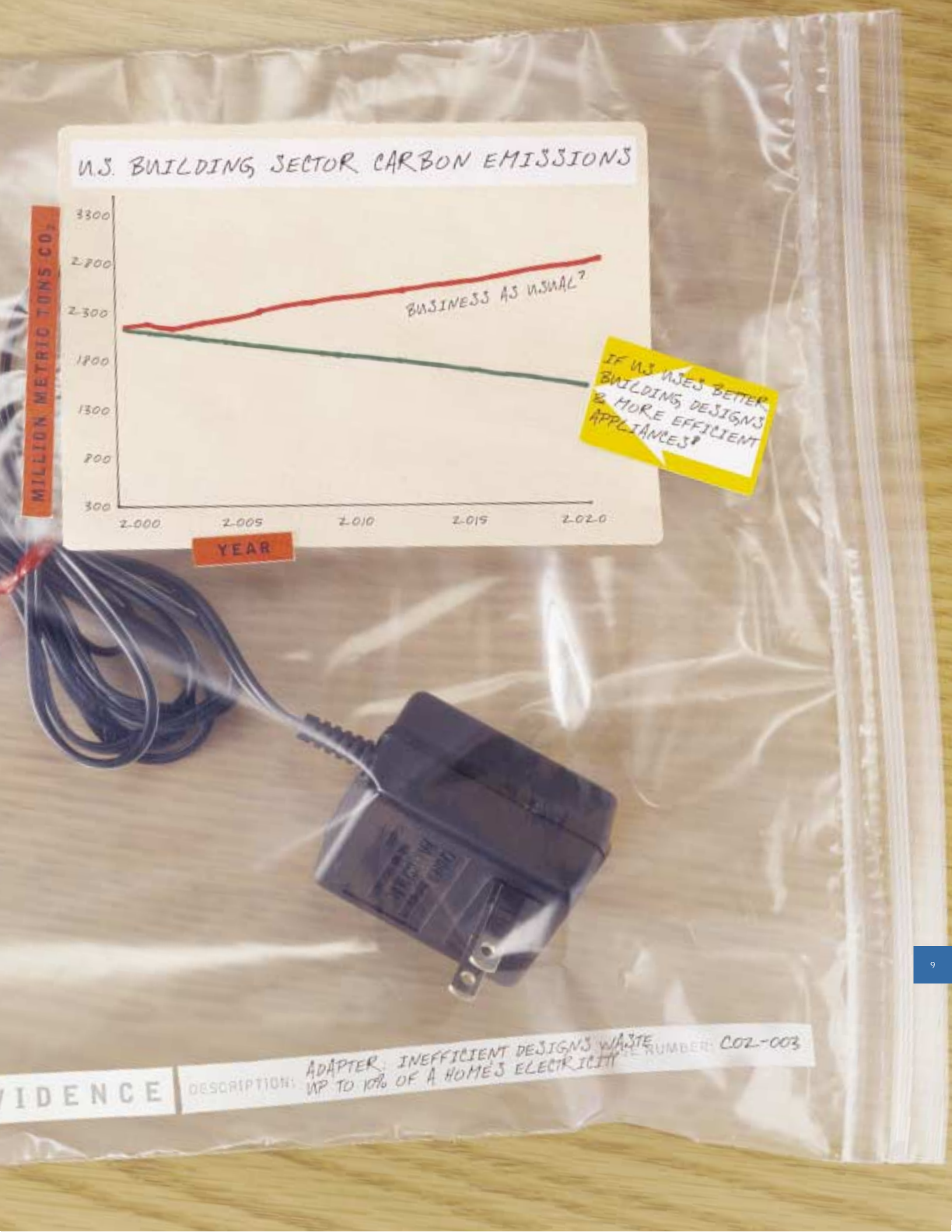
PROMISING DEVELOPMENTS

Existing appliance and equipment technologies can drastically reduce energy use. Today's refrigerators are larger, have more features, and use one-quarter of the energy of 1970 models. Simple changes to air conditioners can cut energy use by 30 percent. If all new residential air conditioners met this performance target, the nation would avoid 120 large new power plants by 2020. Emerging technologies—such as solar cell shingles that replace existing shingles—offer prospects for homes that generate their own electricity with zero carbon emissions.

Appliance and equipment standards for buildings show great promise to transform this sector. They save consumer dollars, increase comfort, and reduce pollution. A recent study by the U.S. national laboratories found such policies to be essential to a low-carbon path for the buildings sector.[6] In the absence of federal leadership on this issue, states are taking the lead. California adopted 11 appliance efficiency rules this year, including two that surpass federal requirements. Oregon also adopted several standards. New Jersey and eight Northeast states are considering them as well.

WHAT THE EVIDENCE PROVES

Available building technologies put money in consumer pockets, increase comfort, and substantially reduce carbon emissions. Broad application allows our country to expand the number of buildings while reducing carbon emissions.


U.S. BUILDING SECTOR CARBON EMISSIONS
MILLION METRIC TONS CO_2
3300
2700
2300
1800
1300
800
300
2000
2005
2010
2015
2020
YEAR
BUSINESS AS USUAL?
IF U.S. USES BETTER BUILDING DESIGNS & MORE EFFICIENT APPLIANCES?
VIDENCE
DESCRIPTION: ADAPTER. INEFFICIENT DESIGNS WASTE UP TO 10% OF A HOME'S ELECTRICITY
CO2-003

PROOF:

FARMERS PROFIT FROM GROWTH IN RENEWABLE POWER

KEY FINDINGS

Wind power is the fastest growing energy resource in the world, increasing at 25 percent per year since 1990. Wind power costs have dropped dramatically from 47 cents per kilowatt-hour in 1981 to under 4 cents per kilowatt-hour today. Other renewable energy technologies like solar cells, geothermal, and biomass exhibit similar cost curves, demonstrating that higher production volumes lead to reduced costs. Unfortunately, renewables supply less than 2 percent of our nation's power. The latest Department of Energy forecast, which assumes no policies to spur renewable energy development, projects that renewable energy will meet less than 3 percent of our nation's power by 2025.[9]

PROMISING DEVELOPMENTS

American farmers and rural communities are leading the way in renewable energy development. Lease payments from wind turbines can double annual farm revenues with minimal impacts on row crops or grazing. In the last three years, Minnesota, Texas, Washington, and upstate New York together have seen about $1.5 billion of new wind energy investments. Farmers, already heavily invested in ethanol production from corn, are increasingly interested in supplying biomass for power from switchgrass, fast-growing poplar trees, and waste from crops and livestock.

Recognizing the prospects of renewables—and seeing no actions at the federal level—state legislatures are stepping in. Recently, New York's Governor Pataki announced his support for requiring New York state to procure 25 percent of its power from renewables by 2012. California, the world's fifth largest economy, passed a similar policy last year requiring that 20 percent of the state's power be from renewable energy by 2015. It's estimated the policy will spur $10 billion in renewable energy investments. All told, 13 states have passed such policies, with Colorado, Washington, and Iowa considering them as well.

WHAT THE EVIDENCE PROVES

Renewable energy means economic development in America's poorest rural economies. Good policy can spur explosive growth in renewable energy, creating a path toward a clean, affluent economy.

VIDENCE

DESCRIPTION: BIOMASS: A NEW FUEL PROVIDES A NEW MARKET FOR AMERICAN FARMERS

CASE NUMBER: C02-003

PROOF:

TECHNOLOGY LEADERSHIP DEMANDS GREATER RESEARCH & DEVELOPMENT INVESTMENTS

KEY FINDINGS

Our nation's energy technology R&D expenditures are declining precipitously. In the last ten years we've seen a reduction of nearly 65 percent: from $3.4 billion per year to $1.2 billion. Leading industries such as telecommunications and pharmaceuticals spend from 8 to 10 percent of their net sales on R&D. Japan, known for its technological innovation, spends five times as much, on a percentage basis, as our federal energy R&D each year.[11] Americans pay more than $700 billion in energy bills each year. However, only one-fifth of one percent of federal funding goes toward technological innovations that could cut energy costs, reduce foreign dependence, and decrease carbon emissions.

PROMISING DEVELOPMENTS

Every energy-using sector is ripe with new technology opportunities—from new batteries, to ultra-cheap fuel cells, to low-cost hydrogen storage. Many require substantial R&D investments to enter the marketplace.

And there are great reasons to support our best energy research. A recent report from a panel of the National Research Council concluded that energy R&D investments are "producing economic benefits, options for the future, and knowledge benefits. It is the committee's judgment that the benefits of these programs substantially exceed the programs' costs and contribute to improvements in the economy, environment, and national security..."[12]

The report goes on to estimate that $7 billion of energy efficiency R&D investments over 22 years—like compact fluorescent and new window technologies—reaped $30 billion in net consumer benefits. Clearly, R&D investments in energy can have significant payoffs.

WHAT THE EVIDENCE PROVES

We cannot build a new energy future on yesterday's technology. Innovation requires long-term R&D and deployment investments. The United States should double its federal clean energy and energy efficiency R&D investments. There are few investments where such a relatively small sum can simultaneously deliver dramatic benefits for our national security, the economy, and the environment.


FEDERAL ENERGY R&D SPENDING
BILLIONS OF DOLLARS
5
4
3
2
1
0
ACTUAL ENERGY R&D SPENDING
YEAR
$16 BILLION
IF U.S. INVESTED THE SAME PERCENT IN R+D AS JAPAN
CURRENT U.S. R+D INVESTMENT
$1.2 BILLION
DESCRIPTION: SOLAR POWER. A PRODUCT OF U.S. R & D THAT PROVIDES CLEAN ELECTRICITY
C02-003

FOOTNOTES

PRESIDENT LETTER

A. Working Group 1, Intergovernmental Panel on Climate Change, *Summary for Policy Makers,* 2001, page 13. http://www.ipcc.ch/pub/reports.htm

B. The Committee on the Environment and Northeast International Energy Committee of the Conference of New England Governors and Eastern Canadian Premiers, *Climate Change Action Plan 2001*, August 2001, page 10.

C. Joint Global Change Research Institute, March 2002. http://www.globalchange.umd.edu/symposium/

D. Energy Information Administration (EIA), *International Energy Annual 2001*, Table H1. http://www.eia.doe.gov/emeu/international/ total.html#Carbon

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2. Doniger, D., Friedman, D., Hwang, R., Lashof, D., Mark, J., *Dangerous Addiction: Ending America's oil Dependence*, Natural Resources Defense Council and the Union of Concerned Scientists, January 2002. www.nrdc.org/air/transportation/oilsecurity/securityinx.asp

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3. EIA, Department of Energy (DOE), *Annual Energy Outlook 2003*, Table A8. www.eia.doe.gov/oiaf/aeo/
4. IBID, Table A19.
5. Clemmer, S., Donovan, D., Nogee, A., Deyette, J., *Clean Energy Blueprint: A Smarter National Energy Policy for Today and the Future*, Union of Concerned Scientists, October 2001. www.ucsusa.org/clean_energy/renewable_energy/page.cfm?pageID=44

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6. Inter-laboratory Working Group on Energy-Efficient and Clean-Energy Technologies, *Scenarios for a Clean Energy Future*; Prepared for the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, 2000. www.ornl.qov/ORNL/Energy_Eff/CEF.htm
7. Energy Information Administration, Department of Energy, *Annual Energy Outlook 2003* Table A19 and Table 19.
8. Inter-laboratory Working Group on Energy-Efficient and Clean-Energy Technologies, *Scenarios for a Clean Energy Future* and EIA, *Annual Energy Outlook 2003*.

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9. Energy Information Administration, Department of Energy, *Annual Energy Outlook 2003*, Table A17.
10. Clemmer, S., Donovan, D., Nogee, A., Deyette, J., *Clean Energy Blueprint: A Smarter National Energy Policy for Today and the Future*, Union of Concerned Scientists, October 2001.

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11. Twenty percent of the Japanese government R&D budget appropriation was directed toward energy, whereas the corresponding number for the United States was 4.2 percent (1994 data) Source: *Federal Energy Research and Development for the Challenges of the Twenty-First Century*, The President's Committee of Advisors on Science and Technology, 1997, page 2-10; Box 2.2 "Energy R&D in Japan." www.ost.gov/Energy/
12. *Energy Research at DOE: Was It Worth It? Energy Efficiency and Fossil Research 1978 to 2000*. National Research Council, 2001, page 63. http://books.nap.edu/books/0309074487/html/index.html
13. National Science Foundation; Division of Science Resources Statistics; Federal R&D Funding by Budget Function: fiscal Years 2001-03 Arlington, VA (NSF 02-330) [September 2002]; Table 25h. Federal R&D budget authority, by budget function: fiscal years 1996–2003, and Table 25g. Federal R&D budget authority, by budget function: fiscal years 1990-95. http://www.nsf.gov/sbe/srs/nsf02330/historic.htm