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THE IMPACT OF FEDERAL ENERGY EFFICIENCY AND RENEWABLE ENERGY R&D PROGRAMS

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY

COMMITTEE ON SCIENCE

HOUSE OF REPRESENTATIVES

ONE HUNDRED EIGHTH CONGRESS

SECOND SESSION

MAY 19, 2004

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THE IMPACT OF FEDERAL ENERGY EFFICIENCY AND RENEWABLE ENERGY R&D PROGRAMS

WEDNESDAY, MAY 19, 2004

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY,
COMMITTEE ON SCIENCE,
Washington, DC.

The Subcommittee met, pursuant to call, at 10:06 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Judy Biggert [Chairman of the Subcommittee] presiding.

COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

The Impact of Federal Energy Efficiency and Renewable Energy R&D Programs

Wednesday, May 19, 2004
10:00am
2318 Rayburn House Office Building

Witness List

Mr. Steve Nadel
Executive Director
American Council for an Energy Efficient Economy

Mr. Paul Konove
President
Carolina Country Builders of Chatham County, Inc.

Ms. Vivian Loftness
Head, School of Architecture
Carnegie-Mellon University

Mr. John B. Carberry
Director, Environmental Technologies
DuPont Central Research & Development

Mr. Peter Smith
President
New York State Energy Research and Development Authority
New York State

Mr. Daniel L. Sosland
Executive Director
Environment Northeast

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HEARING CHARTER

SUBCOMMITTEE ON ENERGY
COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

The Impact of Federal Energy Efficiency and Renewable Energy R&D Programs

WEDNESDAY, MAY 19, 2004
10:00 A.M.—12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

1. Purpose

On Wednesday, May 19, 2004, the Subcommittee on Energy of the U.S. House of Representatives' Committee on Science will hold a hearing to examine the potential contribution of energy efficiency and renewable energy to the Nation's energy needs. The hearing will focus on the contributions of the renewable energy and efficiency R&D programs at the Department of Energy.

2. Witnesses

Mr. Steven Nadel is the Executive Director of the American Council for an Energy-Efficient Economy (ACEEE), a non-profit research organization that works on programs and policies to advance energy-efficient technologies and services.

Mr. Paul Konove is President of Carolina Country Builders of Chatham County Inc., a company that specializes in custom solar home design and construction.

Ms. Vivian Loftness is Head of the School of Architecture at Carnegie-Mellon University. Her design and consulting work has led to the design and construction of numerous energy conserving buildings here and abroad.

Mr. John B. Carberry is Director of Environmental Technology for the DuPont Company in Wilmington, Delaware. His responsibilities include leading DuPont's efforts to find and use affordable renewable energy and energy efficiency technologies.

Mr. Peter Smith is President of the New York State Energy Research and Development Authority (NYSERDA).

Mr. Daniel L. Sosland is Executive Director of Environment Northeast, a non-profit research and advocacy organization, working on energy efficiency and renewable energy, climate change and air quality issues.

3. Overarching Questions

The hearing will address the following overarching questions:

- What are the likely U.S. energy needs for the coming decades? What is the potential for energy efficiency and renewable energy to help meet those needs?
- What are the public benefits of energy efficiency and renewable energy, and what is the proper role for the Federal Government in helping to reap those benefits?
- How have energy efficiency improvements contributed to meeting current energy demands? What programs at the State and federal level, along with programs implemented by industry, have been most successful at promoting energy efficiency and the use of renewable energy resources?

4. Overview

Over the past two decades, the U.S. has become increasingly dependent on foreign sources of energy, particularly oil and natural gas. The U.S. imported 27 percent of its energy (61 percent of its petroleum, of which 70 percent is used for transportation) in 2001. Assuming that current conditions continue into the future, often referred to as a "business-as-usual" scenario, imports are projected to grow to 39 per-

cent of total energy use, and 76 percent of petroleum use by 2025.[1] As the country looks to reduce its dependence on imported energy, there are four potential options: increase the Nation's energy efficiency, increase the domestic production of fossil fuels, increase the use of nuclear power, and increase the use of renewable energy. All of these options face unique challenges to provide the 136 quadrillion BTUs the United States is projected to use in 2025. In fact, it is likely that only a combination of approaches will yield enough energy to sustain economic growth.

Most experts agree that if the United States is going to reduce its dependence on imported energy, renewable energy and energy efficiency will need to meet an increasing percentage of energy demand in the United States over the next 20 years. This is particularly true in the near-term since energy efficiency improvements can reduce demand more quickly than longer-term development of new sources of nuclear or fossil-based energy can expand supply. Many of the additional public benefits attributable to energy efficiency and renewable energy, such as reduced emissions and better peak-load management, are not reflected in their price to consumers.

Energy efficiency is better management of processes, equipment, personnel, and other resources to reduce energy use. For example, by actively managing their energy-intensive industrial processes, the DuPont Company has kept energy use constant since 1990, while production has increased by 40 percent over the same period. Although accelerated efficiency improvements could make a significant impact on demand, there will still be a need for new sources of energy. To meet the growth in demand, the U.S. will require a mix of energy sources, including renewable energy resources. Renewable energy sources such as wind and solar power are competitive in some markets—particularly sunny or windy areas, regions with high energy costs, or specific niche applications—but some expert suggest, that with additional technology improvements, wind and solar power could be cost-competitive in nearly all regions of the country.

Market Barriers

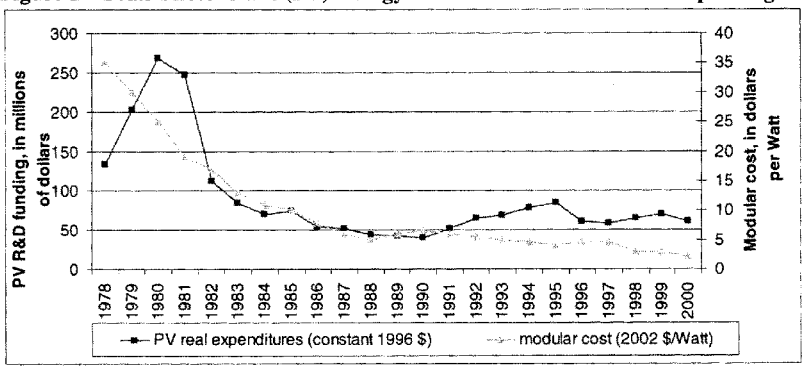
There are significant market barriers to the wider use of energy efficiency and renewable energy to reduce overall demand and substitute for imported energy. Conventional energy technologies have a head start in terms of experience and existing infrastructure, and end-users who might invest in renewable energy and energy efficiency technology do not always realize the full benefits of their investments under current market structures. A familiar example is the landlord-tenant problem, where the landlord who pays for efficiency upgrades does not receive the benefits of the investment; savings go to the occupants of a building who pay the energy bills.

When electricity consumers do improve their end-use efficiency, results can be dramatic. In fact, upgrading the energy efficiency of existing facilities is often less expensive than installing new generating and transmission capacity. According to experts, efficiency improvements often produce co-benefits. More efficient lighting, for example, can reduce cooling costs and improve productivity. Including the savings from reduced energy costs and co-benefits, efficiency improvements can actually provide a return of up to four cents per kilowatt-hour (¢/kWh). Even without co-benefits, lighting, refrigeration, and space heating improvements typically cost between 0–3 ¢/kWh, well below the average cost of electric power. Additionally, there are numerous public benefits from these kinds of improvements. Avoided emissions, reduced infrastructure requirements, reduced sensitivity to fuel-price volatility, and reduced physical disturbances to the energy system, are benefits to the public that are generally not included in the costs borne by consumers.

For renewable energy, the primary barrier is cost. Renewable energy is also relatively immature compared to other energy technologies. Immature technologies tend to fall in cost faster than conventional technology because manufacturers have less knowledge and experience working with them. Therefore federal R&D investments and production incentives can have a large impact on immature technologies, by helping manufacturers reduce costs. For example, Figure 1 shows federal support for photovoltaics R&D and the cost reductions in photovoltaic solar modules that occurred over the same period of time, although it is difficult to isolate the impacts of federal spending from other factors. Similar cost reductions over time are seen for other renewable energy technologies.

[1] *Annual Energy Outlook 2004,* p. 133. Energy Information Administration.

Figure 1 – Solar Photovoltaic (PV) Energy Cost and Real Federal R&D Spending



Another barrier to accelerated market penetration of renewable energy resources is the fact that their lower environmental impact is not reflected in the price of energy. Although the economic value of the environmental impacts of energy use is difficult to quantify, some estimates of the full cost of energy technologies calculate the total costs of renewable energy as lower than the total current cost of conventional technologies.[2]

Another benefit of energy efficiency and renewable energy is their capacity to reduce the peak demand for electricity and natural gas. By displacing the usage of peak generation plants (which are typically the most expensive to operate, the least efficient, and have higher emissions) the use of energy efficiency and renewable energy technologies can lower the price of electricity and natural gas for all consumers, whether or not they directly purchase renewable power or an energy efficient appliance. Both the National Petroleum Council and the American Council for an Energy Efficient Economy have cited energy efficiency as a key step in reducing natural gas prices in the short-term, and reducing price volatility in the longer-term.

R&D Funding

Energy efficiency program funding has varied over the years, peaking, along with energy prices, in the early 1980s. Recently, efficiency R&D programs have been flat-funded at best, with efficiency R&D programs cut by 10 percent ($63 million) in the President's Fiscal Year 2005 (FY05) budget request. These funding cuts are proposed even though energy efficiency R&D funding has been shown to be highly cost-effective. In response to a Congressional request to examine the effectiveness of DOE's energy efficiency programs, a National Academy of Sciences study estimated that for every dollar spent on all efficiency programs between 1978 and 2000 more than four dollars of economic benefits were realized. For example, the Academy estimated that the benefits from efficient lighting research returned $5.3 billion to the public in the form of lower energy bills, while the cost of this research was only $2.5 million, including $755,000 paid by industry. Renewable energy has fared better, increasing by five percent in the FY05 request, although the largest increase is requested for the hydrogen and fuel cell programs.

[2] *"Electricity Generation and Environmental Externalities: Case Studies September 1995,"* p. 44, Energy Information Administration.

Table 1: Science Committee Analysis of Efficiency and Renewable Energy Research and Development funding Trends.

	FY03 appropriation (in millions)	FY04 appropriation (in millions) *	FY05 Request (in millions)	$ Change from FY04 Level	% Change from FY04 Level
Office of EE and RE	$1,202	$1,235	$1,251	$18	1.4%
Weatherization and state grants	$268	$271	$332	$61	23.0%
EE R&D	$612	$607	$544	-63	-10.1%
RE R&D	$322	$357	$375	17	4.5%
EERE R&D total	$934	$964	$919	-$45	-4.7%
Hydrogen and FreedomCAR	$176	$237	$264	$27	12.0%
EERE R&D other than H2 and FreedomCAR	**$756**	**$727**	**$655**	**-$72**	**-9.9%**

* The figures in this chart include all appropriated amounts for FY 04.

5. Background

Energy Efficiency

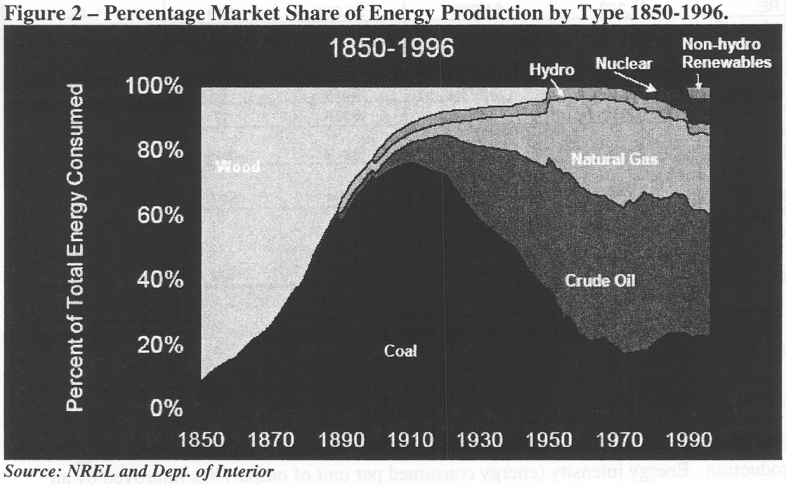
Historically, energy efficiency improvements have reduced the need for more energy production. Energy intensity (energy consumed per unit of output) has improved by an average of one to two percent per year in the U.S. The International Energy Association (IEA) estimates that without the improvements made since 1973 in processing and using energy, world energy use in the year 2000 would have been 50 percent higher—in the U.S. this would be approximately 50 quadrillion BTUs (quads). When a concerted effort is made to improve energy efficiency, reductions in demand can be even larger. Several states have implemented their own programs, with excellent results. New York State reduced energy intensity by average 2.7 percent per year from 1977–1999, and some states have realized annual efficiency improvements greater than three percent. Federal facilities spent $6 billion less in 2001 than they did in 1985 (in constant 2001 dollars), and used 31 percent less energy, in part due to improved energy efficiency.

Energy efficiency improvements can be realized relatively quickly, since there are no delays for siting and construction. In several state programs, utilities have discovered that paying customers to reduce demand is less expensive than building new generation equipment. On a cost per kilowatt-hour basis, efficiency improvements are often the least expensive form of "new generation."

Renewable Energy

Renewable energy generation currently represents a small fraction of the energy portfolio in the U.S., but it is growing rapidly. As Figure 2 shows, at the turn of the last century, oil and gas had limited market shares, but were able to dominate the market within fifty years. Wind and solar photovoltaics have the fastest growth rates in the electricity industry worldwide, with wind generation rates growing at roughly 35 percent per year, and photovoltaics growing at 25 percent per year. Japan is leading the pack by installing 219 Mega-Watts (MW) of solar photovoltaic generating capacity in 2003 alone.

Figure 2 – Percentage Market Share of Energy Production by Type 1850-1996.



Source: NREL and Dept. of Interior

There are also signs in Europe that renewables can supply a large fraction of electrical power. In some regions of Spain and Germany, and all of Denmark, wind supplies more than 10 percent of the electricity demand throughout the year, and in some states in Germany wind provides over 50 percent of local electricity needs for certain months.

As a consequence of aggressive government programs to support wind and solar power technology development and deployment, the Japanese and European manufacturers' market shares of wind and solar power generation equipment have increased dramatically, while the U.S. manufacturers' market share has declined. Japan's share of the world solar photovoltaics market went from 26 percent to 49 over eight years from 1995 to 2003, while U.S. share of the world market went from 45 percent in 1996 to 12 percent in 2003. Similar declines in the U.S. share of the world market for wind equipment can be seen, with the majority of the increases captured by European manufacturers.

Current Activities

Despite the barriers, numerous companies, individuals and government entities have invested in efficiency improvements and renewable energy and have seen large returns. Dupont has kept energy use constant since 1990, while production has grown 40 percent, for a savings of $1.5 billion. This type of success has been replicated in other companies and industrial sectors, with large corporations such as BP (the international energy firm), IBM, Kimberly-Clark and others setting efficiency as a high-priority goal for improving profitability. In the buildings sector, efforts by the joint Environmental Protection Agency (EPA)–Department of Energy (DOE) EnergyStar® program and voluntary standards released by the Green Building Council, an independent non-governmental organization, have contributed to growth in the high-efficiency buildings market. These efforts have also expanded the market for on-site renewable generation.

State governments have also taken an active role in promoting efficiency and renewables. In response to calls for conservation during the electricity crisis of 2000 and 2001, consumers' efficiency efforts produced a 10 percent reduction in demand in less than a year. California is currently promoting demand response and energy efficiency technologies to meet demand before considering new fossil generation. More generally, several states with strong efficiency programs were able to reduce energy intensity by more than three percent per year from 1977–1999.

The Federal Government has several current activities aimed at increasing the use of highly efficient and renewable technologies. These include the R&D in the Office of Energy Efficiency and Renewable Energy (EERE) at DOE, with a funding request of $919 million in 2005. This amount represents a proposed decrease in the FY 2005 budget request, by 10 percent ($63 million) versus current spending. Renewable energy has fared better, increasing by five percent in the 2005 budget request, although the largest increase was for the hydrogen and fuel cell programs.

As Table 1 shows, non-hydrogen research in EERE would decline by 10 percent under the Administration's request.

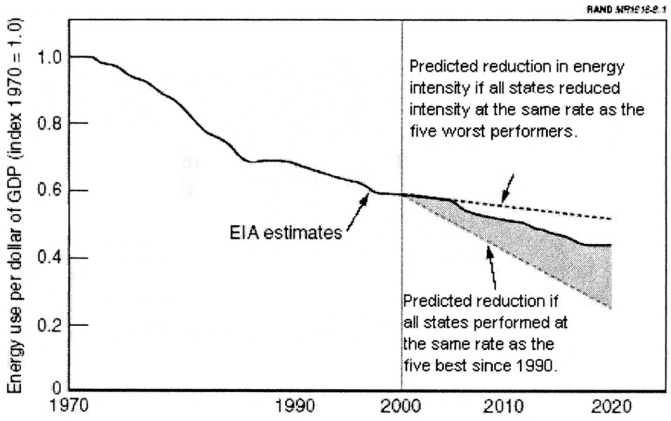
The Federal Government has also set efficiency standards for several appliances in recent years, which have resulted in large reductions in demand. The benefits have been significant, reducing residential heating, cooling and refrigeration energy use by 25 percent, 60 percent, and 75 percent respectively.[3] Four pending standards are expected to save consumers $10 billion in energy costs by 2010.[4] Federal tax incentives for electricity produced from wind are credited by experts with boosting the market share of wind generation, although the wind production tax credit expired on December 31, 2003. Incentives for wind and other renewable generation, as well as credits for highly efficient technologies, are included in several legislative proposals, including H.R. 6, the *Energy Policy Act of 2003.*

The Federal Government has also attempted to lead by example in the marketplace. Federal purchases of renewable energy totaled 362 gigawatt hours (GWh) in 2001, with a goal of 2.5 percent of electricity use by 2005, or 1,384 GWh. By an Executive Order issued in 1999, which the Bush Administration has continued to implement, federal buildings are required to improve their energy efficiency by 30 percent by 2005, and 35 percent by 2010 compared with baseline energy use in 1985. By creating a market for energy efficient and renewable technologies, the government can use its purchasing power to lower the technology adoption costs for other consumers.

Potential

If all states promoted energy efficiency as successfully as the five best states, the reduction in energy intensity (defined as unit of production per unit of energy consumed) would be 2.4 percent per year, a 50 percent improvement over current annual projections.[5] If this level could be sustained, the savings in 2020 would be the equivalent of 3.4 billion barrels of oil.

Figure 3 – Best and Worst-Case Efficiency Scenarios Based on Past State Performance



Source: RAND

[3] Rosenfeld, Arthur H., Pat McAuliffe, and John Wilson. "Energy Efficiency and Climate Change." *Encyclopedia on Energy,* edit. Cutler Cleveland, Academic Press, Esevier Science, 2004.

[4] Loftness, V. "Improving Building Energy Efficiency in the U.S.: Technologies and Policies for 2010 to 2050," proceedings of *The 10–50 Solution: Technologies and Policies for a Low-Carbon Future.* Pew Center on Global Climate Change and the National Commission on Energy Policy.

[5] The Energy Information Administration is the most commonly cited source for domestic energy demand projections. All of its base projections, to ensure consistency, assume no changes in policy. The projections also do not account for variations in R&D spending.

Some of the most impressive benefits come from the *combination* of renewables and efficiency. High efficiency homes with solar power systems on the roof are allowing the creation of homes with near zero energy bills. Some of the larger home-building firms are offering high efficiency and "zero-energy" homes, even creating planned communities of entirely Energy-Star homes, which are high-efficiency homes certified by the EPA.

The primary goal of the renewables programs at DOE is to reduce costs so that renewable technologies can be competitive in the market without further government subsidies. Wind technology is already competitive in areas with the highest wind speed, but further reductions are needed to make wind a viable power source in lower wind speed regions.

6. Questions for the Witnesses

Questions for Mr. Steve Nadel:

1. What is the potential contribution of energy efficiency to meeting future national energy needs? What is the potential for renewable energy? What portion of that potential is cost-effective today, and what portion would require additional research or other incentives?
2. What are the impacts of increased energy efficiency and renewable energy on the natural gas market?
3. What federal and State policies have been successful in encouraging efficiency and renewable energy? What state efforts could be expanded to a federal level?
4. What would be the most cost-effective way for the Federal Government to encourage the use of energy efficiency and renewable energy technologies?

Questions for Mr. Paul Konove:

1. What are the key technology improvements that can result in cost-effective energy savings in today's homes and buildings? Are there renewable energy technologies that can be utilized in new construction in cost-effective manner?
2. What has your experience been with constructing high efficiency buildings? What have been the successes, and the challenges?
3. What areas of energy efficiency and renewable energy technologies need research to improve their operation or cost-effectiveness? What technologies are ready for the marketplace but need improved technology transfer to be widely adopted?
4. How do energy efficiency improvements in new construction differ from retrofitting older buildings? Given that about half the housing we expect to have in the year 2025 has not yet been built, what contribution can improved technologies make toward reducing the energy demands of the future housing stock?

Questions for Ms. Vivian Loftness:

1. What portion of U.S. energy demand do buildings consume? How is that divided among lighting, heating and other major appliances? What are the relative shares of commercial, residential, and industrial building consumption?
2. The Energy Information Administration predicts that energy demand will grow from about 100 quadrillion BTUs (quads) in 2000 to 136 quads in 2025. Taken together, what portion of the 36 percent projected growth in energy demand to 2025 would be attributed to buildings? What proportion of that demand could be met by efficiency investments?
3. What are the greatest opportunities that have not yet been fully explored in federally-sponsored energy efficiency research? Given historical results, what would you estimate the economic rate of return to R&D funding to be?

Questions for Mr. John B. Carberry:

1. Which federal energy efficiency and renewable energy programs has DuPont found to be successful? What benefits has DuPont seen from these efforts?
2. What motivated DuPont to invest in energy efficiency and renewable technology? What federal programs and regulations encouraged or hampered that investment? How should the Federal Government improve its efforts?

3. What is the potential for further efficiency improvements at DuPont? In your opinion, what are the potential impacts of efficiency improvements and the use of renewable resources in the industrial sector on national energy demand? How replicable are the gains made at DuPont? Are any of the improvements considered proprietary? If so, do you license them?
4. How can efficiency improvements and the use of renewable energy throughout the economy affect natural gas prices in the U.S.? How have increased natural gas prices affected DuPont's decisions about plant location?

Questions for Mr. Peter Smith:

1. Why did Governor Pataki feel that it was important to make a commitment to improving New York's energy efficiency, and to increasing the use of renewable energy? What benefits has New York State seen from these efforts? How much did the programs cost?
2. How does New York State measure the effectiveness of its investments in energy efficiency and renewable energy technologies? Does New York State involve industry in its research, and if so how is industry involved? Is industry required to share research costs?
3. What are the potential synergies between State and federal efforts? Are these areas being fully exploited? How can federal efforts be improved? Are there any state policies that should be adopted at the federal level?
4. What are other states doing to promote energy efficiency and renewable energy?

Questions for Mr. Daniel L. Sosland:

1. Why did the Connecticut Legislature feel that it was important to make such a strong commitment to energy efficiency standards, and to increasing the use of renewable energy? What benefits do you expect to see from these efforts? How much are the programs projected to cost?
2. How does the State of Connecticut measure the effectiveness of its investments in energy efficiency and renewable energy technologies? Does the State of Connecticut involve industry research in its efforts, and if so how is industry involved? Is industry required to share research costs?
3. What are the potential synergies between State and federal efforts? Are these areas being fully exploited? How can federal efforts be improved? Are there any State policies that should be adopted at the federal level? What are other states doing to promote energy efficiency and renewable energy?
4. What are technology opportunities that have not yet been fully explored in federally-sponsored energy efficiency research?

Chairman BIGGERT. This is a meeting of the Science Subcommittee on Energy. I want to welcome everyone here to today's hearing to assess the impact and direction of federal energy efficiency and renewable energy research and development.

This hearing couldn't be more timely. Just this week, the average nationwide price of a gallon of gasoline rose above $2 for the first time ever.

This really should come as no surprise. It was three years ago this month that President Bush released his National Energy Policy in response to volatile and rising energy prices: three years ago. Two of the eight chapters of that policy document were dedicated to energy efficiency and renewable energy.

And three times in the last three years the House passed comprehensive energy legislation that greatly expands our use of energy efficiency and renewable energy to meet our growing energy challenges. The same, however, can not be said of the Senate, which hasn't even been able to take an up-or-down vote on the energy bill conference report, because of procedural obstacles.

As a result, we have yet to benefit from a comprehensive energy policy. The United States still imports from foreign sources almost 60 percent of the oil we consume. Even if we increase foreign imports of oil or dip into the Strategic Petroleum Reserve, as some have suggested, we have no way to turn that oil into gasoline or diesel fuel or to get it where it is needed most. We still have static pipeline capacity. We haven't built a large refinery in about 20 years, and we have half as many refineries as we did 30 years ago. Those refineries are operating at almost 100 percent capacity.

And that is just gasoline. I haven't even mentioned electricity or natural gas. In every case, the bottom line is this: we simply can not meet today's energy needs with yesterday's energy infrastructure. No pun intended, but we are virtually in the dark ages when it comes to energy infrastructure. Unless we begin to address some of these fundamental problems, we are going to experience high and volatile energy prices every year, well into perpetuity.

One of the best, most effective ways to address such seemingly insurmountable challenges is through the use of technology: energy efficiency and renewable energy technologies.

In terms of energy efficiency, we are talking about technologies that deliver more goods and services for the same amount of energy. In our homes, that means loads of clean laundry or more bags of chilled groceries without increasing the amount of energy that we use. For our industry, that means increased production without increased energy consumption. For all of us, reducing energy use means lowering our energy costs, reducing our emissions of pollutants and greenhouse gases, and increasing our energy security. In this way, energy efficiency is a very powerful idea.

In terms of renewable energy, we are talking about technologies that allow us to derive energy from sources that can be replenished. During the last decade, renewable energy contributed substantially to the growth in U.S. energy production, outpacing all fuel sources, except for nuclear energy. Despite this progress, renewable energy still only accounts for two percent of our electric generating capacity today. In other words, we still have a long way to go.

Renewable energy is a growing, global industry, and our international competitors are taking renewable energy R&D very seriously. Government investments in renewable energy technologies in Europe and Japan have meant growing market shares for wind and solar power generation equipment for those countries while the U.S. market share is declining. As a nation, we can't afford to sit on the sidelines.

Americans want affordable energy and a clean and safe environment, and yet, because we have ignored technology, we act as though those two are mutually exclusive. That is not true of some of the witnesses we will hear from today. They recognize the multiple benefits of energy efficiency and renewable energy technologies. They invested in the necessary R&D, some independently, some in partnership with the Federal Government, but in all cases, they have success stories to tell and insights to share as we assess the impact of federal energy efficiency and renewable energy R&D programs.

We must continue to invest in these R&D programs if we are to encourage the development and rapid deployment of energy efficiency and renewable energy technologies, but we must do more than that. We must take stock of where we have been and where we are. More importantly, we must figure out where we want to go and determine if existing federal R&D programs can get us there. I know this distinguished panel assembled here will help us to accomplish this today.

[The prepared statement of Chairman Biggert follows:]

PREPARED STATEMENT OF CHAIRMAN JUDY BIGGERT

I want to welcome everyone to today's hearing to assess the impact and direction of federal energy efficiency and renewable energy research and development (R&D).

This hearing couldn't be more timely. Just this week, the average nationwide price of a gallon of gasoline rose above $2 for the first time ever.

This really should come as no surprise. It was three years ago this month that President Bush released his national energy policy in response to volatile and rising energy prices—three years ago. Two of the eight chapters of that policy document were dedicated to energy efficiency and renewable energy.

And three times in the last three years the House passed comprehensive energy legislation that greatly expands our use of energy efficiency and renewable energy to meet our growing energy challenges. The same, however, can not be said of the Senate, which hasn't even been able to take an up-or-down vote on the energy bill conference report because of procedural obstacles.

As a result, we have yet to benefit from a comprehensive energy policy. The United States still imports from foreign sources almost 60 percent of the oil we consume. Even if we increase foreign imports of oil or dip into the Strategic Petroleum Reserve, as some have suggested, we have no way to turn that oil into gasoline or diesel fuel, or get it to where it is needed most. We still have static pipeline capacity. We haven't built a large refinery in about 20 years, and we have half as many refineries as we did 30 years ago. Those refineries are operating at almost 100 percent capacity.

And that's just gasoline. I haven't even mentioned electricity or natural gas. In every case, the bottom line is this: we simply cannot meet today's energy needs with yesterday's energy infrastructure. No pun intended, but we're virtually in the dark ages when it comes to energy infrastructure. Unless we begin to address some of these fundamental problems, we're going to experience high and volatile energy prices every year—well into perpetuity.

One of the best, most effective ways to address such seemingly insurmountable challenges is through the use of technology—energy efficiency and renewable energy technologies.

In terms of energy efficiency, we are talking about technologies that deliver *more* goods and services for the *same* amount of energy. In our homes, that means more loads of clean laundry, or more bags of chilled groceries, without increasing the

amount of energy we use. For our industry, that means increased production without increased energy consumption. For all of us, reducing energy use means lowering our energy costs, reducing our emissions of pollutants and greenhouse gases, and increasing our energy security. In this way, energy efficiency is a very *powerful* idea.

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Renewable energy is a growing, global industry, and our international competitors are taking renewable energy R&D very seriously. Government investments in renewable energy technologies in Europe and Japan have meant growing market shares for wind and solar power generation equipment for those countries, while the U.S. market share is declining. As a nation, we can't afford to sit on the sidelines.

Americans want affordable energy and a clean and safe environment, and yet, because we've ignored technology, we act as though the two are mutually exclusive. That's not true of some of the witnesses we will hear from today. They recognized the multiple benefits of energy efficiency and renewable energy technologies. They invested in the necessary R&D, some independently, some in partnership with the Federal Government. But in all cases, they have success stories to tell, and insights to share as we assess the impact of federal energy efficiency and renewable energy R&D programs.

We must continue to invest in these R&D programs if we are to encourage the development and rapid deployment of energy efficiency and renewable energy technologies. But we must do more than that. We must take stock of where we've been and where we are. More importantly, we must figure out where we want to go, and determine if existing federal R&D programs can get us there. I know the distinguished panel assembled here will help us accomplish this today.

Chairman BIGGERT. Before we start with the witnesses, I would like first to turn to the Subcommittee's distinguished Ranking Member, Mr. Larson, for his opening statement.

Mr. LARSON. Thank you, Madame Chair. I would also like to thank our distinguished panelists for taking time out from their busy schedules to join with us today. I know many of you have traveled a long way to be with us, and we want you to know how much we appreciate that.

I would also like to associate myself with the remarks of our distinguished Chair, but especially when it comes to addressing federal R&D policy and energy efficiency and renewable energy. I believe we often fail to look for insight and information from outside the beltway. From officials in the Administration, from economists and advocacy groups, there is never a shortage of people here willing to help Congress understand this issue, and most often on a national, if not a global scale.

When it comes to putting these policies and technologies into action, it helps to look at those doing this work at the state level. This is not only where we see the results and benefits of innovation and clean energy, this is where we should look for new directions in federal research, development, and demonstration.

Many of us in Congress today come from state legislative backgrounds, and I believe it was Judge Brandise who said that states are the laboratories for democracy. I also believe that they are great laboratories where scientific thought and experiment and pilots take place. And I commend the Chairman again because of our need to continually look at this. We are fortunate today to have assembled the diverse group on this panel of experts who have come to us with genuine hands-on expertise in the field of energy efficiency and renewable energy. Though we may ask them to specu-

late on America's future energy needs, our panelists are not theorists. In their own way, each works firsthand at implementing clean energy policies and technological innovation.

I would specifically like to take this opportunity to introduce one of the witnesses in particular, Mr. Dan Sosland who is the Executive Director of Environmental Northeast, a non-profit environmental research and advocacy organization located in my District. While his efforts have had profound effects on energy efficiency and renewable energy policy in Connecticut, results from Mr. Sosland's work through Environment Northeast can be seen throughout the region. Dan, thank you so much for joining us today.

Now my State of Connecticut is severely capacity constrained in terms of electricity production. Mr. Sosland will testify, Southwest Connecticut is on the Federal Energy Regulatory Commission's top ten list of congested areas in the country. And we know that construction of new fossil fuel or nuclear power plants is not the only answer to our problems. It is crucial that areas like ours around the country discover new ways to produce power while conserving energy and reducing emissions.

The United States Department of Energy has invested billions in the last 25 years on energy efficiency and renewable energy research and development. And in many ways, their efforts have paid off. The technologies developed at the national labs and through partnerships with industry have had untold benefits in the last two decades. However, I believe the question we are trying to get at today is how do the people making energy policy and technical decisions utilize what has been learned in these two decades of federal energy efficiency and renewable energy research.

And that is why you are here. And again, we would like to thank you so much for taking time from your busy schedules to join us and share your expertise.

[The prepared statement of Mr. Larson follows:]

PREPARED STATEMENT OF REPRESENTATIVE JOHN B. LARSON

Thank you Madame Chairman. I would also thank our distinguished panelists for taking time out of their schedules to join us today. Many of you have traveled a long way to be with us and we appreciate that.

When it comes to addressing federal R&D policy in energy efficiency and renewable energy, we often fail to look for insight and information from outside the traditional Washington, D.C. sources. From officials in the Administration, economists, and advocacy groups there is never a shortage of people here willing to help Congress understand this issue, and most often on a national, if not global, scale.

But when it comes to putting these policies and technologies into action, it helps to look at those doing this work at the State, local and industry level. This is not only where we see the results and benefits of innovation in clean energy; this is where we should look for new directions in federal research, development and demonstration.

We are fortunate today to have assembled a diverse panel of experts who come to us with genuine hands-on experience in the field of energy efficiency and renewable energy. Though we may ask them to speculate on America's future energy needs, our panelists are not theorists. In their own way, each one works firsthand at implementing clean energy policies and technological innovation.

I would like to take this opportunity to introduce one of the witnesses, in particular. Mr. Dan Sosland is the Executive Director of Environment Northeast, a nonprofit environmental research and advocacy organization located in my district of Hartford, Connecticut. While his efforts have had profound effects on energy efficiency and renewable energy policy in Connecticut, results from Mr. Sosland's work through Environment Northeast can be seen throughout the region. Thank you for joining us today.

My State of Connecticut is severely capacity-constrained in terms of electricity production. As Mr. Sosland will testify, Southwest Connecticut is on the Federal Energy Regulatory Commission's top ten list of congested areas in the country. We know the construction of new fossil fuel or nuclear power plants is not the only answer to our problems. It's crucial that areas like ours around the country discover new ways to produce power while conserving energy and reducing emissions.

The U.S. Department of Energy has invested billions in the last twenty-five years on energy efficiency and renewable energy research and development, and in many ways their efforts have paid off. The technologies developed at the National Labs and through partnerships with industry have had untold benefits in the last two decades. However, I believe the question we are trying to get at today is, "How do the people making energy policy and technical decisions utilize what has been learned in these two decades of federal energy efficiency and renewable energy research?"

I look forward to the testimony of our panel. Thank you Madame Chairman and I yield back the balance of my time.

Chairman BIGGERT. Thank you, Mr. Larson.

[The prepared statement of Mr. Costello follows:]

PREPARED STATEMENT OF REPRESENTATIVE JERRY F. COSTELLO

Good morning. I want to thank the witnesses for appearing before our committee to discuss the potential contributions of energy efficiency and renewable energy to the Nation's energy needs.

Our nation needs a modern, sound energy system so that Americans will continue to enjoy the benefits of more efficient, available, and affordable energy. Constituents have told me that they are frustrated with rising gas prices and electricity rates. Families have felt pinched at the pump at a time when the state economy is depressed. One thing we know is that it is time to decrease our dependence on foreign sources of oil, especially sources in the Middle East. We must find new ways to produce cheaper and cleaner energy.

In addition to further developing the technology to burn coal as cleanly as possible which directly affects and benefit the economy of Southern Illinois in my district, I believe non-fossil energy sources including ethanol, solar power, and wind energy are extremely important initiatives. As such, I am displeased renewable energy resources remain flat, decreased, or were eliminated and believe we should dedicate more resources toward these programs.

Finally, I am interested in federal energy programs in federal buildings and what actions the Federal Government is taking to be a leader in energy conservation and innovation.

I welcome our witnesses and look forward to their testimony.

Chairman BIGGERT. I would now like to welcome the witnesses. And starting from my left, Mr. Steven Nadel is the Executive Director of the American Council for an Energy Efficient Economy, a non-profit research organization that works on programs and policies to advance energy efficient technologies and services. Welcome. And I would now yield to the distinguished Member from North Carolina, Mr. Miller, to introduce Mr. Konove.

Mr. MILLER. Thank you, Madame Chair.

I am very pleased to introduce Paul Konove, the President of Carolina Country Builders based in Pittsboro, North Carolina, which is in Chatham County, which is not in my District, but is certainly near my District. It is split between David Price's District and Bob Etheridge's District.

Carolina Country Builders Mr. Konove founded in 1985. The focus is on custom solar home design and construction. Mr. Konove is a former Chair of the North Carolina Solar Energy Association, which is now known as North Carolina Sustainable Energy Association. He was also one of the founders of the North Carolina Solar Center at North Carolina State University, which is in my District. He was also one of the founders of the Chatham Home-

builders Association and has participated in the National Renewable Energy Laboratories Exemplary Homes program. He has chaired and helped with several North Carolina Sustainable Energy Association's solar home tours throughout North Carolina. He is a distinguished guest of this panel, Madame Chair, and I am very proud to introduce him.

Chairman BIGGERT. Thank you very much, Mr. Miller.

Next on our panel, we have Ms. Vivian Loftness. She is Head of the School of Architecture at Carnegie Mellon University. Her design and consulting work has led to the design and construction of numerous energy-conserving buildings here and abroad. Welcome. And Mr. John Carberry is the Director of Environmental Technologies for the DuPont Company in Wilmington, Delaware. His responsibilities include leading DuPont's efforts to find and use affordable renewable energy and energy efficiency technologies. Welcome to you, Mr. Carberry.

I now yield to the very distinguished Chairman of the Science Committee from New York, Chairman Boehlert, to introduce Mr. Smith.

Chairman BOEHLERT. I thank you, Madame Chair. And if I may take a moment just before the introduction. I would like to once again thank Mr. Miller. It seems every time this subcommittee or Full Committee has a hearing, we always have a witness from North Carolina. Mr. Miller, thank you, and I thank the Tar Heel State.

Secondly, I want to compliment you, Madame Chair, and the Ranking Member and every Member of the Subcommittee for the time and effort and thoughtful deliberation you are putting in to this subject matter. It is critically important, and you know it is crowding off the front page, hopefully, some of the news from abroad and making us focus more on the problems here at home. And there are some people coming up with instant remedies like releasing the oil from the national stockpile, which is foolhardy and short-sited. It might have an impact of a penny or two per gallon of gasoline on the price at the pump, but it would make us vulnerable in the times of national emergency, so the President wisely has resisted that.

And let me compliment, Mr. Larson, on your party's presumptive nominee. He, too, has rejected that idea. What we have to do—you know, people say where there is a will, there is a way. Well, we have got the way, and the way comes from this Science Committee. We have got to develop the will in the minds of the American people. There are a lot of things we can do, like increasing CAFE standards, which should be a no-brainer. We have got the technology. It can be done. It should be done retroactively. As more investment comes from this committee and we direct it to renewable energy sources, we are doing a great deal in regard to our effective and responsible response to the challenges facing America. And to the credit of the President, he is trying to give this Nation an energy policy. I know we all might have some disagreement on certain segments of it, but we don't have an energy policy. Shame on us as the most technologically advanced nation in the world. We darn well better get one. And I think we all have to work together.

That leads me to introducing our next witness, Mr. Peter Smith, who is the President of the New York State Energy and Research and Development Authority. We affectionately refer to it by its acronym up in New York, NYSERDA. Mr. Smith has been with NYSERDA since 1995, and he started as Program Director for Energy Analysis. In addition to working for the great state of New York, pardon my pride, but you can understand it, Mr. Smith was also educated in the Empire State at Lemoyne College in Syracuse, and he has a masters in public administration. And I am particularly anxious to hear not only what all of the witnesses will tell us, but from Mr. Smith, because I think of the great leadership of the governor of the State of New York, who has made it a goal for New York State to be 25 percent dependent, at a minimum, on renewable energy by the year 2010. That is a worthy goal. So Mr. Smith, any light you can shed on that will be helpful to all of us.

I thank you for letting me indulge the Subcommittee. It is an important hearing. It should be packed. There should be a lot of media here, but the media is more interested in other things that, perhaps, have a little more sex appeal but not nearly as much general appeal and direction. Thank you.

Chairman BIGGERT. Thank you very much, Mr. Chairman.

Finally, let me just mention again, our last panelist is Mr. Daniel Sosland, Executive Director of Environment Northeast.

And with that, as our witnesses may know, and if you don't, we limit spoken testimony to five minutes each, after which the Members of the Energy Subcommittee will have five minutes each to ask questions, so even if you don't get all of your testimony in, it usually comes up in the questions. So welcome to you all.

And we will begin with Mr. Nadel.

I think you might need to turn on your mike or pull it closer.

STATEMENT OF MR. STEVEN M. NADEL, EXECUTIVE DIRECTOR, AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY

Mr. NADEL. Thank you. How is that?

Thank you, Madame Chair.

As you noted, I represent the American Council for an Energy-Efficient Economy. We are a non-profit research organization formed in 1980 to serve as a bridge between the technical and program and policy making communities, to help bring information from one community to another so that we can make progress in terms of energy efficiency.

As you noted, Madame Chair, energy prices are up dramatically. You mentioned some of the oil and gasoline prices, but also natural gas prices have been dramatically higher for the past year, and electricity and coal prices are also climbing. All of these different energy markets are linked. Unfortunately, most economists are predicting that these relatively high prices will be with us for the long-term. Energy supplies have tightened. Our economy is growing. The world economy is growing in places like China, which is now becoming a major oil importer. As you mentioned, refinery capacity is tight. For all of these reasons, the—we can't really expect cheap energy to continue. We may expect some modest price reduction from the very peaks, but ultimately, these prices are going to

be determined by world markets, be it the price of liquefied natural gas, in terms of the natural gas markets, and likewise the world price of oil as determined as much by countries like China and India as it is by the United States. I think we need to be prepared for higher prices than we have had in the past decade.

Fortunately, as you noted, energy efficiency and renewable energy can do a lot to help blunt the impact of these higher prices. Obviously, efficiency reduces energy bills: people use less, they pay less. In addition, efficiency helps actually reduce the price of these energy commodities. The markets are so tight now that if you loosen demand a little bit, then the price goes somewhat down. We did a study last year working with Energy and Environmental Analysis, the same contractor that the National Petroleum Council used, looking at the impacts of energy efficiency and renewable energy on natural gas prices. We found that the markets are so tight that if we were to do a medium level of energy efficiency and renewable energy, two percent savings in the first year, getting up to five percent total savings after five years, natural gas prices would decline by about 20 percent. We are just at that steep of a part of the demand curve.

Fortunately, this energy efficiency has done a lot in the past. It is not just an idea, but it has, in fact, been proven over the past 29 years. If you look at energy use now compared to back in 1973, energy use is basically the same now, despite the fact that our economy has grown by more than 75 percent. If it wasn't for efficiency, we would now be spending nearly $500 billion more on energy purchases each year. So we can thank efficiency for a lot of what we have accomplished of late, but there is a lot more to be done.

We looked at a variety of different studies on what could be achieved from additional energy efficiency renewable energy. Most of these studies conclude that we can save at least another 20 percent from cost-effective energy-efficient technologies by 2020. That ranges in studies by the national labs to studies by various states, including, I know, New York has recently done a study to that effect. Many different studies were done. Utilities have found similar things. 20 percent savings by 2020 seems very achievable.

In addition, renewable energy can save quite a bit. A study by the Union of Concerned Scientists estimated that by 2020 we can get about 10 percent of our energy use from renewable energy. That, in part, is based on the fact that energy efficiency reduces energy consumption and therefore renewables, as a percentage, goes up.

In my written testimony, I provide a number of different suggestions on different policy measures that can be implemented to help improve energy efficiency and therefore help address some of the energy price and other problems that we have been discussing.

Since the title of this hearing is on research and development, I will concentrate, in my closing minutes, on just those aspects. Bear with me a second.

Back in 2001, the National Research Council did a study looking at DOE's Energy Efficiency Programs. They concluded that just six projects have saved consumers and businesses about $30 billion, more than compensating for the total cost of all of the R&D pro-

grams many times over. Similarly, the President's Council of Advisors on Science and Technology 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 improve the productivity of the economy. They recommended that energy—federal energy efficiency R&D and renewable energy expenditures be doubled over a five-year period and concluded that this would provide $40 in net economic benefits for each federal dollar invested.

Unfortunately, we are concerned that energy efficiency budgets R&D budgets are actually declining now. The latest proposal is for a modest decline in these budgets, not for the increase that the PCAST panel supported. We would urge this committee to weigh in with your—the Appropriations Committee to try to restore those cuts and maybe even have a modest increase, if at all possible.

Likewise, we are concerned that so many resources are going to fuel cells and into hydrogen. These are promising technologies, but they are also very high-risk. And what we are hearing from people in Federal Government and in the research agencies is that a lot of other programs are being starved for funds as a result. We need a balanced portfolio, not just investing in a few high-risk investments, just like a stock investor, you know, will have a balanced portfolio, and won't just put it into one or two hot tips. We need to do the same with our R&D dollars.

The final thing I wanted to mention is we have—a lot of focus tends to be on energy efficiency technologies, you know, better LED lights, fuel cells, and those are very important, but there is also a lot of opportunity from better energy efficiency practices, how we engineer things, how we maintain things. And while a lot of this happens at the local level, the Federal Government can be critical in helping to develop things like software, optimization tools, conducting the research to help demonstrate to building owners the benefits of these optimization techniques that I would urge the Committee to pay attention to these energy-saving practices as well as to the technologies.

Thank you very much.

[The prepared statement of Mr. Nadel follows:]

PREPARED STATEMENT OF STEVEN M. NADEL

Thank you for the opportunity to speak with the Subcommittee this morning. My name is Steven Nadel, and I am Executive Director of the American Council for an Energy-Efficient Economy (ACEEE). ACEEE is a national nonprofit organization dedicated to advancing energy efficiency for economic prosperity and a cleaner environment. Established in 1980 to build bridges among the very different worlds of energy efficiency technology research, state and national policy-makers, and energy consumers, ACEEE conducts research, publishes reports, holds conferences, and provides information to policy-makers around the country and the world.

I have been asked by Chairman Biggert to speak with you today about three subjects: (1) a brief overview of expert opinions on today's energy situation and projections for the next 20 years; (2) the potential contribution of energy efficiency and renewable energy for meeting future national energy needs, and the impact increased efficiency would have on natural gas markets;and (3) federal and State policies that have been successful in encouraging efficiency and renewable energy, with an emphasis on research and development (R&D) programs, the subject of today's hearing.

As you are aware, energy price and supply are front-page issues today. Gasoline prices have hit record levels this month, following on the heels of record natural gas prices. Economic and energy experts from Chairman Greenspan on down are now

saying that these higher prices are expected to stay high for years to come, as rising energy demand outstrips national and world supply systems. Clearly, there has never been a stronger imperative for a new commitment to energy efficiency as part of a balanced energy policy.

Fortunately, there is a large potential for cost-effective energy savings. Many recent studies indicate that cost-effective energy-efficient technologies and practices could reduce U.S. energy use by 20 percent or more. Recent research by ACEEE on natural gas markets indicates that even achieving a fraction of these savings would reduce natural gas prices by about 20 percent—markets are so tight now that even modest demand reductions would have substantial price effects.

In order to realize these opportunities, we recommend five key policy initiatives:

1. Promote substantial improvements in the fuel economy of passenger vehicles.
2. Work with states to substantially expand utility and State energy efficiency programs.
3. Work with industry to establish and implement expanded voluntary energy efficiency commitments.
4. Expand and update federal equipment efficiency standards.
5. Expand federal R&D and deployment programs.

Regarding energy efficiency research, development, and deployment (RD&D) in the United States, our research indicates that a renewed commitment to efficiency RD&D is critical to the Nation's economic future and to meeting the environmental challenges we face in air quality and global climate change. We are concerned, however, that declining federal funding for efficiency RD&D in recent years dims the prospects for economic recovery and falls far short of the level needed to respond to the climate challenge. In fact, the overall downward trend in efficiency RD&D may be approaching the point where basic U.S. infrastructure for producing new energy efficiency technologies will be crippled.

In the balance of my testimony, I will expand on each of these points.

The Current Energy Situation

As you are aware, energy price and supply are front-page issues today. Gasoline prices have hit their highest levels in more than a decade, following on the heels of record natural gas prices. Economic and energy experts from Chairman Greenspan on down are now saying that these higher prices are expected to stay high for years to come, as rising energy demand outstrips national and world supply systems. These higher fuel prices are also spilling over into the electricity sector. Coal prices are up sharply this year; and since coal and natural gas together generate two-thirds of U.S. electricity, spot markets for electricity are up as well.

More specifically, according to the Energy Information Administration, retail gasoline prices averaged $1.94 per gallon on May 10, 2004, an increase of $0.10 per gallon relative to a week earlier and an increase of $0.45 per gallon relative to a year earlier.[1] Crude oil closed at a record high of $41.38 a barrel in the New York exchange last Friday (May 14). According to industry experts, these high prices are caused by rising demand (due in particular to economic growth in China, India, and the United States) and tight supplies, particularly for refined products and "sweet crude" (low sulfur crude oil that can be more easily refined than higher sulfur crude). A "risk premium" associated with violence and uncertainty in the Middle East is also a factor.[2]

The big question is how long these high prices will last. Experts agree that there is great uncertainty regarding future prices, with future prices determined by such factors as demand for oil (particularly in key markets such as China and the United States), the supply of sweet crude, the construction of new refineries (particularly refineries that can process the higher sulfur crude that comes from Saudi Arabia), OPEC pricing policies and the degree to which these policies are followed by OPEC and non-OPEC members, and whether there are significant supply interruptions, such as in the Middle East or Venezuela. The Energy Information Administration is probably at the optimistic end of the spectrum of opinion, saying that "[o]il price declines are expected in 2005 as Iraqi oil production continues to increase and inventories are rebuilt toward more normal levels."[3] However, other experts are much less sanguine. For example, speaking at a luncheon at the Petroleum Club in Midland Texas, T. Boone Pickens, the West Texas oilman and financial speculator, pre-

[1] http://tonto.eia.doe.gov/oog/info/gdu/gasdiesel.asp
[2] Banerjee, Neela, 2004, "Tight Oil Supply Won't Ease Soon," *New York Times,* May 16, p. 1.
[3] EIA, 2004, *Short-Term Energy Outlook—May 2004,* http://www.eia.doe.gov/emeu/steo/pub/contents.html

dicted that oil prices will never fall below $30 per barrel again. "I think you'll see $50 a barrel before you see $30," he concluded.[4]

Natural gas prices are also very much in the news. Wholesale natural gas prices have been fluctuating around an average of $5–6 per thousand cubic feet (commonly abbreviated *mcf*) for the past year at the key Henry hub distribution point,[5] up from the $2–3 level that prevailed for much of the last decade. As a result, prices charged to consumers, businesses, and power plant operators are up substantially. EIA has recently projected that "[n]atural gas spot prices (composites for producing area hubs) are likely to average about $5.80 per thousand cubic feet (mcf) this year."[6]

Again, there is great uncertainty about future prices. EIA's last long-term forecast, published in January 2004, projects that natural gas wellhead prices (which are slightly lower than prices at transportation hubs) will decline to below $4 per thousand cubic feet by 2010, and will then gradually rise to the $4–5 range by 2015 and stay in that range over the 2015-2025 period.[7] Independent forecasts, such as Energy and Environmental Analysis' widely respected projection, see similar prices in the 2015–2020 period, largely driven by world liquefied natural gas (LNG) prices. For the next few years, its forecasts are higher than the EIA forecast, projecting annual average hub prices rising from $5.46 this year to $6.13 in 2006, before declining to the $4.50–5.00 range towards the end of the decade.[8] Some analysts are more bullish on prices over the next few years. Andrew Weissman, publisher of *Energy Business Watch,* stated earlier this month that the "supply/demand balance in the U.S. market is deteriorating rapidly, and that a substantial further price adjustment will be required to bring the market back into equilibrium." He suggests that recent "good luck" with mild weather has kept us from realizing how tight markets really are. He is projecting prices above $7.00 per mcf for at least the next year or so.[9]

Volatility and price increases in oil and natural gas markets are in turn affecting other energy sources. For example, natural gas use for generating electricity has been growing rapidly in recent years, and thus natural gas prices have a significant impact on electricity prices. Due largely to natural gas price increases, on a national average basis, electricity prices rose modestly in 2003.[10] With retail prices still regulated in many states, the effect of natural gas prices on electricity prices has been blunted. However, in deregulated markets such as New Jersey and Texas we are seeing 10–20 percent electricity price increases due to rising fuel prices, and customers in some states such as Maryland and Virginia are likely to see similar increases as price controls come off over the next year or so.

With natural gas prices higher, coal is becoming more attractive, and EIA projects a 4.7 percent increase in coal prices this year.[11] However, this includes coal under long-term contracts. Looking just at spot prices, according to Reuters, spot prices for northern and central Appalachian coal last Friday (May 14th) were $58 per ton—more than twice the price last August.[12] With coal demand up, railroads are beginning to experience rolling stock availability problems, which appear to be responsible for some of the recent increases in new coal contract prices. Coal reserves are large, so future prices for using coal, while somewhat dependent on prices of competing fuel, will probably be more affected by future air pollution regulations and the availability of rail infrastructure to deliver greater volumes to users. In the short-term, some utilities are concerned that they may exceed their emissions allowance for coal power plants as they run those plants more. This situation may result in generators asking state environmental regulators for waivers of allowances to avoid having to shut the plants down later in the year if electric demand remains high. In the longer-term, the President's "Clear Skies" proposal calls for gradual tightening of emissions regulations relative to current levels. Other legislative proposals call for more substantial emissions declines. The end result is that the cost

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[4] Romero, Simon, 2004, "Why the Saudis May Not Rescue Oil Markets This Time," *New York Times,* May 16, Section 3, p. 5.

[5] Oilnergy, 2004, *http://www.oilnergy.com/1gnymex.htm.* Spot prices for the past year have varied from a low of $4.50 to a high of almost $7.30 per mcf.

[6] See note #3.

[7] EIA, 2004, *Annual Energy Outlook 2004,* DOE/EIA–0383 (2004), p. 153, Washington, DC: U.S. Energy Information Administration.

[8] EEA, 2004, *EEA Natural Gas Forecast April 2004,* Arlington, Va.: Energy and Environment Analysis Inc.

[9] Weissman, Andrew, 2004, "Macro Level Trends," *Energy Pulse,* May 5. http://www.energypulse.net/centers/article/article_print.cfm?a_id=715

[10] http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_a.html

[11] See note #3.

[12] Reuters, 2004, "High Coal Price Could Bring Summer Energy Crunch," May 14.

of coal as an energy source will go up too, but it is hard to project by how much until Congress chooses which regulatory approach it will take.

Overall, the clear trend is that energy prices are rising. Most experts are projecting higher prices in the future than in the past—the only question is how much higher. If we're lucky, prices will be only modestly higher. But there's also a good chance prices will be substantially higher, providing a considerable drag on our economy, particularly hurting energy-intensive industries such as chemicals, fertilizers, and trucking. Fortunately, prices are determined by the balance between supply and demand. Accelerated efforts to improve energy efficiency would have a significant impact on prices, while also providing substantial environmental and economic benefits. In the next section of my testimony, I will discuss how energy efficiency is a critical part of the balanced energy policy that is needed to address these trends.

The Role of Energy Efficiency

Energy Efficiency's Historic Contributions

Energy efficiency is a quiet but effective energy resource, contributing substantially to our nation's economic growth and increased standard of living over the past 30 years. Energy efficiency improvements since 1973 accounted for approximately 25 quadrillion BTUs in 2002, which is about 26 percent of U.S. energy use and more energy than we now get annually from coal, natural gas, or domestic oil sources. Consider these facts which are based primarily on data published by the federal Energy Information Administration:

- Total primary energy use per capita in the United States in 2002 was almost identical to that in 1973. Over the same 29-year period, economic output (GDP) per capita increased 74 percent.
- National energy intensity (energy use per unit of GDP) fell 43 percent between 1973 and 2001. About 60 percent of this decline is attributable to real energy efficiency improvements and about 40 percent is due to structural changes in the economy and fuel switching.[13]
- If the United States had not dramatically reduced its energy intensity over the past 29 years, consumers and businesses would have spent at least $430 billion more on energy purchases in 2002.
- Between 1996 and 2002, GDP increased 21 percent while primary energy use increased just two percent. Imagine how much worse our energy problems would be today if energy use had increased 10 or 20 percent during 1996–2002!

Clearly, improvements in energy efficiency are essential to a healthy economy. Efficiency keeps energy demand growth down to sustainable levels. If demand grows too fast, supply systems cannot keep up, raising energy prices and possibly creating shortages, which hobble the economy. This effect is true whether the energy comes from fossil, nuclear, or renewable sources. There will always be limits on the materials, land, and capital needed to develop supply infrastructure; there is thus no "silver bullet" energy source or supply system that obviates the need for efficiency. Efficiency has been and will continue to be the keystone of a sustainable energy economy.

Energy Efficiency's Future Potential

Even though the United States is much more energy efficient today than it was 25 years ago, there is still enormous potential for additional cost-effective energy savings. Some newer energy efficiency measures have barely begun to be adopted. Other efficiency measures could be developed and commercialized in coming years, with proper support:

- The Department of Energy's national laboratories estimate that increasing energy efficiency throughout the economy could cut national energy use by 10 percent or more in 2010 and about 20 percent in 2020, with net economic benefits for consumers and businesses.[14]
- ACEEE, in our *Smart Energy Policies* report, estimates that adopting a comprehensive set of policies for advancing energy efficiency could lower national

[13] Murtishaw, S. and L. Schipper, 2001, *Untangling Recent Trends in U.S. Energy Use,* Washington, D.C.: U.S. Environmental Protection Agency.

[14] Interlaboratory Working Group, 2000, *Scenarios for a Clean Energy Future,* Washington, D.C.: Interlaboratory Working Group on Energy-Efficient and Clean-Energy Technologies, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy.

energy use from EIA projections by as much as 11 percent in 2010 and 26 percent in 2020.[15]

- Another recent ACEEE paper examined and synthesized the results of a dozen recent studies on the technical, economic, and achievable potential for additional energy savings in the United States. The review found that most studies agree that there is a cost-effective opportunity to reduce U.S. electricity and natural gas use by 20 percent or more.[16]
- The opportunity for saving energy is also illustrated by experience in California in 2001. Prior to 2001, California was already one of the most efficient states in terms of energy use per unit gross state product (ranking 5th in 1997 out of 50 states[17]). But in response to pressing electricity problems, California homeowners and businesses reduced energy use by 6.7 percent in the summer of 2001 relative to the year before (after adjusting for economic growth and weather),[18] with savings costing an average of three cents per kWh,[19] far less than the typical retail or even wholesale price of electricity.

These estimates are generally based on already commercialized technologies. Substantial additional energy can be saved from technologies and practices now being developed by private companies, and through federal and state R&D programs. For example, ACEEE is now completing a study that identifies dozens of promising emerging technologies for use in buildings.[20] A previous ACEEE study identified many emerging technologies that offer promise for cost-effective energy savings in the industrial sector.[21]

Renewable Energy Technology

ACEEE concentrates its work on energy-efficient technologies and practices. While we are not renewable energy experts, I was asked to comment briefly on the potential for renewable energy in the United States. Recent estimates on renewable energy potential have been made by both EIA and the Union of Concerned Scientists (UCS). EIA estimates that non-hydro renewables accounted for about 3.3 quadrillion BTUs of energy consumption in 2002, which was about 3.3 percent of total U.S. energy consumption that year. In its Reference Case, EIA projects that non-hydro renewables will increase to 5.7 quads in 2020, which is about 4.4 percent of estimated consumption in that year.[22] In contrast, UCS estimates that *with appropriate policy support,* non-hydro renewables can increase to 10.6 quads by 2020. When energy efficiency is factored into the equation (efficiency reduces consumption), UCS estimates that non-hydro renewables can meet 10.3 percent of U.S. energy needs in 2020, more than double the level estimated by EIA.[23]

The Impact of Energy Efficiency and Renewable Energy on the Natural Gas Market

In 2003, ACEEE and Energy and Environmental Analysis, Inc. conducted an analysis to investigate the impact of energy efficiency and renewable energy on natural gas prices. The analysis looked at increased levels of energy efficiency and renewable energy investment, resulting in energy savings of about two percent in one year and a total of five percent over five years. These investments are cost effective with a benefit cost ratio of 3.4.

By reducing demand for electricity and natural gas, especially during peak periods, and increasing the share of renewable energy, the study found that natural gas

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[15] Nadel, Steven and Howard Geller, 2001, *Smart Energy Policies: Saving Money and Reducing Pollutant Emissions through Greater Energy Efficiency,* Report E012, Washington, D.C.: American Council for an Energy-Efficient Economy.

[16] Nadel, S., A. Shipley, and R.N. Elliott, 2004, "The Technical, Economic, and Achievable Potential for Energy Efficiency in the United States—A Meta-Analysis of Recent Studies," In *Proceedings of the 2004 ACEEE Summer Study on Energy Efficiency in Buildings* (forthcoming). Washington, D.C.: American Council for an Energy-Efficient Economy.

[17] Geller, Howard and Toru Kubo, 2000, *National and State Energy Use and Carbon Emissions Trends,* Washington, D.C.: American Council for an Energy-Efficient Economy.

[18] California Energy Commission, 2001, *Emergency Conservation and Supply Response 2001,* Report P700–01–005F, Sacramento, Calif.

[19] Global Energy Partners, 2003, *California Summary Study of 2001 Energy Efficiency Programs, Final Report.* Lafayette, Calif.

[20] Sachs, Harvey et al., 2004, *Emerging Energy-Saving Technologies and Practices for the Buildings Sector* (forthcoming), Report A042, Washington, D.C.: American Council for an Energy-Efficient Economy.

[21] Martin, Nathan et al., 2000, *Emerging Energy-Efficient Industrial Technologies,* Report IE003, Washington, D.C.: American Council for an Energy-Efficient Economy.

[22] See note #7.

[23] Clemmer, Steve et al., 2001, *Clean Energy Blueprint,* Cambridge, Mass.: Union of Concerned Scientists.

prices will both be reduced and be made less volatile. Specifically, we found that in just 12 months, nationwide efforts at this scale could reduce wholesale natural gas prices by 20 percent and save consumers $15 billion per year in retail gas and electric power costs. As efficiency investments continue over the following four years, this level of gas price reduction can be maintained. It is worth noting that changes in just one state or region can result in smaller though still significant price reductions in the immediate region as well as more modest reductions in the Nation as a whole. Nationwide efficiency and renewable energy efforts would result in energy bill savings to residential, commercial, and industrial consumers exceeding $104 billion and require an investment of slightly more than $30 billion over five years.[24]

This analysis was based on forecasts from almost a year ago. We have seen little change in demand and in fact markets have grown tighter so price effects would likely be even greater were we to rerun the analysis today.

Policies to Encourage Energy Efficiency

From our research, there are several key policies that can do much to help achieve the large available cost-effective efficiency improvements discussed above. In our 2001 report entitled *Smart Energy Policies: Saving Money and Reducing Pollutant Emissions Through Greater Energy Efficiency,* we discuss nine policies that will help the United States to achieve these energy savings.[25] In this testimony, I will briefly summarize several of the most important of these policies.

1. Promote substantial improvements in the fuel economy of passenger vehicles.

The fuel economy of the U.S. passenger cars has declined nearly every year since 1987. In 2003, the average passenger vehicle sold had an EPA composite (lab) fuel economy of 24.2 miles per gallon (MPG), down from 25.9 in 1987.[26] Since 1987, federal fuel economy regulations have remained essentially unchanged, and SUVs and other light trucks have increased dramatically in sales. Fuel economy improvements in the United States and other countries in the 1970s and 1980s substantially reduced demand relative to previously predicted levels, contributing to an excess of supply relative to demand and reducing world oil prices. A renewed commitment to fuel economy could save large amounts of energy and money, reduce U.S. dependence on imports from unstable regions of the world, and provide downward pressure on oil prices. However, discussions about changing U.S. fuel economy regulations have been highly controversial. There is a need for creative solutions in order to raise average passenger vehicle fuel economy to at least 30 mpg, and preferably to 40 mpg or more.

2. Work with states to substantially expand utility and state energy efficiency programs.

In many states, utility regulators and legislatures have established "demand side management programs" under which utilities and/or state governments encourage customers to reduce energy use and peak demand through information, technical assistance, and financial incentive programs. Currently, such programs exist in more than 20 states, with total annual program funding of more than $1 billion nationwide.[27] These programs can be marketed and refined to reflect state-specific markets and needs. However, some states have very modest programs and other states have no programs at all. States should be encouraged to expand or start such programs. Such encouragement can take the form of matching federal programs and/or requirements to achieve a minimum level of energy and peak savings each year (the latter based on legislation passed in Texas and signed by then Governor Bush[28]). Senator Jeffords has introduced federal legislation along these lines to encourage such state programs.[29]

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[24] Elliott, R. Neal et al., 2003, *Natural Gas Price Effects of Energy Efficiency and Renewable Energy Practices and Policies,* Report E032, Washington, D.C.: American Council for an Energy-Efficient Economy.

[25] See note #15.

[26] EPA, 2004, *Light-Duty Automotive Technology and Fuel Economy Trends: 1975 Through 2004,* EPA420–R–04–001, Washington, D.C.: U.S. Environmental Protection Agency.

[27] York, Dan and Martin Kushler, 2002, *State Scorecard on Utility Public Benefits Energy Efficiency Programs: An Update,* Report U023, Washington, D.C.: American Council for an Energy-Efficient Economy.

[28] Described in Kushler, Martin, Dan York, and Patti Witte, 2004, *Five Years In: An Examination of the First Half-Decade of Public Benefits Energy Efficiency Policies,* Report U042, Washington, D.C.: American Council for an Energy-Efficient Economy.

[29] S. 1754, the *Electric Reliability Security Act.*

3. Work with industry to establish and implement expanded voluntary energy efficiency commitments.

Several programs now exist to encourage large companies to make and implement commitments to improve energy efficiency and reduce emissions of greenhouse gases, including EPA's Climate Savers program and DOE's Climate Vision. However, commitments to date have been modest, in part because there is little incentive or technical assistance for firms to participate and in part because rules to track savings (and give credit for these savings in future emissions trading schemes) have not been sufficiently developed.[30] Existing programs should be substantially expanded, and DOE and EPA given: (a) resources to assist industrial customers to participate; and (b) a directive to develop appropriate regulations so that firms can track and receive credit for the reductions they achieve.

4. Expand and update federal equipment efficiency standards.

One of the Federal Government's most successful energy efficiency programs has been minimum-efficiency standards on appliances and other energy-consuming equipment. The initial legislation was passed by Congress and signed by President Reagan in 1987; the program was substantially expanded by Congress in 1993 and signed by the first President Bush. As of 2000, the appliance and equipment efficiency standards program had reduced U.S. electricity use more than two percent and saved consumers about $50 billion. Standards already set will increase annual savings approximately three-fold by 2020. Updating existing standards and setting new standards on additional products would increase 2020 savings by an additional 60 percent.[31] Several new consensus standards are included in pending energy legislation passed by the House and Senate. DOE is working on revising other standards, but has been making very slow progress. Congress should complete action on the energy efficiency title in the pending energy bill and should encourage DOE to speed up now-pending standards rule-makings.

5. Expand federal R&D and deployment programs.

R&D programs at DOE and at the state level help to develop new technologies, so that there continue to be substantial opportunities to improve energy efficiency in the future. We elaborate further on the need to expand federal R&D efforts in the section below. In addition, federal efforts to deploy energy-saving technologies and practices should also be expanded. For example, the EPA/DOE ENERGY STAR program has been very effective in achieving energy savings and emissions reductions. We recommend that this program be doubled in size over the next few years. Likewise, state building codes also achieve substantial energy savings. DOE provides important technical assistance and grants to the states for this work—we also recommend that these programs be doubled as well.

Savings from these Policies

Overall, we estimate that full pursuit of these five policies will reduce U.S. annual energy use by about 27 quadrillion BTUs by 2020, a 21 percent reduction relative to the EIA Reference Case forecast. These policies will result in discounted net economic benefits to consumers and businesses of more than $500 billion (1999 $) and will reduce U.S. carbon emissions by more than 400 million metric tones in 2020, a 20 percent reduction relative to the EIA Reference Case. In addition, by making the United States a leader again in energy efficiency, we will be well positioned to provide efficient goods and services in world markets and will be less dependent on imports from unstable regions of the world.

The Key Role of Federal RD&D

To realize efficiency's benefits for the economy and the environment, the efficiency technology "pipeline" must continue to flow. Efficiency technologies, especially those developed through U.S. Department of Energy RD&D, have produced enormous benefits over the past three decades. A National Research Council study issued in 2001 quantified the economic benefits of just six Department of Energy-funded technologies at about $30 billion, based on an R&D investment of about $400 million.[32]

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[30] Elliott, R. Neal, 2003, *Industrial Voluntary Agreements in Context,* Report IE033, Washington, D.C.: American Council for an Energy-Efficient Economy.

[31] Kubo, Toru, Harvey Sachs, and Steven Nadel, 2001, *Opportunities for New Appliance and Equipment Efficiency Standards: Energy and Economic Savings Beyond Current Standards Programs,* Report A016, Washington, D.C.: American Council for an Energy-Efficient Economy.

[32] National Research Council, 2001, *Energy Research at DOE: Was It Worth It?* Washington, D.C.: National Academy Press.

This reinforced the earlier recommendations of the President's Committee of Advisors on Science and Technology (PCAST):

> *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.*[33]

The PCAST report recommended that DOE's efficiency budget be doubled over a five-year period. It projected that so doing would return $40 in net economic benefits for every federal dollar invested.

This committee is aware of the broader concerns about the decline of science and technology funding in America. Recent reports bring into dramatic relief the consequences of failing to maintain a robust RD&D infrastructure for the Nation's key technologies.[34] Not the least of these is the decline in competitiveness of U.S. industry, especially in the emerging technology markets that represent future economic opportunities. The United States spends less per dollar of GDP than our OECD competitors like Japan and Germany.[35] It's not surprising, therefore, that non-U.S. firms dominate markets for key efficiency and renewable technologies such as lighting, hybrid vehicles, industrial automation and machine tools, solar photovoltaics, and wind power. Without a renewed commitment to federal RD&D, U.S. firms will continue to lose ground in these markets, and the American economy and American consumers will be worse off.

In order to work towards the R&D objectives recommended by PCAST, ACEEE recommends that:

- The Administration should use the authorization levels in the pending energy bill as guidelines for its energy efficiency RD&D requests for the FY 2006–2010 budget requests. These authorizations would allow funding to rise by about 50 percent above current levels. While this is only half of the PCAST recommendation, it would represent a significant new commitment to these vital technologies.
- The Committee should commission a study on the state of energy efficiency RD&D infrastructure in the United States. This study should examine the history of RD&D since the 1970s, covering federal, State, and private industry funding. It should describe the RD&D infrastructure as it has evolved over time and as it stands today. It should compare and contract U.S. RD&D to that of other OECD nations. It should also assess the current adequacy of RD&D infrastructure and funding levels, and make recommendations for changes needed to improve the United States' position on this key issue.
- The Committee should commission a study of emerging energy technologies that will improve U.S. energy efficiency. This study should include a review of current federal, State, and private industry RD&D programs, identify and assess candidate technologies, project potential energy savings, and recommend a set of RD&D priorities to the Department of Energy and other affected agencies. Such a study should look at energy-saving practices as well as energy-saving technologies. In our recent work, we have found that R&D on practices (e.g., best practice optimization techniques and software) can be just as important as R&D on technologies. Also, in developing research priorities, a balanced portfolio should be assembled. We are concerned, for example, that R&D on fuel cells and hydrogen are squeezing out important research on nearer-term technology options such as improved hybrid vehicles. A balanced portfolio is needed, just as investment professionals recommend a mix of investments rather than putting all investment dollars into a few high-risk gambles.
- The Committee should review the state and practice of energy analysis in the Federal Government. This includes a review of the macro-economic models and other analysis tools used by the Energy Information Administration and other federal agencies that do quantitative analysis of energy policy issues. Our experience is that these models are frequently unable to model the effects of energy technologies' effects on markets in a "bottom up" fashion, and thus frequently underestimate the potential economic benefits of energy efficiency

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[33] 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.

[34] See, for example, Broad, William, 2004, "U.S. Is Losing its Dominance in the Sciences," *New York Times,* May 3. p. 1.

[35] ACEEE, 2002, "Energy Efficiency Research, Development, and Deployment: Why Is Federal Support Necessary?" Washington, D.C.: American Council for an Energy-Efficient Economy.

RD&D and other policy initiatives. Based on this review, the Committee should make recommendations to the appropriate agencies for improving their analytical processes and tools to better capture the benefits of energy efficiency and other technologies.

In conclusion, it is apparent that energy markets are becoming increasingly volatile and that energy prices are increasing. The amount of the increase is highly uncertain, but accelerated efforts to pursue energy efficiency would save consumers and businesses money and have a moderating impact on prices. There is much that policy-makers can do to increase energy efficiency, including expanding federal RD&D programs in order to keep developing new energy-saving technologies and practices. Such efforts will reduce energy bills, moderate energy prices, help protect the environment, and keep the U.S. competitive in the world economy.

ACEEE appreciates the opportunity to share our thoughts with you on these important issues, and we look forward to working with the Committee on them in the future.

BIOGRAPHY FOR STEVEN M. NADEL

EXPERIENCE

American Council for an Energy-Efficient Economy, Washington, D.C., 1989–present. *Executive Director* (2001–present); *Deputy Director* (1993–2000); *Senior Associate* (1989–1992). Manage a non-profit research organization devoted to promoting energy efficiency through research and advocacy. Directed the Buildings/Equipment and Utilities programs for many years. Major activities include:

- Responsible for overall management of the organization including supervising program directors, fund-raising, overseeing administrative systems, and working with the Board of Directors.
- Directed Buildings and Equipment Program for many years including work on appliance and equipment efficiency standards, building codes, and market transformation programs. Led successful effort to incorporate lamp, motor and HVAC standards and luminaire and office equipment labeling in the federal *Energy Policy Act of 1992.* Led efforts to adopt additional efficiency standards that passed the U.S. House of Representatives and the U.S. Senate in 2003. Played a leading role in initiating market transformation programs promoting high-efficiency refrigerators, clothes washers, residential and commercial air conditioners, and commercial packaged refrigeration systems. Continue to play a major role on U.S. efficiency standards and market transformation programs.
- Directed Utilities Program for many years and continue to play active role. Led path-breaking studies on lessons learned from utility DSM programs (including residential and commercial lighting programs) and on the "achievable potential" from these programs. Currently active in the development of public benefit programs and policies in several states and in the development and implementation of programs to promote advanced lighting, HVAC and refrigeration technologies.
- Supervise Industry Program and led or assisted in numerous studies. Co-authored a book for program and policy planners on "Energy-Efficient Motor Systems."
- Lead and assist with projects to promote energy efficiency in developing countries including work in China, Thailand, India, and Egypt. Spent a year in China working on projects to promote utility integrated resource planning (IRP) and demand-side management (DSM) and to improve the efficiency of refrigerators, air conditioners, motors and lighting equipment in China. Co-wrote manual on IRP/DSM for Chinese utilities and made a series of presentations in China. Led development of Project Brief and Project Document for an $8 million GEF grant for the China Green Lights program. Continue to advise on project implementation. Led development of a $1.5 million UNIDO/UN Foundation project to improve optimization of motor systems in Shanghai and Jiangsu province. Currently coordinate evaluation of this project. Assisting China National Institute of Standardization to develop priorities for new efficiency standards and labels. Technical lead on project assisting Thai government to develop minimum efficiency standards, labels and incentives for eight products.
- Led or assisted on numerous research projects, leading to over 100 published papers.

New England Power Service Company, Westborough, MA, 1987–89. *Senior Analyst* (1988–89). *Analyst* (1987–88). Planned and evaluated energy conservation programs for a major electric utility. Supervised research assistants and consultants.

- Responsible for program evaluation and market research for the Company's commercial and industrial (C&I) lighting programs, new construction programs, stand-by generation program, large C&I shared savings program and residential water heater rebate program. Evaluation work included energy savings, cost-benefit and process evaluations. Market research included mail and phone surveys, focus groups and market data analysis.
- Coordinated a collaborative planning process on commercial and industrial programs involving Company employees, the Conservation Law Foundation, and other interested outside parties.

University of Massachusetts at Boston, 1988–89. *Adjunct Professor.* Taught undergraduate course entitled "Energy Trends."

Massachusetts Audubon Society, Lincoln, MA, 1983–87. *Staff Energy Scientist and Energy Priority Coordinator.* Responsible for coordinating energy programs for a statewide environmental organization.

- Coordinated planning for the Energy Transition Priority, one of the Society's three major priorities for the 1980's.
- Directed research projects including projects to: evaluate the fuel savings achieved by the statewide low income Weatherization Assistance Program; estimate the costs and benefits of appliance efficiency standards in Massachusetts; and monitor the performance of innovative solar energy systems.
- Prepared educational materials including a widely distributed series of consumer handbooks. Provided technical training on energy conservation and solar energy issues to community groups. Directed technical training for regional operators of a statewide, residential, energy conservation loan program.
- Participated in public policy forums. Testified on energy issues before the Massachusetts legislature and state regulatory bodies. Member of official state boards dealing with the energy sections of the Massachusetts building code, the Residential Conservation Service, and urea-formaldehyde foam insulation.
- Wrote and administered grants.

Independent Consultant, New Haven, CT, 1982–1983. Responsible for coordinating projects for several clients with an emphasis on energy conservation in multi-family housing.

- Evaluated the Hartford Heating Plant Efficiency Loan Program—a program for improving heating systems in multi-family housing.
- Coordinated and authored an analysis on the impact of energy prices on housing abandonment and condominium conversion in Hartford, CT.

Wesleyan University, Middletown, CT, 1982. *Teaching Associate.* Taught undergraduate course entitled "Energy Policy: Conflicting Values, Difficult Choices."

Home Maintenance Corporation, New Haven, CT, 1979–1981. *Energy Coordinator.* Responsible for energy conservation, alternative energy, energy planning and energy instruction programs for a non-profit community group working in the Upper Hill, New Haven's poorest neighborhood.

- Developed a "one stop shop" energy conservation program. Set up energy audit and financial counseling procedures, and trained and supervised workers in them.
- Helped develop and implement procedures for integrating energy conservation work into the organization's housing rehabilitation activities.

Congressman Morris Udall, Washington, D.C. Summer, 1975. *Intern.* Researched and wrote on land use issues.

EDUCATION

M.S. in Energy Management, New York Institute of Technology, Dec., 1985. Program combined engineering, energy management and business administration classes. Thesis on low income weatherization programs.

M.A. in Environmental Studies, Wesleyan University, Jan., 1980. Thesis on energy use, conservation and supply in urban areas.

B.A. in Government, magna cum laude, Wesleyan University, May, 1979.

Energy Engineering, Rensselaer Polytechnic Institute. Graduate course work in energy conversion systems, thermodynamics and heating, ventilating and air conditioning analysis.

PROFESSIONAL AFFILIATIONS

American Society of Heating, Refrigeration and Air Conditioning Engineers—member of SSPC 90.1 for many years (Energy-Efficient Design of New Commercial Buildings).

Northeast Energy Efficiency Partnerships—member Board of Directors, Chair of Program Committee.

New Buildings Institute—member Board of Directors and Treasurer.

American Council for an Energy-Efficient Economy
WASHINGTON, DC

May 18, 2004

The Honorable Judy Biggert
United States House of Representatives
Committee on Science
Suite 2320 Rayburn House Office Building
Washington, DC 20515-6301

Dear Chairman Biggert,

As requested for my testimony before the Committee on Science for the 108th Congress, please find attached with this letter a list of the American Council for an Energy-Efficient Economy's sources of federal funding. These grants do not directly support most of the subjects on which I am testifying, but I list them here in order to err on the side of safety.

Feel free to contact me if you have any questions.

Sincerely,

Steve Nadel
Executive Director

1001 Connecticut Avenue N.W. • Suite 801 • Washington, D.C. 20036 • (202) 429-8873 / FAX (202) 429-2248

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AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY
SCHEDULE OF EXPENDITURES OF FEDERAL AWARDS
FOR THE YEAR ENDED DECEMBER 31, 2003

Federal Grantor/Pass-through Grantor/Program Title	Federal CFDA Number	Pass-through Entity Identifying Number	Federal Expenditures
U.S. ENVIRONMENTAL PROTECTION AGENCY			
Market Based Approaches to Reducing Greenhouse Gas Emissions	66.034	XA-83110001	$ 134,503
Market Penetration of Energy-Efficient Technologies and Practices	66.606	X-82883801	125,418
Implementation of the Southwest Energy Efficiency Project	66.606	X-82926801	58,955
Subtotal U.S. Environmental Protection Agency			318,876
U.S. DEPARTMENT OF ENERGY			
Sixth Biennial Industrial Energy Efficiency Summer Study	81.117	DE-FG36-03GO13130	55,000
Assisting China to Establish a Motor Challenge Project	81.117	FC01-99EE41377	28,395
Subtotal U.S. Department of Energy			83,395
TOTAL EXPENDITURES OF FEDERAL AWARDS			$ 402,271

Chairman BIGGERT. Thank you very much.

And now Mr. Konove is recognized.

STATEMENT OF MR. PAUL KONOVE, PRESIDENT, CAROLINA COUNTY BUILDERS OF CHATHAM COUNTY, INC.

Mr. KONOVE. Yes. Good morning, Madame Chairman and Members of the Subcommittee. Thank you for inviting me to present my views on the potential of the home-building sector in meeting our nation's energy challenges. My name is Paul Konove, and I am from Pittsboro, North Carolina. I am honored to be here on behalf of my company and on behalf of the Sustainable Buildings Industry Council.

SBIC's mission is to advance the design affordability, energy performance, and environmental soundness of buildings nationwide. My company designs and builds custom homes in central North Carolina, as was said earlier, in the Raleigh, Durham, Chapel Hill area. Nearly all of my firm's homes rely on passive solar design. The homes and additions we have completed utilize a variety of architectural styles and a variety of budgets. In my experience, I can tell you that sustainable buildings offer enormous potential for addressing our nation's energy needs. I agree with SBIC's position that a new coordinated U.S. buildings program with coherent long-term, non-partisan research, development, and deployment programs on the national level is necessary to achieve better buildings and housings nationwide.

I am going to give you my perspective as a homebuilder and the perspective of SBIC on the questions that you have asked of us.

In my opinion, there are a number of building strategies that improve the performance of the houses that we build today because of improvements in technology, and many of them are cost-effective now. In brief, there are products for foundations, exterior walls, and windows, to name a few, that are utilizing innovative new technologies and now allow for much greater building efficiency. Depending upon why and how these products are used, they may be cost-competitive with conventional products. Fluorescent lighting, both fixtures and lights, are now more available and more affordable than just a few years ago. And there are numerous energy-efficient appliances available on the market, and the Energy Stock program is helping customers identify these products.

If solar access and proper orientation are provided, I believe passive solar design and solar hot water technologies are cost-effective today. Passive solar design can provide space heating in winter and space cooling in summer. Also, building analysis tools, such as Energy-10 software designing low-energy buildings, helps us make cost-effective design decisions. Solar water heating systems, when included in a mortgage, will have a net positive impact on monthly payments. The first home in which I consciously incorporated a whole building framework was completed in 1991. The result was a home that included passive solar design and many other features. My company continues to use this whole building approach, and, when possible, we have worked to incorporate new products and strategies when the opportunities allow. I have learned that the potential for incorporating energy-efficient and renewable energy strategies in new homes is not limited by the design style or con-

struction—excuse me, design style or the project cost. If whole building strategies are not incorporated into the design and construction planning, they will be difficult to include at a later date and will likely cost more at the end of the overall project. An integrated approach to design is the most important way to ensure a high-performance and cost-effective building.

When I participated in the Exemplary Home Program, I learned that our homes' solar designs substantially minimized our need for air conditioning in the hot North Carolina summer. The barriers to passive solar, solar water heating, and photovoltaics, I believe, are not technical but rather a lack of awareness by builders and customers. There is still a need, though, for materials research and development and mass production to reduce the cost of photovoltaics. SBIC has also cited an urgent need for R&D in the area of building performance, monitoring, and verification. Many of the energy-efficient renewable technologies that my company and others around the country are building are very cost-effective today, I believe.

I postponed an appointment for this morning with a developer planning a large project in the county where I live. We were to discuss how these whole building ideas might be applied to the development they are planning. I believe his interest resulted from attending educational activities in my area and the opportunity to meet someone experienced with the whole building approach. But this type of contact is not the norm for most builders in the country.

For an industry as important to the Nation's economy as construction, there should be a coordinated federal strategy for integrating energy efficient and renewable technology into our building methods. Cooperative Extension Service for years has provided this type of reliable information and training for our nation's farmers. One could argue that the construction industry should be supported in a similar fashion in order to remain strong and advanced technologically. Residential buildings represent approximately 20 percent of all U.S. energy consumption. Heating and cooling consume the most energy in buildings. We can cut energy consumption of our homes dramatically if we, as a country, set our minds to achieving this goal.

Madame Chairman and Members of the Subcommittee, thank you very much, and I look forward to answering any other questions.

[The prepared statement of Mr. Konove follows:]

PREPARED STATEMENT OF PAUL KONOVE

Madam Chairman and Members of the Subcommittee:

Thank you for conducting this important hearing and for inviting me to present my views on the potential of the building sector—and of energy efficient, sustainable single-family homes in particular—in meeting our nation's energy challenges. My name is Paul Konove, and I started Carolina Country Builders in 1985 in Pittsboro, North Carolina. I am honored to be here today on behalf of my company and also on behalf of the Sustainable Buildings Industry Council, also known as SBIC, an organization I first joined in the early '90s. The Council's mission is to advance the design, affordability, energy performance, and environmental soundness of residential, commercial, and institutional buildings nationwide. I am also a member of the National Association of Home Builders and my local home builders association.

This morning I will discuss the opportunities I see for the buildings sector—and home building in particular—to be part of a national strategy toward energy independence. From my experience as a home builder, my training as a mechanical engineer, and my involvement in the solar building industry over the last 19 years, I can tell you that sustainable buildings offer enormous potential for addressing our nation's energy needs. Moreover, they can contribute significantly toward solving other critical issues: housing affordability, water quality and supply, environmental protection, economic strength, and the health and safety of the American people. It is essential that builders and designers, government program administrators, and policy-makers understand the importance of integrating energy efficient building technologies and renewable energy technologies if we are to achieve this goal for the buildings sector.

My company designs and builds custom homes in a two-county area that is part of the Triangle Region of North Carolina, which is the area around the cities of Raleigh, Durham, and Chapel Hill. My firm focuses mainly on new solar homes, although periodically we have built additions to existing homes. Nearly 100 percent of the new homes and more than 75 percent of the additions we have built rely on passive solar design, which I will address later. The homes have many different architectural styles, and the project budgets are diverse. Besides my design and construction work, I have been involved in solar energy education and training activities in North Carolina. To keep my business on the leading edge, I strive to be aware of national activities and building trends related to energy efficiency, renewable energy and sustainability. As a small-volume builder, I am representative of many U.S. home-building companies. According to the National Association of Home Builders, 68 percent of their members have four or fewer employees, and 15 percent of their members build 10 or fewer houses per year.

Madam Chairman, you asked me to respond to some specific and important questions about energy efficiency and renewable energy technologies in buildings. I am eager to give you my perspective as a home builder, and I am also proud to provide SBIC's perspective on these questions, a perspective resulting from a quarter-century of research and development of policy positions, publications, technical training, and other resources on "low energy," sustainable buildings.

Because of the complexity of building a home, as a builder it is easy to focus only on the immediate task at hand rather than the big picture of the entire project. But for nearly fifteen years, there has been a growing understanding from building scientists and others in the construction profession that the design and construction of a home needs to be addressed as a complete system. Therefore, I would like to address your questions in the context of a *"whole building" approach to design and construction.* Many architects, builders, home owners, commercial building owners, and policy makers are adopting a more holistic view of building design. Instead of viewing a building as a collection of discrete parts, they know that their home, school, or office building will perform better if it is designed as a *system of interrelated parts.* Of course, these parts must also perform well, and this is where R&D on specific technologies is also important. But it is *how we put these technologies together* that I believe, SBIC believes, and these forward-thinking architects, builders, owners, and policy-makers believe, is what will truly advance the performance of buildings in the United States and enable the building sector to live up to its potential in meeting our energy needs, environmental challenges, and goals for affordable, comfortable, and healthful homes and buildings.

As defined in the Renewable Energy Policy Project (REPP) Research Report of September 1998, *Putting it Together: Whole Buildings and a Whole Buildings Policy,* "The whole buildings concept represents a method of siting, design, equipment and material selection, financing, construction, and long-term operation that takes into account the systems nature of buildings and user requirements. It treats the overall building as an integrated system of interacting components. Thus it is more performance-based than prescriptive."

As one of SBIC's workshop instructors puts it, there is no magic bullet that will make a building energy-efficient, cost effective, sustainable, comfortable, and healthful. There is no single product, material, or technology that will suddenly make the building perform well for those who breathe the air inside or pay the utility bills. While building product manufacturers are making amazing strides in the energy and environmental performance of their products, what is essential is how *all* the building components work together. Components should be carefully considered before the designer makes one sketch, and they should be selected based on how they will interact with the other building components. These decisions should be based on *goals* for the project/home that the owners and designers establish in the earliest stages of programming and design. If these components are not chosen early on, it will be difficult, more costly, or perhaps impossible to complete a building that is

energy efficient and/or that has superior indoor air quality and other "high performance" features.

The Sustainable Buildings Industry Council is one of the few (if not the only) organizations that brings many different buildings-related trade associations, architectural/engineering firms, utilities, consultants, product manufacturers, academic institutions, and builders together under one umbrella in order to advance the knowledge and create the user friendly tools that help designers and builders make complex decisions.

The Federal Government's Role in Buildings R&D

The building construction industry is highly fragmented, with hundreds of thousands of architects, engineers, contractors, subcontractors and construction workers, as well as a complex system of real estate investors, financiers, and owners. No one builder has more than five percent of the market (*Builder* magazine, 2000). The industry is both structurally incapable and economically unmotivated to take responsibility for the required level of whole building research and strategic coordination that can yield major economic and environmental benefits.

SBIC believes that a new, coordinated *U.S. Buildings Program* can bring together isolated building research programs throughout the government, integrate the full range of advanced building components developed by individual companies and organizations, disseminate the results of building science research conducted by government labs, and concentrate the efforts of diverse segments of the building industry. The program should consolidate various federal energy efficiency, solar and renewable technologies, and all other building-related programs into a single, integrated effort with a strong, clear vision of high-performance buildings in America's future. Only a coherent, long-term, nonpartisan research, development and deployment program on the national level can achieve the necessary next step in achieving better buildings and houses nationwide. As articulated in the REPP report,

A robust U.S. Buildings Program:

- Is based on a whole building approach
- Provides sufficient long-term resources for professional training and public education
- Funds collaborative, fundamental, and applied research on building energy performance
- Partners with industry to stimulate demand for high-performance buildings through public awareness
- Supports development of prediction and verification tools for measuring building energy performance, cost effectiveness, environmental soundness, and other important attributes.

Industry-Government Collaboration

Industry needs to inform and contribute to this effort. Programs that foster industry-government collaboration are making great strides. The Department of Housing and Urban Development's *Partnership in Advancing Technology in Housing,* also known as "PATH," helps builders and consumers understand and adopt new housing technologies that help them attain various goals, including energy efficiency (www.pathnet.org). The U.S. Department of Energy's *Building America* program is teaching production builders how to build sustainably, cost effectively, and profitably. The DOE *Zero-Energy Buildings* program, also known as "ZEB," was established to fund projects that provide builders with new and innovative ideas on how to minimize residential energy consumption and use more renewable energy to power a home. The National Association of Home Builders Research Center worked with a builder who designed a home that is capable of achieving net-zero energy consumption. The Tucson Zero Energy Home was modeled with the energy analysis tool, *ENERGY–10,* and features active solar space and water heating, energy-saving fluorescent lighting, low-flow plumbing fixtures, Energy Star® rated appliances, a high efficiency air conditioner, radiant barrier roof decking, windows that minimize solar heat gain, and air admittance plumbing vents, among other energy efficient features. Because ZEB is one of the few federal programs that focuses on building integration, we were alarmed when it looked like it would get lost in the budget battle. Ironically, it fell through the cracks between the jurisdictions of the Appropriations Committee's Energy and Water Subcommittee, which funds DOE's solar programs, and the Interior Subcommittee, which funds DOE's buildings (energy conservation) programs.

And now to your specific questions. . .

1a. What are the key technology improvements that can result in cost-effective savings in today's homes and buildings?

In my opinion, there are a number of *strategies,* made possible by improvements in technology, that improve the performance of houses we build today. Many are cost effective now. Here are some that are included in SBIC's *Green Building Guidelines: Meeting the Demand for Low-Energy Resource-Efficient Homes* (4th Edition).

1) Community and Site Planning

This is not a technology, but it sets the stage for the rest of the project: Proper orientation of homes and of streets and lot layouts in a development are critical for achieving optimal solar access and encouraging the use of site-generated solar energy. In addition, incorporating sustainability principles in community and site planning, such as increasing density, locating new development on infill sites to be near schools, shopping, and public transportation, and clustering homes and buildings to reduce infrastructure and preserve undeveloped land, helps to protect our nation's valuable natural resources.

2) Renewable Energy

If solar access and proper orientation are provided, passive solar design and solar hot water technologies are cost effective today. Building analysis tools such as *Designing Low-Energy Buildings with ENERGY–10* software have been helpful in determining how much passive solar design to incorporate into various projects. I have found these analysis tools are also helpful when discussing design, materials, and cost issues with my clients. Potentially complex issues can be presented in easy to read, graphical format.

3) Building Envelope

Air infiltration control has become a critical issue in housing. There have been technological improvements in recent years in the quality and longevity of caulks and sealant products used for this work. This work is not expensive and allows HVAC systems to be sized smaller (or "right-sized"), which balances out extra costs spent on tightening up a home. HVAC systems have been improved as well. We now have variable speed fans and much more efficient systems than even just a few years ago. Foundations, exterior walls, and windows are utilizing innovative new technologies that now allow for much greater building efficiency. Examples of these products are structural insulated panels (or SIPs), also known as stress skin panels, and insulating concrete forms (or ICFs) for exterior walls, and windows with high-performance glazing. Depending on why and how these products are used, they may be cost competitive with conventional products. I believe they are all poised for more widespread integration into the construction industry.

4) Energy Efficiency

Installing ductwork within the envelope of the home, insulating it sufficiently, and making it tight are excellent energy saving techniques. A blower door test and a duct blaster test have been developed to determine the quality of the installation and extent of air leakage. These test methods, plus more highly efficient equipment, help ensure that consumers are getting what they are paying for.

Compact fluorescent lighting (both fixtures and lights) are now more available at affordable prices, even at large building material retailers. There are numerous energy efficient appliances available on the market, and the Energy Star® program is helping consumers identify these products. I recommend to clients that they investigate these products.

Manufacturers of traditional and innovative building products, many of whom are members of SBIC *(http://www.sbicouncil.org/about/members.html),* are meeting the needs of sustainable building designers. These designers are creating buildings that save energy and provide comfort and health for their occupants, because they are integrating excellent products early in the design process. They are also using energy analysis tools to ensure cost effective design. For efficient buildings to become the norm, however, designers and builders must be able to estimate whole building performance confidently. Designers must have *verification and demonstration* that the individual products and systems have been combined and installed with a whole building approach and are cost effective across a variety of climates and building types, in both new construction and retrofits.

1b. Are there renewable energy technologies that can be utilized in new construction in a cost-effective manner?

Passive solar design, which utilizes the local climate characteristic, allows the building itself to collect, store, and distribute energy from the sun and can provide

space heating in the winter and space cooling in the summer. Those trained to apply passive solar design strategies can do this without adding to the design costs, and this design significantly reduces the need for purchased energy from nonrenewable sources. Passive solar homes have been built across the United States for more than 30 years.

Solar water heaters installed in new homes can provide about 50 percent of the hot water needs of a typical family, and, if included in the mortgage, can have a net positive impact on the monthly payments. Solar water heaters are a mature technology and are widely used throughout the United States.

Photovoltaic systems installed in new, energy efficient houses can provide a portion or all of the electrical energy. This may even be considered a cost effective technology if it's included in the mortgage (in states that have financial incentives) and/or if a portion of the power generated is sold back to the utility company (for example, during the day when the home's energy needs are minimal).

2a. What has your experience been with constructing high-efficiency buildings?

The first home in which I consciously incorporated this whole building framework was completed in 1991. I participated with the architect and the owner as a member of the design team. The result was a home that included the following features:

- Passive solar design
- Advanced framing
- High insulation levels and minimization of air infiltration
- Efficient heating and air conditioning equipment
- Low-flow plumbing fixtures
- Efficient lighting through extensive use of compact fluorescents and energy efficient appliances
- Recycling center
- Materials that were chosen for longevity and minimal off-gassing
- Preparation for the installation of solar hot water in the near future (since at that time North Carolina's solar energy tax credits discouraged more than one completed solar system per year).

Since that project, Carolina Country Builders has continued to use these strategies and to incorporate new products and strategies as much as possible, all with an awareness of the impact on the design and cost of the project.

2b. What have been the successes and the challenges?

An important thing I have learned from my experience is that the potential of energy efficiency and renewable energy strategies is not limited by design style or project cost. Another is that if these strategies are not incorporated into the planning process for both design and construction, they will be difficult to include at a later date, and will likely be more costly than if included from the beginning. One of the surprising things I learned about building passive solar homes resulted from my participation in the National Renewable Energy Laboratory's Exemplary Homes Program. Our own home was monitored for a year under that program. The results convinced us that passive solar design kept us warm in our cold winters and contributed in substantial ways to keeping us comfortable even in the hot central North Carolina summers. It was not the temperature but the humidity that caused the air conditioning system to run. Because we used SBIC's design guidelines when designing our home, we also have better natural ventilation and substantial cost savings on summer electricity bills. The rule of thumb is that seven percent of the home's floor area should contain operable windows. Since most of the new housing will be built in the South (according to *NAHB State and Metro Building Permits, March 2004* "Building Permit Activity for 2003"), I believe this is an important lesson to share with others.

Through the years, I have had both employee and subcontractor turnover. I am continually pleased to find people who are interested in working on and learning about the homes I build. But when I have to change subcontractors or find new employees, I have only a few to choose from who have the skills I require. Otherwise, I have to do on-site training.

Although this changes over time, one of my frustrations is that new products or techniques that are available in one portion of the country are not available in my location. I believe the reason for this is the lack of demand, which comes from a lack of awareness or training about the benefits and cost effectiveness of these strategies.

3a. What areas of energy efficiency and renewable energy technologies need research to improve their operation or cost effectiveness?

Passive solar, solar water heating, and photovoltaics are all ready for greater use. The biggest barriers are not technical in nature, but rather involve a lack of simplified design tools and awareness by both builders and customers. Volume production of solar water heaters would result in economies of scale, which I believe would create significant market growth. The next version of *ENERGY–10* will be such a tool—combining energy efficiency, passive solar design, solar hot water, and PV in the same fast and accurate software package. The renewable energy portfolio standards that are becoming widely used in some states to encourage greater use of renewable energy often do not pertain to design strategies such as passive solar and technology such as solar hot water systems. Those policies should be expanded to include these strategies and technologies, as that will significantly open new markets.

There are probably many areas of energy efficiency and renewable energy that need research, but I am only familiar with a few. One is advanced thermal storage (or plasterboard with integral phase change storage), which could enhance performance of passive solar homes while allowing builders to continue using conventional construction methods. I am aware that there is some work in the area of advanced electrically sensitive or switchable glazings that would reduce heat loss in winter and reduce heat gains in summer.

There is still a need for materials research, development and deployment and volume production to reduce the cost of photovoltaics. Lower cost inverters and lower cost battery storage will allow photovoltaic systems to provide stand-by emergency power, which is an especially valuable capability in terms of energy independence and building security systems.

SBIC believes there is an urgent need for research, development, and deployment (RD&D) in monitoring and verifying of building performance. As noted in the REPP report, and this remains true today, we must continue to invest in software tools that are fast, inexpensive to use, and accurate, and that permit easy analysis of building envelope and component alternatives, including the effects of their interactions. It is also important that the software gives design guidance, setting priorities on strategies that, in interaction with other approaches, deliver the highest or most cost effective return for the package. *ENERGY–10* is good, but it needs further development, such as the inclusion of PV as a design option, which has been planned for nearly five years. These tools must be supplemented by objective, well-documented case studies and demonstrations to validate computer models, provide monitored data on actual building cost and performance, and give confidence to both consumers and lending institutions.

3b. What technologies are ready for the marketplace but need improved technology transfer to be widely adopted?

Many of the energy efficient and renewable technologies my company and other builders around the country are using are cost effective today, but they are not widely used because builders are busy responding to their clients and do not have time to learn about new technologies. For an industry as important to the Nation's economy as construction, there should be a coordinated strategy for educating and training those in the construction industry about these technologies and building methods. Achieving the integration of these methods into standard building practices will enable construction companies to be more profitable, provide consumers with more disposable income by saving on their utility bills, and help the national economy by keeping the construction industry strong.

Prior to being asked to testify today, I had an appointment scheduled this morning with a representative of a California-based developer planning to build a large mixed-use community in the county where I live. He is an active member of our local home builders association, an organization where we have had numerous educational presentations on green building products and strategies over the last two years. He asked to learn more about green building and how it might be applied in the developments they are planning, both local and otherwise. My point in mentioning this meeting relates to my perspective on deployment methods of energy efficiency and renewable energy for the construction industry. I would suggest that his interest was the result of continued local educational activity and the opportunity to come in contact with someone he thinks of as knowledgeable. There is a model for this type of technology transfer that has supported a vital member of our nation's economy for many years: The agriculture industry's cooperative extension service provides reliable information and training for our nation's farmers. Another model is the Manufacturing Extension Center program, which was established by

the *U.S. Trade and Competitiveness Act of 1988.* I would think that the construction industry could benefit in a similar fashion.

SBIC has developed a number of programs to disseminate information to builders, consumers (*Green Building Guidelines* and seminars), K–12 school board members and administrators (*High Performance School Buildings Research and Strategy Guide* and workshops), federal project managers (workshops on *Low-Energy, Sustainable, Secure Building Design for Federal Managers*), and designers of small commercial buildings (*Designing Low-Energy Buildings with ENERGY–10* workshops). The Council has conducted hundreds of training activities, but this meets a fraction of the need. Those who procure buildings need to know how to ask for high performance, and building designers need to learn how to deliver it. Individual, community, state, and federal building decision-makers must be introduced to the benefits of whole building concepts, and architects, engineers, and building operators must be trained to understand how to pursue their trades in the context of whole building performance. At the very least, this will require the introduction and widespread dissemination of user-friendly whole building design tools that can lead owners and designers to sound decisions based on accurate simulations. Again, because of the fractured nature of the buildings industry, there is an important role for the Federal Government in developing software tools that no one group could develop alone and in providing education, training, and technology transfer programs that will help stimulate a transformation of the marketplace. It is also appropriate for the Federal Government to stimulate consumer demand for whole building designs that integrate efficiency and renewable energy sources.

4a. How do energy efficiency improvements in new construction differ from retrofitting older buildings?

In my opinion, all the energy efficiency strategies available to new homes can be used for existing homes, although some of the products, techniques, and/or their cost effectiveness may change. Renewable energy strategies are different. If the existing structure is not oriented correctly to take advantage of sun angles, it may or may not be feasible. Proper orientation for solar roof panels ensures optimal cost effectiveness and aesthetics. In recent years we have been installing more solar hot water systems on homes because of changes in the North Carolina tax law that allows for multiple systems to be completed within the same year. I am currently building a passive solar home where we will be installing both solar hot water and a two kilowatt photovoltaic system. I look forward to building a net zero energy home, but most builders are not yet ready for this. Their homes are not energy efficient enough to justify and support a renewable energy system. Here's an analogy: When doctors plan a heart transplant, they make sure that the body is in good enough health to receive the new heart. We should likewise have our housing in good health so that we can integrate renewable energy systems and build cost effective net zero energy homes.

With new construction, owners might have an ability to select a site that provides excellent solar access, and designers often have the ability to properly orient the building on the site. Existing structures may have existing conditions that are difficult or impossible to change.

4b. Given that about half the housing we expect to have in the year 2025 has not yet been built, what contribution can improved technologies make toward reducing the energy demands of the future housing stock?

Applying no-cost and low-cost design principles can lower the energy consumption of the future housing stock by 30 to 50 percent. By applying a whole building approach in the design and development of homes, we can realize improved comfort, water-efficiency savings, improved indoor environmental quality, and material efficiency. As stated in SBIC's *Green Building Guidelines,* a publication created by home builders for home builders, the millions of homes built every year require a combination of wood, concrete, glass, metal, and other products. These residential buildings consume approximately 20 percent of America's energy every year thereafter in the form of energy consumption and maintenance needs. It is not necessary for our homes to be so energy and resource intensive.

There is enormous potential for savings in the home building sector. Buildings account for 36 percent of total U.S. energy consumption and two-thirds of the electricity used. Residential buildings represent approximately 55 percent of that. Heating and cooling consume the most energy in buildings. In residential buildings, water heating and refrigeration are the next biggest energy consumers, accounting for 24 percent of the energy consumed. *(Energy Research at DOE: Was It Worth It? Energy Efficiency and Fossil Energy Research 1978 to 2000,* http://books.nap.edu/books/0309074487/html/24.html 2001)

Currently, there are approximately 100 million residential buildings in the United States (EIA, 1996). The annual rates of growth and replacement of this building stock have been approximately two percent for residential buildings over the last 20 years (EIA, 1997). Thus, approximately two million new residential buildings and 200,000 commercial buildings have been constructed each year. *(Energy Research at DOE: Was It Worth It? Energy Efficiency and Fossil Energy Research 1978 to 2000,* http://books.nap.edu/books/0309074487/html/24.html 2001)

Wind, solar, biomass, and geothermal power, although growing, still supply only a tiny fraction of U.S. energy needs. In January 2000, however, the U.S. DOE's National Renewable Energy Laboratory released a report which said that the domestic PV industry could provide up to 15 percent of "new U.S. peak electricity capacity expected to be required in 2020." In 2002, shipments of solar PV cells and modules expanded by 15 percent, to around 112 megawatts, according to EIA's Renewable Energy Annual 2002. The average unit price of PV cells decreased in 2002 by 14 percent, to $2.12 per peak megawatt. Solar thermal collector manufacturing rose modestly in 2002, consistent with the general pattern seen since 1992 (except for a sharp rise between 2000 and 2001). Total shipments of solar thermal collectors rose four percent, to 11.7 million square feet. (US DOE Energy Information Administration—Country Analysis Briefs—USA *http://www.eia.doe.gov/emeu/cabs/usa.html* as of April 2004).

Sustainable building design benefits the environment. The United States, with the world's largest economy, is also the world's largest single source of human-caused greenhouse gas emissions. Quantitatively, the most important of these is carbon dioxide, which is released into the atmosphere when fossil fuels (i.e., oil, coal, natural gas) are burned. Current projections indicate that U.S. emissions of carbon dioxide will reach 5,985 million metric tons in 2005, an increase of 1,083 million metric tons from the 4,902 million metric tons emitted in 1990, and around one-fourth of total world energy-related carbon emissions. (US DOE Energy Information Administration—Country Analysis Briefs—USA *http://www.eia.doe.gov/emeu/cabs/usa.html* as of April 2004).

Sustainable design makes homes more affordable. The average household spends six percent of its gross annual income on energy. For a low income household, this number is 12 percent. (Department of Health and Human Services FY 2000 Home Energy Data, *http://www.acf.dhhs.gov/programs/liheap/notebook.htm).*

Sustainable building design is important to our nation's economic health. Single-family and multifamily construction, plus remodeling, account for about 15 percent of the Nation's total economic activity. During economic recoveries, housing's impact on the economy is even greater, accounting for up to one-third of the change in the gross domestic product. (NAHB 2004 Housing Facts and Figures, *www.nahb.org*). According to a report in April 2004 by researchers at the University of California at Berkeley, renewable energy promotes U.S. job growth better than investment in fossil fuels. The report states that investing in renewable energy such as solar, wind, and the use of municipal and agricultural waste for fuel would produce more American jobs than a comparable investment in the fossil fuel energy sources in place today. "Across a broad range of scenarios, the renewable energy sector generates more jobs per average megawatt of power installed, and per unit of energy produced, than the fossil fuel-based energy sector," the report concludes. In terms of net employment, the report states that "all states of the Union stand to gain from the implementation of a portfolio of clean energy policies at the federal level." *(http://www.eurekalert.org/pub_releases/2004-04/uoc_rep041304.php* April 2004)

Sustainable building design is important to human health. According to the U.S. EPA, indoor air levels of many pollutants may be two to five times, and occasionally more than 100 times, higher than outdoor levels. Indoor air pollutants are of particular concern because most people spend as much as 90 percent of their time indoors. Children are especially vulnerable because of their small size and early stage of growth. Common sources can include burning kerosene, wood or oil, smoking tobacco products, releases from household cleaners, pesticides, building materials, and radon. *(http://www.epa.gov/air/concerns/)*

Madam Chairman and Members of the Subcommittee, I want to thank you for this opportunity to share my views and SBIC's perspective on sustainable building design. There is no doubt that buildings can be part of the solution to our energy challenges. I look forward to answering your questions and to continuing this dialogue.

BIOGRAPHY FOR PAUL KONOVE

Paul Konove is the President of Carolina Country Builders, a design/build firm based in Pittsboro, NC. He graduated a BS in Mechanical Engineering in 1971.

Carolina Country Builders was founded in 1985. The work of the company focuses mainly on new custom solar home design and construction. The company builds homes primarily on large lots from $150,000 to under $600,000. In 1986–87 Konove, chaired the N.C. Solar Energy Association (NCSEA—now the N.C. Sustainable Energy Association) and assisting in founding the N.C. Solar Center (established at N.C. State University). Konove also assisted in founding the Chatham Home Builders Association in Chatham County, N. C. From 1993–97 Carolina Country Builders participated in the National Renewable Energy Laboratory's Exemplary Homes Program. Konove has both chaired and assisted in organizing numerous NCSEA solar home tours in the Triangle region of North Carolina and in 2003 initiated the expansion of the tour to North Carolina's first coordinated statewide green home building tour.

Integral to Konove's work over the years are educational presentations that encourage the practical and affordable use of renewable energy, with a focus on passive solar energy and more recently green building strategies. Participants of these training sessions typically include builders, architects, engineers, and consumers. Over the years, these activities have occurred at National conferences, around North Carolina and at local community events.

AWARDS

"Special Recognition for Energy Innovation" awarded by U.S. Department of Energy Technology Transfer—1984

Custom Home of the Year Award for Best Environmental Design from *Custom Builder* (The Magazine for Builders of Premier Homes)—1992

Solar Hall of Fame Award for recognition of his "many years of outstanding effort as a designer, builder, community organizer, educator and advocate of solar energy and green building" by the North Carolina Sustainable Energy Association—2003

PRESENTATIONS/SEMINARS

"The Greening of America's Homes"—2004 NAHB National Green Building Conference, Austin, Texas

"Green Building Opportunities & Techniques"—21st Century Building Expo & Conference, N.C. Home Builders Association, Charlotte, NC 2004

"Green Building Design & Construction" at NCSEA portion of 2003 ASES National Green Building Tour

"Green Building Guidelines"—Boone, N.C. for the NC Solar Center—2003

Solar Home Building Course—N.C. Solar Center—2001

Solar Design and Construction seminar presentation at NCSEA portion of ASES National Tour of Solar Homes

"All you ever wanted to know about thermal mass for solar homes"—2000

"Passive Solar Design Rules of Thumb"—1998

Builders Forum for the American Solar Energy Society (ASES) Annual Conference, Minneapolis, Minn.—1995

Chairman BIGGERT. Thank you very much.

Ms. Loftness, you are recognized for five minutes.

STATEMENT OF MS. VIVIAN E. LOFTNESS, HEAD, SCHOOL OF ARCHITECTURE, CARNEGIE MELLON UNIVERSITY

Ms. LOFTNESS. I am going to use visuals. As a trained architect, there is nothing better than visuals to communicate an idea, although I have lost my own visuals. Oh, there.

[Slide.]

I am representing a handful of universities across this country that have graduate level master of science and Ph.D. programs in building research. And indirectly through my positions, I represent the American Institute of Architects Committee on the Environ-

ment, as well as the U.S. Green Building Council, where I serve on the board.

I am going to try to rapidly go through some key points that I think are critical to this debate. One is that buildings consumer over 35 percent of U.S. energy and over 60 percent of U.S. electricity, and they are an extremely tiny portion of the U.S. R&D budget. Two is that U.S., through that energy consumption, also consume a significant amount of water as well as in the building processes themselves in materials, and they create over 30 to 40 percent of U.S. pollution and waste. The energy consumption story is rising in almost all sectors, but it is rising the most rapidly in buildings and in transportation related to building land use.

There is significant potential for impact in a broad range of building attributes, from lighting, to cooling, to power, to heating, to land use, and to material selection. And I would like to highlight five technologies that have a major impact. Number one, appliance and equipment energy standards and innovations have saved between 50 and 75 percent of the energy use while increasing functionality and, in fact, increasing our export opportunities. And these include ballasts and lamps and refrigerators, and air conditioners, and controls. Much of this has been supported through federal funding at Department of Energy and the national labs. And as was mentioned before, we are looking at things that multiply from one to 20,000 times the benefits from the costs.

If you look at the impact of standards, we need to understand that these kinds of standards did not, in fact, inhibit industry. They actually promoted innovation and development, and again, export technology. Not looking only at refrigerators, but the impact of central air conditioners and gas furnaces, there is much more work to be done at the federal level for a number of other technologies that we have no started because of lack of resources in energy efficiency research and development.

Cool roofs, number two, cool community developments. We have cooling loads that are about six percent of total U.S. energy use. 10 percent of that can be addressed through cool roof introduction, which would also reduce our peak load demands by five percent. These are technologies that can be introduced at the natural cycle of replacement of roofs. We don't have to go through massive new investments. We are looking at innovation, and it has the potential to reduce storm runoff problems that are pervasive in the U.S. as well as reducing smog.

Daylight. If we start to count daylight and natural ventilation as renewables, which I think we should, we will be way past the 10 percent by 2010. I think we are making a big mistake not to include them, because we are actually diminishing the number of daylit buildings and we are diminishing the number of naturally ventilated buildings as we pursue renovations across this country. We have the potential to reduce lighting demands by 30 to 60 percent through effective daylighting and cooling demands between 40 and 75 percent, something that is being actively pursued in Europe today. High rises can also be naturally ventilated and daylit. There are many examples, not so many in this country.

The health potential of natural ventilation, work has been going on through federal funding at Lawrence Burkin National Labora-

tories as showing that the impact of improving ventilation rates, of which natural ventilation is a key attribute, are also reducing flu and absenteeism by nine to 20 percent.

Classrooms that are daylit have 10 to 25 percent higher student test scores. Offices that are daylit have improved productivity scores—productivity gains as well as reduction in sick building symptoms, and of course, 30 percent energy savings pervasively, even in deep section office buildings using perimeter daylight effectively. We, at our research center, have been trying to collect these data sets to, in fact, put the proof sets into a robust life cycle calculator, and we can see productivity gains between 0.4 percent and 18 percent, which certainly more than compensates for any of the costs that might be associated with daylighting. Energy, again, is eight to 75 percent energy savings. They usually won't drive the innovation, but they are the positive impacts of doing that.

Number four, on-site energy generation and energy cascades will increase generation efficiencies from 30 to 70 percent, start to put distributive power plants in campuses, not just academic campuses, but corporate campuses and hospital campuses, and you can start to see the benefits of using the waste heat and generations of cascaded energy efficiencies.

We need to understand that the problem is not just in the end—or in the generation side where almost all of DOE investment is in new forms of generation. There is a microcosm that is going in the efficiency side of this equation, and there is also a significant portion of this, which is transmission losses, that could easily be addressed on the efficiency side of the equation.

Number five, transportation energy efficiency. I realize it is not the purview of this committee, but it is critically related to the way in which buildings are being developed in this country, and we have got to address land use conditions. We need to look at mixed use versus single use zoning. We need to look at pedestrianized environments where you have live, work, walk communities, and we have to understand that there needs to be more than one mode of transportation between our daily lives destinations. I work in this environment. It is a mixed use, and there are multiple modes of transport. I hope it will not decay as a result of lack of land use policies.

Okay. The last three points. We need to enact policy. The market will not take care of it. Utility programs and the U.S. Green Building Council's LEED program leadership in energy environmental design as well as building standards and appliance standards have had a magnificent impact on energy efficiency, and we need to continue to promote those programs. We need to look at energy efficiency and renewables as a supply source, not as a demand, in order to get a balanced portfolio, as was mentioned, in these types of supplies. If you look at refrigerator energy efficiency alone, the impact that those innovations and standards have had is equivalent to our hydropower at this point in time, and far greater than the Three Gorges Dam. And keep in mind that a lot of the Three Gorges Dam is going to go into refrigerators and air conditioners and China.

And finally, we need to invest in building research. You are starving our academic institutions. We have probably 200 Ph.D.

students total in this country looking at building energy efficiency and renewables compared to the thousands and thousands that are looking at a whole host of research agendas, and that is because there is no federal funding, and it is a very fragmented industry with no industrial support that will make sure that those Ph.D. programs can generate the next generation of buildings.

And just to close, this is where I work, a research laboratory, Carnegie Mellon.

Thank you, Madame Chairman.

[The prepared statement of Ms. Loftness follows:]

PREPARED STATEMENT OF VIVIAN E. LOFTNESS

The building sector is the biggest 'player' in the energy use equation and can have the greatest impact on maximizing energy supply and minimizing energy demand while providing measurable gains for productivity, health and the environment. The U.S. Green Building Council has summarized the energy and environmental importance of this sector of the economy: Commercial and residential buildings use 65.2 percent of total U.S. electricity and over 36 percent of total U.S. primary energy. Buildings use 40 percent of the raw materials globally and 12 percent of the potable water in the United States. Building activity in the U.S. also contributes over 136 million tons of construction and demolition waste (2.8 lbs/person/day), and 30 percent of U.S. greenhouse gas emissions (USGBC 2001).

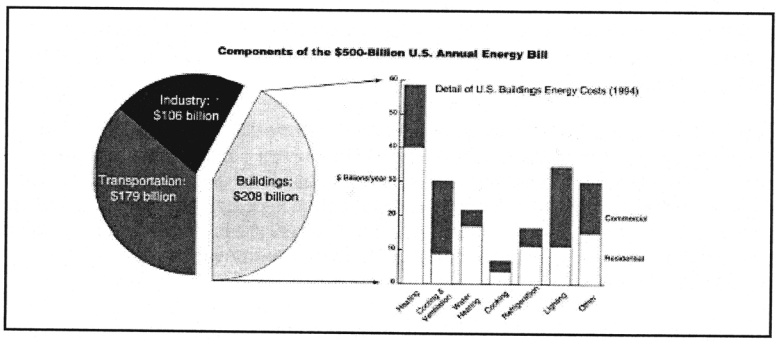
An evaluation and international comparison of the energy load breakdowns in residential and commercial buildings reveal substantial opportunities for energy efficiency in the building sector. While it is not possible to give a comprehensive list of these opportunities, this testimony will illustrate the potential impacts of five specific directions for building energy efficiency in the next 25 years: appliance innovations, cool communities, daylight and natural ventilation, energy cascades, and smart land-use planning.

In December 2002, the European Union adopted the Directive on Energy Efficiency of Buildings with the goal of cost-effective energy savings of 22 percent by 2010. The U.S. needs to enact parallel efforts to ensure that the long-term implications of decision-making in the built environment contribute positively to our energy, carbon and pollution mitigation, and quality of life goals. With the right policies, incentives, and research, building energy efficiency and renewables can have a 20–50 percent impact on building energy use by 2010, and a 75 percent impact by 2050, outpacing both the industrial and transportation sectors in national energy gains.

1.0 The Significance of Building Energy Use

The building sector is the biggest 'player' in the energy use equation and can have the greatest impact on maximizing energy supply and minimizing energy demand while providing measurable gains for productivity, health and the environment (Figure 1, 1997 Interlaboratory working group). The U.S. Green Building Council has summarized the energy and environmental importance of this sector of the economy: Commercial and residential buildings use 65.2 percent of total U.S. electricity and over 36 percent of total U.S. primary energy. Buildings use 40 percent of the raw materials globally and 12 percent of the potable water in the United States. Building activity in the U.S. also contributes over 136 million tons of construction and demolition waste (2.8 lbs/person/day), and 30 percent of U.S. greenhouse gas emissions (USGBC, 2001).

Figure 1 (Interlaboratory Working Group 1997)



Illustrating the scale of the impact that building energy efficiency can have on national goals—if improved standards for residential refrigerator efficiencies had not been introduced in 1975, over 40 GW of additional power plant generation would have been needed in 2001, producing 32 million tons of carbon (MTC). Of equal importance, EER standards for commercial rooftop air conditioners have avoided 135 GW of peak electricity load with associated carbon savings of over 100 MTC (Rosenfeld et al., 2004).

The building sector currently receives the least federal attention for research and development, despite its large potential for addressing climate change through: reducing primary energy requirements and emissions, replacing fuel sources with non-carbon based alternatives, and supporting effective sequestration of carbon in the built environment.

2.0 Five specific directions in building energy efficiency

An evaluation and international comparison of the energy load breakdowns in residential and commercial buildings reveal substantial opportunities for energy efficiency in the building sector. While it is not possible to give a comprehensive list of these opportunities, the following paragraphs illustrate the potential impacts of four specific directions for building energy efficiency in both the 2010 and 2050 time horizons.

2.1 Appliance and equipment energy standards and innovations

The introduction of California and then national standards for equipment and appliance efficiency has had a major impact on national energy use, reducing energy consumption for heating, cooling and refrigeration demands by 25 percent, 60 percent and 75 percent respectively (Figure 2a, Rosenfeld et al., 2004). The direct relationship of appliance electricity demand and CO_2 production illustrates the value of these energy savings in addressing climate change. The impact of both R&D and standards has enabled refrigerator size and amenities to increase while overall energy use is reduced (Figure 2b, Rosenfeld, 2004). Four pending appliance standards (clothes washers, fluorescent light ballasts, water heaters and central air conditioners) are projected to save consumers $10 billion in energy costs, improve functionality, and reduce cumulative emissions by as much as 22 MTC through 2010 (*U.S. Climate Action Report,* 2002). The natural replacement cycle of just four building technologies—ballasts, lamps, windows and refrigerator/freezers—with high performance alternatives would save 190 billion kWh of power demand (and 52MTC) by 2010, with an additional 130 billion kWh (and 35MTC) and 0.3Mbod saved by 2050. There are few engineering obstacles and significant export growth potential in expanding appliance and equipment energy efficiency standards to cover the full range of existing and new equipment being introduced in residential and commercial buildings.

2.2 Shading, Cool Roofs and Cool Development

Six percent of all U.S. energy is used in cooling residential and commercial buildings (Figure 3, Koomey, 1996), at an annual cost of $40 billion, and peak power demands of 250 GW. A 5°F rise in neighborhood temperatures—from excessive absorption of solar energy in our increasingly impervious built environment (due to increases in roads, parking lots and roofs)—considerably increases cooling loads. On

a national level, the creation of "cool communities" with white roofs, pervious paving, and shade trees would yield a 10 percent reduction in annual cooling loads, and a five percent reduction in peak cooling loads (Rosenfeld et al., 2003). Moreover, CO_2 would be sequestered more effectively by urban trees than an equivalent number of new 'forest' trees, and urban flooding would be greatly reduced. In addition to the visible enhancement of our physical environment, cool community planning would yield a 6–8 percent reduction in smog with commensurate gains in the health of our citizens. Given the cycle time of roof replacements and tree growth rates, immediate federal and state policies and incentives are needed to realize the benefits of "cool communities" by 2020.

2.3 Daylighting and Natural Ventilation

Over 10 percent of all U.S. energy is used for lighting buildings, much of this during the daytime when daylight is abundant. In combination with the six percent of all U.S. energy used for cooling buildings in summer and winter, there is significant argument for the environmental benefits of windows for daylighting and natural ventilation. Given the dominant number of existing buildings—schools, hospitals, offices, manufacturing facilities—originally designed for effective daylighting and natural ventilation, the erosion of natural conditioning is a serious energy cost to the Nation. Effective daylighting can yield 30–60 percent reductions in annual lighting energy consumption, with average energy savings for introducing daylight dimming technologies in existing building at over 30 percent (Loftness, 2002). Emerging mixed-mode HVAC systems, that interactively support natural ventilation or air conditioning, are demonstrating 40–75 percent reductions in annual HVAC energy consumption for cooling. The effective use of natural conditioning with well designed windows, window controls, and mechanical and lighting system interfaces, promises to yield major energy efficiency gains of up to five percent of all U.S. energy use, reduce risk in power outages, and provide measurable productivity, health and quality of life gains (Figures 4 and 5).

2.4 On-site generation, the 'Building as Power Plant'

There are two major arguments for distributed energy systems, particularly the development of on-site energy generation that uses neighborhoods and campuses to ensure system efficiencies. First, U.S. transmission and distribution losses alone totaled 201TWh in 2002, or 55MTC per year. Second, the reject energy from power generation is a prime resource for building energy loads through co-generation of steam, chilled water via absorption chillers, desiccant conditioning, and hot water demands. This co-generation of power and building conditioning dramatically improves power generation efficiencies, from averages of 30 percent to well over 70 percent (WADE, 2002). Add to this distributed renewable energy sources such as photovoltaic, solar thermal, fuel cells, micro-turbines or biomass, and buildings can actually become power plants—generating more power than they consume (Hartkopf, 2002). The U.S. has a limited program in distributed energy systems, with too small a federal investment in combined heat and power technology to support research of CHP linked to renewable sources or CHP fully integrated with buildings and campuses. By 2050, each new building completed should be a net energy exporter—a building as power plant—with a diversity of renewable fuel sources as input (hydrogen, geothermal, solar thermal, solar electric, wind) and a building conditioning cascade that eliminates generation losses (Figure 6).

2.5 Land-use and urban growth boundaries

Sprawl and the commensurate abandonment of existing buildings and infrastructures is a serious environmental cost to the Nation. A significant portion of the 20 percent growth in transportation energy use in the past ten years is due to increased mileage in single occupancy vehicles—the automobile travel that stitches together the increasingly distributed activities in our daily lives. While fuel efficiency in automobiles will make an impact on this energy and environmental expense, land use innovation will have a far greater impact on both of these factors, as well as health and quality of life. The impact of urban growth boundaries in both Portland and Seattle has been remarkable, with significant investment in infill construction to maximize the utilization of existing infrastructures. Moreover, these cities have emerged as a mecca for young professionals searching for the dynamic, interactive life styles that are only offered in pedestrian, mixed-use neighborhoods. Dr. Richard Jackson of the Center for Disease Control in Atlanta has begun to link a number of chronic ailments in children—depression, obesity and others—to the isolated nature of single use zoning, neighborhoods where kids must be driven to every venue. For 2050, visionaries such as Malcolm Wells and Peter Calthorpe (references) would argue for completely new environmentally balanced approaches to land use and development: Landscapes that are natural storm water and waste processors, urban

growth boundaries to maximize use of existing infrastructures and support pedestrianization, concrete budgets and tree canopy standards—a vision for the future with dramatically reduced cooling, transportation, and water demands as well as improvements in environment, health and quality of life.

3.0 Actions for building energy efficiency and inter-related benefits

In addition to the obvious benefits of reduced energy demand, dramatically accelerated national investments and policies focused on building energy efficiency will contribute to:

- Reduced unnecessary annual energy consumption (Figure 2)
- Reduced emissions and climate change impacts (Figure 3)
- Increased peak power capacitance and reliability (Figures 6 and 7)
- Improved health, human safety and security
- Improved productivity (Figures 4 and 5)
- Improved quality of life
- Increased exports—products and services
- Setting a proven example for emerging nations with growing demands

With regards to mitigating against climate change, Greg Kats argues in a study of the costs and financial benefits of green buildings "The vast majority of the world's climate change scientists have concluded that anthropogenic emissions—principally from burning fossil fuels—are the root cause of global warming. The U.S. is responsible for about 22 percent of global greenhouse gas emissions. Of this 22 percent, the U.S. building sector is responsible for about 35 percent of U.S. CO_2 emissions, the dominant global warming gas" (Kats, 2003). In addition to energy efficiency gains, building and infrastructure revitalization can have a major impact on reducing urban sprawl and the consequent rapid increases in transportation energy use and emissions from single occupancy vehicles. The critical actions needed to advance building energy efficiency to meet both readily achievable goals in the short-term as well as visionary goals in 2050 and beyond include changes in policy, investment and research at the federal, State and industrial level.

3.1 Policy—the market will not take care of it

Energy is cheap, especially if the externalities of pollution, risk, and health are considered. Consumers do not see energy as a large enough component of their disposable income to evaluate the ROI of energy efficiency in the built environment. Deregulation has already reduced the efforts of major utilities to pursue demand side management and weatherization, programs that will have to be picked up by the already budget constrained States. At the same time, power unreliability concerns may lead residential and commercial building owners to purchase inefficient and polluting standby power rather than consider the significant opportunity to invest in energy efficiency. The contributions of buildings to the discharge of four primary pollutants—NO_X, SO_X, CO_2, and particulates—should be fully recognized in the cost of building energy, to catalyze owners and occupants to pursue more environmentally responsible buildings and building use patterns.

Federal and State energy efficiency standards as well as tax incentives are critical. A remarkable example of environmental gain through policy, especially in today's under-regulated, under-incentivized market, has been the introduction of Leadership in Environmental and Energy Design (LEED) by the U.S. Green Building Council. The LEED rating utilizes certification to establish a building's environmental sustainability level related to: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality and innovation in design practices. LEED goals have been adopted by a growing number of major building decision makers in the public and private sector impacting an estimated three percent of new construction with over 50 percent energy efficiency savings—gains that should be widely adopted.

3.2 Balancing Investment in Supply and Demand

Given the major energy excesses in the built environment, reducing demand must be seen as a major energy *source.* Investments in "mining" this new energy supply will: yield greater economic benefit for a broader array of industries; provide significant gains in reducing environmental pollution; and ensure a longevity to this "supply" that few other sources can ensure. Unfortunately, the continued federal dollars going into R&D for energy supply outweigh R&D dollars for energy demand six to one (DOE/CR–0059, 1999), even though the ROI of energy efficiency dramatically exceeds the ROI of creating new sources. For example, the modest national investments (of around $3M per program) by DOE in R&D for energy efficient ballasts,

low-E windows, and refrigerator standards, reaped national benefits of $9,000, $7,000 and $23,000 per dollar invested (Rosenfeld, 2004).

3.3 Building Research—An unrecognized federal mandate

Investing in building energy efficiency as a new energy "supply" would dramatically surpass production from new oil supplies and power plant investments, as well as offer sustained "sources" of energy that do not generate greenhouse gases. Yet the combined budgets for building research across the Federal Government is less than two percent of federally funded R&D, in no way commensurate with the importance of the built environment to our economy and quality of life (Loftness/NSF, 2000). Given this paucity of research support, there are only a handful of university Ph.D. programs focused on energy efficiency and environmental quality in the built environment, compared to many dozens of universities with federally funded research related to nano-technology and information security for example. Given that the building sector is 20 percent of the U.S. economy, over 35 percent of U.S. energy use and associated environmental quality, and significantly linked to the health and competitiveness of our nation, the federal sector must move beyond today's marginal funding of research in the built environment.

4.0 Conclusions

Energy efficiency in buildings represents a major untapped resource for our energy demands and resultant mitigation of climate change. Standards and removal of market barriers can lead to significant reductions in energy use from key buildings technologies through their natural replacement cycle. A 1997 study undertaken by all five national laboratories determined that building energy efficiency could achieve 230MTC of the 400MTC savings needed by 2010 to meet U.S. targets under the Kyoto Protocol. With the addition of innovative combined cooling, heat and power technologies, a further 170MTC could be achieved, fully meeting 2010 goals through the building sector alone. Over the longer-term, expanded building R&D budgets, industry and university based research, and continuing national policies that focus on building energy efficiency, could trigger dramatic improvements in energy and environmental quality in the built environment. Moreover, these investments would ensure ancillary benefits including revitalization of existing buildings and infrastructures, measurable gains in health and productivity, and a positive influence on energy efficient growth in the built environment of developing nations.

In December 2002, the EU adopted the Directive on Energy Efficiency of Buildings with the goal of cost-effective energy savings of 22 percent by 2010 through four basic actions (Bowie & Jahn, 2003):

1. General framework for calculation of the integrated performance of buildings.
2. Setting of minimum standards in new and existing buildings.
3. Energy certification of buildings.
4. Inspection and assessment of heating and cooling installations.

The U.S. needs to enact parallel efforts to ensure that the long-term implications of decision-making in the built environment contribute to our energy, carbon and pollution mitigation, and quality of life goals. With the right policies, incentives and research, building energy efficiency can have a 20–50 percent impact on building energy use by 2010, and a 75 percent impact by 2050, outpacing both the industrial and transportation sectors in national energy savings.

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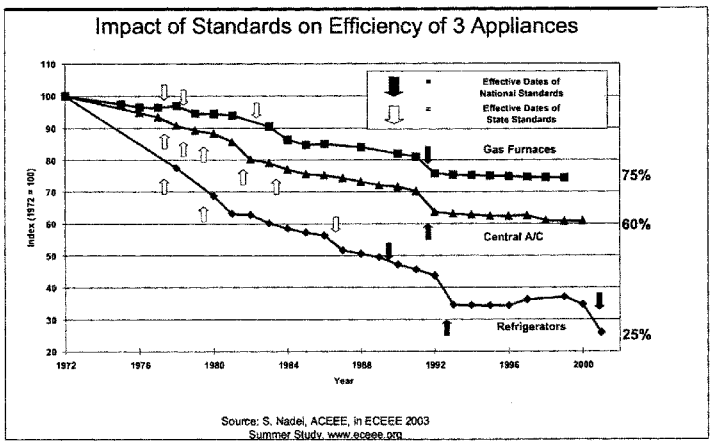
Figures 2a, 2b (Rosenfeld et al., 2004)



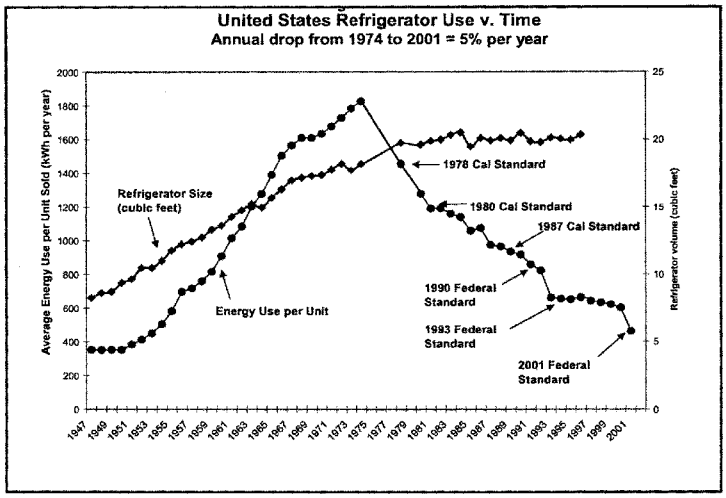


Figure 3 (Koomey 1996)

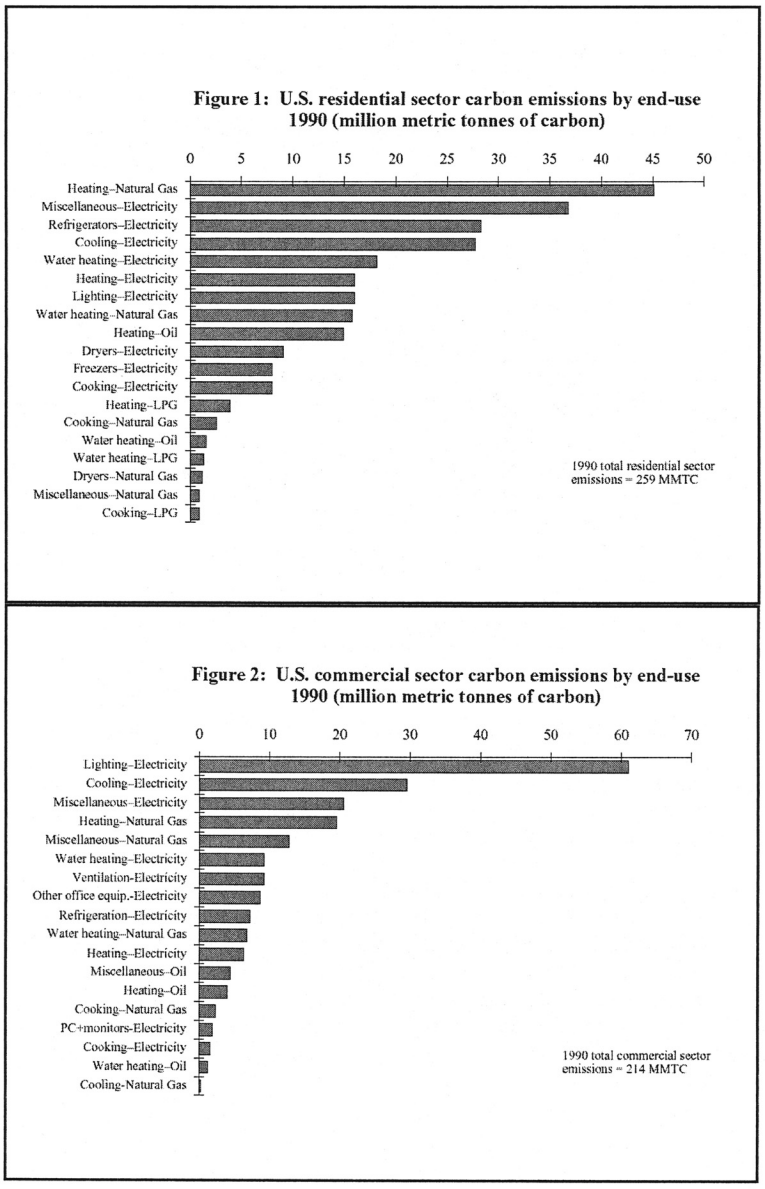
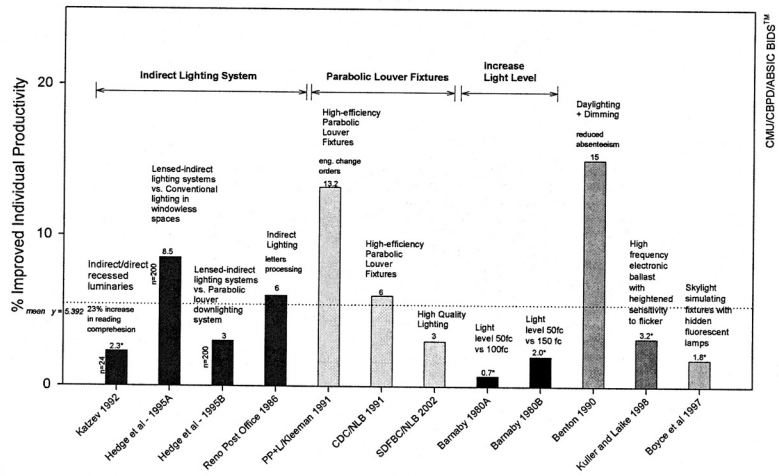


Figure 4



Case Studies Introducing Improved Performance with Lighting Control Strategies

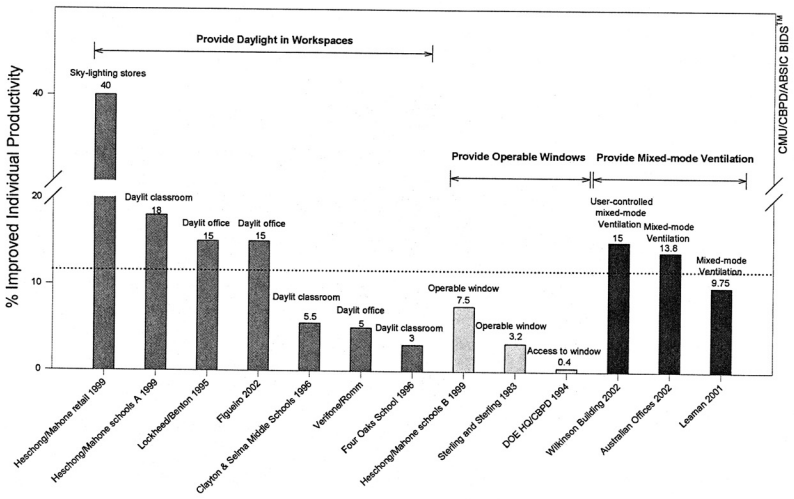
(* Performance improvement for specific tasks multiplied by estimated time at tasks)

Lighting System Quality Increases Individual Productivity

A range of lighting design strategies have been shown to increase individual productivity: glare-free, high-performance fixture design, including lamp, ballast and lens design; indirect-direct lighting; and improved lighting control systems.

The CBPD team has identified 12 studies linking improved lighting design decisions with 0.7-23% gains in individual productivity. Four of these studies demonstrate 3-23% improved performance at a range of tasks given the introduction of indirect-direct lighting systems. Four studies identify 3-13.2% increases in individual performance resulting from higher quality fixtures – high performance electronic ballasts and parabolic louvers. Four studies identify the contributions of higher lighting levels and daylight simulating fixtures to 0.7-2% improvement in individual productivity at a range of tasks.

Figure 5



Case Studies Introducing Improved Performance with Access to Natural Environment

Access to the Natural Environment Increases Individual Productivity and Health

The importance of access to the natural environment to individual health and productivity is related to a number of design decisions: access to windows and view; daylighting through windows and skylights; natural ventilation and mixed-mode ventilation; and directly accessible landscaped indoor and outdoor spaces.

The CBPD team has identified thirteen studies linking improved access to the natural environment with gains in individual and organizational productivity. Seven of these studies have identified 3-18% increases in individual productivity (including student test results) and 40% increases in sales (an organizational productivity measure) as a result of the introduction of daylight in the workplace. Six studies further indicate that the addition of operable windows for thermal comfort, natural ventilation, or simply access to the outdoors, can impact productivity by 0.4-15%. The upper range of these productivity improvements, from 10-15% increased productivity, are achieved in mixed-mode buildings where operable windows are coordinated with mechanical air conditioning strategies.

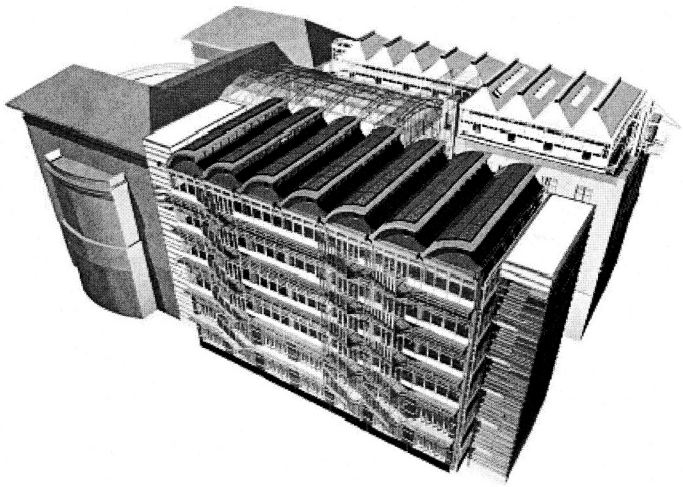


Figure 6

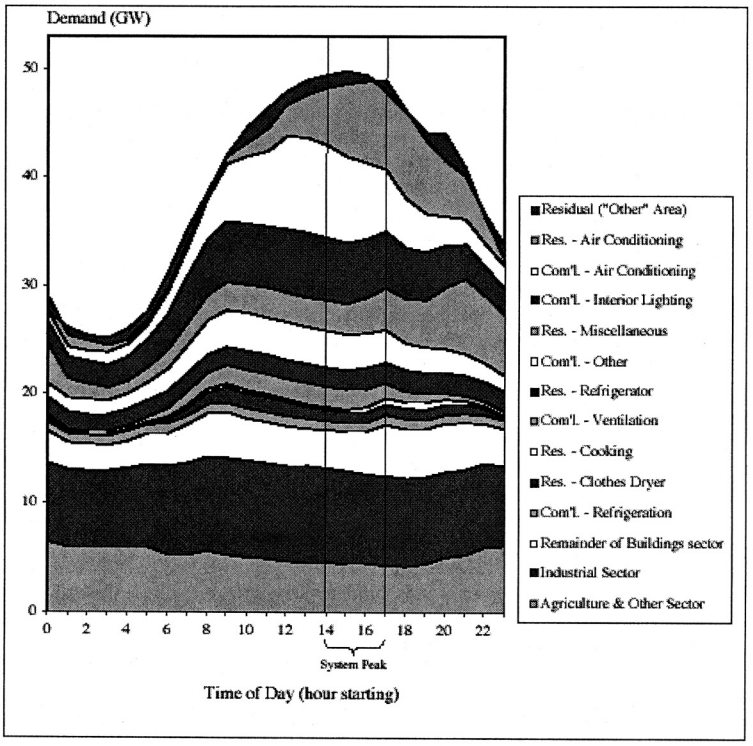
The Carnegie Mellon University
Innovation Works Project

Building as Power Plant

The building as power plant initiative will integrate advanced energy efficient building technologies with innovative distributed energy generation systems, such that most or all of the buildings energy needs for heating, cooling, ventilation and lighting are met on-site, maximizing the use of renewable energies. The combination of energy efficient "ascending" conditioning strategies with "cascading" power-cooling-heating strategies creates the potential for new building projects to become energy exporters – a building as power plant for university, hospital and corporate campuses with growing power demands.

Figure 7 (Koomey and Brown 2002)

Figure 1: California 1999 Summer Peak-day End-use Load (GW): 10 largest coincident building-sector end-uses and non-building sectors



Notes: The ten largest coincident building-sector end uses are shown separately, while the smaller building end uses are aggregated together in "Remainder of Buildings Sector." The end uses are ordered the same vertically in the graph and the legend. Res. = residential buildings, Com'l. = commercial buildings. The non-building sectors are shown as sectoral totals. Thus, the buildings sector accounts for all but the bottom two segments of the graph. The Residual (top-most segment) is the difference between FERC system loads and the CEC forecasting model outputs. This difference is mainly due to small utilities not included in the CEC forecasting model. The "Agriculture & Other" sector includes water pumping, transportation and street lighting.

Source: LBNL analysis of CEC and FERC data (Brown and Koomey 2002).

BIOGRAPHY FOR VIVIAN E. LOFTNESS

University Professor and Head, School of Architecture, Carnegie Mellon University; Senior Researcher, Center for Building Performance and Diagnostics

Vivian E. Loftness is an international sustainability and building performance consultant for commercial and residential building design. She has edited and written a wide range of publications on advanced building systems, energy, climate and regionalism in architecture, as well as design for performance in the workplace of the future. In 2002, she was named Educator of the Year by the American Institute of Architecture Students.

Over the past ten years, Vivian Loftness has pursued advanced architectural research on the performance of a range of building types, from museums to high tech offices, and the innovative building delivery processes necessary for improving quality in building performance. Supported by a university-building industry partnership, the Advanced Building Systems Integration Consortium, she is a key contributor to the development of the Intelligent Workplace—a living laboratory of commercial building innovations for performance, along with authoring a range of publications on international advances in the workplace.

In the Center for Building Performance at Carnegie Mellon, Ms. Loftness has been actively researching and designing high performance office environments with DOE, DOD, Department of State, GSA, NSF and major building industries such as Steelcase and Johnson Controls. She has served on five National Academy of Science panels as well as being a member of the Academy's Board on Infrastructure and the Constructed Environment. Her work has influenced both national policy and building projects, including the Adaptable Workplace Lab at the U.S. General Services Administration and the Laboratory for Cognition at Electricity de France.

Vivian Loftness has a Bachelor of Science and a Master's of Architecture from MIT, is on the National Board of the USGBC, AIACOTE, and DOE FEMAC. She is a Fellow of the American Institute of Architects and is a registered architect.

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Judy Biggert, Chair
Energy Subcommittee of the House Science Committee

May 19, 2004

Financial Disclosure for
Testimony of Vivian Loftness on

The Impact of Federal Energy Efficiency and Renewable Energy R&D Programs

This letter is to formally state that the Center for Building Performance at Carnegie Mellon University has received annual funding from the following federal agencies in the past five years: DOD, DOE, EPA, GSA and NSF. This funding has been at a level of approximately $50,000 per year per agency, in collaboration with an NSF Industry/ University Cooperative Research Center focused on high performance buildings based at Carnegie Mellon University.

Yours Sincerely,

Vivian Loftness
University Professor and Head
School of Architecture
Carnegie Mellon University

Chairman BIGGERT. Thank you very much, Ms. Loftness.

Mr. Carberry, you are recognized.

STATEMENT OF MR. JOHN B. CARBERRY, DIRECTOR, ENVIRONMENTAL TECHNOLOGIES, DUPONT CENTRAL RESEARCH & DEVELOPMENT

Mr. CARBERRY. Good morning, Madame Chairman, Mr. Larson, and Members of the Committee. I am John Carberry, Director of Environmental Technology for DuPont.

DuPont's vision is for sustainable growth while continually reducing our environmental footprint. Energy efficiency, renewable energy, and renewable raw materials are part of that vision. I will address our experiences, our views of federal programs that have proven helpful, and how efficiency and renewable energy can help address high natural gas prices.

The Consumer Federation of America estimated that these high prices have cost consumers an extra $80 billion over the last three years and no discussion of U.S. energy policy can ignore this issue. DuPont has focused on energy efficiency for many years. In addition, DuPont determined that the science regarding global climate change justified rational action, and we established aggressive voluntary reduction goals.

Energy efficiency and renewable energy contributed significantly to the 65 percent reduction of greenhouse gas emissions that we have achieved. From 1973 to 1992, we decreased our unit energy consumption by almost 40 percent. During the '90s, we held our energy use flat while increasing our production over 35 percent. We have modernized on-site power generation systems, including extensive use of highly efficient co-generation. We increased operating capacity and up time of our existing plants. We also increased yield, which reduces energy use and waste generation.

We have made major gains through process changes and, in smaller ways, through improved efficiency in lighting, pumps, and steam. We estimate that since 1990, we have saved almost $2 billion in energy costs versus the business-as-usual case. We make products that help others become more energy efficient. Our Tyvek building wrap, which hopefully all of you see as you have seen new construction, reduces energy use in one year by an amount equal to about 10 to 20 times the energy it took to produce the Tyvek. Our engineering plastics help to make cars lighter and more fuel efficient, and DuPont fuel cell technologies are helping to create the next generation of high-efficiency, low-emission power sources.

We have set a goal of 10 percent of our energy by 2010 from renewable energy. We are at about four percent and are hard at work on projects involving biomass and landfill gas that could yield another four percent.

Partnerships with government agencies have proven to be effective. We are engaged with DOE to develop an integrated, corn-based biorefinery, a technology to more efficiently convert corn into ethanol and bio-based raw material called PDO. Bio-based PDO is for DuPont's bio-based Sarona fiber, which won the President's Green Chemistry Challenge Award recently. We collaborated with both the Department of Energy and the National Institute of Standards and Technology on fuel cell and superconductivity.

Under DOE's Vision 2020 program, we identified criteria for the successful development of biomass energy.

Beyond just DuPont's operation, energy efficiency measures across the economy have significant impacts. With natural gas supplies tight, demand reductions can help reduce price pressures and volatility. Congress can expand programs in home weatherization, building codes, energy efficient appliances, distributed generation, and incentives for renewable energy. While energy efficiency and renewable energy by themselves are not sufficient to close the supply-demand gap, they are clearly an important part of a much-needed national policy for natural gas.

In closing, let me thank you for inviting me. We believe that energy efficiency and renewable energy have a significant role to play. Congress needs to ensure that important programs, such as DOE's EERE programs and NIST's ATP program, are adequately funded to help us advance these technologies. In addition, and perhaps more importantly, the U.S. urgently needs a clear, national policy to address the runaway price of natural gas, a policy that combines measures such as efficiency and renewables to reduce demand, along with improved infrastructure, as the Chair already noted, additional liquefied natural gas import, alternative fuels, such as clean coal, and environmentally responsible domestic natural gas production. I would be happy to ask any—to respond to any questions.

Thank you.

[The prepared statement of Mr. Carberry follows:]

PREPARED STATEMENT OF JOHN B. CARBERRY

Good morning Madame Chairman, Mr. Larson, and Members of the Committee. My name is John Carberry, and I am Director of Environmental Technologies for DuPont Central Research & Development. Among my responsibilities is the technology evaluation to support DuPont's energy efficiency and renewable energy activities. Over its 202 year history DuPont has brought science to bear to address human and environmental needs. Our vision is Sustainable growth; increasing shareholder and societal value while decreasing our environmental footprint. This is a global vision, implemented in the 70 countries in which we operate and in many more countries in which we sell products, many of which help others operate more efficiently. Efficient use of energy, and the use of renewable energy and renewable raw materials are part of that vision. I applaud you for holding this hearing. It is particularly relevant at a time when over-reliance on a single fuel, natural gas, is causing unstable and high natural gas prices that are having significant economic repercussions throughout the entire U.S. economy, as noted by Federal Reserve Chairman Alan Greenspan in his prior Congressional testimony.

In my remarks I will address our experiences with energy efficiency and renewable energy, the business value of efficient use of energy, our views of federal programs that have proven helpful in these areas, and how efficiency and renewable energy can help in addressing high US natural gas prices. Natural gas prices in the U.S. are currently at, and are projected to remain at, two to three times historical levels. The Consumer Federation of America recently estimated that over the last three years these high U.S. natural gas prices have cost consumers an extra $80 billion. No discussion of energy policy in the U.S. can ignore this issue. These sustained high prices are fundamentally the result of a supply-demand imbalance. Government policies are a significant part of the cause, and changes in those policies are necessary to address this serious problem.

DuPont has focused on energy efficiency for many years, for both economic and environmental reasons, consistent with our Sustainable Growth vision. Many of our operations are energy intensive, with energy representing a significant element of manufacturing cost. In addition, in the early 1990s DuPont determined that the science regarding global climate change was sufficient to justify action. We recognized that our emissions contributed to the situation, and we established aggressive voluntary greenhouse gas reduction goals for DuPont. Increasing our energy effi-

ciency and enhancing our use of renewable energy sources has contributed significantly to the 65 percent global reduction in DuPont greenhouse gas emissions that we have achieved, and continues to do so. Other reductions, slightly more than half, came from actions on non-CO_2 gases.

From 1973 to 1992, we decreased our energy consumption per pound of product produced by almost 40 percent. During the 1990s we held our energy use flat on a global basis while increasing our production by over 35 percent. We achieved this in a number of ways, both large and small. We have made changes to our overall portfolio to emphasize energy efficient operations. We have modernized our on-site power generation systems, including extensive use of co-generation, also called combined heat and power. This combined production of electricity and steam is up to twice as efficient and has much lower emissions than typical electric utility power generation. We have also increased the final product yield at our plants, meaning we convert more of our raw materials to final product, reducing energy use and waste generation. In addition, we have increased plant utilization—plants are more energy efficient when they run at a consistent high rate. We have made gains in numerous smaller ways as well, improving energy efficiency in everything from lighting and pumps to how steam is managed on our sites. Many of these improvements are transferable to other manufacturing plants, and we have widely shared our experiences with others.

Allow me to illustrate with a few examples. At one plant we made changes to product packaging that reduced our energy usage 30 percent and improved our packaging. We installed highly efficient large-scale co-generation facilities at several plants, including at our Victoria and Sabine, Texas sites. I would note that the current and projected high U.S. natural gas prices make further investment in co-generation uneconomical.

These reductions in energy use have returned significant business value to DuPont—we estimate that since 1990 we have saved almost $2 billion in energy costs by our more efficient use of energy versus the "business-as-usual" case. Those savings continue. That is genuine business value from better energy stewardship, and it contributes to our substantial global reductions in air emissions, including greenhouse gases.

We also create products that help others become more energy efficient. For example, our Tyvek® Housewrap, used in both residential and commercial applications, in one year reduces energy use by an amount equal to 10–20 times the energy it took to produce the Tyvek®. Our engineering plastics help to make cars lighter weight and therefore more fuel efficient, and DuPont fuel cell technologies are helping to create the next generation of high efficiency low emitting power sources for applications ranging from portable CD players to cars to community power generating stations. Despite these substantial gains, we continue to pursue energy efficiency aggressively. Throughout this decade our goal is to continue to hold energy use flat, even as we pursue aggressive growth. These gains will largely derive from additional incremental measures; most of the larger scale "low hanging fruit" has been picked. Certainly co-generation offers additional opportunities, but as I have already noted the sustained high domestic natural gas prices are posing a barrier in that regard. Energy efficiency and renewable energy sources are also the primary routes for us to continue to make progress in greenhouse gas reductions.

In addition to our efforts at energy efficiency, we have also set significant public goals for our use of renewable energy, targeting to secure 10 percent of our global energy needs by 2010 from renewable sources at competitive pricing. Our renewable energy goals are consistent with our sustainable growth efforts, including a desire to reduce our dependence on depletable resources, further reduce our greenhouse gas emissions and to explore potential new markets. Getting to 10 percent will not be easy. We are currently getting over four percent of our energy from renewable sources, and are hard at work on projects involving biomass and landfill gas, both great substitutes for natural gas, that could yield another four percent. At one site, a landfill gas project could reduce that site's natural gas needs by almost 40 percent. We are exploring opportunities to utilize biomass in our on-site power generation, and are working on enhancing the fundamentals of photovoltaic technologies to reduce the cost of energy generated from the sun.

Partnerships with government agencies have proven helpful and effective in many of these endeavors. We are engaged in very productive partnerships with DOE, including a matching grant program to develop an Integrated Corn Based Biorefinery, a mouthful of a term that basically means that we are developing technology to more efficiently convert corn into ethanol and a bio-based raw material called PDO commonly used in the chemical industry. Of particular note is the goal of converting not just the corn grain itself, but also the corn husks and stalks, which currently are just left in the fields, to ethanol. This would increase farmers' revenues signifi-

cantly. Also of note, the bio-based PDO will provide a raw material for DuPont's bio-based Sarona® fiber, for which DuPont was awarded the President's Green Chemistry Challenge Award last year. This is consistent with our goals of not only enhancing our use of bio-based energy but also the use of bio-based raw materials in our operations. We also have fruitful collaborations with both the Department of Energy and the National Institute of Standards and Technology's Advanced Technology Program on fuel cell and superconductivity related programs. Under DOE's Vision 2020 program, and working with the Green Power Market Development Group, convened by the World Resources Institute and consisting of 12 major U.S. companies, we identified criteria for the successful development of biomass derived renewable energy that allowed the Group to solicit and evaluate commercial biomass proposals. In another initiative with DOE's Office of Innovative Technology we are developing a tool that will help site engineers quickly estimate energy efficiency opportunities so that decisions on priorities and allocation of resources can be made. I would note that we are concerned about inadequate funding for several of these programs in current budget requests.

Let me now address the benefits of energy efficiency and renewable energy beyond DuPont's operations. Aggressive energy efficiency measures across the U.S. economy, including the industrial, commercial and residential sectors, can have significant beneficial economic impacts. Not only the entity reducing its energy use benefits, but more broadly this can have significant beneficial effects on high U.S. natural gas prices. Peak electricity generation, and increasingly base load generation as well, is largely natural gas fired in the U.S. Reductions in electricity demand driven by increased energy efficiency will cause the utility sector to decrease their demand for natural gas. In an environment of tight natural gas supplies, this demand reduction can help to ease upward price pressures and price volatility for natural gas. Estimates by the American Council for an Energy Efficient Economy of the effects of energy efficiency programs on the demand for natural gas suggest the impact on natural gas demand could be significant. Certainly the experience in California several years ago showed that electricity demand could be substantially reduced rather quickly with concerted effort. The U.S. could productively expand programs in areas such as home weatherization, enhanced building codes, more energy efficient appliances and distributed generation. In addition, programs to incentivize the expanded use of renewables in electricity generation can also serve to reduce natural gas demand. While energy efficiency and renewable energy by themselves are not sufficient to close the supply-demand gap for natural gas and bring prices back to Earth, they are clearly an important part of a much needed national policy for natural gas, along with environmentally responsible additional natural gas supply and a diversity of fuels for the electric generating sector.

In closing, let me again thank you for holding this hearing and providing me the opportunity to share our experiences. We believe that energy efficiency and renewable energy sources have a significant role to play in America's energy mix. Congress needs to ensure that important programs, such as DOE's EERE programs and NIST's ATP program, are adequately funded to help us advance these technologies. In addition, and perhaps more importantly, the U.S. urgently needs a clear national policy to address the runaway price of natural gas, a policy that combines measures such as efficiency and renewables to reduce demand for natural gas, improved infrastructure, additional liquefied natural gas imports, alternative fuels such as clean coal, and environmentally responsible natural gas production.

BIOGRAPHY FOR JOHN B. CARBERRY

John B. Carberry is Director of Environmental Technology for the DuPont Company in Wilmington, Delaware where he has been employed since 1965. He is responsible for recommendations on technical programs for DuPont based on an analysis of environmental issues. Since 1988, he has led this function in a transition to increasingly emphasize waste prevention and product stewardship while maintaining excellence in treatment. His major responsibilities have included leading the DuPont focus on the impact of energy costs, finding and using affordable renewable energy, providing technical analysis and recommendations for the DuPont energy goals, leading a team that provides guidance on avoiding persistent and bioaccumulative chemicals and works with the EPA on science based targeting, and leading the team that commercialized the revolutionary "zero emissions, negligible inventory" methylisocyanate (MIC) process.

Mr. Carberry is Chair of the National Academy Committee on the Destruction of the Non-Stockpile Chemical Weapons, a founding member of the Green Power Market Development Group and of the Vision2020 Steering Committee, and a member of the NAE Committees on; Technologies for Sequestering CO_2, and Metrics for Doc-

umenting Progress in Global Change Research. Since 1990, John has presented 30 lectures on environmental issues at 18 universities, given invited presentations at 63 public conferences worldwide and provided 21 literature interviews, or contributions. He holds a B.ChE. and an M.E. in Chemical Engineering from Cornell University and an MBA from the University of Delaware.

Mr. Carberry is a U.S. citizen, born May 1, 1941. He lives in Newark, DE with his wife Sandra. They have two married children and two grandchildren who live nearby.

Chairman BIGGERT. Thank you very much, Mr. Carberry.

Mr. Smith, you are recognized for five minutes.

STATEMENT OF MR. PETER R. SMITH, PRESIDENT, NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY, NEW YORK STATE

Mr. SMITH. Madame Chairman, Chairman Boehlert, distinguished Members of the Subcommittee, thank you for the opportunity to testify today about Governor George E. Pataki's energy efficiency initiatives.

Governor Pataki is both passionate and committed to pursuing energy efficiency to benefit the state's energy consumers, the environment, and the reliability of our energy systems. Energy efficiency is cleaner than renewable resources and cheaper than coal. Maximizing energy efficiency in all sectors of the state's economy is the first step and the lowest cost alternative to improving the state's and the Nation's energy security and reliability.

New York imports about 85 percent of its energy needs and spends about $38 billion on energy of which approximately ½ flows out of the state. Those expenditures represent money spent by New Yorkers outside of New York, and more than likely, in politically volatile regions of the world. New York's efforts have the benefit of reducing our dependence on imported oil and creating and retaining jobs in New York's economy.

With regard to new renewable resources, New York is building the renewable infrastructure through production incentives: training for installers and repair personnel, supporting new technology with financial and technical assistance, and fostering the development of the biofuels industry. For example, more than 41 megawatts of new wind generation is in operation and being sold in New York. Recently, the New York State Public Service Commission certificated the first stage, a 300 megawatt wind farm in central New York, which will be the largest wind farm east of the Mississippi. Additionally, the Governor asked the New York State Public Service Commission to convene a regulatory proceeding on New York's potential for instituting a renewable portfolio standard that Chairman Boehlert noted will be 25 percent of New York's energy bought in 10 years.

With regard to energy efficiency, New York's public authorities, including the New York State Energy Research and Development Authority, the New York Power Authority, and the Long Island Power Authority invest nearly $290 million annually on energy efficiency, renewable energy technologies, low-income programs, and research and development. These programs create jobs in manufacturings of new technologies as well as installing and servicing equipment. For example, today in New York, there are more than 150 companies throughout the state in the energy efficiency busi-

ness. That is up from just over a handful in 1998 when we started what we call the New York Energy $mart program.

Our programs operate on a principle of providing matching funds through co-funding. New York is also the first state in the Nation to have a "green building" tax credit. We recognize that building green is not just good policy, it is good business. The benefits New York has accrued today from programs operated by NYSERDA, the New York Power Authority, and LIPA include annual customer utility bill reductions of over $140 million, a net reduction of electricity use of more than 1,000 gigawatt hours, as well as substantial annual emission reductions. In addition, the dollars invested in New York caused the creation of approximately 3,000 jobs across the state.

Governor Pataki's commitment to energy efficiency and renewable technology is further evidenced by the requirements of Executive Order 111, which he issued in 2001. The Order calls for a 35 percent reduction of energy consumption in state-owned facilities. The Order also mandates the purchase of renewable power. Another program we have is New York's Energy Investment program, or State EnVest, which assists state agencies and authorities in identifying energy efficiency opportunities in their facilities and then leveraging the savings to secure third-party, tax-exempt, lease-purchase financing. The program is supported by competitively procured, master-finance-arrangement and requires no out-of-pocket expenditures or on-balance sheet debt.

We also evaluate New York's programs. Evaluation of our New York Energy $mart program is conducted jointly by competitively selected, independent, third-party contractors and NYSERDA evaluation staff. Our evaluation efforts have demonstrated that we leverage $3 of private sector capitol for every dollar of public benefit funds awarded. The key to the success of our program is changing consumer and business attitudes and behaviors when making energy-related decisions. Part of our New York Energy $mart program is creating sustainable changes in markets.

There are potential synergies between state and federal efforts that are best exemplified by the EPA–DOE Energy Star program. Setting a program platform at the federal level and then allowing the state to act as an implementation partner is a perfect example of a productive federal-state relationship. States have the natural delivery systems to help transform markets for energy efficiency. Cooperation and coordination is also vital to the success of any federal-state partnership. The states need to be involved fully with the implementation of federal initiatives within their borders. Setting uniform standards creates a level playing field for businesses that operate in multiple states.

Much like our efforts under the State EnVest program, a federal initiative could be coordinated to create a master financing structure, which will allow for advertising the benefits of energy efficient improvements over time. In New York, we believe that energy efficiency and renewable resource development is good for the environment, good for the economy, and most importantly, good for energy security reliability. The $mart money is on energy efficiency, which is why in New York we call our program New York Energy $mart.

Madame Chairman and distinguished Members of the Subcommittee, thank you for the opportunity. I look forward to taking any questions you may have. Thank you, Mr. Boehlert.

[The prepared statement of Mr. Smith follows:]

PREPARED STATEMENT OF PETER R. SMITH

Madam Chairman and distinguished Members of the Subcommittee; thank you very much for the opportunity to testify today about Governor George E. Pataki's energy efficiency initiatives in New York State.

Governor Pataki is both passionate and committed to pursuing energy efficiency to benefit the State's energy consumers, the environment, and the reliability of our energy systems. Energy efficiency is cleaner than renewable resources and cheaper than coal. Air emissions are avoided, and the dollars saved by the customer are free to be spent elsewhere within the State's economy. Maximizing energy efficiency in all sectors of the State's economy is the first step, and lowest cost alternative, to improving the State's and the Nation's energy security and reliability.

The Governor's commitment to energy efficiency and clean, renewable energy technologies are driven by the goals of increasing sustainability, reliability, energy security, economic growth, and protection of our environment. New York imports more than 85 percent of its energy needs and spends about $38 billion dollars annually on energy, of which approximately one-half flows out of the State to pay for imported energy. Those expenditures represent money spent by New Yorkers outside of New York, and more than likely in politically volatile regions of the world. New York's efforts to promote energy efficiency and renewable technology have the benefit of reducing our dependence on imported oil, and creating and retaining jobs in the New York economy. New York's efforts acknowledge that we must begin with the here and now—more efficient energy use means less harm to the environment, and greater economic growth.

Renewable Resources

New York is building the renewable infrastructure through production incentives for wind generation, training for photovoltaic installers and repair personnel, supporting digester technology with financial and technical assistance for the agricultural community, and fostering the development of the biofuels industry. As well as encouraging the use of distributed generation through combined heat and power applications and fuel cell technology. The Governor has set the stage for a growth industry with tremendous energy and economic potential.

For example, more than 41 MW of new wind generation is in operation and being sold in New York thanks to a public/private partnership under the New York Energy $martSM Program. Recently, the NYS Public Service Commission certificated the first stage of a 300 MW wind farm on the Tug Hill Plateau in Central NY. The Flat Rock Wind Project will be the largest wind farm east of the Mississippi.

In addition, the Governor asked the New York State Public Service Commission to convene a regulatory proceeding on New York's potential for instituting a Renewable Portfolio Standard (RPS) in an effort to ensure that 25 percent of New York's electricity is purchased from renewable sources over the next decade.

Energy Efficiency

New York's public authorities including, the New York State Energy Research and Development Authority under the New York Energy $martSM Program, as well as the Programs funded by the New York Power Authority, and the Long Island Power Authority, invest nearly $290 million annually on energy efficiency, renewable energy technologies, low-income programs, and research and development. The New York Energy $martSM Program is funded through a System Benefits Charge on the transmission and distribution of electric energy for the State's investor-owned utility company customers.

There are jobs created directly in manufacturing, as well as to install and service equipment. There are jobs created by companies saving money on their energy bills. For example, today in New York there are more than 150 companies throughout the state in the energy efficiency business. That is up from a handful in 1998 when we started the New York Energy $martSM Program.

Industry partners are essential to helping identify the problems faced by energy consumers, craft viable solutions, and secure the financial commitment to install the appropriate technologies. New York's public benefit programs offer technical assistance and financial incentives that prompt building owners, managers, and related professionals to leverage their own capital in an effort to make the project a reality. Our programs operate on the principle of matching funds through co-funding where-

by the assistance we provide stimulates the project toward implementation, but does not simply provide funding for projects that would have taken place without the availability of the program. Many of our efforts are aimed at transforming the marketplace to value the multiple benefits of energy efficiency by spurring customer demand and establishing a competent professional infrastructure to provide "green" products and services.

New York is the first State in the Nation to have a "green building" tax credit. We recognized that building green is not just good policy, but good business.

The benefits New York has accrued to date from the New York Energy $martSM Program and the programs operated by NYPA and LIPA, include annual customer utility bill reductions of more than $140 million, a net reduction of electricity use of more than 1,000 Gwh, the enabling of 41.5 MW of Wind generation capacity, and 300 KW installed photovoltaic capacity; as well as annual emission reductions of NO_X by 1,000 tons, SO_2 of 1,600 tons and CO_2 reductions of 1.3 million tons. In addition to the energy and environmental savings the program dollars invested has caused the net creation of approximately 3,000 jobs across the state.

As an example of our efforts, Hudson Valley Community College, outside of Albany, NY is now operating independently of the electric grid by reclaiming the methane gas from a nearby landfill. The gas is used to fire a combined heat and power system that provides electricity while using the waste heat for winter thermal load and summer cooling, coupled with energy efficiency improvements throughout the campus.

Leadership by Example

Governor Pataki's commitment to energy efficiency and renewable technology is further evidenced by the requirements of Executive Order No. 111 which he executed in 2001. The Order calls for a 35 percent reduction of energy consumption in State owned facilities, from 1990 levels, by 2010. The Order also mandates the purchase of renewable power. Initially 10 percent of the State facilities' energy purchases must be made from renewable power sources by 2005, and ultimately 20 percent by 2010.

New York's Energy Investment Program, or State EnVest is further evidence of Governor Pataki's leadership by example with State facilities. State EnVest assists State agencies and authorities in identifying energy efficiency opportunities in their facilities and then leveraging the savings to secure third-party tax-exempt lease purchase financing. The annual energy savings potential is identified throughout the facility and is then amortized over a repayment period to cover principle and interest. The program is supported by a competitively procured Master Finance arrangement, and requires no out-of-pocket expenditures or on-balance sheet debt.

Program Evaluation and Metrics

To ensure that our programs meet our expectations for participation levels and meet our established energy and dollar savings goals, we have fully integrated a formal evaluation effort with program design and delivery—the first State in the country to do this.

Evaluation of the New York Energy $martSM Program is conducted jointly by competitively selected, independent third-party contractors and NYSERDA evaluation staff. Our efforts stress the importance of measuring and verifying program outcome impacts as an integral part of determining the success of our programs. Our delivery approach for energy efficiency and renewable energy development is predicated on establishing public and private partnerships. As such, our evaluation efforts have shown a three-to-one ratio of private sector capital investment to public sector dollars. The commitment of the energy services industry, renewable energy developers, building construction professionals, appliance manufacturers, distributors and dealers, as well as research institutions are an invaluable component in all of our program initiatives. We have evaluation plans in place to document and measure the progress of each of the programs in our portfolio within this broader context.

Key to the success of our programs is changing consumer and business attitudes and behaviors when making energy-related decisions. Creating sustainable changes in markets supporting the purchase of energy-efficient products and appliances bearing the ENERGY STAR label and ENERGY STAR buildings, along with helping grow an energy services industry, improving the State's housing stock, and creating training and certification programs for photovoltaic installers and building operators and auditors are also directly attributed to the program efforts as documented by the evaluation findings.

Federal/State Cooperation

The potential synergies between State and federal efforts are best exemplified by the EPA/DOE Energy Star Program. Setting a program platform at the federal level and then allowing the State's to act as an implementation partner is a perfect example of a productive federal/State relationship. As long as there is an effective mechanism for feedback, the relationship works very well. The State's have the knowledge necessary to reach the appropriate customer base, and understand any regional nuances related to effective implementation.

The coordination of effort is vital to the success of the federal/State partnership. The State's need to be fully involved with the implementation of federal initiatives within their borders. Setting standards on the federal level creates an even playing field for businesses that operate in multiple states. Individual States can act as proving grounds for federal initiatives, and help assess the potential for replicability among other States. Ground level deployment is most effective when managed by the individual States.

State and federal efforts need to be coordinated to create a financial model for amortizing the benefits of energy efficiency improvements just as you would any other capital investment. This approach allows the building owner or operator the opportunity to leverage the energy efficiency potential of their facility as a method to finance improvements. The annualized energy savings can service the principle and interest burden over an amortization period driven entirely by the level of savings achieved. This approach requires no up front funds, and can be structured as off balance sheet debt.

Energy efficiency and renewable resource development is good for the environment, good for economic growth, and most importantly, good for energy security. The smart money is on energy efficiency, which is why in New York we call our program New York Energy $martSM.

Madam Chairman, and distinguished Members of the Subcommittee, thank you for the opportunity to testify today. I would be happy to take any questions you may have.

BIOGRAPHY FOR PETER R. SMITH

Peter R. Smith was appointed President of the New York State Energy Research and Development Authority by the NYSERDA Board of Directors on January 26, 2004.

Prior to his appointment, Mr. Smith served for nearly one year as Acting President as well as serving as Vice President for Programs at the Authority since 2000. As Vice President for Programs, he oversaw delivery of the Authority's energy efficiency, energy analysis, economic development, research & development, residential, nuclear waste, and bond financing programs. Mr. Smith joined NYSERDA in 1995 as Program Director for Energy Analysis. He also represented NYSERDA's Chairman on the New York State Board on Electric Generation Siting and Environment.

Peter is responsible for the overall management of the Authority which is a public benefit corporation of the State of New York with assets of more than $330 million. NYSERDA is also the third party administrator of New York's five year $750 million public benefits program which was created as part of the State's move to electric competition. As administrator, NYSERDA operates over 30 programs under the umbrella of New York Energy $martSM.

As President he also serves the State of New York as Chairman of the Energy Planning Board; and as a member of the State Environmental Board, the Water Resources Planning Council, and the Disaster Preparedness Commission. He is the State's liaison officer to the U.S. Nuclear Regulatory Commission and represents New York State on the National Low-Level Radioactive Waste Forum.

Mr. Smith is also active on the national energy scene. He was appointed by the Secretary of the U.S. Department of Energy (U.S. DOE) to the State Energy Advisory Board (STEAB) which provides programmatic and policy guidance to U.S. DOE's Office of Energy Efficiency and Renewable Energy. He also is a member of the Board of the American Council for an Energy-Efficient Economy (ACEEE). Mr. Smith serves on the Board of the National Association of State Energy Officials (NASEO), and is NASEO's representative on the U.S. DOE/U.S. Environmental Protection Agency-sponsored National Council on Competition and the Electric Industry.

Peter has more than 26 years of experience in analyzing and studying energy and environmental issues and problems. He holds a Master's Degree in Public Administration from the Nelson A. Rockefeller School of Public Affairs and Policy, State

University of New York at Albany, and a Bachelor of Arts in History from LeMoyne College in Syracuse, New York.

Chairman BIGGERT. Thank you very much, Mr. Smith.

Mr. Sosland, you may proceed.

STATEMENT OF MR. DANIEL L. SOSLAND, EXECUTIVE DIRECTOR, ENVIRONMENT NORTHEAST

Mr. SOSLAND. Thank you, Madame Chair and Members of the Committee. My name is Dan Sosland. I am the Director of Environment Northeast. As Congressman Larson generously noted, we work at the state level to promote sound energy and climate change policies. I very much appreciate the opportunity to testify today on what I believe is one of the most pressing and critical issues facing the country. And I want to focus on the state of Connecticut and what it is actually doing to capture the benefits that many of the witnesses have testified to today.

In 2000, like many states in the Northeast, Connecticut restructured its electric utility system. At the time, and these issues continue, and they are familiar to us all, Connecticut was grappling with the problems of high energy costs, antiquated power plants, system reliability, and poor air quality issues. In enacting its Electric Restructuring Act, Connecticut chose to take some steps to make the system more efficient and less polluting. It built on a history of energy efficiency programs by creating a new Conservation and Load Management Fund. It also created a new Clean Energy Fund to invest in the technologies of the future. Those two funds combined put Connecticut as the state with the highest per capita spending on conservation and renewables in the country. It took other steps, such as adopting a Renewable Portfolio Standard to promote clean energy in the marketplace.

I find it interesting, though, that—to note that much of the impetus for these policies came from environmental advocates like myself. There were critics of these provisions that suggested these funds were too large, that the money could not be spent well, would be wasted. These were surcharges and taxes. But over the course of the last four years since 2000, the Conservation and Load Management Fund has proven that it is providing substantial benefits to this State. The programs it offers are, in fact, oversubscribed, particularly programs in the business sector, commercial and industrial customers. They are often locked out of programs by April or May of the calendar year, so demands on the fund are actually much larger than what the resources can provide. Skeptics at the time from different walks of life are not among the fund's largest boosters.

As Congressman Larson noted, FERC, the Federal Energy Regulatory Commission, has rated Southwest Connecticut, the portion around Stanford, roughly, up to New Haven, as one of the Nation's top ten congested areas for electricity. Public utility commissioners and regulators in Connecticut and legislators have now recognized that energy efficiency and other steps, like distributed resources and clean energy, are among the best tools at relieving stress on the transmission system and certainly, perhaps—well, not perhaps, but certainly the lowest cost tool to do that.

Individual businesses that participate in the programs extol the value of these efforts to improve productivity at their businesses and, in many cases, retain or expand jobs. The lesson learned in Connecticut is that there is enormous potential for energy efficiency that we know how to capture, and that it is a low-cost way, not only for environmental improvement, but for economic stimulus.

The programs offered are comprehensive. They are designed to provide services for residential, commercial, and industrial customers, as well as government entities. They are developed under a stakeholder board, a conservation board, which combines business, environmental, and consumer interests in developing the policies under which the spending occurs. The programs are administered and delivered by the two distribution utilities in the state. These programs were recently evaluated by an independent consultant and against their peers and ranked, I am very proud to say, first in delivering a bang for the buck.

The programs range from providing incentives for the purchases of efficient products, like lighting and air conditioners, to services and designing new buildings, major renovation, and construction. Special programs are offered for low-income customers. There is a new R&D program that has been very effective, and there are even two building centers, called smart living centers, in the State, one near Hartford, one near New Haven, that people can drive in from the road, and see the products that are—that they can purchase. They have design assistance for architects and builders. These programs are screened through a rigorous cost-effectiveness test that is required by statute. Every dollar spent is required to provide more than a dollar in benefits.

And the programs are specifically designed to overcome the market barriers that—many of which are identified in the hearing charter. These include a lack of information for customers, product or service unavailability, split incentives.

So what are the impacts? Over the last 10 years of efficiency programs in Connecticut, about 800 megawatts of power plant capacity has been avoided. That is about the size of a medium nuclear power plant. Consumers have saved over $1 billion that they would otherwise have paid in energy costs. In the last four years alone, enough energy has been saved to power 1.8 million homes for a year.

More importantly, and I think this is a very important point, the programs reduced the total amount of energy needed to meet the electricity needs of the state. The studies shown by the conservation board show that the growth in demand for electricity has been reduced from 1.7 percent every year to 0.6 percent. And on the margin, what that means is that there is an 80 percent reduction in the need to build new capacity to meet the electricity demands of the state.

On price, there have been studies that have shown that for peak pricing, conservation efforts in New England have reduced the cost of pricing for hot summer days, when demand is greatest, by millions of dollars. The conservation board has undertaken a fairly comprehensive study of the potential for conservation in Connecticut. This report will be released soon, and it concludes that

capturing the maximum cost effective potential will save $1.9 billion over the next 10 years, that is $1.9 billion that would be spent on energy on customer bills that will not be spent, will avoid 900 megawatts, again, another nuclear power plant, and will be done at an average cost of 1.4 cents a kilowatt hour. We can actually level, and in some cases, decrease the growth in demand for electricity. And the impact for economic productivity that that means is enormous.

Connecticut has taken other steps as well. A few days ago, Governor Rowland signed into law a bill that requires—sets minimum energy efficiency standards for eight products to be sold in the state. I also think it is very important that the system operator in New England, for the first time, and we believe the first time for any system operator, has included efficiency as a measure to mitigate the problems, the potential brownouts and blackouts that can occur in the summertime in a congested area like Southwest Connecticut. Efficiency bids of four to 10 megawatts are going to be provided to help meet that emergency situation.

I realize I am out of time, but I would like to mention a few things on renewables. The state is taking very active efforts to promote increased renewable energy. Governor Rowland has followed Governor Pataki's lead, has called for the state to lead by example and purchase 20 percent of electricity from clean sources by 2010, 50 percent by 2020, and 100 percent by 2050, that is following a recommendation from stakeholders involved in the climate process, bipartisan support for that, improving the portfolio standard, offering customers new options to buy green power and efficiency services, supporting the Clean Energy Fund's efforts to invest in fuel cells and other technologies.

There is a great deal that we can do here, a great deal of synergy between federal and state programs. We have some suggestions on that, and I would look forward to providing more information in the future.

Thank you.

[The prepared statement of Mr. Sosland follows:]

PREPARED STATEMENT OF DANIEL L. SOSLAND

Mr. Chairman and Members of the Committee:

My name is Daniel L. Sosland. I am the Executive Director of Environment Northeast (ENE), an environmental advocacy and research organization based in Connecticut and Maine. ENE works at the state level to promote sound energy and climate mitigation policies. Thank you for the opportunity to testify today on the potential for energy efficiency and renewable energy. My testimony will focus on the impact and potential for energy efficiency in Connecticut with some references to the rest of New England and the opportunities for a growing role for clean energy.

Why did Connecticut make a commitment to energy efficiency and renewables?

In 2000, like many states in the Northeast, Connecticut chose to restructure its electric utility system. Connecticut was grappling with a series of issues: high energy costs, antiquated power plants, system reliability and poor air quality. In enacting its Electric Restructuring Act, Connecticut also sought to make its electric system more efficient and less polluting by:

- establishing an $86 million a year fund to provide programs for commercial, industrial and residential customers. This fund built on a 10 year history in the state of developing sound programs that cost-effectively invested rate-

payer funds to make Connecticut homes, businesses and government more efficient.

- creating a new Clean Energy Fund, collecting up to $30 million annually, to invest in bringing new clean energy technologies to the marketplace. The combined funds made Connecticut the state with the highest per capita spending on energy efficiency and renewable energy development.
- including provisions to require purchases of clean energy by electricity suppliers through a Renewable Portfolio Standard.

Much of the impetus for these provisions came from environmental advocates like those of us at Environment Northeast. Critics of these provisions suggested that the energy efficiency funds could not be spent because the opportunities did not exist. They complained about added costs as well.

In fact, as the state Conservation and Load Management Fund (C&LM Fund) has progressed, the programs it supports are oversubscribed. Demands on the funds are huge—as are the benefits. Skeptics from different walks of life now recognize and support this effort—indeed some of the most skeptical entities are now among the fund's biggest boosters. Regulators see the value of these investments for reducing consumer costs and addressing the state's constrained electric system. The environmental benefits are valued as a cost-effective way to help improve the state's poor air quality, which, among other things, is a significant constraint on economic growth. Individual businesses extol the value of the programs to their ability to lower energy costs, improve productivity and in many cases retain or expand jobs. In the recently completed state climate change stakeholder process, energy efficiency and renewable policies received unanimous support from business, state and academic interests. The lesson learned in Connecticut is that there is enormous potential for energy efficiency. Efficiency is a low cost way not only for environmental improvement, but for economic stimulus. It is a tool ready and available to reduce energy costs and help business be more productive. This lesson is now influencing new approaches to pursuing energy efficiency, including, in a nationally significant precedent, the regional system grid operator, ISO–New England.

What are the benefits of energy efficiency and how is it captured in Connecticut?

Energy efficiency reduces the energy used by customer end-use devices and systems, without affecting the level of service and without loss of amenities. It is not turning out the lights. Electric energy savings and peak load reductions are achieved by substituting technically more advanced equipment and processes to produce the same or an improved level of end-use service with less electricity. All programs must meet cost-effectiveness tests so that they produce net savings over time. Connecticut sought to obtain these benefits:

- Reduce load, peak demand & energy use
- Provide direct cost savings to consumers and businesses
- Lower market prices for all consumers by mitigating peak demand costs
- Mitigate market and fuel price volatility
- Reduce security risks and interruptions
- Improve air quality and allow room for economic growth
- Substitute local jobs for fuel purchases
- Mitigate climate change.

Connecticut captures these benefits through several approaches.

Ratepayer Funded Conservation and Load Management Programs

The Conservation and Load Management Fund (C&LM) offers a comprehensive array of programs tailored to residential, commercial, industrial and governmental customers. The programs are designed under the guidance of a stakeholder board, the Energy Conservation Management Board (ECMB), representing business, environmental and consumer interests, and administered by the two distribution utilities—The Connecticut Light and Power Company and The United Illuminating Company.

Programs range from incentives for purchasing efficient products like lighting and air conditioners to assistance in making planned new construction and major renovation projects more energy efficient. Special programs are offered to low income customers. Connecticut has also developed an effective RD&D program with a portion of the funds.

The programs are screened through a rigorous cost-effectiveness test that is required by statute. Every dollar collected is required to provide more than a dollar

in benefits to the electric system. The cost-benefit test compares the benefits of the efficiency measure to the costs. In many cases, the benefit to cost ratios exceed three. New commercial and industrial construction programs produce benefit to cost ratios in the 4–6 range. Connecticut uses two tests: the "electric system test" and the "total resource test." The electric system test compares the present value of future program electric savings to present conservation fund expenditures. The total resource test compares the present value of future electric system and other customer savings (from other fuels or benefits) to the total of the conservation expenditures and customer costs necessary to implement the programs. Programs are regularly evaluated for their quantitative effectiveness.

The programs are designed to address and overcome market barriers for consumers and market participants, such as:

- Lack of information or search costs, hassle and transaction costs, performance uncertainties, market response uncertainties, asymmetric information and opportunism,
- Product or service unavailability, organizational practices or customs,
- Split incentives, inseparability of product features, irreversibility, the failure of market prices to reflect the time-differentiated nature of demand and energy use, and the failure of market prices to reflect the full cost of energy to society
- Significant institutional barriers as well, including developing market rules focused on supply resources or on shorter-term demand response.

Programs seek to leverage their financial resources by focusing on "market timing" events—decision points when consumers enter the market to purchase products or design buildings. When a consumer is ready to purchase a motor, lighting or build an addition, the programs seek to induce the purchase or design of efficient products by paying all or a substantial portion of the incremental cost of the efficiency measures. This approach seeks to avoid the problem of lost opportunities: once a product is purchased, it will remain in use for its lifetime. When a building is built, it will stand for 30 years or more. By capturing the opportunities when they occur, the programs seek to ensure that they are not lost for the useful lives of the equipment or structures.

Types of Measures Installed

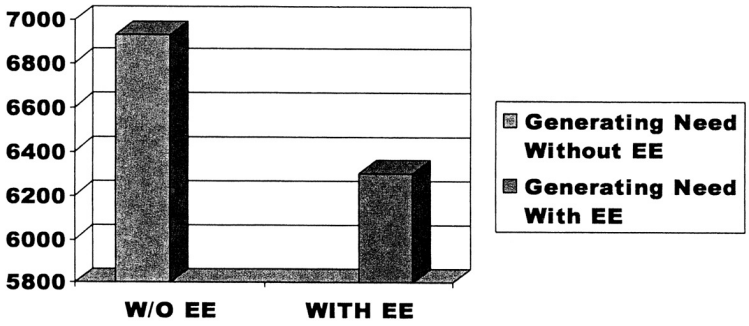
Technologies installed range from lighting and cooling systems, to building envelopes, motors and design changes to plant facilities. For example, in commercial buildings, some of the biggest savings occur from installing lighting systems (lamps, ballasts and controls can save up to 50 percent of lighting load); updating HVAC (heating, ventilation and air conditioning) systems; replacing inefficient office equipment and testing and sealing air ducts. Reductions from 15–50 percent will occur with these changes with payback periods ranging from less than one to five years typically. The cost of the effective measures is less than three cents/kwh.

Two program examples—both have won ACEEE Exemplary Program Awards:

1. Custom Services: Vendors approach fund managers with specific projects in mind and the program offers incentives to cover the incremental cost of upgraded efficiency measures.
2. RD&D: Provides funds for innovative electric efficiency and distributed resources for projects that have not been commercially proven. Funded projects include fuel cell manufacturing technology and residential heat pump clothes dryer. Projects are screened and evaluated by a stakeholder group of industry, environmental and business members. DOE is represented on this board and has contributed towards various projects. Industry shares in cost through co-pay requirements.

What are the Fund's Results?

Since the early 1990s, the investments from the state's conservation programs have avoided the need for another 800 MW of power plant capacity—nearly the size of a major nuclear power plant. Consumers saved $1 billion in avoided energy costs—money better used for other purposes. Over the course of the four years from 2000–2003, enough electricity was saved to power 1.8 million Connecticut homes with electricity for a year.

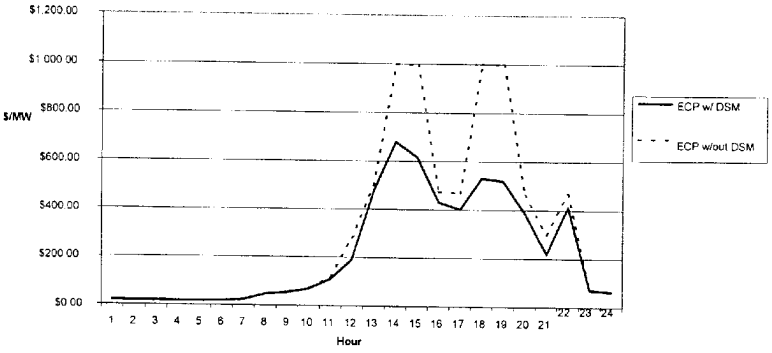


Connecticut Power Plant Capacity Need (Megawatts)
With and Without Energy Efficiency Investments
Source: Environment Northeast

Numerous testimonials exist showing how businesses saved money, increased productivity and in many cases were able to hire more employees.

Importantly, these programs are reducing the total amount of energy needed to meet the demands of the state—a measure of the increase in efficiency and productivity these programs can provide. Studies for the ECMB show that the programs reduce the state's annual growth in capacity demand from 1.7 percent to 0.6 percent—an 80 percent reduction. In a state facing severe congestion in its transmission system, efficiency has become a major tool in managing stress on the wires. And because of the statutory cost-effectiveness requirement, for every $1 spent the fund produces $4 in benefits in the form of lower energy costs to homeowners and businesses.

Another important effect of energy conservation in a deregulated market is that it can have a dramatic effect on peak pricing. The following chart is from a study by the Massachusetts Department of Energy Resources. It shows that 115 MW of energy efficiency load reductions avoided about $6.7 million in additional costs on the spot market on a hot summer day with high peak demand. (06/07/99)



Impact of Efficiency on Market Prices

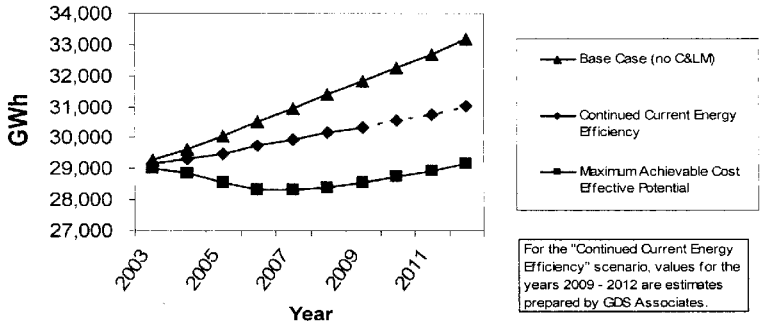
Future Potential

The ECMB has undertaken a study of the cost-effective energy efficiency potential in Connecticut for the future. This report will be released soon. It concludes that capturing the maximum cost-effective potential—not theoretical potential, but what can actually be obtained at low cost with existing technology—will produce the following economic benefits:

- $1.9 billion in savings over 10 years in the form of avoided energy costs
- $2.8 billion in benefits less $900 million in costs (present value)
- 900 MW avoided capacity
- 4,466 GWh avoided energy consumption by 2012: enough energy to power 600,000 homes
- an average cost of 1.4 cents/kwh.

This graph shows projected trends under three scenarios: no conservation, existing programs and capturing the additional cost-effective potential. This chart indicated that Connecticut can actually achieve level growth in demand—a measure of the amount of efficiency that can be obtained in the system.

Figure 1-2 - Connecticut Energy Forecast (GWh): Base Case, Continued Current Energy Efficiency, and Maximum Achievable Cost Effective Potential



Source: Draft Assessment of Energy Efficiency Potential in Connecticut and Southwest Connecticut, Quantum/GDS Associates

Appliance and Equipment Energy Efficiency Standards

Just over a week ago, Gov. Rowland signed legislation to require minimum efficiency standards for eight commonly purchased products in Connecticut which are not covered by federal standards. By 2010, these standards will reduce annual electricity demand in Connecticut by 225 gigawatt-hours, equivalent to the electricity consumption of 37,500 households. These reductions mean that:

- Annual electricity demand in Connecticut will be reduced by 65 megawatts by 2010 and by 126 megawatts by 2020.
- Annual greenhouse gas emissions will be reduced by 66,000 metric tons, which is the equivalent of removing 50,000 cars from the road.
- By 2010, Connecticut consumers and businesses will save $40 million on their electricity bills, savings that grow to $435 million by 2020.

These benefits will increase the overall economic productivity in the state.

ISO New England and Congestion

Southwest Connecticut—Fairfield County, Stamford and Bridgeport—has been identified by FERC as one of the top 10 congested areas in the country. Each summer, ISO–New England, the grid operator, prepares for summer emergency peaks by inviting bids for resources to mitigate the problem. This year for the first time,

and we understand for the first time for any grid operator, ISO added efficiency installations as one of the means to address this need in addition to paying customers to reduce their load or installing emergency generators. Approximately 4–10 MW of efficiency improvements were selected to relieve summer congestion. Unlike the other approaches, efficiency produces no incremental emissions and continues to provide savings beyond the period covered by the auction. We hope that this trend of treating efficiency on a level playing field will continue not only in Connecticut and New England but around the Nation.

Climate Change Solutions: Efficiency as Low Cost Approach

Connecticut has also adopted a bipartisan approach to addressing the challenges of climate change. Through an intensive nine-month process, stakeholders representing more than 30 business, academic, state agency and environmental interests, including Environment Northeast, met to examine ways Connecticut could reduce its emissions of warming gases. In the modeling upon which that process relied for information, energy efficiency measures stood out as the most economic way to meet greenhouse gas targets. Energy efficiency measures not only produce large emissions reductions, but because they make energy consumption more productive, they provide economic stimulus and offer opportunities for services and manufacturing.

Next Step in Efficiency: Pursue All Fuels Approach including Natural Gas, Oil and Electricity

Tremendous potential exists to develop programs that capture efficiencies across fuel types. If an energy efficiency vendor can treat all fuels in a facility at the same time—i.e., reducing heating requirements in a building using oil or gas as the fuel when implementing lighting and other electric efficiency measures—the fuel savings would be large and at lower cost. Environment Northeast has developed information on the benefits of a state program for natural gas and oil efficiency. We estimate programs to invest in natural gas and oil efficiency would produce benefit to cost ratios of approximately 3.0 and 4.0, respectively. Those are indicators of the enormous potential in these areas for lower consumer costs and reduced fuel consumption.

Renewable Energy Potential

Connecticut has also recognized the importance of spurring market development of clean energy sources. The benefits to the state include:

- The need to diversify its fuel sources and avoid over reliance on natural gas—and the corresponding value in reducing exposure to market price volatility
- The need to find effective ways to improve Connecticut's poor air quality
- The opportunity to create jobs from new industries of the future.

The state is pursuing the goal of increasing renewable energy through several mechanisms:

- **State leading by example: Recently, Governor Rowland endorsed a recommendation from a state stakeholder process to purchase 20 percent of the state's electricity from clean energy sources by 2010, 50 percent by 2020 and 100 percent by 2050.** This goal, which has bipartisan support in the state, reflects growing recognition that clean energy sources are needed to improve air quality. But it also recognizes the value in diversifying the state's energy mix. Currently, only one percent of the state's electricity comes from clean sources. Connecticut's dependence on natural gas as a major power plant fuel is growing. In the past, over reliance on oil and nuclear power has left the state vulnerable to price hikes and reliability problems.
- **Renewable Portfolio Standard:** State law requires that sellers of electricity obtain minimum percentages of their power from a defined set of clean energy options.[1] These percentages ratchet up to seven percent of the cleanest sources by 2010 and an additional 10 percent in other renewable sources.

[1] Clean energy sources eligible under the Renewable Portfolio Standard are defined in Conn. Gen. Stat. § 16–1(a) as follows:

(26) "Class I renewable energy source" means (A) energy derived from solar power, wind power, a fuel cell, methane gas from landfills, ocean thermal power, wave or tidal power, low emission advanced renewable energy conversion technologies, a run-of-the-river hydropower facility provided such facility has a generating capacity of not more than five megawatts, does not cause an appreciable change in the river flow, and began operation after the effective date of this sec-

- **Clean Energy Utility Offers:** Connecticut is currently developing the rules for a "green power" option for its utility customers. This will provide consumers an easy check off system to choose clean power and efficiency offers from selected market players. These offers should be in place by the fall.
- **Clean Energy Fund.** The state created the Clean Energy Fund in 2000 to invest in renewable energy companies and technologies. Seen as an industry of the future with employment potential, the CCEF has focused on the state's fuel cell industry as well as investments in other clean power resources.

Federal/State Synergies and Considerations

Current federal efforts have not accorded energy efficiency the primary policy emphasis which it deserves. One example is the development of appliance efficiency standards by the Department of Energy, which appears to be stalled. The only significant action has been an effort to roll back an air conditioning standard approved by the previous administration, which was forestalled by a federal court ruling on a suit instituted by several states, including Connecticut. As a result, states have been compelled to take the lead with respect to products not covered by federal standards, as discussed above. States cannot, however, increase standards for the many products now covered by federal standards, even if technological advances warrant improvement. Obviously, it would be far better for DOE to actively pursue opportunities to develop higher national standards where appropriate and cost-effective. Reasonable standards save energy cost-effectively without the need for devoting State and federal program funds to incentives and marketing activities.

An example of positive federal-state synergy is the relationship of the federally funded industrial productivity centers and CL&P's Prime program. Prime provides productivity audits to achieve greater manufacturing efficiencies through more efficient, streamlined processes and waste minimization. It works closely with ConnSTEP, a manufacturing resource center for Connecticut which is sponsored by the Commerce Department's Manufacturing Extension Partnerships and the State Department of Economic Development. ConnSTEP also works in partnership with the DOE sponsored Industrial Assessment Center at the University of Massachusetts to conduct full facility assessments focusing on conserving energy, reducing pollution, increasing productivity, and reducing costs. The assessments identify energy conservation measures, provide recommendations and estimated costs for implementation, and specify payback periods. ConnSTEP reports that four assessments conducted in Connecticut manufacturing companies during the past year have identified savings of $588,000 in process improvements; 4,153,200 kWh in electrical energy savings; 63,679 MMBtu in natural gas savings and 7.8 million gallons in process water savings. These programs have had considerable success in meeting process productivity and energy efficiency needs in a coordinated manner.

The Energy Star program has also been a valuable ally for state efficiency efforts. EPA has built a credible and well known brand with Energy Star and it has become a powerful force for efficiency. The Northeast Energy Efficiency Partnership has developed regional efforts to promote Energy Star products through advertising, customer incentives, buydowns for manufacturers and distributors and other techniques. The combination of the Energy Star brand and coordinated activity by utility and state conservation programs has produced substantial increases in the purchase of efficient appliances and equipment.

The following are a few suggestions for improving the federal role in promoting energy efficiency.

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tion, or a biomass facility, including, but not limited to, a biomass gasification plant that utilizes land clearing debris, tree stumps or other biomass that regenerates or the use of which will not result in a depletion of resources, provided such biomass is cultivated and harvested in a sustainable manner and the average emission rate for such facility is equal to or less than .075 pounds of nitrogen oxides per million BTU of heat input for the previous calendar quarter, except that energy derived from a biomass facility with a capacity of less than five hundred kilowatts that began construction before July 1, 2003, may be considered a Class I renewable energy source, provided such biomass is cultivated and harvested in a sustainable manner, or (B) any electrical generation, including distributed generation, generated from a Class I renewable energy source.

(27) "Class II renewable energy source" means energy derived from a trash-to-energy facility, a biomass facility that began operation before July 1, 1998, provided the average emission rate for such facility is equal to or less than .2 pounds of nitrogen oxides per million BTU of heat input for the previous calendar quarter, or a run-of-the-river hydropower facility provided such facility has a generating capacity of not more than five megawatts, does not cause an appreciable change in the river flow, and began operation prior to the effective date of this section.

- Allow efficiency delivery services and programs to qualify for federal funding. It is program delivery that produces actual energy savings.
- Work with a wider group of stakeholders in the states to determine DOE priorities. Federal outreach efforts tend to focus on utilities, other large corporations and state agencies. Consider expanding this outreach to consumer, environmental, low-income and community groups for input on their priorities and perspectives.
- Establish stronger requirements for regional grid organizations to include efficiency improvements as an integral part of their planning and investments.

Additional Opportunities for Federally Sponsored Technology Research

There are a broad range of opportunities to improve the efficiency of equipment and structures. The following are a few that have been suggested by experts in the field.

- More research is needed on installation procedures, tune-up methods and outside air access for commercial air conditioning equipment. The opportunities to reduce summer peak loads are enormous, but the problems are difficult.
- Advanced evaporative cooling technologies could be widely used, but require additional development and testing.
- Daylighting controls and office plug load controls are well along in development, but need more monitoring and analysis to be perfected.
- Heat-pump water heaters present an opportunity for very substantial savings, but have yet to be developed to commercial viability.
- Advanced commercial package refrigeration technologies (coolers, ice makers, etc.) also need development support.
- Promote RD&D on technologies that would further market potential. For example, on-site clean distributed generation combined with efficiency would produce projects that could (i) resize energy load requirements at a customer facility and then (ii) install on-site clean generation to meet load requirements.

DISCUSSION

Chairman BIGGERT. Thank you very much.

And now we will turn to questions. Each Member will have five minutes to ask questions. And I will yield the first time to the distinguished Chairman, Mr. Boehlert, for five minutes.

Chairman BOEHLERT. Let the record show that that is the first time she has ever yielded to me.

Thank you very much, Madame Chair.

You all know that we are in difficult times with respect to the budget for a whole variety of reasons far removed from this committee room. If it was up to us, we would up the numbers in just about every single important area of science, and—but it is not up to us exclusively. We have things like Iraq and Homeland Security. And you know, the budget calls for a 10 percent cut in energy efficiency R&D at DOE. We are trying to restore as much of that as we can. What would be the impact of a 10 percent cut, number one? And what do we lose in the process? Sometimes, we are shortsighted. We just talk about, well, do you cut 10 percent this year and—but we fail to recognize that the 10 percent that is cut this year may result in a loss of 20 percent increase in benefits next year, et cetera. So could you quickly, panel members, individually comment on that?

Mr. NADEL. I can add a couple of things. I think a 10 percent cut would mean several programs would have to be canceled, other programs would be stretched out. But as you kind of eluded to, it could also have devastating impacts in terms of staffing. I have

heard from some of the national labs, for example, that if they don't get funds restored, they are going to have to lay off certain staff, and then there won't be the ability to restart those programs in the future. So a lot of this is long-term staff and we are losing a valuable resource in terms of continuing this work.

Chairman BOEHLERT. But if anyone can guesstimate, a 10 percent cut now results in a loss of 20 or 30 percent. If you could quantify it in some way. In other words, I am trying, to the best of my ability, to convince decision-makers outside this committee that it is very shortsighted and shame on us. How about you, Mr. Konove?

Mr. KONOVE. As a builder in my local area, it would also be difficult to, I think, come up with a percentage and a number, although I would agree with what Mr. Nadel was saying. But I think the important thing to consider is how to coordinate the programs that do exist. There might be some efficiencies that you find there. There are HUD programs. There are Department of Energy programs. And from my perspective in the field, there is not necessarily a lot of communication between those happening, and so to try to have some more impact on the local level, having those coordinated whether in a particular U.S. buildings program, as SBIC has proposed, or some other entity would be very helpful with the limited funds that we do have.

Chairman BOEHLERT. Ms. Loftness.

Ms. LOFTNESS. It is a tough question. I guess, working on the basis that the programs that have existed have had multipliers of somewhere between 5,000, 10,000, and 20,000 to one, maybe that gives some impact of what those 10 percent cuts are doing to the multiplying factor of energy efficiency.

Chairman BOEHLERT. That is music to my ears, and this is unfair, because you are just getting the question. Give some thought to it after, and would you mind sharing with the Committee some of your thoughts on it? Because, you know, sometimes you have to spend money to make money, and a modest expenditure, restoring all or part of that cut, I think, would produce handsome dividends for the future. But it is tough to quantify. It is sort of a gut reaction, so whatever you can share with us——

Ms. LOFTNESS. And just one more comment. Almost every energy efficiency strategy you come up with has at least a 10-year, and in many cases, a 50-year life. So we are looking at things that are very long-term consequences for the Nation and its energy use.

Chairman BOEHLERT. Yes. Mr. Carberry.

Mr. CARBERRY. I guess I would follow-up with that. My experience is when you make cuts like that, you destroy momentum, and momentum takes three, four, five, or 10 years to build and cash in, so if you make a cut like that, the probability that it would have a multiplier of 10 to one is pretty serious.

Chairman BOEHLERT. Mr. Smith, any thoughts?

Mr. SMITH. Mr. Boehlert, when we look across the board and we look at, for instance, what I am familiar with, the federal funds that come to the states, particularly the state energy programs, a 10 percent cut, we just did an exercise for the Office of Management and Budget to understand the dollar—how much dollars spent in federal funds, what it leverages out in the states, and it

leverages about eight or nine to one. For every dollar, federal dollar that comes to the states through the state energy program, they can leverage those dollars eight or nine to one. So if you look at a 10 percent cut, and that is about a $50 million program, that is the only one I am really very familiar with, then we are looking at multipliers of that. We are looking at nine or ten times that cut to the states. And I think the states are aware we deliver those programs to the people.

Chairman BOEHLERT. Thank you.

Mr. Sosland.

Mr. SOSLAND. Well, I would just note that—I would just start from the premise that we are not spending enough money on energy efficiency and renewable development. Anyway, I know that——

Chairman BOEHLERT. That is the premise we start from.

Mr. SOSLAND. Right. And, you know, it is frustrating, because we can identify with the data from the states and the different organizations and businesses how much the savings that can occur, the job creation that can occur, and the productivity increases that can occur, those all get lost when there is an inadequate budget, whether it is the spending level that you are trying to restore or, you know, the 10 percent cut only makes it that much worse. We are losing opportunities every day that will last 10, 20, 30 years, and we really can't afford that, given our current energy situation.

Chairman BOEHLERT. Well, I would ask all of you, and thank you for those answers, to give it some thought as you leave this room and if you can do anything that would—skip the verbiage, but as much as possible, a written response, try to quantify the impact of a cut of this magnitude in terms of lost opportunities for benefit in the near-term. You have got to spend money to make money. That is an old adage, and I believe here is an area where we spend the necessary money, we make it back many fold.

So Madame Chair, I really appreciate that. If you have a second round, I want you all to be thinking of this, microgeneration, I would like to discuss that, probably with Ms. Loftness and Mr. Smith.

Chairman BIGGERT. Thank you.

And the Ranking Member from Connecticut, Mr. Larson, is recognized for five minutes.

Mr. LARSON. Thank you very much, Madame Chairman. I also hope we have a second round so I can talk about the hydrogen economy, but I want to follow up on Mr. Boehlert's line of questioning as well. And with a plea on your part, probably some of the most effective lobbying we have seen was from the Union of Concerned Scientists. And inasmuch as some of our major governmental institutions have become paralyzed by their own inertia, I think what it takes to move this Nation is, in fact, people like yourselves who have the expertise, who have the knowledge, and who have the data to come forward and through a unifying effort, demonstrate to the public, as you have in your testimony, the solid foundation and basis on which these are value-added areas whose multiplying effect only benefits us both in the short- and the long-term, and oh, by the way, our cuts only further impair your ability.

Throughout the testimony, you mentioned a couple of things, and if you would just comment on them, again, the starvation that is going on that you talked about, what that does in terms of impeding students and the future of this country in terms of attracting people to these areas of science, engineering, and math and what we see going on by contrast in other countries where we used to be numero uno, how we are losing out while other countries are gaining.

Mr. Smith, if you would follow up on your financing idea that you talked about in terms of the Federal Government. If you would elaborate more on that in—as part of this question as well, I would appreciate that. And collectively, starting with Mr. Sosland, if you would be able to address this issue of what it is, do you think, in renewables that we would need to do to reduce the dependency on foreign supplies by 20 percent—25 percent. What are some of the most immediate things that we could do to achieve those goals?

So if you could answer those for me, I would greatly appreciate it.

Mr. SOSLAND. Well, I think there are programs in place at the state level that are—have a lot of promise and are underfunded. And if we could find a way to support and continue—leverage these investments, as some of us have mentioned, into R&D, fuel cells. I mean, I am a big believer in the hydrogen economy, actually, but I am a believer in doing demonstration projects that prove the market credibility of technologies. And one area that I think has tremendous promise that is totally underfunded is the area of going into businesses and investing in efficiency, doing a demonstration where you downsize the load of the facility whether it is an office building or a manufacturing facility, and then you put on-site generation that is clean, that is maybe not completely accepted in the marketplace yet, but is viable, you meet some of that load with this cleaner on-site technology. And you combine the two, and you show the business community, and you show the world that these can happen. We almost had projects like that underway in Connecticut with, for example, a credit card company that needs reliable power. There was a facility in Connecticut that provides backup services for ATM machines in Connecticut and New York. If that goes down, the dollar cost in insurance is in the millions of dollars per minute. Providing a way to better size the load for that facility, put in microturbines, to put in fuel cells, even though they are expensive now, downsize with the efficiency investments, show what can be done at a working, real facility, I think those are the kinds of projects that I think would provide——

Mr. LARSON. Those are great examples.

Mr. Smith, how about the finance example you were talking about?

Mr. SMITH. Thank you. Thank you, Mr. Larson.

We—in New York, we use what we call our State EnVest program. And we are working with public buildings, because states have to lead by example. Public authorities have to lead by example. So what we find is that there is a lack of a capitol out there for energy service companies to come into state buildings to take the initiative. So what we did was did a master lease arrangement. We did a master financing that makes a pool of money available

to energy service companies to access tax exempt financing, municipal lease financing, and then they are able to go into the state agencies and to the public authorities and to the localities to undertake energy efficiency initiatives in those buildings, in those operations, no cost to the state agency, no cost to the budget, and then it is—and allows them to take those——

Mr. LARSON. How much money from the Federal Government could—would you—would assist that pool? I assume if the Federal Government gave more money, you could expand the——

Mr. SMITH. Right. In New York, we are doing about $125 million. Our first charge of money was $125 million. We have allocated, right now, about $90 million of that for state authorities and some. And what—if we are talking at a federal level, the—recently the super—that authorization lapsed in September, and that would be a mechanism in order to undertake it, and we are probably talking about 10 or 20 times more money to——

Mr. LARSON. So it is something that other states could replicate as well if——

Mr. SMITH. Certainly. Certainly.

Mr. LARSON. Ms. Loftness.

Ms. LOFTNESS. Yes, let me thank you for asking the question about universities. I think the—if there is a 10 percent cut at the Department of Energy, I think that the first thing that would go is any funding that goes out to the universities in an effort to keep the labs vital, which they should absolutely be. It is the last piece in the chain. Having said that, I think there is a tremendous synergy that we are not taking advantage of. The National Science Foundation and the National Institute of Health are the largest funders of university-level research and Ph.D. programs, and they do not have a line in their mandate on either of them that focuses on buildings and building environment and energy issues. And even a line in their mandate would totally transform the opportunity to actually seek funding from the National Science Foundation and the National Institute of Health.

Let me add to that that the issue of homeland security has a lot of synergies with environmental quality. And energy efficiency and homeland security actually do have an alliance that has not, in fact, been spelled out in any of the mandates relative to homeland security, which is beginning to fund university-level efforts and, of course, a number of issues related to the war and star wars are beginning to actually shift focus at university campuses. And somewhere we have to decide what it is we want to export as a Nation, and I would think environmental quality is a wonderful thing to export.

Mr. LARSON. I see my time has run out, but I hope during a second round I will be able to get back to the other panelists and I have another——

Chairman BIGGERT. Thank you very much.

And—when—years ago, and this is a long time ago, my husband and I went to Europe on $5 a day, so you know how long ago it was, that book, "Europe on $5 a Day." But we stayed in these funny little hotels that had a lot of staircases. And at night, when you would come home, you would push a little button, and the lights would light up on the stairway, but you had to make it to

the next landing before the lights went off, and if you didn't, then you were looking all around to find the lights. And to me, I know it seemed like a great idea how energy conscious they were over there. And I always wondered why we never had anything like that. We seem to be, you know, the big spenders on energy. And we have talked about a lot of topics here today, and you made a lot of valuable recommendations on how the Federal Government can improve its efforts on efficiency and maybe find a way to light those—you know, to have something like the lights and renewable energy, but as we have been talking about, this is a very tough budget year, and I think we are not going to be—very unlikely that we can fund a lot of the great ideas that you have given us. So if each of you, and I think that Mr. Sosland has already addressed this question, if you can name the one item that will give the most bang for the buck, as you have said, Mr. Sosland, in other words the most budget efficient, if you will, and I would like you to start—and very briefly, as short as you can.

Mr. Nadel.

Mr. NADEL. Okay. Thank you.

Probably the single area that gives the most bang for the buck is the federal Appliance and Equipment Efficiency Standards program that Ms. Loftness talked about. In that case, we are talking benefit to cost ratio of thousands to one. Relatively modest costs. The programs is scheduled in the budget to take, I think it was a $1 million hit or $2 million hit, that will really restrict the ability to develop new standards. A couple of more million dollars, then we are talking, you know, thousands of megawatts of additional savings. So that is probably the single biggest bang for the buck.

Chairman BIGGERT. Thank you.

Mr. Konove.

Mr. KONOVE. From my perspective with the home building industry, I would look, again, at coordinating programs that you have in process now, but also with the perspective of including industry. People that are associated with home building or construction industries are on the verge of getting involved in a tremendous way through the green building movement that is coming. And they are starting to really get active in terms of their products and their education. But a coordinated effort similar to the manufacturing extension centers where it is working with business and industry to get the word out and to get the training out could be helpful.

Chairman BIGGERT. Thank you.

Ms. Loftness.

Ms. LOFTNESS. This one is really tough to come up with one.

I guess my feeling would be that voluntary standards adopted both at a federal level and in partnership with various states are going to have, and have had, a major impact, so LEED standards or equivalent standards for federal and state level buildings.

Chairman BIGGERT. Thank you.

Mr. Carberry.

Mr. CARBERRY. I guess number one would be working on the programs that take the price and price volatility out of the natural gas supply. The volatility is the largest impediment to investment because of the uncertainty that it drives. And so therefore, looking at those issues, there is an excellent report, the National Petroleum

Council's recent report on this issue, and I recommend that as an opportunity.

Chairman BIGGERT. Thank you.

Mr. Smith.

Mr. SMITH. Okay. I will say I agree with Mr. Nadel that appliance efficiency and building standards and codes are very, very important. One would be to continue the money for the state energy offices. I am blessed in New York to have a lot of public benefit funds. There are many states where the federal funding is crucial for delivering those programs to people that need them. That would—I would underline that continued funding for the state energy program is important for that delivery mechanism.

Chairman BIGGERT. Mr. Sosland, would you like to add anything or——

Mr. SOSLAND. I agree with everyone.

Chairman BIGGERT. Okay.

I think I have time for just one more question, and that is to Mr. Carberry. I was impressed with DuPont's future goal to continue to keep its energy use constant while dramatically increasing production. What would be the impact on natural gas demand if DuPont's energy efficiency and renewable technology investments were replicated throughout the industry?

Mr. CARBERRY. I guess the first thing I might point out is that if you look at the national statistics, industry is the only sector that has managed to keep their energy demand relatively flat for the last 10 years. And of course, that is because, as large industry, you know, they see the dollars in a concentrated form and put engineers, like me, working on the problem. The gains are in the order of a reduction of 30 or 40 percent from the business-as-usual case. I would say that most of our experience is that you can get that first 10 percent fairly quickly and the rest of it gets good and hard, but since 1990, for instance, I would say that our business-as-usual case would put us 40 percent higher than where we are right now. So, you know, assuming that the others that haven't done that could achieve the same gains, those are very, very large gains. And there is no one magic answer, either. It is a little bit like a winning football team. Man, you have got to have them all.

Chairman BIGGERT. So if the impact on natural gas demand, if the Federal Government then made a strong push for the energy efficiency and renewable energy throughout the country, the gains would even——

Mr. CARBERRY. That could be very—that could be even more dramatic, because natural gas is at the margin. It is used heavily by the electrical power industry for variable demand and increasingly for baseload. So if those efficiencies started rolling through the entire economy, and I believe one of the speakers previously already made that point, the leverage would be even greater. And I think we saw that experience in California.

Chairman BIGGERT. Thank you.

Mr. Miller, from North Carolina, is recognized for five minutes.

Mr. MILLER. Thank you, Madame Chair.

Mr. Konove, I had a question about a North Carolina program that I think is relatively recent, the North Carolina Green Energy program. Could you describe that program, how it works, and al-

though I think it is a little early to say how well it is working, how well it appears to be working in the first few months?

Mr. KONOVE. I believe you are talking about the green building program that is getting underway with the North Carolina Solar Center?

Mr. MILLER. No, actually, this——

Mr. KONOVE. Oh, the Green Power program?

Mr. MILLER. Right, the Green Power program.

Mr. KONOVE. Okay. Well, I am purchasing green power myself. The Green Power program is a statewide program in North Carolina, allowing consumers to purchase, through their utility bills, green power for the promotion of the utilities and the state to build renewable energy development. And from my understanding, I mean, it is starting to reach the people. It has really just gotten off of the ground in the last couple of months, but it is a way that consumers are enabled to—or to take power into their own hands to purchase renewable energy systems. And we are starting out with just a limited supply within the state, and we are going to be monitored by a third-party system. And within a year or two, they are going to confirm how much renewable energy generation has been added to the system in North Carolina, and I am looking forward to it improving our capabilities quite a bit.

Mr. MILLER. Thank you.

My second question, not specifically to Mr. Konove, and I think it may come close to duplicating some earlier questions, particularly Mr. Larson's questions earlier, most of the talk about energy conservation and competition has focused on the effective energy cost. But is there also an international market for conservation technologies, alternative energy technologies, and how are we doing in that market? Are we competitive in the international market? And I don't know which one of you is most appropriate to answer that. Mr. Konove, since you are from North Carolina, though, I would love to have your opinion on any topic you would——

Mr. KONOVE. Thank you, Mr. Miller. I will certainly add something. I am sure that most of the other panelists can add as well.

Clearly, there is tremendous potential for energy efficiency and renewable energy in the world. And many of the other countries around the world are actually taking a greater advantage in reaching into this market at a faster rate than we are, I believe. And we are probably missing that capability, and so I think there is clearly a need for more investment in technology and spreading the products that we do have around the world. I think right now, from my perspective in home building, energy efficiency technology and renewable energy technology, on one level, we can use whatever we have now and tremendously increase the benefits of our housing. We can easily get 30 to 50 percent improvement in the housing that we build and can, with a little bit of work, get up to a higher percentage. And that—those technologies could clearly be exported to other countries around the world, but I don't believe we are taking advantage of it as nearly as we could.

Mr. CARBERRY. If I could, I would like to—Mr. Miller, I actually lived and worked in North Carolina for a little while at our Wilmington, North Carolina plant. Would that entitle me to speak on this subject?

Mr. MILLER. Not quite the same entitlement, but still, yes.

Mr. CARBERRY. I think the United States had a dramatic opportunity and a significant lead in some of these technologies, particularly photovoltaics and wind power. Unfortunately, we have been overtaken and passed by, among others, the Germans, particularly the Germans. And one of the main reasons is that the German program is one of steady progress, and the United States program has been, unfortunately, hindered by an on again, off again support. And on again, off again support is very damaging to investment, as well you can imagine, because investment horizons are long and, therefore, if support comes and leaves, the business goes someplace else. And the Germans have passed us in both capacity and technology. And I think that lack of support is a significant issue.

Ms. LOFTNESS. If I could add to that, at this point, when you look at the rapid growth in China and the amount of construction that goes on in China, America is exporting expertise to that environment but not actually exporting as much technology as they could, because our technologies are not competitive, as was eluded to. And it looks as if in a number of arenas, China is going to be the major source of some of the most environmentally innovative, including absorption chillers and a number of different technologies that we will—we are not investing in and they are. So I think it is a major export—missed opportunity, and we need to actually set these targets as industrial innovation targets so that we not only improve the environmental efficiency here in the States, but we also have something that we can export as we start to decline in some of the technological advances.

Chairman BIGGERT. Thank you, Mr. Miller.

The gentleman from Georgia, Mr. Gingrey, is recognized for five minutes.

Mr. GINGREY. Thank you, Madame Chairman.

Going back to the Chairman's question and in talking about her experience in Europe on $5 a day an how she was going up the stairs in one of those pincionnes or whatever they are called, late at night and if you didn't get to the first landing quickly, all of a sudden the lights—in this country if you did that, of course, you probably would run the risk of falling down those stairs and breaking your leg and then there would be a class action lawsuit and all of this other stuff. And I couldn't help but think about this place here, if—you know, God forbid, those of us who sometimes like to work late at night, you come in the building and you get to walk up the escalators, because they turn them off, clearly to save a little energy, and I really experienced that, Madame Chairman, this weekend. I was flying back from Michigan and I got to Atlanta at about one o'clock in the morning. And all of the trams were shut down, and I had the pleasure of walking two miles with three bags on my back to finally get to my car. And I thought, now this is a heck of a way to save energy, but I understand what you say in these many rolling blackouts, if you will, and there are some problems with that, because I almost had a heart attack getting to my car, because of this energy efficiency.

I wanted to ask a question, though, of Mr. Nadel. In your testimony, you gave a fairly broad estimate for the future of natural gas prices. I think you said $4 per cubic thousand up to, possibly, $7

per thousand cubic feet of natural gas. In your opinion, how likely is the extreme case of $7 per thousand cubic feet, and would you—would increased use of energy efficiency and renewable energy technologies, would it reduce the likelihood of very high natural gas prices in the future? And you know, what is the extreme?

Mr. NADEL. Okay. In terms of $7 per thousand cubic feet of natural gas, it is a distinct possibility. I—you know, a 20 percent chance, 30 percent chance, something along those lines. The markets are extremely tight.

To answer your second question, energy efficiency and renewable energy can make a big difference. Our study last year, using the same models as the National Petroleum Council, found that medium levels of efficiency renewables could cut costs by—gas prices by 20 percent. So if it was $7, that is $1.40 off of it. So there are pretty significant impacts.

Mr. GINGREY. Anybody else want to respond to that? I think we have got a little bit more time before my five minutes expire.

Mr. CARBERRY. We have got a divided opinion here, but I believe we have already seen $7, and I believe the futures are already well north of $6 and maybe going even higher than that, so $7 is more a reality next summer than a projection almost, it would seem. So I think we are going to be there. The real issue is probably the—is again probably the volatility. Everything you look at in terms of natural gas prices say that there is a lot of technology that if the natural gas prices are going to be north of, and you can pick any number, $4, $4.50, $5, there are a lot of breakpoints in there, reliably, there would be a lot of investment put on the ground. The problem is, the investment usually runs $2 billion for this or that, and so people have to have a lot of certainty around it. We need stability, and that is probably the most important—volatility is hurting us more than the average price practically.

Ms. LOFTNESS. If I could maybe sort of respond to the first half of your comment, which is that energy efficiency is sort of paralleled with a reduced quality of life or sort of things that sort of compromise the sort of quality of life, I think there are certainly a group of energy efficiency strategies that would, in fact, reduce service, but the large quantity of energy efficient strategies that we are talking about will actually improve the quality of life. I mean, you could take the light fixtures in this room and make this a far more beautiful historic room and cut the energy load here by probably down to 10 percent of what you see with equal light levels. And so there are things that we should and could be doing that will enhance the quality of life, better windows improve thermal comfort for senior citizens and housing. So I think it is important not to think of efficiency as a loss but as, actually, a gain.

Mr. GINGREY. You know, and this comment I made is somewhat tongue and cheek, and I meant to be humorous, but really it is kind of serious because, as the Chairman mentioned, I mean this is years ago when she and her husband were on this trip and back—they were doing things. And in this country, of course, we are so burdened by rules and regulations, that is why on the Floor of the House yesterday the bill of regulatory reform was so important, and then we talk about losing jobs and outsourcing and all of that. We can't compete with some of these other countries in re-

gard to wages. We know that, but they are killing us, because they are not burdened by all of these rules and regulations and things that would really prevent just like she was talking about to be able to do things like that for fear—God forbid, you know, you go out of business because of a product liability lawsuit or whatever just because you are trying to do something that makes sense.

Mr. SMITH. Can I respond to that, the stairwell incident? There is a company in New York that NYSERDA has invested in that has dimmable ballasts, dimmable fluorescent lamps that go in stairwells, and they dim down when there is no one in the stairwell. As soon as someone appears in the stairwell, they come to full light. They are cost effective. We are demonstrating them right now in multi-family housing in New York City. It is a start-up company. And this is the kind of technology we can export to the world and we should look at as opportunities, wherever you are on the climate change thing, it is opportunities like this to export our technology and our know-how to the world. And I think we have answers, and I agree, efficiency isn't freezing in the dark, it is making—it is using all of the energy you want but in the most efficient manner.

Chairman BIGGERT. Thank you.

The gentlewoman from California, Ms. Woolsey, is recognized.

Ms. WOOLSEY. Thank you.

First of all, I would like to thank our Chairwoman and our Ranking Member and the six panelists for a magnificent hearing. This has been great.

And then I want to ask a very broad question that you won't want to answer, but then I do have a question. And my question is how stupid are we? I mean, we are not only not investing in R&D, we are cutting R&D for efficiency and renewables when our very security in this country depends upon being independent of foreign fuel, when our environment depends upon green technologies, not just ours, the world's, when new technology, green technology could actually be the answer to what the economy needs in this country, but we are letting other countries take these technologies that ought to be ours and benefit from them. And I—actually, I have introduced H.R. 1343 called the Renewable Energy and Energy Efficiency Act, which sets a goal for our nation that at least 20 percent of energy produced domestically will be energy efficient by the year 2020, and it calls for new investments in renewable energy and energy efficiency R&D. It establishes competitive grants to help bring new commercial technologies in these areas to market. And in the overall, this bill is an opportunity to help craft responsible energy policy by ensuring our national security through more diverse energy sources. I have eight co-sponsors on it, seven of them are Democrats from this committee.

And so my question to you—I am really frustrated by this, obviously. And I haven't worked this part of the—my bill, so I would have more if I was working it, believe me. But I want to know where the grass roots are. Where are the groups in this country that need to put pressure on Members of Congress to make us do the right thing, because you are all wonderful, but you are one person each. We need lobby efforts from our Districts, from your industries, your groups. We need it. We need it badly, and we need

to be told, "Do the right thing or you are going to get booted out of office." So my question is where are these people?

From you, yes, Mr. Sosland?

Mr. SOSLAND. Well, I appreciate your comments and many of the comments here. It is terrific to work in this field and see the interest from this subcommittee. I don't work in Washington. We work at the state level and state capitals, and there are so many groups. There is so much information. ACEEE, Steven Nadel's group, has a tremendous amount of material and information. The national environmental organizations have it. There are trade associations, energy efficiency service companies. They are all out there, and it—I don't have an answer to you other than to say, you know, maybe you can talk to the foundation community about the grant programs, but we know what the answers are. We have the data from the states. We have it from NYSERDA. We have it from Connecticut. We have it from California, and——

Ms. WOOLSEY. Yeah, I know that. I have it in my own District, believe me.

Mr. SOSLAND. Right. And we need to find a way to get that information to resonate.

Ms. WOOLSEY. Okay.

Mr. SOSLAND. And I think we now—I think that the topics that we are talking about are now answers to problems that are on the radar screen: energy security, energy independence. Framing the question that way may help somewhat. The groups are around. Maybe they need to be more visible, but I think it is——

Ms. WOOLSEY. Well, they do, and that is my question to you, because we all know—I mean, obviously, we know what we should be doing. We are not doing it. And it is going to come from outside pressures.

Ms. Loftness, you——

Ms. LOFTNESS. You are absolutely right to chastise us, in a sense, because——

Ms. WOOLSEY. Well, not you.

Ms. LOFTNESS. Well, no, I mean us in terms of a broader constituency for these goals who have not actually made this—or been able to put the amount of, sort of, lobbying effort and advocacy effort in Washington. Just as an anecdote that might be pertinent to this, what—all of the deans of the engineering schools all across the country come to lobby Congress once a year. And they all fly in from all over, and they all fly on the same airplanes and so, all of the—well, anyway, another story. But I—they come to lobby for the National Science Foundation and the importance of engineering—higher level education and engineering. And I think they have had an impact. And why the environmental universities in all disciplines, be it policy, engineering, science, architecture, why we are not coming to make that same pitch is a weakness on our part and something that we should be addressing.

Ms. WOOLSEY. And you should be bragging as you come about what you are accomplishing.

Mr. KONOVE. I would also encourage all of us, you all, too, to make it personal. I think if you go home to your Districts and on the questionnaires that we—as citizens that we receive from you all periodically were to simply ask the questions or meetings to ask

the questions, you are going to find that no matter which side of the table that people are on or whatever the economic situations, if you ask them about energy efficiency technologies and renewables in language that they can understand and provide them the—do they want this or do they not, you are going to find that an amazing number of people want the capability to make these changes. And——

Ms. WOOLSEY. Well, let——

Mr. KONOVE.—a lot of these people can not come to Washington to make themselves known.

Ms. WOOLSEY. Well, actually, in my—I represent the two counties north of the Golden Gate Bridge north of San Francisco. We have a—I could go on and—I could sit here for five minutes and tell you what is happening in my District. They get it. Hence they elected me.

Mr. NADEL. Okay. I totally agree with you that in this country we are very much fixated on the short-term, be it here in Congress, be it at different companies around the country, and they don't realize that this is a very long-term effort that we need to address. A couple of thoughts, one the fact that energy prices are getting higher or are certainly getting increased attention. If the predictions that these will be sustained prove true, then I think there will be a significantly higher voter interest in these topics. Second, the increasing reliance on oil imports, given all of the concerns about the Middle East, I think that will also gradually increase interest and attention. Our oil imports are only going up, not down. Third, I think a lot of it is going to depend on the unions, the private companies who are increasingly less competitive than they used to be. I know Representative Boehlert was talking about fuel economy. I mean, I am very concerned that the U.S. manufacturers have their heads in the sand, that they are maximizing profits through the next couple of years, but when we have sustained high oil prices, that they don't have the hybrids, they don't have the advanced diesels and that they are going to be at a major competitive disadvantage. Toyota has now passed Ford to be the world's number two car company. My guess is within the next 10 years, they are going to pass GM and become number one. Our companies need to take a longer-term view and innovate in order to stay competitive.

Ms. WOOLSEY. Be smart.

Oh, and just a comment, but on the oil import. Some of the responses around here would be to drill off our coasts, and that, too, is short-term thinking.

Thank you, Madame Chairman.

Chairman BIGGERT. Thank you for your comments. You always tell it like it is, right?

Ms. WOOLSEY. I am known for that.

Chairman BIGGERT. I did have the opportunity to hold a field hearing with Ms. Woolsey in her District, and it was in a building. Now this was about alternative fuels, and it was in a building that was absolutely spectacular.

Ms. WOOLSEY. Right.

Chairman BIGGERT. Solar. Everything that you could think of as far as energy——

Ms. WOOLSEY. Building materials from——

Chairman BIGGERT. The works. In my first question—in response to my first question, all of you listed outreach activities or appliance standards as the most cost-effective ways to improve energy efficiency. In our comprehensive energy bill, we do have a lot of the appliance standards, tax credits, and all of those things, and a lot of this is for the consumer to help with the effort. And it is kind of discouraging that I think, you know, people don't really—a lot of people don't do that, and Mr. Konove talks about his buildings and how if you were building something that you can put in all of these things, particularly in new construction is much more difficult than old construction. Now I happen to live in the tear-down capital of the world right now, and that is Hinsdale, Illinois, so we are getting an awful lot of tear-downs and new buildings, but I don't see a lot of these efficiencies, the use of solar, the kind of roof and everything. How do we get the developers and the builders and the person that wants to build the building to do this? And even with Ms. Loftness, with your—the type of building that you—the commercial building that you are talking about, what can we do as the government? What can you do? And what can we do just in a broad, general education program of people in this country and how important this is to face us right now?

Mr. Smith.

Mr. SMITH. In New York, in our New York Energy Smart program, we decided that we had to raise consumer awareness. And so what we did was we had to spend money in media. And what we got is we got the spokesman, Steve Toms, from "This Old House," was our spokesperson for energy efficiency. So we went on to the television ads. We bought time on radios. And what we found was if we educated consumers and we did a lot of media advertising, I could see a bump in our website, and I could also see that people wanted this—if they understood, because it is complex—we spend more on a cell phone in a year than we spend on energy. And so people had to understand what they could do, so we used media, but then we backed it up with certified contractors, who we would arm them with information. We would arm them with technologies so they could do a very good job at your house, and then we would guarantee those savings. And we would back it up with low-interest financing, and then roll it out across the state. And it came, you know—home performance with Energy Star. We partnered with the DOE and EPA, and we took the Energy Star label. And we pushed the Energy Star label very hard. And so we have a home performance Energy Star, we have assisted homes for working folks, and we give them a greater incentive to do this. But we coupled educating contractors with media, with program details, and by making very comprehensive programs that touch all of the sectors of the economy. It is a tough thing to do. It has taken us three or four years. We are getting some traction now. We are having a lot of responses. $2 per gallon of gasoline helps a lot as well.

Chairman BIGGERT. Yes, Mr. Sosland.

Mr. SOSLAND. I just wanted to make the point that—to underscore, awareness is very important, but once awareness exists, there then has to be a method of implementing the request. If a

consumer is educated, they are requesting a building design, and the architect needs to be able to respond. The builder needs to be able to respond. They need to know how to—because too often, and the data shows this, the reaction is you don't really want to do that. It is too expensive. So the premise of a lot of these programs that work is you combine awareness—whether it is through an audit program or an advertising program—with the tools to then implement it, an incentive program that provides the building and architectural services, and educates the architects. Those kind of very nuts and bolts activities are what are required, really, to move it and make it a—make the request something that is real. And I think that the place to look is those mechanisms.

Chairman BIGGERT. Ms. Loftness.

Ms. LOFTNESS. I would like to add one more dimension to creating the consumer demand. I think the link between health and energy has not been clearly drawn, and I think there is a real need for that level of research. It does take—it is typically multi-year research. It is typically the kind of research that NIH and NIEH do extremely well. I think once you realize how critically linked these are, including things such as air quality, as well as daylight in buildings, you will start to see a push from the health side, especially relative to the kids in schools.

Chairman BIGGERT. Mr. Carberry.

Mr. CARBERRY. Well, I don't claim to be an expert in this area, but based on the students that I have worked with, it seems to me we never seem to work on this problem until we work with college students, and that is too late. And in the discussions that I have had with high school level science teachers, the level of science and economics taught at the high school and maybe even at the grade school level is fairly inadequate compared to what the needs of our society are. And I really think that part of our reason for our grass roots problem there is that we have let that get watered down, for whatever reason, and so it is very hard to then teach to an emerging adult population that doesn't have the background. We ought to work on that problem.

Chairman BIGGERT. I would agree, and I also have a bill on financial literacy, and I know that—and have been working on research and development and trying to—and Mr.—Dr. Ehlers will probably talk about that. That is his project, too. But also just trying to find more young people to go into the sciences. And I think every time I go out to a school and talk to the students and tell them how important this is, and particularly, you know, half of the population that seems to think by seventh and eighth grade that they shouldn't be an engineer or they shouldn't be a scientist, so——

Mr. Nadel.

Mr. NADEL. Okay. I wanted to add that one very important vehicle for reaching the consumers in business is to move one step up in the supply chain. It is working with the builders, it is the architects, it is the engineers who in turn would work with these customers. But there is a lot of need for research on how best to identify the benefits so that these people can then sell efficiency or renewable energy to their customers. There is a need for improved training techniques to train the builders, train the architects on

these advanced techniques, because they are the ones who are working with all of these customers, so I see that as a very critical federal need to help develop those materials that could be used to educate these key audiences.

Chairman BIGGERT. So there should not be a shift in research and development? That still is a very important factor in all of this?

Mr. NADEL. Right, but some of that research and development is research on what are the benefits and how best to sell them——

Chairman BIGGERT. Okay.

Mr. NADEL.—how—the software, et cetera, so that they can move into the field.

Chairman BIGGERT. Okay. And then Mr. Konove, since you have done the building, is there still a huge discrepancy in the cost? If we have—from, like, the energy bill, if it ever passes, with the tax incentives for a lot of these things, is there still some—we need to do that in order to convince the consumer, or are the consumers going to wake up and say, you know, "This is really important to—for the world," really, and our air quality, our water quality, everything that we take advantage of this research and build this type of house. Or will they say, "No, I can't do it, because it is too expensive."

Mr. KONOVE. I think it is clearly what everybody else has said. It needs to be the communication and the education of everyone so that they can understand what the situation is.

Chairman BIGGERT. I was just wondering if you have run into that with people in North Carolina.

Mr. KONOVE. Well, what I was going to add was if you communicate and educate then people can understand and make those judgments of what is affordable with themselves, because it is so different with—because there are so many different situations in terms of the costs or the technologies that are involved. But I would add that the education that needs to be done on the—whether it be media level that—or a statewide level is that the people that are trained to be able to help or to be the resource people, in a large state, it needs to be more than just a statewide, even media effort, because even in North Carolina, which is not as large as some of the Midwestern states, you go to the east and you go to the west, and if the media or the resource person is centrally located, the other people still are not reached, and so that is another component that needs to be clearly taken into account.

Chairman BIGGERT. Thank you.

Quickly, Mr. Carberry.

Mr. CARBERRY. I just realized, you know, there may be an opportunity here in the suppliers of energy efficient equipment. One of the things that struck me is when I was in California you could buy a highly efficient, long-life light bulb in practically any drug store at a reasonable price. In the state of Delaware, you could search high and low and not be able to buy that same darn bulb, and it drives me crazy. All right. Why? All right. Because there has clearly got to be a market for those. I don't know how to research that, but something ought to be done about it. I had the same experience when I tried to replace my air conditioner. My 20-year supplier of air conditioners told me he didn't have any air conditioners

because he didn't have any cheap, residential air conditions. And in the end, he could have sold me, and did, a much better air conditioner, a highly efficient air conditioner, and if he had done the return on investment calculation or somebody had helped him, he would have realized the darn thing was worth, like, 15 or 18 percent on your money, and that is not a bad investment.

So there is an opportunity here for training, I guess, suppliers, key suppliers in key areas. I am not sure exactly how to get at it and certainly not in two minutes, so——

Chairman BIGGERT. Thank you. Thank you very much.

Mr. Larson.

Mr. LARSON. That is where I am going to start with my line of questioning, because I think that this is something for Lou Dobbs to go along with outsourcing that he ought to focus on. But it does get to cut to the chase with respect to the problem, which is investment in research and development, which all of you have eloquently addressed. How do we overcome the hurdle, however, when we are wed to a system, and we will start with Mr. Carberry, where, you know, your corporation is geared towards its performance based on quarterly returns, not on long-term investment and planning, and this is systemic? Now that brings value added to our economy, and it is something, you know, we don't want to—we are not looking to mess that up, but I think that that points out, in dramatic fashion, all of the more need for research and development on the part of the government for the government to step forward. It also coincides with something that individuals like to receive, which is a tax break. I have never met an individual in society that doesn't like a tax break. And so when you look at research and development and it comes square up against investment return on the stocks that you have invested in or getting a tax cut back from your government, the public seems all too willing, again, I believe because of the lack of understanding of the value added, that these investments would bring. Would you comment on that, starting with Mr. Carberry, and then I will go quickly to my next question?

Mr. CARBERRY. Okay. The—yes, the investment barrier is a serious one. Probably the most serious one we face right now is cogeneration. It is one of the most efficient energy generation forms, but that gets you to natural gas, combined cycle cogeneration, and the high price and high variability of the cost of natural gas is discouraging that kind of investment right now. So there is again a case where investment is damaged by a volatile price situation.

Mr. LARSON. So let me ask you, as a follow-up, let us say, for example, that the Federal Government were to project out and say as we look out and we see that with respect to future building use, but specifically in the area of federal, municipal, and state buildings, i.e., school buildings we will take for an example, where we both have to look at buildings that will be energy efficient and cost effective into the future, and then look at the mode of transportation, whether it be by bus or fleets of automobiles that every municipality, every state, and every federal agency has to purchase, should the Federal Government step forward and say, "We are mandating that by X year that we have hybrids to get us back and forth to work, that our buildings meet the standards and the scru-

tiny and we are providing the research and development dollars to achieve those goals and the money is funded to states and municipalities so that they can invest to achieve those goals, but here is the goal." If we don't have a benchmark, we are never going to get there. We are just going to end up chasing our tail. How would all of you respond to that?

Mr. CARBERRY. Rational building and transportation stand rational, gradual, certain, orderly——

Mr. LARSON. What is gradual?

Mr. CARBERRY. I don't know. You know, you would have to take each one and work on it——

Mr. LARSON. Okay.

Mr. CARBERRY.—obviously, but you know, you can't go for 20 percent next year and then stop. But those kind of standards in transportation and housing and all—and appliances, all of those kinds of standards, national standards, are a very, very strong driver.

Mr. LARSON. Ms. Loftness.

Ms. LOFTNESS. Yeah, I would like to add to that. I think when you look at individual appliances, standards are absolutely the way to go, because you can—and at least labeling standards, which help the consumer understand the difference between two things that are sitting side by side. And I—it helps to drive very, very quickly higher performance technologies. Tax breaks also to industry as well as consumers is a major driver, and in fact, the reason that I think we are seeing wind power and PB power take off in Europe far faster than here is because of long-term commitments in terms of both purchasing those power sources in the federal—in the public sector as well as in providing tax breaks.

I do think that it is important not necessarily to try to mandate in a building sector a single technology, because there is such a wide range of issues, I mean, even transportation choices that exist in school systems around this country, and one of the reasons why some of the building standards are allowing you to look at a portfolio of choices. And when you hit a LEED silver, you are simply committing to a certain level of investments across an ensuite of environmental and energy efficiency——

Mr. LARSON. So you would recommend a portfolio for states that they could choose from?

Ms. LOFTNESS. That they can choose from, so that they can customize it to the age of the building, the location, and—but we are all making progress together against a set of goals.

Mr. LARSON. Mr. Nadel.

Mr. NADEL. Yes. I would say the emphasis should be on how do we encourage the states and the utilities to offer programs at the more state and regional levels. They are the ones who understand the local markets that can work with the local media, et cetera. It is very hard to do that from the federal level. I know we have done a bunch of work on the federal tax incentives, and we certainly support them, but they are a relatively blunt instrument, because you have to—well, relatively simply for the Department of Treasury and the IRS to work with it, you sometimes lose some of the nuances that are needed. So I would tend to try to encourage things that a program that Texas adopted under then Governor Bush where, as part of the utility restructuring, they mandated

that all of the utilities operate energy efficiency programs to reduce load growth by at least 10 percent. There is a lot of flexibility for the utilities to modify that to suit their local needs. They just have a goal they need to meet. I know Senator Jefferds has introduced a bill at the national level to set up a similar type of program. Likewise, there have been proposals for some of the federal matching funding for states programs. You have heard from Pete Smith about the New York program, from Dan Sosland about the Connecticut program. Could there be some type of federal carrot to encourage states to match those funds and run these types of programs at the more local level?

Mr. LARSON. Mr. Sosland.

Mr. SOSLAND. Well, I—you know, there are various success stories to build future policy off of. The wind production tax credit has been very important for the wind industry. And it was—it looked like it might not go forward, they were quite upset. So tax incentives work. I think of a paper company that I had worked with on its efficiency. And we identify tremendous potential in linking pumps, old pumps, motors, just, you know, all of the hardware. Internally, they had a return investment commitment and a mandate from their corporate headquarters. So their efficiency investments competed against any other investment they would make in the facility. So they were looking at paper improvement and not doing efficiency. But if you understand how the business has to operate and there were a tax credit specifically to improve the efficiency in the facility, something like that might work.

Another example, though, is—relates to what we are talking about, commercial clothes washers, efficient clothes washers. The market penetration of those has increased where there have been utility programs designed to promote those and overcome market barriers. This idea of overcoming market barriers at the state level is very, very critical to market penetration of efficient technologies and products.

Mr. LARSON. That is why we need your fund, right, Mr. Smith?

Mr. SMITH. Yes, sir. I think from the New York perspective, I am a large state, and we spend a lot of money in public benefit funds, and we invest about $50 million a year in R&D for energy and environmental products around New York State. One example in what Mr. Carberry talked about is a combined heat and power applications. We have done about 115 projects across New York State using combined heat and power generation. A very good example that is in my testimony is Hudson Valley Community College whereby we are using landfill gas to take the college off of the electricity grid to run it through some engines, and it—so the college is totally energy independent now. We have done a very extensive energy efficiency program at the college. They use the leftover heat in the summertime to run air conditioning. They use the leftover heat in the wintertime to heat the buildings. It is cost-effective. It will help them get a handle on their energy costs so that they don't have to raise tuition for those kids coming to community colleges. It is making smart investments, and it is looking at the opportunities for those investments.

Mr. LARSON. And I did, again, want to acknowledge that you are from North Carolina and extend my condolences for the University

of Connecticut's drubbing of Duke and just pass that on. Unfortunately, Mr. Miller isn't here to hear that, but——

Chairman BIGGERT. But he will.

Mr. KONOVE. And my hearing is a little deficit now, too.

But no, what I would suggest is whether—you know, similar to the LEED program that has really encouraged institutional buildings and government buildings around the country to really improve their capabilities, something like that could essentially happen with any product that uses energy, whether it is pumps or lights or controls or gears. If there are incentives within those industries or awards or some type of program to be recognized for having the most efficient line of lights or the most efficient line of pumps, it may not cost much money to do that, but it could provide marketing capabilities for those industries to say we have this line of efficient devices. And that could be anything across our country. But that kind of an effort is not occurring at this point in time, that I am aware of.

Chairman BIGGERT. Thank you.

The gentleman from Michigan, Dr. Ehlers, is recognized.

Mr. EHLERS. Thank you, Madame Chair.

I am sorry that I missed part of it. This is one of my favorite topics, but I have three Committee meetings going on simultaneously. But I find it just fascinating listening to the discussion since I have gotten back, because I have been in this discussion so many times. And it is a national puzzle. But I think there are some answers. First of all, people do not understand energy. The average person, in fact, including some very sharp businessmen, does not understand energy. This led, in the '70s, when people first began to be really concerned about energy consumption, led to a bunch of scheisters getting out there, ripping off the public, and reinforcing the public's concern that there is really no good solution.

The—but there is also an attitude, even among hardheaded business folks, that somehow even though efficiency is the hallmark of success of a company or a corporation, we want to be more efficient, because it means greater productivity, et cetera. But yet when it applies to energy, energy efficiency is somehow linked to the idea of longhaired, fuzzy-headed, knee-jerk liberals and therefore can't be any good. And so they tend to overlook some really good opportunities to conserve energy in their operations, because they just discard—out of hand. And I think it is again because of a lack of understanding energy. And I—as a physicist, it seems to me the crucial factor is they—it is because they can't see energy. There is a physical quantity, but you can not see it. You can't feel it. You can't measure it easily. And the only real measure is the price at the gas pump or the utility bill at the end of the month.

I have given a number of speeches and written some articles entitled, "I Wish Energy Were Purple," and I just project what people's behavior would be if they could see energy, if, in fact, it were purple and they were driving down the road in their Toyota Prius, and as it came by there was just a little bit of purple around it, and then an SUV came by in such a cloud of purple you could hardly make it out. People would quickly change their behavior. Or if they drove home and saw purple oozing out of the house around the windows, they would change their behavior. But it is not there,

and that has—we have to communicate to the public in some meaningful way what energy is and how you can detect it and how you can measure it.

That leads me to a question about the Department of Energy. First of all, I think they should have a much bigger role in this. They should recognize the problem and more resources. Someone mentioned during their testimony the agriculture extension services, and I happen to think that that is one of the greatest things that we have. When I was in the state legislature in Michigan, Michigan State University, land grant university, they would develop something in the labs one year and farmers had it in the field the next day. In your field of energies, when I was at Berkeley, we had a great building energy facility, still there, and I have traced it since I left there. It takes roughly 20 years from the time they discover something until carpenters are actually using it in the field. That is incredible. And if you ask why, the Federal Government spends $440 million per year on agricultural extension service. I doubt if they spend $1 million on energy extension service. And so we have got a lot of work to do there, especially in DOE.

Something else, this is leading to a question. I am almost finished with my sermon. The question is on the energy modeling, I think, Mr. Nadel, you mentioned some concern about the energy modeling that the Department of Energy uses. I have heard other criticisms of it. And by that, I assume you mean the economic energy model. And I am interested in comments from others, particularly Mr. Smith, because you have had to deal with this issue in New York. Are the energy models used by DOE useful to you or not useful? Have you developed any of your own within your organization that you find more useful? And I am not really trying to put you on the spot here, but I think this is a major problem that we should look at.

Mr. SMITH. Well, I will take the first shot at this. We do use the Energy Information Administration's model, but we customize them for New York State, because they are too coarse for our use, and they are also—they don't reflect what goes on within the state. So we do use those models, but we customize them for New York State. We also use our own modeling systems. We also design our own modeling system, because we find that we want—you know, a model only gives you a roadmap and what we want to see is more of the hills and the valleys and the nuances. So we have very extensive econometric models that look at specifically the factors and influence New York State's economy that influence on New York State's energy systems and the interplay between those systems. So on a very high level, DOE's models are useful in that I customize them and do other greater modeling capabilities in the State to reflect what I need, to reflect what the Governor needs and his folks.

Mr. EHLERS. Mr. Carberry, let me ask you about one aspect of this. Energy modeling is complex, I will be the first to admit it, but I think too many aspects are left out. Just as an example, I have often believed that—or often made the statement that natural gas is too good to burn, an incredibly good petrochemical feedstock, and I think we should not be burning it to produce electricity when we have very good alternative means for doing that. I am interested

in your perspective as—coming from a corporation that makes extensive use of natural gas as a petrochemical feedstock, at least I assume they do. I don't think that that is entered into the models at all, that value. If we burn up all of the natural gas or we have to import LNG at great costs, what impact does that have on the economy? What impact does that have on your country? And should that be factored into the energy models?

Mr. CARBERRY. Well, it is—it has an enormous impact on the economy, and in fact, probably the best example to offer of that is that most of the high value—the high volume, low value petrochemicals have been eroded from this country and gone to places like Saudi Arabia, for instance, methanol, which is a basic building block because of their low price for natural gas as a feedstock. So yes, the damage of burning natural gas as a fuel spilling over into the damage as a feedstock, it is an enormously important feedstock to us, and that damage is very significant. There are numerous examples of it causing U.S. production capacity to move off shore to places where natural gas is cheaper as a feedstock. So anything that we do that reduces the demand for natural gas helps our industry that is based on—our chemical industry that is based on natural gas. And much of the U.S. chemical industry is more based on natural gas than the European chemical industry, which is a little more petroleum based. So it is a very cogent observation, Mr. Ehlers.

Mr. EHLERS. Well, basically, our energy modeling or energy policy is resulting in more jobs going abroad in this particular field?

Mr. CARBERRY. To the extent that it drives up the price of natural gas, yes.

Mr. EHLERS. Right. Okay.

Any other comments from any of you on this issue?

Mr. KONOVE. Yes. In terms of energy modeling for homes and small buildings, there is some software available to us today, one of which is Energy-10, but you know, it still needs more work, and we need, as builders and designers, something that we can use that is work—that works fast and is accurate so that we can verify what the designs that we are working with, how they will perform. We need to verify how the—how they are working prior to doing the actual construction. And I understand that the Energy-10 program also was about to—you know, it is jumps and starts, in terms of financing, was about to start to include a photovoltaic portion, and so there are some things in our area that we could use more work on but have been very helpful, and they are very easy to use in terms of providing initial analysis at the beginning of the design and then further on helping to refine the design as we go on.

Mr. EHLERS. Ms. Loftness.

Ms. LOFTNESS. Yes, if I could add to that, in terms of simulation tools, I mean, certainly the investment that the Federal Government has put in simulation tools has been well spent. There are innumerable number of projects and certainly academic programs that are based upon the use of Energy-10 and DOE–2 and other software that is critical to our understanding of energy flows. Having said that, there are weaknesses in those tools, and the hardest ones are really the passive technologies, really simulating the impact of daylight, really understanding the impact of natural ven-

tilation as a conditioning system, understanding the importance of time lag or heavy masonry in dry climates, desert climates, where we are building with abundance but typically with very lightweight buildings that don't take advantage of the day-night temperature swing. So a lot of those performance simulation characteristics are much harder to simulate because they are dynamic. They can't be done with a static calculation, and so there are tools there that are—that really would be extremely beneficial, especially as decisions are being made in new construction and those environments.

Mr. EHLERS. Mr. Nadel.

Mr. NADEL. I would agree that there are many useful modeling tools coming out of DOE. The DOE–2 model, for example, is one of the six technologies that the National Research Council focused on and so that is producing billions of dollars worth of benefits. But in terms of the overall modeling of the entire U.S. economy, what they call the National Energy Modeling System, that definitely needs some work. We find that when we try to do efficiency and renewable energy, it just doesn't have the handles, if you will, to manipulate. We often have to do spreadsheet analyses separate from that, and then in order to develop one or two key inputs that they have. So it is very difficult to do efficiency and renewable energy policies.

Also, they tend to be very static. This committee works on R&D and new technologies. The models tend to emphasize existing technologies, existing relationships, and don't assume that the world continues to innovate. We need much more dynamic modeling to really be able to take the long-term view and best model appropriate programs and policies.

Mr. EHLERS. All right. Just let me finish with one quick comment. I still remember a friend of mine who went to visit a building development in Colorado, in Denver, because the builder had advertised "energy efficient buildings". And in fact, he had tried to make them energy efficient. But he noticed that the builder had put Styrofoam insulation on the outside of the concrete foundation up to ground level, but not above it. My friend asked him, and he said, "Well, you don't need it there. You know. It is—you just need it below ground," which is exactly the opposite. Simply not understanding energy flow and insulation.

I apologize for taking so much time, Madame Chair.

Chairman BIGGERT. Thank you very much, Mr. Ehlers.

Well, this concludes our hearing, so without objection, all written testimony will be included in the record or entered into the record. And Members may submit additional questions in writing. I hope that the panel will answer these questions in writing.

And with that, I would like to thank the panel for your excellent testimony, your expertise in this subject. And it has been an outstanding panel, so again, thank you very much, all of you.

And with that, the Science Subcommittee on Energy is adjourned.

[Whereupon, at 12:12 p.m., the Subcommittee was adjourned.]