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S. HRG. 110–1142

ENERGY EFFICIENCY TECHNOLOGIES AND PROGRAMS

HEARING

BEFORE THE

SUBCOMMITTEE ON SCIENCE, TECHNOLOGY, AND INNOVATION

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

ONE HUNDRED TENTH CONGRESS

FIRST SESSION

JUNE 21, 2007

Printed for the use of the Committee on Commerce, Science, and Transportation

U.S. GOVERNMENT PRINTING OFFICE

74–985 PDF WASHINGTON : 2012

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ONE HUNDRED TENTH CONGRESS

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ENERGY EFFICIENCY TECHNOLOGIES AND PROGRAMS

THURSDAY, JUNE 21, 2007

U.S. SENATE,
SUBCOMMITTEE ON SCIENCE, TECHNOLOGY, AND INNOVATION,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Subcommittee met, pursuant to notice, at 2:34 p.m. in room SR–253, Russell Senate Office Building, Hon. John F. Kerry, Chairman of the Subcommittee, presiding.

OPENING STATEMENT OF HON. JOHN F. KERRY, U.S. SENATOR FROM MASSACHUSETTS

Senator KERRY. This hearing will come to order. Thank you all very much for being here.

I apologize for being a moment late. We're obviously in the middle of a critical debate on energy, and I've been busy trying to work on CAFE, so I apologize, we're running a little behind.

This hearing of the Subcommittee is on the issue of energy efficiency. As most people who have been focused on the issue of global climate change understand, there are three very significant ways that you have an opportunity to be able to deal with it rapidly, to the best of our knowledge. One is through clean coal technology, finding a way to burn coal cleanly, carbon-neutrally, either capture or sequester or some other technology that may or may not appear. The second is alternative and renewable fuels, which we're busy debating on the floor of the Senate and otherwise. We're moving in various ways towards various ethanols, increasingly cellulosic. But also the potential of other alternative sources, as well as renewable, that may or may not make up a big difference. And the final fastest, cheapest, most efficient, biggest, and most immediate grab is energy efficiency. It's staring us in the face.

We waste stunning amounts of our produced energy. We lose it through the inefficiency of appliances, through the inefficiency of autos, through the inefficiency of products, through the problems with some; heating systems, *i.e.,* leaks under the ground, and other kinds of systems, such as escalators that never stop running, lights that never go off. It's just unbelievable how much energy there is to be saved and grabbed, and what a significant contribution to global climate change doing so would be.

That's what we're here to talk about today. Today's focus is energy efficiency. And it's amazing how many businesses are suddenly beginning to see that light bulb come on as they start to take

advantage of it and improve their bottom line. Lots of companies are redesigning their buildings using environmentally friendly products. The result is that, if you look at something like Texas Instruments, in Dallas, they had a profound sea change in what they were able to do, or not do, because they were thinking of moving to China. By redesigning their building, creating a design that was smaller, lower, not as high, with pipes that are straight, not bent everywhere, so that it takes less energy to move the fluid through them, and by putting in various climate control and other kinds of products, they've been saving a net of something like $3 million a year. And were able to keep the jobs in Dallas, not go to China, and continue to contribute to the base of that economy.

There are countless stories like that. My wife was very involved in the development of a green building in Pittsburgh. She built the first office space that was green, and subsequently, the contractor who built it, who had never heard of green building, has become a completely green contractor, and has now funded a chair—I think it's at the University of Pittsburgh or Carnegie Mellon—for green building and they're teaching green building. Pittsburgh became the top green city in America, replaced by Portland, Oregon, when they grabbed onto green building, other places are also going green. They now have a convention center in Pittsburgh, it's an entirely self-contained building. Green. The only green convention center in the United States.

These are all the possibilities, folks. China is about to build, literally, several hundred million green housing units. They're looking at ways to do that, and they're turning to other places for the technology to do it. There's a huge market here. This is opportunity staring us in the face, and that's what we want to talk about today.

I'm delighted to have Mr. Charles Zimmerman, the Vice President of Prototype and New Format Development for Wal-Mart Stores, Inc.; Ms. Kateri Callahan—I've got to put these on, I guess, for this stuff—the President of the Alliance to Save Energy; Mr. Tom Hicks, the Vice President of LEED® of the U.S. Green Building Council; Dr. Martha Krebs, the Deputy Director of the Research and Development of the California Energy Commission; Mr. Jay Birnbaum, Senior Vice President and General Counsel for the CURRENT Group; and Mr. Douglas Johnson, the Senior Director of Technology, Policy, and International Affairs, for the Consumer Electronics Association.

Welcome, all of you, and thank you very much for being here.

Let me turn to Senator Klobuchar for her comments.

STATEMENT OF HON. AMY KLOBUCHAR, U.S. SENATOR FROM MINNESOTA

Senator KLOBUCHAR. Well, thank you, Mr. Chairman. Thank you for holding this very timely hearing. In fact, I'm going to have to leave early to go preside over the Senate, where we're continuing to debate the energy bill.

Thank you for being here on this important topic. I've certainly seen more and more interest, in our state. From tiny little towns with city councils who have decided to change out all their light bulbs, to major governments in Minneapolis and our counties that are trying to do everything to make their buildings more green.

I think one of the things that's changed in the last year is that people are starting to understand this isn't just about environmentalism, but it's also about saving money. I hope that's one of the things that you talk about as you go through your testimony. I want to thank you for that, and tell you that's where my heart is. Set the standards high, because I believe when you set those standards high, which we really haven't been doing in the last 10 years in Washington, the investment will follow, the behavior will change, and we will be much better off.

Thank you very much.

Senator KERRY. Thank you, Senator Klobuchar. And thanks for your leadership and involvement on these issues; much appreciated.

Let's begin and roll down. Let me just warn everybody, we do have a "Chair turns into pumpkin" problem at about 10 of 4, because I've got to go down to the State Department and meet with the Secretary. I think we can get everything in here and have a lot of questions and a good dialogue in that period of time.

So, Ms. Callahan, if you want to start, and we'll go from there.

STATEMENT OF KATERI CALLAHAN, PRESIDENT, ALLIANCE TO SAVE ENERGY

Ms. CALLAHAN. First, let me thank you, Mr. Chairman, for allowing me to appear today.

I'm Kateri Callahan. I serve as the President of the Alliance to Save Energy. And I'd like to start by thanking you for all of your many years of leadership on environmental issues, and particularly on energy efficiency.

We believe, as the Alliance to Save Energy, that we have proof that what you said is very true, that energy efficiency is the cheapest, the quickest, and the cleanest way to tackle what we see as the linked problems of our growing energy demand: rising prices and global warming. And we believe we have the proof of that.

We've done studies that show that, over the past 30 years, energy efficiency improvements and technologies and public policies have contributed and combined to displacing the need for about 43 quads of energy. That's about 40 percent of today's energy use. And what that means is that energy efficiency is actually contributing more to meeting today's demand for energy than any other single resource, including petroleum. Notwithstanding that current contribution, and what's, I think, so important and beautiful, if you will, about energy efficiency, is that there is still more, and—that can be done, and significantly more as we try to meet the exploding growth in energy in a sustainable fashion.

The McKinsey Global Institute just did a study that showed that, through cost-effective, energy efficiency measures, we can reduce energy use in our homes by about 36 percent, and almost 20 percent in our commercial buildings. And that's very important, because, as you most likely know, the buildings in the United States contribute about 40 percent of our CO_2 loadings, and that's a figure that's equivalent to India and Japan, the two countries combined, their contribution of CO_2. So, tackling energy use in buildings is important.

My testimony details a number of efficiency programs and polices that we represent. They—we try to look at it, in terms of sectoral impact—buildings, transportation—and then the utility sector are the ones covered in the testimony that's submitted for the record.

Senator KERRY. Let me just say that everybody's testimony will be put in the record, in full. So, if you can each summarize, then that way that'll give us more time to——

Ms. CALLAHAN. Right.

What we did was to try to build our recommendations around our finding that the most effective Federal policy is one that combines four elements so that you get a continuous cycle of improvement. The first is to invest in research and development so you keep the technologies in the pipeline. The second is to provide incentives so that you create the initial markets for those technologies. The third is public education so you get widespread commercialization of the technologies. Then, once you have that, you put in place the codes and the appliance standards that allow you to set a minimum efficiency or a maximum energy allowable use for the commercial projects.

So, on the first, on research and development, one of the things that we're recommending is a commercial buildings initiative. That would provide the technologies and the knowledge base to allow us to get to carbon-neutral buildings, which is a goal that's being embraced by policy leaders and leading organizations all across the United States. That provision is actually in the Senate energy bill, thanks to Senator Dorgan, one of your fellow committee members, and we are very pleased with that. We hope that, after authorizing such an initiative, it can be appropriated.

A second key element in the building sector are the energy—the model efficiency codes that are established for commercial buildings and houses at the Federal level. We have sought for, and actually have in the House bill, but not in this bill, a directive to DOE to ensure that we get a 30 percent reduction in our model energy codes, reduction in energy use by 2010, and a 50 percent reduction in the new codes that we put forward in—by 2030. Again, it's in this—it's in the House bill, not in the Senate bill. We're hopeful that it'll come out in a final package.

We also look at Federal energy management. And I know that's something that Congress has been very focused on. We worked with our Alliance Chairman, Senator Pryor—again, one of your fellow members—to develop a set of policies, that would create a new paradigm and structure for Federal energy management, that we believe will allow the Federal Government to meet the aggressive goals you all set in EPAct 2005, and that the President put forward in his latest Executive Order. Those provisions, again, are put forward as an amendment to the energy bill, and we're hoping this Subcommittee will support that.

Appliance standards, which you mentioned, Senator Pryor—or Senator Kerry, excuse me—are one of the most important things that we've done in this country, in terms of driving efficiency. We are proposing a set of recommendations, of consensus-based appliance agreements that have been developed with the manufacturers and the advocates, but also, and importantly, recommendations for

DOE to conduct their rulemakings in a more timely fashion, in a more—put in place more effective standards.

The appliance standards, just to give you a notion of the magnitude of these, the ones that we have in place today are displacing the need for about 7 percent of our current electricity use. They, by the year 2010, will allow us to not emit 65 million metric tons of CO_2, and they're going to save American consumers and businesses $234 million in avoided energy costs. So, they are very effective.

There are 15 products out there that we've identified for which there's no Federal standard. So, there's work that the Congress could do here. And we think that if you put in place standards on those 15 products, you could save about $54 billion in avoided energy costs by 2030.

And finally, we've recommended programs in the utility area. The utilities in this country, natural gas and electricity utilities, have proven to be a very effective deliverer of energy efficiency. And so, we're supporting an energy efficiency resource standard that would require utilities to implement programs that result in a specified amount of energy efficiency, or electricity and natural gas savings. They're very much like a renewable portfolio standard, so they're market-based and flexible, and a mechanism that will allow us really to put energy efficiency on par with other generation.

So, in conclusion, as you look to, perhaps, develop legislation on energy efficiency through this Subcommittee or other means, we stand ready to help you with that. We've got lots of good ideas we'd like to see translated into Federal policy. And we believe that, through energy efficiency, you're not only going to transform the current energy crisis and tackle global climate, but you're also going to have a win-win for consumers in terms of money back into their pocketbook and the creation of a stronger economy.

Thank you for your time.

[The prepared statement of Ms. Callahan follows:]

PREPARED STATEMENT OF KATERI CALLAHAN, PRESIDENT, ALLIANCE TO SAVE ENERGY

Introduction

The Alliance to Save Energy is a bipartisan, nonprofit coalition of more than 120 business, government, environmental and consumer leaders. The Alliance's mission is to promote energy efficiency worldwide to achieve a healthier economy, a cleaner environment, and greater energy security. The Alliance, founded in 1977 by Senators Charles Percy and Hubert Humphrey, currently enjoys the leadership of Senator Mark Pryor as Chairman; Duke Energy CEO Jim Rogers as Co-Chairman; and Senators Jeff Bingaman, Byron Dorgan, and Susan Collins along with Representatives Ralph Hall, Zach Wamp and Ed Markey, as its Vice Chairs. Attached to this testimony are lists of the Alliance's Board of Directors and its Associate members.

The Alliance is pleased to testify at a hearing on energy efficiency technologies and programs. At the request of committee staff, I will focus on the energy efficiency of buildings, both in direct policies and by encouraging utility energy efficiency programs, but will also touch on transportation efficiency.

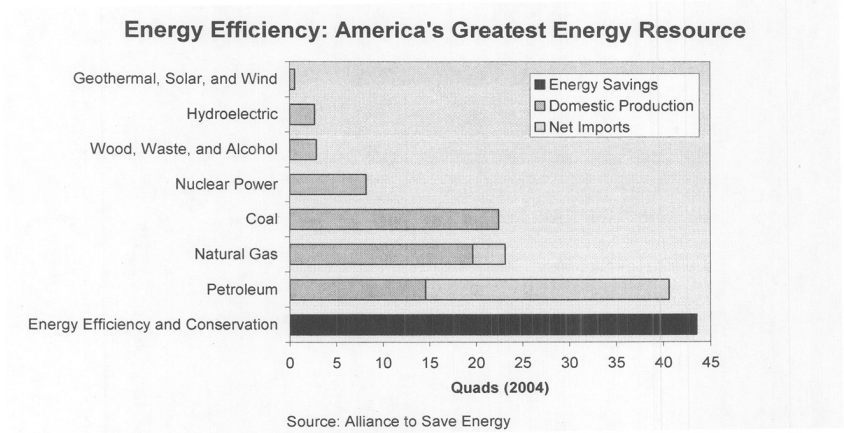
Energy Efficiency: America's Greatest Energy Resource

Natural gas prices have doubled in the last few years, and gasoline and electricity prices also reached all-time highs. Recent energy price increases cost American families and businesses over $300 billion each year. The President recognized energy security as a major issue in the State of the Union message. And the world's scientists recently reaffirmed the urgent need to reduce global warming. These problems are not going to go away—electricity use in the United States is projected to

grow by half by 2030. Such growth will lead to higher prices, greater volatility, and increasing dependence on foreign natural gas as well as foreign oil.

Energy efficiency is the quickest, cheapest, and cleanest way not only to tackle our current energy cost issues, but also to meet the anticipated future growth in energy demand in the United States. The enormous contribution of energy efficiency to meeting our energy needs is achieved with little or no negative impact on our wilderness areas, our air quality, or the global climate. Energy efficiency enhances our national and energy security by lessening requirements for foreign energy sources. Further, energy efficiency is invulnerable to supply disruptions; is rarely subject to siting disputes; is available in all areas in large or small quantities; and generally costs much less than it would to buy additional energy.

Energy efficiency is the Nation's greatest energy resource—efficiency now contributes more than any other single energy resource to meeting our Nation's energy needs, including oil, natural gas, coal, or nuclear power. The Alliance to Save Energy estimates that without the energy efficiency gains since 1973 we would now be using at least 43 quadrillion Btu more energy each year, or 43 percent of our actual energy use.



Much of these savings resulted from Federal energy policies and programs like appliance and motor vehicle standards, research and development, and the ENERGY STAR® program. Federal action for energy efficiency has been most effective when it combines four elements to create a cycle of improvement: (1) Support for research and development on new energy-efficiency technologies, (2) Incentives and early adoption to create initial markets for the most advanced products and technologies, (3) Public education to spur widespread commercialization of efficient options, and (4) Standards and codes to set an efficiency floor. This testimony will discuss policies in all these areas.

The Potential Impact of Energy Efficiency in Buildings

Building energy use is a major factor in the linked problems of energy prices, energy security, and global warming, and must be a major part of their solution. More than one-third of all energy used in the United States, and more than two-thirds of electricity, goes to heat, cool, and power buildings. Just over half of that is for homes, the rest for a wide variety of commercial buildings.

Great strides have been made in improving the efficiency of appliances, heating and cooling systems, equipment, and the building envelope (walls, windows, doors, and roofs). At the same time the growing size of homes and appliances, and the growth in electronic equipment have overwhelmed the efficiency savings.

An even greater savings potential remains—a recent study by the McKinsey Global Institute found that measures that pay for themselves in 10 years would save 36 percent of energy use for homes and 19 percent of energy used for commercial buildings. A 2000 study by several national labs estimated that energy-efficiency policies and programs could cost-effectively reduce U.S. energy use in residential buildings by 20 percent and in commercial buildings by 18 percent over a 20-year span, essentially reversing the growth they projected in building energy use. The American Institute of Architects has called for reducing fossil fuel use in new and renovated buildings by 60 percent by 2010 and by 100 percent by 2030.

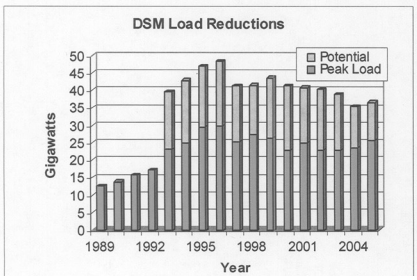
A combination of several policies and programs have made a real impact on saving energy in buildings, including appliance standards, building energy codes, labeling programs, tax incentives, and research and development of new technologies—I will talk about some of these later in the testimony. But one of the most effective approaches has been utility energy-efficiency programs, and I will start with these.

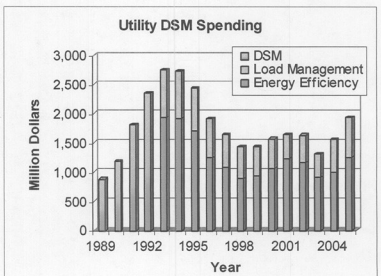
Utility Energy-Efficiency Programs

Why should utilities reduce their sales by helping their customers reduce energy consumption? Many utilities have found that helping their customers to save a kilowatt-hour of electricity is cheaper and easier than generating and delivering that kilowatt-hour. For these utilities and their customers energy efficiency is a key energy resource.

As California found out in 2001, a slight excess of demand for electricity over available supply can cause blackouts, massive price spikes, and economic turmoil. Small increases in demand have doubled retail natural gas prices nationwide over the last few years, resulting in plant shutdowns and home foreclosures. Energy-efficiency programs are the cheapest, quickest, and cleanest way to respond to these challenges. In California in 2001 an aggressive campaign reduced peak electricity demand by 10 percent in less than 1 year, and thus helped avoid further shortages.

These demand-side management (DSM) programs use measures such as rebates for efficient appliances, commercial lighting retrofits, and energy audits to help their customers use less energy. The cost to the utility for the energy savings is often around 2–4 cents per kilowatt-hour (kWh), much less than the cost of generating and delivering electricity. Such efficiency investments save consumers money, increase consumer comfort, reduce air pollution and global warming, enhance economic competitiveness, and promote energy reliability and security.





Over the last two decades, states worked with regulated utilities to avoid the need for about one hundred 300-Megawatt (MW) power plants. However, utility spending on DSM programs nationwide was cut almost in half as the electricity industry was partially deregulated in the late 1990s. In the last couple years there has been a resurgence of interest in electricity and natural gas energy-efficiency programs, with new programs in states such as Georgia and Arkansas, and added funding in leaders like California and Vermont. Some states have also chosen to run similar demand reduction programs themselves.

Utility Sector Energy-Efficiency Policies

Recommendation: Fund the Energy Efficiency Pilot Program authorized in Section 140 of the Energy Policy Act of 2005, and require states to consider adopting policies to promote utility energy-efficiency programs.

Several major new reports have focused in part on the need for new policies to promote utility energy-efficiency programs, including:

- The *National Action Plan for Energy Efficiency* brought together more than 50 organizations, led by the Edison Electric Institute and the National Association of Regulatory Utility Commissioners (NARUC). They seek "to create a sustainable, aggressive national commitment to energy efficiency through gas and electric utilities, utility regulators, and partner organizations."
- The Western Governors' Association Clean and Diversified Energy Initiative set an ambitious goal of a 20 percent increase in energy efficiency by 2020 in the West; the *Energy Efficiency Task Force Report* examines how to achieve it.
- The U.S. Environmental Protection Agency's *Clean Energy-Environment Guide to Action* details many policies and practices states are adopting to manage their energy needs and air quality.

- The Department of Energy, in consultation with NARUC and the National Association of State Energy Officials, as well as the Alliance, issued a report on state and regional policies that promote utility energy-efficiency programs under section 139 of the Energy Policy Act of 2005.

Together these reports set forth policies needed to help utilities create effective energy-efficiency programs. These policies include:

Adopt energy efficiency goals, requirements, or commitments, with reporting on progress and oversight. For example, California conducted a study of the potential savings from cost-effective energy-efficiency programs in the state, set targets for each of its regulated electric and natural gas utilities, required each utility to submit plans to meet those targets, and approved $2 billion in funding for the planned programs over 3 years.

Use energy efficiency as a priority resource when planning to meet customer needs. As utilities in some regions plan to build the first new generating plants and transmission lines in years, they are showing more interest in alternatives. For example, Georgia Power in its most recent Integrated Resource Planning (IRP) process agreed to initiate the first energy-efficiency programs in a decade.

Provide robust and stable program funding. Funds can be provided as part of utility rates or through a small surcharge on utility bills (a public benefits fund or system benefits charge). For example, Wisconsin recently increased its public benefit fund and protected it from raids to pay for state deficits.

Set rates to incentivize utilities and customers. Typically utilities earn more by selling more energy. It is important to "decouple" utility revenues from sales, or to provide utilities with performance incentives for effective energy-efficiency programs, in order to align utility benefits with customer benefits. For example, Northwest Natural, a natural gas utility in Oregon, has a "conservation tariff" that helps it promote energy savings rather than sales.

Carefully evaluate energy-efficiency programs, with measurement and verification of energy savings and appropriate cost-effectiveness tests, so all stakeholders can rely on the energy savings. For example, in Texas savings estimates used to meet the state peak load reduction requirements are verified by a contractor to the Public Utility Commission of Texas.

These policies are typically set at a state level, by public utility commissions or sometimes by state legislatures. However, as there are compelling national interests that cannot easily be addressed by individual states, Federal action is needed. While most individual states are not large enough to affect the shortage of natural gas that has driven up prices, concerted Federal action could have an impact. In addition, the grid failures that blackened much of the Midwest and Northeast in 2003 showed that reliability issues are not confined within state lines.

As a focus for Federal policy, the energy efficiency resource has several advantages:

- It is readily available in all parts of the nation,
- It is available for direct natural gas use as well as for electricity,
- It is cost-effective today, and
- The potential savings are enormous.

The Senate recognized the potential of utility energy-efficiency programs, and the need for a Federal role, in its 2005 energy bill. In addition to the required report in Section 139, Section 140 authorized $5 million a year for 5 years to create state pilot programs designed to achieve 0.75 percent annual reductions in electricity and natural gas use. In the Senate version of the bill, Section 141 would have required state public utility commissions to consider policies to promote utility energy-efficiency programs. The Alliance urges appropriation of funds to implement Section 140, which was enacted, and thanks the Senate for including funds in its appropriations bill last year. We also strongly support enactment of Section 141. But we believe more concerted Federal action is needed.

Energy Efficiency Resource Standard

Recommendation: Enact a Federal energy efficiency resource standard for electric and natural gas utility energy-efficiency programs, coordinated with any renewable electricity standard.

Several states are already developing innovative policies to set performance standards for utility energy-efficiency programs alongside standards for generation from renewable sources.

Like a renewable electricity standard (RES), an energy efficiency resource standard (EERS) is a flexible performance-based and market-based regulatory mechanism to promote use of cost-effective energy efficiency as an energy resource. An EERS

requires utilities to implement energy-efficiency programs sufficient to save a specified amount of electricity or natural gas, such as 0.75 percent of the previous year's sales. Note that an EERS is not a requirement that the utility's sales decrease in absolute terms or a limit on its sales at all; it is a performance requirement for the utility's energy-efficiency programs.

An EERS gives utilities broad flexibility about how and where to achieve the energy savings. Utilities can meet an EERS through the kinds of effective demand reduction programs that have been conducted in many states for years. They also may be able to use customer combined heat and power, and energy loss reductions in the distribution system. They can implement their own programs, hire energy service companies or other contractors, or sometimes pay other utilities to achieve the savings by buying credits. The program savings are independently verified.

Usually, the costs of the energy-efficiency programs must be recovered from energy customers through utility rates, but the savings from avoided energy supply are greater than the efficiency cost. It is important for states to set rates in a way that utilities are not financially penalized for reduced sales due to effective energy-efficiency programs.

According to the American Council for an Energy-Efficient Economy, a national 0.75 percent EERS would by 2020:

- Save 386 billion kWh of electricity (8 percent of total use) and 3,600 billion cubic feet of natural gas (14 percent) each year.
- Reduce peak electric demand by 124,000 MW (avoiding about 400 power plants),
- Save consumers $64 billion (net after investments), and
- Prevent 320 million metric tons of carbon dioxide greenhouse gas emissions each year.

An EERS and an RES may be used in combination. Renewable and efficiency requirements reinforce each other in several ways in the states:

- *Texas* has separate renewable and efficiency requirements. The efficiency targets focus on peak demand—utilities are required to avoid 10 percent of the expected increase in electric peak demand through efficiency programs. They have easily exceeded these targets.
- *Connecticut* added to its RES a separate tier under which utilities are to save 1 percent of electricity use each year through residential and commercial programs and combined heat and power. *Pennsylvania* includes energy efficiency with certain other resources in one tier of its alternative energy portfolio standards.
- *Hawaii* and *Nevada* added efficiency resources as options in their portfolio standards—with higher overall targets—after utilities claimed to have difficulty meeting renewable targets (Nevada caps the amount efficiency can contribute).
- *California* has a "loading order" that sets efficiency as the preferred resource; once cost-effective efficiency measures have been exhausted, utilities are to use renewable sources, and only then traditional sources. The PUC sets targets for utility energy-efficiency programs based on a study of their potential savings.

A national EERS should build on these examples and on state regulatory expertise but ensure that energy efficiency meets national goals.

Appliance Energy-Efficiency Standards

Recommendations for appliance efficiency standards: Strengthen appliance efficiency standards by:

1. adopting additional standards based on negotiated agreements,
2. directing DOE regularly to review and update both test methods and standards to keep pace with rapidly changing technology, with accelerated consideration of the products with the greatest energy savings,
3. clarifying DOE's authority to set standards that best serve the public interest, including regional standards and multiple specifications for a single product,
4. clarifying that Federal preemption does not apply to products for which there is no Federal standard, and
5. providing adequate and stable funding for the DOE program.

Appliance standards have been one of the most effective energy-efficiency programs. Standards in place today are expected to save 7 percent of U.S. electricity use and reduce greenhouse gas emissions by 65 million metric tons by 2010, and

are expected to save consumers $234 billion (this is *net* savings—after repaying any increased first-cost for more efficient appliances). Energy efficiency advocates and states have identified at least 15 appliance types with significant energy savings opportunities but no Federal efficiency standards at present. Adopting efficiency standards for these 15 products alone could save 52 TWh of electricity and 340 billion cubic feet of natural gas annually by 2020, and save consumers $54 billion in energy costs between now and 2030. Even more could be saved by updating existing Federal standards.

In recent years the Alliance and other energy-efficiency advocates have focused much of our attention on lengthy delays and lack of progress at DOE in setting required appliance standards. Due to a provision in EPAct 2005—and a lawsuit—last year DOE set an explicit schedule for appliance standard rulemakings, which was later adopted in a court order. So far, they have met that schedule. However, the two new DOE-proposed standards (on distribution transformers and residential furnaces) were far weaker than we and many others believe is required by Federal law, justified by DOE's own data and analysis, and needed in order to meet the energy needs of our Nation.

We urge you to monitor carefully both DOE's adherence to its regulatory schedule and the actual outcome of the rulemaking process. In addition, Congress should take additional steps to strengthen the Federal appliance standards and testing program and assure that it is adequately funded.

First, since EPAct 2005 we have reached additional consensus agreements with product manufacturers on new and updated standards. DOE believes it does not have the authority to adopt one of them, for residential boilers. In addition, efficiency advocates and industry groups are currently in negotiations on several other products. We urge Congress to act promptly to enact into law all negotiated agreements that are reached.

Second, at present, there is no requirement for DOE regularly to review and update all existing standards and test procedures. The existing law does require a limited number of reviews for some products, but subsequent reviews are discretionary. In addition, Congress should establish a general requirement for periodic review of all standards and test procedures every 5 to 8 years, updating them if justified, and should provide funding for DOE to maintain this schedule. In particular, DOE test methods for a number of products are seriously lagging the pace of technology development, thus preventing effective standards for those products (examples include tankless water heaters, products that use standby power even when turned "off," and many appliances with advanced electronic controls). If DOE fails to keep its standards up-to-date, Congress should allow states to set standards to limit the demands on their energy systems from those products.

In addition, DOE has limited its schedule for setting appliance standards to Congressionally-mandated rulemakings with a date certain. This narrow approach has delayed consideration of some standards with the greatest potential energy savings. For example, DOE has identified furnace fans and residential refrigerators as two product standards that offer the potential for very large energy savings, but the agency has yet to even schedule these rulemakings. Congress should direct DOE to begin these two important rulemakings as soon as possible.

Third, Congress should allow DOE to consider alternative approaches in setting appliance standards where these better serve the intent of the law: to maximize cost-effective energy savings. We offer several examples:

- Congress should explicitly authorize DOE to set regionally-appropriate appliance standards for climate-sensitive products such as furnaces, boilers, air conditioners, and heat pumps, since regional weather conditions can significantly affect the feasibility or cost-effectiveness of a given technology or efficiency measure. For example, "condensing" furnaces can cut energy losses in half, but may not be cost-effective in warm areas where they are seldom used. A regional furnace standard would save large amounts of natural gas.
- Congress should clarify that DOE may include two or more specifications for different features of the product that all contribute to energy efficiency. One example is the authority for DOE to set standards for air conditioners in terms of both average efficiency, which reduces consumer bills, and performance during the hottest summer days, which provides added benefit by easing the strain on electric utility systems during peak demand periods. A second example is the ability to set efficiency requirements for both direct electricity use and consumption of (heated) water in the case of a dishwasher or clothes washer.
- In addition, expedited procedures for consideration of consensus standards proposed to DOE may speed up adoption of non-controversial standards.

Finally, Congress should make it clear that Federal law does not preempt states from setting their own appliance standards in the absence of a Federal standard in place. This principle has generally been upheld in interpretation of the Federal appliance standards laws, but in some cases it has been argued that the mere authority for DOE to set standards should preempt the states, even if DOE fails to exercise that authority. If DOE fails to act, or if it establishes a "no standard" Federal standard, a state should be able to adopt its own energy-saving standards for that product.

Building Energy Codes

One of the most important opportunities for reducing energy use and costs is by designing and constructing a new building to be energy-efficient from the start. Every new building that is not efficient represents a lost opportunity—one that will likely be with us for another 30–50 years or longer, a time frame that will almost certainly see much higher prices and much more intense concern over energy supplies, air pollution, and greenhouse gas emissions.

There is cause for optimism in the growing interest shown by builders and developers in green buildings and rating systems such as the U.S. Green Building Council's LEED; the bold new policy commitments to energy efficiency targets by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), the American Institute of Architects, and the U.S. Conference of Mayors; and the Federal Government's own commitment (in EPAct 2005) to design new Federal buildings to be 30 percent more efficient than current practice. But a great deal of work remains to be done. Congress can support and encourage these broader initiatives with specific actions that take best advantage of Federal leverage in building codes and Federal financing for home mortgages.

Recommendations for assisting state energy-efficient building codes:

1. Congress should direct DOE to support a process of continuous improvement in the model energy codes for both residential and commercial buildings, targeting a 30 percent reduction in new building energy use by 2010 and a 50 percent savings by 2020. States should be required to adopt codes that match these energy savings and to achieve high rates of compliance with their codes.

2. To make sure that energy codes are not just a paper exercise, Congress should fully fund the programs for state code compliance and training authorized in Section 128 of the Energy Policy Act of 2005.

Under present law independent organizations (the International Code Council and ASHRAE) set national model residential and commercial building energy codes. DOE reviews updates in the model building codes to determine if the revisions improve energy efficiency. Following that determination, each state is required to review and, for commercial buildings, update its own building code to meet or exceed the model code. However, there is no penalty for a state that fails to comply.

Two changes are needed. First, DOE should set a goal for continuous improvement of the model building codes. Rather than wait passively for action by others, DOE should instead take the initiative to engage with organizations including ASHRAE and the International Code Council to advance the model codes steadily toward specific targets: 30 percent efficiency improvement by 2010, for both residential and commercial model codes, and at least 50 percent improvement by 2020. ASHRAE has already adopted a similar goal, but there is no similar urgency for residential buildings, and it is hard to move diverse, consensus-based organizations to take ambitious action. DOE support is needed both for technical underpinnings and to represent the national interest in reduced energy use and greenhouse gas emissions. If the outside organizations fail to achieve these goals, then DOE should propose modified codes that do.

Second, we need to encourage state action to update and achieve full compliance with the energy codes. States should be required to adopt strong codes for residential as well as commercial buildings. And they should be required to achieve strong compliance with their codes. In a recent review of residential energy code compliance studies from a dozen states, compliance rates were found to vary widely, but the average was far below 100 percent, and typically closer to 40 to 60 percent. A number of studies have pointed to the constraints, including staff time and expertise, facing many local code enforcement agencies in making sure that energy code requirements are met, both at the design and permit stage, and in verifying actual construction and installation practices on-site.

Congressional oversight would be helpful here as well. The code compliance program authorized under Section 128 of EPAct 2005 is a small but important step toward providing an incentive for states to adopt and enforce up-to-date energy codes; it should be fully funded. In addition, DOE has not made the required determina-

tion of energy savings on any recent code updates: the 2003, 2004, or 2006 residential IECC or the 2001 or 2004 ASHRAE commercial standard.

Recommendations for Federal standards for manufactured homes and buildings funded by the Federal Government:

1. Congress should require HUD to strengthen the national energy efficiency standards for ***manufactured housing*** *to the same levels required by the model building code for site-built homes.*

2. Congress should require that ***federally insured mortgages*** *be available for new homes only if the homes meet or exceed model energy efficiency codes.*

3. Congress should require that all new DOD ***Privatized Military Housing*** *be designed to meet or exceed the criteria for an ENERGY STAR®* home.

About one in 12 new homes in the United States is a manufactured housing unit (147 million in 2005). Because these homes are factory-produced with many standardized components, manufactured housing units should be inherently more energy-efficient than their site-built counterparts. For example, it is much easier and more cost-effective to achieve an air-tight duct system in the factory than on a construction site. Instead, manufactured homes are generally much less efficient than site-built homes, due to poorly insulated walls and roof, single-pane windows, and inefficient heating and cooling systems. A 2004 Pacific Northwest National Laboratory report found that improving the energy efficiency of a manufactured home, not even to the current IECC, would save an average of $150–$180 per year. The initial cost would be about $1,000 to $1,500.

The Department of Housing and Urban Development, which is responsible for adopting the Manufactured Housing Construction and Safety Standards (MHCSS), has not updated these standards to keep up with changing energy prices and technological advances. As a result, the "HUD-code" standards are now well below the comparable energy efficiency code requirements for new site-built homes. For example, a new manufactured home built for Minnesota today is required to have only as much wall insulation—and not as much ceiling and floor insulation—as a site-built home in Miami.

Many of these manufactured units are sold to low and moderate income families—those who can least afford to pay the rising utility bills for gas, electricity, and in some cases propane heating. And often taxpayers end up subsidizing the ongoing costs to operate these inefficient housing units through the Low-Income Home Energy Assistance Program (LIHEAP) or through the Low-Income Weatherization Assistance Program, which helps pay for energy-saving retrofits. It is far easier and cheaper to make these manufactured homes more efficient in the first place.

To qualify for a federally insured mortgage, a new home should be required to meet or exceed the efficiency levels of the model energy code. This will assure that Federal taxpayer funds are not used to underwrite inefficient new homes with higher utility bills—a different kind of hidden, long-term "mortgage." Updated standards would affect a lot of housing: a 2003 U.S. Census Bureau survey found, for homes constructed in the previous 4 years, 486,000 FHA mortgages, 225,000 VA mortgages, 29,000 USDA mortgages, and 38,000 public housing units.

Current law requires HUD and the Department of Agriculture (USDA) to set energy-efficiency standards for public and assisted housing and new homes (other than manufactured homes) with federally insured mortgages. However, the agencies have never changed the standard from the legislated backstop of the 1992 Model Energy Code (the predecessor to the IECC) and ASHRAE Standard 90.1–1989.

In order to move military service members and their families out of outdated housing units, Congress authorized the Department of Defense (DOD) to enter financial partnerships with builders to construct an estimated 185,000 homes using joint funding. DOD is leasing the homes for up to 50 years, and will pay the energy bills through utility allowances to the military personnel. DOD imposes many standards on these units, and energy efficiency criteria are established for some projects, but there are no uniform energy standards applied to all Privatized Housing projects. If these homes are built to ENERGY STAR® Homes criteria, each military family—and ultimately the Federal taxpayers—will save an average of $300 a year in energy bills. The added initial cost of ENERGY STAR® homes is about $1,500 to $3,000.

Buildings Research, Development, and Deployment

Recommendation for a buildings RD&D program: Establish and fund a long-term program to develop and establish in the market net-zero energy commercial buildings.

To create the technology and knowledge base needed to achieve the long-term goal of net-zero energy (and "carbon-neutral") buildings, the Federal Government needs

to make a major commitment—in close partnership with states, utilities, and the private sector—to a comprehensive, multi-year program to transform building technologies and practices. This transformation must go well beyond individual technical measures to include a design process that integrates sustainability from the start, and effective means of managing construction and building operation to assure continued high performance over the lifetime of the building and systems.

The need is especially acute in the commercial buildings sector, where the challenge of maintaining performance, comfort, occupant health, and amenities while radically reducing energy consumption without significantly increasing costs is even greater than for smaller residential buildings. Yet "net-zero energy homes" rather than commercial buildings have received the lion's share of funding and program attention to date by DOE, utility and state programs, and private partnerships.

Investing 1/10 of 1 percent of the $135 billion in annual energy costs for all U.S. commercial buildings would represent a substantial increase over the current Federal efforts by DOE and all other agencies. But this is the equivalent of less than 12 hours of energy costs for the Nation's commercial building stock—a reasonable price to assure that we really have the technologies and practices to cut energy use by more than half over the next two decades. To be effective, these funds would need to be directed toward a well-orchestrated plan to address *innovation* in technology and practices, strategic and well-monitored *demonstrations* of these new methods, and paths to effective large-scale *deployment* in new and existing commercial buildings.

Such an integrated strategy requires careful preparation and broad engagement of the building industry, the design professions, financial institutions, government policy-makers, and private owners and developers. There is growing interest in sustainable design but the industry is fragmented, risk averse, and driven largely by short term economic interests. By itself the Federal Government cannot create the needed technologies, nor force the market to accept them. But it can and should be the catalyst in partnering with industry, states, and utilities for these essential steps.

Increasing Energy Efficiency in Federal Facilities

Recommendations for Federal energy management:

1. Establish a procedure to implement all cost-effective efficiency improvements in large Federal buildings.
2. Increase oversight and funding, and modify authority for Energy Savings Performance Contracts.

The United States Federal Government is the single largest consumer, and the single largest waster, of energy in the world. In 2005 the Federal Government overall used 1.6 quadrillion Btu of "primary" energy (including the fuel used to make the electricity it consumed), or 1.6 percent of total energy use in the United States. Taxpayers in this country paid $14.5 billion for that energy. Almost half of that energy, and more than half of the cost, was for vehicles and equipment, primarily for military planes, ships, and land vehicles. The rest, 0.9 quadrillion Btu at a cost of $5.6 billion, was for heating, cooling, and powering more than 500,000 Federal buildings around the country.

Repeated efforts over the last two decades have resulted in dramatic energy and cost savings, but large cost-effective savings remain available. Overall Federal primary energy use decreased by 13 percent from 1985 to 2005, and the Federal energy bill decreased by 25 percent in real terms, even after the 27 percent jump in fuel prices in the United States in 2005. Congress and the president have set even more aggressive targets for future savings that could yield well over $1 billion in energy cost savings each year from Federal buildings alone.

But these savings will not occur without greater funding and oversight. In addition to greater appropriations, the Alliance supports a new focus on energy efficiency throughout Federal buildings and increased use of Energy Savings Performance Contracts (ESPCs) and Utility Energy Service Contracts (UESCs). The Alliance believes that a new paradigm and a new structure are needed to ensure that all large Federal buildings are made energy-efficient, that improvements are not made just when appropriations happen to be available or an energy manager happens to be a champion of efficiency. Thus we recommend a package of policies that have been introduced in a new bill by Senator Pryor, S. 1434:

- All large Federal buildings and facilities should conduct comprehensive energy and water savings evaluations ("energy audits") to identify and prioritize all economic opportunities for investments to reduce energy and water use. These evaluations should consider both capital investments, such as a new boiler or

chiller, and operational improvements, such as checking and adjusting lighting or mechanical system controls.

- Agencies should implement all measures identified in the energy and water evaluations that have a simple payback of fifteen years or less. The calculation of cost savings should consider not only energy and water costs but also reduced costs of building operations, maintenance, repair, and equipment replacement.
- It is critical that the agencies not only make the capital investments but also make sure that the measures work, and keep on working. Start-up commissioning, and periodic recommissioning, are an essential part of all measures to ensure that they work as intended—followed by effective operation, maintenance, and repair as well as measurement and evaluation of savings.
- Sustained oversight is needed to ensure that every agency is implementing these measures. While Congressional action is important, the first level of oversight should be agency self-certification through an open web-based tracking system, along with benchmarking of building energy and water use, and reviews in the agency energy scorecards that the Office of Management and Budget already prepares.
- Both the energy-savings evaluations and the measures themselves should be funded through a combination of increased appropriations and private financing through ESPCs and UESCs.

The Alliance also supports additional modifications to ESPC authority to remove a number of arbitrary impediments. First, the authority for Federal agencies to enter into ESPCs should be permanently extended, to avoid the problems that have occurred with the lapse of authority in 2003–2004. Second, energy managers should be able to use appropriated funds and financing through ESPCs to fund the same project. Third, Congress should end any self-imposed agency caps on the duration of ESPC contracts below the statutory limit of 25 years and on total obligations under ESPCs.

Energy Efficiency Tax Incentives

Recommendations for energy-efficiency tax incentives:

1. Provide long-term extensions, with improvements, of tax incentives for highly efficient new homes, home improvements, commercial buildings, appliances, and vehicles.

2. Enact a vehicle fuel use "feebate," with incentives for fuel-efficient vehicles paid for by a fee for gas guzzlers, to reduce fuel use in all vehicles.

The Energy Policy Act of 2005 (EPAct 2005) included important tax incentives for highly energy-efficient new homes, improvements to existing homes, commercial buildings, heating and cooling equipment, appliances, fuel cells, and hybrid and advanced diesel vehicles. These incentives for consumers and businesses have the potential to help transform markets to embrace energy-efficient technologies and thus to help the best buildings, vehicles, and equipment become mainstream.

Unfortunately, most of the EPAct 2005 incentives were not put in place for a long enough period of time to ensure market transformation. Most of the incentives were limited to 2 years—expiring on December 31, 2007. And, while two of the incentives—for commercial buildings and new homes—were extended for 1 year and so now are set to expire at the end of 2008, this is still not adequate to ensure a meaningful impact on the market. A large commercial building initiated when the bill was signed in August 2005 will not be finished before the commercial buildings deduction was set to expire in December 2007. A building initiated now could not be finished before the new expiration date in 2008. In order for these tax incentives to be effective in creating a market transformation toward greater energy efficiency and reductions in energy use they need to be given more time to work. Lifting or increasing the caps on the incentives for hybrid vehicles is equally important.

The Alliance also supports a new, performance-based tax credit for whole home retrofits that save energy, included in the EXTEND Act, which we thank the Chairman for cosponsoring. The credit is on a sliding scale based on percentage energy savings, starting with homes that are certified as saving 20 percent of energy use. This new approach should encourage much greater energy savings by helping homeowners find the best measures for their homes and subsequently ensuring that the savings are realized from the improvements made. The new credit will require an inspection and certification of the energy savings in order to establish the level of credit to be received.

And the Alliance supports a more comprehensive approach to incentivizing more fuel-efficient vehicles. A new, innovative approach to encouraging efficiency of light-

duty cars and trucks is a national "feebate" system. A national feebate would apply a fee or rebate to new vehicles based on the expected lifetime fuel use of the vehicle. We would recommend that the fee and rebate apply to manufacturers of all light-duty passenger vehicles—including SUVs and minivans—but they could be determined relative to vehicles in the same class or to vehicles of the same size. The fee or rebate would then be proportional to the fuel economy, determined relative to a dividing line or reference mpg.

We would recommend setting this dividing line between fees and rebates each year such that the total fees would pay for all the rebates thereby allowing the program to operate at no cost to the government. Under such an arrangement, about half the vehicles would receive a rebate, and about half the vehicles would be assessed a fee.

This would create an incentive for manufacturers to use fuel-efficient technologies in the vehicles they produce, and hence should increase the availability of efficient vehicles, as well as creating an incentive for consumers to purchase more efficient vehicles. As fuel economies increased, the reference mpg's would be ratcheted up, creating an incentive for continual improvement, but never out of line with the existing market. This policy has the potential to improve fuel economies throughout the passenger vehicle fleet, not just give new technologies a foothold in the marketplace.

Transportation

Given that the transportation sector accounts for two-thirds of U.S. oil use and that passenger cars and light trucks consume 40 percent of that oil, it is critical that we address vehicle fuel consumption. There is no shortage of technologies to improve vehicle fuel efficiency. Many of these technologies are already in vehicles, including electronic controls and ignition, light weight materials, improved engine designs. Other technologies are now being pulled "off the shelf" and increasingly deployed in new vehicles. They include (for example):

- Variable Cylinder Management—turns off cylinders when not in use.
- Advanced Drag Reduction—further reduces vehicle air resistance.
- Variable Valve Timing and Lift—optimizes the timing of air intake into the cylinder with the spark ignition.
- Reductions in Engine Friction—using more efficient designs, bearings and coatings that reduce resistance between moving parts.
- Hybrid Drive Trains—internal combustion engine combined with electric motor and regenerative braking.

While advanced technologies have been, and continue to be, deployed in new cars and trucks, we're not getting more miles per gallon (mpg) as a result. We are getting more towing capacity, more acceleration, more weight, and more space.

For the last 20 years, the Nation's oil policy has in effect been made in America's car showrooms. It is time for the Federal Government to provide more guidance in the vehicle marketplace. I have already discussed the idea of a vehicle fuel use "feebate." But the most important single policy would be a strong increase in Corporate Average Fuel Economy Standards.

Between 1975 and1985, fuel economy standards were used to help achieve a 70 percent improvement in new vehicle fuel economy. But since the mid-1980s, CAFE standards have been largely unchanged. Worse, old testing methods, a loophole for "trucks", and credit for "dual-fuel" vehicles that almost always run on gasoline have further weakened existing CAFE standards. EIA estimates that the actual fuel economy of vehicles is about 20 percent lower than the CAFE standard test results suggest. If we are to address the interconnected issues of gas prices, oil imports, and climate change, we need to reform and significantly increase CAFE standards in order to direct our technological ingenuity to saving fuel.

Conclusion

The Energy Policy Act of 2005 included some important measures to reduce building energy use, including new appliance standards and tax incentives. But, while helpful, they were not aggressive enough to address the critical energy issues facing our Nation. In the last year and a half, concern about the linked issues of energy prices, energy security, and global warming has only grown. There are measures we could and should take, such as consumer education, that would have an immediate impact. But polls also show that a large majority of Americans are rightly more concerned that Congress find long-term energy solutions than that Congress quickly address current prices. There is an opportunity now to enact significant energy-efficiency measures that will benefit the economy, the environment, and energy secu-

rity for years to come. The buildings being designed and constructed today will determine our energy use for decades to come. The Alliance urges you to seize the opportunity to reduce energy waste, supply shortages, price volatility, pollution, and global warming, to transform energy crises into economic opportunities.

Senator KERRY. Thank you very much, Ms. Callahan. We appreciate it.

Mr. Zimmerman?

STATEMENT OF CHARLES R. ZIMMERMAN, P.E., VICE PRESIDENT, PROTOTYPE AND NEW FORMAT DEVELOPMENT, WAL-MART STORES, INC.

Mr. ZIMMERMAN. Thank you, Chairman Kerry and distinguished members of the Committee.

My name is Charles Zimmerman, and I'm Vice President of Prototype and New Format Development for Wal-Mart Stores. In my current role, I'm responsible for the architectural and engineering system design for all of our retail facilities.

On behalf of Wal-Mart and our 1.8 million associates around the world, I'd like to thank the Subcommittee for its work on this important issue and for holding this hearing today. Wal-Mart appreciates the opportunity to participate in this critical discussion.

Our company holds a really unique position in the world of energy. While there are no firm statistics, it is widely understood that Wal-Mart is the largest private purchaser of electricity in the world. Since energy is also Wal-Mart's second largest operating expense, it should come as no surprise that we've been focused on energy efficiency practically since the day we were founded.

Fortunately, our global presence gives us a great opportunity for energy efficiency comparisons. As Wal-Mart has continued to expand into other countries, our primary mode of expansion has been to acquire existing stores in those countries; therefore, it is interesting to note that the stores we have built in the U.S. are actually more energy efficient than those we have acquired in any other country thus far. This is even true for stores in countries with much most stringent energy regulation and much higher utility rates than the U.S., such as the U.K. and Japan.

In fact, the stores we acquired in the U.K. actually use twice the energy, and our stores in Japan, one and a half times as much as energy, as our stores in the U.S. This is because Wal-Mart has always recognized what many other companies have not, and that is that energy is not a noncontrollable expense.

Since nearly one-third of Wal-Mart's energy is consumed in the form of lighting, we have developed, over the last decade, what we feel is one of the most energy efficient lighting systems in the world. In fact, our installed lighting load in one of our newer stores is nearly 50 percent less than the baseline requirements established in the Energy Policy Act of 2005. This truly innovative system results in the fact that during daylight hours, our sales floor lighting is either off or, at the very least, significantly dimmed. This is possible thanks to a sophisticated daylight harvesting system comprised of hundreds of skylights per store that are connected to sensors and the state-of-the-art control technology. This allows our sales floor lighting system to continually modulate the amount of energy needed based on the natural light available. This

system is so dynamic that it even gradually ramps the lighting levels up and down as clouds pass over the store.

In our non-sales-floor areas, such as offices, breakrooms, and restrooms, lighting is controlled by occupancy sensors that turn off the lights when no one is in the space. Even our freezer-case lighting has now evolved into an amazing display of advanced technology, as it is now comprised of motion-activated LEDs, or light-emitting diodes. These lights turn themselves on as a customer approaches, and then turn themselves off as the customer leaves. The result is a lighting system where virtually all the lighting in the building is dynamic and only "on" to the degree that conditions warrant.

And this is just lighting. Similar dynamic efforts are underway with our HVAC and refrigeration systems.

As efficient and forward-thinking as our energy practices have always been, we also have very aggressive goals in our sustainability and energy efficiency efforts for the future.

In October of 2005, we announced plans to reduce the energy consumption in our already energy efficient existing buildings by another 20 percent by 2012. We also announced plans to develop a new store prototype that will increase efficiency another 25 to 30 percent by 2009. In an effort to eclipse these goals, we currently have over a dozen retrofit initiatives that are in some phase of development or implementation. In fact, we will retrofit over 1,300 existing stores in the U.S. this year alone with either HVAC, refrigeration, or lighting retrofits, or a combination of all three. These 1300 retrofits all result in paybacks of 2 years or less, and energy savings approaching 18 percent.

We are also applying these technologies to our new-store program and will open, within the next 12 months, stores that meet or exceed our 25 to 30 percent efficiency goal.

As proud as we are of these accomplishments and innovations, we are even more proud to share what we are learning with everyone, including our competitors. The best thing about the information we are sharing is not—is that it's not theory, it is proven, real initiatives with proven, real paybacks.

I am often told by others that until there are new technologies, or until there is additional legislation, energy efficiency will never achieve mainstream attractiveness. Believe me, the technology exists. We're examples of that. Wal-Mart is not waiting for legislation to cause us—proactively, but we would like to encourage Congress to continue to look at new incentives that will help others act proactively, as well.

In conclusion, I'm very proud to work for a company that is committed to invest up to $500 million per year to move toward our goal of being supplied by 100 percent renewable energy, but I am even more proud that they encourage me to proactively share our innovations with the world.

We, at Wal-Mart, applaud Congress in its efforts to communicate the necessity and the benefits of energy efficiency. We look forward to working with you to effectively and constructively address these issues.

Thank you for your time and allowing me to speak on behalf of Wal-Mart on this very important topic.

Thank you.

[The prepared statement of Mr. Zimmerman follows:]

PREPARED STATEMENT OF CHARLES R. ZIMMERMAN, P.E., VICE PRESIDENT, PROTOTYPE AND NEW FORMAT DEVELOPMENT, WAL-MART STORES, INC.

Chairman Kerry, Ranking Member Ensign and distinguished Members of the Committee:

Wal-Mart Stores, Inc., thanks the Subcommittee for its work on this important issue and for holding this hearing today, and we appreciate the opportunity to participate in this critical discussion.

Background

Wal-Mart is based in Bentonville, Arkansas. Our company employs approximately 1.3 million Associates from all 50 states and approximately 1.8 million Associates worldwide. Each week over 176 million customers worldwide choose to shop at Wal-Mart, which we feel reflects the success of our dedication to providing Every Day Low Prices to our customers. Wal-Mart does not just operate stores, clubs, and distribution centers in communities; we take a proactive stance in community involvement on a number of issues.

Purpose of Hearing and Wal-Mart's Role

The purpose of this hearing is to better understand the technologies and practices available today that increase energy efficiency and reduce greenhouse gas emissions. Wal-Mart is eager to share its information and experiences and we applaud the Committee for its interest in this important subject.

Wal-Mart's Policies and Procedures

Wal-Mart takes a keen interest in the serious risks—and opportunities—of global climate change. More than 2 years ago our CEO Lee Scott announced that Wal-Mart would make "sustainability" an organizing principle for the company. In recognizing that climate change is among the greatest issues confronting our business, our customers, and our communities, he announced three goals for our company: to be supplied 100 percent by renewable energy; to create zero waste; and to sell products that sustain our resources and the environment. Since that time we have acted rapidly to become a cleaner, greener and more sustainable company. This past January we announced our support of the effort by the companies and organizations of the U.S. Climate Action Partnership (US–CAP), and endorsed the group's call for strong mandatory national policies and market-based programs for greenhouse gas reductions. Wal-Mart looks forward to working with Congress and the White House to enact meaningful legislation to slow, stop and reverse the growth of greenhouse gas emissions. To be clear, we take this position because we believe it is in the best interest of our customers, our employees, our stockholders and our Nation to tackle this challenge. But we also believe that with the right policies, businesses large and small—from Wal-Mart, to our suppliers, to small businesses across the country—can save. We believe this because of what we are seeing every day as we undertake our aggressive sustainability agenda.

As part of this commitment, we intend to be the most energy efficient retailer in the world and we are working hard to achieve this commitment.

While there are no firm statistics, it is widely believed that Wal-Mart is the largest "private" purchaser of electricity in the world. In fact, Wal-Mart is widely considered to be the second largest purchaser in total energy, second only to the U.S. Government. Energy is also Wal-Mart's second largest operating expense. Therefore, it should be no surprise that Wal-Mart has been focused on energy efficiency practically since it was founded.

As Wal-Mart has continued to expand into other countries, our primary mode of expansion has been to acquire existing stores in those countries. The stores we have built in the U.S. are more efficient on an "energy per square foot basis" than those we have acquired in any other country. This is even true for stores in countries with much more stringent energy regulations than current U.S. regulations and much higher utility rates, such as the UK and Japan.

Nearly one-third of Wal-Mart's energy is consumed in the form of lighting. Recognizing this as an opportunity for responsible business practice, we have developed over the last decade, what we feel is, one of the most efficient lighting systems in the world. Our installed lighting load is more than 40 percent less than the baseline requirements established in the Energy Policy Act of 2005.

During the day, sales floor lighting, in stores built in the last decade, is off or significantly dimmed. This is possible thanks to a sophisticated daylight harvesting

system comprised of hundreds of skylights per store that are connected to state-of-the-art sensors and control technology. This allows our sales floor lighting system to continually modulate the amount of energy needed, based on the natural light available. This system is so dynamic that it gradually ramps up and down as clouds pass over the store. In our non-sales floor areas such as offices, break rooms and restrooms, lighting is controlled by occupancy sensors that turn off the lights when no one is in the space. Beginning in January, even our freezer case lighting has evolved into an amazing display of advanced technology when it became comprised of "motion-activated LEDs." The lights turn themselves on as a customer approaches, and turn themselves off as the customer leaves. The result is a 200,000 square-foot building where virtually all of the lighting is dynamic and only "on" to the degree that conditions warrant.

From an HVAC and refrigeration standpoint, Wal-Mart has always "reclaimed" or "recycled" the waste heat from our refrigeration equipment to generate our domestic hot water. We are beginning to take this a step further in new stores, testing the concept of heating the entire store with the "waste heat" generated by this equipment. Wal-Mart views the "waste heat" as a source of energy and we are expanding the use of this "free" energy source.

Wal-Mart recognizes the influence and implications of responsible energy policy by a large retailer. We strive to continue to decrease our footprint on the environment. As efficient and forward-thinking as our energy policies already are, we have very aggressive goals in our sustainability and energy efficiency efforts for the future.

In October of 2005, we announced plans to reduce energy consumption in our existing energy-efficient buildings by 20 percent over the next 7 years. We also plan to develop a new store prototype that will increase efficiency 25 percent–30 percent over the next 4 years.

We also plan to retrofit over 400 of our refrigeration systems and HVAC systems this year with technologies that will reduce our energy consumption by 8 percent and 6 percent respectively and have a payback of less than 2 years. Additionally, we have recently approved an investment of $25 million to retrofit 500 of our existing stores this year with motion activated LED lighting. This never before utilized technology will result in an energy reduction of 3 percent and a payback of 2 years. Wal-Mart plans to continue using energy retrofit efforts to reduce energy consumption; currently over a dozen similar initiatives are in some phase of development or implementation.

In regards to new store prototypes, we opened the first two of our newly developed "higher efficiency" prototypes earlier this year in Kansas City, Missouri, and in Rockton, Illinois. These stores are predicted to be 20 percent more efficient than our earlier prototypes. By early next year we plan to have met our goal and be opening stores that are 27 percent more efficient. Plans are already in development for stores that approach and possibly exceed 50 percent efficiency in certain climate zones.

As proud as we are of these accomplishments and innovations, we are more proud to share what we are learning with everyone, even our competitors.

Wal-Mart recently opened a new facility in Savannah, Georgia, which included the first low-temperature CO_2 secondary loop refrigeration system ever installed in the United States. At the grand opening, we conducted tours of the facility providing detailed descriptions of the systems to Target, Food Lion, Publix, Costco, and many others since.

We have recently shared these details on our initiatives and their related paybacks at the Department of Energy, Pentagon, Defense Science Board, Office of Management and Budget, the National Academy of Sciences and even with our retail competitors, Office Depot and Best Buy. We also recently shared our story of energy efficiency in Mexico City at a meeting of the Commission on Environmental Cooperation. The information we are sharing is not theory; it is real initiatives and real paybacks.

Wal-Mart has often been told by others that there need to be new technologies, or that there is a need for new legislation before energy efficiency becomes something with mainstream attractiveness. While Wal-Mart is not waiting for legislation to act proactively in the area of energy efficiency, we would encourage Congress to continue to look at new incentives that will help others to act proactively like Wal-Mart. Our experience tells us that there is a tremendous amount of opportunity to increase the energy efficiency of our economy, save consumers money, and address the serious threat of global climate change.

Wal-Mart takes pride in the fact that it has committed to invest up to $500 million dollars per year in innovative, energy saving and climate-friendly technologies, but we are even more proud to pro-actively share our innovations with the world.

Conclusion

Wal-Mart seeks excellence and responsibility in everything we do. We constantly strive to improve our business processes and to enrich the communities in which we are located. We at Wal-Mart applaud Congress in its efforts to communicate the necessity and the benefits of energy efficiency.

Thank you for inviting Wal-Mart to present testimony on this very important topic. We look forward to working with the Committee to effectively and constructively address these issues.

Senator KERRY. Well, thank you for your testimony, Mr. Zimmerman. And I'll have more to say about it afterwards, but thank you.

Dr. Krebs?

STATEMENT OF MARTHA A. KREBS, PH.D., DEPUTY DIRECTOR, RESEARCH AND DEVELOPMENT, CALIFORNIA ENERGY COMMISSION

Dr. KREBS. Mr. Chairman, my name is Martha Krebs. I'm the Deputy Director for Research and Development at the California Energy Commission. It's a pleasure to be here today and discuss the experience of the State of California and other—and its State agencies to provide advanced energy efficiency technologies to Californians.

There were two critical policy actions taken in the decade after the 1973 OPEC oil embargo that has sustained California's leadership in energy efficiency.

First, it established the State's appliance and new-building standards in 1976 and 1978. As administered and updated by the California Energy Commission on a 3-year cycle, these standards repeatedly raise the bar for efficiency gains and ensure that California's buildings and appliances remain the most efficient in the Nation.

The second critical policy action was decoupling the utilities' rates of return from the volumes of electricity or natural gas that they sell. Since 1982, the State's investor-owned utilities use modest regular adjustments to electric and gas rates to sever the link between the utilities' financial health and the electricity and natural gas volumes that they sell. Decoupling helps align the interests of utilities and their customers.

From this period in time, California IOUs began to offer and sustain a variety of programs to foster efficiency investments by industry and individual customers. They ranged from direct subsidies to rebate and buy-down programs. In conjunction with these utility programs, and to support the use of advanced efficiency technologies, the California Energy Commission established additional incentive programs in both the efficiency and renewable areas. As a result, California's per-capita electricity use has been essentially constant since the mid-1970s. At least half of this difference has been shown to be due to the success of the State energy efficiency policies, the standards, and the utility incentive programs.

Since 2003, energy efficiency programs in California have been guided by the loading order. It places cost-effective energy efficiency and demand response at the top of the State's procurement—electricity procurement resources, followed by renewable energy generation and then cleaner and more efficient fossil-fuel generation.

In 2005, California's Public Utility Commission required the State's regulated utilities to fully integrate energy efficiency into their resource procurement process. Utilities are now required to invest in energy efficiency whenever it is cheaper than building new power plants.

In 2006, California utilities began aggressive programs to execute their energy-saving goals. The utilities have budgeted more than $2 billion to deliver their energy efficiency programs from 2006 through 2008.

In looking forward to the next procurement order, the next 3-year cycle, from 2008 to 2010, the PUC is holding workshops, this summer, to explore the technical and financial basis for even larger efficiency savings in the future, and also as part of the response to the Governor's climate action and the legislature's climate action program.

As part of California's utility restructuring legislation, in 1996 the legislature created the Public Interest Energy R&D Program at the California Energy Commission. Today, the CEC has about $80 million annually to support energy R&D, to advance new energy technologies. Not much by comparison to the Federal program, but very large by comparison to any other State program.

The legislative goals are to help develop and bring to market new technologies for efficiency, renewables, as well as clean fossil fuel generation, transportation, transmission and distribution, and environmental impact. And though my testimony does not discuss it, the investments by the Federal Government in all of these areas are a huge source of leverage for our programs.

PIER's funding priorities have reflected the goals given to us, and about—from 2001 to 2006, 35 percent of our resources were spent on efficiency and demand response. We've had a lot of results and payoff as a result of that. We've introduced nine new lighting technologies, eight heating, ventilation, and air-conditioning technologies. We've provided the basis for 14 code changes in the new 2008 efficiency standards process. And we have, along with our utilities, worked to demonstrate our new technologies on State university campuses and at private-sector commercial and industrial sites.

In industry, we've also focused on our agricultural sector, particularly in terms of water use, as well as in our farms and our food processing industry. And we've worked with—in the information technology and semiconductor businesses in Silicon Valley with respect to improving efficiency in data centers and server farms.

We've also worked on new communications technologies that allow two-way interaction between utilities and their customers to provide demand response in times of critical peaks, particularly in California summers.

We've developed these technologies from the beginning with an eye on getting them into the market. We build our projects so that we have the right industry players, so that they can take it to market after we do the research. User input is sought from the beginning. And we work with our utilities in a very integrated way so that the emerging technologies that we provide to them are—become the basis for the next generation of efficiency procurement

that they're going to be required to deliver by the Public Utility Commission.

Thank you, Mr. Chairman.

[The prepared statement of Dr. Krebs follows:]

PREPARED STATEMENT OF MARTHA A. KREBS, PH.D., DEPUTY DIRECTOR, RESEARCH AND DEVELOPMENT, CALIFORNIA ENERGY COMMISSION

Mr. Chairman, Members of the Subcommittee, my name is Martha Krebs, I am the Deputy Director for Research and Development at the California Energy Commission. It is a pleasure to appear before you and to discuss the experience of the California Energy Commission (CEC) in working with the State's Investor Owned Utilities (IOU) to provide advanced energy efficiency technologies to California's end-users.

Overview

In this testimony, I will describe some of the foundational actions that California has taken to establish its leadership in electrical energy efficiency for more than 30 years. Recent actions in efficiency procurement programs as well as climate change policy will assure continuing improvements in electrical energy efficiency, thus reducing demand in the coming years. Finally I will describe the approach that the CEC's Public Interest Energy Research (PIER) program has taken in working with the California IOU's and other State agencies to develop and help bring to market new efficiency technologies. Much of the information in this testimony is based on California Energy Commission documents, in particular, the 2005 Integrated Energy Policy Report and "Energy Efficiency in California and the United States," Chang, Rosenfeld, and McAuliffe, which will appear later this year in Climate Change Science and Policy. The opinions expressed here are my own; while I try to express the policy and accomplishments of California and the CEC, it is not an official document.

California's Energy Efficiency has Improved Continuously Over the Last Thirty Years as a Result of Deliberate Policy Action

There were two critical policy actions taken in the decade after the 1973 OPEC Oil Embargo that has sustained California's leadership in energy efficiency: Appliance and new building efficiency standards and the decoupling of public utility financial returns from the volumes of electricity and natural gas sold.

Standards. California established the state's appliance (Title 20) and new-building (Title 24) standards in 1976 and 1978, respectively. It was the first state in the Nation to adopt efficiency standards for appliances. After other states followed, the Federal standards were established in the National Appliance Energy Conservation Act of 1987. As administered and developed by the California Energy Commission, these standards are regularly updated and strengthened, repeatedly raising the bar for efficiency gains and ensuring that California's buildings and appliances will remain the most energy efficient in the Nation. California's most recently adopted statewide energy efficiency standards for buildings and appliances (the 2005 updates are expected to save 2,800 MW over the next 10 years (about 5 percent of the 60 GW of in-state capacity). The standards updating process takes place over a 3-year period that involves open participation by utilities, manufacturers and consumer representatives.

Decoupling. The second critical policy action involved establishing an incentive for utility investments in energy efficiency. Under traditional utility regulation, a utility's recovery of its infrastructure investment costs is tied to how much energy it sells. According to this model, energy efficiency results in lower-than-anticipated sales and thus prevents utilities from fully recovering their fixed costs. As a result, traditional regulation deters utilities from investing in energy efficiency and instead encourages them to increase sales to increase revenues. However, since 1982 (with a brief hiatus in the mid-1990s, when "restructuring" took resource planning responsibilities away from the utilities), California law has required the state's investor-owned utilities to use modest regular adjustments to electric and gas rates to sever the link between the utilities' financial health and the amount of electricity and natural gas they sell. This concept, known as "decoupling," removes significant regulatory and financial barriers to utility investments in cost-effective energy efficiency improvements, and helps align the interests of utilities and customers.

From this period on, California IOUs offered a variety of programs to foster efficiency investments by industry and individual customers. These ranged from direct subsidies to rebate and buy-down programs. To support the utilization of advanced

technologies in conjunction with the utility programs, the CEC was authorized to establish additional incentive programs for both efficiency and renewable technologies.

Results. With concurrent investments in energy efficiency programs across the state, California has pursued strong energy efficiency programs and policies that have set it apart from the rest of the U.S., *Figure 1* shows that California's historical energy efficiency policies have enabled the state to hold per capita electricity use essentially constant, while in the United States as a whole, per capita electricity use increased by nearly 50 percent since the mid-1970s.

Calculations by Commissioner Arthur Rosenfeld and his colleagues assume that about one-half of the difference between California and the rest of the United States' per capita consumption is due to climate, price, and mix of industries, but the other half is due to the success of state energy efficiency policies, standards and utility programs that promote energy efficient technologies. If California's per capita emissions had grown at the same rate as the rest of the country since 1975, the state would have needed approximately 50 additional medium-sized (500 MW) power plants.

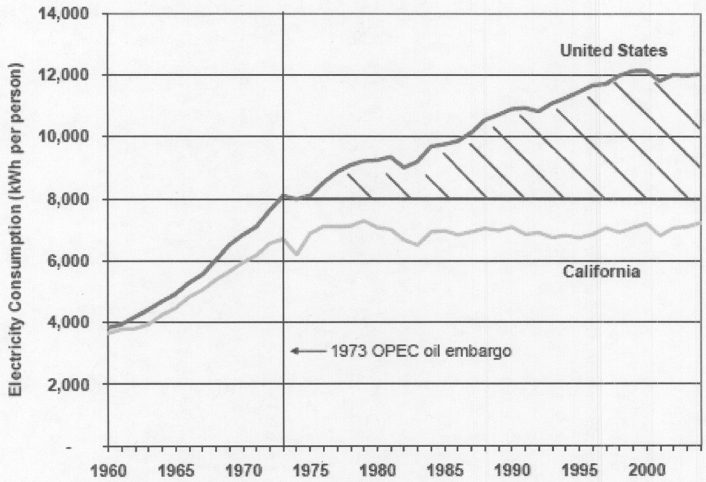


Figure 1: Per Capita Electricity Consumption in California and the U.S.

Figure 2 shows the annual energy savings from California's energy efficiency utility incentive programs and efficiency standards. When summed together, the three decades of energy efficiency programs and standards have resulted in annual efficiency savings today equivalent to approximately 15 percent of California's annual electricity consumption, as shown in Figure 2. From CO_2 reduction perspective, these savings have reduced CO_2 emissions from the electricity generation sector by nearly 20 percent compared to what otherwise might have happened without these programs and standards. This equates to an avoidance of CO_2 emissions in the state as a whole of about 4 percent due to historical energy efficiency programs and standards.

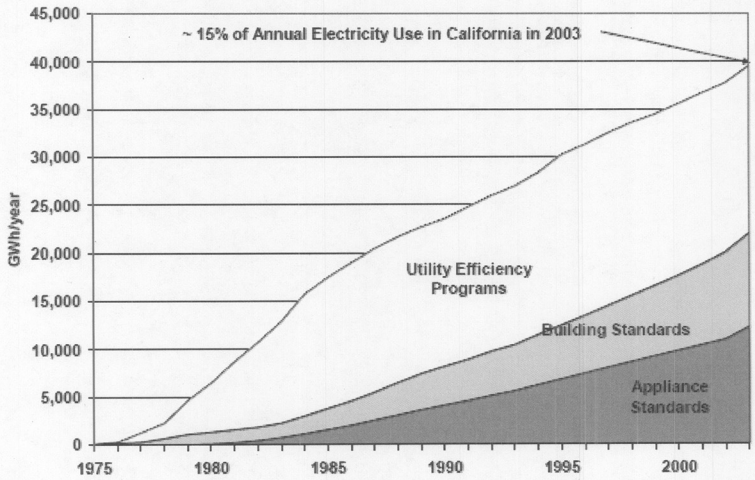


Figure 2: California's Annual Energy Savings from Efficiency Programs and Standards

These energy savings, and associated reduction in greenhouse gas emissions, have delivered substantial net economic benefits to California. The state's efficiency standards, which are designed to be cost-effective, accelerate energy savings across the state. The cost of utility efficiency programs has averaged two to three cents per kWh saved, from the utility perspective. This is less than half the cost of the avoided baseload generation—the generation type most often displaced by energy efficiency programs—and is about one-sixth of the cost of peak generation. Over the last decade alone, these efficiency programs have provided net benefits of about $5.3 billion to California's customers from foregone electricity purchases. Though California is often maligned for its high electricity retail *rates* compared to the rest of the U.S., the state's energy efficiency policies have reduced overall energy *bills* for its residents and businesses. Since 1973, on a per capita basis, energy bills in California have averaged $100 per year less than U.S. bills.

Energy Efficiency Is a Critical Component of California's Future Energy and Climate Change Response Policies

The Loading Order and the 2006–08 Efficiency Resource Procurement by the Investor Owned Utilities. Since 2003, energy efficiency programs in California have been guided by a formal state policy that places cost-effective energy efficiency above all other energy resources. The Energy Action Plan, which was adopted by the state's energy agencies, endorsed by Governor Schwarzenegger, and later updated in 2005, establishes a "loading order" of preferred energy resources. The loading order declares that cost-effective energy efficiency and demand response are the state's top priority procurement resources, followed by renewable energy generation, and finally cleaner and more efficient fossil-fueled generation.

After examining the potential for cost-effective achievable energy efficiency improvements in the state, the California Public Utility Commission (CPUC) in 2004 established energy savings targets for the Investor Owned Utilities that are the most aggressive in the Nation. These targets will more than double the current level of savings over the next decade. While other states' energy efficiency efforts deliver annual savings ranging from about 0.1 percent to 0.8 percent of their electricity use, the annual California targets will ramp up to 1 percent by 2008.

Figure 3 illustrates the historical annual energy savings and the targeted savings levels, which significantly surpass historical reductions. In a few years' time, California's per capita electricity consumption should begin to decline. The energy savings targets will avoid nearly 5,000 MW of peak demand in the next 10 years, averting the construction of a new 500-MW power plant every year. Customers will also obtain some relief from rising natural gas bills through the tripling of annual gas savings by the end of the decade.

In 2005, California regulators adopted a new administrative structure for the delivery of energy efficiency programs that charges the state's regulated utilities with

fully integrating energy efficiency into their resource procurement process. Utilities are now required to invest in energy efficiency whenever it is cheaper than building new power plants, and the savings achieved through these energy efficiency programs will be subject to independent verification. This rigorous evaluation of savings will be essential to ensure that the savings have in fact occurred and can be counted upon for resource planning purposes, as well as for the state's greenhouse gas emission reduction goals.

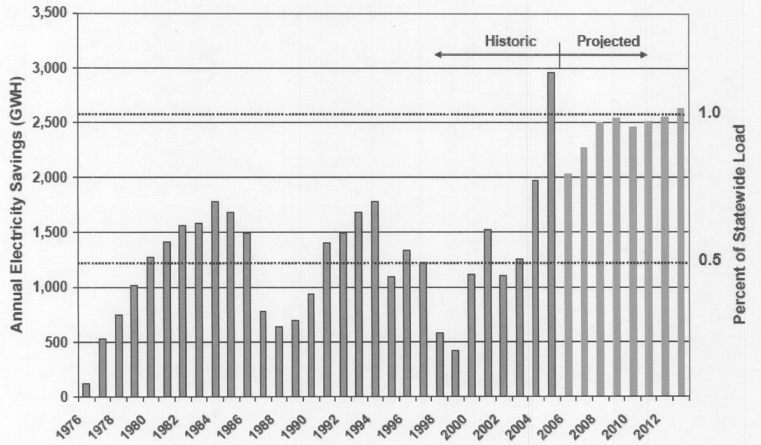


Figure 3: Historical and Projected Electricity Reductions in California

In 2006, California utilities began launching aggressive programs to execute their energy savings goals. The utilities have budgeted $2 billion to deliver their energy efficiency programs during the three-year cycle from 2006 through 2008. This three-year investment will return nearly $3 billion in *net* benefits to California's economy through reduced energy bills and the avoided construction of new power plants. Moreover, by 2008, these programs will reduce the state's annual greenhouse gas emissions by over three million metric tons of CO_2, which is equivalent to removing about 650,000 cars from the roads.

In looking forward to the next procurement order beyond 2008 as well as climate change response requirements, the CPUC is holding workshops this summer to explore the technical and financial basis for even larger efficiency savings in the future.

California Climate Action Policy Specifics. In June 2005, Governor Schwarzenegger signed Executive Order S–3–04, which established aggressive greenhouse gas reduction targets for California: reduce greenhouse gas emissions to 2000 levels by 2010; to 1990 levels by 2020; and to 80 percent below 1990 levels by 2050. The 2020 emissions reduction goal was subsequently codified by *Assembly Bill (AB) 32*, California's Global Warming Solutions Act of 2006, which was signed into law by the Governor in September 2006.

Energy efficiency strategies figure prominently in the state's plan for meeting the 2010 and 2020 GHG reduction goals. While per capita emissions in the utility sector are slowly declining, the state's absolute GHG emissions have risen since the mid-1970s due to continuing population growth of 1.8 percent per year. Some of the strategies identified in this sector involve efficiency efforts already underway as discussed above. For example, currently funded programs and existing efficiency standards in the electricity and natural gas sectors are expected to save 15.8 $MmtCO_2$ in 2020 (about 9 percent of what will be needed to meet the state's goal). Other efficiency strategies will require additional action. Existing and expanded efficiency improvements in the buildings and industry sectors are expected to contribute 17 percent of the total greenhouse gas reductions needed to meet the state's 2020 goal.

These contributions to California's emissions reduction goals could be even greater, as the greenhouse gas reductions resulting from future improvements to the state's building and appliance energy efficiency codes and standards have yet to be determined. While transportation is the largest source of GHG emissions (41 percent), electricity consumed by buildings and industry (including electricity imported from out-of-state) is the second largest source of California's GHG emissions, total-

ing 108 million metric tons of carbon dioxide equivalent ($MmtCO_2$) and accounting for 22 percent (of the state's total GHG emissions). Natural gas use in buildings and industry contribute another 14 percent of California's GHG emissions.

California's Energy Technology Research and Development Programs Have Emphasized Energy Efficiency

From its initial establishment in 1975, the California Energy Commission has developed and administered incentive programs that support the development, demonstration and deployment of advanced energy technologies across the spectrum of energy generation and end-use. The scale of this effort was substantially increased when the Public Interest Energy Research Program was created in 1996.

In 1996 as part of AB 1890 (Chapter 854, Statutes of 1996), California's utility restructuring legislation, the legislature required that $62.5 million be collected annually from the three investor-owned electric utilities and deposited in the Public Interest Energy Research and Development Account, to be invested by the California Energy Commission for energy-related research, development and demonstration (RD&D) efforts that serve the greater public interest. Thus, administration of public interest RD&D was shifted from California's investor-owned utilities to state government, a major change intended to ensure an appropriate role for public interest energy research in a newly competitive energy marketplace.

By 2002 the Federal natural gas public research surcharge administered by the Gas Technology Institute was being zeroed out by the FERC, California acted to maintain RD&D for its gas utilities. In 2003, the legislature authorized and the CPUC created the Public Interest Natural Gas Research Fund that is administered by the CEC in conjunction with its electric PIER funds. This fund is collected from California's investor owned natural gas utilities; in FY 2007–08, it will provide $18 million for RD&D. Thus the CEC has about $80 million annually to support RD&D to advance new energy technologies, the largest such research funds among the 50 states.

The legislature explicitly defined what energy RD&D "in the public interest" means following three principles; they have guided PIER's investments over its first decade of existence:

- Provide environmentally sound, safe, reliable and affordable energy services and products;
- Support RD&D not adequately provided by competitive or regulated energy markets;
- Advance energy science and technology to the benefit of all California's citizens.

PIER is reauthorized every 5 years. Its 2006 reauthorization took place in an atmosphere of high concern and determination to address the impacts of climate change. The legislature rearticulated PIER's goals with an emphasis on reducing greenhouse gases and having market impacts. They also added a new mandate for transportation research relevant to both vehicles and fuels that reflects the concern about transportation as a major source of greenhouse gases. The remaining three goals reflect the continuing importance of the Loading Order discussed above. The goals are:

"Develop and help bring to market, energy technologies that provide increased environmental benefits, greater system reliability, and lower system costs"

- "Advanced transportation technologies that reduce air pollution and greenhouse gas emissions beyond applicable standards, and that benefit electricity and natural gas ratepayers.
- "Increased energy efficiency in buildings, appliances, lighting, and other applications beyond applicable standards, and that benefit electric utility customers.
- "Advanced electricity generation technologies that exceed applicable standards to increase reductions in greenhouse gas emissions from electricity generation, and that benefit electric utility customers.
- "Advanced electricity technologies that reduce or eliminate consumption of water or other finite resources, increase use of renewable energy resources, or improve transmission or distribution of electricity generated from renewable energy resources."

PIER's funding priorities have reflected these goals. Figure 4 represents the cumulative PIER investment from 2001–2005. The transportation RD&D effort began in FY 2005–06 and is not reflected in this figure. The figure indicates the importance that CEC has placed on efficiency and demand response as a priority target for Energy RD&D in California.

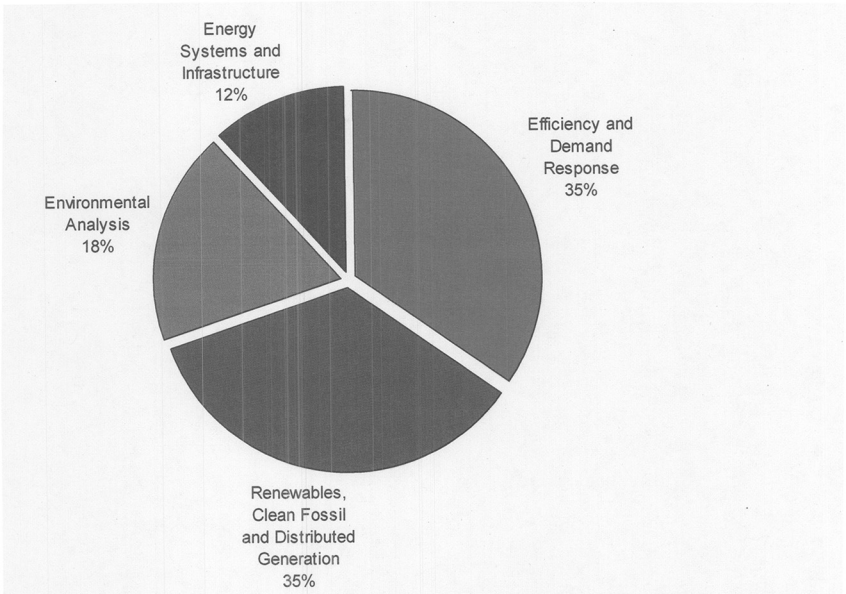


Figure 4: Proportion of PIER Funding by Research Areas for 2001-2005

The CEC RD&D Approach to Efficiency Research. To support the state in accomplishing these policies and goals, as well as anticipate future needs, the PIER program has defined five strategic objectives that will provide California with affordable, comfortable and energy-smart choices for daily life and a strong state economy:

1. *Reduce energy cost and improve performance of efficiency end-use systems (residential, commercial, industrial, agricultural).* This objective is directly tied to helping the state meet the aggressive efficiency goals, as well as supports the implementation of efficiency as the first option in the loading order.
2. *Develop energy-efficient technologies for unique California conditions and industries.* This objective will also help the state meet the aggressive efficiency goals and it will help address issues related to population and economic growth in hot inland areas.
3. *Reduce water use and improve efficiency of alternative water sources, treatment, and delivery*. In addition to supporting the efficiency goals, this objective supports the policy to reduce electricity demand related to the water supply.
4. *Develop end-use cost-effective load management and demand response technologies*. This objective supports the aggressive peak demand reduction goals and help mitigate the impact of increased peak demand spikes due to the growth in hot inland areas.
5. *Develop knowledge base for future decisionmaking and informed end-use policy relative to electricity*. This objective will address the trends, technology gaps, and emerging energy issues to provide policymakers with the knowledge required to develop effective future policy in this area.

Buildings Efficiency RD&D Approach. The Buildings RD&D effort area includes new and existing buildings in both the residential and the non-residential sectors. The program seeks to decrease building energy use through research that will develop or improve energy efficient technologies, strategies, tools, and building performance evaluation methods.

A number of specific issues and technologies have been addressed. Customers do not have affordable and effective tools, technologies, controls, and strategies to respond to future time dependent price structures for electricity. Because affordability is the primary driver for building equipment purchase decisions, development of lower first-cost options for energy efficient products, as well as lower operational

costs for energy consuming systems, are essential for increasing the adoption of energy efficiency measures in California.

Decisions regarding building components, systems, and operations are generally made based on non-energy considerations, but understanding and addressing the substantial energy impacts of key non-energy considerations such as health, safety and productivity are critical to improving energy efficiency in California's buildings. The existing building sector is so large that efficient replacement products, improved operational strategies, and appropriate intervention tactics that can reach the existing building market are critical.

Systems and equipment frequently perform less efficiently than predicted due to suboptimal integration of subsystems and components, improper installation, poor maintenance, and user's inability to detect and diagnose equipment performance degradation, thereby reducing the equipment life and increasing energy costs. Technologies, products, strategies and business models developed for national markets do not adequately address California's unique building energy needs, and do not take advantage of state organizations, programs, and initiatives which can help facilitate improved building energy efficiency. The digital revolution has opened up new, more affordable opportunities for energy savings and peak demand management in buildings, but the proliferation of entertainment and information systems has also significantly increased plug loads.

The Buildings research effort has paid off in numerous technology introductions in the last 3 years:

- Nine new lighting technologies for home, office, and institutional environments using both compact fluorescents and LED technologies.
- Eight commercial Heating, Ventilation and Air Conditioning Technologies.
- Fourteen Code Changes for the 2008 Efficiency Standards Process.
- The UC–CSU Campus Technology Demonstration Program—11 technologies on 13 campuses.

Industry RD&D Approach. The industrial, agriculture and water sectors in California use 30 percent of all the electricity consumed annually in the state. These sectors—vital to California's economy—rely on an affordable, reliable and sustained supply of energy. Through Research, Development and Demonstration (RD&D), the program seeks to improve the energy efficiency of industrial processes, agricultural operations, and water and wastewater treatment plants. These sectors are also sensitive to the cost, reliability and quality of electric power. Therefore, besides improving energy efficiency, the program also strives to research, develop, and demonstrate technologies that help these sectors deal with cost, power quality and power supply reliability issues. The following priorities guide RD&D in this area:

- Industry—California has a substantial industrial base. The energy reliability of these industries is critical not only for California's economy but for the national economy as well. The major industries—such as food processing, electronics and e-commerce, petroleum refining and production—all depend on continued low cost and reliable energy.
- Agriculture—Agriculture forms a large segment of California's economy worth $27.2 billion in cash receipts in 2000. Agriculture is highly dependent upon electrical energy for irrigation and post-harvest processing. Electrical costs and power reliability are critical for a successful and sustainable agricultural operation. The PIER IAW develops techniques and technologies for advanced irrigation and other load management practices that will help this sector cope better in the current electric market.
- Water—The availability of low-cost clean water is essential to California's economy and continued prosperity. The state transports and treats large volumes of water across the state. Both of these activities rely heavily on electric power. RD&D pursues energy efficiency improvements for processing water for urban, industrial and agricultural consumption and energy-efficient wastewater recovery.

PIER Industry Efficiency RD&D has focused advanced technologies for refrigeration and cooling, waste heat recovery, low emission combustion technology in the industrial setting, water treatment and recovery technologies, process heat production, and efficient data centers/server farms.

Demand Response RD&D Approach. Electricity demand in California increases most dramatically in the summer, driven by high air conditioning loads. The generation system must be able to accommodate these high summer peaks, in addition to the demand swings caused by weather variability and the economy. Though peak demand periods typically occur only between 50–100 hours a year, they impose huge

burdens on the electric system. One measure of the "peakiness" of the electric system is load factor, which measures the relationship between annual peak in MW and annual consumption in MWh. If peak demand grows faster than annual average consumption, the load factor decreases. In California in recent years, weather-adjusted load factors have decreased as air conditioner loads have increased.

One problem with meeting peak demand is that most new gas-fired power plants are combined cycle designed to run at high load factors where they are most efficient and can generate enough revenue to recoup investments. Combined-cycle plants also have less capability to ramp up and down to meet peak demand than the older steam boiler units, which make up the majority of California's fleet of power plants. While some utilities have invested in simple-cycle peaking plants that run just a few hours each year, most of the state's new power plants are combined-cycle and are not well matched with swings in system demand.

Demand response programs help reduce peak demand in two ways. First, price-sensitive programs provide customers with the financial incentives and metering technology to reduce electric loads when prices and electricity demand are high. Second, reliability programs provide customers with a non-price signal that clearly shows when system resources are strained and demand reduction would be most beneficial. Reducing system load before it reaches capacity constraints increases the reliability of California's electricity grid. By reducing the need for additional system infrastructure or peaking generation, demand response also lowers consumer electricity costs over the long term.

Price-sensitive and reliability programs are both key components of demand response. The state has historically relied on reliability programs in times of constrained supply, most recently during the summer of 2005 in Southern California. Advances in metering and communications technologies allow significant improvements to price-responsive and signal-responsive programs. New metering technology will be the primary platform for the state's future demand response policies. Both types of programs are being designed to allow customer control—a key feature expected to increase participation by providing customers with greater choice over impacts on their homes and businesses.

PIER Demand Response RD&D includes research on automated demand response technology (AutoDR) for both buildings and selected industrial processes. These technologies focus generally on two-way communication technologies integrated with energy and process controls to permit customers to optimize their work and manufacturing environments while responding to the external energy supply and pricing signals from the utilities. PIER also supports research that examines alternative pricing approaches and mechanisms that can elicit effective demand response from electricity consumers. California electricity utilities are critical participants in this research.

Results from 4 years of PIER R&D on AutoDR involving over 40 different facilities revealed average demand reductions of about 10–15 percent during three- to six-hour long peak demand response events. Representatives from firms as diverse as Albertson's, Target, and Cisco report that they believe automating demand response by price signals can institutionalize these savings, thereby providing California with reliable demand response savings. PG&E plans to install AutoDR technologies in 200 large commercial facilities in 2007 to reduce peak demand by 15 MW.

PIER Efficiency RD&D Programs Focus on Market Success From the Beginning of Individual Projects; California Utilities are Key Players

In addressing these issues, maintaining a strong market connection is a key goal of the PIER Buildings Program. The PIER Buildings Program strives to maintain a strong market connection in various ways including:

- Identification of research that is responsive to known market needs.
- Inclusion of market partners on research teams.
- Identification and implementation of market linkages including linkages to the building community, industry, equipment manufacturers, utilities, codes and standards groups, and other implementers of building efficiency market actions.

A major focus of planning and conducting PIER efficiency research is on implementing the research results—we seek market connections early in a research project to encourage industry players who will adopt the results and achieve market impact. Such connections take on many forms, including advisory groups, coordinating groups, and industry organizations. Projects are developed with a view toward progression from technical verification leading to ultimate demonstration in the user's environment. User input is sought from the beginning. This approach is represented in Figure 5 below.

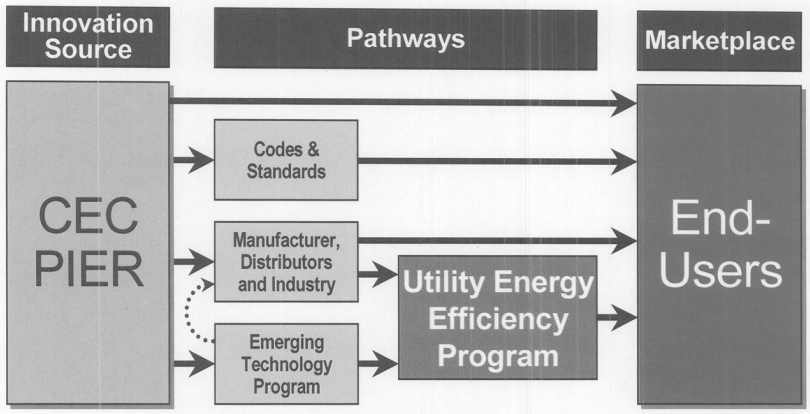


Figure 5: Efficiency Research Program Delivery Mechanism to Market

Many Efficiency RD&D projects enlist the support and guidance of an Advisory Committee and some larger research programs/projects have a Technical Advisory Group (TAG). These advisors are industry representatives from a wide range of disciplines, including building operation/management, insurance, city building codes, energy research, product manufacturing and distribution, and the electric/gas utilities. These advisory bodies provide input on market needs; help refine project scopes; suggest market adopters; and review research results.

PIER efficiency research also connects with the market through California's Emerging Technology Coordinating Council. The council is a collaboration of public agencies involved with administrating California utility-ratepayer funded programs for energy related research and energy-efficient emerging technologies. The group includes representatives from the California Energy Commission, Pacific Gas & Electric, Southern California Edison, Southern California Gas, and San Diego Gas & Electric.

The utilities' emerging technology programs as well as their incentives and efficiency procurement programs are critical elements of the market development and commercialization efforts of the CECs Efficiency RD&D program. All of these programs are the result of California's progressive commitment to efficiency and its recognition that technological advance can change the way we produce and use energy. I am pleased to be able to present this information to you.

This completes my prepared testimony. Thank you.

Senator KERRY. Thank you very much, Dr. Krebs.

Mr. Johnson?

STATEMENT OF DOUGLAS K. JOHNSON, SENIOR DIRECTOR, TECHNOLOGY POLICY AND INTERNATIONAL AFFAIRS, CONSUMER ELECTRONICS ASSOCIATION

Mr. JOHNSON. Thank you, Mr. Chairman.

CEA represents the innovation industry. Our 2,100 members make the products that keep America connected, informed, and entertained. Our members drive the U.S. economy and ensure that America represents—or remains as the world's innovation leader.

Our members are committed to energy efficiency and conservation. Energy efficiency is not just the right thing to do, it is good business. Efficient energy use minimizes heat generation, the enemy of performance and longevity in our products. Many industry trends drive the improving energy efficiency of electronics, in-

cluding convergence, miniaturization, portability, and the transition from analog to digital technology.

At CEA, we take a number of concrete steps to promote energy efficiency. First, we promote the use of industry standards for energy efficiency. Recently, we developed new standards for energy use in set-top boxes, and helped devise a standard for measuring power use of digital televisions. These voluntary programs and standards initiatives deliver more energy efficient products to consumers and business.

In addition, we conduct research studies to ensure that policymakers and the public have accurate information. These studies analyze the energy use of our products, as well as the energy-saving benefits of telecommuting and e-commerce.

CEA also educates consumers about the energy use of our products. CEA's *myGreenElectronics.org* website presents commonsense consumer tips for saving energy, and an energy-use calculator which allows consumers to determine how much power is required for their electronics. The website also allows consumers to search for energy efficient products.

As part of our educational efforts, we publicly highlight green products and technologies at our international trade show, the International CES. We also, at that trade show, encourage energy conservation through product displays, conference sessions, and a prestigious Eco-design Award.

Finally, we work cooperatively with government agencies to promote voluntary, market-oriented programs, such as ENERGY STAR®. Through ENERGY STAR®, our products have saved 18.8 billion kilowatt hours of energy and avoided emissions equivalent to 3.8 million metric tons of carbon.

However, despite its success, the ENERGY STAR® program is threatened by unnecessary regulation at the State level. Of particular concern are California mandates for audio and video products and external power supplies based on the voluntary thresholds established within the ENERGY STAR® program. While we support California's objective of energy conservation, we are very concerned about the specific approach.

ENERGY STAR®'s success is due, in part, to its voluntary nature. Making voluntary specifications mandatory will likely discourage participation in the national ENERGY STAR® program, with unfortunate consequences for consumers and manufacturers, as well as energy savings, in general.

In light of these issues and concerns, CEA has urged California to withdraw its regulations for consumer audio and video products and recognize the success of voluntary programs, such as ENERGY STAR®, which better support energy efficiency in the consumer electronics market.

In conclusion, this Committee's focus on energy efficiency is important and necessary. Electronics are part of the energy-savings solution. Our products save energy by providing control over home heating, cooling, and lighting. They allow teleworking and remote access to information and entertainment, which save fuel and reduce carbon emissions.

We urge you to support innovation and consumer-oriented initiatives, like ENERGY STAR®, which are the keys to energy efficiency for the consumer electronics industry.

We're committed to working with you and my fellow panelists toward a greener and more efficient future. I look forward to addressing any questions you may have.

Thank you.

[The prepared statement of Mr. Johnson follows:]

PREPARED STATEMENT OF DOUGLAS K. JOHNSON, SENIOR DIRECTOR, TECHNOLOGY POLICY AND INTERNATIONAL AFFAIRS, CONSUMER ELECTRONICS ASSOCIATION

Introduction

Chairman Kerry, Ranking Member Ensign, and Members of the Subcommittee:

I am pleased to accept your invitation to testify on behalf of the Consumer Electronics Association (CEA). CEA is the principal U.S. trade association of the $155 billion consumer electronics industry. CEA's more than 2,100 members are involved in the design, development, manufacturing, distribution and integration of audio, video, in-vehicle electronics, wireless and landline communication, information technology, home networking, multimedia and accessory products, as well as related services that are sold through consumer channels. CEA's members include large and small manufacturers as well as many leading retailers. CEA also produces the Nation's largest annual trade event, the International CES. We commend the Subcommittee for holding this hearing on the important issue of energy efficiency and appreciate the opportunity to provide the views of our membership.

Our members design, make and sell the products and services that keep us connected, informed and entertained. Our companies drive the U.S. economy and ensure that America remains the world's innovation leader.

The hallmarks of our industry are dynamism and rapid change. This constant innovation, complemented by voluntary programs and initiatives, is the primary driver of improved energy efficiency in our industry. In order to meet consumer expectations, it is essential that our products use electricity efficiently and effectively. Efficient use of energy minimizes heat generation, the prime enemy of component performance and longevity. Energy efficiency is also essential to minimizing costs associated with design and components, such as heat sinks. Beyond improvements in design, there also are ongoing industry trends which naturally drive, support and sustain the increasing energy efficiency of electronics. These trends include convergence, miniaturization, portability and the transition from analog to digital technology.

CEA's members are committed to energy efficiency and conservation.

For many years, the consumer electronics industry has worked cooperatively with government agencies in pursuit of successful voluntary, market-oriented programs and initiatives, such as ENERGY STAR®, which highlight and support energy efficient product design and purchasing. To date, the ENERGY STAR® program for consumer electronics and residential office equipment has saved 18.8 billion kWh of energy and avoided emissions totaling 3.8 million metric tons of carbon equivalent. Recently, consumer electronics manufacturers have focused on new industry-led standards at the national, regional and international levels that relate to and support energy efficiency. Together, these voluntary initiatives have transformed the market and delivered more energy efficient electronics to consumers and businesses.

As the consumer electronics industry's principle trade group, CEA has taken a comprehensive, multi-faceted approach to addressing energy efficiency for our industry sector. Specifically:

1. *CEA conducts research and analysis to ensure that policymakers and the public have accurate information.*

Many estimates of consumer electronics energy consumption still rely on data developed in the late 1990s. Yet, consumer electronics products have changed dramatically over the last decade, and their energy consumption characteristics have improved, particularly due to innovation as well as the success of the ENERGY STAR® program. To provide better data to policymakers, CEA commissioned a recently completed independent analysis of consumer electronics energy use that covered all significant energy-using product categories in our industry. This landmark study provides a more refined assessment than prior studies, particularly for product usage. The full report, titled "Energy Consumption by Consumer Electronics in U.S. Resi-

dences," is available on CEA's website at *www.ce.org/energy*. Among the findings are the following:

- Excluding digital televisions (DTVs), residential consumer electronics consume 11 percent of residential electricity and 4 percent of total U.S. electricity;
- Annual residential consumer electronics electricity consumption equals 147 TWh, excluding DTVs;
- There has been dramatic growth in the installed base of products, especially PCs, computer monitors, set-top boxes and DVD players;
- Active-mode power consumption varies with device type and has increased for TVs and PCs but decreased for computer monitors;
- With the exception of complex set-top boxes, standby power consumption has generally decreased, a testament to the effectiveness of the ENERGY STAR® program.

As indicated, the only significant category excluded from this study is digital televisions. The existing standard for measuring TV energy consumption in on-mode is outdated and inappropriate for measuring power consumption for today's digital televisions. To address this issue, an international industry standards development committee involving a wide variety of private and public sector stakeholders recently completed the draft of a new standard that will provide a fair measurement of TV energy use across all types of DTV displays. Simultaneously, CEA initiated a project to collect TV power consumption data using the new international draft standard so that CEA's overall energy use study can be updated this summer. The DTV data also will be provided to support the ENERGY STAR® program, which is revising its specification for televisions.

As noted above, standby power consumption has not decreased for the category of set-top boxes, which includes cable and satellite set-top devices. Currently, there is no ENERGY STAR® program covering set-top boxes. CEA believes this product category represents an important opportunity for ENERGY STAR®, and CEA is working with the U.S. Environmental Protection Agency which this spring began development of a new ENERGY STAR® specification for set-top boxes.

In addition to our energy use analysis, CEA commissioned another study, to be completed this week, which examines the energy-saving and emissions-reducing benefits of using consumer electronics products for telecommuting and e-commerce. Telecommuting reduces energy consumption associated with transportation to and from the office and, in some cases, a portion of the energy associated with commercial office space. The draft final version of this study estimates that telecommuting today reduces energy consumption by an amount equivalent to the annual electricity consumption of between approximately 0.8 million and 1.1 million U.S. households.

2. *CEA has been a leader in developing industry standards supporting energy efficiency.*

The industry standards setting process is an important forum for developing standards relevant to energy efficiency. CEA, an American National Standards Institute-accredited standards development organization, has developed two voluntary industry standards related to energy use in set-top boxes. As noted earlier, CEA and its members also have supported the development of a new international industry standard for measuring power consumption for today's digital televisions, as the current decades-old standard is inappropriate for today's DTVs.

3. *CEA informs consumers about the energy use of consumer electronics.*

CEA believes that our industry has a responsibility to inform consumers about the energy use of their products. This year, CEA launched a new consumer education initiative built on *myGreenElectronics.org,* a comprehensive resource focused on the energy-conscious and environmentally responsible use of consumer electronics at all phases of a product's life cycle. The energy efficiency portion of the site presents common-sense consumer tips for saving energy with electronics. Additionally, CEA added an energy-use calculator to *myGreenElectronics.org* which allows consumers to calculate and understand, in terms of watts and dollars, how much is required on average to power their electronic products. Finally, the website includes a tool that enables consumers to search for products for which energy efficiency is a selling point.

4. *CEA showcases and promotes energy-efficient products.*

CEA has used the International CES as a platform to highlight the importance of energy efficiency and conservation, including displays of energy efficient products and technologies; conference sessions on energy efficiency and public policy; and an eco-design award for environmentally-friendly products.

In addition, CEA organized an energy efficiency product technology demonstration on Capitol Hill on May 16, 2007, which highlighted energy efficiency and innovation in several product categories, including desktop and laptop computers, cable set-top boxes, and televisions.

The best way to encourage improved energy efficiency in the consumer electronics industry is through the ENERGY STAR® program.

The market for consumer electronics is dynamic, highly competitive and characterized by rapid innovation, significant time-to-market pressures, rapid rates of market penetration, and rapid transition from one technology to another. Consumer electronics products are vastly different by design, function, consumer use and performance than the residential, industrial and commercial appliances and electro-mechanical equipment that have been subject to the U.S. Department of Energy standards and rulemaking process.

Unlike residential, industrial and commercial appliances, which tend to be designed for a single purpose, consumer electronics typically offer several features and functions and are used in at least three ways that distinguish them from appliances. First, people use consumer electronics to communicate with one another; they also use consumer electronics for entertainment; and, finally, people use consumer electronics to receive and store information.

In light of these characteristics and considerations, the best public policy for encouraging and supporting energy efficiency in the consumer electronics industry is the ENERGY STAR® program. This government-industry partnership program, which covers more than a dozen major categories of electronics, provides the necessary flexibility, market-orientation, competitive incentive and consumer recognition that support energy efficiency for our dynamic industry. Most importantly, ENERGY STAR® has a long and established track record of success.

As a voluntary, consumer-oriented program, ENERGY STAR® has resulted in significant energy savings and reduced greenhouse gas emissions.

The consumer electronics industry is a strong supporter of the voluntary, market-driven and national approach to saving energy represented by the Federal ENERGY STAR® program (*www.energystar.gov*). This successful government-industry effort, which benefits from strong participation by manufacturers, captures a broad range of consumer electronics and creates a competitive incentive for energy savings. The ENERGY STAR® program, coupled with the natural trends toward energy efficiency in electronics design, provides consumers with the products and features they demand, along with a logo recognized by almost two-thirds of consumers.

ENERGY STAR® is clearly the best policy approach to saving energy in the consumer electronics sector, and it has resulted in significant energy savings and reduced greenhouse gas emissions. As noted earlier, the ENERGY STAR® program for consumer electronics and residential office equipment has saved 18.8 billion kWh of energy and avoided emissions totaling 3.8 million metric tons of carbon equivalent, according to the U.S. Environmental Protection Agency's latest annual report on ENERGY STAR®. In addition, according to EPA, consumer electronics accounted for 31 percent of energy saved by all residential products in the ENERGY STAR® program. Finally, consumer electronics including computers and monitors represent 55 percent or 1.1 billion of the two billion purchases of ENERGY STAR® products since 1992.

While continuing to target and reduce power consumption of products in low-power standby mode, ENERGY STAR® is evolving to address active mode power consumption.

For most of its history with consumer electronics, the ENERGY STAR® program has focused on reducing standby-mode power consumption. Recently, ENERGY STAR® has begun to take a more holistic view of a product's energy use by considering active-mode electricity use as well. The ENERGY STAR® specifications for computers and imaging equipment take into account both active and standby mode power consumption. The revised ENERGY STAR® specification for televisions as well as the new ENERGY STAR® specification for set-top boxes also will take into account active mode energy use in addition to standby. For these and other consumer electronics products, the consideration of active mode power use presents new challenges related to operating modes, product features, and consumer usage patterns. CEA and its members will continue to work closely with EPA to ensure outcomes that achieve energy savings while protecting innovation and consumer choice.

Despite its success, the ENERGY STAR® program is threatened by unnecessary regulation at the state level.

In 2005, the California Energy Commission (CEC) imposed unprecedented regulations limiting the energy consumption of several categories of consumer audio and video products as well as external power supplies, also known as AC power adapters, which are used with a wide range of consumer and commercial products. We

support the CEC's focus on energy use, but we are very concerned about the CEC's specific approach.

To support its regulations for consumer audio and video products, the CEC relied on outdated and inaccurate information about energy consumption which led to erroneous conclusions about cost-effectiveness and energy savings. Moreover, for one particular product category not yet on the market in the U.S., digital television converter boxes, the CEC relied on claims that tens of thousands of units were already in the hands of California consumers.

Of particular concern relevant to ENERGY STAR® is that the CEC's new mandatory regulations for consumer audio and video products and external power supplies are based on the voluntary thresholds established within the ENERGY STAR® program. Though the ENERGY STAR® specifications on which the CEC based its regulations have been superseded by new ENERGY STAR® specifications in several cases, they were never intended as nor negotiated to be mandatory limits after any set period of time. For external power supplies, the CEC's mandatory regulations are identical to the voluntary ENERGY STAR® specifications for this same category. These voluntary criteria for power supplies had just been negotiated by ENERGY STAR® program representatives and industry several months prior to the CEC's action which made them mandatory.

The success of the ENERGY STAR® program is in fact due to its voluntary nature. ENERGY STAR® program criteria are the result of broad industry participation, careful negotiation, and recognition of market and technological facts and limitations. Contrary to the spirit and purpose of the ENERGY STAR® program, the California Energy Commission, in its revised Appliance Efficiency Regulations, created mandatory regulations based on voluntary specifications. The CEC's action threatens to undermine the future success of the ENERGY STAR® program itself. Once the voluntary ENERGY STAR® program criteria are viewed as potential mandates, uncertainty among manufacturers increases, and the negotiations leading to the program criteria would be altered. In a recent CEA member survey, more than half of respondents indicated that mandatory standards based on ENERGY STAR® program criteria would discourage future participation in the ENERGY STAR® program. In this way, the CEC's mandatory standards for consumer audio and video products and external power supplies will weaken the national ENERGY STAR® program, with unfortunate consequences for consumers and manufacturers, as well as energy savings in general.

In light of these issues and concerns, CEA has urged the CEC to withdraw its regulations for consumer audio and video products and recognize the success of voluntary programs such as ENERGY STAR®, which better support energy efficiency in the consumer electronics market.

Conclusion

In many ways, electronics are part of an energy savings solution. Many home networking products help save energy by providing increased control over home heating, cooling and lighting systems. Information technology and telecommunications products allow teleworking and remote access to information and entertainment content, both of which save fuel and reduce greenhouse gas emissions. In addition, electronics are key enabling technologies that drive energy efficiency in various other industrial sectors such as automobiles and manufacturing.

This committee's focus on energy efficiency is important and necessary. As policymakers consider programs and policies that support the efficient use of energy, we urge Congress to support innovation and promote consumer-oriented initiatives like ENERGY STAR® which are the keys to energy efficiency achievements for the consumer electronics industry.

Thank you again for the opportunity to share CEA's position on this important public policy issue. I look forward to addressing any questions you may have.

Senator KERRY. Thank you very much, Mr. Johnson.

Mr. Birnbaum?

STATEMENT OF JAY BIRNBAUM, SENIOR VICE PRESIDENT AND GENERAL COUNSEL, CURRENT GROUP, LLC

Mr. BIRNBAUM. Good afternoon, Chairman Kerry. Thank you. I appreciate the opportunity to talk, this afternoon, about Smart Electric Grids.

CURRENT Group, my company, designs, deploys, and operates Smart Electric Grids for electric utilities. Smart Grids are crucial

for our country's national security, economic stability and development, and energy policy, overall.

Let me talk about what we—what I mean when I refer to "smart grid." We're not referring just to advanced meters or distributed energy or renewable resources, although we are talking about all of those items, as well. A "smart grid," in particular, is a stable, fully automated, self-healing distribution network that alerts the utility company immediately when problems arise in the network. It then triggers prompt and even automated preventive and proactive corrective action by the utility. This improves the utility's efficiency, and enables demand-side management and distributed energy resources, and increases the overall reliability and security of our power supplies.

If you would indulge me for 1 minute on a technical description, what we do when we create a Smart Grid is, we install sensors throughout the electric distribution grid, from the substation all the way down to an end-user premise. Even appliances can be equipped, as some of the previous panelists have mentioned, with devices that can help the utility company manage those appliances from a demand response standpoint. The utility company then can communicate with those devices over a high-speed communications system and a high-powered computing system. Right now, utility companies really don't know what goes on inside their distribution grids between the substation and the end-users, and what a Smart Grid enables them to do is not only to know what's going on, but to avoid outages, repair outages much more quickly when they do occur, and create much more efficient distribution technologies.

The Smart Grid is available today. This is not a technology of the future. CURRENT is deploying the Nation's first true system-wide Smart Grid in the Dallas/Fort Worth region of Texas. When finished, it will cover nearly 2 million homes and business. We invite you and the other members of the Subcommittee to come see it in Texas; or, if that's a little far from your jurisdiction, since we're a Maryland-based company, we actually can demonstrate it to you right outside the Capitol Beltway. Some members of the Committee staff and other members of—staff members within the Congress have witnessed this demonstration.

Because the technology is available today, Mr. Chairman, one thing that we would caution Congress about doing is trying to legislate Smart Grid technologies in such a way that, although well intended, will actually delay deployments. Further studies, additional administration-based commissions, and even Federal funding, for the most part, aren't necessary for advancing Smart Grids. What we need to do is tackle the disincentives and regulatory uncertainties that utilities have, and address those, hopefully at the Federal level, and create incentives for utility companies to actually deploy the technology. One area where Federal funding might be necessary is in—for significantly rural and other hard-to-serve areas.

Right now, the peak demand for electricity is projected to increase by 19 percent in this country over the next 10 years, yet spending for capital improvements is only supposed to increase by about 6 percent, and that tends to be more disproportionately favored toward generation and transmission, not in the local dis-

tribution grid. Ten to 20 percent of electricity is actually lost, by the time it is generated, before it actually reaches the end-user, due to faults and inefficiencies in the distribution and transmission systems, and a Smart Grid can actually address a lot of these inefficiencies.

We've all seen examples of the vulnerabilities of our local distribution networks. The most well known is perhaps the August 1993 blackout, but we've had a number of storm-related and power-supply related outages. All of our local newspapers have examples of problems with reliability utility companies have when their grids break down and they don't quite know why, or where, those breakdowns are occurring.

EPRI, the Electric Power Research Institute, estimates that power outages and power-quality disruptions cost U.S. businesses at least $100 billion a year, 87 percent of which, EPRI estimates, could actually be avoided by a Smart Grid. EPRI also estimates that reduced CO_2 emissions—or CO_2 emissions could be reduced by as much as 25 percent, and electric consumption, generally, reduced by as much as 10 percent through implementation of a Smart Grid.

A Smart Grid can make more use out of plug-in vehicles and renewable and distributed energy resources. For instance, you can plug your car in at night, while the energy prices are at its lowest. You can then actually draw electricity from that car and all the other cars that are parked during the day while energy prices are at their highest, thereby, saving money and actually mitigating the need for peak power plants.

Similarly, with respect to solar or wind or other renewable sources of energy that are not available 24 hours a day, 365 days a year, the utility company can match demand with those sources of energy, so you can decide to sign up to a program that not only reduces your electric consumption by turning off a pool pump or an air-conditioner or a water heater while prices are high, but also while green energy sources are not available.

For this reason, we think any renewable portfolio standards that Congress adopts should include investments in Smart Grid to the same extent as investments in renewables. The greenest and the cheapest kilowatt is the one we never have to generate.

Finally, Mr. Chairman, Federal guidelines are generally required, because utility companies, although aware of the technology—and certainly the larger utilities have access to capital to build Smart Grids—they have a number of regulatory disincentives and somewhat skewed economic incentives to build distribution plant improvements. And I'd be happy to talk to you and the—and your staff, at your convenience, about those incentives.

[The prepared statement of Mr. Birnbaum follows:]

PREPARED STATEMENT OF JAY BIRNBAUM, SENIOR VICE PRESIDENT AND GENERAL COUNSEL, CURRENT GROUP, LLC

Thank you, Chairman Kerry, Ranking Member Ensign, and members of the Subcommittee, for the opportunity to testify about Smart Electric Grids.

A Smart Electric Grid enables an electric utility to monitor and maintain a more stable, fully automated, self-healing distribution network that alerts immediately when problems arise—and then triggers prompt, or even automated, corrective action. Smart Grids will dramatically improve the efficiency of the Nation's electric

distribution infrastructure, enable demand-side management and distributed energy resources, and increase the reliability and security of the Nation's power supplies. Smart Grids are crucial to any comprehensive clean-energy policy and have the following capabilities:

- *Smart Grid enables electric utilities to—*
  - —improve efficiency through automated control and load balancing
  - —save businesses billions of dollars by preventing, pinpointing and restoring power outages and power disturbances
  - —identify and prevent theft and tampering
  - —improve diagnostics and predictive maintenance based on rich data streams never before available
  - —provide real-time monitoring of electric grid and other critical infrastructure
- *Smart Grid helps energy consumers—*
  - —enhancing demand-side management programs means lower costs, fewer new power plants, and lower emissions
  - —enabling real-time pricing and information about energy use gives consumers better control of their bills, lets market forces influence usage patterns, and lowers overall energy costs
- *Smart Grid promotes alternative energy sources—*
  - —provides monitoring and control that optimizes generation portfolios of dispersed renewable sources like wind and solar energy
  - —facilitates real-time net metering that enables distributed generation based on accurate market signals

CURRENT Group, LLC ("CURRENT") designs, develops and deploys Smart Electricity Grids. Specifically, CURRENT deploys a network of advanced sensors capable of collecting and monitoring data from the substation, transformers, meters and other electric distribution devices along the power lines, all connected through a high-speed and low-latency communications system and a distributed computing system capable of real time analysis and event prediction. The Smart Grid increases the efficiency, reliability, safety, and security of the electric distribution network and expands the capabilities and benefits of demand-side management that can lower consumers' energy bills and reduce the need to build more greenhouse-gas emitting generation plants.

To deploy the Smart Grid, CURRENT overlays its state-of-the-art technology at points throughout the existing electric distribution network. No retrofitting or conditioning of the distribution electric grid is required. Once a *CURRENT*® Smart Grid is deployed, it can communicate with points anywhere along the distribution grid as well as each electric outlet inside homes and businesses. A utility therefore can monitor and control capacitor banks, transformers, switches, substations and other critical infrastructure, as well as manage Demand Response programs for end-users and measure and coordinate available distributed and renewable energy sources. CURRENT is headquartered in Maryland with offices in Texas, New York, Ohio and California.[1]

What are the Efficiency Benefits of the Smart Grid?

Each year, the Nation's 131 million electricity customers (nearly every household and business) pay about $247 billion in electric revenues, at an average price of about 7 cents per kilowatt-hour.[2] Demand for electricity is projected to grow 40 percent by 2030, which in turn will likely increase prices. That is why Smart Grid is crucial—it offers a cost-effective way to increase the amount of electricity available through greater efficiency and network reliability. In other words, a megawatt saved is even better than a megawatt generated because it costs less and because such efficiency-captured electricity is as at least as clean as solar, wind or other renewable energy resources.

The strain on the Nation's nearly 100-year old electric distribution grids is expected to worsen in coming years as already old distribution networks age further and demand for electricity outpaces the construction of new facilities. Peak demand for electricity is projected to rise by 19 percent nationally over the next decade, but

[1] Further information about CURRENT is available at *http://www.currentgroup.com.*

[2] *Overview of the Electric Grid*, U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability, Gridworks Program, available at: *http://www.energetics.com/gridworks/grid.html.*

capital committed to electric generation, transmission and distribution is expected to grow by only 6 percent during the same period.[3] Yet at the same time the Nation looks to meet rising demand, 10 to 20 percent of electric energy is lost before it reaches the end-user due to network faults or inefficiencies—inefficiencies that can be reduced by a Smart Grid.

The Electric Power Research Institute (EPRI) estimates that power outages and "blink of the eye" power quality disruptions cost U.S. businesses at least $100 billion per year.[4] Smart Grid can immediately increase the efficiency of businesses nationwide by providing utilities with real-time actionable intelligence about their networks that can be used to prevent such costly disruptions.

What are the Demand Response Benefits of Smart Grid?

Forty percent of the Nation's energy consumption is used to produce the electricity that is essential for economic prosperity and national security and electric power generation produces roughly 40 percent of the Nation's carbon dioxide emissions. As stated above, increased efficiency of existing distribution and consumption equates to making additional power available at lower costs and with less environmental impact. Such efficiencies reduce the need for constructing new generation plants and associated transmission facilities. Smart Grids can provide the communications and monitoring necessary to manage and optimize a portfolio of distributed and renewable energy resources. Indeed, since a Smart Grid is capable of reducing electricity consumption up to 10 percent by 2020, leading to a reduction of 25 percent in CO_2, it should be considered a renewable energy resource in its own right—after all, the cleanest power of all is power you do not have to use due to captured efficiencies.

The Electric Power Research Institute projects that Smart Grid-enabled distribution could reduce electrical energy consumption by 5 percent to 10 percent, carbon dioxide emissions by 13 percent to 25 percent, and the costs of power-related disturbances to business by 87 percent.[5]

A Smart Grid enables electric utilities to increase the efficiency of their existing electric distribution networks by enabling utilities in real time to collect and analyze power supply and usage data from distribution network elements and from millions of end-user devices. A Smart Grid can collect such data as often as every minute or "on demand," which provides much more information and control than systems that allow less frequent reads fewer devices or of only end-user devices or distribution elements. A Smart Grid's real-time capability allows utilities and end-users to partner in shaving peak loads enough to reduce the need for expensive new generation plants. This saves end-users money and helps to reduce greenhouse gas emissions over time—the Electric Power Research Institute (EPRI) has projected that the Smart Grid can reduced electricity consumption by up to 10 percent (comparable to or more than the supply available from renewables), reduce emissions by up to 25 percent and reduce the costs of power-related disturbances by 87 percent.[6]

Many Members of Congress are encouraging use of renewable energy resources like wind and solar energy. The Smart Grid can improve the value of such renewable resources, which in the case of wind and solar are often dependent on the time of year or prevailing conditions that can vary throughout any 24 hour period. With Smart Grid, real-time information about the availability of renewable-generated power can be combined with real-time information about the demand in any given part of the grid. For this reason, any Renewable Portfolio Standard (RPS) considered by the Congress should treat Smart Grid efficiencies as eligible for inclusion in RPS.

Although we will continue to need new and improved generation plants, including those that provide renewable energy resources like wind, biomass, and solar, the United States also must maximize the efficiency, reliability, security, and safety of the electric distribution network. Another benefit of Smart Grid is its ability to ensure that plug-in electrical vehicles are truly a clean-energy option. Although 70 percent of all cars, trucks, vans and SUVs could be powered from the electric grid, the time-sensitive demand response enabled by Smart Grid and its ability to measure distributed generation sold back into the distribution grid is necessary to maximize the environmental and economic benefits of widespread plug-in electric vehicle

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[3] The Brattle Group, *The Power of Five Percent: How Dynamic Pricing Can Save $35 Billion in Electricity Costs*, Discussion Paper filed with the Maryland Public Service Commission (May 16, 2007) (citing North American Electric Reliability Council, 2006 Long Term Reliability Assessment).

[4] *http://www.energyfuturecoalition.org/preview.cfm?catID=57* (citing EPRI estimate).

[5] *See* Electric Power Research Institute, *Electricity Sector Framework for the Future: Achieving the 21st Century Transformation* (Aug. 2003), page 42 ("*EPRI Report*"), copy available at: *http://www.globalregulatorynetwork.org/PDFs/ESFF*__volume1.pdf.

[6] *See EPRI Report*, page 42.

adoption.[7] Automobiles can be charged during the lowest rate periods, say at night, and be used to distribute energy back into the grid at high peak times, thereby saving money and mitigating the need for peak power plants.

Encouraging a Smart Grid also will help American companies gain and preserve market leadership in what is fast becoming a worldwide market. Countries all over the world need a modernized electric grid, and companies from the United States can be leaders in this global market. Indeed, CURRENT and other American companies already are pursuing such international opportunities, which will create high tech jobs here at home.

Why must Congress act to encourage Smart Grid?

Smart Grid is a reality today. For instance, in and around Dallas/Fort Worth, Texas, CURRENT is presently deploying the Nation's first true Smart Grid with Oncor Electric Delivery. This system, which ultimately will reach almost two million homes and businesses, is already reading advanced meters at 15-minute intervals; conducting network monitoring that can detect problems *before* they cause power outages, safety hazards or system quality problems; and providing power outage and restoration detection if outages do occur.

Although CURRENT is deploying the first Smart Grid today, utilities in general are slow to embrace new technologies largely because of regulatory uncertainty and economic disincentives. Federal action to address both of these issues is essential to accelerate Smart Grid deployments. Utilities often anticipate that their discretionary adoption of new technology may be politically challenged or that cost recovery will be denied after the fact. An even greater disincentive faces a utility that might seek to create efficiency or encourage lower consumption. Under traditional regulatory models, a utility profits by selling energy. There is no real incentive for a for-profit entity to spend money in order to earn less. As a result, utilities have strong regulatory and financial incentives to spend money on more traditional items, such as new power generation plants, rather than acquiring new technology to make more efficient use of existing power. An added aspect of such disincentives is that a utility can earn a much higher rate of return on new generation plants than on conservation, so utilities accordingly can be expected to spend more on such traditional assets.

As a result of the aging distribution networks, skyrocketing demand, the increasing costs of building generation plants, and the existing disincentives for change, CURRENT believes Federal legislation in this area is essential. We suggest Congress consider various incentives for utilities, including grant programs (particularly to small utilities that want to adopt Smart Grid), tax incentives, accelerated depreciation, financial incentives for energy efficiency spending, and inclusion of Smart Grid in any Renewable Portfolio Standard. Suggested investment incentives would include the following:

Renewable Portfolio Standard—since Smart Grid can reduce electricity consumption by up to 10 percent (an amount comparable to renewables), a utility's deployment of a Smart Grid should be included in any Renewable Portfolio Standard.

Cost Recovery—utilities should have the certainty of knowing that they can include in their rates the actual costs of investing in Smart Grid systems.

Enhanced Return—utilities should be permitted to earn an enhanced return on their investment in Smart Grid systems, including a return on a portion of their operating and maintenance expenses, to induce utilities to spend on Smart Grid investments.

Retained Savings—As an alternative to an actual return on operating and maintenance expenses, utilities could be permitted to retain a meaningful portion of the savings resulting from such expenses to the extent they result in efficiencies that otherwise would be passed on to end-users (thereby producing a return on the utility's expenditure).[8]

Obsolete Equipment—A utility should be able to recover the costs of equipment rendered obsolete by its deployment of a Smart Grid system, based on the remaining depreciable life of the obsolete equipment.

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[7] Pacific Northwest National Laboratory Study, available at: *http://www.pnl.gov/news/release.asp?id=204* (Dec. 11, 2006).

[8] This is especially applicable since O&M expenditures to implement a Smart Grid will cost the utility, and therefore its rate payers, less than if the utility were to capitalize the entire cost of building the Smart Grid.

Regulatory Reform—States are vital players in the regulation of the Nation's electric infrastructure, but should not be allowed to prohibit or impede a utility's deployment of a Smart Grid system on its distribution facilities.

Although CURRENT encourages Congress to act now to encourage the further and nationwide deployment of the Smart Grid, it is important that any legislation first do no harm. CURRENT would like to underscore the delays that will result if legislation were to focus too much on items that, although well-intended, would in fact delay Smart Grid deployments, such as additional studies, demonstration projects, and creation of additional agencies. The technology needed for a Smart Grid already exists. The savings available from a Smart Grid are also demonstrable today. More study is not necessary. What is needed is to remove existing regulatory constraints and to create affirmative incentives for rapid action. As was the case decades ago when the Rural Electrification Act helped to wire the Nation, Congress should act to ensure that the benefits of a Smart Grid become available to all Americans as swiftly as possible.

Senator KERRY. I look forward to that. Thank you very much.

Mr. Hicks, you're the cleanup.

STATEMENT OF TOM HICKS, VICE PRESIDENT, LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGNS (LEED®), U.S. GREEN BUILDING COUNCIL

Mr. HICKS. Thank you.

My name is Tom Hicks, and I'm the Vice President of LEED, which is the nationally recognized green-building rating system administered by the U.S. Green Building Council.

USGBC is a nonprofit coalition of more than 9,500 private, nonprofit, and governmental organizations working to transform the building design, construction, and operations. Our vision is simple, that all buildings achieve sustainability within a generation.

Thank you for your leadership in this area, Senator Kerry, and for providing us the opportunity to talk with you today.

Across the spectrum of green building, new products, new services, and new ways of tackling building process are emerging, laying the foundation for what stands to be one of the greatest market evolutions in history. USGBC helps bring these innovations to market quickly, using its role as a market educator to provide the knowledge transfer that integrates new ideas and technologies into building practice.

One key venue is USGBC's annual Green Build International Expo and Conference, which, last year, attracted 13,000 professionals, featured almost 1,000 exhibitors, and had 12 full educational tracks in all aspects of green building, setting up the mechanism for ongoing technology and idea-sharing.

USGBC also encourages the introduction of new ideas, technologies, and scientific advances directly into the LEED rating system. Many of these innovations are focused on optimizing energy performance. That's critical, because every year, buildings are responsible for 39 percent of the U.S. CO_2 emissions, 70 percent of the U.S. electric—electricity consumption. They also use 15 trillion gallons of water and consume 40 percent of raw materials globally.

Green buildings are an immediate and measurable path toward energy independence and slowing climate change. Green buildings use an average of 36 percent less energy than conventional buildings, with a corresponding reduction in CO_2 emissions. In fact, if half of all new construction in the U.S. were built to that standard,

it would be the equivalent of taking more than 1 million cars off the road every year.

Green buildings make sense, both for the environment and for the bottom line. Studies show that, on average, LEED buildings cost less than 1.5 percent more than conventional construction, and that investment is paid back in full within the first year, based on energy savings alone.

But energy savings aren't the only story. Water conservation, reductions in construction waste and effective storm-water management not only mean savings for the building owner, but also reduce the demand on municipal infrastructures.

In fact, it's the aggregation of practices in the five key areas addressed by LEED—energy, water, indoor air quality, materials, and site—that deliver true high-performance buildings.

Health and productivity benefits are equally impressive. Studies from prestigious organizations, such as Carnegie Mellon University, demonstrate that people in green buildings have 40 percent fewer incidents of colds, flu, and asthma. Patients in green hospitals are discharged as much as 2 and a half days earlier. And children in green schools score up to 18 percent better on test scores.

The lower operating costs associated with the LEED-certified buildings are resulting in buildings with higher net operating income, and thus, higher asset value than their conventional counterparts. Leading institutions, including Bank of America, PNC Bank, Goldman Sachs, Citigroup, Wells Fargo, and CB Richard Ellis have all embraced LEED.

Insurance companies, including AIG and Fireman's Fund, now offer premium discounts for green buildings. Today, 889 buildings have been certified, and 6,700 more are in process, totaling 1.1 billion square feet. Every business day, $100 million worth of construction registers with LEED. There are LEED projects in every State and in 26 countries, and, increasingly, building owners and developers are choosing to certify their entire building portfolios.

The LEED rating system addresses all building types, from the individual home to commercial office buildings to large-scale developments. It also addresses the full building life cycle, from construction to operations to renovations.

As green buildings are integrated into the mainstream, costs come down, aggregate benefits go up, and the whole of the market is driven to innovation. It is the case study for how even a large and fractured industry, one that represents 14.2 percent of the U.S. GDP, can change itself from the inside out, and how environmental achievements can be won side by side, with powerful economic results.

USGBC is committed to our mission, because green buildings save energy, reduce CO_2 emissions, conserve water, improve health, increase productivity, and cost less to operate and to maintain. Green buildings are becoming highly prized assets and a critically important part of the solution to global climate change and energy independence.

Thank you, again, for the opportunity to address you today. We look forward to working with you to accelerate transformation of the built environment to sustainability.

Thank you.

[The prepared statement of Mr. Hicks follows:]

PREPARED STATEMENT OF TOM HICKS, VICE PRESIDENT, LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED®), U.S. GREEN BUILDING COUNCIL

Thank you for providing the U.S. Green Building Council (USGBC) with the opportunity to testify on the benefits of green buildings. We commend Chairman Kerry for his leadership in this critical area.

My name is Tom Hicks, and I am USGBC's Vice President of LEED, USGBC's green building rating system that has become the leading national rating system for evaluating and certifying green buildings. It is a privilege to talk with you about the role of the Council and the LEED® (Leadership in Energy and Environmental Design) Green Building Rating System™ in addressing the urgent challenge of energy efficiency and climate change, and the many far-reaching benefits of green building.

The Impact of the Built Environment

Buildings are an essential element of the solution to the energy, resource, and climate issues our country is facing.

Buildings have a lifespan of 50–100 years, throughout which they continually consume energy, water, and natural resources, thereby generating significant CO_2 emissions. In fact, buildings are responsible for 39 percent of U.S. CO_2 emissions per year. If the U.S. built half of its new commercial buildings to use 50 percent less energy, it would save over 6 million metric tons of CO_2 annually, for the entire life of the buildings—the equivalent of taking more than 1 million cars off the road every year.

In addition, buildings annually account for 39 percent of U.S. primary energy use; 70 percent of U. S electricity consumption; use 12.2 percent of all potable water, or 15 trillion gallons per year; and consume 40 percent of raw materials globally (3 billion tons annually). The EPA estimates that 136 million tons of building-related construction and demolition debris are generated in the U.S. in a single year. (By way of comparison, the U.S. creates 209.7 million tons of municipal solid waste per year.)

Green buildings are a significant part of the solution to the problems of energy dependence and climate change. The average LEED certified building uses 32 percent less electricity, 26 percent less natural gas and 36 percent less total energy than a conventional building. LEED certified buildings in the U.S. are, in aggregate, reducing CO_2 emissions by 150,000 metric tons each year, which equates to taking 30,000 passenger cars off the road.

Of the various strategies that have been proposed, building green is one of the most effective for meeting the challenges of energy consumption and climate change. The technology to make substantial reductions in energy use and CO_2 emissions in buildings already exists; modest investments in energy-saving and other climate-friendly technologies can yield buildings and communities that are significantly more environmentally responsible, more profitable, and healthier places to live and work.

By addressing the whole building, from construction materials to cleaning supplies, LEED generates opportunities to reduce emissions and environmental impact throughout the supply chain and the complete building lifecycle. Sixty five percent of the credits in the LEED Rating System reduce the CO_2 footprint of the building. The avenues by which LEED mitigates climate change include:

Energy

LEED awards credits for reducing energy use in buildings through such means as installing energy efficient heating and cooling systems; using renewable power (*e.g.,* daylight, solar heating, wind energy); requiring building commissioning; and purchasing green power.

Water

On average, a LEED certified building uses 30 percent less water than a conventional building, which translates to more than 1 million gallons of water saved per year. Reducing the amount of water that needs to be conveyed to and treated by municipal wastewater treatment facilities also reduces pumping and process energy required by these systems. LEED also promotes on-site treatment of storm water to minimize the burden on municipal treatment systems.

Materials

LEED buildings use fewer materials and generate less waste through measures such as reusing existing building structures whenever possible; developing a construction waste management plan; salvaging materials; using materials with recycled content; using local materials; and implementing an on-site recycling plan. Reduced materials consumption lowers the overall embodied energy of the building, which has a direct impact on the building's carbon footprint.

Transit- and Density-Oriented Development

LEED buildings earn credits for being located near public transportation. LEED also rewards car pooling; using hybrid or electric cars; and bicycling or walking instead of driving. In addition to the emissions produced by the cars themselves, the infrastructure required to support vehicle travel increases the consumption of land and non-renewable resources, alters storm water flow and absorbs heat energy, which exacerbates the heat island effect.

Green Building Trends and Market Transformation

Just a few years ago, green building was the domain of a vanguard of innovative practitioners. Today, green building is being rapidly adopted into the mainstream of building practice in both the residential and commercial sectors. McGraw-Hill Construction forecasts that the combined annual commercial and residential green building markets will total $62 billion by 2010.

USGBC's LEED Green Building Rating System serves as an essential, proven tool for enabling this market transformation. Equally as important as recognizing leading practice through third-party certification, LEED has given the community of building design, construction, and management professionals a concise framework for best-practices in high-performance green building design and operations.

To date, there have been 889 LEED-certified buildings worldwide, with the majority in the United States. In addition, more than 6,700 commercial building projects have enrolled with USGBC, and are pursuing certification. In total, 1.1 billion square feet of construction space is being built to meet LEED, and that figure grows daily.

The growth is manifest in USGBC's green building professional accreditation program as well. Since the program's launch in 2002, more than 36,000 professionals from all disciplines have become LEED Accredited Professionals (LEED APs).

The LEED Rating System was originally developed for new commercial construction projects, and the rapid uptake of the program demonstrated that the market needed additional tools to address different building types and lifecycle phases. USGBC released rating systems for the operations and maintenance and commercial interiors markets in 2006, and is currently pilot-testing rating systems for homes and neighborhood developments. Already, more than 6,000 homes and 200 builders are participating in the LEED for Homes pilot test; nearly 200 homes have been certified to date. LEED for Neighborhood Development, which integrates principles of smart growth, urbanism, and green building at the neighborhood level, is also being pilot-tested. More than 350 projects have enrolled for consideration for the pilot. USGBC recently launched LEED for Schools, and is completing rating systems for healthcare facilities, retail, labs, and campuses.

In addition, USGBC is currently piloting a new LEED program for portfolio performance that meets the needs of large owners of commercial real estate who are seeking to green their entire real estate portfolios. This innovative approach provides cost-effective solutions to improve building performance across entire companies and organizations. The goal is to facilitate immediate and measurable achievements that will contribute to long-term sustainability. The portfolio program focuses on the permanent integration of green building and operational measures into standard business practice. USGBC is working with 26 market leaders as a part of the pilot, including American University, Bank of America, California State University—Los Angeles, Cushman & Wakefield, Emory University, HSBC, N.A. , PNC Bank, State of California Department of General Services., Syracuse University, Thomas Properties Group, Transwestern, University of California at Merced, University of California at Santa Barbara, University of Florida, and USAA Real Estate Company.

Green Building and Innovation

Across the spectrum of green building, new products, new services and new ways of tackling building process are emerging, laying the foundation for what stands to be one of the greatest market evolutions in history. USGBC takes seriously its role in helping these innovations come to market quickly, and uses its role as market educator to provide the support and visibility these kinds of advances deserve. One

key venue is UGBC's annual Greenbuild International Expo and Conference, which last year attracted more than 13,000 attendees, featured almost 1,000 exhibitors, and 12 full educational tracks in all aspects of green building, setting up the mechanism for ongoing technology and idea sharing.

USGBC also encourages the introduction of new ideas and scientific advances directly into the LEED rating system through Innovation in Design credits, which can be introduced and tested by individual project teams before being put out for public comment and balloted through the consensus membership process.

Green building technologies touch every element of green building design—from site selection, to water and energy efficiency and management, to indoor environmental quality, to recycling of construction waste.

Many of these innovations are focused on optimizing energy performance, and reduce environmental impacts associated with excessive energy use. The fluorescent lamp, for example, saves three-quarters of a ton of carbon dioxide and 15 lbs of sulfur dioxide. It also saves $30 to $50 over the life of the bulb because it uses 75 percent less energy and lasts 10 times as long.

ENERGY STAR® has been a significant catalyst for the development of energy efficient appliances for office buildings, ranging from computers and copiers to printers and water coolers. All save on the amount of electricity used, reducing the demand for energy.

Green buildings have also been a significant driver for renewable energy resources, by encouraging on-site renewable energy in order to reduce environmental impacts associated with fossil fuel energy use. Some of the innovations in this area include:

- Biomass, where plant material is converted to heat energy in a boiler or gasifier to generate electricity. The heat is converted to mechanical energy in a steam turbine, gas turbine or an internal combustion engine, and the mechanical device drives a generator that produces electricity. Current biomass technology produces heat in a direct-fired configuration. Biomass gasifiers are under development and are being introduced to the marketplace.
- Photovoltaics (PVs) are composite materials that convert sunlight directly into electrical power. In recent years, the efficiency of the cells has increase and the cost has dropped. As a result Building-Integrated Photovoltaics (BIPVs) are increasingly incorporated into building elements such as the roof, cladding or window systems. They generate direct current electricity, which must be converted to alternating current before it can be used in mainstream building systems.
- Wind energy, where wind is converted into electricity via large rotors, has gained a lot of attention in buildings. Advances in the wind energy market include the development of a vertical-axis wind turbine which relies on simplicity of design and advanced blade configuration to create a potentially low-cost, efficient power system.
- Green roofs, where a roof of a building that is partially or completely covered with vegetation and soil, or a growing medium, planted over a waterproofing membrane. It provides amenity space for building users, reduces heating loads on buildings, cleans air, reduces storm water runoff and increases roof life span.

Research has shown that electrical lighting makes up a significant portion of energy use in buildings, especially commercial buildings. Re-designing new buildings to optimize the use of natural light or "daylighting" to replace electrical lighting in areas such as atriums, hallways, cafeterias, and playrooms can have a significant impact on energy reduction.

Electrochromic or "smart" windows save energy by controlling the amount of solar heat that passes through the window glass. For example, in winter, they lighten to allow heat to pass through the glass but not back out, reducing the amount of energy needed for home heating. In summer, they darken without blocking visible light to reduce the amount of heat coming into the home and decrease cooling costs. Electrochromic windows darken or lighten by a chemical reaction that is set off by a small voltage (you can run an entire house on the voltage required to run one traditional light bulb).

Although they can technically be classified as electrochromic materials, the new reflective hydrides that are being developed for windows behave in a noticeably different way. Instead of absorbing light, they reflect it. Thin-film solar cell material made of nickel-magnesium alloy is able to switch back and forth from a transparent to a reflective state. The switch can be powered by electrochromic or hydrogen and oxygen gases (gas-chromic technology). Furthermore, this material has the potential to be even more energy efficient than other electrochromic materials.

High-performance, whole-building design methods integrate passive solar, energy efficiency and renewable technologies to reduce building energy consumption. Many buildings use passive solar to offset significant electrical loads, such as replacing electrical lighting with natural light or "daylighting" and reducing heating and cooling loads by storing heat and cool air in building materials such as brick. Low-cost solar hot water systems can significantly contribute to reaching the goal of cost-effective energy savings greater than 50 percent in most climates.

On the horizon, there is great promise for inexpensive highly efficient nanocomposite materials for solar energy conversion and thermoelectric materials that can transform heat directly into electrical energy.

It is clear that new technologies are transforming not just what we do but how we do it, reinventing the building industry and driving market transformation.

Costs and Benefits of Green Building Using LEED

Projects enroll in LEED by registering their intent with USGBC and paying a fee of $450. Project certification fees are approximately $0.03 per square foot, and average about $4,500.

According to third-party studies published and updated by Capital E and by Davis Langdon in the past 24 months, the average total additional cost for using LEED on a project (including professional fees, materials, and systems) is 1.5 percent or less. That cost is typically repaid in the first 10 months of building operation based on energy savings alone.

For example, according to *U.S. Banker Magazine*, the greening of the Bank of America Tower, being constructed in Manhattan, is adding less than 2 percent of its projected cost. The project expects to recoup any investments through reduced electricity usage and water-saving techniques.

Harvard Business Review cites the DPR building in Sacramento, California, as having invested 1.4 percent upfront additional costs to implement green measures. The project is expected to more than make up the investment by generating over $400,000 in operations savings.

About the U.S. Green Building Council

The U.S. Green Building Council (USGBC) is a nonprofit membership organization with a vision of sustainable buildings and communities within a generation. Our 9,500 member organizations and 92,000 active individual volunteers include leading corporations and real estate developers, architects, engineers, builders, schools and universities, nonprofits, trade associations and government agencies at the Federal, state and local levels. Green buildings save energy, reduce CO_2 emissions, conserve water, improve health, increase productivity, cost less to operate and maintain, and increasingly cost no more to build than conventional structures. Because of these benefits, they are becoming highly prized assets for companies, communities and individuals nationwide.

As the developer and administrator of the LEED® (Leadership in Energy and Environmental Design) Green Building Rating System™, USGBC is a leader in green building and green development. Founded in 1993, USGBC is a 501(c)(3) nonprofit organization, an ANSI-accredited standards developer and a newly active participant in ISO technical working groups. The organization is governed by a diverse, 31-member Board of Directors that is elected by the USGBC membership. Volunteer committees representing users, service providers, manufacturers, and other stakeholders steward and develop all USGBC programs, including the LEED rating system, through well-documented consensus processes. Seventy local USGBC Chapters and Affiliates throughout the U.S. provide educational programming to local communities.

A staff of more than 85 professionals administers an extensive roster of educational and informational programs that support the LEED Rating System in addition to broad-based support of green building. USGBC's LEED Professional Accreditation program, workshops, green building publications, and the annual Greenbuild conference provide green building education for professionals and consumers worldwide.

About the LEED® Green Building Rating System™

LEED is the nationally recognized benchmark for the design, construction, and operations of high-performance green buildings. Since 2001, LEED has provided building owners and operators with design and measurement tools with the reliability and integrity they need to have an immediate, quantifiable impact on their buildings' performance.

LEED is a voluntary standards and certification program, and was developed to promote leadership in the building industry by providing an objective, verifiable definition of "green." LEED is a flexible tool that can be applied to any building type

and any building lifecycle phase, including new commercial construction; existing building operations and maintenance; interior renovations; speculative development; commercial interiors; homes; neighborhoods; schools; healthcare facilities; labs; and retail establishments.

LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas, with an additional category to recognize innovation: sustainable site development, water savings, energy efficiency, materials and resources and indoor environmental quality. Each category includes certain minimum standards ("prerequisites") that all projects must meet, followed by additional credits that are earned by incorporating green design and construction techniques. Four progressive levels of LEED certification—Certified, Silver, Gold and Platinum—are awarded based on the number of credits achieved. USGBC provides independent, third-party verification that a building meets these high performance standards.

USGBC member committees develop the LEED Rating System via a robust consensus process that enables USGBC to incorporate constantly evolving practices and technologies. The key elements of the process, which USGBC has refined over more than a decade of leadership experience, include a balanced and transparent committee structure; Technical Advisory Groups to ensure scientific consistency and rigor; opportunities for stakeholder comment and review; member ballot of new rating systems and substantive improvements to existing rating systems; and a fair and open appeals process. Details about the LEED development process are publicly available on the USGBC website, *www.usgbc.org*.

USGBC is continuing to advance the market with the next evolution of LEED, which will harmonize and align LEED rating systems and versions, as well as incorporate recent advances in science and technology. Congruent with this effort, USGBC is introducing a continuous improvement process into LEED, which will create a more flexible and adaptive program and will allow USGBC to respond seamlessly to the market's evolving needs. Particular focus areas include technical and scientific innovations that will improve building performance; the applicability of LEED to the marketplace, in order to speed market transformation; and the customer experience, to ensure that LEED is an effective tool for the people and organizations using it.

The inclusion of Life Cycle Analysis (LCA) is an important step in the technical development of LEED. USGBC's Life Cycle Assessment working group has developed initial recommendations for incorporating Life Cycle Assessment (LCA) of building materials as part of the continuous improvement of LEED.

LCA holistically evaluates the environmental impact of a product throughout its life cycle: from the extraction or harvesting of raw materials through processing, manufacture, installation, use, and ultimate disposal or recycling. USGBC's long term objective is to make LCA a credible component of integrated design, thereby ensuring that the environmental performance of the whole building takes into account the complete building life cycle.

In 2006, citing the qualities outlined above, the U.S. General Services Administration submitted a report to Congress concluding that LEED is the "most credible" of five different rating systems evaluated. The GSA currently requires its new buildings to achieve LEED certification.

Building projects are enrolled in the LEED program by registering their intent with USGBC through LEED Online. After the building is constructed, the project teams submit proof-of-performance in the form of online documentation through LEED Online. LEED Online was developed through a partnership with Adobe Systems Inc.

Expert certification teams review and verify project documentation, and award LEED Certified, Silver, Gold, or Platinum certification based on the number of credits the project achieves based on a sliding scale.

LEED and the Government

Governments at all levels have been highly influential in the growth of green building, both by requiring LEED for their own buildings and by creating incentives for LEED for the private sector. From the Department of Energy's support for the initial development of LEED, to the Federal Energy Policy Act of 2005, to the many cities and states that have adopted LEED, the public sector has demonstrated considerable vision and leadership in the transformation of the built environment. Currently, 12 Federal agencies, 22 states and 85 local governments have made policy commitments to use or encourage LEED.

The Federal Government has been a particularly strong supporter of USGBC and LEED. The U.S. Department of Energy enabled the development of LEED with a $500,000 grant in 1997, and has also provided USGBC with $130,000 in grants to support the Greenbuild Conference and Expo. Staff from the national laboratories,

FEMP and other program areas have actively shared their expertise to develop and refine LEED. USGBC has also collaborated with DOE's Office of Energy Efficiency and Renewable Energy with Building Green on the High Performance Buildings Data base.

The U.S. General Services Administration—which is the Nation's largest landlord—requires its new buildings and major renovation projects to achieve LEED certification. As mentioned previously, GSA also submitted a report to Congress affirming that LEED "continues to be the most appropriate and credible sustainable building rating system available for evaluation of GSA projects." In particular, GSA noted that LEED applies to all GSA project types; that it tracks the quantifiable aspects of building performance; that LEED is verified by trained professionals and has a well-defined system for incorporating updates; and that it is the most widely used rating system in the U.S. market.

Government leadership will continue to be essential to the advancement of green building. USGBC supports targeted, viable government initiatives that facilitate market transformation, including:

- The creation of an Office of High-Performance Green Buildings within the U.S. General Services Administration to coordinate green building research, information dissemination and other activities, as provided by S. 506, the High-Performance Green Buildings Act of 2007.
- The expansion of the Office Director's duties that would facilitate: metering, sub-metering and continuous commissioning of Federal buildings in order to measure energy use and to ensure that building systems are delivering the efficiencies for which they are designed; agency reports on their CO_2 reductions using the existing energy targets required by Federal law; establishment of green building education and training programs for Federal agency staff in order to ensure that the capability exists to achieve agency sustainable building goals.

Research

In a March 2007 report, USGBC found that research related to high-performance green building practices and technologies amounts to only 0.2 percent of all federally funded research. At an average of $193 million per year from 2002 to 2005, research spending is equal to just 0.02 percent of the estimated value of annual U.S. building construction. These funding levels are not commensurate with the level of impact that the built environment has on our Nation's economy, environment and quality of life. USGBC recommends that total annual Federal funding equate to 0.1 percent of annual construction value, $1 billion.

Furthermore, USGBC has identified the following eight research program areas toward which such funding should be applied: Life Cycle Assessment of Construction Materials; Building Envelope and HVAC Strategies; Lighting Quality; Transportation-Related Impacts of Buildings; Performance Metrics and Evaluation; Information Technology and Design Process Innovation; Indoor Environmental Quality; and Potable Water Use Reduction in Buildings.

High Performance Schools

In the U.S., more than 55 million students and more than 5 million faculty, staff, and administrators spend their days in school buildings. These buildings represent the largest construction sector in the U.S.—$80 billion in 2006–2008—which means that greening school buildings is a significant opportunity to make a major impact on human, environmental, and economic health.

Most important, children in green schools are healthier and more productive. Design features including attention to acoustical and visual quality, daylighting, and color have a profound impact on children's ability to learn. Green schools also have superior indoor air quality and thermal comfort, and expose children to fewer chemicals and environmental toxins—which has been linked to lower asthma rates, fewer allergies, and reduced sick days.

Green schools cost less to operate and greatly reduce water and energy use, which generates significant financial savings. According to a recent study by Capital E, if all new school construction and school renovations went green starting today, energy savings alone would total $20 billion over the next 10 years. On average, a green school saves $100,000 per year—enough to hire two new teachers, buy 500 new computers, or purchase 5,000 new textbooks. The minimal increase in upfront costs—on average less than $3 per square foot-is paid back in the first year of operations based on energy savings alone.

To further this effort, USGBC supports Federal authorization and funding of K–12 green school demonstration projects in targeted school districts throughout the country. Such a directive must also include a requirement that the buildings are

constructed so that they can serve the students as teaching tools on green building design, construction and operation.

Conclusion

The U.S. Green Building Council is a coalition of leaders from every sector of the building industry working to transform the way buildings and communities are designed, built, and operated through market-based tools. USGBC's LEED® (Leadership in Energy and Environmental Design) Green Building Rating System™ has become a nationally accepted benchmark for high-performance green buildings.

In just 7 years, LEED has had a significant, positive impact on the building marketplace. LEED was created to establish a common standard of measurement for what constitutes a "green" building, and provides independent third-party validation of a building's green features. LEED provides building owners and operators with the tools they need to make an immediate and measurable impact on their buildings' health and performance, which is why more than 1.1 billion square feet of construction space is being built to LEED standards. The impact is growing: Every business day $100 million worth of construction registers with LEED; 50 people attend a USGBC training course; 20 people become LEED Accredited Professionals and four organizations join USGBC as members.

Green building is essential to environmental, economic, and human health. Annually, buildings account for 39 percent of U.S. primary energy use; 70 percent of U.S. energy consumption; use 12.2 percent of all potable water, or 15 trillion gallons per year; and consume 40 percent of raw materials globally (3 billion tons annually). The EPA estimates that 136 million tons of building-related construction and demolition debris is generated in the U.S. in a single year.

Buildings are an essential part of the solution to mitigating climate change and establishing energy independence. The average LEED certified building uses 32 percent less electricity, 26 percent less natural gas, and 36 percent less total energy than a conventional building. LEED certified buildings in the U.S. are in aggregate reducing CO_2 emissions by 150,000 metric tons each year, which equates to 30,000 passenger cars not driven. Building green is a highly effective strategy for meeting the challenges ahead of us. The technology to make substantial reductions in energy use and CO_2 emissions in buildings already exists, which means that modest investments in energy-saving and other climate-friendly technologies can yield buildings and communities that are significantly more environmentally responsible, more profitable, and healthier places to live and work.

Federal, state, and local governments have been instrumental in the growth of green building, both by adopting green building themselves and by encouraging it in the private sector. The government's continued leadership will be essential to ongoing advancements in this area. Significant opportunities exist in increasing Federal funding for green building research and in Federal support for the design and construction of green schools.

Thank you again for the opportunity to present the views of the U.S. Green Building Council. We look forward to working with you to facilitate the transformation of the built environment to sustainability.

Senator KERRY. Thank you, Mr. Hicks.

Thank you, all of you. I think we've got a really interesting cross-section here, between those who are sort of pushing on an industry to change something, those who represent an industry that is changing something, those who are providing some of the public leadership, as well as some who are designing systems. And you can see the cross-section of the ways in which a whole bunch of people get pulled into a terrific economic enterprise. At the table, I think, there's a living example of the upside of all this.

Mr. Hicks, first of all, congratulations to LEED. The numbers of people that I am increasingly meeting around the country, somebody will brag to me, "Wow, you know, we're a LEED platinum building,". Right here in Washington we've got the Sidwell Friends School. I've met several members of the Board of Trustees who come up and make a point of bragging on the school and what they've achieved in this building. And, likewise, I was visiting Biogen, up in Cambridge, Kendall Square has a superb building. It's won awards. The sun comes up, and the blinds open up more.

It's computer-driven. And as the sun moves, then the blinds change. The creativity is enormous. I think you folks have had a good chunk of helping people to be aware.

Let me understand what you're doing to make sure that everybody who touches a building is beginning to become aware of you. How do you do that? What's your outreach, and what do you need to, sort of, raise the level of awareness even more?

Mr. HICKS. Thank you. Well, I believe what we're seeing is just a representation of what's going on in society today and across—not only in this country, but across the globe, in—just an interest in protecting our resources. I think what we're doing, and what LEED encourages, is really an integrated approach to the design, the construction, and the operations of buildings. And so, that really, necessarily, includes people from around the building, those that are not just designing the building, the architects and the engineers, but also those who are occupying the building, who are paying the bills. And in the current paradigm, that really doesn't exist, where it's really those——

Senator KERRY. So, what do you do to reach them? How do you proactively go out and make sure people are aware of these standards and of the possibilities?

Mr. HICKS. Well, I think it's—there's a tremendous amount of outreach that we have through our chapter network. There are 70 chapters that are members of the U.S. Green Building Council, and it's—through those efforts, there's a lot of advocacy that's been done on the local level to try——

Senator KERRY. What's your budget, annually?

Mr. HICKS. Annually, this coming year we're going to be about $40 million.

Senator KERRY. Where does that money come from?

Mr. HICKS. We have money that comes from our 9,500 member organizations that are part of the USGBC, through our educational programs, through our professional accreditation, and through our certification of LEED.

In terms of support, where we could use the most help, I think, from the Federal Government, is really in research. If you look at the federally funded research, about $1 to $2 of every $10,000 is used in green buildings, or in building research, and we'd like to see that be closer to $1 in $1,000 or $1 billion per year because of the impacts that buildings have on our society.

Senator KERRY. Well, it's a good idea. What are you able to say to people is the average cost to a current homeowner of purchasing a LEED-certified building? What's the projected payback for that person?

Mr. HICKS. It's going to follow very similar to what we're seeing on the commercial side, as well, which is typically within a year. In fact, on the commercial-building side, we're seeing it within 10 months, that that cost premium is being paid for, and that's just with the energy savings alone, that doesn't account for the water savings and the waste cost savings that might accompany that.

Senator KERRY. So, obviously it depends on the size of the home and the amount——

Mr. HICKS. Absolutely.

Senator KERRY.—but that's a pretty good payback time, 10 months.

Mr. HICKS. Absolutely. And I think what we're seeing today is that green buildings and green homes are being built for not a penny more. I think the market's maturing, and has learned how to deliver green buildings.

Senator KERRY. What are the biggest barriers that you find are keeping prospective builders and developers from planning a more energy efficient building? As you go out there, what frustrates you?

Mr. HICKS. I think it's—what's most frustrating is actually perceptions. I think it's that people get to understand the true costs and the real benefits that come—the immediate and measurable results that come from green buildings—I think, just kind of getting past that barrier of perceptions. People, necessarily, think that because it has all these wonderful qualities and delivers all these wonderful results, "Oh, it must cost more." But that, in fact, is not the case. And studies—recent studies are showing that, again, buildings are being built to green, to LEED standards, for not a penny more.

Senator KERRY. Are you finding that the various associations, building trades, architects, et cetera, are proactively now beginning to say, "Tell us more about this," or, "How do we join in this effort?"

Mr. HICKS. Without a doubt. The Alliance to Save Energy is one. And BOMA, IFMA, ASHRAE, AIA have all been part of—we've been actively engaged with all of those folks to promulgate sustainability into their membership and into their agendas, as well.

Senator KERRY. And are you satisfied with the pace, at this point?

Mr. HICKS. The pace is—been incredible. And—but, at the same time, we can, and have to, do more. And I think, you know, my—what I do every day is look at how we can increase the capacity and scale to meet—not only meet the demand that we see today, but meet the demand that we're going to see 6 months from now and a year from now, because it's growing by the day.

Senator KERRY. Well, it's an exciting prospect, and we wish you well with it, obviously.

Mr. Birnbaum, what, for a consumer who hears you talk about a "smart grid," it sounds, kind of, "Whoa, that's out of my league. How do I tap into that? What do I do?" How do you, begin to put that down into the grassroots, if you will, so that people can understand what their role is and what's available to them?

Mr. BIRNBAUM. A good question, Senator.

The Smart Grid itself is something that the utility company obviously has to deploy before you and I, as consumers, can take advantage of it. When we talk to consumer advocacy groups, for instance, what we talk about are the savings that consumers can experience. The money, whether it's a business, can save, that we can save by signing up to demand response programs——

Senator KERRY. But do you need to get a whole bunch of homes in one community all to take part? Or could one home sign up and benefit?

Mr. BIRNBAUM. You'd want to—obviously, the larger the scale, the better. The way we approach——

Senator KERRY. Is your business plan one that is built on that scale? I would assume——

Mr. BIRNBAUM. Yes. In fact, our business model is based upon doing business, first and foremost, with the electric utility itself. So, when the utility decides to develop—deploy a Smart Grid across its entire footprint, everyone benefits, whether—whether they choose to or not, they will benefit.

Senator KERRY. How do you cost something like that out? Is it per home? Per kilowatt hour? How do you do it?

Mr. BIRNBAUM. It's usually per home, per meter, per square mile. It varies, depending on whether it's rural, suburban, urban, the utilities' cost structure. What we tend to do is, we have sophisticated business models, and we work with the utility company to plug in their costs and the potential savings, to show them how they can benefit.

Senator KERRY. What kind of technology does a home consumer have to invest in to make this happen?

Mr. BIRNBAUM. Very little. The technologies that, I think, Dr. Krebs was talking about, essentially demand response or digital load control switches, a device that you put on your water heater or your air-conditioner, and you can basically have that attached—the utility company could come attach that—and you don't need to do anything else. You would sign up for a program, give them the ability to reduce load at certain times during the day.

Senator KERRY. Do you have estimates for the amount of reduction in electricity produced in Texas or elsewhere where you've deployed?

Mr. BIRNBAUM. As far as what we expect or what we have——

Senator KERRY. What you have achieved.

Mr. BIRNBAUM. It's still—the deployment is in its infancy. We started deploying the technology last fall, so, at this point, no, but we're—we have real, live examples of outages that have been avoided, efficiencies that have been created by detecting things going on in the network, that clearly go on in every utility every day, but the utility company has no way of knowing about it until eventually it resulted in an outage, where somebody called and said, "I've lost power."

Senator KERRY. In the six policy recommendations for incentivizing the Smart Grid, is there one that's the most important? Where would you say, and what would have the most impact on the Smart Grid?

Mr. BIRNBAUM. Well, probably in the area of decoupling and cost recovery, in general. Utility companies——

Senator KERRY. You mean the billing structure.

Mr. BIRNBAUM. Yes. Yes.

Senator KERRY. You need to have the company be able to say, get rid of this incentive to actually use more electricity.

Mr. BIRNBAUM. Correct. What—utility companies look at a capital expenditure and say, "Well, if I do that, I want to be absolutely certain the utility commission in my state is going to approve that, so I can get a rate of return. Otherwise, we spend money"——

Senator KERRY. Sure.

Mr. BIRNBAUM. —"and create efficiencies, and don't get a return." So, that sort of regulatory certainty is probably the most important thing that——

Senator KERRY. Is there something we could do to more rapidly encourage the embrace of this?

Mr. BIRNBAUM. Absolutely. Just 2 years ago, Congress adopted, under PURPA, amendments that drove the states toward advanced metering technologies. A number of states have had advanced metering system proceedings. The same thing can be true of Smart Grid. I think encouragement and requirements that States either—encouraging States to have their utilities adopt, or prohibiting States from taking policies that would impede utilities from adopting Smart Grid, probably are the most helpful things we can get at the Federal level.

Senator KERRY. Mr. Johnson, all of us have wrestled with consumer home electronics, et cetera. Some of us still have VCRs that flash, and we don't know how to stop them.

[Laughter.]

Senator KERRY. I gather that, notwithstanding the increases that you've talked about, and the benefit of some of the cable boxes and so forth that are more effective now, apparently electricity usage by consumer electronics, when it's either idle or off, still cost an estimated $3.2 billion a year to the American consumer. So, what do we do to further decrease this? I mean, that seems like a pretty big grab that a lot of families would love to have back.

Mr. JOHNSON. Sure. Thank you, Senator.

I'd like to, of course, know more about what's behind that number. It's a number that I've not heard before. But what I can say about standby power in the consumer electronics industry is—it is a good news story, really—that ENERGY STAR® has focused on this for many years, starting in 1992, and now, today, addresses all major product categories in our industry with a program that, again, attempts to drive down standby power consumption in various product categories over time. And it's done a terrific job.

There's one category—you did mention cable set-top boxes—ENERGY STAR® recently launched a new specification development program for set-top boxes, specifically. So, we believe this is an important category for ENERGY STAR® to focus on.

But, really, standby power is a good news story. Our—the research that I mentioned in our testimony has shown that, over time, standby power consumption has gone down for almost all major categories of electronics. And, again, the remaining ones, set-top boxes, is now the focus of ENERGY STAR®.

Consumer electronics use approximately 11 percent of household energy, or household electricity; 2.6 percent is attributable to standby power. So, three-quarters of the time, roughly, we're talking about active-mode power consumption; oh, and one-quarter of the time, standby mode. So, it's about that proportion for consumer electronics.

Senator KERRY. We'd be happy to give you the documentation on the figures. They come from a number of different observations made by groups that are concerned about this. But is there a specific technology or some specific areas that we could encourage

greater R&D in, or deployment in, that would more rapidly have an impact on this?

Mr. JOHNSON. Well, again, this is——

Senator KERRY. I mean, an awful lot of Americans don't have a clue that some appliance they've bought is plugged in, but not on, but still drawing power.

Mr. JOHNSON. Sure. Some——

Senator KERRY. A lot of people are paying for something they're not using, and there must be some more effective technology, at this point to combat this. Barring harm that can be done to some particular kinds of appliances because they needs to remain in a warm-bulb status or something. I notice most printers, for instance, take time to warm up. You turn them on cold. But you leave them on, and they're drawing unnecessary power sometimes for weeks on end.

Mr. JOHNSON. Let me highlight a couple of things regarding standby power.

First of all, as I mentioned, it's been reduced in many categories. What remains does serve a purpose. And some products——

Senator KERRY. So, you're saying we can't go any further?

Mr. JOHNSON. I'm saying—you can always go further, but it's a question of tradeoffs and how quickly. Standby power serves to enable remote controls, it serves to enable program guides in some products, it enables a quick startup of your television, for example. So, there are important consumer benefits or features that consumers want in products, that do require a little bit of standby. So, again, the effort is to drive it as low as possible, but maintain those features that consumers want. And many printers I'm aware of, many—much—many products in the office equipment category are ENERGY STAR® compliant, and do, when they're not being used, go back to a very low standby power mode.

Senator KERRY. One of the things that you talk about is the lack of information on energy savings opportunities, sort of the back door to what I've just been talking about here. And you highlight, obviously, the upside, the ENERGY STAR® program. And I think it's a good program, a very, very important program, personally. It's done a lot of good. But I think it could do a lot more good. And the question that ought to be asked is, why are we seeing data showing that only 57 percent of the American public recognizes the ENERGY STAR® logo as a program that's aimed at energy efficiency? We've got a real barrier in consumer-awareness limits in this area. And my question is, what recommendations would you make to us that are within our grasp, or to the American consumer, for decreasing their energy inefficiency, and increasing their efficiency?

Mr. JOHNSON. I'm glad you mentioned that. Consumer education and the recognition of an energy—ENERGY STAR® is really important. And, on one hand, it requires funding and focus; on the other hand, I think it requires partnership. CEA has been focused on consumer education by providing, at the beginning of last summer, energy-saving tips for electronics. We noticed that a number of utilities in State energy offices just did not have enough energy-saving tips related to electronics and ENERGY STAR®. So, we've tried to support and complement that with our own tips. We've de-

veloped a website that gets the message out about ENERGY STAR®, where to find products that are ENERGY STAR® compliant, and also what to do with those products to help save energy. There are, I think, ways to bolster the ENERGY STAR® label, and recognition of it. You mentioned it's about 57 percent. I think our research showed it's around 60, but it's somewhere in there. But, I think, through EPA's efforts and the private sector's, we can drive that up further for electronics by leveraging what we've done online and what many retailers are doing in the store.

Senator KERRY. Well, we certainly want to work on it, and we'd love your cooperation and ideas, and we might try to figure out how we might augment this in a very significant way. When we talk about grabbing back energy, there's a big educational challenge for all of us. I think we ought to design, and think about what we can do here, to stimulate that in ways that we have done it in the drug field, we've done it in the health field in certain things, like smoking. There are different areas where we've proven pretty effective at it, and had a major impact on behavior. I think that this needs to be plus-upped significantly, and we ought to work together to think about how we're going to do that.

I see Ms. Callahan is nodding in assent, and we'll work with all of you to try to do that.

Dr. Krebs, you know, we're all watching California, obviously, with great interest, and we congratulate you and others on the very exciting and interesting choices that you all have been making out there. Can you share with me, expand if you will, on the decoupling of the financial returns of a public utility and its sales, of that mechanism. That's been key, I gather, to your ability to be able to get the Commission to move forward. It's always struck me as bizarre that we have this reverse social policy in place, where, all over the country, a lot of places reward consumers for being wasteful.

Dr. KREBS. This is not my area of expertise. I have come to recognize the importance of it as I have been working in California. There is a—there is a report that, I believe, was released sometime last year, the *National Action Plan for Energy Efficiency,* which did a detailed study of decoupling under different circumstances for different kinds of utilities, where the states' different economies are taken into account. California had the particular benefit that, when it made this choice, it was a state with a growing economy, and so that—the impacts, the costs of the change, were minimized, and the social benefits that are available wherever you do it—in every kind of a utility in every kind of a State economy, there are social benefits to the states, overall—but there are sometimes costs. And, in particular, in California we had the fortunate situation where we had a growing economy, no history to move around, and so, we reaped general benefits, not just the social benefits. But it was hugely important, because the utilities, prior to this decision on the part of the Public Utility Commission, and, subsequently, the legislature, were—basically, conservation meant you sold less electricity, you sold less natural gas, and, as a consequence, your return on investment was based on what you sold. When you basically said, "You will get so much for providing connection to electricity, and then so much for—you know, a certain percentage for

what you—for the volume you sold, but not all of your rate of return," it basically allowed them to use some of their funds for encouraging efficiency. And I think that, as the Senate and the House look at a national approach to decoupling, you need to take into account these regional issues. But I think that plan, in particular, demonstrated the different circumstances that different kinds of utilities might face, but the overall social benefit.

Senator KERRY. In your written testimony, you observed that the, I think the California research budget's about 28 million bucks. Is that right?

Dr. KREBS. Eighty million.

Senator KERRY. Eighty million.

Dr. KREBS. Yes.

Senator KERRY. That's a fund you have that supports research, development, and demonstration.

Dr. KREBS. That's correct. And it——

Senator KERRY. But 35 percent of that is allocated to efficiency and demand research, response research.

Dr. KREBS. Yes.

Senator KERRY. A smaller amount goes specifically to the efficiency/demand side, is what I'm saying——

Dr. KREBS. That's——

Senator KERRY.—the whole fund.

Dr. KREBS. That's correct.

Senator KERRY. OK. The Federal research budget, that's about 5 percent of the Federal research budget—which is $520 million, is given to this whole idea of projected increase in electricity demand predicted over the next 20–30 years. Do you think we need to do more?

Dr. KREBS. Yes.

Senator KERRY. How much more?

Dr. KREBS. Well, there have—we work——

Senator KERRY. What would be an appropriate funding level for national energy efficiency research, in your judgment?

Dr. KREBS. I would say at least double that. We've been working with colleagues at the Lawrence Berkeley National Laboratory, which is funded by DOE, and they're looking at incentives for the commercial building sector that probably are in excess of a billion dollars.

Senator KERRY. Mr. Zimmerman, thank you for being here, and congratulations to Wal-Mart for being smart. We all know they're smart in retail, but I guess this is sort of a sideline of retail, in the sense that it augments the bottom line; but it's not exactly selling a product, it's being efficient in the management of your operation. And you saw, long ago, how critical that would be.

Can you talk about the new prototype stores that are going to be more efficient than those that have been opened before? Can you just say, quickly, what technologies and innovations are currently available that other people ought to look?

Mr. ZIMMERMAN. LED lighting is probably the single biggest. We made our first application last year with LED lighting, and we are aggressively pursuing—it's in every new store that we build today, and actually will be retrofitted into 500 existing stores this year, and then next year. But it's just one application. We're working

with GE and Philips and other entities, looking at how the entire sales floor can be lit with LED.

Senator KERRY. And what kind of capital cost does it take to create this progressive lighting, I cite that all the time when I talk to people about this, in terms of hotels, where you come——

Mr. ZIMMERMAN. Right.

Senator KERRY.—out of your room, and in the hall—it's dark, and, the minute you move, it lights up; and, progressively, as you move down the hall, it gets darker behind you and lighter where you're going.

Mr. ZIMMERMAN. Right. In our specific application, it's about $50,000 per store. So, the 500 stores are—is a $25 million capital outlay. But it's immediate positive cash-flow, and it's 2-year paybacks on today's——

Senator KERRY. Two-year payback.

Mr. ZIMMERMAN.—LED prices. Two-year payback on today's LED prices.

Senator KERRY. Which will obviously go down.

Mr. ZIMMERMAN. This time next year, it'll be 12 months or less.

Senator KERRY. Well, I hope every establishment does this. This is the kind of information, Mr. Hicks, we've got to get out there. People have got to be aware of this. No new building should be designed anywhere in America that doesn't take advantage of these kinds of things.

Mr. ZIMMERMAN. Right. Two weeks ago, at GE's Ecoimagination celebration in L.A., Jeff Immelt said there are 16 other companies lined up to purchase this actual application that we developed with GE, but, until they get their new assembly line on in July, they can't deliver the product. But it—the news is picking up speed. I mean, 2-year paybacks, that's a hard investment to beat.

Senator KERRY. So, what, in your opinion, has limited the adoption of this technology by competitors and other large retailers?

Mr. ZIMMERMAN. Absolutely, first cost. I mean, even with the great payback, everything we're doing has an initial first cost. And it's because we're starting at a much more aggressive base than maybe some of Mr. Hicks' other entities he works with. But we have a first cost on all of these things. But, again, everything we're doing today, from a retrofit standpoint, has a 2-year or less payback, so it's an easy decision.

Senator KERRY. What, when you say "easy decision," do we need to take—you've done it without an incentive, and you've done it on your own. I'm trying to think about some kind of government incentive. On the other hand, the faster a lot of people start to embrace, the better off we're all going to be. What would you recommend to us, in terms of getting it out there more broadly?

Mr. ZIMMERMAN. You know, incentives would motivate some, but I think just the example of others—and, you know, you—a Wal-Mart as an example; a U.S. Capitol, as an example—you know, it's one of my bad habits, but I counted the incandescent lamps in this building—or in this room alone, and there are 100 of them, and they're new incandescent lamps. They could have been compact fluorescents behind these frosted glasses. And this time of year, with the tens of millions of high school students and college students visiting our Nation's Capitol and seeing the most energy inef-

ficient buildings they can find in the country, this ought to be another place to be an example, other than just the Wal-Mart stores of the world.

Senator KERRY. It is, and it will be, and Nancy Pelosi and Harry Reid beat you to the punch by about 2 hours.

[Laughter.]

Mr. ZIMMERMAN. Right. We met with Dan Beard yesterday, and we're going to help him with what we know——

Senator KERRY. They did big things out there. We've been pushing this for some time. In my office, I've got a whole bunch of the new lighting. It tends to be brighter but, nevertheless, makes savings. The bottom line is, you're absolutely correct, and the entire footprint of this building has to change, and it's going to be, very rapidly, now, as we get this energy bill out of here, as will a whole bunch of fleet purchasing and other kinds of procurement policies and practices within the entire Federal Government building establishment. So, I think, you know, people have finally caught on to that.

Mr. ZIMMERMAN. Right.

Senator KERRY. There's a big sea change in the offing here.

I've got to run, in a moment here, and I apologize for that, but Ms. Callahan, where do you think, beyond the comments that Mr. Zimmerman, on the building side, where in your judgment, should we be putting our emphasis to augment what you and others have been so engaged in at the grassroots level?

Ms. CALLAHAN. Well, a couple of things, if I can do cleanup, as the last one, and make comments on some of the things made. I said, in my written testimony, we think a commercial buildings initiative, funded by the Federal Government, in partnership with all the folks we're working with, the American Institutes of Architects, the labs, the U.S. Green Buildings Council, is something that needs to be done. And the order of magnitude that Dr. Krebs mentioned, it's large. We think about a $2 billion program, but if you look at it over an annual basis, you're looking at an investment of no more than 12 hours of our building stock energy cost. It's one-tenth of 1 percent of what we spend in this country each year on energy costs in buildings. So, I think that's a very important place.

You mentioned public education. The Alliance does a lot of work with the Departments of Energy, EPA, and in concert with groups and businesses from around the country, folks like Wal-Mart, and we haven't been able to capture the kind of money that's necessary to do the commercialization transformation that we're discussing here. For example, last year we cobbled together a million dollars, and the studies that we did on that—to give consumers savings tips around the home, whether it's consumer products or in the car or on the roads. But that million dollars got us $140 million—or 140 million—140 million impressions, excuse me. So, if you think about what we could do if the Federal Government actually put appropriations to the authorizations that you all had in EPAct 2005—you authorized a $400 million consumer education and outreach program on efficiency—if you just put some of that money to it, we can go far. And I'll give you an example. In New York, you cited the ENERGY STAR® label about 67 percent, I think you said—or——

Senator KERRY. Fifty-seven.

Ms. CALLAHAN. What? Fifty-seven? Fifty-seven percent. If you go to New York, where we've worked with the State and done very aggressive consumer education and outreach, that number is 80+ percent recognition, and people are—that are surveyed—are saying they're using the ENERGY STAR®—not just understanding what it is, but using it as a purchasing tool. So, it's there. That can be done.

Appliance standards, I mentioned we're trying to negotiate something right now with the lighting manufacturers. A single standard to get the cheap, inefficient, incandescent bulbs off the market, the 25-cent bulbs off the market in the next decade, that could represent the energy savings of all the appliance standards we've put in place between 1987 and 2000. So, those are just a few of the things. And I think——

Senator KERRY. Those are great.

Ms. CALLAHAN.—that's the areas—you know, it's—it is, it's R&D, public education, incentives, and then the standards. That's the four areas.

Senator KERRY. Well, those are great, and they're important. I'm going to make sure that each of my colleagues gets a summary memo of today's hearing, because I think it's really important for them to be aware of the breadth and scope of possibilities here.

I think if everybody in America could hear this kind of thing, and be more aware of it, we would make huge leaps. The key here is, really, how do you, in this multimedia unbelievable sort of cacophony of entertainment news that we all live with, get people to pay attention long enough to realize they can save some money and make some money? So, hopefully, we can get there.

I think one of the things, frankly, that ought to be part of it, the President's request for 2008 has $1.236 billion in support of the Department of Energy's Efficiency and Renewable Energy Programs. That's a 16.5 percent decrease, folks, from last year's appropriations. It's 1 percent less than 2005. So, it's downward, downward, downward. The total budget for the Department of Energy is $24.3 billion. I just don't believe, and I think every one of you agree with me, that a $1.2 billion investment in energy efficiency is adequate for this country, given where we are, what we're losing in energy inefficiency. We're paying much more than that in inefficiency. We could turn that around in a year or two, with major efforts.

When you look at the rise in electricity purchases that are predicted, and you couple that to the pulverized-coal-fired problem, in terms of the current trend line of what provides that rise, we've got a serious issue. So, this is a big, big deal, and I can assure you I'm going to spend a lot of time, have been already, and will continue to just keep this right in the face of our colleagues in each of the committees that I'm on.

We had a little setback today on the tax portion of the energy bill. But, ultimately, we'll get something through that's going to make sense. There were a lot of good incentives in there, and we're going to try, in the next days, to tie down some important things. We also have the DOD authorization coming up. There are some important defense initiatives we can take on savings, and so forth.

There's almost no bill now that comes in front of us where we don't have an opportunity to try to make a difference.

So, keep doing what you're doing, and keep us informed of what you think we can do to be more effective in helping you, as well as showing initiative on our own.

I'm greatly appreciative to you for taking time to be here today. Thank you very, very much.

With that, we stand adjourned. Thank you.

[Whereupon, at 3:49 p.m., the hearing was adjourned.]

A P P E N D I X

SMARTCOOL SYSTEMS, INC.
Vancouver, BC, Canada, June 29, 2007

Hon. JOHN F. KERRY,
Chairman,

Hon. JOHN ENSIGN,
Ranking Member,
Subcommittee on Science, Technology, and Innovation,
Committee on Commerce, Science, and Transportation,
U.S. Senate
Washington, DC.

RE: HEARING ON ENERGY EFFICIENT TECHNOLOGIES AND PROGRAMS—WRITTEN STATEMENT

Dear Chairman Kerry:

Thank you for the opportunity to present our written statement on the topic of "Energy Efficient Technologies and Programs" following last week's hearing to you, Ranking Member Ensign, and the distinguished Members of the Committee. Our company, Smartcool Systems Inc., an advanced global energy solutions company, specializes in energy and cost reduction technologies specific to air conditioning and refrigeration compressors for commercial and retail businesses.

Therefore, it is with enthusiasm that we share our experiences with the Committee by submitting for the record the attached paper titled "Electrical Energy Reduction in Refrigeration and Air Conditioning." We will be presenting at the *2007 Energex Conference* in Singapore on November 27 to 30, 2007 to an international audience of energy and environmental sector leaders and stakeholders. It is our aim to provide the Committee with further insight on the technological advances taking place specific to meeting the challenges of reducing electricity use among air conditioning and refrigeration systems.

Important factors to take away from the presentation include:

- According to the U.S. Department of Energy, the second largest use for electricity is cooling (air conditioning and refrigeration) at 15 percent. The challenge with air conditioning and refrigeration has been to develop energy reduction systems that are cost effective and less complex to install.
- In air conditioning and refrigeration systems, the compressor is the largest consumer of electricity, consuming about 70 percent in most cases. Reducing the amount of time the compressor runs will substantially reduce the amount of energy used.
- Smartcool Systems Inc.'s technology, the Energy Savings Module (ESM)™, reduces electricity consumption (kwh) and maximum demand (Kw/KVA) of compressors by improving their performance and maintaining temperature control. The ESM™ is not a controller. Instead, it is a supplement, or an interface, designed to work with existing equipment.
- Through "Compressor Optimization" the ESM™ reduces compressor running time by up to 30 percent with no affect on temperature conditions. Other technologies will impact the temperature. The ESM™'s copyrighted software also manages the suction pressure of the refrigeration or air conditioning system, allowing it to cool more efficiently.
- The *U.S. Department of Energy's Oakridge National Labs* conducted tests of the ESM™ in 2004. The results indicated a reduction of compressor kWh usage of 11.8 percent for the total test period, and 18.1 percent for the high load test period.
- The ESM™ is utilized globally by leading corporations in commercial, retail, and food service industries. For one corporation, the ESM™ demonstrated an

overall reduction in electricity use of 30 percent, resulting in a ROI of 33 percent over 36 months. The ESM™'s performance is easily measured and verifiable.

- Currently it is estimated that globally the ESM™'s are reducing electricity use each year by 213,000 Mwh and Greenhouse Gas emissions by 255,000 tons. This is enough electricity to supply a city with a population of 250,000 people.

Chairman Kerry, we contend that support from governments around the world, with the United States taking the lead, is needed to assist in the acceptance and implementation of green technologies like the ESM™. We look forward to working with you, and the Committee, to address this and the many challenges facing us so that we all can benefit from green technology.

Thank you.

Respectfully submitted,

GEORGE BURNES,
President and CEO,
Smartcool Systems Inc.

ELECTRICAL ENERGY REDUCTION IN REFRIGERATION AND AIR CONDITIONING

Ken Landymore, Director of Operations and George Burnes, President and CEO, Smartcool Systems Inc.

1. Introduction

In the coming decades, actions to limit greenhouse gas emissions could affect patterns of energy use around the world and alter the level and composition of energy-related carbon dioxide emissions by energy source.

Carbon dioxide is one of the most prevalent greenhouse gases in the atmosphere. Anthropogenic (human-caused) emissions of carbon dioxide result primarily from the combustion of fossil fuels for energy, and as a result world energy use has emerged at the center of the climate change debate.

2. Carbon Dioxide Emissions

The U.S. Energy Information Authority [1] projects that world carbon dioxide emissions will increase from 25,028 million metric tons in 2003 to 33,663 million metric tons in 2015 and 43,676 million metric tons in 2030. Much of the growth occurring in Asia (see Figure 1 & 2).

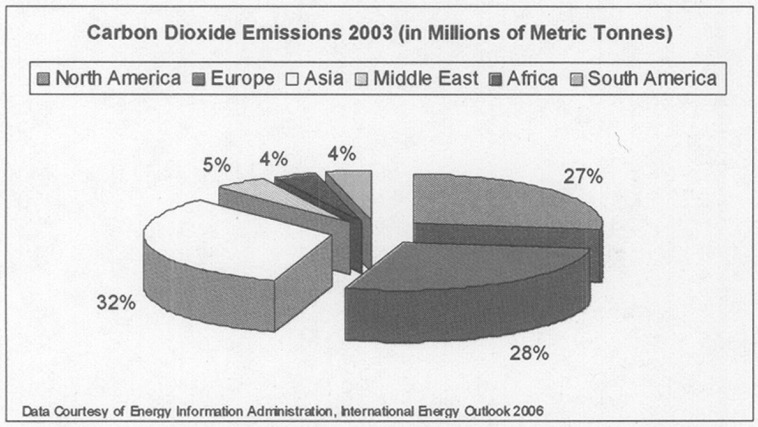

Figure 1: Worldwide Carbon Dioxide Emissions 2003

[1] Energy Information Administration Office of Integrated Analysis & Forecasting (2006) International Energy Outlook 2006.

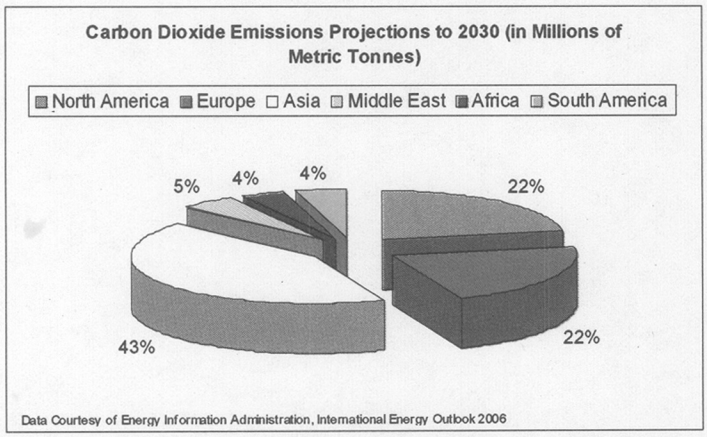

Figure 2: Projected Worldwide Carbon Dioxide Emissions 2030

When most people consider carbon dioxide emissions, they think of large factories, forms of transportation and burning both man made and through forest fires.

Most people would be surprised to learn that electricity actually causes more carbon dioxide emissions than all other anthropogenic sources;

According to the Energy Industry Administration[2] in the United States, electricity generates 39 percent of the total anthropogenic carbon dioxide emissions.

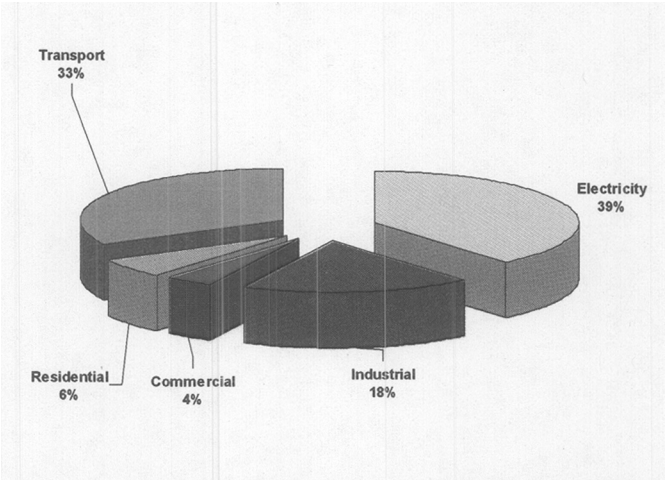

Figure 3: Carbon Dioxide by Sector and Source 2005

These emissions are expected to grow by almost 45 percent over the next 25 years and grow to 42 percent of the total carbon dioxide emissions.

[2] Energy Information Administration Office of Integrated Analysis & Forecasting (2006) Annual Energy Outlook 2006.

3. Greenhouse Gas Reduction

In order to reduce the production of greenhouse gases, it is reasonable to assume that we should focus on the reduction of emissions in both electricity and transportation.

As most people are aware, the result of continuing and increasing pressure from geo-political events, environmental lobby groups and governments around the world is an accelerating global demand to reduce the dependence on fossil-fueled electricity. International treaties such as the "Kyoto Accord" have resulted in many countries formally committing to significantly reduce greenhouse gas emissions. Even countries such as the United States that have not formally signed onto the "Kyoto Accord" have introduced their own plans to aggressively reduce "greenhouse gas" emissions. Recent geo-political instability in major fossil fuel-producing regions has only served to increase public demand to reduce dependence on fossil-fueled electricity.

4. Energy Usage

What makes this a bigger challenge than most would think is that our dependence on energy is increasing. World energy consumption[3] is projected to increase by 71 percent from 2003 to 2030. Fossil fuels continue to supply much of the energy used worldwide, and oil remains the dominant energy source.

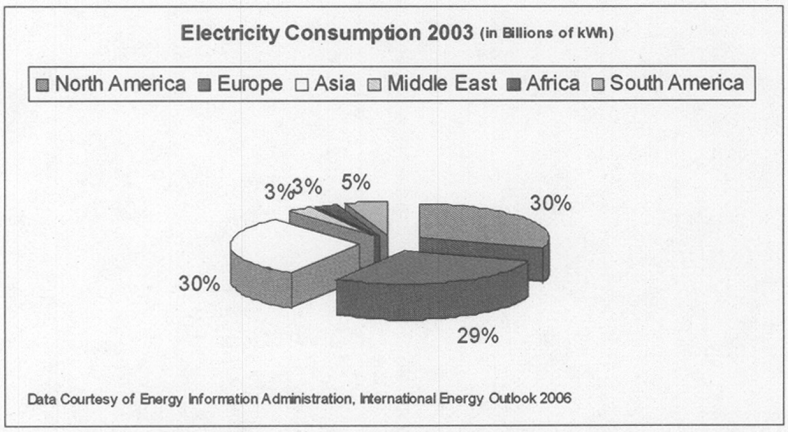

Figure 4: Worldwide Electricity Consumption 2003

Trends in end-use sector energy consumption can vary widely, according to the level and pace of economic development in a given region. On a worldwide basis, energy demand in the industrial sector grows most rapidly, at an average rate of 2.4 percent per year. Slower growth is projected for the buildings sectors: residential energy use rises by an average of 1.7 percent per year and commercial energy use by 1.8 percent per year from 2003 to 2030 for the world as a whole.

[3] Energy Information Administration Office of Integrated Analysis & Forecasting (2006) International Energy Outlook 2006.

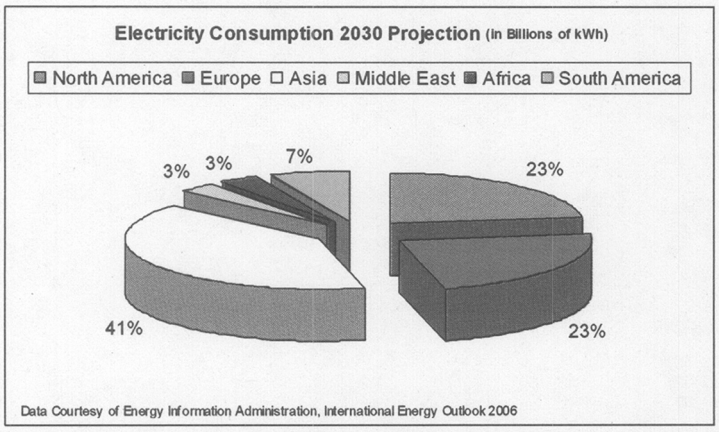

Figure 5: Worldwide Electricity Consumption 2030

All of this is surprising when you consider the efforts to reduce greenhouse gases will require the reduction of emissions caused by them.

5. Electricity Use Reduction

There are two ways to reduce the emissions caused by electricity. The first would be to use more renewable energy sources like wind and solar power. The second is to reduce the amount of electricity we are using around the world.

According to the U.S. Department of Energy [4], the largest single use for electricity is lighting (27 percent) followed by cooling (refrigeration and air conditioning) at 15 percent. In countries with higher ambient temperatures, the usage in air conditioning will be significantly higher, likely coming much closer to the percentage represented by lighting in the U.S.

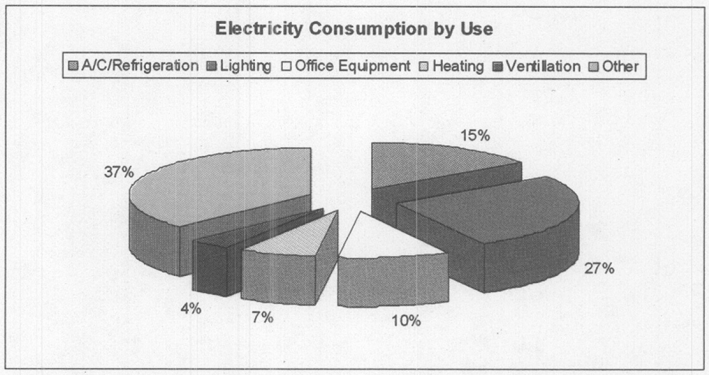

Figure 6: North American Electricity Consumption by Use 2005

There has been a great deal of development in the lighting field to reduce energy, however, in the area of A/C and Refrigeration, most of the development has resulted in expensive and complex systems requiring highly skilled installers and programmers. The cost of these systems prohibited the installation by most small to medium consumers and even larger businesses have been challenged to justify the expense.

[4] Energy Information Administration Office of Integrated Analysis & Forecasting (2006) Annual Energy Outlook 2006.

6. Air Conditioning and Refrigeration Challenge

In air conditioning and refrigeration systems, the compressor is the largest consumer of electricity, in most cases consuming about 70 percent of the total electricity. Reducing the amount of time the compressor runs will substantially reduce the amount of energy used.

The refrigeration cycle is dynamic and changing. From the time the compressor commences to run until it stops, the suction pressure, evaporator temperature, the rate of heat exchange, refrigerant flow, and many other factors are continuously changing. The total efficiency of the system changes through the entire life cycle.

The majority of modern controls concentrate on the conditioned space temperature, the chilled water temperature or suction pressure. The compressors are switched on in a response to call for cooling and will operate until that demand for cooling is satisfied. To avoid rapidly and repeatedly switching the compressors on and off (short cycling) which will cause damage to the compressors, the control bands are usually set with a minimum differential of approximately 4 PSI or 5° F. In many cases the compressor control differential is greater than this.

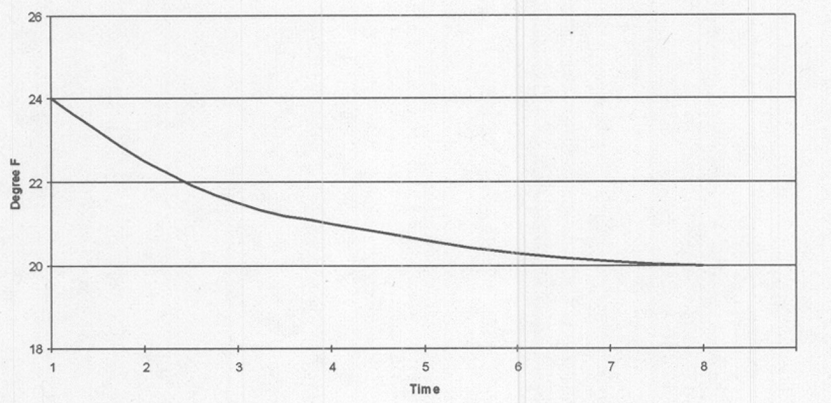

Figure 7: Modern Refrigeration Control Band

The compressors capacity to remove heat is directly proportional to the operating temperature. That is, the higher the controlled temperature, the higher the suction temperature (evaporator temperature), the faster the rate of heat removal.

For example,[5] Figure 8 shows the compressor cooling capacity at each 1.8 degree of suction temperature to reduce the temperature from 50° to 41°.

[5] Sydney Seaworld Study conducted by the University of Technology, Sydney.

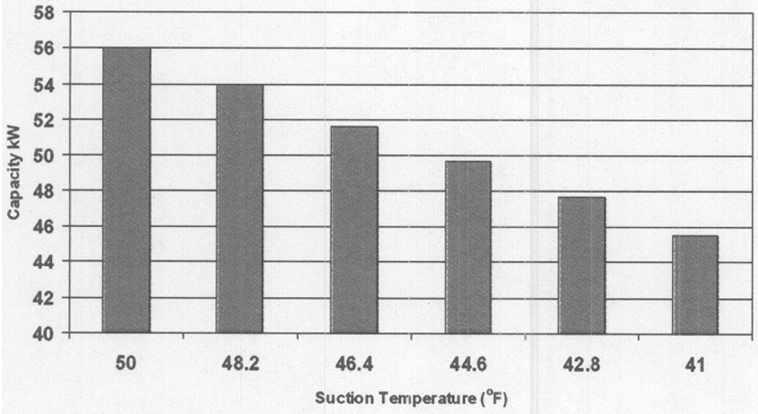

Figure 8: Compressor Cooling Capacity Over Suction Temperature

When the compressor first starts at the high limit point it will be operating at maximum efficiency with a high suction pressure. As the conditioned space temperature is reduced, the suction pressure reduces and compressor capacity is reduced. Therefore each degree of temperature reduction takes a longer period of time and uses substantially more electricity.

Table 1: Capacity, Time & Energy for Nominal 40 kW Heat Load

Temperature °F	Cooling Capacity kW	Motor kW	Minutes / 1.8°F	kWh / 1.8°F
50	56	16.6	0	0
48.2	54	16.4	6.60	1.84
46.4	51.6	16.2	7.56	2.05
44.6	49.7	16.0	9.18	2.45
42.8	47.7	15.8	11.03	2.91
41	45.5	15.3	14.40	3.57
		Totals	**48.77**	**12.82**

Looking at the example in Table 1,[6] Reducing from 50° to 48.2° takes only 6.6 minutes and 1.84 kWh.

Reducing from 42.8° to 41° takes 14.4 minutes and 3.57 kWh.

The last 1.8 degree of pull down used almost twice the energy and time.

[6] Sydney Seaworld Study conducted by the University of Technology, Sydney.

This example uses only a ± 4.5° F suction temperature differential. Even with this small control band there is a significant difference in energy consumption between the first one point eight-degree reduction and the last one point eight-degree reduction.

Figure 9[7] illustrates the percentage of energy used per degree. The last degree of pull down used 28 percent of the total energy for the cycle.

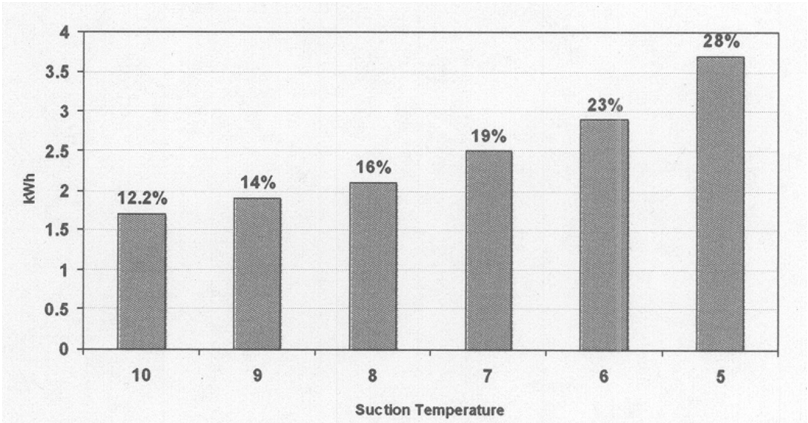

Figure 9: Energy Used During Each Degree of Cooling

Eliminating the last 1.8 degrees, that is start at 50 °F and stop at 42.8 °F providing a differential of 7.2 °F, reduces energy consumption by 28 percent. Unfortunately this increases the mid-point temperature from 45.5 °F to 47.3 °F.

7. Air Conditioning and Refrigeration Solution

Smartcool Systems Inc. is an advanced energy conservation solutions company that specializes in energy and cost reduction technologies for commercial and retail businesses. The company's wholly owned subsidiary, Smartcool International Inc., is the owner, developer, manufacturer and worldwide distributor of the Energy Saving Module (ESM)™.

The Energy Saving Module System 4000™ is designed specifically to reduce the electricity consumption (kwh) and maximum demand (Kw/KVA) of refrigeration and air conditioning compressors by improving their performance and maintaining temperature control.

The Energy Saving Modules™ are designed to interface with all types and makes of air conditioning and refrigeration controllers from the simple thermostat single condensing systems to the most sophisticated computer based multiple compressor parallel systems.

The Energy Savings Module System 4000™ is not a controller. It is a supplement to the existing system—designed to work with the existing A/C and Refrigeration equipment along with current control methodology—to reduce the consumption of energy. When a call for cooling comes from the existing control the ESM 4000™ takes over to determine when and for how long each compressor or unloader will run.

Because the primary control is not replaced, at any time, the ESM 4000™ can be put into bypass and the system returns to operating exactly as it was prior to the installation. This is an important distinction for system repairs and/or troubleshooting.

The ESM System 4000™ enables the compressor to maximize the rate of heat removal by optimizing the natural physical properties of the compressor operating cycle. This process, known as "Compressor Optimization" can reduce compressor running time by up to 30 percent with no affect on the temperature conditions.

[7] Sydney Seaworld Study conducted by the University of Technology, Sydney.

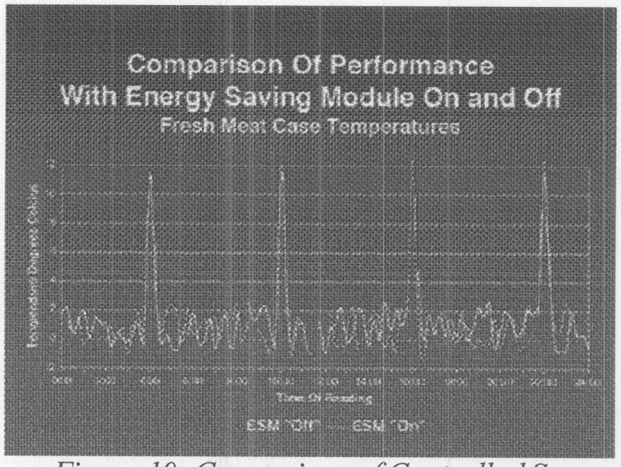

Figure 10: Comparison of Controlled Space Temperature in Refrigeration System

Figure 10 demonstrates how the ESM™ has no appreciable impact on the controlled space temperature. Many other technologies like floating setpoint will impact the temperature.

Through the use of copyright software, the ESM™ manages the suction pressure of the refrigeration or air conditioning system in order to cool more efficiently. This is illustrated in figure 11.

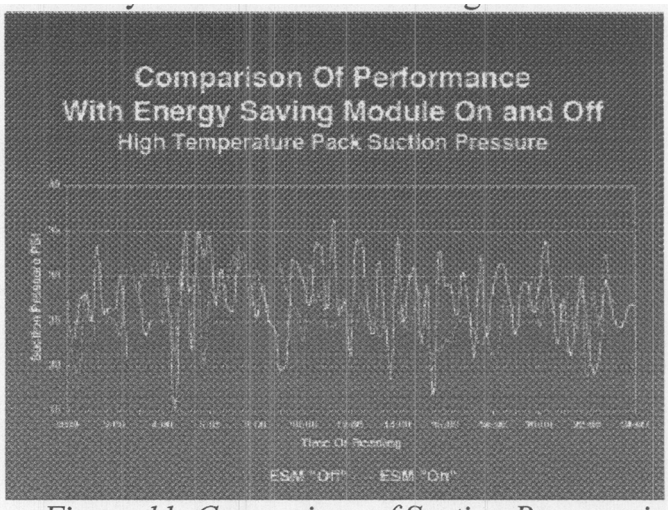

Figure 11: Comparison of Suction Pressure in Refrigeration System

By controlling the suction temperature or pressure over a narrow band, it is possible to maximize the compressor performance, increase cooling capacity by as much as 30 percent and achieving compressor optimization.

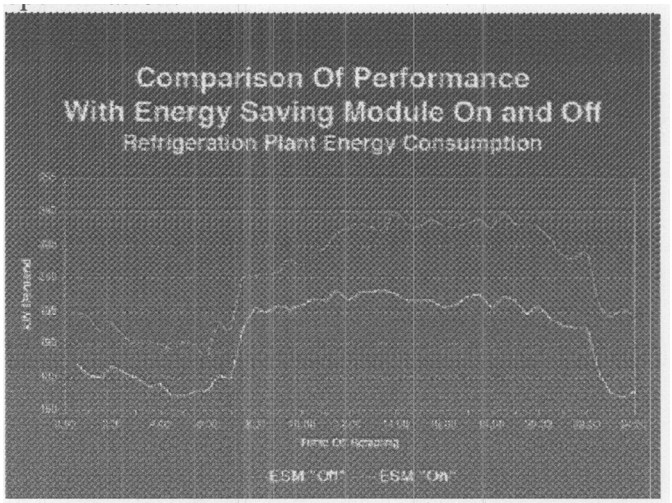

Figure 12: Comparison of kW Demand in Refrigeration System

Having two modes, the ESM System 4000™ can operate in Simplex for single compressor applications and in Multiplex for multi-compressor parallel racks and packaged units. Additionally, through our intelligent interface module, even the most complex chiller packages can benefit from the implementation of the ESM™.

In March 1998, the Los Angeles Department of Water & Power conducted a study of the Smartcool product in a live field test. The results were that: the average kWh saving, for comparable days, is in the range of 20 to 24 percent; the unit is capable of reducing the operating time of the compressors of the refrigeration system, which reduces the energy consumption of the compressors and saves electric billing dollars; and the compressors were turned on and turned off more often during the "ON" time when the unit is in saving mode. The number of cycles per hour was registered at 3 to 4 cycles per hour, which is in the safe range of cycles for a compressor.

Oakridge National Labs which is part of the U.S. Department of Energy conducted several studies of the ESM™ during 2004. The results were indicated to be the reduction of compressor kWh usage of 11.87 percent for total test period and 18.1 percent for high load test period.

Smartcool's services are utilised by some of the worlds leading corporations particularly in the commercial, retail and food service areas.

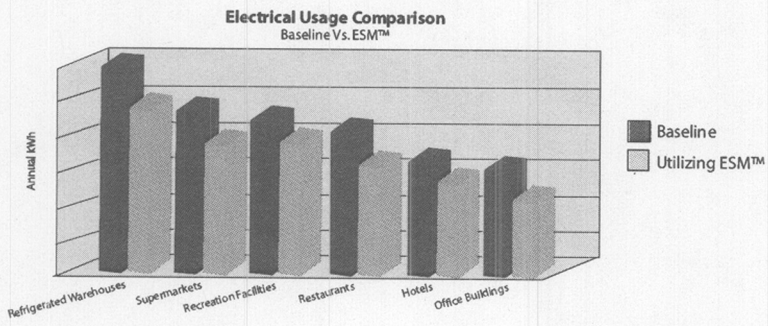

Figure 13: Savings Achieved Using ESM™ By Market Type

A test initiated by Tesco UK[8] where two stores were tested for a 4-week period, resulted in between 17 and 21 percent energy reduction Tesco concluded that: the ESM™ has again proven substantial energy savings under test conditions and will deliver a return on investment well within the 3 year limit set; these savings provide substantial financial and environmental benefits to Tesco; and all savings have been made without detrimental effect to plant operating criteria.

Similarly, Telstra, the Australian telephone company commissioned a test[9] on their central office locations. The results were that: the evaluation clearly demonstrated an overall reduction in electricity consumption of 30 percent when the Energy Saving Module System 4000™ was operating; this reduction resulted in a straight-line return on investment of 33 percent or 36 months; and the total number of compressor starts increased by only 3 per day when the ESM™ was on, however the compressor running time was reduced by 36 percent. The benefits of the reduced compressor running would exceed any adverse effect of the increased starts. Telstra stated that this evaluation has comprehensively shown the ESM System 4000™ to be a cost effective and reliable energy management tool whose performance can be easily measured and verified.

Since 1992, over 25,000 Energy Saving Modules™ have been sold or installed worldwide. In that time, Smartcool products have reduced electricity consumption by 1.2 million Mwh, eliminating over 1.4 million tons of greenhouse gas emissions.

Currently it is estimated that worldwide the Energy Saving Modules™ are reducing electricity use each year by 213,000 Mwh and Greenhouse Gas emissions by 255,000 Tons. This is enough electricity to supply a city with a population of 250,000 people.

8. What Is Needed?

For the Kyoto accord and other greenhouse gas emission reduction initiatives to work, it is important for a number of areas to focus on both clean power alternatives and reducing the reliance and use of existing power sources.

Support from governments around the world is needed to assist in the acceptance and implementation of technologies like the ESM 4000™. This could come in the form of grants, funding, and low interest loans to Companies who adopt these technologies. Additionally, legislation that enforces business and residential to reduce their power usage will ensure we can meet the aggressive targets we are committed to.

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[8] Steven Martin (2003) Report On The Performance Of The Energy Saving Module For Tesco Express At Maida Vale & Fulham.

[9] Transfield Services (2002) ESM Evaluation—Dalley Street Telephone Exchange—September 2002.

Secondly, the Utilities that provide these power services must also embrace technologies such as these. Many of the U.S. Utilities provide rebates to Customers who install these technologies. This improves the return on investment for the Customer, but also reduces the cost of infrastructure that the utility would otherwise be required to build. This may also be another source for low interest loans to Companies who install these.

Additionally, industry must embrace these technologies. With a strong return on investment of between 24 and 36 months, there exists a strong financial business case for these products. More importantly, the strong environmental case needs to be accepted as the responsibility of all Companies and citizens of the world.

Ultimately, it will take all of us to meet the need for reduction of fossil-fuel energy dependence.

References

[1] Energy Information Administration Office of Integrated Analysis & Forecasting (2006) International Energy Outlook 2006.

[2] Energy Information Administration Office of Integrated Analysis & Forecasting (2006) Annual Energy Outlook 2006.

[3] Sydney Seaworld Study conducted by the University of Technology, Sydney.

[4] Transfield Services (2002) ESM Evaluation—Dalley Street Telephone Exchange—September 2002.

[5] Steven Martin (2003) Report On The Performance Of The Energy Saving Module For Tesco Express At Maida Vale & Fulham.

PREPARED STATEMENT OF JACK HÉBERT, PRESIDENT AND CEO,
COLD CLIMATE HOUSING RESEARCH CENTER

Introduction

I would like to thank Chairman Inouye, Vice Chairman Stevens, Subcommittee Chairman Kerry, Ranking Member Ensign, and the Members of the Subcommittee on Science, Technology, and Innovation for the opportunity to address the issue of energy efficient technology and programs. I apologize that I was not able to present this in person but my schedule would not allow it.

Although there is not a firm consensus on the exact figures, there is agreement between builders and researchers that buildings account for a significant amount of the United States energy consumption. The energy usage is divided almost equally between residential buildings and commercial buildings (Source: Annual Energy Review 2003. DOE/EIA–0384 (2003). Energy Information Administration, U.S. Department of Energy, September 2003.)

With proper planning, most developments and buildings today can be designed to use much less energy at little additional cost. Attention to siting, building form, glass properties and location, material selection and the incorporation of natural heating, cooling, ventilation, and day-lighting are among the strategies available to achieve this end. Through the application of the most current research, the energy needed by a building, a development or a community, can be supplied or supplemented by renewable sources such as solar, photovoltaic, wind, biomass, and other viable sources. All of these strategies incorporate energy efficiency and conservation to produce the most effectively-sustainable buildings and homes for the Nation and beyond.

In Alaska, energy efficiency is important for our very economic viability and survival, especially in our homes and buildings. To that end, the Cold Climate Housing Research Center (CCHRC) is currently engaged in research, demonstration projects, and in product testing and development to provide healthy, durable housing that is affordable and energy efficient—in a word, sustainable. Our research has made clear those areas where the Federal Government can help support the research in the development of building technologies that use much less energy in the near term, with the goal of our Nation's building stock being more efficient in construction and operation. It should also be noted that Alaska's needs are indicative of the needs for energy systems in many under-developed regions of the world. Systems deployed successfully in Alaska will have applications in many parts of the world, opening new markets for innovative American businesses. Additionally, experience with new technologies in remote Alaska settings will be applicable for growing the use of distributed-generation technologies in the lower 48 states' power grid.

If U.S. building energy usage is halved or even approaches zero in the foreseeable future, this will have a major impact on national energy security and the sustainability of our communities—not to mention the fuel bills of home and business owners! In this effort, CCHRC is leading by example. Our new Building and Infrastruc-

ture Research and Testing Facility (RTF) is designed to use 60 percent less energy than a conventional building of comparable size and function in Fairbanks, Alaska. CCHRC is also working to reduce fossil fuel use even further by using bio-fuels and solar energy systems.

Included here are six aspects of work that CCHRC is doing to reduce energy usage in Alaska and recommendations for how the Federal Government can further that work:

I. Private Sector Collaboration—CCHRC Examples

In 1999, the Alaska State Home Building Association, representing over 1,000 building industry members, and itself a member of the National Association of Home Builders, recognized the need to conduct research, test, and develop materials and technologies appropriate to northern climates. To this end, the members committed to the creation of the Cold Climate Housing Research Center, a 501(c)(3) nonprofit entity, whose mission is: *promoting and advancing the development of healthy, durable and sustainable shelter for Alaskans and circumpolar people through applied research*. Four years after its start, the CCHRC Board of Directors authorized construction of a facility to house the testing and product development labs needed to accomplish its mission. The charge is clear: research, test, and develop, if necessary, the materials and technologies to provide healthy, durable, and economically sound housing for the people of Alaska and other northern locales.

CCHRC's nonprofit status allows it to establish collaborations with both private and public sector partners. CCHRC is located on the campus of America's only Arctic university, the University of Alaska Fairbanks (UAF) where the newly-constructed Research and Testing Facility (RTF) is housed. CCHRC works with UAF faculty and staff to develop joint research proposals. Major funding comes from state and Federal agencies that collaborate with many private sector donors who contribute materials, products, labor, and funds to support the goals of the RTF. CCHRC is also developing relationships with industry partners to help further guide and support the product testing and development programs at the RTF.

Some examples of the collaboration with private sector partners in product testing include:

- HVAC digital control systems—Siemens Building Technologies.
- Insulation—DuPont, Johns Manville, Thermo-Kool, Western Insulfoam, Vertex.
- Ventilation—Venmar, Lifebreath, Fantech, Solutions to Healthy Breathing.
- Heating—Weil-McLain, Viesmann, Monitor, Stone Castle Masonry.
- Windows—Capitol Glass/Northerm Window.
- Building materials—Spenard Builders Supply, Mannington Commercial, Rivers Wood Products.
- Data collection and display—GW Scientific, Campbell Scientific.

CCHRC also has cooperative agreements with such other nonprofit agencies as:

- *Golden Valley Electric Cooperative*—demonstration of alternative energy systems and conservation strategies and technologies.
- *Interior Alaska Building Association*—outreach and continuing education.
- *Alaska Building Science Network*—outreach, education, and training.
- *Cooperative Extension Service, UAF*—outreach, education, and sustainability.
- *Audubon International*—outreach and community sustainability.

CCHRC Recommends

Cooperative programs involving private sector partners need increased funding by the Federal Government. Programs such as the Partnership for Advancing Technology in Housing (PATH), Partnerships for Home Energy Efficiency (PHEE), The Small Business Innovation Research (SBIR) and the National Science Foundation's Partnerships for Innovation (PFI), Building America, Healthy Homes, Weatherization, and others, benefit from private sector partnerships because they have the ability to leverage government funding into grounded projects that address real private sector needs.

II. National Security, Global Warming, Sustainability, and Energy

To meet growing energy needs, the U.S. imports an ever-increasing percentage of its energy supply, in the form of gas and oil, each year. This creates an unsustainable and unstable situation for national security, environmental concerns, and economic needs. It places U.S. energy security in the hands of other nations, fuels concerns over climate change, and may contribute to the increase in dramatic

weather events with significant costs in terms of human life and public and private funds. The U.S. does not have enough reserves of its own to reverse the Nation's supply shortages by simply increasing domestic production. Development of economically and environmentally sustainable energy efficiency programs and alternative sources of energy is critical and will require a significant investment. One way to reduce energy consumption in the built environment is through efficiency and conservation, which takes committing large amounts of both public and private resources.

CCHRC has undertaken several initiatives to address this situation:

- *CCHRC Research and Testing Facility* is designed to lead by example using 60 percent less energy than a comparable building and showcasing several strategies for energy efficiency, conservation, and alternatives.
- Audubon International has designated CCHRC as the *Alaska Center for Sustainable Community Development.*
- With the North-North Network and UAF, CCHRC is working on a *Sustainability Initiative* to increase the sustainability of the UAF campus and to begin an interdisciplinary curriculum in northern sustainable design at UAF.
- With partners at the Alaska Housing Finance Corporation (AHFC) and the Canadian Mortgage & Housing Corporation (CMHC), CCHRC is planning a *Forum on Sustainable Northern Shelter* to be held in Fairbanks this October.
- With the Cooperative Extension Service at UAF, CCHRC is committed to finding solutions to *community sustainability in rural Alaska*, especially housing and related systems.
- With the Alaska Housing Finance Corporation and the Alaska State Home Builders Association, CCHRC has begun the process of recasting the *Alaska Building Energy Efficiency Standard* in terms of the International Energy Conservation Code with the intent that it might be addressed by a statewide building code review.

CCHRC Recommends

The Federal Government, through programs at U.S. Department of Energy, the U.S. Environmental Protection Agency, the National Science Foundation, and the U.S. Department of Housing and Urban Development must initiate programs aimed at energy independence. Part of this effort must: (a) target energy use reduction through increased efficiency and conservation in homes and other buildings, and (b) develop environmentally-sound energy sources for buildings and communities. Partnerships that involve the private sector, along with universities and state agencies, are particularly well-suited to contribute real solutions. National support for transformative processes already underway by groups such as the National Association of Home Builders (NAHB) and the many state and local groups focused on green building will be essential.

III. Demonstration Projects—The RTF Example

The CCHRC Building and Infrastructure Research and Testing Facility (RTF) on the University of Alaska Fairbanks campus is designed with transparency in mind. CCHRC encourages public tours of the building and visits to its website to demonstrate how it operates. CCHRC wants to show:

- how much energy from each source is being utilized,
- how efficiently and cleanly the energy is consumed,
- the different ways to heat and cool the building,
- the better ways to filter indoor air,
- how wall and window systems are performing,
- that the lighting strategy is providing maximum daylight and using minimum electricity,
- that the water system is collecting rainwater, recycling grey water and storing storm water on our green roof; and
- How the building is interacting with the permafrost and ground water beneath it.

Over 400 sensors are embedded in and beneath the building to monitor its operation and performance. In addition to housing research, testing and product development, the building itself is a multitude of research and testing projects.

Demonstration projects such as this are important to lay the foundation for change. The public needs to see that efficient strategies exist and that they work.

Essentially, people need to be able to "kick the tires" before they will "buy" new ways to design communities, get to work and play, and build and live in homes and office buildings that consume much less energy.

CCHRC has an agreement with Golden Valley Electric Cooperative to demonstrate alternative energy systems, such as solar, wind, bio-fuel, and hybrid systems at the RTF. The Fairbanks North Star Borough is also funding a project in the facility to demonstrate the use of several clean-burning, wood-fired heating appliances with the goal of making the building produce more energy than it uses.

The success of the RTF as a demonstration project is remarkable. CCHRC has had so many requests for public tours that it has had to set up a regular public tour schedules on Thursday afternoons. CCHRC has had a steady interest from UAF faculty and students in proposing joint research projects. CCHRC has also had many requests to test products, even though it is not yet set up to do so. Finally, CCHRC fields frequent calls from future homeowners seeking advice about a piece of equipment or a certain approach to building. Obviously, there is substantial public interest in building better shelter.

CCHRC Recommends

Demonstration projects are important elements to facilitate change for efficiency in the building community. Even if the technology is well proven to scientists and engineers, it is still crucial to educate builders and owners about better ways to design and construct buildings. The Federal Government must vigorously fund and support state and local efforts to demonstrate products and technologies that can make this change happen.

IV. Alternative Energy Projects at CCHRC

One of CCHRC's important goals is to test, develop, and demonstrate alternative energy solutions. Some of the technologies are built into the RTF and some await future funding to be implemented. However, some alternative energy projects are already underway or are on the drawing board and they include:

Masonry Heater Project: The first thing one sees when entering the RTF is a beautiful, natural rock fireplace called a masonry heater. It has an enclosed firebox, like a woodstove with a glass door, and a massive rock edifice like an old-fashioned fireplace. The flue does not, however, go straight up the chimney as it would in a stove or fireplace; rather, it is convoluted throughout the masonry so that the heat of the fire can be transferred to the rock and brick. In this way, one hot fire per day can provide enough constant radiant heat to warm an average house throughout the cold Fairbanks winter. This technology was first developed in China and Greece long ago and was widely used in 15th century northern Europe. Because the fire is so hot (reaching 2,000 degrees F) it burns very cleanly compared to a conventional wood stove or fireplace. The RTF heater is instrumented so that CCHRC can document its efficiency and emissions levels. The heater's massive size and associated cost are drawbacks to widespread use of masonry heaters in homes, yet CCHRC plans to work toward developing lower cost versions as options for people who want to burn wood in the most efficient and environmentally sound manner.

Wood Energy Project: The wild land fires in the interior of Alaska pose both a challenge and an opportunity. A primary way to reduce the risk to settlements in and adjacent to these vast forested regions is to reduce the fire fuel-load by clearing fire breaks around individual structures as well as along entire ridge lines. This presents an opportunity to develop local economic enterprises utilizing the bio-fuel that otherwise would be wasted. If a sufficiently robust industry can be developed using this "waste wood," it could help fund the continued creation of firebreaks around the vulnerable areas of the Fairbanks North Star Borough.

The Fairbanks North Star Borough has funded a project to research, develop and test a variety of wood-burning technologies and products that could be the basis for local enterprises. These technologies range over a wide scale of complexity and size from ordinary wood stoves and pellet stoves to masonry heaters and village-scale combined heat and power units. Perhaps the most compelling need is to develop the technology for building combined heat and power (CHP) generators in villages in rural Alaska where the price of fuel oil and electricity is threatening their very existence. This project will evaluate the technological options for providing the fuel source, processing it, and feeding it into a CHP boiler. CCHRC will provide some of these critical evaluations, testing and demonstration links in establishing new and sustainable local enterprises. In addition the project will develop and test the cleanest wood burning technologies available so as to minimize the impact on the urban air shed in Fairbanks.

Solar-Thermal Demonstration Project: Utilizing the sun to heat domestic hot water is practical in Fairbanks, Alaska for about 8 months out of the year. Solar-

heated domestic water systems have reasonable payback periods even though they are only usable for part of the year. They also may allow oil-fired boilers to be shut down for several months, thereby eliminating the worst period of standby losses. These systems are particularly well suited for visitor industry facilities that only operate seasonally.

CCHRC plans to test evacuated-tube and flat plate solar hot water collectors and integrate this system into its Viesmann Boiler domestic hot water system. CCHRC collaborated with the Golden Valley Electric Association and the Cooperative Extension Service to offer a technical training class in the installation of solar hot water collection systems which featured hands-on training to install these systems in the RTF. The system will be instrumented so that performance and cost-effectiveness can be demonstrated in an on-going manner to a broader audience via the Internet.

Solar Photovoltaic Hybrid Demonstration Project: The Cold Climate Housing Research Center has proposed to partner with British Petroleum (BP) and Alaska Native corporations on a project to develop a sustainable solar power system that works in circumpolar regions. The project will be based at CCHRC's Research and Testing Facility. The *"Beyond Petroleum"—Integrating Solar Energy in Rural Alaskan Communities Research Project* will benefit many communities in the circumpolar regions. Many rural circumpolar communities face ever-increasing energy costs due to being off the grid and the rising costs of fuel transport. The RTF is a perfect site for testing northern solar power systems and developing Alaskan expertise in solar system design, installation and maintenance to benefit Alaskan villages. The Fairbanks climate offers the full range of weather conditions for cold climate testing and performance evaluation of products, systems and techniques.

The purpose of this project is to design, install, and operate a micro-hybrid power system. It will consist of 15 KW of PV solar panels, battery banks, AC and DC coupled inverters with capability to tie into the GVEA grid, and a back-up generator. A web-based data acquisition component will be incorporated allowing researchers to share results. The system will feature: (a) testing of several different solar/micro-grid configurations, (b) the potential to incorporate other energy technologies (bio-diesel, fuel cells, bio-mass etc.), (c) robust data collection, and (d) education, research and outreach components, including an interactive "Solar on the Web" feature.

CCHRC Recommends

These critical research, development, and demonstration projects usually involve, in one way or another, the donation of equipment, materials, and labor from private sector partners. This important private sector contribution should be encouraged by offering tax incentives. Congress should consider tax incentives that would encourage more investment by private sector partners that work on projects to shift away from fossil fuels to alternative, environmentally sound energy sources. By utilizing private sector partners in this way, the burden of developing and expanding critical research in efficiency programs is not shouldered solely by industry or government alone.

A strong Federal and state partnership to develop and demonstrate new energy-saving, energy-generation and transmission technologies is clearly warranted. Such an investment would not only serve Alaska's residents, but also help to develop a market for American technologies by inviting the developing world to see how America is solving its energy needs for its rural and remote regions. Alaska could easily become America's showcase for distributed power generating technologies.

V. DOE Building America in Alaska

CCHRC was funded by two grants under the Department of Energy's Building America program. Some of CCHRC's work began with funding from the second grant and has been carried forward with funds from Alaska Housing Finance Corporation. These grants have led to important advances in basic envelope design in Alaskan residential construction, which is called the Residential Exterior Membrane Outside-insulation Technique (REMOTE), or REMOTE technique.

Building America in Alaska I: CCHRC, the U.S. Department of Energy, and Alaska Housing Finance Corporation (AHFC) formed a Federal/state/industry partnership to implement the Building America program in Alaska. A Building America in Alaska (BAA) team of building industry professionals from across the state worked with cold climate experts from the Building Science Consortium. The primary goal of this project was to develop plans for energy efficient, durable, healthy, and cost effective homes that are affordable to moderate-income Alaskans. The team designed a single-family residential home with modifications for each of three major climatic regions/environments found in Alaska. Building America home, using the CCHRC design or Building America technology, were constructed by Bee Construction in North Pole (Interior) and blu-Spruce Construction in Juneau (Southeast) and

sold shortly at or near completion. The performance target for these homes is Five Star Plus, or the highest level of efficiency.

A Final Report was delivered to AHFC October 30, 2001, and included the building design, material list, construction costs, and performance testing and energy modeling of the finished homes. CCHRC staff worked with the Fairbanks Chapter of Habitat for Humanity to utilize the Building America design and technology in other projects. *The Builders Guide: Cold Climates*, developed through the Building America program, was reviewed by the Alaska team and CCHRC staff, and updates were recommended, compiled, and delivered to the Building Science Consortium.

Building America in Alaska II: CCHRC's second grant from the Department of Energy was awarded for a State Energy Program Special Project to continue work on the *Building America in Alaska* program. The goals were: (1) to develop builder's education courses on BAA approaches to residential construction and to continue education and promotion of Building America techniques to the Alaskan home building industry; (2) to test and monitor the Building America houses constructed in Alaska in 2001 and assess their performance; and (3) to develop a Building America strategy to address the cold, wet climate of Southeast Alaska which includes construction of a test module for checking wall panels for moisture, durability and energy efficiency. Within this project, the CCHRC Mobile Test Lab (MTL) was constructed in North Pole and shipped to Juneau in January 2003. Students of Construction Technology at the University of Alaska SE built and monitored various wall systems in the test module for a year. The wall built with the REMOTE technique out performed other wall sections in terms of drying. The MTL was later refitted with new wall panels, new equipment, and continues to be monitored under funding from AHFC.

REMOTE Wall: The REMOTE technique combines an outside insulation wall envelope system with more conventional roof and foundation envelopes to maximize the benefits of both systems. An impermeable membrane is attached to the exterior of the wall's sheathing with foam insulation exterior to that. This membrane is then tied to an interior vapor barrier for the roof and foundation of the structure. The benefit of this system is that condensation within the building envelope is eliminated along with all the associated moisture problems. Nine wall systems were tested in Juneau utilizing the Mobile Test Lab. Of the nine walls tested, the best performing wall was the REMOTE wall. The REMOTE wall offered the most reliable results to the drying of built-in moisture and had the lowest recorded moisture content in the sheathing, framing and bottom plate at the conclusion of the testing. During intentional wetting experiments in which moisture was introduced to the wall cavity, the empty cavities dried in days, the fiberglass filled cavities dried in weeks, and the foam-filled cavities did not dry during the experiment. This shows that the fundamental design where all of the insulation is on the outside of the wall is the most robust for eliminating moisture problems.

In September 2005, the Tlingit-Haida Regional Housing Authority (THRHA) received an award in recognition for its development and application of innovative approaches and best practices in housing and community development at the U.S. Department of Housing and Urban Development's (HUD) National Indian Housing Summit. The work involved an application of the REMOTE wall. THRHA was one of six housing organizations from around the country to receive one of the prestigious awards. In addition, THRHA was recognized for its partnerships with CCHRC, the University of Alaska Southeast Construction Technology Department, and Southeast Alaska Building Industry Association for exploring new building techniques and materials suitable to Southeast Alaska's climate.

CCHRC Recommends

The U.S. Department of Energy's Building America program has been very important for developing and demonstrating improved building techniques. Greater focus should be given to energy efficiency and conservation in buildings within this program. The program should also be expanded with funding to ensure its availability in all of the states with a regional structure, primarily so that applications can be considered in the context of the local region. Building America has been very successful nationwide and has been embraced by NAHB and the homebuilding industry.

VI. HUD Healthy Homes and DOE Weatherization

CCHRC, the Alaska Housing Finance Corporation, University of Alaska Fairbanks and Anchorage, and State of Alaska Weatherization agencies in Fairbanks and Anchorage partnered on the *Healthy Homes in Alaska Project* which studied the connection between indoor air quality (IAQ) and asthma in children. CCHRC has also done several other projects on IAQ and ventilation issues, including the mold

survey and wildfire smoke remediation studies described below. All of these studies are more fully reported at *http://www.cchrc.org/completed.html*. There is an essential connection between the development of energy efficient buildings and ventilation: as we insulate and tighten up buildings to prevent heat loss or entry, it becomes increasingly important to provide intentional, mechanical ventilation to supply fresh air and to control the build-up of moisture in the buildings. The ventilation system must be optimized to use the minimum amount of energy and materials consistent with the air exchange requirements. Finally, outdoor air is not necessarily "fresh," so it is often important to filter the incoming and re-circulated air to obtain the best, healthy indoor air quality.

The Healthy Homes in Alaska Project: This project was designed to test whether or not improving the indoor environmental quality of homes for children with asthma might improve their health. Only children who lived in low-income homes were eligible, and the parent or guardian of the child was required to own the home. Another goal of this project was to increase the capacity of the *Low-income Weatherization Program* to remove possible respiratory hazards in the homes of low-income people who have children with asthma or other upper respiratory diseases. The *Healthy Homes in Alaska* project was conducted in two areas in the state. Fairbanks is Alaska's second largest city and is located in the Interior. Hooper Bay is a larger bush community of 1,014 residents on the Bering Sea coastline. These communities were selected because they have residents with diagnosed asthma, have an involved health provider in the region, and are generally representative of conditions and housing stock throughout the state. The project provided indoor air quality assessment, health screenings of affected children, and housing remediation to selected homes. We identified and studied a total of 36 homes: 10 eligible participants in the Fairbanks area, 9 participants in Hooper Bay, and 8 and 9 control homes in Fairbanks and Hooper Bay, respectively. The remediation in the control homes consisted of the standard weatherization items such as improving insulation, replacing windows and doors, sealing air leaks, as well as providing some safety items such as smoke and CO detectors. In the participants houses the weatherization protocol was augmented by items designed to remove possible asthma triggers such as moldy window sills, bedding, or furniture. Some changes in the home were made to prevent the moisture and temperature conditions that lead to the growth of mold such as adding cloths dryers, installing shelving and bed frames to improve air circulation by the walls and floors, and installing quiet bath and kitchen fans to remove moist air from the house. Qualitatively, the clients in the healthy homes reported improved comfort and health as well as reduced energy bills. While the quantitative results of this study were based on a small number of research subjects, and asthma is a disease with multiple causes, there are some interesting suggestive results: (1) It is possible that the homes of children with asthma have higher levels of indoor air pollution than the homes of similar people without asthma; and (2) The remediation may have helped to improve the pulmonary function tests and the IgE levels of asthmatic children, although the numbers from this small a study were not sufficient to reach statistical significance.

Mold and Mildew Survey: The prevalence of mold in Alaska Native housing is a significant health issue. CCHRC documented over 1,700 residences with mold problems in a survey funded by HUD. See *http://www.cchrc.org/completed.html#mold*. These instances varied from mild mildew around windows, in kitchens, or in bathrooms to severe mold development requiring the destruction of the building. CCHRC has been funded by the Alaska Housing Finance Corporation to provide consulting services to Alaska Native housing authorities on these and other issues including the development of low-cost ventilation systems as adequate ventilation is one of the keys to maintaining a healthy, mold-free home.

Remediation of Wildfire Smoke in Fairbanks Homes: For over 2 weeks in the summer of 2004, fires around interior Alaska raised the outdoor particulate level significantly over EPA's fine particle standard for $PM_{2.5}$ of 65μg/m^3. The actual figure exceeded 1,000μg/m^3 during part of that period. This study demonstrated a 76–92 percent improvement of indoor air quality, depending on method of remediation. See *http://www.cchrc.org/FANTECH.pdf*. Indoor air was tested in houses pressurized with filtered outdoor air, as well as in non-pressurized houses in which the air was re-circulated and filtered. Although residents of all houses rated the improvements from "better" to "very significant," the percentage reduction in fine particulates was greatest in pressurized houses. This study has implications for builders in areas in which air quality can be hazardous to health, no matter the cause.

CCHRC Recommends

The DOE Weatherization programs provide a significant improvement in the older housing stock, reducing the annual gas heating bills by an average of 32 percent

(see *http://www1.eere.energy.gov/office_eere/pdfs/wap_fs.pdf*). As CCHRC develops more strategies for retrofitting older houses, the lessons learned by the weatherization agencies across the Nation will be increasingly important to incorporate. Improvements in the health of children and adults with asthma and other respiratory conditions can also be made with the development and application of appropriate ventilation and filtration standards.

In addition to the work of CCHRC, we are acutely aware of the national focus on energy consumption of buildings, green building and the need for incentives to promote sustainable building practices. These issues have gained significant prominence in national public policy forums.

Energy Consumption and Efficiency

Energy efficiency is the primary focus for many builders and home buyers. While many figures are being thrown around these days, the Energy Information Administration (EIA) estimates that buildings accounted for 39.4 percent of total U.S. energy consumption in 2002. Residential buildings accounted for 54.6 percent of that total, while commercial buildings accounted for the other 45.4 percent (*Annual Energy Review 2003*, DOE/EIA–0384 (2003)—for heating, cooling and electric appliances. Builders know that building with energy conservation in mind is both practical and profitable.

Recently, a number of groups, including the U.S. Conference of Mayors, have joined with the American Institute of Architects (AIA) to support the *Architecture 2030 Challenge*, which suggests that buildings are the major source of demand for energy and materials and, incidentally, produce greenhouse gases. The *Challenge* includes the goals of:

- All new buildings must be designed to use 50 percent less fossil fuels.
- An equal amount of existing building area must be renovated annually to use 50 percent of the amount of fossil fuel they are currently consuming; and
- All new buildings must be carbon-neutral by 2030 *i.e.,* uses no fossil fuels and emits no greenhouse gases in operation).

A more detailed look at data provided by the EIA reveals that the 2030 challenge has arbitrarily derived the number of "half" of energy consumption and greenhouse gases by combining two categories for which the EIA reports and creating a new "buildings" category. Based on EIA's 2000 Annual Energy Review, adding the categories of "Commercial," "Residential," and a portion of the "Industry" categories, the 2030 challenge arrives at a number of 48 percent. This estimate reflects a portion of the industrial sector that is attributed to buildings because of heating, cooling, etc., but how the AIA arrive at the actual percentage is open to question.

Older homes, for which present-day builders and architects bear little responsibility, account for a very large share of residential energy consumption. Single family and multifamily units built in the decade before the Residential Energy Consumption Survey (RECS) of 2001 account for only 2.5 percent of total energy consumption in the U.S. Even if each of the new homes built over the 1991–2001 period consumed zero energy, it would only have reduced total consumption in the U.S. by 2.5 percent. Finally, more than half of total residential energy consumption consists of energy lost between generation and consumption—that is, energy lost in the process of producing and transmitting electricity, rather than energy actually used in residential structures. This fact illustrates the importance of developing energy producing systems within the structures themselves.

ENERGY STAR® *and Green Building*

ENERGY STAR® is the most prominent of the many voluntary programs builders utilize and was the very first program endorsed by the National Association of Home Builders (NAHB). ENERGY STAR® homes meet specific energy efficiency guidelines established by the U.S. Environmental Protection Agency that achieve notable energy savings above the current energy standards. To date, more than a half-million above-code ENERGY STAR® homes have been built.

ENERGY STAR® also serves as a resource and efficiency benchmark and as an integration point for NAHB's own Model Green Home Building Guidelines. Since the 1990s, NAHB has been preparing for the evolution of green building into the main stream. Green building means energy efficiency, water and resource conservation, sustainable or recycled products, and indoor air quality all incorporated into the everyday process of home building.

Published in 2005, NAHB's Model Green Home Building Guidelines (Guidelines) were developed through an extensive year-long review of existing programs and industry best practices within an open, consensus-based process involving more than 60 industry stakeholders—including builders, researchers, manufacturers, environ-

mentalists, and government agencies. The NAHB Research Center, an American National Standards Institute (ANSI)-accredited standards developing organization, co-developed the Guidelines with NAHB. Due to broad acceptance by local home builder associations, the Guidelines will undergo formal consideration procedures to become the ANSI-accredited standard and serve as an official "industry standard practice."

The Guidelines embody the flexibility that builders need to achieve efficiency and conservation goals without meeting costly national or state-wide mandates. Local adoption of the Guidelines allows builders to more appropriately address regional and local environmental concerns, properly assess life-cycle costs based on local building codes and climate zones, and encourage innovation to meet higher and broader energy efficiency objectives. Simply, there is no one-size-fits-all green building standard. Alaska, North Dakota, Florida, and Maine all have different efficiency needs and requirements based on their climate and builders need the flexibility of a program like the Guidelines to reach those goals.

One popular green building standard that is being considered as a requirement throughout the country, particularly at the state and local level, is the Leadership in Energy and Environmental Design (LEED), sponsored by the U.S. Green Building Council (USGBC). Due to its success at mandating LEED–NC programs for many government facilities, USGBC is currently offering a pilot program, LEED–H for homes, to further encourage the penetration of the LEED brand into the private sector.

While many state and local governing bodies have mandated the use of LEED, some local leaders, *e.g.,* in Boston, have recognized an important fact that many builders also recognize: the LEED–H program is costly, requires many mandatory provisions, offers little flexibility, and contains extensive implementation fees that could cost a builder, and ultimately the public, from $12,000 to $15,000 extra per home. A close analysis of NAHB's Model Green Home Guidelines and USGBC's LEED–H for homes is attached.

Overall, at a time when housing needs the most innovation and most resources spent on achieving resource and energy efficiency, builders should not be forced to use those resources for certification and implementation fees just to comply with costly mandates for programs like LEED–H. Builders need many options and methods for achieving strides in energy efficiency and will be sidelined with requirements, for LEED or otherwise, by any government—state, local, or Federal.

Tax Incentives for Energy Efficient Housing

Finally, another crucial way to encourage energy efficiency in housing is by extending and expanding tax incentives that passed as part of the Energy Policy Act of 2005. Unlike spending programs or one-size-fits-all rules, tax provisions allow market participants—builders, homeowners, and homebuyers—to marry the energy incentives with market-determined supply and demand.

For example, the newly established New Energy Efficient Home Credit (Section 45L of the Internal Revenue Code) provides a $2,000 tax credit for the construction and sale of a new home which reduces energy use by 50 percent or more. This program provides benefits to home buyers and communities by facilitating the construction of new property that takes advantage of the latest technology—and in a manner that will work in the marketplace. Rules that simply eliminate the market for new homes or other property through unreasonable restrictions do not encourage the adoption of energy efficient property. In fact, they do the opposite. They encourage retention of older, less efficient property.

Other examples of new energy tax incentives are the energy efficient commercial building deduction (Section 179D), the existing homes tax credit (Section 25C), and the solar credit for residential property (Section 25D).

Congress could improve the efficiency of these programs by making them permanent. Presently, these tax incentives are scheduled to expire over the 2007 and 2008 period. This limited duration reduces the effectiveness of these programs as home building in many cases takes months or even a year or more to complete.

Conclusion

A directed national effort must be initiated immediately to address the global issue of unsustainable energy consumption and its many effects. Buildings, land development and related infrastructure, including electrical generation, transportation, water and wastewater systems are major factors to consider. Applied research and demonstration projects are very necessary components for identifying and developing technologies and strategies that will move toward effective solutions. The direction the Nation takes is dependent on the quality and application of that research. Through a collaborative approach involving industry and the marketplace,

financial incentives, Federal and state regulatory agencies, and most importantly each individual's commitment, we can make a positive change. The United States must lead this effort by example to the rest of the world. This is an opportunity for the Nation to come together. For the first time there is general agreement about the impacts of unrestrained energy use and a real concern for the future. This issue can galvanize us as a nation around a common goal for the common good. CCHRC and the building and research communities of Alaska are prepared to embrace that movement. It is our hope that we can be a valuable part of that solution.

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