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Subcommittee on Energy

Research, Product Testing and Development, and Incentives to Reduce Energy Use in Residential Buildings and Community Infrastructure

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Introduction

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 Infrastructure Research and Testing Facility (RTF) is designed to use 60% 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 1000 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 US 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% 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 2000 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 purchase an evacuated-tube solar hot water collector and the associated parts to integrate this system into its Viesmann Boiler domestic hot water system. CCHRC is also working 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 will feature hands-on training actually installing this system 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 re-fitted 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 1014 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 1700 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 two 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/m³. The actual figure exceeded 1000μg/m³ during part of that period. This study demonstrated a 76-92% 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% (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% of total U.S. energy consumption in 2002. Residential buildings accounted for 54.6% of that total, while commercial buildings accounted for the other 45.4% (*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% less fossil fuels
- An equal amount of existing building area must be renovated annually to use 50% 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%. 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 in 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, environmentalists, 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 Efficient 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% 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.