# Written Testimony Prepared For The Senate Energy and Natural Resources Committee

# For a Hearing to Examine Opportunities for Efficiency in Building Management and Control Systems

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**Introduction**

I would like to thank Chairman Murkowski, Ranking Member Cantwell, and the Members of the Committee on Energy and Natural Resources for the opportunity to address the issue of energy efficient technology and programs.

Alaska presents some of the most extreme and varied environments on earth, from the arctic tundra to the Bering Sea, with hundreds of villages that are inaccessible by road and located far away from energy resources. In this environment, shelter literally means the difference between life and death. Compounding these challenges is the fact that Alaskans face the highest energy costs in the nation. These challenges have helped make Alaska a world leader in energy efficient building and technology. We would like to share several of the lessons that we have learned about building in the world's harshest conditions.

The Cold Climate Housing Research Center (CCHRC) has worked since 1999 to develop efficient, healthy, durable buildings for Alaskans and other northern people. Our housing designs integrate sound building science and advanced technologies to reduce energy costs by 80% over conventional construction while improving health and indoor air quality. Incorporating local and traditional knowledge about climate, architecture, and land use ensures housing meets the cultural as well as economic needs of the people.

Good housing is essential to a safe and healthy life. Yet in Alaska, tens of thousands of homes are cold, under-ventilated, and extremely inefficient. Rather than providing refuge from the elements, a large portion of the housing stock has become a financial burden and an actual health hazard to occupants. Unfortunately, those with the fewest resources are impacted the most, including Alaska Native infants and elderly, who suffer from the highest rates of upper respiratory disease in the country due to unhealthy housing.

CCHRC's deep experience working in both urban and rural Alaska has shown that building healthy, efficient homes is one of the best investments towards healthy, secure, and economically viable communities. Using proven building science and rigorously tested materials, we can dramatically reduce energy use while ensuring healthy indoor air quality for residents, with little additional upfront cost. This applies not only to homes but to commercial buildings and public facilities as well. For instance, CCHRC's facility in Fairbanks is the farthest-north LEED Platinum building on earth. It was designed and built to meet these standards at a cost equivalent to other commercial buildings in the region through close collaboration with the builder, designer and engineering, creating a cohesive team approach.

Lowering our energy demand not only helps families and communities; it also reduces the stress on our natural resources, eases pressure on the electric grid, and makes our communities more resilient to natural disaster and economic uncertainty. This testimony includes four examples of how energy efficiency has benefited Alaska families and businesses and recommendations for how the federal government can further that work:

**I. The power of energy efficiency**

The U.S. government spends billions of dollars on facilitating oil and gas production every year. The national security, social, and environmental issues stemming from energy production only add to the price tag. It is far more cost-effective and politically popular to address our energy demand. Reducing energy consumption in the built environment is a vast and untapped resource in the United States. In Alaska, we have seen how investing in better buildings has yielded energy savings and reduced greenhouse gas emissions at a very affordable price.

While energy production is vital to our economy, both nationally and in Alaska, investment in energy efficiency has the quickest return on investment. Consider, for instance, the savings of investing in more efficient lighting. On average, upgrading a 60-watt incandescent light bulb to a 10-watt LED will save about 110 kWh in a year. At the national average electricity rate of 10 cents per kWh, that is about $11 in annual savings. Considering that an LED costs about $3, one is looking at an annual return of about 370 percent. For comparison, investing in the oil industry typically produces about a 10 percent annual return for investors. The bottom line is: Investing in the simple energy efficiency upgrade results in reduced stress on natural resources and extraordinary financial benefits at the same time.

The benefits of efficiency can be shared across the spectrum. First, energy efficiency saves money for families. In Fairbanks, for example, the average family spends $8,000 a year to power and heat their home, nearly four times the national average. Investing in energy efficiency retrofits through building better walls, more efficient appliances, and building controls saves more than 30% on energy per year, paying for itself in approximately 8 years (source: Home Energy Rebate Program Outcomes Report, CCHRC and Alaska Housing Finance Corporation, 2012). Investing in energy efficient new construction yields even higher savings with an average of 40% - 80% energy savings over conventional construction. After that, energy savings accumulates over the life of the house.

Energy efficiency also saves money for government. Poor housing is a burden on public budgets. In Alaska, roughly $15 million a year is spent on low-income heating assistance (source: US Department of Health and Human Services, Office of Community Services, 2017) and an additional $31 million a year on power subsidies in rural villages (source: Alaska Department of Treasury). These are costs incurred year after year resulting in no substantive changes. For what is spent annually in subsidies could be used to invest in weatherization and energy retrofits to 7,000 homes. Weatherization not only saves money for government and homeowners, it also improves the useful life of buildings when sound building science is incorporated, creates jobs, and contributes to self reliance .

**II. Low-hanging fruit**

Of all energy used in the U.S. each year, about 40% is consumed by buildings, according to the Energy Information Administration. The energy usage is divided almost equally between residential and commercial buildings (Source: Annual Energy Review 2016. DOE/EIA-0383) A well-insulated, airtight, and properly ventilated building is the quickest way to reduce this energy consumption. For new construction, this can be done at a low additional cost. When it comes to retrofitting existing buildings, this approach requires upfront capital which, without government support, is only available to building owners with disposable income. Retrofits must be based on vetted building science in order to achieve energy goals and avoid health and durability problems (described in Part IV).

There are many low-cost measures that result in high returns on investment; replacing incandescent or fluorescent lighting with LED lighting can result in 400% returns. Implementing building controls and automation to heating and ventilation systems is another cost-effective way to save energy and lessen the overall demand on the grid. These systems must be installed by qualified technicians but can easily be operated by building managers. Examples include setback controls for HVAC systems and smart thermostats that can sense whether the building is occupied. These features, combined with a super-insulated building envelope, have made CCHRC's building the farthest-north LEED Platinum building in the world and runner-up for Siemens "Smartest Building in America."

**III. Energy efficiency creates jobs and investment in our communities**

As a state that is built on resource development, we have seen the impact of energy efficiency on the workforce in Alaska. Over the past 10 years, the State of Alaska has spent $716 million making energy efficiency improvements to nearly 20% of occupied homes in Alaska. Our home weatherization and energy rebate programs have saved homeowners 33% on energy bills annually. These long-term energy savings resulted in a 12% return on the state's investment, very competitive in today's economy. At the national level, weatherization programs have yielded about $4 in benefits for every dollar invested, according to the U.S. Department of Energy (Office of Weatherization and Intergovernmental Programs, Weatherization Assistance Program, August 2015).

Investing in energy efficiency creates jobs. In Alaska, the equivalent of 8,600 full-time jobs were created through the state's weatherization and energy rebate programs (nearly 6% of the workforce). In addition to the programs themselves, every $1 million in energy savings added 11 permanent jobs to the economy, according to a report by CCHRC and the University of Alaska Anchorage Institute of Social and Economic Research. That's an estimated 700 jobs. The economic impact would be amplified on a national scale. In 2015, Americans spent 6% of total GDP on energy expenses (including both the residential and commercial sector); that includes billions of dollars that could have otherwise circulated through the U.S. economy.

Throughout Alaska, CCHRC has worked with communities to design and build energy efficient, affordable demonstration homes using local labor and traditional knowledge. Thoughtful design informed by indigenous populations with thousands of years of experience living in this environment helped to significantly reduce the cost of construction. As a result, these homes use 80% less energy than other homes in the same communities, while also being healthier and more durable.

**IV. Energy efficiency promotes grid security and resiliency**

Energy efficiency lowers the cost of operating a power grid. As more homes and businesses come online, new capacity is required in the form of power plants, hydroelectric dams, or other generation facilities. Making buildings more efficient is far more affordable than building expensive new infrastructure.

In Alaska, the power system is especially vulnerable to wind, storms, icing and earthquakes, and stabilizing the grid requires a reliable backup system. Smaller building energy loads on the grid mean less expensive backup systems. In addition, efficient buildings are less vulnerable to power outages, especially

in extreme climates with high heating or cooling loads. Tragedies like the deaths of eight elderly patients in Florida after Hurricane Irma last month may have been prevented if the building envelope had passive qualities that maintained an acceptable temperature, even without power.

**V. Energy efficiency promotes health, financial security, and social equality**

In general, upper- and middle-class families are the ones who have greater access to energy efficient homes and reap the benefits of lower fuel costs, greater financial security, and improved health. Lower-income households, on the other hand, are most burdened by energy costs and generally cannot afford to make efficiency improvements and investments.

When homeowners start feeling the crunch of energy prices, many take matters into their own hands by tightening the building envelope or adding extra insulation, especially in particularly hot or cold climates. Without a proper understanding of building science, however, these actions can exacerbate health and safety concerns. For instance, tightening up a building envelope without providing balanced ventilation can cause backdrafting of combustion appliances and release gases such as carbon monoxide into the home, resulting in severe sickness or even death. Adding certain amounts of insulation without a proper understanding of moisture dynamics can result in trapped moisture within the building envelope, a common cause of mold. This affects the durability of the house as well as the health of occupants. In these cases, it is essential that homeowners and building managers be educated about these issues or at least have access to professional help.

Unhealthy housing leads to other problems for occupants. Respiratory disease has been directly linked to poor indoor air quality, which could very effectively be addressed through well designed ventilation systems. With simple-to-use controls and homeowner education, these ventilation systems can provide fresh air to homeowners without significantly increasing energy costs, while alleviating the respiratory illness associated with poor air quality.

Access to healthy, efficient, and affordable housing promotes equality. Alaska has a history of inequality in housing. Since western housing was introduced to Native Alaskan communities that was inappropriate for the climate, social and physical health has deteriorated. Rural Alaskans typically do not have the resources or understanding of bureaucracy to create affordable, energy efficient, healthy homes for their villages. While housing authorities have made admirable strides toward meeting this need, they are at capacity and cannot generate the adequate housing to meet critical demand. Lack of housing in villages had led to overcrowding, compromised air quality, and reduced quality of life.

The Cold Climate Housing Research Center has worked intimately with communities to improve rural housing through addressing these systemic problems. A recent example involves a Yupik Eskimo family of 6 living in a 2 bedroom home with extremely poor air quality and no functioning water or sewer system. The majority of the household income was spent on heat and power bills. Because they were unable to obtain financing for a new home, they were forced to choose between their health and leaving their traditional village. Through a collaborative effort involving CCHRC, USDA's Rural Housing program, and the Alaska Native Tribal Health Consortium, the family was able to design and build a new,

low-energy home that incorporates clean water and clean air. CCHRC has many other examples of these successes on its website at www.cchrc.org.

**VI. CCHRC's Recommendations**

New buildings can and should be designed to use much less energy than existing buildings at little additional cost. Attention to siting, building form, window properties and location, material selection and the incorporation of natural heating, cooling, ventilation, and daylighting are among the strategies we are using to achieve this end. After maximizing energy efficiency, a building's energy demand can be met or supplemented by renewable sources such as solar, photovoltaic, wind, biomass, and other viable sources. We recommend specific steps to move in this direction:

**Continue funding energy efficiency programs.** 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 and support 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 are already underway by groups such as the National Association of Home Builders (NAHB) and the many state and local groups focused on green building.

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 continues to advance retrofit strategies, 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 through applying appropriate ventilation and filtration standards.

**Continue funding results-based research on building envelopes, heating and ventilation systems.** These results are immediately utilized by building managers, homeowners, and builders across the country. Smart controls and building automation systems are part of this integrated approach, but this approach alone may not be suitable for mass implementation. Lower-hanging fruit (insulation, better lighting) will have a much greater impact for mass implementation. At the same time, we need to fund research institutions for advanced control systems so they can be easily integrated with existing systems.

**Support education for building managers, homeowners, builders, and building energy technicians.** Just because controls are installed does not mean they are used. For instance, the energy lost to ventilation systems in commercial and public buildings that run continuously could easily see 50% savings through setback controls already in place. While homeowners and building owners could also see drastic energy savings by applying setback settings and smart controls for their heating, cooling, and ventilation systems, a lack of understanding of the purpose of these systems often prevents their use.

In a survey conducted on public buildings across Alaska, a large number of buildings had advanced automation and control systems that were deliberately rendered inoperable by facility personnel. Such systems require training and understanding on the part of personnel or they'll just go to waste. It is essential that building managers, homeowners, builders, and building energy technicians are properly educated to understand the impact of energy-saving measures on their budgets and bottom lines.

**Encourage public-private partnerships**

Cooperative programs involving private-sector partners need increased funding by the federal government. Programs such as the Small Business Innovation Research (SBIR) and the National Science Foundation's Partnerships for Innovation (PFI), Healthy Homes, Weatherization, and others benefit from private-sector partnerships because they have the ability to leverage government funding into projects that address private-sector needs.

**Encourage demonstration Projects**

Demonstration projects are important to facilitate change in the building community. Even if the technology is well-proven among 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.

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 encourage investment in projects that shift away from fossil fuels to clean energy sources. By engaging private-sector partners in this way, the burden of developing and expanding critical research in efficiency programs is not shouldered by industry or government alone.

A strong federal and state partnership can drive the development of new energy-saving, energy-generation and transmission technologies. Such an investment would not only benefit the U.S. population but also help develop a market for American technologies by inviting the developing world to see how America is solving its energy needs in rural and remote regions. Alaska could easily become the nation's showcase for distributed power generating technologies.