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RENEWABLE ENERGY PRODUCTION, STRATEGIES, AND TECHNOLOGIES

HEARING

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

ONE HUNDRED ELEVENTH CONGRESS

FIRST SESSION

TO

CONSIDER RENEWABLE ENERGY PRODUCTION, STRATEGIES, AND TECHNOLOGIES WITH REGARD TO RURAL COMMUNITIES

CHENA HOT SPRINGS, AK, AUGUST 22, 2009

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RENEWABLE ENERGY PRODUCTION, STRATEGIES, AND TECHNOLOGIES

SATURDAY AUGUST 22, 2009

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Chena Hot Springs, AK

The committee met, pursuant to notice, at 10:22 a.m. at Chena Hot Springs Resort, Milepost 56.5, Chena Hot Springs Road, Hon. Lisa Murkowski presiding.

OPENING STATEMENT OF HON. LISA MURKOWSKI, U.S. SENATOR FROM ALASKA

Senator MURKOWSKI. All right. Good morning. We will call to order this hearing, this field hearing of the Senate Energy and Natural Resources Committee. The hearing this morning is concerning the potential importance of renewable energy power sources to meet our Nation's energy needs.

It's wonderful to be here at Chena Hot Springs. It's wonderful to be outside, even if we are in a tent, but being here on a Saturday morning on a glorious Interior day is terrific.

What we will focus on today is the importance of renewable energy power sources, as I say, to meet our Nation's energy needs, what types of technology we should be working to foster, what financial assistance may be needed from Congress to make these differing types of energy expand nationwide. Of course, of particular interest at this hearing is the use of renewable energy in high-cost rural areas.

Before I move further into my opening comments, I want to recognize a few individuals. First, my colleague, Senator Stevens, has joined us here this weekend. Senator Stevens has long been a leader in advancing energy issues in this State, and I'm delighted that he is with us today. We have Representative Paul Seaton from Homer who is with us. We also have Representative John Harris—actually Speaker John Harris has joined us. As others come into the room, I'll hopefully be able to acknowledge them as well.

We know that renewable energy has been a topic, a very popular topic, in recent years in Congress. Back in 2005 we passed the Energy Policy Act. We provided in that act a host of research and development grants and tax aid for renewables. Then in 2007, in the Energy Independence and Security Act, we went even further, providing more aid for geothermal and for ocean energy projects, and earlier this year we extended the renewable tax credits for a number of years. This winter the Obama administration suggested that

this country should be spending $15 billion a year to expand renewable energy production.

We know that we've got a long ways to go when it comes to furthering the use of renewal energy. Petroleum last year accounted for 39 percent of our total energy needs, natural gas accounted for 23 percent, coal 22 percent, and nuclear power was at 8 percent. All renewables together accounted for just 7 percent of our Nation's total energy production, and what we think of as new renewable, which is the wind, the solar, the geothermal, and new forms of biomass, this is just at about 3 percent. So we've got a long ways to go.

But it is a real improvement in the past 5 years. Since 2003 we've seen wind energy generation triple, up above 1 percent of total energy generation. Biomass still leads all renewables, accounting for 53 percent of renewable energy with hydropower in second place at 36 percent. Wind and geothermal are holding in there at about 5 percent, solar electricity accounts for 1 percent of renewable energy, and ocean marine energy development is barely a rounding error at this point in time.

But as Alaskans we know that renewable energy offers great potential in this State, where we see—particularly during the winter, our electricity from diesel generation costing about—an average of about 65 cents per kilowatt hour. I was in Newtok yesterday. They're sitting at about 85 cents a kilowatt hour. Given those prices, anything that supports free fuel may produce real cost savings, if the capital construction costs can be financed and can be controlled.

About 40 percent of the State might benefit from geothermal energy, either shallow vent geothermal, or the future enhanced geothermal systems that are now under study.

Right now about 24 percent of our State's total electricity comes from hydropower. There's about 28 hydroprojects that are currently producing electricity statewide. But we've got about another 250 projects that are already identified sites for hydroelectric generation from lake taps to water diversion from streams and rivers.

We lead the Nation here in Alaska in the amount of power that we could gain from ocean marine hydrokinetic projects, using the waves, using the currents to produce our power. Just the State's southern coast theoretically could produce 1,250 terawatts of power a year. This is 300 times more power than Alaskans use each year.

We also lead the Nation here in Alaska in traditional per capita biomass. Alaskans are burning about 100,000 cords of firewood each year for space heat. The State is already burning 8 million gallons of fish oil a year down in Kodiak to power boilers to dry fish meal, and using some of that for electricity generation.

We generate 650,000 tons of garbage a year, which Fairbanks is already planning to convert into energy. Anchorage is underway on generating 2.5 megawatts of electricity from methane gas produced by the Anchorage landfill. This is enough to power 2,500 homes. None of these forms of biomass take into account the 9.5 million acres of timber lands in the Tongass National Forest in the Southeast, or the lands and timber lands in the Chugach National Forest down in Southcentral.

We all know about our enormous wind potential here in the State. Kotzebue has 17 wind turbines that are currently producing about 8 percent of the community's power. There's more wind turbines already erected in dozens of villages in rural Alaska. Most of southern and western Alaska possess the best wind potential in the whole country. We've got the Fire Island wind farm that's on the threshold of construction in Anchorage, there are good wind sites south of Fairbanks, and AVEC, the Alaska Village Electric Co-op hopes to install more than 50 turbines in 36 rural villages, if they can find the money, it's always about the money. But the plan is out there.

All of these sites, particularly the large geothermal sites in the Aleutians and the hydro sites, offer the possibility of using renewable energy to generate hydrogen fuel or ammonia fuel that hopefully, someday, we could export, like we export our oil today, to fuel Alaska's economy of the future.

Now, this hearing is meant to focus on the renewables, to look at what the development can mean for the State, and especially to look at the very innovative ways that technology can be used to generate renewable energy and energy efficiencies that will ultimately lower consumers' costs.

You know, I mentioned the high prices that we're paying. When we think about what happened last year when Alaska as a State—actually the country as a whole, but more particularly the remote villages just got nailed with the high prices of fuel, and, you know, we don't have a lot of margin for error there.

We've had congressional hearings back in Washington DC. Some of you have had an opportunity to speak at them. The congressional hearings are a little bit different breed than what you may have experienced if you have gone down to Juneau. Congressional hearings almost never permit unlimited verbal testimony, although someone can submit written testimony for the hearing record. I'll give you the address later if you would like to submit some testimony if what you hear today prompts something that you would like to submit.

Today at the hearing we've got two panels of witnesses intended to provide a host of information. The witnesses will cover an overview of renewables, their need and potential, and what the Federal Government should be doing to increase their energy generation. I expect we're going to hear some innovative suggestions. I hope we will get some innovative suggestions for the technology in the future, and perhaps better information than what we get in Washington for how renewables can be harnessed to generate the power while we're producing less carbon.

We have a court reporter here today, and everything that is said will be part of the record to be taken back to DC, and this testimony from the hearing will be made available to other Senators on the Energy Committee hearing. So the good ideas that are presented today will be reviewed and studied by the Senate members and staff. So I'm hopeful that this hearing will be a useful springboard to advance renewable energy development, both here in Alaska and nationwide.

So hopefully, we're counting on it being a good sounding board to hear what we in Congress should be doing when it comes to both

a policy and a financial aid standpoint to help renewable energy development.

The sites today—when I spoke with Senator Jeff Bingaman, who is the chairman of the Energy Committee, and indicated that we wanted to hold this field hearing at the Chena Energy Fair—we indicated that this was the perfect place to do it. Chena is the first site in the country, first site in the country, to sport a working low-temperature geothermal power plant. As you know, the plant is powering the PA system here this afternoon and everything else from the ice museum's chiller system to the greenhouse fans and lights.

Then later this afternoon I will be participating, as I'm sure many of you will, in the christening of the first truly mobile, self-contained geothermal power plant. It's been built here, and it's awaiting field testing in Florida.

The innovations here at Chena that have been developed by Bernie Karl, who will be one of our witnesses on the second panel, and those who have helped him, are truly an inspiration for a host of renewable projects that are under consideration throughout the State. Whether it's the Fire Island wind project or Mount Spurr or Naknek, Manley Hot Springs, or Atukan, geothermal projects. Whether it's the hydroprojects that we're talking about, Lake Chakachamna, Susitna, the Grant Lake hydropower near Dillingham, we've got Thayer Creek down in Angoon. There's so much out there.

So I'm hopeful that with this hearing and what we gather today, we're going to be moving toward the day when there are the resources at the Federal, State, and local level to make these projects proceed. Later this afternoon at the energy fair, I'll talk a little bit more about what the Federal aid is and what's out there and available to further renewables. But right now I would like to hear from our witnesses about what more we should be doing to spur our renewable power generation, where we should be focusing those limited resources.

So today, this morning, we have on our first panel Mr. Brian Hirsch. He's the senior project leader in Alaska for the U.S. Department of Energy's National Renewable Energy Lab. We also have a gentleman that is familiar to so many in the energy world, Steve Haagenson, who's the director of the Alaska Energy Authority. We have Gwen Holdman. Gwen has taken me around Chena here numerous occasions explaining all the wonders of what goes on. Gwen is now the director of the Alaska Center for Energy and Power at the University of Alaska Fairbanks. We also have Chris Rose. Chris has truly been a leader in renewable energy. He's the executive director of the Renewable Energy Alaska Project.

So, ladies and gentlemen, it's a pleasure to welcome you here today. Without further adieu, why don't we start with you, Mr. Hirsch, and just go down the line. We'd ask you to try to limit your comments to about 5 minutes. Your full written statement will be included as part of the record. So if you want to summarize or add on anything, we'd certainly appreciate it. But welcome to you.

STATEMENT OF BRIAN HIRSCH, SENIOR PROJECT LEADER, ALASKA NATIONAL RENEWABLE ENERGY LABORATORY, CHENA HOT SPRINGS, AK

Mr. HIRSCH. Thank you, Senator. Thanks for the opportunity to discuss renewable energy technology and development, especially as it pertains to rural energy in Alaska, and the U.S. Department of Energy's involvement in these issues.

As you stated, I am Brian Hirsch, on assignment here in Alaska with the National Renewable Energy Laboratory, which is the U.S. Department of Energy's primary National Laboratory for research and development on energy efficiency and renewable energy issues.

In recent years DOE and NREL has been called upon to provide on location technical assistance and support to State and local entities, especially in locations like Alaska where there's high costs, complexities, and challenges around logistics and rugged climates.

We face many challenges here in providing energy for the State and the Nation. My testimony here will look primarily at what we've been able to accomplish, and challenges and opportunities for the future.

Alaska's well known for our substantial fossil fuel resources. We are less well known for our renewable energy opportunities, but they are equally abundant. We believe that with proper development, they can support vibrant communities, help the environment, and a prosperous future. We need look no further than Chena Hot Springs, as you mentioned.

The U.S. Department of Energy has been involved very much with everything from the very initial wells and development of the lowest temperature electricity producing geothermal systems here, as well as the mobile geothermal system that will be unveiled today, and an experimental 3,000 foot well that is also looking at enhanced geothermal production that may have broader application throughout Alaska and the country.

As you mentioned, Alaska has substantial tidal and wave potential. The Electric Power and Research Institute estimates that Alaska has 80 percent of tidal and 50 percent of wave potential for the entire country. Just harvesting a small portion of that would more than meet Alaska's needs and allow us to export and support energy needs in the Lower 48 and elsewhere and become a renewable energy exporting State, as well as a fossil fuel exporting State.

Challenges associated with that have to do with converting the energy, delivering it to shore, and where it's needed, and storing it for the time of year. Because of our extreme seasonality, Alaska is the most challenged of any State in the country on these issues. These are the areas of our focus.

So, for example, we've been partnering with the Denali Commission on an emerging energy technology grant program that both the National Renewable Energy Laboratory and the National Energy Technology Laboratory combined establishing the Arctic Energy Office is on the review committee, and we are targeting experimental technologies that really have the most potential benefit for Alaska around these storage and delivery issues.

Alaska has considerable wind resources, as you mentioned. The U.S. Department of Energy has a cost share with the State of Alaska on an anemometer loan program that can measure the wind re-

sources, and high-resolution wind maps to identify and pinpoint where those wind resources are. We've identified over 100 communities, primarily on the coastal areas, that have commercially developable wind resource, or cost effective wind resource.

Over the past several years, through congressionally directed projects, we have supported initiatives around in Kotzebue, on Saint Paul Island, in Selawik and other areas with the utilities in those communities. DOE's and NREL's early support of these projects help to answer important questions about wind turbine performance in cold weather, constructing foundations in permafrost, and integrating wind power into local electric grids.

Because of these early and sustained efforts, Alaska is now widely recognized as a world leader in wind-diesel technology. We are working closely with the University of Alaska Fairbanks, Alaska Center for Energy and Power to help establish what's called the Wind-Diesel Application Center. I suspect you may hear a little bit more about that on this panel later. There's also several community scale wind energy projects now operating or under construction throughout the State as a result of some of these early efforts.

DOE's Tribal Energy Program is quite actively fostering solutions as well. For example, one of the projects we thought of is a comprehensive biomass effort in the village of Fort Yukon with the Council of Athabascan Tribal Governments. That project is looking at everything from forest management and local business development to diesel fuel substitution for district heating, and eventually electricity production. Which, electricity production is really a challenge still. Heating is a lot easier to do, and so really the cutting edge of the technology is using biomass for these combined heat and power units. So that's another area of focus that once we figure that out will be widely transferrable to other parts of the State, and likely the Nation.

Other Tribal Energy Program successes include photovoltaic or solar electric system installations in Arctic Village, the furthest north tribally owned tracking array in the world—solar tracking array in the world in Venetie Village and Lime Village. I was personally involved in some of the installations prior to my work here at NREL in the Arctic Village and Venetie installations. DOE was a fundamental and important partner in both installation and some of the monitoring and distribution of the information and performance from those systems.

Like early wind projects, installing solar panels in far northern regions, we've been able to answer questions about how well the solar panels perform in cold weather. What we've found, among other things, is that cold weather actually improves performance of the solar panels because there's less resistance in the panel itself. We haven't quite figured out how to get the solar panels to produce energy in the dark yet. We're working on that one. I think that's way out there in the future. But what we realize more so, seriously, is that obviously solar panels are not going to be a year-round solution. But for up to 8 months a year, they substantially improve the energy portfolio in many of the rural areas.

In-stream hydrokinetic is another very promising technology. Also in my former life, prior to working at NREL, I was involved in the installation of the first in-stream hydrokinetic turbine in the

country on the Yukon River in the Village of Ruby. There is an exact replica of the turbine, I noticed, out here for people to observe at the Energy Fair here today. So that was with the Yukon River Intertribal Watershed Council Consortium of 70 tribes and the First Nations in Alaska and Canada, along with the Ruby Tribal Council and the city of Ruby. There is tremendous potential of taping of power and moving water in Alaska's streams and rivers.

The Alaska SeaLife Center in Seward is researching the use of ocean water as a heat source for heat pumps. This is another exciting and innovative project that has wide-scale potential for replication throughout the country—throughout the State and country in coastal areas.

Emerging opportunity that probably is not widely recognized is improved energy efficiency with marine vessels. Alaska produces over 50 percent of the Nation's seafood, and is highly dependent on long-distance shipping for harvesting, importing and exporting, which adds significant costs to all goods that come from outside. Some new diesel engines, modern controls, and operational strategies such as replacing hydraulics with electric motors have the potential to save between 10 and 40 percent of existing fuel. There's so many goods that come here from outside that we don't quite realize the hidden costs of some of that improved energy efficiency.

Along those lines we're also looking at electric vehicles, in particular in the rural areas, for things such as four-wheelers and snow machines. There's also an effort on designing site and culturally appropriate housing. There's a project that the Cold Climate Housing Research is doing—Cold Climate Housing Research Center, excuse me, is doing through their Northern Shelters Program—that is in Anaktuvuk Pass. That is combining traditional Inupiat design principles with modern technologies to create a low-cost, net zero energy home that is also—the process at least is widely applicable to elsewhere.

My testimony is primarily focused on rural areas, but DOE and NREL have also been active in the Railbelt with our regional integrated resource planning effort and looking at some of those projects that you mentioned earlier, Senator, the Fire Island wind project and Mount Spur geothermal and Lake Chakachamma and Susitna hydroprojects. We're also working with developers and industry in Cook Inlet and Kachemak Bay looking at some tidal resource potential for the large urban areas of Alaska.

So as we prepare for energy efficiency and renewable energy driven economic transition, we're also looking at work force development issues, and trying to nurture green jobs wherever possible. Also looking at smart grids which have tremendous potential in Alaska because the grid is of a size that we can actually manage. Some of the issues down in the Lower 48 are so large that it's very difficult to even run projects and say if that's going to actually have a real impact in a large scale, where here in Alaska from island communities to just small remote areas, there's much more of an opportunity to do so.

Finally, I would just draw your attention to DOE's activities involving the administration of the American Recovery and Reinvestment Act. There's $18 million of Weatherization Systems Program, $28 million of the State Energy Program, $14 million of the Energy

Efficiency and Conservation Block Grant Program, as well as another $12 million that's directly going to Tribal and—Tribes and Native Corporations through the Energy Efficiency and Conservation Block Grant Program, totaling over $72 million that DOE in distributing to the State and trying to work in partnership with the state to effectively use that money, or at least deliver it to them, and then it's up to them. We're very happy with how that's playing out.

So I thank you very much for this opportunity to discuss DOE's and NREL's activities in the state, and I welcome any questions you have.

[The prepared statement of Mr. Hirsch follows:]

PREPARED STATEMENT OF BRIAN HIRSCH, SENIOR PROJECT LEADER, ALASKA NATIONAL RENEWABLE ENERGY LABORATORY, CHENA HOT SPRINGS, AK

Thank you, Senator, for this opportunity to discuss the status of renewable energy technology and development, especially as it pertains to rural Alaska, and the US Department of Energy's involvement in these issues. I am Brian Hirsch, on assignment here in Alaska from the National Renewable Energy Laboratory (NREL). NREL is the U.S. Department of Energy's (DOE) primary National Laboratory for research and development of renewable energy and energy efficiency technologies. My work here is supported by the DOE's Energy Efficiency and Renewable Energy Office, through NREL's Deployment and Industrial Partnerships division. In recent years, DOE and NREL have been called upon to provide "on location" technical support and assistance at State and local levels, especially in locations like Alaska, where there is a clear sense of urgency to accelerate the deployment of more efficient and renewable energy technologies.

We face many challenges today in providing the Nation the energy it needs while protecting our environment. These challenges are even more difficult when we factor in the costs and complexities of meeting the energy needs of rural and remote communities. Much work is being done to adapt the most appropriate energy efficiency and renewable energy technologies to serve the needs of remote areas of Alaska. My testimony today will look at what we have been able to accomplish in this regard, as well as challenges and opportunities for the future.

Alaska is well known for its substantial fossil fuel resources, such as oil, gas, and coal. Alaska's renewable energy potential is less widely recognized, but equally abundant. Over the long term, there is tremendous potential for developing renewable energy that will support vibrant communities, a healthy environment and a prosperous economy.

The Electric Power Research Institute (EPRI) estimates that Alaska holds possibly 80 percent of the tidal energy potential, and 50 percent of the wave energy potential, for the entire United States. Even just a small portion of this energy would be sufficient to power all of Alaska, and leave substantial excess power for export. However, there are difficult and costly technical challenges to generating this power, moving it to where there is demand, and storing it for when it is most needed.

Alaska also has considerable wind energy resources. Large areas of the State—primarily along the coasts—have Class 5 or greater wind regimes, a designation which qualifies them as potentially attractive sites for commercial wind power production. We know this because NREL's Wind Powering America (WPA) program has helped to fund an anemometer loan program and high-resolution wind resource maps, in partnership with the State of Alaska. This research has identified over 100 remote villages with a Class 5 or greater wind regime. NREL's WPA program has selected Alaska as a high-priority State, and has supported ongoing development of the Alaska Wind Working Group, through the Renewable Energy Alaska Project (REAP).

Over the past several years, DOE Congressionally Directed Projects have supported innovative wind-diesel hybrid initiatives in Kotzebue, Selawik, and St. Paul Island, through utilities including Kotzebue Electric, the Alaska Village Electric Cooperative and TDX. DOE's and NREL's early support of these wind projects helped to answer questions about wind turbine performance in cold weather, constructing foundations in permafrost and integrating wind power into local electric grids.

Because of this early and sustained effort, Alaska is now widely recognized as a leader in wind-diesel technology. This has led to, among other things, the establish-

ment of the Wind-Diesel Application Center, or WiDAC, through the University of Alaska Fairbanks' Alaska Center for Energy and Power (ACEP). Several community-scale wind energy projects are now in operation or under construction throughout the State.

DOE's Tribal Energy Programs have also been quite active in fostering renewable energy solutions for Alaskans. Support includes a comprehensive biomass project at Fort Yukon with the Council of Athabascan Tribal Governments, which addresses everything from diesel fuel substitution for district heating, and eventual electricity generation, to forest management and local business development. Lessons learned from this initiative could be transferrable to other communities and regions with significant biomass resources.

Other Tribal Energy Program successes include the solar photovoltaic (PV) systems installed in Arctic Village, Venetie, and Lime Village. These ground-breaking solar initiatives, much like the early wind projects, are answering important questions about the performance of these solar electric systems in the rugged Alaskan climate.

What we learned is that solar panels can actually perform up to 15 percent better in cold weather. This is because there is less power loss due to heat, and there is more sunlight available due to reflection off of surrounding snow. Of course, in the dead of winter, there is essentially no light, and thus, no power production. So while solar power is not a complete solution for Alaska, it can be an important contribution to the power needs of many areas, for eight or more months a year.

In-stream hydrokinetic turbines offer significant promise given the untapped potential of streams and rivers around the State. The Yukon River Inter-Tribal Watershed Council, a consortium of 70 Tribes and First Nations in Alaska and Canada, was the first to successfully install an in-stream hydrokinetic turbine in the United States. The system is deployed at Ruby, Alaska, in the Yukon River, and was completed in collaboration with the Ruby Tribal Council and the City of Ruby.

Geothermal energy could likewise play a major role in the future of Alaska. Here at Chena Hot Springs is the lowest temperature, electricity-producing geothermal facility in the world. This represents an important advancement in the technology that, as it develops, could make geothermal energy a practical alternative to many more areas of the country that have good, though not ideal, geothermal potential. Both Chena's initial geothermal project and its adaptation for process water from oil and gas fields—projects being highlighted at the Energy Fair here today—have been funded in part by DOE.

The Alaska SeaLife Center in Seward is researching the use of ocean water as a heat source for heat pumps. This is another exciting and innovative project that has potential for application throughout coastal Alaska as well as other coastal areas throughout the Nation.

The Denali Commission is a longstanding supporter of rural energy projects, including wind turbines, energy efficiency, and a new Emerging Energy Technologies (EET) grant program. DOE's Arctic Energy Office, which combines the resources of NREL and the National Energy Technology Laboratory (NETL), is working closely with the Denali Commission on a new EET grant program, funded at almost $4 million, to select the best technology projects for rural Alaska.

One emerging opportunity lies with energy efficiency in marine vessels. Alaska produces about 50 percent of the Nation's seafood and is highly dependent on long-distance shipping for importing and exporting, which adds significant costs to goods throughout the State. New diesel engines, modern controls, and operational strategies such as replacing hydraulics with electric motors, together have the potential to save from 10 percent to 40 percent of total fuel use. Similarly, we are exploring options for electric vehicles, including ATVs and snow machines, that are commonly used in rural villages, to increase efficiency and reduce use of fossil fuels.

Designing site- and culturally-appropriate housing is another area where we can make great strides for energy efficiency and renewable energy. The Cold Climate Housing Research Center, through its Sustainable Northern Shelters program, is blending modern technology with traditional Inupiaq design principles in the design of an affordable net-zero energy home in Anaktuvuk Pass. While the Anaktuvuk Pass project is unique, this work can become a model for other residences and communities throughout Alaska and beyond.

While my testimony thus far has focused on rural areas of the State, we have also been participating in the Railbelt Integrated Resource Planning process, which is looking at potential renewable energy projects with greater economies of scale. These include large potential renewable energy developments in the Railbelt, such as Susitna and Chakachamna hydro, Mt. Spurr geothermal, and Fire Island wind projects. We are also supporting proposed tidal development in Cook Inlet and Kachemak Bay.

As we prepare for energy efficiency and renewable energy-driven economic transition, we have also begun to look at workforce development, career and technical training potential in both rural and urban Alaska. As we expand our work here, we must look at every turn as to how we can nurture more green jobs in the State.

I should additionally note that DOE is closely involved in the administration of the American Recovery and Reinvestment Act, ensuring that funds are properly directed to the State, and that they have the most impact, especially to help meet the clean energy needs of Alaska. The State is in the process of receiving more than $18 million in Weatherization funds, more than $28 million for the State Energy Program, and almost $14 million through the Energy Efficiency and Conservation Block Grant Program. Alaska Native Villages and Regional Corporations are to receive an additional $12.2 million. In all, Alaska will receive more than $72.2 million through the American Recovery and Reinvestment Act.

Finally, DOE has shown its increased support for EERE activities in Alaska through establishment of my current position, overseeing and providing leadership on many of the projects discussed above.

Thank you for this opportunity to discuss the work that I, my organization, the National Renewable Energy Laboratory, and the U.S. Department of Energy, are doing on behalf of clean energy in Alaska. I'd be happy to answer any questions you may have.

Senator MURKOWSKI. Thank you, Dr. Hirsch.

Mr. Haagenson. Welcome.

STATEMENT OF STEVE HAAGENSON, EXECUTIVE DIRECTOR, ALASKA ENERGY AUTHORITY, AND STATEWIDE ENERGY COORDINATOR, ANCHORAGE, AK

Mr. HAAGENSON. Thanks, Senator. Senator Murkowski and the Democratic staff, thanks for the opportunity to talk to you today about this interesting topic of energy. It seems to be taking up a lot of time and a lot of interest because it's really our survival.

But my name is Steven Haagenson, and I'm the executive director of the Alaska Energy Authority, and also the statewide energy coordinator. I was appointed about a year and a half ago to look at energy and come up with an energy plan for Alaska. As I look at Alaska, I found that we're—in knowledge, we're truly blessed in Alaska. Along with that blessing comes a little bit of a curse. The curse we have, which makes us different than most every other State, are our long distances and our low usage. A small population that can—and the long distance to deliver energy can make almost any project uneconomic, and it can really stress out a lot of the economics throughout the whole industry.

So as we looked at that, we came up with a plan that would actually address that. So we went out in Alaska and we asked them three questions. We went out to about 28 communities in Alaska, and we said, what resources do you know of that are available to make energy in your backyard because you eat, sleep, play, hunt, and fish here? The second question is, what don't you want us to use? The third question would be, why not? Those three questions gave us a lot of information—from Alaskans that know more about it than we would from—as a State perspective.

Then also—and then we said, OK, let's determine how much energy they need. Because you need—before you start planning a power plant or any source of energy—you need to know what your need is. So we went through and identified the amount of energy that was consumed across Alaska in each community and put it into a data base. The data base also put it into perspective of what it would cost to make those resources, if they were available to them, and make energy out of them.

In January 2009, we issued a report called Alaska Energy, A First Step Toward Energy Independence, and it's being used across Alaska today. Many communities are looking at it and using it as a resource to kind of say, well, this—I know I have this available now, so now how can I make it real? As we look at the study also, we went through and we developed a map. The map of our community so we can see what resources are available in each community. It's nice to see that there's wood in this area, but remember the curse of distance. If it's more than 20 miles away, you may not be able to afford to get it there.

So we looked very specifically at every community and said, what's in their backyard? We have a map of that. We found out, a little bit to my surprise, that there are some places that only have one resource. If you are looking at the lower Yukon—down in the YK Delta, they may only have wind. There is no other resource for them to use. If you look up in the upper Yukon, they may only have wood. So—and there's some of the places that have many blessings, many different resources.

But when we start thinking about what would you do if you only had wind and we're trying to replace our electricity, our heat, and our transportation fuels? So we said, well, let's use—obviously use a wind turbine. So how can we make electricity—we can make electricity very typically today. There's some challenges on how much you can penetrate into the system with wind-diesel coordination. So we wanted to jump past that and go to 100 percent wind.

As we deployed the wind, that makes a lot of sense, when the wind is blowing, you make lots of extra energy. Then we thought of—you know, naturally I thought of Chena Hot Springs, and we've made an artificial geothermal. The rest of the energy would go into a big tank. We're looking at storage medium right now. The tank would basically store hot water. That way when the wind doesn't blow—now you have a source of hot water to heat your community, and you would have a source of hot water to possibly, if you wanted to, to use an ORC or a Chena Chiller to make electricity when the wind isn't blowing.

The question is, what's the economics of that? We hired a consultant to actually go through that, look at the efficiencies, look at the economics, look at cost of that, and we are working on developing that technology right now. It's in the letter. We're looking at every community in Alaska to see what resources they have and how we can deploy them.

We started listening to Alaskans, and we've been talking to Alaskans about what they really want. A lot of them are just saying, tell me what you can do now. This is not about 10 to 20 years from now. It's very tempting to get up and—you know, and come up with a plan out there and do a—come up with a great plan. I guess my analogy is if a person comes to you and they're starving, you give them a few corn seeds and say here, plant these, and by the time they grow, then you eat that, and then you'll be fine forever. That works great as long as you can survive until they grow.

So that's, I think, the situation that Alaska is in right now. We need to have an immediate plan, a short-term plan, a mid-term plan, and a long-term plan. We're developing that. We're also adding a stretch goal or an aiming stake at coal to say where do we

want to be in the 20- to 30- to 40-year plan. That simply put is to be 100 percent renewable for all of our electric and all of our heat and all of our transportation. It sounds like a lofty goal, but it's a stretch goal. I think Alaska has the resources to do it, if we have the courage to go down that path.

With this plan, what we'll do is develop a resource map for each community based on the resources available to them. It will be given to the community so they can see if that's what they want to—if they—you know, because at the end of the day, they need to own this. This is not about coming up with a great plan—and we've had many brilliant plans in the past for energy. This is about Alaskans owning the plan and wanting to go down the path.

At the end of the day, the best plan will fail if you don't have ownership across the State. So our next step is to go out to Alaska and say, here's what we see from our perspective from what we know about your resources in your backyard, then we can deploy it, and we'd like—this is what we see, so what you—what do you want us to do in the plan, then we'll make it theirs.

So let's look at the—let's talk about what these steps are. We have the immediate plan, and what can we do in the immediate? Right now the immediate stuff is really energy conservation and the efficiency increases, both supply and demand side. There's a lot of things we can do on the efficiency side. But energy efficiency and conservation are two different things, and, you know, I'm going to take some of the resources end of it.

Energy efficiency is something you can—it will happen whether we think about it or not. If you buy your energy efficient refrigerator and you plug it in and you're using it, you don't have to think about saving energy. It's just going to save energy. If you get compact fluorescents, you're going to save energy. If you decide—if you walk out of here and decide to turn the lights off, right, that's a choice. When—in Alaska when it gets 40, 50, 60 below, people make different choices than when it's 60 above. So you can't really rely on that. So that's a choice. We have education needs that have to be done, and make sure they're using energy wisely. Then we'll figure out ways to use it more efficiently, and then we'll go down the path.

As you see, the short-term solutions are really what we're doing today. There's just way more of it. It's wind-diesel applications, it's using wood that's available, it's using the small hydrokinetic devices we can install. There's a lot of things we can do today that are pretty much proven, mature technologies. If you get into the mid-term, then you start getting more risk in the technology. When you get farther out, you get into the—it's artificial geothermal. You get into storage conversion technologies that's risk; it's going to come up. So it gets fuzzier.

We're going to try to give an aiming State goal so people can go down the path to understand what their long-term future will look like in Alaska. This report, and I'm scared to say this, but it's—hopefully we'll have this—we have a lot of work to do between now and then, but we're hoping to have these out by the end of November so we can get it to Alaskans and let people work on it and soak on it and own it. This report will also have a concept in there for financing the plan. Because just showing them a path doesn't help

them. We need to come up with methods that will allow them to go down the path and make it real.

The other thing that we have is to mitigate risk. We need to mitigate the risk because—like gaining knowledge. Right now we have questions like how fast do willows grow? If you're going to use willows as a resource, you better know if it's sustainable. Is the land available? Can you—and it may be great to have a forest. In some places if you don't have access to land, you're sunk. So all the different technologies, you have to understand what you're going to rely on, how it can move forward, and we'll be developing that as best we can. But that's when you—as you move into the future, we'll get more information to answer those questions and identify an effective path you want to continue down.

So remember that the aiming State concept—I'm a hunter, you know, so we're going to aim our—so we're going to start studying this rifle end. We're going to get it on paper first, and we're going to analyze the bull's eye later on, but the first step is today is a start. I think we can study this to death. I'm not a studier, I'd rather sit there and do something. But I think we need to make—look at our money use wisely and spend it correctly, because we don't have unlimited money. We need to very carefully focus our mission, get it about right, in the right quadrant or so, and move down that path to success.

So I'll be available for any questions at your convenience.

[The prepared statement of Mr. Haagenson follows:]

PREPARED STATEMENT OF STEVEN HAAGENSON, EXECUTIVE DIRECTOR, ALASKA ENERGY AUTHORITY, AND STATEWIDE ENERGY COORDINATOR, ANCHORAGE, AK

Chairman Bingaman, Ranking Member Murkowski and members of the Committee, thank you for the opportunity to appear before you today.

The people of the State of Alaska are truly blessed with an abundance of natural resources. Surrounding all these resources is a shroud of beauty that on its worst day is breathtaking. There are vast areas dotted with communities with beauty at every turn. From an energy perspective, Alaska's attributes can be characterized as both blessings and curses. We are truly blessed with abundant energy resources, and somewhat cursed with long distances and low usages, which can strain the economy of scales in delivery as resources are transported to their point of use.

Alaskans have long known there are local resources that can be used to power Alaska, but have moved toward the ease and convenience of energy-dense hydrocarbon fuels. Each Alaskan had their own reasons for looking for alternative fuels, some driven by rising costs, while others identified with new phases such as sequestration or carbon-footprint.

ALASKA ENERGY

In January 2009, the Alaska Energy Authority (AEA) published a report titled "Alaska Energy-A first step toward energy independence." This guide is now being used by communities to review the available resources and to help them determine their least cost energy options. The guide is available on the Alaska Energy Authority website, www.akenergyauthority.org.

Alaska Energy—A first step toward energy independence contains two main sections. The first section contains a 245 page narrative that provides a statewide background on energy in Alaska, current policy and planning efforts and issues, and discussion of the various technology options that may be available across the State. The second document is an 888 page technology screening tool that was developed to allow each community to review locally available resources and determine the most cost efficient energy options based on the delivered cost of energy to residents.

For the first time, energy use in each community was determined for three major components: electricity, space heating, and transportation.

In the spring and early summer of 2008, AEA engaged Alaskans through twenty-eight town hall meetings that were held throughout the State. Three questions were

asked at these meetings: 1) What resources do you know of near your community, where you live, play, fish and hunt that could be used for energy? 2) What resource don't you want to see used? and 3) Why not? AEA used this information to develop a resources matrix for each community, showing the available energy resources. Potential resources include hydroelectric, in-stream hydro, wind, solar, tidal, wave, biomass, geothermal, municipal waste, natural gas, propane, coal, diesel, coal bed methane, nuclear, and technologies for gasification and Fischer-Tropsch liquids.

Technology teams were formed for each resource and technology to identify available technologies that could be deployed to use the identified resources. People with passion and expertise were brought into the technology workgroups to help determine the most appropriate technology. Alaska Center for Energy and Power was brought in to help guide the technology discussion and help with the plan development.

The Technology workgroups are currently using the acquired information on usage, resources and technologies to determine the capital costs, and operations and maintenance costs for each technology. The capital costs and O&M will be adjusted to each community through the use of factors developed by HMS Construction Cost Consultants.

The net result is a focusing tool that provides each community with the least cost options for their electric, spacing heating and transportation. Prices will be based on a delivered cost that includes capital cost for infrastructure and alternative infrastructure that may be required for alternative fuel options. Operations and Maintenance costs and fixed energy costs were included to determine the delivered cost of energy to the community. The delivered cost number is intended to identify the real cost of current and alternative energy sources.

DEVELOPING AN ALASKA ENERGY PLAN

A resource map was constructed that indicated the available resources for each community. As would be expected, every resource is not available in each community. It was a surprise, however, that even with all the resources in Alaska, there are regions that have only one viable local resource for fuel. For example, western Alaska communities may only have wind, or the Upper Yukon may only have wood.

Costs for wind energy are included in the report, but in the electric wind-diesel systems wind energy is limited to 20-30% due to control complexity and system operations. The other observation was that even with a 30% wind penetration, the remaining 70% of the electrical energy would come from diesel. As Senator Murkowski knows very well, diesel can be extremely expensive in rural Alaska, so we searched for solutions that use 100% wind for both electric and heat.

Energy Storage and conversion become critical when intermittent resources may be unavailable for days, months or even years. Let's look at this further.

ARTIFICIAL GEOTHERMAL

Wind can provide electricity and heat, but what do we do when the wind isn't blowing? The key is to store energy when the wind blows so it can be used at a time when the wind stops. For years, water has been used for energy storage and transfer in geothermal applications. There may be many storage mediums but for this discussion we will use water.

A large wind farm could provide electrical energy directly to the distribution system with the excess electrical wind energy being input and stored in the water tank.

When the wind stops, the hot water would provide heat and could be used to make electricity through a binary phase turbine, similar to the Chena Chiller Organic Rankine Cycle (ORC) generator used at Chena Hot Springs. Stored energy could be augmented through other renewable resources such as solar, hydrokinetic or tidal, or other fuel resources such as diesel or wood.

STORAGE

Storage allows the use of a resource when the need exists but the resource may not be available.

Tidal power may require storage for a day, where wind may require storage for weeks, and solar energy may require storage for a year. Sizing of the storage medium is critical to ensure adequate energy is stored and can be released when required. Energy loss, conversion efficiencies, expected discharge durations can all affect the sizing of the storage device.

Alaska Center for Energy and Power (ACEP) is investigating energy storage technologies.

Tidal power is very predictable in the one-day storage duration and would allow for smaller storage capacity. Wind would require larger storage capacity that would

be based on the mean time between wind blows. Solar and hydrokinetic would require seasonal storage that may be required for up to one year. Seasonal storage would have the largest capacity and would need to store energy with minimal loss for these long periods.

Cold Climate Housing Research Center (CCHRC) is looking at use of a large insulated thermal mass that would be heated in the summer time with abundant solar energy, and used as a thermal source for a heat pump to heat buildings in the winter. There may also be opportunities to use a heat pump to store the heat in the thermal mass in the summer time and extract it when needed in the winter months.

ENERGY CONVERSION

The selection of a specific conversion technology is critical for extracting stored energy and converting it to usable energy, but reliability is also a critical factor. Skill levels required to operate the overall system must be maintained. In this manner, communities can strive to keep operations and maintenance costs at a minimum

COMMUNITY PLANS

The Alaska Energy Authority is now developing for each community a draft plan that will deploy technologies and storage mediums for locally available fuels. In talking to Alaskans it is clear that they want a recommendation for today, and a technology path to follow for the long-term. Our energy plan for each community includes:

- Current resource usage levels;
- Immediate (0-1 year);
- Short-term (1-3 years);
- Mid-term (2-10 years);
- Long-term (5-15 years) and a;
- Stretch Goal or aiming stake of 100% renewable energy for our electric and heat.

We developed these community plan components in response to the commonly heard and pressing Alaskan question, "What can I do now?" In the immediate timeframe, conservation and efficiency increases are key. Many Alaskans have already improved demand-side efficiencies by installing compact fluorescent bulbs or participating in the Alaska Housing Finance Corporation's weatherization program. On the supply side, Rounds I and II of Alaska's Renewable Energy Fund are providing $125 million to approximately 100 renewable energy projects across Alaska.

Short-term and mid-term solutions are achieved by deploying technologies that have short construction times, for example: wind-diesel systems for electricity; wind-thermal systems or highly efficient, clean burning wood stoves for heat.

Long-term solutions are achieved by using mature technologies, such as hydroelectric, or with emerging technologies. Hydroelectric has an extended timeframe for permitting and construction, and emerging technologies require additional information before recommending commercial application. It is important to begin evaluating emerging technologies today, in order that we understand the application when our decision to deploy is made.

Once AEA has prepared the preliminary community plans, we will share the plans with utilities, native corporations and municipalities. Alaskans have expressed great interest in participating in their community plan development. Local participation is critical to the success of energy planning. Each community and region will identify their preferences and ultimately make the plan their own.

WHAT WE DON'T KNOW

There are several areas where gaps exist in the application of storage and conversion systems. As in all energy supplies the resource needs to be gathered, converted into transportable energy and delivered to the point of consumption.

More research and information is required to fill the gaps in our existing knowledge base, such as:

- Justification of a deployment philosophy;
- Assessment of wind resources with on-site anemometers;
- Assessment of willow resources to determine growth rates;
- Determine sustainable renewable resource rates;
- Assess the resource potential for wave and tidal power;
- Develop technologies for capturing wave and tidal resources;
- Land ownership research for access to resources;

- Transition between mediums without disrupting the energy supply;
- Use of battery backup to transition between modes;
- Optimize delivery systems to provide redundancy and reduce the costs;
- Evaluation of technology and storage efficiencies;
- Capital cost estimates based on required sizing for technologies;
- Opportunities to reduce construction and operating costs;
- Identify opportunities for in-State component construction and assembly;
- Identify opportunities for in-State operations and maintenance personnel training;
- Development of model communities to demonstrate technologies;
- Financing options.

We are currently exploring these questions at a very high level, but more research is required before the gaps in our present knowledge base can be filled.

PUTTING IT ALL TOGETHER

The Alaska Energy Plan will provide direction and focus to the vision that all Alaskans should have access to affordable power. By making energy from locally available resources to meet local energy needs, Alaskans will change the curses of long distance and low usage into an expansion of our blessings.

The aiming stake approach will allow Alaskans to create a renewable energy future on our own time frame as economic conditions allow. If Alaska gets even half way to this stretch goal, we will be well ahead of most States and Nations. Then, much like the North Star, we can serve as a steady, shining guide to others undertaking the path to energy independence.

Thank you and I would be happy to take any questions that you may have.

Senator MURKOWSKI. Thank you, Steve.

Let's next go to Gwen Holdmann. Welcome.

STATEMENT OF GWEN HOLDMANN, DIRECTOR, ALASKA CENTER FOR ENERGY AND POWER, UNIVERSITY OF ALASKA, FAIRBANKS, AK

Ms. HOLDMANN. Thank you, Senator Murkowski and the virtual members of the committee. I appreciate the opportunity to appear before you today.

Senator Murkowski, I'd like to thank you personally for all that you have done to increase focus on renewable energy resources and the use of those resources to develop energy projects in the State and across the country. You've put a lot of work into this, and it is appreciated and valued. So thank you very much.

I'd like to shift the focus a little bit about how we talk about energy. Energy is often discussed as a means to an end, but in actuality, energy is really a tool that we need to obtain the goods and services that we need in our lives every day. Stable priced energy such as what can be achieved from renewable energy projects are needed so that current and future Alaskans and Americans can benefit from high-paying jobs, and so that we can continue to develop our economy, and to build wealth for individual residents and for our State and country as a whole.

Chena Hot Springs is a perfect example. Because it has the geothermal power plant out here, Bernie and Connie Karl know exactly what their energy costs are today. But also what they're going to be 10 and 20 years from now. Those stable prices allow them to build a business plan based on that certainty, and that provides a lot of value to them in terms of moving forward into that future.

Alaskans are the highest per capita energy users in the country, in a country that is the highest per capita user of energy in the world. That should give us pause for thought. On average we use more energy per individual resident here than anywhere else in the

world. There are a lot of reasons for this, and this does not mean that we are necessarily more wasteful than other people. But the point is is that we need a lot of energy. The cost of those energies are not necessarily born equally by all of Alaska's residents. Each region has particular challenges associated with it.

Because we're talking about renewables today, I'll focus on the rural communities, and we are currently on a path right now to spend over $4 billion in diesel fuel alone—that's not all energy costs; that's just diesel fuel—in rural Alaska in the next 20 years. That's a big number, and virtually all of those dollars would go to interests based outside of our State. But with those kinds of big numbers can also come big opportunities.

The high-cost of energy in Alaska, and particularly rural Alaska, make emerging technologies like distributed wind, biomass, geothermal, and tidal energy economic to deploy today. However, many of those technologies are more complex and expensive to install and operate than traditional diesel systems. Is the role of applied energy research like that conducted through the Alaska Center for Energy and Power at the University of Alaska to try and address the technical challenges associated with energy projects in order to bring the costs down and make renewable energy projects economic to install and reliable to operate.

All energy projects are not created equal. We must be prudent in our investment and new technologies as Mr. Haagenson just mentioned. To this end, the university is working on improving the efficiency of diesel engines, testing advanced energy storage and control systems, and a variety of other renewable energy technologies.

We're also looking at the resources to make sure that projects that we're developing are sustainable in the long term. We're working with Bernie right here at Chena Hot Springs to monitor the reservoir, and to continue to work with him to develop strategies to tweak production and injection of the hot water that makes this place work. We're also looking at growing willows as a biomass crop and what that would take, and doing research needed to deploy in-river hydrokinetic turbines as part of our energy mix.

Many of the proposed solutions we are working on are also more broadly relevant to achieving the U.S. goals for increasing renewables as a component of our national energy portfolio. For example, a major challenge in dealing with the high penetration of renewables is that a high amount of renewables on our grids, in particular wind, effect our electric grid infrastructure. Our grids were not designed for fluctuating power sources, and that has become a challenge not only in Alaska, but other parts of the country.

For this reason, Alaska has the opportunity to serve as a model and as a proving ground for the country, and I hope that the Senate will recognize that role that Alaska can potentially play. As an example, we've been working with Kodiak Electric Association on modeling the integration of hydropower wind and diesel on their electric grid. Kodiak has a goal of 95 percent of their electric power being produced by renewable resources in the very near future. They are really on track to achieve that with the first megawatt-scale wind turbine Federal turbine installed in the State of Alaska.

When we think about this 95 percent renewables, which is also something that Chena has achieved here, is a very lofty goal when you consider that, as you mentioned, Senator, that in the country only 8 percent of our power generation is from renewable resources. We have been working with them to determine how to reach this objective through the use of both short- and long-term energy storage. Achieving those kinds of high penetration is not a simple technical task, and it does require some additional infrastructure to make that happen.

The work we're doing at Kodiak right now is very relevant to much—the much larger national grid as certain parts of the country are quickly ramping up installed wind power, too. The limited grid at Kodiak affords an opportunity to optimize and prove really high-powered models developed by Sandia National Lab for the much more complex grid in the Lower 48 and verify those so that we can be doing the same types of things in the rest of the country. At a later time, testing new energy storage options on the Kodiak grid to achieve that grid stability will also be relevant to stabilizing the national grid. At the University of Alaska, we've been testing the next generation of battery technologies to meet the needs of both Alaska and throughout the country.

The U.S. also needs to rethink Alaska's role in the context of future global energy needs. Alaska is an exporting State, energy exporting State. Today we export our fossil energy resources, and those will be critical to Alaska's future for a long time. However, we must also begin to consider how we can develop our stranded energy sources, both fossil and renewable, to meet growing international demand for energy.

There are ways to export energy other than through electric power and through natural gas pipeline. That's through the value-added processing of products and raw materials. This presents a very real opportunity for the United States to reshape and rethink how Alaska fits into the global energy picture in a world that will become increasingly hungry for cheap and stable energy prices. This is not just an economic issue, this is also an issue of national security. As we ship more and more of the processing of raw materials we use every day off shore to Nations with cheaper energy than our own, we become increasingly vulnerable to political upheaval and instability in other regions.

We believe that it is our position that a long-range strategy needs to be developed for optimally using Alaska's energy resources for the benefit of both the State and the Nation. Thank you for your time. We recognize our future energy solutions will include a mix of renewable resources and fossil fuels. Alaska is a critical asset to furthering a national agenda of providing affordable and stable energy for the country, and we believe the energy research program such as the university's will have a key role to play in shaping that future.

We ask you to continue to press for funding for these critical research programs so that we can develop more economically viable projects and continue to improve the ones that have already been built. We would like to ask you to also keep in mind that Alaska's particular needs sometimes differ from those of the rest of the country, and while we have a role to play, there can also be chal-

lenges for us to fit into some of the funding opportunities that are out there when we're looking at the specific issues that are needed to be addressed up here in Alaska. Thank you for your time.

[The prepared statement of Ms. Holdmann follows:]

PREPARED STATEMENT OF GWEN HOLDMANN, DIRECTOR, ALASKA CENTER FOR ENERGY AND POWER, UNIVERSITY OF ALASKA, FAIRBANKS, AK

Chairman Bingaman, Ranking Member Murkowski and members of the Committee, thank you for the opportunity to appear before you today.

The U.S. is the highest per capita energy user in the world, and Alaska has the highest per capita energy use in the country.[1] However, these costs are not borne equally by Alaska's residents. Rural residents spend on average 12.7% of their annual income on energy related costs, compared to 3.6% for Anchorage and around 5% nationwide.[2] If we continue along the path of the status quo for Alaska over the next 20 years, we are slated to spend $4,141,304,772 on diesel fuel for heat and electricity in rural Alaska.[3] When this fact is put in the context of our patchwork of isolated grids and general lack of infrastructure, Alaska is clearly in a singularly unique position. In our dispersed population and limited infrastructure, we mirror 2nd and 3rd world countries, but in our energy use we are rivaled by no one in the developed world. Our situation is unique, and as such the solutions we seek must be similarly unique.

You have had the opportunity to see some of those solutions at work here at Chena Hot Springs today. Secretary of Energy Chu had a similar opportunity when he recently visited Bethel and Hooper Bay. After his visit, he made the comment that Alaska could serve as a proving ground for new energy technologies. I could not agree more with that assessment. The high costs of energy in Alaska—particularly rural Alaska—make emerging technologies economic to deploy today. In addition, Alaska is grappling with the challenges associated with high penetration of renewables, particularly wind, on our electric grid infrastructure. Many of the proposed solutions are also more broadly relevant to achieving the U.S. goals for increasing renewables as a component of our national energy portfolio. For example, The Alaska Center for Energy and Power has been working with Kodiak Electric Association on modeling the integration of hydropower, wind, and diesel on their electric grid. Kodiak has a goal of 95% of their electric power being produced by renewable resources, and we are working with them to determine how to reach this objective through the use of both short and long term energy storage. The work we are doing at Kodiak is also relevant to the much larger national grid as certain areas of the country are quickly ramping up installed wind power. The limited grid at Kodiak affords an opportunity to optimize and prove models developed by Sandia National Lab for the much more complex grid network in the lower-48. At a later time, testing new energy storage options on the Kodiak grid to achieve greater grid stability will also be relevant to stabilizing the national grid. At the University of Alaska, we have been testing the next generation of battery technologies to meet these needs both in Alaska and throughout the country.

In addition to this type of modeling and testing of energy storage, The Alaska Center for Energy and Power (ACEP) at the University of Alaska is actively engaged in research related to hydrokinetics, biomass, wind and geothermal energy. In addition, we recognize that our future energy mix will include a combination of fossil energy and renewables, and as such the University is also conducting research in optimizing existing power generation systems, and in maximizing production of our know fossil energy resources through research in heavy oil recovery, methane hydrates, and ultra clean coal.

Our partnerships with national energy labs are critical to addressing these issues. On the heels of Secretary Chu's visit and comments, we have sent the Secretary a request to develop more collaborative relationships with the national labs with the goal of using Alaska as a model and proving ground for the country. We welcome DOE's recent decision to establish a permanent NREL staff position and office in Alaska as an excellent starting point, and would like to request that specific re-

[1] From Energy Information Agency

[2] Symmary: Estimated Household Costs for Home Energy Use, May 2008, ISER Publication Sharman Haley, Ben Saylor, and Nick Szymoniak Note No. 1 Revised June 24, 2008.

[3] Based on Alaska Energy Authority Energy Database using ISER fuel price estimates, PCE fuel consumption values, and assuming consumption and fuel price don't change and an interest rate of 3% over 20 years.

searchers from NREL and SNL be assigned to work directly with the University of Alaska to address critical research questions.

Alaska also has another key role to play on the national stage. Alaska is an energy exporting State. Today we export our fossil energy resources and those will be critical to Alaska's future for a long time. However, we must also begin to consider how we can develop our stranded energy resources—both fossil and renewable—to meet growing international demand for energy. There are ways to export energy other than through electric power, and that is through value added processing of products and raw materials. Last week a report came out that suggests the overall extent of sea ice in the arctic will continue to decline. While the debate continues regarding climate change, we can agree on one thing. This presents a very real opportunity for the U.S. to reshape and rethink how Alaska fits into the global energy picture, in a world that will become increasingly hungry for cheap and stable energy prices. This is not just an economic issue, this is also an issue of national security. As we ship more and more of the processing of the raw materials we use every day offshore to Nations with cheaper energy than our own, we become increasingly vulnerable to political upheaval and instability in other regions. By assessing whether Alaskan resources could be tapped to develop energy ports associated with new potential shipping lanes, the U.S. can position Alaska as a global energy broker and develop a strong, sustainable economy long after our fossil energy resources begin to decline. It is our position that a long-range strategy needs to be developed for optimally using Alaska's energy resources for the benefit of the State and the Nation. The Alaska Center for Energy and Power is interested in working with your committee and appropriate Federal agencies on this issue.

Thank you for your time. We recognize that our future energy solutions will include a mix of renewable energy and fossil fuels. Alaska is a critical asset to furthering the national agenda of providing affordable and stable energy for the country, and we believe the University has a key role to play in shaping that future. It is our hope to work more closely with your national labs and other federal resources in addressing critical research questions necessary to achieving that future vision for Alaska and for the country.

Senator MURKOWSKI. Thank you, Gwen.

Chris Rose, welcome.

STATEMENT OF CHRIS ROSE, RENEWABLE ENERGY ALASKA PROJECT (REAP), CHENA HOT SPRINGS, AK

Mr. ROSE. Thank you, Senator Murkowski. Thank you, members of the committee. I appreciate the opportunity to speak here today. For the record, my name is Chris Rose. I'm the executive director of the Renewable Energy Alaska Project. REAP is a coalition of 67 organizations around the State, and also around the country that share the goal of increasing the production of renewable energy in the State and promoting energy efficiency.

We are composed of almost 20 utilities, over 20 businesses and developers of renewable energy, 4 or 5 environmental groups, consumer groups, Alaska Native organizations, and we also have 10 local State and Federal agencies that act as advisory members so that we can have their input at our board meetings and in the work we do. We're an education and advocacy group. We do things like put on forums, renewable energy fairs, conferences, put together, along with the Alaska Energy Authority, the Renewable Energy Atlas of Alaska, which we have now printed and distributed almost 25,000 of over the last 3 years. So those are the kinds of things we do, and we really focus on statewide issues, and so I appreciate the opportunity to talk about the Federal issues, but just keep in mind that we really focused a lot on the State things that are happening here.

As many of the other members, the other witnesses have stated, we have some of the best renewable energy resources in the world, and you said that yourself, Senator. You went through the list. We

do have some of the, and fortunately or not we've had so much oil and gas in this State that we've, I think, ignored our renewable energy resources up until relatively recently. They've just been in the background, because we haven't necessarily needed them, although we have been using our hydro resources for quite some time.

We do have this huge opportunity now to seize, both here in the State and also at a national level. The way that we frame this issue of renewable energy when we're out there talking to people is in terms of risk management. Because there are lots of risks, and continuing on the status quo. The first one is already hitting us, and that's price. Worldwide energy demand is expected to double by the year 2050 and quadruple by the year 2100.

We're looking at places like India and China where everybody wants to drive a car, everybody wants to have the same kind of lifestyle that we have. If everybody in China used the same amount of oil per capita as Americans, Chinese today would use every drop of oil that's produced, and there would not be anything for the Europeans or the Americans or anybody else.

So we're facing a future where worldwide demand for energy is increasing quite rapidly. At the same time, the fossil fuels that we have really built our civilization on are a finite resource. So they're diminishing, so price is going to go up. It's going to trend up, and that's a real risk if we don't diversify our portfolio and put in flat-price renewable energy resources, and that's, I think, what Gwen and other people are talking about, is we can predict the price of these renewable energy resources, and that is a huge boon for investors and for the business community.

Of course, another big risk is climate change. I included in the testimony that I—the written testimony, a small article that I pulled off the Internet just 2 days ago about some research that's just been done here in Fairbanks, the University of Alaska Fairbanks, about ocean acidification, which I think is probably the biggest concern we have right now in terms of the short term. Right now we're looking at a situation where pteropods and other small creatures are unable to form shells because of the increasing carbonic acid concentrations in the ocean. Of course, that could really impact our fishing industry.

But the biggest insurance companies in the world see this and an economic issue. They're the ones who are paying for these climactic events that are occurring around this country and around the world. So another driver, and that's what's driving us toward carbon regulation, which is going to cause the price of fossil fuels to go even higher.

I think that one of the biggest risks is that this is $150 billion a year business right now, and most of that business is happening elsewhere, not in the United States. It's expected to quadruple by the year 2015. We have this huge opportunity here to be a part of that clean energy revolution. A lot of people are looking at this as the next industrial revolution, and, in fact, it has to be, because energy is the lifeblood of any economy. We can't do anything, we can't grow food, we can't transport ourselves, we can run businesses without energy. So we're talking heat transportation and electricity.

As Gwen and others have pointed out, we've got this testing bed in rural Alaska, whether we recognize it or not. When you can produce hydrokinetic energy, for instance, at 50 cents a kilowatt hour, which is demonstration technology, that's not going to really save anybody money in the Lower 48. That saves people money today in Alaska. So this is the perfect place to be testing these kinds of things that are relatively expensive, with 90 percent of the tidal and 50 percent of the wave energy and all this geothermal and wind, we should be leaders in this technology.

There's 2 billion people on the planet right now with no electricity. That's almost a third of the world. That's a huge market. All those people wanted electricity yesterday. If we can perfect these technologies like wind-diesel hybrid systems and hydrokinetics and solar, we can then be exporting that technology around the world. So we have this huge opportunity that we see.

Solar, for instance, is one thing that's really exciting for me. It really hasn't taken off in Alaska because it doesn't follow our load. We don't use a lot of air conditioning, we don't have a lot of lighting in the summer, and yet, when plug-in hybrids come in next year, I'll be buying one of those cars, I'll be putting solar panels on my house, and I'll be running my car off of solar. So when you start applying solar to transportation, all of a sudden the whole game changes in terms of how we might be able to use that.

So with hydro, solar, all these other opportunities up here, we clearly have a huge opportunity for Alaska. I just want to hit a few Federal policies, and like I said, we're not—we're not concentrated on those, but there are a few Federal policies that are important to mention right now.

There's a Renewable Electricity Standard that's in front of Congress. One thing that the REAP board has talked about quite extensively at one of our board meetings is the definition of hydro. Right now—and I know you've been working very hard on this, Senator—I think the Lower 48 sees hydro as something that has been kind of past its life, and also is a—can be of concern to fish. Of course, we're concerned about fish up here, too. But we have many, many hydroprojects or possibilities up here that the Lower 48 doesn't have. So if there's an RES and a renewable electricity credit market, we want to make sure that our hydroprojects get those RECs.

Also, regarding RECs, we want to make sure that any policy that is formed at the Federal level for renewable electricity as standard does not squash inadvertently the voluntary REC market. Because the voluntary REC market right now is really helping renewable energy grow. So we want to make sure there's no double counting, and that if there's voluntary RECs out there, that they're not used for compliance. We also want to make sure that if there are RECs that are sold before an RES is actually instituted, that the—those RECs vest in the purchaser and not the entity that produced the power. Because otherwise if we don't do that, it can inadvertently squash that voluntary REC market.

The Clean Renewable Energy Bonds have been a really fantastic program. Kodiak Electric, which has been mentioned here several times, used those bonds. They're one of the first entities in Alaska to really use those successfully. That program should be expanded,

and maybe more various types of projects could be included in that program.

I just had a meeting with John Goll, who's the regional director of MMS the other day, and we were talking about a forum maybe later in the fall about the new MMS leasing program. That's something we really have to look at very closely, because any offshore wind industry, hydrokinetic industry that's going to be evolving offshore could really be hurt if this program is not setup correctly.

Right now I think MMS is in a difficult position to figure out how to actually evaluate those resources. Because for one thing we don't have a lot of baseline information about what the resources are, and I think there might be an inherent conflict in extracting revenue through those leases, and at the same time having policies like the Federal Product Tax Credit that are actually rewarding and incentivizing renewable energy. So there's a little tension there between those two, and especially with hydrokinetics and offshore wind which are nascent industries. We really want to make them get off the ground and grow. We don't want to hold them back, but we're really pleased overall that FREC and MMS have resolved the jurisdictional conflict over that issue.

Twenty percent wind. DOE has had a 20 percent wind goal now for about 2 years. There's a very extensive report. As Brian Hirsch pointed out, NREL's been working on this. The Wind Powering America program, which is part of NREL has been working—we've been working very closely with them over the years. That's a very important program to educate people about wind.

There's no doubt technologically and physically that we can do 20 percent wind by 2030 in this country. But there's going to be a lot more transmission, there's going to be a lot more education that's going to have to precede that, and so we're really looking at DOE's goal of 20 percent wind as a doable goal. We would like to see as many resources put into that as possible, because that is the most mature and commercially viable of all the new renewable energy resources past hydro. Forty-two percent of all installed new electrical capacity in the United States last year was wind. So it's a very, very fast-growing industry.

On the issue of job training, research and development, there's a lot to do there. We're going to have to prepare all our workers, and we're going to have to really be leaders in this. The things that Gwen's doing at the Alaska Center of Energy and Power could really have world ramifications if we can provide—if we can get better storage, if we can really work on these wind-diesel hybrid systems, if we can perfect hydrokinetics. We have this opportunity here in Alaska to help not only the United States, but also the world.

I guess I would just close with the discussion of vision, and that is—and on the State level working on the same thing, which is we need an overall vision and policy about where we're going. Without that vision and where we're going in 100 years, we're not going to be able to draw the road map to see how we're going to get there. But the fact is that we're probably going to run out of fossil fuels sometime in the next 100 years, or at least they're going to become so expensive it's going to be difficult to use them.

So where are we going to go? How are we going to get to a place where we are 100 percent renewable like Steve Haagenson says?

It's the economies and it's the cultures and the societies in this world that see that like Iceland, like Brazil and other places that have that vision that are going to be the most economically competitive, and the ones that are going to prosper. So we're really hoping that Congress can look 50, 60, 70 years down the road for the United States and say, how are we going to get there? Because we have tremendous renewable energy resources in this country, and especially in Alaska.

I think it's crazy in some ways in Alaska that we're looking at exporting this natural gas that we have that for Alaskans could last 1,000 years. But if we pipe it to Chicago, we'll run out of it in the same time the Chicagoans run out of it. So we got to think about ways that we're going to be able to preserve some of our resources here in Alaska and the United States, our fossil reserves, and at the same time really push hard on the renewables. We really do appreciate all the work that you've been doing on this, Senator Murkowski. Thank you very much. Thank you for the opportunity to testify.

[The prepared statement of Mr. Rose follows:]

PREPARED STATEMENT OF CHRIS ROSE, RENEWABLE ENERGY ALASKA PROJECT (REAP), CHENA HOT SPRINGS, AK

Members of the Committee, for the record my name is Chris Rose and I am the Executive Director of the Renewable Energy Alaska Project, also known as REAP. Thank you very much for the opportunity to testify at this hearing.

After introducing REAP I would like to describe how REAP approaches the issue of renewable energy, then briefly touch on some federal issues that impact renewable energy development.

REAP is a coalition of 67 entities, including organizational members consisting of Alaska electric utilities, businesses, environmental and consumer groups and Alaska Native organizations that share the goal of increasing the production of renewable energy in Alaska and promoting energy efficiency. Besides those members REAP also includes local, State Federal Agencies and institutions that also have an interest in renewable energy. Examples of those Advisory members are the Alaska Energy Authority, the Alaska Center for Energy and Power, the Denali Commission the National Renewable Energy Laboratory (NREL).

Over the last 5 years REAP's work has primarily focused on the State level. As an education and advocacy group we have five primary objectives which are to:

1) promote energy efficiency;
2) foster and promote stakeholder unity in support of renewable energy;
3) work to get viable renewable energy projects in the ground;
4) work to implement policies that promote more renewable energy and;
5) build a market for renewable energy in Alaska.

Each year REAP hosts several events, including the annual Alaska Renewable Energy Fair, the Business of Clean Energy in Alaska conference and numerous forums on renewable energy and energy efficiency.

At the State level we have worked hard to educate policy makers about the benefits of renewable energy and energy efficiency. Besides several bills that are now pending in the Alaska legislature, our work has resulted in the creation of the Alaska Renewable Energy Grant Fund into which the legislature has appropriated $125 million over the last 18 months for over 100 renewable energy projects across Alaska. It is one of the largest clean energy funds in the Nation, and represents the highest per capita spending on renewable energy in the United States.

RENEWABLE ENERGY AS RISK MANAGEMENT

REAP sees the issue of renewable energy in the context of risk management. The risk is continuing to rely on the status quo for our energy, with its heavy reliance on fossil fuels.

The first risk is affecting us already, and that is price. World energy demand is expected to double by 2050, and quadruple by 2100. Meanwhile the fossil fuels that

have built our economy are finite resources that are diminishing. The laws of supply and demand are pushing fossil fuel prices higher, especially in places like rural Alaska where diesel, heating oil and gasoline prices are significantly higher than in the rest of the country. As we move into the 21st century and Nations like China and India develop economies with higher per capita energy use, the price of fossil fuels will go even higher. However, with renewable energy the "fuel" is free, whether it is wind, sun or flowing water, resulting in the generation of flat-priced power.

A second and related risk is geopolitical. Many would argue that we are already suffering from the fact that roughly 65% of the world's proven and conventional oil reserves are in five countries in the Middle East: Saudi Arabia, Kuwait, Iran, Iraq, and the United Arab Emirates. Increasingly, the entire world is competing for this relatively inexpensive oil that lies in an area of the world where the United States' access is getting more and more difficult to obtain. Renewable energy is local and inexhaustible energy.

A third risk is climate change. With each of its successive reports the Intergovernmental Panel on Climate Change (IPCC) has concluded there is an increasing chance it is we humans and our carbon emissions that are causing climate change. Even without conclusive proof of the cause, it is clear that climate changes are occurring much more quickly than scientists have been able to predict, and that we must do something about it.

Perhaps the most disturbing change that we are facing is the buildup of carbonic acid in the oceans that is rapidly changing their chemistry. As reported by The Daily Climate on August 20, 2009, by some estimates the oceans have absorbed 30% of the carbon dioxide emitted since the beginning of the industrial revolution. The ocean's pH has dropped nearly 30 percent over the past 250 years to levels not seen in 800,000 years, and if emissions continue unchecked in 40 years, the oceans could be more acidic than anything experienced in the past 12 million years, according to some climate models.

According to The Daily Climate story, as ocean pH drops and acidity rises, organisms such as corals, oysters, clams and crabs have trouble pulling from seawater the minerals to create protective shells. New research from the University of Alaska Fairbanks suggests Arctic oceans are particularly susceptible to acidification because cold water absorbs more carbon dioxide than warmer water. The newest data from the Gulf of Alaska shows that acidity levels far higher than expected might already be impacting the food web. In several sites the increasing acidity has changed ocean chemistry so significantly that the pterapods at the base of the food web that support the state's salmon runs are unable to form shells. According to Jeremy Mathis at the University of Alaska Fairbanks, "[t]he increasing acidification of Alaska waters could have a destructive effect on all of our commercial fisheries. This is a problem that we have to think about in terms of the next decade instead of the next century." For this and many other reasons, scientists and Nations around the world are looking for ways to decease carbon emissions. Renewable energy does not emit carbon dioxide when it is generated.

The last risk is a business risk. The clean energy industry is estimated to be about a $150 billion business this year, and it is expected to at least quadruple by 2015. One example of this growth is the wind industry, which has been the world's fastest growing energy sector for over a decade. Last year 42% of all new electrical generation installed in the United States was wind. The risk is that the United States and states like Alaska will largely miss out on what many believe will be the next industrial revolution. For example, today General Electric is the only American company that ranks in the top ten of wind turbine manufacturers. If the United States is to remain competitive in an increasingly competitive world, we must anticipate trends like carbon regulation and the desire by business and industry to have access to predictably priced and local power.

In Alaska we have a unique opportunity to be part of the new clean energy economy that is coming our way. We need to recognize that village Alaska can be a laboratory for energy innovation. Only in rural Alaska, where electricity rates often exceed $1/kWh, can a demonstration project that produces 50 cent/kWh actually save residents money at the same time that a technology is tried. Alaska is already seen as a world leader in wind-diesel hybrid technology, and Kodiak Electric Association just installed the first wind-diesel-hydro hybrid project in North America. There are currently over two billion people in the world with no electricity at all, many of whom live in remote villages in the developing world that will likely leap frog the standard central power station model straight to distributed energy systems like the ones we are developing in remote Alaskan communities. If we can perfect those systems in Alaska, the state has the opportunity to export that technology and know-how across the planet.

FEDERAL POLICY ISSUES

Because REAP is primarily focused on State issues, our 21 member board of directors has not yet taken an official position on most federal energy policy. However, I will make some brief comments on a few issues.

NATIONAL RENEWABLE ELECTRICITY STANDARD (RES)

The RES is the only federal policy that the REAP board of directors has taken up and voted to support, with certain provisions. Because SB 433, as drafted last spring, would exempt Alaska utilities because of their small size, REAP supported it because Alaska entities could still take part in the Renewable Energy Credit (REC) market that it would create. The provisions that would given extra credits for renewable energy produced on tribal lands was particularly supported, as long as it did not apply to electrical grids of less than 10 MW. This exclusion was something that small village utilities in particular believe is important to prevent independent power producers (IPPs) from coming into a village and competing with small village utilities that are already in fragile economic States.

The other provision of interest to REAP members in any RES is the definition of hydroelectric power as renewable energy. REAP believes that properly permitted hydroelectric power in Alaska should count as renewable energy for purposes of the REC market that would be created. Alaska has many potential hydro locations that have not been developed, and Alaskans will be the first to scrutinize any impacts that a hydro facility will have on fish.

FEDERAL PRODUCTION TAX CREDIT

REAP is pleased with the recent extension of the federal production tax credit (PTC). It remains to be seen what shape the various renewable energy industries will be in 2012, but it is likely that many of them, including tidal, wave and solar, will need another, longer term extension of the PTC. It is very difficult for U.S. markets to compete in the renewable energy space with countries in Europe, several of which provide 20-year market certainty with feed-in tariffs.

CLEAN RENEWABLE ENERGY BONDS (CREBS)

CREBs have already helped Kodiak Electric Association build the largest wind farm in the Alaska. The program should be expanded, and perhaps restructured to fund a greater variety of projects.

THE REC MARKET

Currently, many organizations, households, government agencies, farms, and businesses voluntarily purchase "green power" in the form of renewable energy certificates (RECs), or install on-site renewable electricity generation like solar as part of their commitment to reducing their global warming footprint. The voluntary market has been an important driver of clean energy development across the United States, responsible for millions of dollars in new investment. The voluntary market grew by 62% in 2004, 37% in 2005, 41% in 2006, and 53% in 2007. If the voluntary market continues to grow at an annual rate of 40% (based on recent experience), it will reach nearly 50 million MWh by 2010.

The Senate RES provisions of American Clean Energy and Security Act (ACESA) should be amended so that the Act does not inadvertently undercut the thriving voluntary renewable energy market. Specifically, the amendments should 1) expressly prohibit voluntary renewable purchases to be used toward RES compliance and 2) clarify federal renewable energy certificate (FREC) ownership for contracts involving unbundled RECs created prior to enactment.

It is an essential principle that double counting of claims be disallowed. Either a voluntary or a compliance claim can be made for each MWh of clean energy sold, not both. To prevent double counting, ownership of and rights to Federal RECs should be clear. When a renewable generator has sold electricity and/or renewable energy credits, certificates or attributes associated with such generation under a contract that was entered into before the date of enactment of the federal RES, ownership of the Federal renewable electricity credits associated with such generation should vest in the party that purchased the renewable energy certificates. This clarification of ownership rights to federal RECs will provide essential market certainty necessary to maintain a thriving voluntary renewable energy market.

Unless addressed this issue would not only seriously undercut voluntary green power marketers, but could also compromise the standard's fundamental goal of increasing renewable energy deployment, since voluntary purchases have been major drivers of such growth.

20% WIND BY 2030

A great deal of work at the federal level is necessary to reach the DOE's stated goal of 20% wind by 2030. The DOE has produced a comprehensive report on this goal. However, outreach efforts, like those led by NREL's Wind Powering America (WPA) program, need to be strengthened. WPA has supported REAP in its outreach efforts in Alaska, and has selected Alaska as one of its 13 priority States. As such, WPA has worked aggressively with REAP and the Alaska Energy Authority (AEA) to share the development of a high resolution wind map of the State to identify the quality of wind resources along the Railbelt as well as the hub and remote communities. Additionally, WPA funded the anemometer loan program to prospect for wind in rural communities.

NREL, AEA and REAP held the international wind-diesel conference in Alaska in 2008 in recognition of both the progress and need for a robust wind-diesel market in Alaska villages. The cost-shared early wind-diesel pilot projects in Wales and Selawik developed many lessons learned that were incorporated in successful commercial projects in other AVEC villages. The cooperation on the emerging wind-diesel research center at UAF will be important in training new engineers in the controls and design challenges remote electricity systems.

WPA has been effective across the country in helping to educate the public and policy makers that wind is a mature and commercially competitive technology. While wind currently provides just over 1% of the Nation's electricity today, it is clear that the 20% goal is achievable when one looks at countries like Denmark which is already 20% wind electricity. Iowa currently leads the United States, at 15% wind.

MMS AND OFFSHORE LEASING

REAP is pleased that Interior Secretary Salazar has recently helped resolve the jurisdictional dispute over hydroelectric and hydrokinetic resources that existed between the Minerals Management Service (MMS) and the Federal Energy Regulatory Commission (FERC). However, the leasing system that Congress has now asked MMS to develop for renewable energy resources more than three miles offshore sets up some real challenges for the agency in how to evaluate those resources during the leasing process. It is going to be very difficult to value offshore wind and hydrokinetic (tidal and wave) resources without more baseline information about those resources. Furthermore, too high a leasing price could effectively kill the nascent and currently undercapitalized offshore wind and hydrokinetic industries before they have a chance to get off the ground. There also seems to be an inherent conflict between the federal production tax credit that is designed to incentivize renewable energy development, and a leasing system that is designed to extract revenue from renewable energy developers.

RESEARCH AND DEVELOPMENT

As already alluded to, the United States trails behind Europe, Japan, and many other Nations in the development of clean energy technology. In order to catch up and become a leader in this incredibly important field, the United States must help fund research, development and deployment of new technologies. As noted, Alaska is a perfect place to test technologies because we can save people money at the same time we demonstrate technology. With over 90% of the Nation's tidal energy potential, 50% of the Nation's wave energy potential and incredible wind, geothermal, biomass and solar resources, Alaska should be a leader in renewable energy development. Such development should extend beyond electricity to heat and transportation. Today heating bills in rural Alaska are more of a problem than electric bills. Communities in Southeast Alaska which have excess hydroelectric capacity and short road systems are perfect to demonstrate how an all-electric transportation system could work. More electric transportation should also be considered in Alaska's Railbelt, where today large hydro projects are being considered and citizens are exporting hundreds of millions of dollars outside the State each year to purchase gasoline. With plug-in hybrid automobiles on the near horizon, Alaska should also be working to utilize our excellent summer solar resources to save on fuel from March through October.

In the area of hydrokinetic energy, the federal government should consider helping to fund basic environmental research to study the technology's possible impacts on marine life. The cost of that research is now being borne by a nascent industry that is having trouble paying for it. Other Nations, like Canada, are cost sharing in this research, making them more attractive places for tidal and wave energy companies to do business.

JOB TRAINING

In order for the United States to be ready for the energy challenges ahead we must train our workforce. Renewable energy and energy efficiency will create jobs and help the United States compete in the world economy. Federal grants to States and institutions of higher learning to establish workforce development programs will help accelerate the clean energy economy in the United States.

CARBON REGULATION

As already noted, the REAP board of directors has not taken any position on the various proposals to set up a cap-and-trade program or carbon tax. However, it is clear that economic price signals do often work, and the more expensive a commodity is, the less demand for it is created. Higher prices for one commodity also give space to competitors selling another. In the case of carbon, it seems likely that carbon regulation will help promote the development of more renewable energy. Establishing a price on carbon would also recognize its true costs, and discourage a simple reliance on the status quo. Depending on what legislation might be passed, it is likely that money would flow to the State of Alaska in the form of emission allowances that the State could use to further promote renewable energy and energy efficiency.

CONCLUSION

The federal government's role in expanding the clean energy economy in the United States and in Alaska is pivotal. Energy is the lifeblood of our economy. Unless we aggressively seek ways to increase the percentage of clean, local and stably-priced renewable energy in the Nation's portfolio, the country will become increasingly uncompetitive with other Nations and economies that are anticipating that supply and demand of finite fossil fuels and concerns about climate change are going to continue to make fossil fuels more expensive in the future.

Because energy is such a huge and important area, and because of the limited time that I have had to prepare for this testimony, it cannot be exhaustive. However, REAP appreciates the opportunity to testify, and looks forward to working with the Committee in any way possible in the future. Thank you.

Senator MURKOWSKI. Thank you. Thank all of you for your testimony this morning. It's been very interesting, good discussion, and I think a very important part of our committee records. So I thank you for that. I've got several questions that I'm going to ask of you, and probably submit a lot more to you as your homework, and we'll include that as part of the record, but in the interest of moving through the panel to the second panel today, I'll let you off the hot seat on some of it.

I want to acknowledge a few of our State leaders that have joined us since the initial introduction. We've got Senator Therriault in the back. I see Senator Bob—or excuse me, Representative Bob Herron back there as well. Representative Dahlstrom, Representative Charisse Millett. I think that's all that I've seen. Who else? Representative John Coghill. So welcome to all of you, and thank you for your leadership on energy interests. Representative Jay Ramras is in the back as well, so pleased to have you all here. Who else am I missing.

Audience Member: Senator Thomas—I mean, Paskvan. Senator Paskvan.

Senator MURKOWSKI. Senator Paskvan right back there. OK. Who else is back there. Thank you for joining us, and for your leadership at the State level on these issues. I know that there has been more than a few energy field trips this summer for our legislators, and I think that that's a very important part of what we're doing here at the State.

I want to ask a question. We're here at Chena Hot Springs, where you have one guy, basically, with a vision and a plan and

a sense of energy that made good things happen, and he got a little bit of help from a DOE grant at the outset. But a lot of this was shoestring stuff and just really believing in the potential of what we have here.

So much of what happens from a policy perspective back in Washington, DC, is we've got a tendency, through our policies, inadvertent or not, to pick winners and losers when it comes to energy and how we advance it. Chris, you suggested that, you know, wind is one that we've seen real advances, and we can meet that goal. I think part of that is because we've really put those Federal dollars and those grant opportunities toward wind. But they look at geothermal, for instance. When I say they, I mean the Department of Energy and others at the Federal Government. They look at geothermal and say, well, that's a mature technology. As a mature technology, you don't fit into these nice, neat opportunities where you can get these emergency—excuse me, emerging energy technology grants.

So you've got something going on here at Chena Hot Springs that what we're dealing with is not mature technology, it is a completely different process. It would qualify as emerging, but we've decided that we're going to go with those more proven technologies. Steve, I think you mentioned that in your assessment statewide of what potential is out there, we got a lot of everything throughout the whole State, but in some areas you just have wind, or you just have biomass. So through our initiatives and how we direct grant funding, to a certain extent, we're kind of defining what's going to be good and what's going to be bad, and it may not be what works best in the YK Delta. It may not be what works best in Southeast.

So help me out a little, and I'll start with you, Mr. Hirsch, when we're talking about how we advance, meaningfully advance some of these more cutting edge energy vision—visioning things, how do we do it so that it's more than just a pilot project that gets a little bit of funding and you get some interest, but it doesn't have any follow through in terms of the funding to really put this in the ground and make a difference?

Mr. HIRSCH. Thank you. It's a really excellent point, and a very insightful question to add. It's something I personally have been wrestling with for many years, and it's primarily our developer and the contractor prior to my recent appointment here at NREL. Something I mentioned briefly earlier as far as some of the projects I've been working on that are very small scale. There's several approaches, I think. From the government perspective, what seems to make sense is nobody wants to fund a loser. So there is a challenge about putting a lot of money into something that doesn't work very well. We all know that anytime even when you fund a grant, there's a risk that they're not going to perform the way it's presented. So what I've seen happening, what I've actually personally been promoting a lot, is this sense of this emerging energy technologies.

My sense of it in Alaska, more than almost anywhere else, has these challenges that we have that are more difficult—and that we can benefit most greatly from. Around, for example, this tidal and wave energy. We have so much energy that we don't quite know how to handle it even if we were to get it. So I think what we need

to do is have a multi-tiered approach. Understandably, for example, the Alaska Renewable Energy Fund at State level that AEA is overseeing excellently. That's really for commercial, off-the-shelf proven technology. That's the focus on reducing power costs with things that we know.

At the same time, and what several of us have been pushing for, Chris Rose, all of us really, have been identifying this need for this emerging energy technologies fund where it's—and there, you know, pretty strict definition where the concept makes a lot of sense. It's something that's 3 to 5 years out roughly for developing this technology to the point where it could become commercial. It's proving grounds.

So Denali Commission has taken the first step in funding some of their own money, putting their skin in the game to develop that—to essentially gamble on high risk, but potentially very high payoff-type projects. Looking at some of the energy storage issues around anhydrous ammonia that you mentioned in your initial discussion, as well as energy storage around wind to really increase the high-penetration rates.

Then we're working on a State level—or many people are working on a State level mirror image of this emerging energy technologies fund for—similar to the Renewable Energy Fund that the State is doing to—and it's probably not going to be as much money, and it will have very targeted projects. It's a—this could be a game changer. That's, I think, really what we're looking for at this stage. At the same time, we have to, I think, believe, to some degree, in the American history of innovation and really—what I've seen is a real opening of peoples' ideas. It used to be you talked about solar thermal in Alaska, and people laughed you out of the room. Now they're serious about this heat pump in Seward, and Chena Hot Springs here is distributing vacuum tubes with solar thermal that a few years ago you would be—you wouldn't be taken seriously.

So a lot of it has to do with hearings, such as what you're holding here and the attention from the national level and the real education that policymakers—I've seen an incredible increase of policymakers' understanding of these issues. So everybody who's getting involved really ought to be commended. I think together we're working through those solutions, but they're absolute difficulties. So thank you.

Senator MURKOWSKI. I appreciate your perspective on that. I will, I guess, ask for your encouragement within the administration. As you know, back in 2007, we were successful in including within the Energy Independence and Security Act a provision that allows for the authorization of renewable energy deployment grants here in Alaska where the Federal Government kicks in and helps with matching funds there for construction of some of these projects. Authorization is good. It's absolutely important, it's necessary, but we'd sure like to make sure that there is support within the president's budget to allow for the funding to go forward.

Because I think all of you have discussed, in one way or a shape or a form that the vision is good, but we've got to have the financial aid, whether it's at the State, local, or Federal level to help facilitate. So we appreciate your encouragement. I don't know whether

you can speak for Secretary Chu, but if you can and you can give me the affirmative answer now, I'd really appreciate it.

Mr. HIRSCH. I'd only do that once, and then that would be over.

Senator MURKOWSKI. Yes, yes, yes. OK. We don't want to put you in that——

Mr. HIRSCH. Just very briefly there, you mentioned this geothermal situation, for example, where it wasn't viewed as a mature technology. Just this year there's been a new understanding of that, and there has been a recent solicitation on what they call enhanced geothermal systems where there was exactly that issue where they realized all of the technologies around geothermal are not mature. There has been new funding for that. Similarly with hydropower where it's been recognized as mature. Just this month, I believe, there was a solicitation that came out on upgrading hydropower facilities that already exist. So there's a beginning recognition of what you're talking about, but more of this discussion will absolutely help.

Senator MURKOWSKI. I want to ask a question, and I'll throw it out to any of you. When we talk about the technologies that are out there, whether it's for wind or solar panels or anything else that we might be doing, we recognize that our climate up here, our environment adds some difficulties or some challenges. Steve, you mentioned the fact that the solar panels actually enhance the energy efficiency if it's cold. That's something that I didn't know.

How much more of a challenge is it operating in an Arctic environment when we're talking about our renewable energy sources? I know that, for instance, with the wind turbines, what we have up north has to be a little bit different than what they're utilizing down there in California. How unique is our market in terms of the technologies, and how much more do we have to refine them in order for them to really—to work well here?

Mr. HAAGENSON. Senator, I think Alaska's always different, right?

Senator MURKOWSKI. Always different.

Mr. HAAGENSON. That's the——

Senator MURKOWSKI. We tell everybody, but they don't believe it, so they come up here.

Mr. HAAGENSON. So starting at that point, I think we do have some different challenges up here. I think one of the things we—like right now we have a lot of energy, right? In the wintertime we don't. Like Chris mentioned, they don't peak at the same times we need them. So I think that one of the things that we need to look at is storage, right. If we can solve this problem in storing energy for a day for tidal, for a month for wind, or for a year for solar or hydrokinetic or something like that, if we can solve that problem, we can deploy it anyplace in the world. Because this is one of the toughest environments to operate in.

Senator MURKOWSKI. You actually mentioned in your comments that—I think you said we are working on developing that storage technology now. Who—can you give me a little more detail on that?

Mr. HAAGENSON. Yes, I can. We've hired a consultant, WH Pacific, to actually take that concept and make it real and find out if we have any operating deficiencies, the storage, the size it would take, the costing effort. HMS is helping us come up with a cost es-

timate. Then we'll deploy that out to every community, you know, in our big model. So we'll see it as part of the costs, to see what the best operating options would be.

So we're developing that. We're looking at one other thing. I was talking to a friend of mine at the Cold Climate Housing Center the other day, and we said we're going to put a heat pump at Weller School. In my days in Fairbanks, I remember that the ground is about 38 degrees, and you're trying to take it to 38–32 degrees and it's going to stop working. He said, well, what we want to do is we want to put thermal cells in—I mean, thermal cells, not the portable tape, but thermal and heat—solar cells, and we're going to collect, you know, a big slab of concrete in Weller School parking lot, we're going to insulate that slab, and we're going to just take that slab up to about 190 degrees, say, and then in the wintertime, it'll be hot, we'll then put a heat pump on that and take it from 190 down to 32. So and they're thinking they can get a lot of energy out of that slab.

Again, it's a storage technology. So there's a lot of challenges here, but I think—and I'm going to go back to your first question that—about the first answer, I think what we need is passion, OK, in Alaska. If you think about Bernie for a second, I don't know how many of you have had the pleasure of saying no to Bernie.

Senator MURKOWSKI. It doesn't work.

Mr. HAAGENSON. It doesn't work, right. So why is that? Because he's passionate. He's the most passionate guy I know. You tell him no, and he's going to tell you the five reasons why you can't say no. He's going to go forward without you. So we need more Alaskans like Bernie. I'm saying that with a little hesitation. We need more Alaskans with passion like Bernie. Nothing personal, Bernie.

Senator MURKOWSKI. We all understand.

Mr. HAAGENSON. Thanks. So I mean, that's—and that's not a question do you have passion, you don't want unbridled passion, but you need to—now the question is how do you handle risk. Like Dr. Hirsch mentioned, you don't—you know, you don't want to reward failure. You don't want a bad budget, but the question is how can you fund things like that, and who should fund it until you make the next step? Because a lot of breakthrough technologies need risk. Bernie took risk. He—you know, he was told many times that wouldn't work, it's too cold. One man told him that over and over again. He went and found a solution, and they're wishing that they would have listened to him one today.

So how do you encourage risk, and how do you—you know, how do you get people with passion to move the risk forward? You'll find solutions in Alaska. There are a lot of passionate people in Alaska. There's a lot of creativity across Alaska happening today. How do we get that and share it, share the successes, and then learn from the mistakes and don't repeat them?

So Brian also mentioned the Renewable Energy Fund. I'm on record on that—on those projects as zero failure. OK. Now, he's—and I think we can pull it off. But that's not the program designed to look at technology, to look at advanced technologies. It's just designed to deploy technology. ACEP is very good at looking at technology, looking at the risk, evaluating, bringing the issues to the

forefront and solving them. That's really one of Gwen's strong points.

So we need to, as Alaskans, come together and figure out what we really value, how we want to move forward, how are we going—how we deal with risk, and don't hammer the guy who has a little failure, and encourage him to say well, OK, if that didn't work, tell me another way it will work. So, you know, in my prior life, I was—I was told I would—had to make two mistakes a day. If I wasn't making mistakes, I thought I wasn't doing anything. I think we need to get that attitude in Alaska. Thanks.

Senator MURKOWSKI. OK, Gwen, you looked like you wanted to hop in there.

Ms. HOLDMANN. I did. I've just been thinking about the project here at Chena, and maybe—I'd like to give a little bit of history on the very, very early pre-Chena history of the—of this low temperature geothermal power plant. I think that it might be illustrative in the way this project was brought together in the private sector and how we may be able to shift some of the ways that things are done at a national level in terms of having more collaboration between different fields.

We tend to have stove pipe technologies a little bit. The wind guys are wind guys. They work on wind. The hydrokinetic guys, they work on hydrokinetics. You know, that's also a challenge I've been dealing with at the university. Energy is an interdisciplinary problem, it's a—and the solutions are going to be interdisciplinary, too. We need to get more kinds of cross collaboration between different programs at the national level, and especially I think within the national labs, I'd like to see that happen as well.

To give you a little background on how this Chena chiller came to be is that United Technologies is a very large company. They have a number of different subsidiaries. What they do from time to time, and this is at the risk of telling this story without representatives from United Technologies here, but they bring different engineers, their top level, brightest guys from different programs together and to kind of think tank sort of circumstances. So guys that really have nothing to do with each other in their areas, don't have anything in common, to sit down and figure out what they might be able to do together to come up with a new product or a new idea that could ultimately become a marketable product and make the company money.

So in this case, they took some of their bright guys from Carrier Refrigeration that had this very, you know, standard, off-the-shelf, 100-year-old refrigeration technology, mixed it with a guy that had designed a new turbine for a jet engine, and literally out of that thinking came to say gee, we're actually—this waste heat recovery, this low-temperature waste heat recovery system using a new turbine design, coupled with the Carrier Refrigeration system. So essentially this is running a refrigeration system in reverse where you're taking—where you're taking a temperature difference, a hot and a low temperature, and then you're using that to make power rather than electric power to create a temperature difference. Which is how roof power refrigeration systems work.

So they got these guys together, they engineered this system, and then in talking about it a little bit more, they realized there's

geothermal applications. That's really how this happened, but it really started from this cross seeding of different technology areas. I don't see that we're doing that enough in this country. If there's ways that we can kind of facilitate that in order to find new solutions, and I think improve all of our systems and the challenges that we have, that would really be something that would be worth taking a look at.

I should also note that there's a critical juncture in there, too, where DOE stepped in and kind of funded that project here at Chena. Without that, I don't think that there would be a United Technology pure cycle, geothermal, low-temperature power plant today. I don't know if that's true, but it certainly was a critical juncture where that Federal funding has now moved us into a commercially available technology that hopefully will benefit a lot of other people.

Senator MURKOWSKI. Your point about kind of the silos that we have within the energy world I think is very apt. We see that, and it's—so much of it, unfortunately, is about the funding that comes to you. If you're working wind and you're competing with all of the other energy sources for those dollars. Those Federal dollars, unfortunately, are limited, and they're limited at all other levels as well. So instead of the sharing and the collaboration that you're talking about, and that I absolutely agree must happen in order to facilitate some of the ingenuity that has to go on in order to accomplish some of these difficult tasks, our systems are not set up to really allow for that.

I've actually had a conversation with Secretary Chu about that. You know, he's coming at it from the researcher/scientist point of view, and I think he appreciates the difficulty of it. Our challenge is to do what we can to really help facilitate a greater level of collaboration. Because we don't have it. So maybe rather than starting from the Secretary's position and working on down, we need to force it from the bottom up. I think you see that, and I appreciate you giving the history and the background on this, because I think it does demonstrate that if you have the passion that Steve talks about and enough people that are willing to think outside the box in terms of the solutions, we can get there. Again, jumping in with the DOE grants at the appropriate time doesn't hurt the situation either.

Chris, I'll let you make a comment, and then we're going to have to move to the next panel.

Mr. ROSE. Sure. Just a quick comment that reflects on both of your questions. There are winners and losers that are chosen on the generation side for a number of reasons, and we have unique challenges here, but as Gwen pointed out, we're the highest energy users per capita in the world here. So what we really should be focusing on is energy efficiency. There are many reports out there and studies that point out we could reduce our energy load by 20 to 25 percent.

So that's 20 to 25 percent of the future generation we don't have to build. So the more we can focus on the energy efficiency part up front, the less we have—generation we have to build. If we're the highest energy per capita users in the world, we should be leaders in energy efficiency. If we were looking at ourselves as a business,

we would call that waste, and we would say, we're going to make more money because we're going to waste less. So I think we have to kind of look at ourselves that way and say, we're going to waste less, but we're going to keep all that money in our economy and we're going to let it multiply. Thank you.

Senator MURKOWSKI. I think when you remember and you appreciate that we are the No. 1 consumer, and you also appreciate the extent to which energy costs impact us in this State—you go outside to the Lower 48 and the average American household spends about 3 to 6 percent of their income on energy costs. In some of the rural parts of this State, we have families that are spending, you know, close to 47 percent of their income on energy costs.

When you put it in that perspective, we've got an obligation as a State to figure it out, how we're going to do it here. Because yes, it impacts—it impacts people all over the country, but there's a huge difference between 3 to 4 percent of your family budget going toward energy costs, and when the price spikes, boy, you deal with it. But when you're paying close to 50 percent of your family income on energy and price spikes, we don't have anywhere to go. So this is an initiative that, again, should consume all of us. It should make us passionate about how we can really make a difference in reducing those costs, working toward an energy efficiency and conservation. But really using the ingenuity that I think makes Alaska wonderfully unique and wonderfully independent and figure out how we can do better by all those who live here.

So with that, I want to thank you for your comments. If you have additional input that you want to provide for the record, we'd certainly welcome that. You will be receiving some additional questions from me that if I could have you respond in writing, we will incorporate that as part of the record, as well. So thank you for your time and your leadership on energy issues.

Let's go ahead and invite up the second panel, if we can, please.

OK. I would like to go ahead and get started with our second panel. We probably have about an hour to move through this second group. I know that we've got a whole schedule of events after this, and so I want to make sure that we have sufficient time to hear from, again, this distinguished group of individuals. We have on the second panel, Mr. Bernie Karl. Bernie has been mentioned repeatedly this morning. So I'm glad, Bernie, you were here to take all the comments, compliments, and be here to defend yourself if necessary. Bernie Karl is the president of Chena Hot Springs Resort here, and the head of Chena Energy, LLC. We also have with us Barbara Donatelli. Barbara is the vice president of CIRI, and is very involved with the Fire Island wind farm. Next to Barbara we have Jim Dodson, who is president of the Fairbanks Economic Development Corporation. We also have Doug Johnson, who is the Alaska project director for the Ocean Renewable Power Company. The final individual on the panel on the panel rounding us out is Dennis Meiners of the Intelligent Energy Systems. So it's a pleasure to have the five of you with us this morning.

Bernie, we will begin with you. As a thanks to you and to your wife, Connie, for hosting the Renewable Energy Fair, and allowing us to conduct this field hearing at Chena. We appreciate it a great deal.

STATEMENT OF BERNIE KARL, PROPRIETOR, CHENA HOT SPRINGS RESORT AND GEOTHERMAL POWER GENERATION FACILITY, CHENA HOT SPRINGS, AK

Mr. KARL. Senator Murkowski, thank you for the opportunity to address both you and the committee on what I believe is probably the most important issue facing the world today: energy. I'd like to—a special thank you today to Senator Stevens, who's been involved in all of our energy fairs so far, and who has been one of the strongest supporters of renewable energy in the country. So my thanks to Senator Stevens for being here today, and for all that he's done for the State of Alaska, because it has been tremendous, and without his help there would be a lot of—a lot of rural Alaska that would not have water, would not have sewer, and would not be looking at renewable energy today.

With that being said, what can we do? I think that Einstein says it best. Einstein says that imagination is more important than knowledge. I think our problem is, is that we don't teach imagination. We don't teach that to our children to use it. If you have an imagination, you can imagineer. Without imagination there's no imagineering going on.

Gwen didn't have it exactly right when she talked about United Technologies, because we were already going to build a power plant, but not with them. We were building it with Barbara Nichols. There would have been a power plant built, so she was wrong about that, because it would have been built because I had already signed a contract with them with a handshake. We already had the $750,000 to do it. It would have worked on this low-grade temperature, because they were already doing it.

But what happened is United Technologies called us and said, hey, we understand you're going to do this. You heard of us? I said, no, I haven't heard of you. Who are you? We own Sikorsky Helicopter. I know about Sikorsky. We own United—we own Carrier Refrigeration. I said, well, I've got some of those rascals. We own Otis Elevator. I said, I was on one this morning. Hamilton Sundstrand. I said, well, I went to school for Sundstrand Pumps. OK, you're calling, how can I help you?

You see, even though you have all of these brilliant people doing brilliant things, sometimes you still need a little imagination to go with it with all this brilliance. So when they called, they said, hey, we got this idea, would you want to be involved in it. I said, we already have a deal going. So no, I don't think we want to be involved. Well, my contract with Barbara Nichols, I was released from it because he said he's an engineer and he also worked for Pratt & Whitney many years ago. He said, I believe this is a better idea, I believe you should go with them. I believe this will be better for more people.

Today you're going to find out it will be better for more people. With a portable unit that will be able to go to an oil well and hook up in 1 hour. There's 250,000 producing oil and gas wells just in Texas alone. One State—just one State—150,000 oil wells that are not even producing. They're capped off. If we just took that, we could make 5- to 10,000 megawatts. Not my number. Not my number. Comes from MIT.

If we harness 2 percent of the earth's energy, just 2 percent of it, that's a thousand times more than the world consumes. We talk about solar, we talk about wind, we talk about the money they get. Senator, as you know, the geothermal budget was zeroed out. Zero. With your help and with Senator Steven's help, you were able to get back some money, a small amount. Thank you for that. Thank you for what you've done. But it was zeroed out. It's not like—it's not like we care about zero. Try that on for size.

Why do we have serial number 1, serial number number 2? Why do we have the first portable unit here if it's such a mature industry? I say the geothermal is every bit as important, or maybe even more important because you can base load on it. It is the only renewable energy that you can base load on. But yet it gets the least amount of attention; even to this day it gets the least amount of attention. Shame on us. It's because we're addicted to oil in one arm, and we're addicted to greed that somehow we have convinced people that we can't do it. The word can't is not in my vocabulary. It shouldn't be in our children's vocabulary.

Webster's got to be an idiot. Webster says that failure is if you don't succeed. So we have these projects, you give them a grant, and they don't succeed, so you say it's a failure. I say failure is if you don't try. I say failure is if you give up. If you don't give up, you could never be a failure. But yet we teach our children that failure is if you don't succeed. Shame on us.

I've not heard one person mention hydrogen, or mention carbon. The 2 most prevalent elements on earth. The good Lord builds everything out of carbon, and builds everything out of hydrogen. The only one that doesn't use it very well right now is man. The only mammal on earth that deliberately destroys his environment and then denies it is us. What is wrong with that picture? Something is wrong with it.

I mean, we should be the world's leaders. Alaska should lead this parade. Why do you want to follow a parade when you can lead it? With our high energy costs, we should be leading the parade. My wife and I are motivated by huge debt load. That's what motivates us. We have $2 million of our money, and $650,000 that we borrowed. If anybody thinks he's a self-made man, he's a fool. Because all of these people have helped you all through your life, starting with your maker, and then with your parents, and then all these people around us.

United Technologies has been a tremendous partner. The University of Alaska Fairbanks has been a tremendous partner. The food that you see growing here, none of that would be happening without the university. There's a lot of knowledge at the university. Go use your universities. Do I think they should be funded? Absolutely. Do I think we can overstudy stuff? Absolutely. Do I think we need to have projects that are successes? Absolutely. Do I think that the future is the brightest it's ever been in the history of man? Absolutely. There's more opportunity now than there's ever been in the history of man. But it's in reinventing ourselves. It's not as business as usual.

Right now you'll notice when you look around this Energy Fair, not only are there a lot of vendors that have a lot of good ideas, but go look at the LEDs, the light-emitting diodes. These have the

same kelvin, they have the same spectrum as your light bulbs. They will reduce your power costs by—for lighting by at least 50 percent. We will guarantee it. We will guarantee it. You look at the new lights in the greenhouse. They're red and blue spectrum, because that's what the plants want. It's going to cut our lighting load by 90 percent. By 90 percent. We've spent 3 years of our life looking into it. Now we are importing them. They'll be available for Alaska. I believe that Alaska can cut its lighting load for all of Alaska in the next 2 years by 50 percent. In 2 years' time. What can you do now? You do that. You do it now, not tomorrow, today.

What was the best time to plant a tree, a Chinese proverb? Thirty years ago. What's the best—second best time? Today. Change your light bulbs. Look at the solar heating out here. Why do we have it here? Because it makes infinite good sense. That's why. Because technology has come that far. It's here today. Change today. Do what you can do today. Remember that if you take just a hug, just a hug from the earth, there is enough energy there to take care of all of our needs. All of our needs. I'm not saying that it is the silver bullet. I'm just saying there's enough there, and there's been very little effort put into it. Thank you for the opportunity.

[The prepared statement of Mr. Karl follows:]

PREPARED STATEMENT OF BERNIE KARL, PROPRIETOR, CHENA HOT SPRINGS RESORT AND GEOTHERMAL POWER GENERATION FACILITY, CHENA HOT SPRINGS, AK

My name is Bernie Karl, and I run the Chena Hot Springs Resort and Geothermal Power Generation Facility in Chena Hot Springs, Alaska. My wife and I have been devoted to this project for many years; have invested much of our own resources, time, energy and imagination into making this happen.

What is it exactly that we want to have happen, and why are we so devoted to our project at Chena Hot Springs? Alaska is known for its vast quantity of natural resources, fossil fuels, and minerals. We have a long history of energy development that continues to lead us in the direction of fossil fuels. Times are changing however. Petroleum has peaked in worldwide production, and the price of this commodity is hardly stable. The price of a barrel of crude went over $150 last summer and is now $70. Stable gas prices and the hope for renewed petroleum discoveries at workable costs are gradually vanishing. Any business argument concerning fuel would say that we should diversify to the use of other fuels, to be better prepared when our prospects become poor. We feel that the force of these developments and continued high prices must turn us towards a new and active consideration of renewable energy sources, new biomass energy generation, as well as food production.

We feel that Chena Hot Springs is well positioned to test, develop, and otherwise exploit these possibilities: from the "old" days when geothermal energy was considered viable only at temperatures of 230 F and our temperatures of 165 F were considered a joke, we have succeeded in generating 250 kW from relatively low temperature water. We are currently testing a mobile geothermal Organic Rankine Cycle Unit which draws off of an oil well with a mixed oil/water effluent stream which will soon be sited in Florida. Texas, for example, has 250,000 oil and gas wells which produce 95% hot water along with 5% oil and gas. Geothermal opportunities abound and will expand with the introduction of this mobile unit. The further we explore, the more we find, and we have only just begun. Chena Hot Springs is at the cusp of this research and development effort.

Aside from worldwide considerations, the needs for alternative power specifically for rural Alaska are enormous. The exhaustion in late winter of petroleum resources which come to Alaska villages by barge up the rivers and the need then to fly replacement fuel by plane to interior villages, the chronic high fuel and PCE costs, several times that of Anchorage or Fairbanks, and all of the associated high village expenses which flow from these high basic fuel prices, are nothing less than criminal. This must change.

This project and its possibilities for rural Alaska represent not just thinking up a new strategy or thinking outside of the box. Such metaphors are far too meager. Changes in energy use and the resultant possibilities for rural Alaska are im-

mensely difficult because they are so monumental. These changes embrace an overturning of cultural norms, the acceptance of a western business model, and changes in styles of living. Our efforts should be of the same magnitude as the Nana Regional Cooperation, which used to say in signing off their radio stations, "This program was brought to you by the Nana Regional Cooperation, doing business in Alaska for Ten Thousand Years." We have to 'make corresponding changes in energy use and respect the earth's bountiful gifts.

Things have, however, started to change. I am thankful to the Department of Energy and to the Obama Administration for their leadership in providing the much needed funding to get some of these projects off the ground. It was three years ago that I testified before this committee in Washington D.C. At that time, there was a threat of eliminating the Geothermal Technologies Department within the DOE. Today, there is funding available to further geothermal projects, one of man's longest used renewable energies.

Nevertheless, in this land of massive oil, natural gas, and coal development our goal is to bring to light the development of non-fossil fuel resources: geothermal, biomass, wind, hydro, and solar. Alaska is our country's last frontier, but has the potential to be first in renewables. I would like to thank this committee for hearing my testimony, and personally thank Senator Lisa Murkowski for making this field hearing possible.

Senator MURKOWSKI. Thank you, Bernie. I appreciate your vision and your passion.

Barbara Donatelli.

Ms. DONATELLI. Yes.

Senator MURKOWSKI. Welcome.

STATEMENT OF BARBARA DONATELLI, SENIOR VICE PRESIDENT, ADMINISTRATION AND GOVERNMENT RELATIONS, COOK INLET REGION INC., ANCHORAGE, AK

Ms. DONATELLI. Thank you very much, Senator Murkowski.

I really appreciate the opportunity to be here today and give an update on the Fire Island Wind Farm. That's currently the largest renewable energy project under development in Alaska, and we're really pleased to be able to be a part of working on bringing this project online.

CIRI and its partner, enXco formed Wind Energy Alaska in 2007 to develop and operate commercial-scale renewable projects in Alaska. The company is developing Alaska's first commercial-scale wind farm on Fire Island three miles west of Anchorage in Cook Inlet. The 36-turbine, 5-megawatt project will produce clean renewable electricity, and serve as an anchor to help additional railbelt wind projects to achieve national goals for energy independence and reduction of greenhouse gas emissions. We expect to generate enough power to—enough power for more than 18,000 homes in Anchorage.

Southcentral Alaska currently relies on natural gas from the Cook Inlet basin for most of its electricity and heating energy. In 2008, Railbelt Utilities, excluding Golden Valley Electric, generated more than 93 percent of their power with natural gas. However, as we all have heard, the Cook Inlet gas production is in steep decline, down from 205 billion cubic feet in 2005 to 146 billion cubic feet in 2008. An alarming 29-percent drop in only 3 years. At the same time, price volatility is increasing.

In 2008, natural gas prices fluctuated from a high of $13.32 per million cubic feet in July to a low of $5.38 in December. Fluctuations of this magnitude make planning difficult and have a devastating impact on both residents and businesses. The Fire Island project will generate flat-price renewable power. That will diversify

Southcentral Alaska's energy resources to increase reliability, and decrease rate payer's vulnerability to natural gas shortages and price swings.

Developing the Fire Island project has not been without its challenges. A key challenge we still must overcome is securing approval from the FAA to relocate the aviation navigation equipment, commonly referred to as the VOR, off of the island. As it currently stands, FAA restrictions necessitated by the VOR will not permit us to build an economically viable project.

On July 15, 2009, Wind Energy Alaska filed new applications with the FAA to expand the proposed Fire Island Wind Farm to a financially viable 36–turbine project. Then just this week, in anticipation of receiving a notice of presumed hazard, Wind Energy went to Washington DC and delivered a VOR relocation plan. We believe that plan will provide the FAA the data it needs to determine that the potential interference caused by the turbines can be mitigated by relocating the VOR and thereby allowing the project to move forward.

Our plan is to construct an upgraded digital doppler VOR on property at Ted Stevens Anchorage International Airport. Then after FAA certification of the new equipment, the existing Fire Island VOR facility will be decommissioned. Analysis indicates that the VOR can be relocated with no adverse impact to airspace operations, and with the benefits of increased facility security, reduced operation and maintenance costs, and equivalent or improved air navigational services for pilots.

Importantly, Wind Energy Alaska is not asking the FAA to move the VOR. Instead we are asking FAA to enter into a memorandum of agreement that would allow the project to move the VOR with FAA support on an expedited basis. If we can meet this schedule, the Fire Island project will begin delivering power by the third quarter of 2011.

Now, a little bit about rural Alaska energy needs. As we've heard already from many other folks who've testified, currently most rural heat and electricity needs are met with heating fuel and diesel. These costs have risen sharply in recent years. Some communities are trying to find ways to reduce their energy costs by improving efficiencies, and by developing renewable energy sources.

Currently the lowest cost renewable energy available today is wind. There are nearly a dozen communities around the State with combination wind-diesel systems displacing diesel fuel burned in those communities. As we've also heard, the energy storage is one of the biggest challenges to renewable energy development. Electricity produced by wind generation must be used pretty much at the same time it's produced. It can't really adjust to changing demand. Consequently, a system is needed to store that excess energy when demand is low, and then to supply extra power when demand is high.

Currently, electricity storage is difficult, inefficient, and expensive. Commercial batteries, for instance, run into the millions of dollars per megawatt capacity. Other hurdles to broader development of rural wind systems include lack of availability of village-scale turbines, lack of availability of spare parts, and lack of a trained work force in many cases.

Unfortunately some of our communities in Alaska lack adequate wind sources necessary for the existing turbine design. Research into low-speed wind turbines could lead to the development of a machine capable of serving communities that currently don't have sufficient wind resources for wind generation.

There are some potential synergies between the Fire Island wind project and rural renewable energy initiatives. The Fire Island project could include several smaller-scale turbines that could be used to teach Alaskans to install, maintain, and operate wind projects in their own communities.

Finally, some recommendations about what can be done to promote wind development. On the policy side in locations where wind development has proposed potential hazards to aviation and must be approved by the FAA, we believe the current process could be streamlined to help bring projects online on a more timely basis. This could possibly be accomplished through establishing an office within FAA, or assigning a project manager to potential wind development. That could help navigate the wind developer amongst the various FAA directorates and help, you know, get it through the approval process in a more timely manner. We think that would be area that could—we could really be a help to not only wind projects in Alaska, but potentially around the country.

On the technology side, research into the development of energy storage systems that really address this intermittent nature of most renewable energy technologies would be a real boost to not only wind generation, but to other renewable projects. We think the development of work force training centers that support the implementation, operation, and maintenance of renewable energy technology—technologies would be an important factor as well. The development of enhancements to existing wind turbine designs to extract more energy at low wind speeds.

So thank you again for allowing us to testify about our project and some of the challenges and—that we've encountered.

[The prepared statement of Ms. Donatelli follows:]

PREPARED STATEMENT OF BARBARA DONATELII, SENIOR VICE PRESIDENT, ADMINISTRATION AND GOVERNMENT RELATIONS, COOK INLET REGION, INC., ANCHORAGE, AK

INTRODUCTION

My name is Barbara Donatelli. I am the Senior Vice President of Administration and Government Relations for Cook Inlet Region, Inc. Thank you for providing CIRI an opportunity to testify today about the largest renewable energy project currently under development in Alaska.

CIRI and its partner enXco Inc. formed Wind Energy Alaska in 2007 for the purpose of developing and operating commercial-scale renewable energy projects.

CIRI is one of 12 Alaska-based corporations established by the Alaska Native Claims Settlement Act of 1971 to benefit Alaska Natives who had ties to the Cook Inlet region. The Anchorage, Alaska-based company is owned by more than 7,500 Alaska Native shareholders. CIRI and its subsidiaries have a well-diversified businesses portfolio that includes energy and resource development, real estate development, oilfield and construction services, tourism, telecommunications and government contracting.

enXco has been a leading wind energy project developer and operator for more than two decades. The company develops, constructs, operates and manages renewable energy projects nationwide. It is a significant owner and developer of wind energy installations in the United States and is North America's leading third-party provider of operations and maintenance for wind farms.

CIRI and enXco each own a 50 percent interest in Wind Energy Alaska.

FIRE ISLAND WIND PROJECT

Wind Energy Alaska is currently developing Alaska's first commercial-scale wind farm. The project is located on Fire Island, which lies three miles west of Anchorage in Cook Inlet. The 36-turbine, 54-megawatt project will produce clean, renewable electricity and serve as an anchor for additional Alaska Railbelt wind projects to help achieve national goals for energy independence and reduction of greenhouse gas emissions. The project will generate enough power to meet the annual requirements of more than 18,000 residential customers.

Unlike any other region in the United States, Southcentral Alaska relies almost exclusively on natural gas from the local Cook Inlet basin to generate electricity. In 2008, Railbelt utilities, excluding Golden Valley Electric, generated more than 93 percent of the region's electricity by burning natural gas produced from Cook Inlet. However, Cook Inlet gas production is in steep decline, down from 205 billion cubic feet in 2005 to 146 billion cubic feet in 2008—an alarming 29 percent drop in only three years.

Clean, renewable wind energy will help diversify power generation resources, increase reliability and decrease ratepayers' vulnerability to supply shortages and price volatility of natural gas. In 2008 alone, natural gas prices fluctuated wildly setting a high price in July of $13.32 and subsequently tumbling to $5.38 per million cubic feet in December. Price fluctuations of this magnitude have a devastating impact on both the citizens and businesses in Southcentral Alaska.

As the natural gas supply situation tightens, it is foreseeable that volatility, as well as the absolute price, will increase. The Fire Island wind project can generate 54 megawatts of clean, predictably-priced renewable energy within two years, if the project goes forward.

Developing the Fire Island wind project is not without its challenges. One of the critical challenges is securing approval from the Federal Aviation Administration (FAA) to relocate the navigation equipment, commonly referred to as the VOR, which is currently located on the island.

On July 15, 2009, Wind Energy Alaska filed applications with the FAA to erect 36 wind turbines on Fire Island. This week, in anticipation of receiving a Notice of Presumed Hazard, WEA presented the Fire Island Wind Project VOR Relocation Plan to FAA directorate OE/AAA (Obstruction Evaluation/Airport Airspace Analysis). The intention of the plan is to provide the FAA with the necessary analysis and data to mitigate the hazard and allow the project to move forward.

WEA's plan is to construct an upgraded, dopplerized VOR located on property at theTed Stevens Anchorage International Airport. Then, after certification from the FAA, the existing VOR facility located on Fire Island will be decommissioned. WEA's analyses indicate that relocation of the VOR can be completed without adverse impact on airspace operations and will offer the FAA and Anchorage International Airport increased security, reduced operation and maintenance costs and will provide equivalent or better air navigation services to the affected aeronautical community.

Importantly, WEA is not asking for the relocation to be undertaken by the FAA. Rather, WEA requests an agreement for relocation and requests FAA support in completing the relocation project on an expedited timeframe.

WEA has met with airport management, regional FAA management, aviation stakeholders and Federal, State and local government officials. None have opposed the project or the mitigation plan to relocate the VOR, and several have expressed strong support for relocation. A dopplerized navigational aid facility on Ted Stevens Anchorage International Airport property would benefit the FAA, aviation users, the airport, security interests and renewable energy proponents.

RURAL ALASKA NEEDS

While the cost of electricity in Southcentral Alaska is rising, the cost of living in rural Alaska is extremely high by national standards. Energy costs in rural Alaska exceed national averages by several orders of magnitude. Individuals and families are leaving villages, large and small, due in part to the overwhelming cost of energy.

TECHNOLOGY

Currently in rural communities, heat and electricity energy needs are met almost entirely with heating fuel and diesel. Liquid fuel costs have risen sharply in the last several years. Deploying technologies that increase efficiency and reduce or avoid the use of liquid fuels are needed to lower the overall cost of energy or at least reduce the rate of increase.

There are a number of renewable energy technologies on the horizon in Alaska. Solar has been considered for rural Alaska and some experimental projects have been proposed. Hydro kinetic is being investigated for use in river applications. Tidal generation is being evaluated in several locations. Low temperature geothermal has been demonstrated as viable at Chena Hot Springs. Small hydro is being evaluated and shows promise in a limited number of locations.

The lowest cost renewable energy available today is wind energy. There are nearly a dozen combination wind/diesel systems in Alaska today. All are deployed in rural settings and displace diesel fuel burn.

One of the chief obstacles to greater use of all renewables is storage of the energy. Since electricity has to be used as it is produced, storage is difficult, inefficient and expensive. Batteries, for instance, are very expensive when used to store large amounts of electric energy.

In at least three rural Alaska locations excess wind energy is stored in the form of hot water. During periods when more wind energy is being produced than a village can absorb, large water heaters automatically turn on. Water is heated and used for space heating in public buildings. Greater use of hot water storage will increase the use of renewable energy to meet more of the total energy needs in rural village settings.

EXISTING STUDIES

The Institute of Social and Economic Research (ISER) in a December 2008 study concluded that excess wind could be stored as hydrogen. The hydrogen could be used for heating and local transportation needs, i.e. small trucks, snow machines and 4-wheelers. The basic idea is to find ways to meet local energy needs with locally available resources.

The study discusses handling, maintenance and sustainability issues as well. Studying energy storage to find ways to more reliably use local resources to meet the total energy needs of small rural communities would benefit the individual community as well as increase the use of renewables generally, whether the by wind, solar, geothermal, hydro or others underlying energy sources.

Other basic hurdles to broader deployment of rural wind systems is lack of availability of small turbines for village applications, commonality of turbines among villages, spare parts and work-force training. In a 2004 report to the Denali Commission, BP engineers postulated that wind energy could benefit villages operating on diesel for electric power generation. The report suggested choosing a common turbine for a given region. The common turbine would allow for interchangeable spare parts and streamlined training for technicians performing turbine maintenance within a geographical region.

SYNERGIES

Potential synergies exist between the Fire Island wind project and the renewable energy initiatives of rural Alaska. The Fire Island project could be used to train Alaskans to perform turbine maintenance for wind projects in rural communities. Wind turbines for rural Alaska are smaller but operate on the same principles as those used in the Fire Island wind project. By installing several smaller turbines on Fire Island the project could double as a work-force and technology implementation training site.

Unfortunately many communities in Alaska lack the wind, hydro, solar, geothermal, hydro kinetic or tidal resources necessary to utilize a renewable energy resource. Research into low wind speed wind turbines could lead to the development of machines capable of serving villages with average wind speeds currently considered too low for energy extraction.

ADDITIONAL RESEARCH

Rural and urban communities across the Nation would benefit from additional research in the following areas:

1. Development of energy storage systems that address the intermittent nature of most renewable energy technologies as well as help meet the broader needs of the community, including transportation and heating.
2. Development of a workforce training center to support the implementation, operation and maintenance of renewable technologies in rural Alaska.
3. Development of enhancements to existing wind turbine designs to extract more energy at low wind speeds.

SUMMARY

Thank you again for providing CIRI an opportunity to testify today about the challenges of developing the Fire Island wind project. We look forward to working collaboratively with the community, the FAA and other State and Federal officials to make the first commercial-scale wind project in Alaska a long awaited reality.

Senator MURKOWSKI. Thank you for hanging in there. It's been a long process.

Ms. DONATELLI. It has.

Senator MURKOWSKI. We know that. Next let's go to Jim Dodson. Jim, welcome.

STATEMENT OF JIM DODSON, PRESIDENT & CEO, FAIRBANKS ECONOMIC DEVELOPMENT CORPORATION, FAIRBANKS, AK

Mr. DODSON. Thank you, Senator Murkowski. Thank you for your continued commitment to all Alaskans and Alaska's energy needs.

Alaska is blessed with vast energy resources. Beyond our conventional non-renewable resources of oil, natural gas, and coal, Alaska is also blessed with abundant natural resources—renewable natural resources in the form of water, wind, geothermal, solar, biomass—renewable resources that could provide for Alaska's energy needs virtually indefinitely. Unfortunately, these renewable energy resources, most within easy reach of all Alaska communities, have been woefully underexplored and underdeveloped until only recently, while our vast conventional energy resources, particularly oil, have been a boon to State government, but have proven a drain on most Alaska citizens and most Alaska communities.

Alaska is a sparsely populated State, only 680,000 Alaskans. Our communities are spread across an immense State that covers 660,000 square miles. This makes the distribution of goods and services, like heating fuel and electric power, expensive and challenging. Over 50 percent of all Alaska homes are heated with fuel oil. Sixty-seven percent of their energy cost is from home heating.

The cost of energy is crushing our economy. Many rural Alaska residents are leaving their communities, communities that have existed for hundreds of years are no longer sustainable because of the cost of energy. For Interior and rural Alaskans living in a winter Arctic environment, saving money by simply turning down the thermostat at 40 below, or turning off our lights when the sun only shines a few hours a day, is not an option.

Alternative and renewable energy sources can be a part of Alaska's energy solution, but it is not the entire solution. Affordable, reliable, and sustainable alternative energy will take time, research, and investment if we are to achieve America's goal of 25 percent renewables by 2025. Twenty-five percent renewable, 75 percent conventional, but 100 percent affordable.

Fairbanks Economic Development Corporation and the Fairbanks community has promoted energy issues from conservation, to biomass, to energy from municipal waste, to in-State use of natural gas, to hydroelectric power generation, to a biomass/coal to liquids project.

When working on a biomass project we found that though the resource potential in the Fairbanks community, including woody biomass, crop slash, processed timber residue, land clearing and fire

mitigation materials, and municipal solid waste were substantial. Only municipal solid waste was at a stage where it might be immediately used for energy production. For other biomass resources, questions regarding their true abundance, chemistry, cultivation, reforestation would all have to be answered before they could truly be utilized as a sustainable energy source.

Alaska has vast forest lands. Its forest resource potential is immense. However, Alaska lags far behind other States in accurate, up-to-date forest inventory analysis. Neither the Federal Government nor the State have adequately invested in the necessary forest inventories. Surveying for forest type and tree species using onground techniques is critical for any sustainable use of biomass for energy resource.

Also, just as a birch is different from barley, the energy output of different plant species can be radically different. Understanding the Btu output per volume of individual indigenous and introduced species is critical. We must determine what crops will produce more energy from use than they consume from production and transportation.

When working on a waste-to-energy project, we found that existing commercial technologies were not scaled to be economic for similar communities. Communities such as Fairbanks, with just less than 100,000 people, and all of rural Alaska, cannot afford the heat and power generated from waste-to-energy projects that are currently—or equipment that is currently available commercially. Research, development, and testing, demonstration must be continued to allow waste-to-energy projects to become a viable part of the energy solution for small Arctic communities.

In December 1958, an ad in the Fairbanks Daily News-Miner read: Coming, Natural Gas for Fairbanks, Nature's Perfect Fuel for Home and Industry. As you know today, more than 50 years later, that fuel source is still coming. With only 680,000 residents, Alaska is not a large enough market to attract private investment in a gas line solely to service Alaska markets. That perfect fuel that could reduce Alaska's energy cost, that should be Alaska's fuel for 75 percent—be the Alaska fuel for communities use 75 percent of their energy needs, that would contribute to the reduction of Alaska's CO_2 footprint, that can eliminate the Fairbanks PM2.5 issue. It is no closer to Fairbanks today or the majority of Alaska communities than it was 50 years ago. Conventional thinking will not solve this problem; simply hoping for private industry to make natural gas available to all Alaskans at an affordable price will not reduce our energy costs, meet EPA air quality guidelines, or reduce our CO_2 emissions. Innovative thinking and bold leadership from our national and State officials is needed to make natural gas available to all Alaskans, and it is needed now.

The first license request to build the Susitna Dam project was submitted to the Federal Regulatory Commission in 1984. That application was dropped within a year when the price of oil dropped and energy was perceived to be cheap.

Hindsight tells us that the decision to drop the Susitna Dam application was wrong; energy produced from crude oil is not cheap, and our 1985 decision not to proceed with the construction of that project has contributed to today's high energy costs, increased CO_2

emissions, and possibly global warming. Building Susitna Dam is a long-term project; it is not the answer for today's staggering energy costs, but it is an answer for future clean energy needs, and today is the time to restart the Susitna Dam project.

In 2008, the Fairbanks Economic Development Corporation contracted with Hatch Limited for an engineering and feasibility study on a coal, biomass, and natural gas to liquid facility. That facility would take underutilized, low-value Alaska resources—biomass and coal—and produce jet fuel, Arctic-grade home heating fuel, no-sulfur road diesel. It would provide synthetic-blended liquid fuel for the United States military, firmly anchoring Alaska's military, a full 25 percent of our economy, to Alaska. It could be a base-load consumer for an in-State natural gas pipeline. Anccording to publications by Dr. Paul Metz of the University of Alaska and the United States Department of Energy, there is a strong indication that the CO_2 produced in such a facility would be as valuable as a miscible injectant for enhanced oil recovery, sequestered, while at the—still at the same time allowing for the production of up to 12 billion additional barrels of North Slope crude from existing fields.

Alaska is uniquely positioned to help America—to help America transition to a new energy future. No other people and no other State in our Nation are more reliant on energy for their survival. No other people have more to lose should we fail to succeed than the people of Alaska. No other people have more of a vested interest in seeing that these new and innovative technologies work. No other State has such a wide diversity of renewable, sustainable fuel sources at such a tremendous—at such an enormous abundance than Alaska. Therefore, no State is better positioned to drive the research on these new technologies than Alaska. If you create it, Alaska can power it. No other State has such a wide range of temperatures and climatic extremes, is as hard or unforgiving as Alaska. Therefore, Alaska is better positioned to serve as a test bed and proving ground for new energy technologies than anyone. Alaska tested, Alaska tough resonates for a reason. If you can make it work here, you can make it work anywhere.

It is unfortunate that the national discussion on energy is often dominated by advocates of the extremes—those who say we can continue on forever with business as usual, or those who say we must chuck conventional energy sources and move wholesale into renewable. Alaska and America need both renewable and conventional energy. The president's goal is 25 percent energy generated from renewable sources by 2025. In Alaska, if we were able to provide rural Alaska with 25 percent renewable energy for free, their energy bill would still be unsustainably expensive. Alaska—energy is a fundamental component of any economy. 25 percent renewable, 75 percent conventional, but 100 percent affordable. Growing our economy, creating jobs and opportunity for people, that should be our mission. The president's 25/75 target is bold, but it is realistic. At least in Alaska it is achievable. Together we must begin the journey that will complete our mission. Thank you for your time.

[The prepared statement of Jim Dodson follows:]

PREPARED STATEMENT OF JIM DODSON, PRESIDENT & CEO, FAIRBANKS ECONOMIC DEVELOPMENT CORPORATION, FAIRBANKS, AK

Senator Murkowski, thank you for your continual commitment to all Alaskans and Alaska's energy needs, and please thank your follow members of the Senate Energy and Natural Resources committee for their willingness to learn more about our energy issues.

Alaska is blessed with vast energy resources. Beyond our conventional non-renewable energy resources of oil, natural gas and coal, Alaska is also blessed with tremendous renewable energy resources in the form of water, wind, geothermal, solar and bio-mass—renewable resources that could provide for the Alaskan people's energy needs virtually indefinitely. Unfortunately these renewable energy resources, most within easy reach of all Alaska communities, have been woefully underexplored and underdeveloped until only recently, while Alaska's vast conventional energy resources, particularly oil, though they have been a boon for Alaska's State government, have proven a drain on most of Alaska's citizens and most Alaska communities.

Alaska is a sparsely populated State: there are only 680,000 Alaskans. Our communities and our people are spread across an immense State that covers more than 660,000 sq. miles. This makes the distribution of goods and services, like heating fuel and electric power, expensive and challenging. Over 50% of all Alaska homes are heated with fuel oil. Home heating accounts for 67% of Interior and Rural Alaska's energy cost. According to a State of Alaska survey conducted in June of 2007, Interior Alaskan residents were paying an average of $2.47 per gallon for fuel oil and Rural Alaskans were paying an average of $6.25 per gallon for the same product. Since June of 2007 the price of crude has, at one point, more than doubled. Likewise, because oil is used widely in Interior and Rural Alaska to fuel electrical generation, electric rates, particularly in Rural Alaska, can be higher by a factor of twenty or more than in localities with access to a more diversified energy mix including natural gas, hydroelectric and coal. It was reported in the Anchorage Daily News that 20% of Rural Alaskans are paying 47% of their income for energy costs, while that same group living in Anchorage are paying 9% of their income for energy. Because of this, and the crushing effect it is having on their economies, many Rural residents are leaving their communities; communities that have existed for hundreds of years are no longer sustainable because of the cost of energy.

For Interior and Rural Alaskans living in a winter Arctic environment, simply turning down the heat at 40 below, or turning off the light when the sun only shines a few hours a day, to save money is not an option.

Alternative and renewable energy sources can be part of Alaska's energy solution, but they are not the entire solution. Affordable, reliable and sustainable alternative energy will take time, research and investment to accomplish America's goal of 25% energy from renewable sources by 2025. As we move towards alternative and renewable energy sources we must not forget, that even if we accomplish this ambitious goal, we still must find solutions to deliver conventional energy to all Alaskans so that the remaining 75% of their energy usage is affordable—25% renewable, 75% conventional but 100% affordable.

The community of Fairbanks has taken a leading role in developing renewable energy sources for Alaska. Lead by the Fairbanks Economic Development Corporation and its' think tank organization, the Interior Issues Council, the Fairbanks community has promoted energy issues from conservation, to bio-mass, to energy from municipal waste, to instate use of natural gas, to hydro-electric power generation, to a biomass/coal to liquids project.

All of these initiatives present opportunities but also face unique challenges.

When working on Biomass projects we found that, though the resource potential of the Fairbanks community—including woody biomass, crop slash, processed timber residue, land clearing & fire mitigation material and municipal solid waste—was substantial, only municipal solid waste was currently at a stage where it might be immediately used for energy production; being readily available in volume, and already economically collected and transported. For other biomass resources, outstanding questions regarding their true abundance, chemistry, agronomy, cultivation and reforestation, along with economic systems of harvest and transport, would all have to be answered before they could move to the type of commercial scale production required for sustained industrial use.

Alaska has vast forest lands and, on its face, its forest resource potential is immense. However, Alaska lags far behind other States in accurate and up to date Forest Inventory Analyses. Neither the Federal Government nor the State of Alaska have adequately invested in necessary forest inventories. Surveying for forest type and tree species using on-ground techniques is critical for any sustainable use of

biomass as an energy resource. Research needs to be funded that will link ground-truth data to remote sensing data allowing us to cut future costs for continuing inventories and provide a more complete biomass inventory of the State of Alaska.

Also, just as a birch is different from barley, the energy output of differing plant species can be radically different. Understanding the Btu output per volume of individual indigenous or introduced plant species is critical both for estimating the energy potential of existing forests and for determining the best foliage to plant in its place once those existing stands have been cleared. Parallel to this is the necessity for ascertaining the growth rates of different species under varying conditions and varying regimes of fertilization and care. An economic system for harvesting the biomass must be identified. All this must be done in a way that allows for the economical transport of the harvested biomass from field to facility—producing more energy for use than is consumed in production and transport. It is only with this type of information in hand that we can optimize biomass cultivation and name it truly a sustainable energy resource. Therefore, research on species selection for Btu output, regeneration, harvest, transportation and reforestation needs to be funded.

When working on a waste to energy project we found that the existing commercial technologies were not scaled to be economic for smaller communities. Communities such as Fairbanks, with just less than 100,000 residents, and all of Rural Alaska, cannot afford the power and heat generated from what waste to energy equipment is currently commercially available. Research, development, testing and demonstration must continue to allow waste to energy projects to become a viable part of the energy solution for a small arctic community.

In December of 1958 an ad in the Fairbanks Daily News Miner read: "Coming.Natural Gas for Fairbanks, Natures Perfect Fuel for Homes and Industry!" As you know today, more than 50 years later, that fuel source is still "coming". With only 680,000 residents, Alaska is not a large enough market to attract private investment in a gas line solely to service Alaska markets. That "perfect fuel" that could reduce all Alaska's energy cost—that should be the fuel that Alaska communities use for 75% of their energy needs, that would contribute to the reduction of Alaska's CO_2 footprint, that can eliminate Fairbank's PM2.5 issues—is no closer today to Fairbanks or the majority of Alaska than it was 50 years ago. Conventional thinking will not solve this problem; simply hoping for private industry to make natural gas available to all Alaskans at an affordable price will not reduce our energy cost, meet EPA's air quality guideline or reduce our CO_2 emissions. Innovative thinking and bold leadership from our National and State officials is needed to make natural gas available to all Alaskans; and it is needed NOW.

The first license request to build the Susitna Dam project was submitted to the Federal Regulatory Commission in 1984; that application was dropped within one year when the price of oil dropped and energy was perceived to be cheap. Hindsight tells us that the decision to withdraw the Susitna application was wrong; energy produced for crude oil is not cheap and our 1985 decision to not proceed with that project has contributed to today's high energy costs, increased CO_2 emissions and, possibly, accelerated global warming. Building Susitna Dam is a long term project; it is not an answer to today's staggering energy costs but it is an answer for future clean energy needs and today is the time to restart the Susitna Dam project.

In 2008, the Fairbanks Economic Development Corporation contracted with Hatch Ltd for a high level engineering and feasibility study of a Biomass, Coal and Natural Gas to Liquids facility. This facility would take underutilized, low value Alaska resources—biomass and coal—and transform them into ultra clean, high value liquid fuel products like jet fuel, arctic grade home heating fuel, virtually no-sulfur road diesel and naphtha. But more than that, the facility would establish Interior Alaska as a major producer of synthetic blended liquid fuels for the military, firmly anchoring Alaska military, 25% of our economy, to Alaska. This project could also be a critical base load consumer for an In-State Natural Gas pipeline. Additionally according to a white paper written by Dr. Paul Metz of the University of Alaska Fairbanks, basing his analysis on the 2005 U.S. Department of Energy report, there is strong indication the CO_2 produced by such a facility could be valuable as a miscible injectant in Enhanced Oil Recovery—sequestered, while at the same time allowing for the production of up to 12 Billion extra barrels of safe, secure, domestically produced North Slope crude from existing fields.

Alaska is uniquely positioned to help transition America to a new energy future. No other people and no other State in our Nation are more reliant on energy for survival. No other people are more vulnerable should we fail to succeed than the people of Alaska and, therefore, no other people have a more vested interest in seeing that these new and innovative technologies work—we need them to work. No other State has such a wide diversity of renewable, sustainable fuel sources, in such enormous abundance, than Alaska and, therefore, no State is better positioned to

drive the research on new energy technologies—if you create it, Alaska can power it. No other State has such a wide range of temperature & climatic extremes, is as hard or unforgiving, as Alaska and, therefore, no State is better positioned to serve as the test bed and proving ground for new energy technologies—"Alaska Tested, Alaska Tough" resonates for a reason; if you can make it work here, you can make it work anywhere.

Having helped perfect these systems—simplifying, hardening and proving these technologies—Alaska will have acquired a body of experience and expertise that is itself highly valuable and eminently marketable—allowing it to remain not only an exporter of energy resources but an exporter of energy knowledge, long after its conventional energy resources have been depleted.

It is unfortunate that the national discussion on Energy is often dominated by advocates of the extremes—those who say we can continue on forever with business as usual or those who say we must chuck conventional energy sources and move wholesale to renewable energy. Alaska and America need both renewable and conventional energy. The President's goal is 25% of energy generation using renewable sources by 2025. That goal leaves 75% of our energy coming from conventional sources. We must not forget that even if we were able to provide Rural Alaska with the 25% renewable energy for free their bill would still be unsustainably expensive. Energy is a bedrock component and fundamental underpinning of any Economy. "25% renewable, 75% conventional but 100% affordable".protecting our economy while we advance it, creating jobs and opportunities for people—should be our MISSION.

The journey of 1,000 miles begins with the first step and we will do ourselves a great service—greatly improve our chances of reaching our destination—if we simply accept that there probably aren't any short cuts; we will have to walk every step of the way. This recognition is inherent in the President's 25-75 target. It is bold, but it is realistic and, at least in Alaska, it is achievable. The experience of the Fairbanks community and Fairbanks Economic Development Corporation regarding energy—facing challenges but seeking opportunities, encountering barriers but working to overcome them, stumbling at times but always, always moving Forward—is a trail that must taken but together we can reach our destination.

Senator MURKOWSKI. Thank you, Jim. I appreciate your testimony.

Doug Johnson, welcome.

STATEMENT OF D. DOUGLAS JOHNSON, DIRECTOR OF PROJECTS, ORPC ALASKA, LLC, ANCHORAGE, AK

Mr. JOHNSON. Good afternoon. To those of you that aren't Alaskans, welcome to Alaska. Thank you for taking your valuable time to hear our testimony today.

I'm Doug Johnson, the Alaska projects director for Ocean Renewable Power Company. Our company is currently developing two projects here in Alaska and one in Maine. Our project in Maine is a tidal energy project in Western Passage, on the American side of the Bay of Fundy. Our projects here in Alaska are a tidal energy project in Cook Inlet adjacent to Anchorage and a river energy project on the Tanana River about 100 miles from here in the community of Nenana.

My great-grandfather came to Alaska in the gold rush. His cousin was one of the Three Lucky Sweeds that made the original gold strike in Nome. Today, like those pioneers of the past, a new generation here in Alaska is pioneering the development of the renewable energy industry.

Never before has there been a greater opportunity for new sustainable economic development here in Alaska and across our country than today. The transition to low or no carbon renewable energy is inevitable. As the climate data is telling us, it's needed sooner rather than later.

Currently in the arena in marine hydrokinetics, the Europeans are the world leaders. Fortunately it is still early in the game and we have the opportunity to leap-frog the Europeans using our native innovative abilities. If we don't take advantage of this opportunity, it will be another loss of stature for the United States in the global arena. More importantly, a loss of new jobs in a key emerging industry. The world looks to the United States as a leader in innovation, and we have the unique opportunity to demonstrate our leadership once again.

To take advantage of this opportunity, our industry needs your help now. As a fledgling industry here in Alaska we see four key road blocks that government can remove. Without this help, we will not be able to realize the environmental and economic promise of marine renewable energy.

Roadblock No. 1: Lack of Federal agency coordination. Lack of timely coordination amongst the agencies wastes scarce and valuable human and monetary capital, a luxury an emerging industry cannot afford. We need agencies to be well coordinated producing streamlined highly—high-quality development processes.

Roadblock No. 2: Technology-stifling impact of baseline data collection requirements for pilot projects. We are spending a million dollars this year in Cook Inlet, with agencies requesting we do the same or more next year without ever having a device in the water. We believe that in Alaska a year of baseline combined with the substantial available data is adequate with the proviso that we continue extensive monitoring with our devices in the water. This is the best way to assess the potential environmental effects. If we find a serious problem, our devices can be shut down immediately and removed in days.

Roadblock No. 3: Increased Federal and State research role. We need the Federal and State agencies to actively partner with us as stewards of the public resource to assist in a more fully—to assist in more fully characterizing our pilot sites energy resources, physical and environmental and marine life.

Roadblock No. 4: Lack of continuity between pilot project license and full commercial license. Presently there is no clear pathway to go from a pilot project license to a commercial project license. We propose the development of a clear bridge from successful pilot to a commercial license.

I have included a detailed discussion of each of these points in my written testimony, including our proposed solutions. The time is now, the opportunity is before us, and we in the marine renewable energy industry are ready to move forward. With your help, our country can take the leadership role in this exciting new industry. Thank you for the time to speak with you today.

[The prepared statement of Doug Johnson follows:]

PREPARED STATEMENT OF D. DOUGLAS JOHNSON, DIRECTOR OF PROJECTS, ORPC ALASKA, LLC, ANCHORAGE, AK

Good afternoon and for those of you who are not Alaskan's welcome to Alaska. Thank you for taking your valuable time to hear our testimony today.

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project in Cook Inlet adjacent to Anchorage and a river energy project in the Tanana River about 100 miles from here in the community of Nenana.

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To take advantage of this opportunity, our industry needs your help now. As a fledgling industry, here in Alaska we see four key road blocks that government can remove. With out this help, we will not be able to realize the environmental and economic promise of marine renewable energy.

1. LACK OF FEDERAL AGENCY COORDINATION

- Lack of timely coordination among the agencies wastes scarce and valuable human and monetary capital, a luxury an emerging industry cannot afford.
- We need agencies to be well coordinated producing a streamlined high quality development process. D. Douglas Johnson's Oral Testimony Thursday, August 20, 2009
- Need to ensure that FERC Pilot Project process is implemented fully, and that the NOAA and USFW staff cooperate fully with its streamlined permitting procedures, designed to empower testing of R&D technology in temporary, low impact projects. Currently some Services staff resist cooperation with Pilot Project process, insisting on baseline data and review which is equivalent to full project review.

2. TECHNOLOGY-STIFLING IMPACT OF BASELINE DATA COLLECTION REQUIREMENTS FOR PILOT PROJECTS

- We are spending 1million $ in Cook Inlet this year with agencies requesting we do the same or more next year before we ever get a device in the water o We believe that in Alaska a year of baseline combined with the substantial available data is adequate with the proviso that we continue extensive monitoring with our devices in the water. This is the best way to assess potential environmental effects. If we find a serious problem, our devices can be shut down instantly and removed in days.

3. INCREASED FEDERAL AND STATE RESEARCH ROLE

- We need the Federal and State agencies to actively partner with us as stewards of the public resource to assist in more fully characterizing our pilot sites energy resource, physical environment and marine life

4. LACK OF CONTINUITY BETWEEN PILOT PROJECT LICENSE AND FULL COMMERCIAL LICENSE

- Presently there is no clear pathway to go from a pilot project license to a commercial project license
- We propose the development of a clear bridge from successful pilot project to a commercial license

I have included a detailed discussion* of each of these points with my written testimony, including our proposed solutions.

The time is now, the opportunity is before us, and we in the marine renewable energy industry are ready to move forward. With your help, our country can take the leadership role in this exciting new industry.

Thank you for the time to speak with you today.

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*Document has been retained in committee files.

Senator MURKOWSKI. Thank you, Doug.

Our final panelist this afternoon is Mr. Dennis Meiners. Welcome.

Mr. MEINERS. Thank you, Senator.

STATEMENT OF DENNIS MEINERS, CEO, INTELLIGENT ENERGY SYSTEMS, ANCHORAGE, AK

Mr. MEINERS. Senator, thank you very much for the opportunity to speak with you and the committee today. My name is Dennis Meiners. I'm the CEO of Intelligent Energy Systems, and director of Power Corp. Alaska.

Intelligent Energy Systems is a project coordinator and developer for rural energy projects. We work directly with villages to develop appropriate solutions to solve energy problems. Power Corp. Alaska is an integrator and advanced control system provider.

But what I'm here to talk to you about is the group—the Chaninik Wind Group, and our Chaninik projects. I have been working in wind-diesel for the last 15 years, 10 at the Alaska Energy Authority. When it came to renewables, we were looking at using renewables to decrease dependency on diesel fuel at the Energy Authority.

I think that there are three truths that are—or 3.5 truths that are self-evident about rural energy. The first one is that we must—there's no choice, we must end the dependency on fossil fuels. Two, right now with the current tools we have, we can decrease the use of fossil fuels by 40 to 50 percent in over 100 villages based on wind. That's not just for electricity, but that's for heating fuel, transportation, and electricity. The third truth is that village wind heat—I'll call it village high-penetration wind heat—is really a pathway to our national energy future.

Now, some people may laugh at that, but we've heard from other panel members that villages are proving grounds for the integration, stability, and management of high levels of renewable energy. That's the truth. The 0.5 truth is wow, Bernie, I agree with Bernie.

What we're doing in the Chaninik Group is a group of four villages between Kwigillngok, Kipnuk, Kongiganak, and Tuntutuliak at the mouth of the Kuskokwim River. They have a very good wind resource there. Their goal was to combine as a group to build wind-diesel systems to make the communities more self-reliant.

We have three projects underway. Each of those projects has about one kilowatt of installed capacity per resident. We're taking that energy—that's a lot of wind power in relation to the population and the electric load. In fact, at most times the wind power will provide more energy than is needed to meet the electric load. That excess energy will be stored in thermal storage units in individual homes to decrease heating costs.

One of the first things we did was to do an energy survey to find out how much energy individual homes were using, and where there energy budget was being spent. What we realized early on was that although electricity is expensive at about 65 cents a kilowatt hour, the real impact on a household was paying the heating bill. You can have 1,000 square foot house, and they may have a heating bill that's 6- to $8,000 a year for a family that's maybe—has an income of around $40,000 total. Then when you look at a

subsistence lifestyle that requires you to use outboards and snowmachines to go gather your food, and gasoline is expensive, what we see is that probably two-thirds of a home energy budget goes to heating fuel, and maybe 15 percent goes to electricity, and the rest goes to transportation.

So the major problem that we're trying to address is heat, we're—and when you look at the wind, the wind resources available, and when you need the heat, it's when the wind blows. Most of the wind blows at night in the wintertime, so you need to store it. So we're taking—we have installed excess wind capacity. We take that excess wind, and we store it in individual thermal devices in homes. These devices are about the size of a Toyo Stove, which is a common heating appliance in rural homes. It contains bricks that heat up to around 1,200 degrees. Those bricks store the heat, and they're used throughout the day.

We estimate that with our current projects we can only provide for about a 50 percent heating fuel displacement in a quarter of the homes. What we see in the next phase of projects in—we're looking at a project in Kipnuk where we would like to go to provide three to five kilowatts of installed wind capacity per resident and displace a total of 50 percent of the heating fuel and the fuel used to generate electricity in the entire community.

We have to innovate with wind power. Current wind systems that are going in now have about one-third of a kilowatt of installed capacity of wind per resident. The energy produced from that—from those—from that wind is used to displace fuel at the powerhouse only. What we see is that that's not a solution. When you install a small amount of wind power, say one or two wind turbines, the economics don't favor a scaled construction effort to drive the individual cost of—per kilowatt down, and also the systems don't produce enough electricity to make the maintenance operations economic.

If we put in large wind turbines in small communities and we focus on displacing the major portion of fuel, which is used for home heating, that changes the entire economics of renewable energy in rural Alaska. First of all, you're no longer sending dollars out of the community to the fuel companies. You're keeping those heating dollars in the local pockets of the residents. Too, we can sell that using advanced metering and control systems with grid stability. We can sell that electricity to a resident for at least 50 percent of the cost of the heating fuel. So not only have you reduced the heating cost to the consumer, but you've also increased revenues to the local utility.

So the Chaninik Group was formed with a focus on 100 percent displacement of fossil fuels with renewables. Now that's a long-term goal, but our short-term goal, it's in the church of the here and now. We're doing hand-to-hand combat with the technologies that we have, and we know that we can get to 40 to 50 percent. Now, if the Chaninik Group is successful, then that model should spread to at least half of the villages in Western Alaska.

I think that if we look at wind not as supplying electricity, but if we look at the whole energy picture in a community, there's solutions here. Those same solutions apply across the Nation. Because if you look at wind—the wind resources available in the Midwest,

there's a lot of excess wind at night. So the same wind heat storage solution is applicable throughout the country. The same backbone, the same control backbone, the same metering backbone that has to go in to manage that wind energy separate than diesel-generated electricity is the same backbone that's needed to provide lower-cost electricity or use renewable types of energy to provide power for plug-in vehicles.

So the Chaninik Group, we see ourselves sort of as the little gnat out there that's annoying the tail that wags the dog. The big dog is the electric—the big boys with the big wind turbines and the big oil companies and the—you know, the major energy suppliers. We need solutions that are applicable for us now. We're pioneering those. We think they're going to be valuable for everyone.

I know this is a national sort of a—a national issue. I just want to say that there are a lot of other small companies and small efforts across the country that are helping us. We have partners in South Dakota, North Dakota, North Carolina, Vermont. We're encouraging new—new wind manufacturers in Arkansas, we're buying software and engine generator controller parts from across the—from Colorado and Michigan, all across the country. We need the helps of—we need the help of many, many small businesses to assist our efforts. So this is not just an Alaska effort, this is a—this is a must for Alaska, but it's also important for the rest of the country.

So thank you, Senator, for the opportunity to speak today.

[The prepared statement of Mr. Meiners follows:]

PREPARED STATEMENT OF DENNIS MEINERS, CEO, INTELLIGENT ENERGY SYSTEMS, ANCHORAGE, AK

ABSTRACT

The Chaninik Wind Group was formed in 2005 by the villages of Kongiganak, Tuntutuliak, Kwigillingok, and Kipnuk with the objective of effectively capturing the wind resources of Western Alaska to foster self-reliance.

The residents of these communities are completely dependent on fossil fuels, and can spend up to $8.00 per gallon for heating fuel, and $0.65 per kilowatt hour for electricity. Diesel fuel is needed to generate electricity to light and heat homes. Gasoline at $7.00 per gallon powers outboards and snow machines needed to gather food. Energy accounts for 25% of a typical household budget, which leaves little for food, health care, clothes and the necessities of supporting a family or community. Small communities can't survive without significantly reducing dependency on fossil fuels.

Today Chaninik is in the beginning stages of implementing village wide wind-heat smart grids, designed to displace up to 50% of all the fossil fuels used for heating, power generation and transportation.

Success of these projects reflects national goals of reducing dependency on fossil fuels, lowering energy costs, and improving the economic and environmental health of the Nation. The Chaninik projects are important because they are directly and rapidly addressing the technical challenges of stabilizing energy grids while effectively managing large injections of wind energy. These are challenges that we all need to address if we are to have a cleaner, stronger, safer country.

WIND HEAT SMART GRIDS FOR ALASKA

Electrical delivery in rural Alaska consists of over 170 isolated diesel grids, spread across a geographic area larger than the States of California, Texas and Montana combined. These communities are isolated from each other, unconnected by electrical interties, or accessible by roads. According the estimates by the Alaska Energy Authority, 100 of these communities have wind resources sufficient to generate electricity. Wind energy has the potential to displace 50% of the diesel fuel used for heating and power generation. This level of wind penetration would lower residen-

tial energy costs, increase revenues to local utilities, and stabilize local economies, by keeping dollars in the community and creating local jobs.

To achieve this objective, village energy systems must move from current installed wind systems which represent ½ kW of installed capacity per resident to systems with 3 to 5 kW of installed capacity per resident. The hybrid wind diesel power systems must be designed for grid stability at wind penetration rates of 400% or more, and with ability to capture, store and manage excess wind capacity. In the case of villages, distributed electric thermal stove storage, smart metering systems, and flywheel grid stability systems will be used to achieve these objectives. This same model could serve equally well for the implementation of plug-in vehicles, or widespread use of wind heat across the lower 48 States and Hawaii.

In rural Alaska, there is a similar match between wind power and the need for heating fuel. Wind energy represents the single most cost effective and widely applicable source of renewable energy today. On windy winter nights, wind generation will drive off-peak electric rates down, making wind assisted heating the low cost heating option. Due to the variable nature of wind, as larger and larger proportions of wind are added to the village power system, sub second power fluctuations must be stabilized. This is done by rapid injection and absorption of real energy with a flywheel energy storage unit, which allows for smaller and smaller amounts of diesel generation as excess wind energy is stored for later use.

Increased use of Electric Thermal Storage (ETS), referred to as Wind Assisted Heating, is one tool that is ready now to allow the electric grid to productively use higher percentages of renewable energy. This will ensure the new investment in wind generation is fully utilized, minimizing carbon emissions and keeping heating costs low.

While the potential exists for the widespread and significant displacement of diesel fuel, much of the wind resource occurs at night in the wintertime. In the village systems, this wind energy will be stored in thermal stoves located in each residence. In another application the thermal stoves could be substituted for a plug-in vehicle. Heating requirements are greatest when the winter winds blow, and this method is estimated to lower home heating costs by 50% with the revenues flowing into the village owned utility rather than leaving the community with the fuel company.

CHANINIK WIND HEAT SMART GRIDS

The Chaninik Wind Group has begun construction of three medium size Wind-Heat Smart Grids (a diagram* of the system is below)

Each system is designed to integrate, capture and store large amounts of wind energy whenever it is available, and use that energy cost effectively to displace diesel fuel usage. Each system will be equipped with a smart metering system to dynamically manage, price and account for the sale of wind energy separate from diesel, so that the customer can participate in the cost savings. The wind turbines, integrated control system, and flywheel energy storage module that rapidly injects and absorbs power fluctuations hold the grid stable as wind is made available to charge thermal stoves in homes and community buildings.

The three medium size systems with 1.5 kW of installed wind capacity per resident are underway in Kongiganak, Kwigillingok and Tuntutuliak. These systems only have enough wind capacity to provide wind heat for 1/4 of the homes, while still displacing 40% of the fuel used to generate electricity.

A fourth system proposed for the community of Kipnuk is based on the installation of 3 kW of installed wind capacity per resident and is designed to have sufficient wind capacity to displace 50% of all heating fuel used throughout the community for heating and power generation. This system is likely to be the model for the rest of rural Alaska.

The ability to utilize high proportions of wind energy versus fossil fuels requires the same technical platform used in each Chaninik community: integrated controls, flywheel grid stability, smart metering, and appropriate energy storage devices. The only differences are the amounts of installed wind capacity and the extent of the metering and energy storage devices. The principles and methods being pioneered by Chaninik can be applied on larger grids and more extensive energy systems with thermal energy storage and plug in vehicles. For Chaninik the system is designed to maintain high fuel displacements for power generation even at lower wind speeds, because of the capability of the flywheel energy storage systems and reduced need for heating.

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*Graphic has been retained in committee files.

COST SAVINGS: THERMAL STORAGE VS. BATTERIES

A residential or small commercial heating system costs about $30 per kWh installed compared to a recent installation of a 7mWh Sodium Sulfur (NaS) Battery at approximately $150 per kWh. Electric Thermal Storage systems are more cost effective because they work like the thermal battery with the heating system included.

Thousands of electric thermal systems have been installed across North Dakota, South Dakota, Iowa, Minnesota and Wisconsin to take advantage of off-peak rates available from coal fired power plants. These systems are used as a primary source of low cost heat. Increased installation of wind will enable more wide spread use of Wind Assisted Heating systems.

LOW CARBON FOOTPRINT AND LOW COST OF OPERATION

Opportunities exist to pair wind assisted electric thermal energy storage units with air source heat pumps (ASHP). This combination offers the possibility of displacing even more heating fuel with wind energy reducing the carbon footprint of the home heating system as more renewable energy is added.

DYNAMIC DEMAND RESPONSE

Dynamic device control and pricing through advanced metering is needed to enable devices such as electric thermal storage devices, plug-in vehicles, water heaters, and air conditioners to respond to the availability of wind energy. Maximizing wind resources involves being able to quickly respond to the availability of wind by providing pricing options for customers, while at the same time maintaining power quality through voltage and frequency control. The combination of flywheel grid stabilization, integrated generation control and advance metering are needed to manage the system.

THE REGIONAL SMART GRID

When completed, the combined four village project will have created a series of Wind Diesel Smart Grids that are linked together with a digital control and metering network. Advanced controls, metering, and communications tools represent a scalable backbone for extending this network to other communities, in the Chaninik region and throughout Alaska. The Smart Grid Network represents significant costs savings through remote technical and administrative cooperation.

Wind Diesel Hybrid Smart grid tools include: supervisory generation and distribution controls, advanced metering infrastructure, wind turbines, thermal storage devices, and grid stability and control methods, in this case flywheel energy storage.

CONCLUSION

The success of the Chaninik wind group is both necessary for villages to survive and vitally important to this country. These projects lead the way to new, more productive and more cost effective uses of wind energy. Some examples of the value they create include:

1. Expanded use of wind power for heating, power generation, and transportation.
2. Implementation of the smart grid tools to improve management and link communities together.
3. Stabilization of local economies, through creation of jobs, and substituting local renewable resources for fuel purchases.

The successes of these projects can have an immediate impact in Washington State, Wyoming, Kansas, Indiana, Minnesota, Wisconsin, New York, California, Iowa, Texas, and Colorado.

Progress in Rural Alaska is only possible with small business partners across the Nation, here are just a few:

North Dakota—Electric Thermal Storage, Steffes Corporation, Dickenson North Dakota

South Dakota—Transformers, T&R Electric Supply Company: Training: Airstreams Renewables, Inc., turbine supply and maintenance; Energy Maintenance Services, Howard South Dakota

North Carolina—Triangle Software and Elster meters

Washington State—Pacific Northwest National Labs, Fluke, Applied Power and Control, North Coast Electric, Lynden Transport, Horizon Lines, Oak Har-

bor Trucking, Outback Inverters, Itron, Weyerhaeuser, Schweitzer Engineering Laboratories, Costco
Arizona—Sandia National Labs
Arkansas—AWE Windturbines
Colorado—National Renewable Energy Laboratory, Woodward Ft. Collins, Sustainable Automation,
Vermont—Northern Power Systems, Draper laboratories
Michigan—National Instruments, IXXTP.

Senator MURKOWSKI. I appreciate your testimony. Dennis, how much are the thermal units if it's in somebody's residence? What does the unit cost right now?

Mr. MEINERS. A thermal unit is probably around $2,000. But in rural communities, because the electric system is so—may not be up to code, some code improvements have to be made, so a typical installation for one of these systems is—could be 3- to $4,000.

Senator MURKOWSKI. You know, the conversation that we've had with this panel particularly, whether it's geothermal, wind, biomass, ocean tidal, or wind opportunities, wind-diesel, I think we recognize that unless we can be building things to scale to allow for the efficiencies in small communities, wonderful technology is happening all over out there, but if you can't figure out how you make it cost efficient in a village, cost efficient in a smaller community where, you know, we're not hooked into anybody else. One of the discussions that we haven't had which really gets people a little bit agitated when I bring it up because it's—it is something that we've got to deal with, if you're not living right where the energy source is, you got to move it to get it to the people, and it's al—the big issue about transmission, which, on a national scale, is something that, you know, some of my colleagues just don't even want to go there, because then we're really talking about some controversial issues. But I think it's important to recognize that we're going to have to figure out in this State how we can take a small community like Kipnuk, which, you know, maybe has 350, 450 people there—800 in Kipnuk? OK. So I'm down by half. But still, you've got an 800-person community, and for us to go in and say well, we're going to help you reduce your energy costs, but the cost of doing so is absolutely prohibitive, we haven't helped them out. So getting things to scale.

The project that you described, Dennis, in how we can really be looking to the whole energy picture and how we reduce those costs is, I think, something that we need to key into with—particularly in this State. I was in Newtok yesterday, and they're moving that village to another spot on higher ground on Nelson Island. There's four different villages on that island, and the question now is how they tie into one another to utilize some of the energy opportunities that exist out there. But again, this is something that we haven't had much, if any, discussion here in these two panels this morning. But I think, again, we recognize that our geography makes it complicated and difficult, but we've got to be looking to how we deal with the transmission issues as well.

As I mentioned with our first panel, I've got a whole host of questions that I will ask to each of you in writing and would ask for your cooperation so that we can include them as further part of the record. But I want to just kind of throw out to each of you—and I'm watching my watch, Bernie; I think we've got about 10 minutes

before we got to cut it off here so we can move on to your program? Is that about right?

Mr. KARL. You got all the time you want, Senator.

Senator MURKOWSKI. All right. I'm not going to mess with the schedule here. But from your perspectives, whether it's in geothermal or wind or ocean or biomass, how can we, from the Federal level, better help to facilitate some of the smaller-scale projects? Because they're not nearly as interesting and intriguing on paper. If you're not supplying power to large regions, large numbers, how can we better help to facilitate that?

You know, Bernie, you have made your—the Chena Hot Springs here, it's a self-contained unit. You're doing everything for this little community. But again, when DOE is looking to move grants, you're competing against requests that look pretty good on paper in terms on supplying and meeting the needs. Now, the Fire Island project, you get that pulled together and the ability to offset some of our energy costs, particularly as we see costs rising in the future as we see the reserves coming out of Cook Inlet dwindling, we've got to be addressing that. How do we better facilitate some of these smaller-scale opportunities? I throw that out to any one of you.

Senator MURKOWSKI. Bernie, go ahead.

Mr. KARL [continuing]. To start with, Senator, there's a tremendous opportunity right now with the administration and the money that—I don't know where you're getting it. I guess you're printing it because——

Senator MURKOWSKI. That's another hearing for another date, I think.

Mr. KARL. But with that being said, right, wrong, or indifferent, the opportunities are tremendous right now. I think it's in reinventing ourselves, as I stated once before, but in Fairbanks, Alaska, right now with the help, again, of United Technologies, and with the help of Alaska Energy Authority, I can tell you the Alaska Energy Authority has been a tremendous—a tremendous resource for the State of Alaska. It has tremendously good leadership who gets it, who understands that there has to be an energy policy. They are helping Chena Power in Fairbanks, Alaska, to build a 500 kW power plant that will be running with no smokestack. It will be the first commercial power plant. It will scaled to work in any village in Alaska. I can assure you that any village in Alaska can be self-sufficient for all of its fuel, for all of its energy, and for all of its food in the next 10 years if it wants to be. You can be thankful to United Technologies, and you can be thankful to AEA for believing in the project and not being a hinderance.

But you see, one of the biggest things was, well, you got to get this permit and you got to get that permit. Let's work at not having permits.

Senator MURKOWSKI. I think the ocean energy guys would like that. I know that for a fact.

Mr. KARL. But let me tell you—let me tell you how you work at not having permits. You have to imagine it again. The Jay Florida project was going to fail. You want to know why—$1 million for getting the permits, and another year of time. So Quantum Resources said forget it, we didn't buy into that. Mr. Karl, we told you

our share was $348,000, now our engineer says another million for permitting, we're not going to do the project.

So what do you do? You come back to Alaska and you tell them OK, we'll do it with no permits. They say, yeah, right. We made it portable. We have no emissions. It's legal height, it's legal width, legal weight for all 50 States. You have to look at what you can do. In Fairbanks, Alaska, we're building a new biomass plant with no smokestack. I don't need to worry about air permits because I don't have any emissions. I don't need to worry about disposal permits because I'm not going to dispose of anything. It's called biomimicry. You mimic what nature does.

The Native populations of Alaska have been doing that for centuries. They've lived off of biomass. They've used their environment for 10,000 years. For 10,000 years they've used their environment. Cold is a wonderful thing if you use it. So is heat, it's a wonderful thing if you use it. What if we combine the two? What if we combine them? We can make a tremendous amount of energy on a Delta-T of just 100 degrees. With a company like United Technologies to help, it's pretty easy.

Do we need the Department of Energy's help? Absolutely. Absolutely. Because when you're doing all of these so-called experimental things, there's a lot of risk. I've never, ever considered risk. Now, maybe I should. My wife tells me all the time, she says, you are no philanthropist. I said, some day I want to be. So—oh, she's like having a 50,000 pound anchor on the old rear end. But I need her, obviously.

So with that being said, these opportunities right now are real. It takes—as Senator Stevens always said, money is going to evaporate for Alaska. We need to work together. There's going to be less funds. So you need the Federal Government, you need Alaska Energy Authority, you need the university, you need private sector, you need United Technologies, you need everybody working together as a synergy, as a synergy. You can get a lot done. You have to be willing to work together and share these ideas.

I think that is the future for renewable energy. I don't say there's a silver bullet, I say you have to use it all. Storing energy is like a no brainer. The good Lord's been storing energy his whole life. Right? Right in the earth. We store energy all the time. It's ours to take, but to use it wisely.

Senator MURKOWSKI. I want to ask, too, a little bit more about the permitting issue, because that's where we at the Federal level—you say there's roadblocks out there.

Mr. JOHNSON. Yes.

Senator MURKOWSKI. I think it's important for us to understand how we can realistically remove or perhaps soften some of these roadblocks. Because wonderful ideas on paper, but if the government is saying, OK, we got a great energy policy out here, we want to encourage all these renewables, and yet we put these hurdles up in front of you that are either so bureaucratically impossible or so incredibly expensive, we haven't facilitated anything.

Mr. JOHNSON. Exactly. Thank you, Senator. I have an idea for you. I think we should be pitching Alaska as the laboratory for our country, the laboratory for developing renewables, and the laboratory for developing a process to facilitate this. We got an amazing

innovation here. Just look around us and see what Bernie is doing, look at what Dennis is doing out in Western Alaska, look at what we're trying to do with the hydrokinetics. It's happening. But what we have to be able to do is facilitate the development of it. Yet that policy that's there, the permitting processes that are there, what we need is agency coordination. Because we can unleash the innovation that we have if we can have the agencies work with us and sit at the table and work through this and develop processes that don't.

Senator MURKOWSKI. Do you feel that you do not have that cooperation presently?

Mr. JOHNSON. We're working toward it, but it's a—it's challenging because you've got people in, you know, different places in the country physically, and you've got different people in different sort of mind or thought processes or where they're at in terms of their ideas around renewables and how they ought to be developed. So it's policy and developing the coordination between the agencies.

Like, in our instance, it's Federal Energy Regulatory Commission, or FERC, and the folks at NOAA. You know, trying to get NOAA and NMFS and FERC all working together so that we can get the permit process moving forward in a way that makes sense that we can participate, that doesn't bankrupt us in the process.

Senator MURKOWSKI. From the State perspective, do you feel that there is greater ability working within—at the State level?

Mr. JOHNSON. Yes, the State of Alaska has been fabulous. This Alaska—our Alaska Energy Authority is a tremendous asset to us here. Virtually everyone that I've met in State government has been tremendously supportive of our efforts. I know in renewables in general. So the staff's been great to work with.

Senator MURKOWSKI. We've got some issues with it, and I think we heard a little bit of that from the first panel as well. But I know with the Fire Island project, this is something that has been in process for years, and it has been the Federal Government, which has been the impediment, whether it's the FAA issue. But it is—it really seems to be that the stumbling blocks are at the Federal level, even though we have put in place this huge initiative that we're going to advance renewable energy in a meaningful and significant way.

Dennis.

Mr. MEINERS. Senator, and on the permitting issue, I think it's just—at least from the wind projects, if Federal money comes in and you use Federal money for a wind project, it spins you in a whole new parallel universe of permitting and agency interest. In these recent renewable energy projects, it was State funded. I think that there are certain agency representatives who are just not well educated about the impacts or the nonimpacts of these systems, say, on tribal lands or in communities. So they tend to slow the process down and try to spin it back into that whole permit process. So I think there needs to be a clear dividing line between where the jurisdiction is and where it isn't. They can say we have no jurisdiction here and be able to do it very quickly. So that would speed things up.

Mr. JOHNSON. Absolutely.

Mr. MEINERS. Because there's a lack of ability to make decisions there, there are new people, so there needs to be some kind of re-education, perhaps, at that level. Because I have projects—the projects in the Chaninik area do not require permits. You go to certain people, and they say, we don't have any jurisdiction here, and other people say, oh, I think we might have jurisdiction here, and so 6 months later they decide that you don't. So I just think there needs to be maybe some retraining on the permit level.

Senator MURKOWSKI. Certainly from the jurisdiction perspective, as we know, with the offshore energy issues, there's a huge controversy and fight between the FERC and MMS, and literally a process that took years to resolve, and, you know, we're hopeful that, in fact, now it has been resolved and that projects can be moving forward. But again, you've got good substantive projects on the drawing board that can't advance because of Federal agency issues that just shouldn't be there in my opinion.

I am going to, again, submit a series of questions to each of you, but I want to thank you for your contribution here at this field hearing. I think it's been interesting to have a little bit from the various sectors that are making some good things happen within the State. If you don't—if you're not excited about what our potential is for renewable energy in this State, you haven't woken up yet this morning, because it is real and it is vibrant and it's a terrific thing.

I want to close by reminding, not only the panelists, but any of you who have attended today, that if you have comments, if you wish to submit written testimony on any other Alaska Renewable Energy projects or ideas that you might have, you can submit them to the committee in writing. We will hold the record open for 10 days for you to do so. You can send them to the Committee on Energy and Natural Resources in Washington, DC, or you can e-mail them to Chuck Kleeschulte, who is on my energy staff here. Chuck's e-mail address—you can get it from Chuck. But you can e-mail him, or you can also send it to my Fairbanks office here. Althea St. Martin, who is standing up taking the picture there, is located in Fairbanks. Her number here in Fairbanks is 456–0233. She can get them to our committee's Washington staff and get them included in the formal record.

I want to acknowledge and thank the committee staff that have joined us, both down from the Democratic side and the Republican side. They helped to facilitate these field hearings, and their advance work is greatly appreciated. So Mike and Chuck, thank you very much. With that, we will conclude.

[Whereupon, at 12:46 p.m., the hearing was adjourned.]

APPENDIX

RESPONSES TO ADDITIONAL QUESTIONS

RESPONSES OF D. DOUGLAS JOHNSON TO QUESTIONS FROM SENATOR MURKOWSKI

GENERAL OCEAN ENERGY

Question 1. Your testimony did a wonderful job of summarizing the key issues that the federal government needs to consider to improve marine renewable energy. I agree that there is a lack of timely coordination among federal agencies, and that there should be a streamlined permitting process between FERC, NOAA and USFW to get projects into streams. Can you give more detail on exactly how you envision such a permitting system to work once we get past pilot projects, and into regular licensing of renewable plants? How do we mesh such a system with the NEPA requirements for environmental impact statements before licensing of significant federal actions?

Answer. A transition from the Pilot License process to a Commercial License process has not been defined by FERC and is greatly complicated by the conflicting statutory roles of the various Federal agencies involved in licensing and relicensing of hydrokinetic projects. The White House and Congress must assure that all federal agencies support reasonably scoped studies that both allow for the rapid and successful deployment of small scale FERC Pilot Projects and the subsequent commercial project build out, particularly given that traditional hydropower licensing regulations are being used for hydrokinetic projects and the much larger expanse of the marine environment as compared to traditional riverine systems. The White House Office of Energy and Climate Change Policy, working with the Council on Environmental Quality, Oceans Policy Committee, or other appropriate senior-level management coordination group, should address and rapidly resolve this issue in order to ensure that federal agencies coordinate effectively to advance the FERC Pilot Project license process and the development of marine hydrokinetic technology in order to protect the environmental, economic, and security interests of present and future generations of Americans. Ideally, a standard set of license conditions could be developed to further minimize the time and expense involved in Pilot Project Licenses and subsequent commercial build out of projects.

MMS-FERC SITING

Question 2. One issue facing the marine renewable industry is getting rapid approval of permits for siting devices. While there has been a memorandum of understanding between the Minerals Management Service and the Federal Energy Regulatory Commission that hopefully will speed up permitting it is not clear how it will work. What in your view would be the best way to proceed to speed permitting and environmental impact statements and reviews for ocean energy permitting, if you have not already answered this from above?

Answer. We have a number concerns about the outcome of the memorandum of understanding and the MMS process. Our concerns are major as We believe the current MMS structure is unworkable from a number of perspectives:

1. The structure is based on oil, gas and minerals industries where the resource is "extracted" forever. Hydrokinetic technologies "use" a portion of the energy but when the devices are removed, the energy of the tides and ocean currents continue.
2. Lease areas do not conform with the footprint needs of alternative energy technologies and the process does not provide for site control
3. The proposed pricing and revenue sharing make renewable energy projects uneconomic and it is not a process we can afford to pursue.

In summary FERC and MMS need to coordinate better to insure projects are permitted in a timely, responsible manner.

OCEAN POLICY TASK FORCE

Question 3. In August NOAA was in the State holding a hearing of an Ocean Policy Task Force that is considering how to improve data collection and conduct the science needed for environmental reviews for ocean energy projects. One of the recommendations was that agencies work with NOAA to close knowledge gaps and develop a single clearinghouse of information on the effects of marine hydrokinetic projects on fisheries and marine mammals to improve marine spatial planning decisions? Do you have any other suggestions on what can be done to improve and speed the planning/ approval process?

Answer. We agree that a central clearing house for environmental information if designed and implemented properly, would help the process; under no condition should the Ocean Policy Task Force recommendations include a moratorium for ongoing projects; and we must stop the abuse of our oceans by slowing CO_2 emissions and marine renewables can play a major role in this regard.

RESPONSES OF GWEN HOLDMAN TO QUESTIONS FROM SENATOR LISA MURKOWSKI

Question 1. General technology question.—I know that your center has applied for a number of grants under the so-called federal stimulus act. Can you talk more than you did in your testimony about them and what types of areas should be where the government focuses its research assistance? Where are the weak spots in our efforts to develop renewable energy at present?

Answer. The Alaska Center for Energy and Power has been pursuing federal funding opportunities as appropriate to our mission of meeting State and local needs for applied energy research. In the past couple of months, we have applied to:

1) DE-FOA-0000109.—Innovative Geothermal Exploration Techniques. Our proposal was titled: 'Validation of Innovative Exploration Techniques at Pilgrim Hot Springs, Alaska', and uses geophysical techniques designed for volcanology research and applies them to geothermal exploration. We pioneered this technique at Chena successfully, and think it could be expanded to characterize other moderate temperature resources with a discreet thermal surface feature.

2) DE-FOA-0000090.—Wind Energy Consortia between Institutions of Higher Learning and Industry. Our proposal was titled 'Proposal to Expand the Wind Diesel Application Center at the University of Alaska', and was developed as a consortium of a large number of industry partners, the Alaska Energy Authority, and Renewable Energy Alaska Project (REAP).

In addition to these two, we have submitted several other proposals for both research and curriculum development. We have also been making a significant effort to increase partnerships and projects with the State and private sector. Half of our currently funded projects are with private sector clients, and the majority of ACEP's funding (87%) is from State sources. ACEP has averaged 3 proposals per month since founded, and has had a success rate of 64% of proposals developed ultimately being funded.

There have been 2 very significant challenges for ACEP in seeking federal funding opportunities. First of all, we have repeatedly found that the specific needs of Alaska do not entirely overlap the greater research needs of the Nation. For this reason, many funding opportunities are not applicable to the type of research we are most interested in conducting. This has been a challenge for us, and also for other research organizations focused on Alaska. It should be recognized that Alaska has some unique research needs that are in some ways more representative of 2nd and 3rd world countries than most parts of the U.S. We frequently need to tailor our proposals to ensure we are addressing the national research agenda, and this is often at the detriment of the work we are best positioned to complete and that has greatest relevance to the State. A perfect example is with the second proposal listed above, the 'Wind Consortium' funding opportunity. This opportunity is specifically geared toward meeting a national goal of achieving 20% wind by 2020, and focuses on development of large turbines and wind farms that are not appropriate for Alaska. We tailored our proposal to focus on energy storage, modeling and system integration, and cold weather related research, but I think it is unlikely to be funded. That is too bad, because no one is doing the type of research with high penetration wind we can be doing in Alaska, and Alaska can in many ways serve as a model for the lower-48.

IDEA FOR RESEARCH ASSISTANCE

Many States, including Alaska, have a tendency to not spend dollars on applied research, especially related to energy. Funding is being spent at the State level on projects, but often research is left to the federal government and private sector. Perhaps one way to encourage more research at the State level is to provide Federal match for any State grant fund developed for the purpose of encouraging innovation in energy and other industries—essentially an emerging technologies match fund. This would decentralize some of the focus and stimulate competition on a new level—to address the specific research needs of individual States or regions, without the necessity of trying to tie research objectives back to the country as a whole.

Question 2. Storing renewable energy—I know that you are interested in working on the issue of how to make renewable energy fit better into the grid. How you develop systems to better mesh diesel generation, which is going to be around for a long-time in Alaska, with renewables like wind and marine hydrokinetic. What should Congress and the DOE be doing to help smooth out power production and reduce the cost of backup power needed as renewable energy increases in its percentage of generation in a utility system?

Answer. These ancillary issues are absolutely critical to long-term grid stability (not to mention transportation applications), and is an area where I think Alaska can position itself to play a leading role. ACEP has a long history of working on the energy storage issue, and we have an extensive database of manufacturers and projects. The problem of energy storage is still a difficult challenge and is the type of problem that may ultimately require a disruptive technology—a major leap in innovation that perhaps is still on the drawing board—to truly effect the necessary advancement. For this reason, I think it is necessary to continue to invest in a suite of storage technologies at different levels of commercial readiness (or non-readiness).

On the bright side, this is an area where Alaska can really play a leadership role and be a place to demonstrate technologies at early commercial stages. The issues we see in rural Alaska, and even the larger population areas, mirror the types of challenges we will see on our grids in the lower 48 as we push higher percentages of renewables onto the limited infrastructures that exist.

For example, we are working with Kodiak Electric Association to model their electric grid. We hope to develop a plan to include both short and long-term energy storage in order to achieve 95% renewables as a percentage of generation (wind, hydro, and diesel). We are working with Sandia National Lab on this problem. They are interested in working on Kodiak because it is a way to test models they have developed for the lower-48 on a discreet, isolated grid. In addition, we have been testing an advanced flow battery manufactured by VRB in our lab for the last 2 years, and have developed proposals to test additional ones as well. We are working with utility partners on the energy storage issue, including Kotzebue Electric, AVEC, and Golden Valley Electric Association.

It is really important to stress that Alaska already has some of the highest penetration levels of wind in the Nation. The opportunity this presents is significant, because many of the methods being pioneered to deal with these issues are scalable to larger grids. The National Renewable Energy Laboratory (NREL) has a wind-diesel testbed in Colorado, which is somewhat defunct at this time. We are working with their program managers to ramp up our capabilities here in Alaska and develop a more modern testbed at ACEP, with real data from our partner utilities used to test control and storage options and other optimization strategies. We think this is important work (so does NREL and our industry partners), but we need $4M to develop the facility. That was the purpose of the 'Wind Consortium' proposal we developed, but I think it is unlikely to be funded because the focus was on larger turbines and wind farms than are appropriate for Alaska.

Question 3. Cost of Renewables—As an engineer you have looked at the cost of renewable energy versus fossil fuel use. Do you have suggestions on how we make renewables economically competitive with fossil fuels without having to provide continuing tax subsidies? Outside of conventional hydro power and perhaps onshore wind, few renewables are close at present in construction costs to gas-fired or coal-fired electrical generation. What should we be doing to try to close that cost gap?

Answer. One of the key points to understand is the difference between capital costs and lifecycle costs. I think it is going to be unlikely that the capital costs of renewable energy systems will drop to the level of traditional fossil-fuel based generation any time soon. This is largely due to economies of scale, the maturity of the technology, and the fact that it is really tough to beat the energy density you find in fossil fuels. But the capital costs are not the important factor—the lifecycle costs are. On that basis, renewables can often be quite competitive with fossil energy assuming that the cost of fossil-based fuels will rise in the future (the Energy Informa-

tion Agency is currently predicting >$110/barrel average in 20 years). The trick is that we can't know for sure if, or how much, those costs will increase. That means we can only guess at the long-term fuel costs, and thus life-cycle costs, of the fossil-fuel based generation whereas we have fairly good certainty for the renewable option.

When it comes to energy, subsidies of some sort seem to be the rule rather than the exception throughout history. I have observed that as a country we have often subsidized all sorts of energy production, exploration, and development activities—both renewables and fossil fuel. Other countries take the approach of taxing fossil fuel heavily, thus making renewables more economically attractive on that side of the equation. The critical thing seems to be to try and be consistent with subsidies. Inconsistency reaps marginal benefits at best. For example, the production tax credit here in the U.S. would be far more effective had it been enacted for 10 or 15 years right from the start, rather than being constantly renewed.

The bottom line is that renewable energy as a whole is a relatively new industry, and as such, the economies of scale do not yet exist. If we can enact policies to boost production and ramp up development, eventually subsidies could be phased out. But in the short term, they are probably needed if we want to transition away from dependence on foreign oil. If done properly, subsidized programs can result in significant public benefit—like the NASA program in the 1960's and 1970's. Think of all the different types of products that were an indirect result of setting a national goal of being the first country to reach the moon. If we make a true national commitment to wean ourselves away from foreign energy sources, we can strengthen our position as a country from a national security perspective, build long-term infrastructure that will benefit future generations, and begin moving toward the economies of scale needed to make renewable technologies economic when compared to fossil fuels.

RESPONSES OF JIM DODSON TO QUESTIONS FROM SENATOR MURKOWSKI

GENERAL

Question 1. Jim you talked in your testimony about two projects, the biomass, waste project to generate electric power for Fairbanks and the biomass, coal project to produce synthetic fuels for use in the Interior and for military use in Alaska. I personally support both projects and certainly backed the $10 million grant to the Air Force to study the latter project last fall—I just wish the money was being spent as it was intended when the grant was approved by Congress. But more generally, electricity in Fairbanks has become a real issue. At 22 cents per kilowatt hour it is far higher than other major communities in the State are facing for power from natural gas, coal or hydropower sources. Why do you feel that biomass will be a cheaper and more dependable source for power and or fuel in the future for Alaska's Interior?

Answer. My reference to biomass refers to the fact that many grants are being offered, both through AEA and DOE for biomass heat and energy generation. The problem is biomass mass is not currently being produced for energy in any kind of commercial sense and neither the State nor the Feds have done enough research on biomass inventory, crop selection for biomass reforestation, harvesting or regeneration for it to be so. All this needs to be determined before biomass is available for sustained energy use.

As far as the CLT project, research suggests that, by using biomass with coal in the gasification stage, the CO_2 emissions can be reduced by as much as 30%. Also, the direct combustion or, in the case of CTL, consumption of biomass is considered carbon neutral. As people are made to feel the "cost of carbon" in coming years, through either direct taxation or the impacts of cap-and-trade, it is likely biomass, still relatively under-competitive today, will become more so in future.

I don't believe we are going to find a State-wide alternative energy source, including biomass, that will be less expensive than conventional energy and, as you know, many want to put money into alternatives and forget about coal, oil and natural gas. I am not one of them. I believe we must use both and phase in the one (alternatives/renewable) as circumstance and economics cause us to phase out the other.

FOLLOW UP

Question 2. Given the shortness of time at the hearing I didn't have the opportunity to talk to you about this, but I recently received a letter from Lt. General Dana T. Atkins of the Air Force (Aug. 19th) saying that the Air Force is "enlisting the assistance of the Fairbanks Economic Development Corp. in assessing local, State and national supporting and opposing organizations to determine what their

core issues are and to develop strategies to ensure they are adequately addressed." What is your understanding of what the Air Force is asking of the FEDC and does it provide any financial assistance for the second phase study of the town's coal/biomass to liquids project?

Answer. I will call you (Chuck) about this answer.

GASIFICATION TECHNOLOGY

Question 3. Both of your projects involve gasification of waste, or biomass or coal. That technology is well known, the Fisher Tropsch process being around since before WWII being a part of the equation. It is more expensive, but does allow for the more convenient sequestration—capture—of carbon dioxide. Should the federal government in your view be pushing to bring down the costs of carbon capture and storage too—and what should we be doing to aid that technology to become more cost effective?

Answer. I think it is foolish to believe we can move wholesale to renewable energy sources away for coal, oil and natural gas. Even the President is suggesting that 75% of our energy is going to come for conventional sources in 2025. For the federal government to spend time and money on renewables and not spend equal or even more on learning how to more effectively deal with CO_2 is a recipe for failure. Yes, the government should invest more on research into carbon capture and sequestration—finding ways to capture more of it and proving ways to indefinitely store it. Note that even the most "conventional" proposals for long-term storage—pumping into depleted oil or gas wells—has not been "proven" in a scientific sense and remains as weapon available for use by those who wish to see all fossil fuel based energy discontinued. Other potential means of storage are but that much more theoretical. Making the research investment to prove—or disprove—the effectiveness would be highly beneficial to all sectors of the economy. Also, standing ready to help defray some of the cost of carbon transmission—i.e. pipelines—might also be beneficial: reducing industry resistance in proportion to their reduction of prospective cost.

BIOMASS, AIR QUALITY CONCERNS

Question 4. Alaska, of course, has a lot of biomass. As I said in my opening statement there is 114 million acres of Interior forests that could produce biomass. But most biomass projects involve combustion and that opens the door to air pollutants. Fairbanks already is under the threat of potential air quality sanctions for PM 2.5 violations in future years. How would your projects actually help Fairbanks to meet air quality concerns in the future?

Answer. Any biomass burning in the Fairbanks area should be limited to complete combustion, such as biomass gasifiers or other highly efficient biomass burners. The problem in Fairbanks is that many of the biomass burners don't even meet the current EPA standards. "Complete combustion" leads to fewer particulates and industrial/commercial scale gasification of the kind envisioned emits no air born particulates at all. Also, because the CTL as designed could serve as a large fluid heating source, much in the same way the Wainwright and Eielson power plants do now, it could, through the installation of radically expanded distributed heating system, allow for the discontinued use of potentially thousands of PM2.5 production sources: home heating furnaces.

RESPONSES OF CHRIS ROSE TO QUESTIONS FROM SENATOR MURKOWSKI

COMPARISON OF TECHNOLOGY

Question 1. You for years have been studying all types of renewable energy technology looking to see what would be best and most cost effective for use in rural Alaska communities. What do you believe is the best technology for the future? Obviously that depends on location, whether you are in a windy area, whether you are along a river or coast, whether you have good biomass potential, whether you are on top of a geothermal hotspot. But is there any general direction that you believe the technology is headed and what is the best technology in general as far as being economic?

Answer. Rural Alaskan communities are simply too small to ever expect the same kind of economies of scale that larger communities enjoy. That being said I think it is possible for most small communities to survive the escalating price of fossil fuels by considering the following:

1) Energy efficiency and conservation.—Most villagers will tell you that they are already modifying their behavior to conserve energy. People in rural Alaska use far less electricity per capita that people in Anchorage. However, this use could be reduced further by replacing inefficient appliances with more efficient ones. This does not take behavioral change, only some basic education and up-front capital. But as you know, the bigger issue for rural Alaskans is the cost of heating their homes, and to a lesser extent, the price of transportation fuels. Many homes in the Bush still need to weatherized. In my opinion, Alaska should be setting a world standard for energy efficiency with new home construction. Efficiency and conservation should always be considered before, or at least simultaneously with, new generation. It is almost always cheaper to save a unit of energy that to produce it. I think we have all been guilty of focusing too much on generation technologies.

2) Development of advanced hybrid systems.—Alaska is already seen as world leader in wind-diesel hybrid technology. We should be building on this leadership role. There are over two billion people living in the developing world without any electricity, almost one third of the world. That's a huge market that Alaska could lead. We can demonstrate many technologies and save people money at the same time, something that can't really be done many places. As you noted, the answer to what kind of renewable resource is used is site specific. Alaska should keep focusing on wind because we have about 100 communities that could use it to displace diesel. The Wind Diesel Test Center that is getting off the ground at UAF is going to focus on how we can get more "high penetration" wind-diesel hybrid systems operating in Alaska. Those are systems where over 50% of the community's electricity could come from wind at certain times. These systems require more advanced control systems to marry the wind turbines with the diesel engines. Those control systems need to be optimized and improved for better high penetrating systems. We need R & D & D for this. The ceramic stoves that could use excess electricity in a high penetration system are an example of one way to use the excess electricity for heating. Charging electric vehicles would be another way to optimize a high penetration hybrid system. Of course, any renewable resource could be plugged into a hybrid system. Kodiak now has a wind-diesel-hydro hybrid system.

In terms of its possible reach, hydrokinetic power seems to be the technology that could most benefit rural Alaska. There many Alaska communities that are located either on a river, or on the ocean where tidal and wave power will be possible in the future. I believe because of its predictability, proximity to load, and sheer immensity tidal and wave power should and will get a lot of public and private money to commercialize it and make it cost competitive through technology advancements and improving economies of scale. As a sister of straight tidal technology, river hydrokinetics can benefit from advances in tidal power. However, there are special issues on rivers like floating debris that must be solved. Wave and tidal power are both advancing in Europe, and in Maine and Oregon. Alaska may have already lost its "first mover" advantage in tidal and wave, despite the huge amount of resource we have. However, the huge amount of resource in Alaska, along with the need for more affordable power in rural areas, should move hydrokinetics to the top of the list of technologies with future promise for the State. Alaska is likely not going to be a leader in solar PV technology because so many other Nations are already so far ahead and will continue to lead technology advancements. However, I believe that as more electric and plug-in electric hybrid vehicles become available rural areas could benefit eight months a year from solar PV power charging stations. As diesel prices go up and PV prices go down, the addition of solar PV to other hybrid systems will make economic sense. Solar thermal already pencils out to heat water and potentially whole buildings in places where fuel oil prices are high. Small hydro and geothermal are very site specific and will be viable if located near enough to a load. Biomass for central heating is another promising technology. Several Alaskan communities are currently putting in systems and many more are located near sustainable sources of woody biomass and/or wood residues.

TECHNOLOGIES FOR THE FUTURE

Question 2. Everyone right now is focused on wind, solar, geothermal, biomass, and do a degree ocean renewable. We in Alaska know that hydroelectric is a wonderful source of power from an environmental standpoint, but problems in the past in the Lower 48 have certainly caused barriers to be erected against federal aid for hydroelectric. Are there new technologies out there that should be pushed, whether generating fuel from algae—pond scum—or using renewable energy to produce hydrogen from water—hydrogen being a fuel that can be shipped when high voltage

transmission is expensive and difficult to site. Where should we be focusing our attention to maximize energy production for Federal aid dollars? Should hydro be more in that mix?

Answer. Large hydro should and probably will be in the mix for the Railbelt's future. My bet would be that Chackachamna's economics come out looking better than Susitna's. Large hydro will help the Railbelt diversify its energy portfolio and retire old and inefficient gas turbines. If we do build so much large hydro that we have excess electricity on the Railbelt, I think it would be prudent to apply that energy to electric transportation and heat for the citizens of the State who will no doubt be subsidizing the initial capital outlay that will be required to build large hydro. It certainly would be nice to allow new, "properly permitted" hydro projects in Alaska to trade RECs under any new cap and trade scheme that might become law. As far as new technologies go, without a massive effort to change our infrastructure to accommodate the storage and transportation of hydrogen, I do not see that as a near term way to store excess or stranded renewable energy resources. I am, however, intrigued with the notion of making anhydrous ammonia from large stranded renewable energy resources, especially those located near ports in the Aleutians. Agrium was using the hydrogen in natural gas to make ammonia-based fertilizer for years. Anhydrous ammonia, or fertilizer, are two products that can be readily shipped and monetized using existing infrastructure. I think it is worth looking into tapping into our large stranded renewable energy resources with electrolysis and ammonia production in mind. Bill Leighty from Juneau is a leading authority on using Alaska's stranded renewables for hydrogen and/or ammonia production.

Advancements in battery technology will help firm all variable renewable energy resources. Compared to other technology advancements over the last 50 years, advances in batteries are relatively meager. Again, because of our unique isolated grid communities, Alaska has a special incentive to lead in batteries and other energy storage technologies. Finally, I would put in another plug for developing highly energy efficient homes. It will save Alaskans billions of dollars over the long term and it may also help spur an industry and knowledge base that can help us diversify our economy, something we desperately need to do.

RESPONSES OF STEVE HAAGENSON TO QUESTIONS FROM SENATOR MURKOWSKI

Question 1. As a State official responsible for power plannmu, what would be the recommendations you would give the federal government for what it should be doing to assist in energy development? Obviously everyone wants more money; but with a federal deficit of more than $1 trillion this year and a forecast deficit of $1.3 trillion for FY 10, finding that money is difficult. What should we be doing to better utilize our existing funding for energy development? How can we be smarter in promoting energy production and usage?

Answer. Recognizing that funding has become difficult at both the State and Federal levels, we need to focus our efforts on smart thinking to better utilize existing funding or remove roadblocks for energy development. When money is tight, the development of a triage method will focus funds to reduce risk and fill knowledge gaps with applied research. The triage tools should focus on risk reduction to reduce the failures before large scale deployment of a technology.

There are many technologies and resources available for energy development. As a general rule, pure research provides valuable information on emerging technologies but may be years away from a mature application. Applied technology provides expanded knowledge that will move the application toward commercial operation. The National Renewable Energy Lab and Denali Commission are two great examples of federal groups that are focused or moving emerging technologies toward commercialapplication. University of Alaska Fairbanks, Alaska Center for Energy and Power is also heavily involved in applied research to fill knowledge gas on resource sustainabity and emerging technology. The Cold Climate Housing Research Center (CHRC) has recently constructed a low-cost,low-energy efficient home in AnaktuvuhPass. A slide show of the construction of the Sustainable Northern Shelter project in Anatktuvuk can be seen at www.cchrc.org. It is smart business to build low-enegy homes to reduce the energy consumption as we develop technologies that use local resources to construct and power our communities.

The following is a list of technologies, resources and demonstration projects which could be developed to enhance the sustainability of Alaskan communities:

- Sustainable Northern Shelter programs;
- Gasification Technologies for biomass: direct-fired or plasma;
- Assessment of wind resources with on-site anemometers;
- Assessment of willow resources to determine growth rates;

- Assess the resource potential for wave and tidal power;
- Develop technologies for capturing wave and tidal resources;
- Control technology to provide integrated system operations;
- Optimize delivery systems to reduce the costs and increase reliability;
- Evaluation of energy conversion technology and storage efficiencies;
- Capital cost estimates based on required sizing for technoiogies;
- Opportunities to reduce construction and operating costs;
- Identify opportunities for in-State component construction and assembly;
- Identify opportunities for in-State operations and maintenance personnel training;
- Development of model communities to demonstrate technolcoies;
- Domestic use, transportation and storage of hydrogen;
- Domestic use, transportation and storage of ammonia; Cellulosic Ethanol production from biomass;
- Access to low interest loans and loan guarantees.

There are federal programs for energy development under US Department of Agriculture, Housing and Urban Development and Bureau of Indian Affairs which range from loan guarantees to loans to grants. Economic development programs are key to a sustainable community. An economic base would provide jobs that would in turn provide income to allow for payment of bills and expenses. There are many economically depressed areas in Alaska that could benefit from a hand up as they develop long-term careers in their communities.

With the significant federal in holdings in Alaska, harvesting and accessing local resources will likely involve federal review, permitting and approval. A comprehensive review to streamline the permit process could provide easier access to available resources and benefit communities across Alaska.

Question 2. Producing renewable energy is useful, what would be even better technology to store the energy made when the wind is blowing, the sun shining and water flowing. In your testimony you spoke about trying to store renewable electricity by heating water and then using that hot water for either space heat or to generate electricity using potential low-temperature turbine technology. Can you amplify on what you are seeking from the State's consultant and how such a system might work in a typical village? What other technologies are you seeing that most interest you for reducing overall energy costs either through promoting energy efficiency, or storing energy or converting it into transportable fuels? There is talk about hydrogen fuels or about using wind to produce ammonia, which is somewhat easier to transport than hydrogen. I know you looked at biomass/waste generation while at GVEA. What looks like the most cost-effective, best alternatives from your viewpoint at this time?

Answer. Alaska has resources which may not be available when they are needed. To solve this situation AEA is looking at storage mediums which can store energy for one day, one month and one year. Tidal power, although very predictable, is not continuous and may use a one day storage medium. Solar is very plentiful in the summer but will require up to 12 months storage for use in the winter months.

Tidal power could use a short-term storage medum such as batteries, compressed air air, or pump storage which could hold excess power anti needed to provide power at slack tide, it is en electrical system requirement to provide continuous power. Alternatively, if a barge was constructed to house hydrokinetic devices, the energy could be used to power a compressor to make ice when the tide is flowing and stop when the tide is slack. The availability to obtain ice closer to the fishing grounds could save significant fuel for both production and transportation of ice rather than picking up ice at a distant port.

Wind power would use a mid-term thermal storage medium such as hot water, thermal-oil or other material. Wind can provide electricity and heat when the wind is blowing. The key is to store energy when the wind blows so it can be used at a time when the wind stops. For years, water has been used for energy storage and transfer in geothermal applications. There may be in any storage mediums but for this discussion we will use water. A large wind farm could provide electrical energy directly to the distribution system with the excess electrical wind energy being input and stored in the water tank. When the wind stops, the hot water would provide heat to a community and could be used to make electricity through a binary phase turbine, similar to the Chena Chiller Organic Rankine Cycle (ORC) generator used at Chena Hot Springs. Alternatively, the diesel generators could be operated at an increased efficiency to make electricity with the water jacket heat being stored in the water tank. Stored energy could be augmented through other renewable resources such as solar, hydrokinetic or tidal, or other fuel resources such as diesel or wood.

Solar power is very predictable but will require long-term storage such as a super insulated thermal mass. CCHRC is looking at use of a large insulated thermal mass that would be heated in the summer time with abundant solar energy, and used as a thermal source for a heat pump to heat buildings in the winter. There may also be opportunities to use a heat pump to store the heat in the thermal mass in the summer time and extract it when needed in the winter months.

The attached PowerPoint* shows a map of Alaskan communities with local resources identified.

- NUMBERS indicates Wind Class (7 being best)
- W indicates Wood and Biomass
- H indicates Hydroelectric
- GAS indicates Natural Gas
- COAL indicates Coal
- T indicates Tidal
- GEO indicates Geothermal

As you look at the map you will see areas where there is only one resource. The best alternative is the one that uses the locally available fuel, so in southwest Alaska we are looking at mainly wind with our artificial geothermal, hot water energy storage system (page 23 of the PowerPoint). In the upper Yukon, we are looking at main wood and biomass Ccra wo has traditionally been used to provide heat in areas where it is available. Sustainability may become an issue as more people use cord wood. Biomass from fast growing plants may provide a better energy source as they require less acreage to provide a sustainable resource. The sustainable harvest level of both cord wood and fast growing biomass will need to be determined, as well as the access to rty where the resource resides. Appropriate conversion technologies will need to be identified for each resource to make both heat and electricity.

Hydrogen is considered a clean, non-carbon based fuel, but only if it is made from a renewable energy source. Similar to electricity, hydrogen can be considered an energy medium rather than a source of energy. Being the smallest atom know to man, hydrogen presents its own storage and transportation chalIenges. With some applied research into the utilization, hydrcoen could become a vital fuel which could be generated from Alaska's vast tidal and wave power resources.

Ammonia is another non-carbon based fuel which could be generated in Alaska using remote resources that would be uneconomic for domestic uses due to the high delivery costs to the point of use. This is another emerging technology in which Alaska could be the leader eid supplier of ammonia to a global market.

Thank you again for the opportunity to testify. Let me know if there is any way can help advance local production of energy in Alaska.

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*Document has been retained in committee files.