Written Testimony
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Committee on Energy and Natural Resources

On

Energy Technology Innovation and Deployment Opportunities for Alaska's Energy Future

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Respectfully Submitted By Steven Gilbert
Manager, Projects Development and Key Accounts
Alaska Village Electric Cooperative, Inc.

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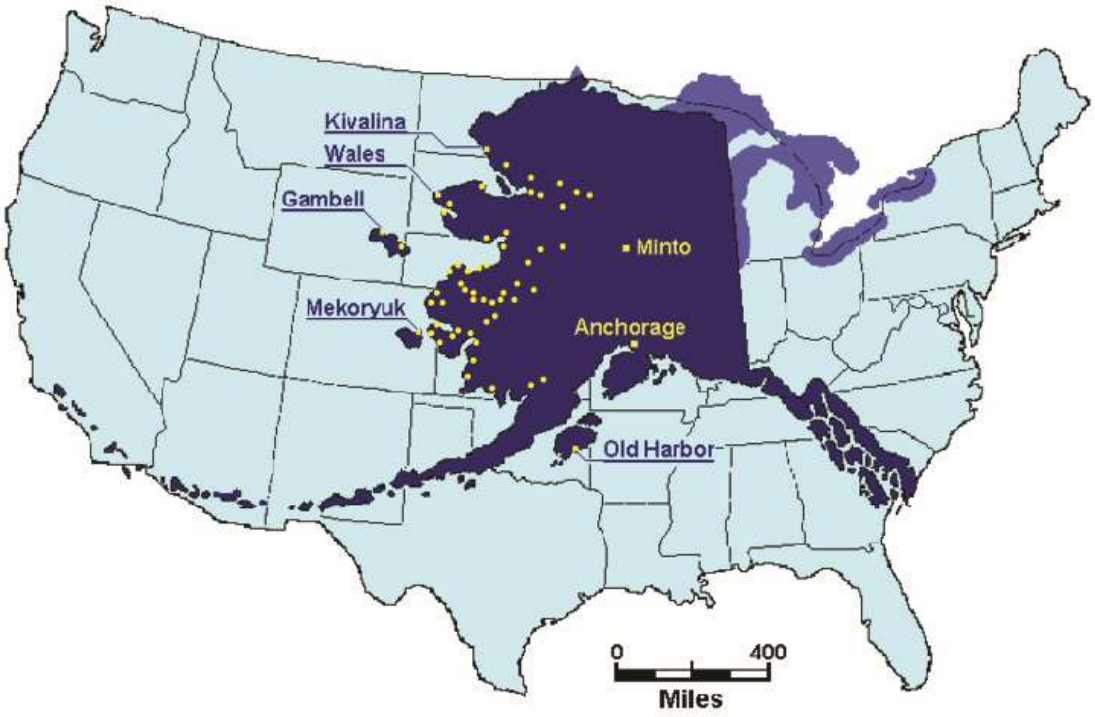
Senator Murkowski, thank you for the opportunity to testify in Alaska.

My name is Steve Gilbert. I serve as department manager of Projects and Key Accounts of Alaska Village Electric Cooperative (AVEC). I have worked in the electric power industry for more than 35 years and during my career have become familiar with most conventional and renewable energy generation sources.

AVEC was established in 1967 as the culmination of an effort of the then-Governor of Alaska to find a way to deliver central station electricity to the small villages that housed Alaska's rural, mostly indigenous population. The task was daunting, given the distances, geography, absence of infrastructure of any kind and extreme climactic conditions of our great state.

Working with USDA REA (Rural Electrification Administration, now Rural Utilities Service) a unique electric cooperative was established – one that would serve communities whose physical boundaries did not coincide with those of other member villages. This patchwork of electric grids began with three communities that were electrified in late1968. Old Harbor, Nulato and Hooper Bay are an average of 400 air miles from Anchorage, AVEC's base of operations and an average of 470 miles from each other.



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AVEC served communities are largely clustered in western Alaska, (Anchorage is included for geographic reference only)

AVEC today serves 56 communities in Alaska and does so with 48 separate diesel fueled power plants. Several of our communities have populations of less than 100 while our largest, Bethel, has a population of more than 6,200.

Discounting Bethel, which is more than five times the population of our second largest community, the average village population is 450 – likely less than the occupants of a single apartment building in most cities.

AVEC is, in effect, operating a series of 48 stand-alone micro-grids. As small stand-alone grids we cannot benefit from interconnection with other grids to optimize reliability and share costs as is the case with virtually all communities in the Lower-48. Instead we must provide redundancy within our power systems to allow for planned and unplanned generation maintenance. Extended outages in a community equate to life, health and safety crises almost immediately. During the winter, houses freeze up and human life is at risk. During the short summers, extended loss of refrigeration could mean the loss of an entire season of subsistence food.

AVEC systems typically consist of a stand-alone power plant with three or four generators. Sizing is carefully done so as to operate the most efficient generator to meet the needs of the day and the season. Redundancy is determined based upon having adequate capacity when the largest generator is down for maintenance and another fails unexpectedly. As a result, AVEC owns 80 megawatts of generation to supply an average load of 13 megawatts.

In addition to AVEC's 48 power plants, we maintain diesel tank farms in each community. Because fuel is delivered by barge during the short "open water" season, we must be able to store fuel for an entire year at a minimum. Since weather can delay the arrival of the first barge, we will generally ensure that we have up to 14 months of fuel on hand by the end of the delivery season.

In this day of the drive to distance ourselves from fossil fuels, rural Alaska's dependence on diesel is surprising to an outside observer. Alaska is one of the nation's leading energy states with vast reserves of natural gas. It would seem self-evident that Alaskans' energy needs would be met with inexpensive, low-emission sources such as that natural gas. That is not possible however, because Alaska lacks the basic infrastructure that is ubiquitous in other states.

Alaska lacks roads, railways, adequate port and dock facilities, paved runways, transmission grids, communication grids and other elements deemed necessary for modern American society. As a result, we have had to develop micro-systems to meet the needs of the people who have been resident in these areas for many hundreds of years. However, these micro-systems come at very high cost per capita.

As an example, AVEC's investment in utility plant to serve our villages is more than $17,000 per service or meter. That is 4-5 times the investment typical in the Lower-48 states and reflects the very large redundancy built into our generation plants as well as the value of the fuel storage systems that go with it.

Despite these staggering costs, AVEC has nonetheless been a leader in deploying wind generation in communities with a robust wind regime. We typically install wind turbines that, at peak output, exceed the connected electrical load at the time. We install diversion systems that shunt excess wind generation to passive loads such as electric boilers in water treatment plants and other public buildings and reduce the use of diesel fuel in those facilities. While use of excess wind does not displace AVEC's fuel it does help communities reduce fuel they need for water treatment. To accomplish this AVEC is using off the shelf equipment in an innovative way which keeps up front costs lower. Depending on location, these wind to heat systems save communities between 8,000 and 10,000 gallons a year using excess wind.

AVEC has been engaged in developing wind generation since 2003 and owns and operates the largest fleet of wind turbines in Alaska – 34 machines are located in 11 communities and serve another four through modest transmission connections. In 2015, 6% of the electricity we sold came from wind. That is significantly better than the US total of 4.4%. In communities with optimal wind regimes we are able to meet 25%+ of their electrical needs from wind.

Where practical, AVEC offers recovered heat to communities where engine heat is captured in the cooling loop. The heat that would otherwise be rejected to the atmosphere in a radiator is recovered and used by communities to heat buildings and/or community water treatment plants. There are modest costs to operate a heat recovery system. The heat is provided to the community at a cost well below the cost of the equivalent fuel the heat replaces and saves thousands of dollars each year.

AVEC also has a full time training supervisor who travels between villages. The supervisor provides ongoing training for power plant operators. There is an on-going need for people with the requisite skills necessary to maintain the systems and troubleshoot problems when they arise. AVEC works with local technical colleges to identify skills that schools need to teach students to prepare them for field work.

Renewables are intermittent, with output goes dependent on wind speed. AVEC has developed the basic design for what we call a "grid bridging" system. The intent is to allow AVEC to operate diesel engines at the lowest possible rating, without causing damage or significant efficiency reduction. The power plant will rely on the grid bridging system to carry the community as the wind trails off and the diesel unit comes up to carry the load. As the wind picks up, the diesel will reduce its output and fuel consumption is reduced. This function is called spinning reserve and is currently

supplied by a diesel engine. The grid bridging system will provide the reserve energy and significantly reduce fuel consumption. The grid bridging system has application potential in the lower 48 states as larger utilities also grapple with integration of intermittent resources.

AVEC has also branched out into the tug and barge business. With diesel fuel playing a critical role in meeting the energy needs of rural Alaska, AVEC decided to enter this arena in order to deliver lower cost fuel to its constituents. Through an innovative business arrangement with professional barge operators, AVEC has been a catalyst for competition which has led to consistently lower cost fuel transportation across the entire western Alaska market.

Alaskans do not wish to be tied to the yoke of fossil fuels. Fuel spills occur routinely because the fuel is stored and handled so frequently, although rarely are they of such magnitude as to command national attention. Nonetheless, spills and combustion emissions are a continuing threat to human health and extremely expensive to respond to. That is why AVEC is committed to reducing our dependence on diesel fuel, which can only be achieved by improving efficiencies and by installing alternative sources of generation.

Generation efficiencies are achieved through optimizing generator output and running the most practical sized engine at any given time. AVEC's customer/members have realized savings through our use of electrical interties between villages. The interties allow us to serve 56 communities with 48 power plants, reducing operating costs. Interconnection of nearby communities helps AVEC optimize power generation efficiency and spread the benefits of wind.

The cost of operating a power plant accounts for ten cents per kWh. That is the average cost of a kWh delivered to a home in the Lower-48 today – but is only one fifth of the cost of a kWh across the AVEC system.

Because of the very poor economies of scale in rural Alaska, costs are very high. While all technical, administrative and support services are provided from our Anchorage headquarters; each stand-alone generation and distribution system accounts for 1.5 full time equivalent employees and two local part time employees to operate the plant.

To put the very small scale of these utility operations into perspective, a village's entire annual power consumption is the equivalent of half the consumption of a typical grocery store in Anchorage. All 56 of our communities together represent a population of almost 32,000, about the same as Fairbanks, but the combined electrical usage is less than 10% of Fairbanks.

Electricity is the underpinning of modern society. Without abundant, affordable, reliable electricity, modern society cannot function efficiently. That is palpable in rural Alaska

and, to a lesser extent, in urban Alaska as well, where the cost of electricity is 150% that of the US average.

As we address the delivery of electricity, AVEC is keenly attuned to the interlinked needs of sustainability for our communities. Space heat is typically provided by diesel fuel or wood, where that is available. Again, cost-effective alternatives are simply not available or practical. Transportation infrastructure in and to our communities is almost non-existent. Economic development is stymied absent these underlying basic needs and the social fabric of the community is strained by the day-to-day struggle of existence.

The State of Alaska has been a major player in the effort to overcome the shortfall in infrastructure to serve Alaska – a role that in the Lower-48 was largely met by the federal government. The Denali Commission has been a significant contributor when funding was available in past years. Unfortunately, their role has perforce diminished as funding sources have dwindled.

In the energy sector, the State has established the Power Cost Equalization program to make a lifeline amount of electricity affordable for individual Alaskans, while non-residential users pay often unsustainable electric and heat bills to operate their modest businesses. The State has established a Renewable Energy funding program that has been better capitalized than any other state. Millions of gallon of diesel are being displaced annually by projects funded through this program. Unfortunately the State has had to significantly reduce funding of this program. The State funds research opportunities for emerging energy technologies. The State also established low cost financing options for energy infrastructure for larger utilities.

But the State cannot carry all of the necessary infrastructure development with its limited resources. The Federal government through DOE and other agencies supporting the Energy Policy Modernization Act should consider leveraging lessons learned in Alaska. It should be looking at deploying innovative commercially viable technologies, such as what we are trying to do on a small scale.

The federal government has passed legislation to help with these costs. The Department of Agriculture runs the High Energy Cost Grant program through the Rural Utility Service (RUS) that does make grants, plus loans, available to fund the installation of renewable electricity systems, but funding for the program has been cut repeatedly over the past decade. And Congress in 2007 approved in the Energy Independence and Security Act the creation of two matching grant programs to provide grants for up to 50% of the cost of installing proven renewable energy systems in high-cost regions.

Unfortunately those grant programs have never been implemented by the Department of Energy nor actually been funded by the executive and legislative branches. Providing additional funding for these programs, plus for additional transmission aid, also currently available through RUS, would dramatically improve the likelihood that islanded grids could afford to install renewable energy systems and not only reduce consumer power costs over time, but also reduce the consumption of fossil fuels with their associated emissions.

AVEC has also expressed its strong support for the establishment of an Alaska Energy Network Innovation Hub. This audacious project encapsulates an Alaskan vision of 100% self-sufficient micro-grid systems. This effort coupled with our drive to interconnect communities could catalyze a fundamental leap in delivering energy to remote and Arctic communities and could establish Alaska as an energy innovator second to none.

Specifically, AVEC requests the federal government to support:

- More electrical interties between communities which increases economies of scale, reduces operating costs and allows for the benefits of renewable energy sources such as wind to be distributed to more villages.
- Grid bridging, uses off the shelf equipment but allows for the integration of more wind generation than would otherwise be possible. 30 – 60 seconds of storage.
- Thermal energy using both recovered heat and excess renewable energy. By intentionally sizing the renewable energy system to exceed, periodically the electric systems ability to absorb all the power, the renewable energy can be sized to meet more of the villages energy needs both electrically and for heat.
- Training of personnel to maintain existing systems and adapt to ever increasing renewable energy on the systems.
- Funding of an Alaska Energy Network Innovation Hub to create duplicable solutions for remote and islanded communities.

It is time for a renewed, holistic approach to meeting the basic infrastructure needs of rural Alaska. With the US chairmanship of the Arctic Council, a spotlight is being shone on the only arctic state in the US – Alaska. This is where the impacts of climate change are being most sharply felt. This is where economic and living conditions most closely resemble those of developing countries. This is where the vast resources of the Arctic Ocean nurture the land and the people and whose shores will witness the evolution of new transportation, tourism and mineral extraction activities.

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It is time for the federal government to partner with the State of Alaska and those of us that exist to serve Alaskans to continue and enhance the infrastructure development that is critical for our future.

We should be expanding our vision of micro-grids to include sustainable clusters of communities that are not connected to a grid but that collectively can be served by robust technologies that represent reliable, affordable, clean abundant energy.

Thank you for the opportunity to testify.