GLOBAL APPLICATIONS PROGRAM
Sharing Alaska’s Expertise in Microgrids with the World

“Alaska has the world’s greatest concentration of experience and expertise for integrating renewable and conventional power in hybrid systems.”

— Peter Lilienthal, CEO
HOMER Energy

HOMER Energy is the world’s leading microgrid modeling software company, with over 100,000 users in 163 countries.
We estimate that Alaska is home to approximately 12% of the developed microgrids in the world incorporating grid-scale levels of renewable generation. The integration of variable resources (wind and PV), as well as limitations of local hydro and geothermal power has led to the development of a niche support industry in Alaska, with significant experience in the design, development, and operation of these hybrid microgrids.

Alaska is home to over 100 small community microgrids distributed across its geographically diverse regions. Over the past decade, investment in renewable generation has increased dramatically to meet both a desire for greater energy independence and reduce the cost of delivered power. Today, over 70 microgrids in Alaska are powered by renewable energy, including small hydro, wind, geothermal, biomass and solar combined with baseload generation typically provided by a diesel powerhouse.

By sharing lessons learned through projects developed in some of the most remote and challenging areas of the world, Alaskans are playing a key role in addressing energy poverty globally.
Kodiak Electric Association, Inc. (KEA) operates a truly islanded grid. There are no electrical, natural gas or oil pipeline connections to the mainland, and no on-site fossil fuel resources. Every millijoule of the 151 GWh of energy KEA delivered on “the Rock” in 2013 came either from the natural environment around them, or from diesel-powered generators operating with barged-in fuel.

In 2007, KEA established the vision to produce 95% of its energy sales with cost-effective renewable power solutions by the year 2020. That vision has inspired an overhaul of what was once a heavily diesel-reliant electric system to what is now a fully renewable power grid. In 2009, KEA achieved local ownership of the Terror Lake Hydroelectric Facility, and in 2014 its generating capability was expanded to 33 MW with the installation of a new third turbine-generator. In 2009, KEA constructed Alaska’s first utility-grade wind farm, and an expansion in 2012 brought the Pillar Mountain Wind Project’s total nameplate generating capability to 9 MW. In 2012, KEA integrated 3 MW of frequency-stabilizing energy storage with a lead-acid battery system, and construction is currently underway to integrate an additional 2 MW of energy storage capability with a new flywheel system. KEA maintains a fleet of diesel-fueled generators at four geographically dispersed locations to provide 36 MW of emergency backup power capability behind its integrated wind-hydro system. To safely and reliably transmit and distribute this power to its 4,042 Cooperative members, KEA manages 6 substations, 34 miles of transmission line, 202 miles of overhead distribution line, 138 miles of underground line, and 3 miles of underwater cable.

Kodiak’s remote and isolated electrical grid poses many challenges, yet KEA’s innovative engineering and resource management strategies have successfully integrated high penetration rates of wind, dispatchable hydropower, and diverse energy storage systems together to achieve energy independence. KEA generated 95% of its electricity with renewable power in 2013, and the utility is on track to achieve nearly 100% renewable energy in 2014. Kodiak’s local member-owned Cooperative, KEA supplies power to the 8 seafood processors that together rank Kodiak as one of the top fishing ports in the nation. In addition to the seafood industry’s significant power demand, KEA also powers the America’s largest US Coast Guard Base, whose support mission spans from Southeast Alaska to the North Pole.

At St. Paul the spirit of innovation and system enhancement continues. In 2014, TDX Power was awarded a grant in the second round of Alaska’s Emerging Energy Technology Fund to work with Beacon Power and Intelligent Energy Systems to integrate a Beacon Power BP400 flywheel energy storage element into the system for enhanced stability and voltage support of the grid, with the expectation that it will increase diesel-off time by an additional 10% to 15%.

Companies involved include TDX Power, Northern Power Systems, Beacon Power Systems, and Intelligent Energy Systems.

TDX Power is a subsidiary of Tanadgusix Corporation, a company wholly owned by Native Alaskans originating from the remote Alaskan community of St. Paul. The TDX Power experience with the hybrid wind/diesel system at St. Paul is an outstanding example of Alaska’s progress toward achieving the affordable, reliable and efficient energy solutions needed for success in remote and isolated grid systems across the world.

On their home island of St. Paul, TDX Power has been operating a wind-diesel fueled microgrid for the past 15 years with up to 100% wind powering the grid — all without using a battery system. The system consists of three 225-kW wind turbines and two 150-kW diesel gen-sets. The system supplies electricity and space heat to an airport and industrial complex with airline offices, equipment repair, and storage facilities. Continuous power supply is accomplished by diverting excess wind energy to secondary heating loads, and incorporating a 300 kVA synchronous condenser to maintain grid stability.

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Chena Hot Springs is home to the lowest temperature commercial geothermal power plant in the world, operating since 2006. Generating 300 kWe from its geothermal power plant to support the site's microgrid, the powerhouse uses modular units designed for industrial waste heat applications. Driven through an Organic Rankine Cycle, the system is operated off thermal water temperatures as low as 72°C (165°F).

In addition to power generation, the owners of the Chena Hot Springs resort are committed to making the resort as self-reliant as possible. The thermal waters are also used to provide heat and power to a year-round greenhouse operation, heat all the buildings and two thermal pools for recreational bathing, and provide year-round cooling using hot water via an absorption refrigeration cycle for a 10,000 square foot ice museum that exhibits numerous sculptures and ice architecture.

Companies involved include Energy Concepts, Chena Power, United Technologies Research Center, and Kashan Turbines.
Cordova, Alaska
Low impact run-of-river hydro microgrid

Alaska has 14 microgrid hydropower projects serving local communities, primarily in the southeast region of the state. These include run-of-river, lake tap, and small dams ranging from 10 kW to 10+ MW in size. Small local utilities, understanding the local terrain and resource availability, have generally spearheaded the development of these projects.

An example is Cordova, a small fishing community of 2,300 residents, whose microgrid is served by two run-of-river hydro projects and a diesel powerhouse. Cordova Electric produces up to 60% of Cordova’s electricity from the 6.0 MW Power Creek Hydroelectric Project, and up to 20% from their 1.2 MW Humpback Creek Hydroelectric Project, both low impact, run-of-the-river hydroelectric power generation. Combined, Cordova generates between 60% and 80% of their power from renewable resources, with the remainder supplied by a diesel powerplant.

Cordova has also invested in a number of community conservation and energy efficiency initiatives such as LED streetlights and diesel efficiency improvements, and installing capacitors to smooth out spikes in the voltage and frequency caused by the inrush current from large motors at the local fish processors. In addition, they have invested in improving the efficiency of their diesel powerhouse by recovering low quality heat rejected from the diesel engines to power an Organic Rankine Cycle system that generates electricity.

Companies involved include Baltimore Air Coil, Electric Power Systems, Hatch Engineering, Low Impact Hydro Institute, Marsh Creek LLC, Mowat Construction, Pratt-Whitney Power Systems, R&M Consultants, and Whitewater Engineering.
In 2010, the Tok School boiler fired up to deliver 5.5 MMBTU of heat to the school. A 5,400 square foot building houses the Hurst N65 Multiphase 300 PSI steam boiler, and has a fuel storage capacity of 200 tons of woodchips. The school uses approximately 2,000 tons of woodchips per year, at a rate of 7 tons per day. Dense spruce forests are harvested for fuel as part of a fire mitigation project. In 2013, the 208 volt, 125 kW synchronous AC generator was put online to produce power for the school. Currently the system produces 50 kW of electricity, almost meeting the needs of the school. As of March 2014 the system had produced almost 129.5 megawatt hours of electricity worth over $68,000. Excess heat warms a year-round 2,700 square foot greenhouse growing produce for the students. Additional heat remains available for a future district heating loop that will send heat to 7 additional community buildings. The operational costs offset by this project has allowed the Tok school to hire a music teacher and counselor, improving the quality of education for the students in this small Alaska community.

Companies involved include CTA Architects Engineers, Messersmith Manufacturing, Inc., and Yukon Construction.

Tok students engage in reforestation activities to ensure their biomass project is sustainable.
NORTHWEST ARCTIC BOROUGH, ALASKA

Water treatment plant powered by the sun

In the summer months, Alaska's Northwest boasts near 24 hour daylight and six communities in the Northwest Arctic Borough are harnessing the sun's power through installed solar photovoltaic (PV) arrays for their water treatment plants. The energy generation has exceeded expectations. In Ambler, the first full year of PV solar production was 6.98 MWh, with peak production in April, May, and June. Elevated power generation in spring is due to the increased sunlight and up to 30% solar reflection from the snow. At times, the water treatment plant has been powered entirely by PV solar. The estimated annual savings for each solar PV plant is $6,000 to $8,000. The project was funded by the region's Coastal Impact Assistance Program (CIAP) and supported by the Alaska Native Tribal Health Consortium. Design and construction of the array was done by Remote Power and the Bering Straits Native Corporation.

Companies involved include Alaska Native Tribal Health Consortium, Bering Straits Development Company, and Remote Power, Inc.
ALASKA RENEWABLE ENERGY PROJECTS

Alaska has over 70 community microgrids that are powered by renewable energy, and many more that use renewable resources and recovered heat for space heating.

DEVELOPING PARTNERSHIPS

ACEP's Global Applications Program was initiated to develop collaborative relationships between Alaskans and other regions of the world facing similar energy challenges. We are actively exploring means through which global partnerships can be developed with both public and private sector organizations, in order to address the global issue of energy poverty. Here are some of the companies working on this issue in Alaska:

- Agnew Beck Consulting
- Alaska Center for Energy and Power
- Alaska Energy Authority
- Alaska Native Tribal Health Consortium
- Alaska Power Association
- Alaska Power and Telephone
- Alaska Village Electric Cooperative
- Bering Straits Native Corporation
- Chenega Energy
- Coffman Engineers
- Cook Inlet Regional Corporation
- Cordova Electric Cooperative
- Crimp and Associates
- Dalson Energy
- Electric Power Systems
- Hatch Engineering
- Huntley and Associates
- Intelligent Energy Systems
- Marsh Creek
- Northwest Arctic Borough
- Ocean Renewable Power Company
- Polar Consult
- Renewable Energy Alaska Project
- RSA Engineers
- Solstice Alaska Consulting
- STG
- TDX Power
- Trimble Strategies
- WH Pacific