

Emerging Energy Technology Fund Round 1 Project Status Updates

The Alaska State Legislature created the Emerging Energy Technology Fund (EETF) in 2010 to promote the expansion of energy sources available to Alaskans. EETF grants are for demonstration projects of technologies that have a reasonable expectation of becoming commercially viable within five years. Projects can either:

- Test emerging energy technologies or methods of conserving energy
- Improve an existing technology
- Deploy an existing technology that has not previously been demonstrated in the state

Through a matching grant from the Denali Commission, \$8.9 was made available to developing emerging energy technologies in Alaska for Round 1 of EETF.

“Alaska faces some of the highest energy costs in the nation and as a result, we continue to be at the forefront of finding innovative solutions and new energy technologies,” said Sara Fisher-Goad, AEA executive director.

For the EETF, energy technology is defined as technology that promotes, enhances, or expands the diversity of available energy supply sources or means of transmission, increases energy efficiency, or reduces negative energy-related environmental effects. Energy technology can include technologies related to renewable sources of energy, conservation of energy, enabling technologies, efficient and effective use of hydrocarbons and integrated systems.

The following fifteen projects have begun work on EETF demonstration projects. A sixteenth project selected for funding was cancelled before a grant was issued.

Arctic Field Testing of the Eocycle EO-25/12 Wind Turbine**Project Lead: Northwest Arctic Borough****Location: Kotzebue****Project Type: Wind****Award Amount: \$293,300**

The Northwest Arctic Borough is demonstrating the cold weather capabilities of a 25-kW wind turbine at the Kotzebue wind farm. The turbine will be installed on a tilt-up tower that uses a winch for installation in place of a crane. The tipping mechanism eliminates the need for a crane or tower climbing during installation or maintenance.

Year 1 Progress

The turbine and tilt-up tower arrived at Kotzebue on the last barge of the year. The project team was able to take advantage of an existing unused tower foundation; the tower and turbine are now fully assembled and mounted. The turbine is currently in the final stages of commissioning.



Assembling the tower



Installing turbine blades

What's Next

After the turbine has been fully commissioned, performance data will be collected for one year. A fully instrumented meteorological tower will be installed within five rotor-lengths of the tower to collect baseline wind data as the turbine generates electricity.



Tower tilted down



Raising the tower

Photos from Northwest Arctic Borough and Kotzebue Electric Association.

Ultra-Efficient Generators & Diesel Electric Propulsion

Project Lead: Genesis Machining & Fabrication

Location: Kodiak

Project Type: Diesel Efficiency

Award Amount: \$247,036

Genesis Machining and Fabrication proposes to demonstrate low-cost diesel electric-power generation and propulsion technology.

The project will demonstrate that a modification to existing motors leads to an increased power density. The proposal also includes novel power electronics designs that can be used in boats for both marine propulsion and to power onboard generators.

Year 1 Progress

During the first year, the team demonstrated the functionality of the inverter in an electric vehicle testbed which has logged more than 1,000 Kodiak road miles. A proof-of-concept 15 kW load matching genset which delivers power via the inverter was also built and demonstrated. Now that functionality has been confirmed, next efforts will focus on documenting the efficiency of the systems.



Converted '97 Eagle Talon EV testbed



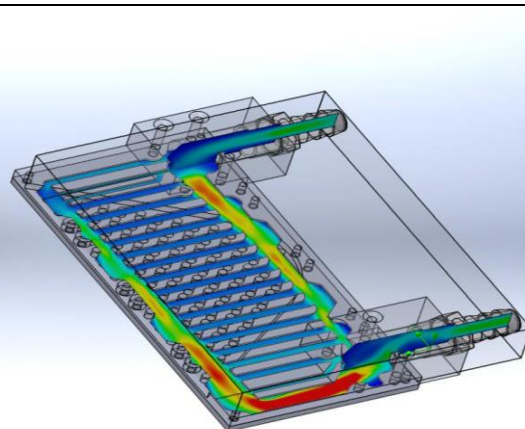
Monitoring performance in the EV testbed

What's Next

In the second year of the project, the team will focus on efficiency testing and demonstrate the next prototype iteration in a Diesel-Electric bus testbed. The testbed will house a 150 kW genset and employ both the Power Dense Motor and Universal Modular Inverter Controller technologies for propulsion and stationary power generation.



Modified 15 kW genset



Designing the controller heat sink

Photos from Genesis Machining and Fabrication.

Arctic Thermal Shutters & Doors

Project Lead: Arctic Sun, LLC

Location: Fairbanks

Project Type: Energy Efficiency

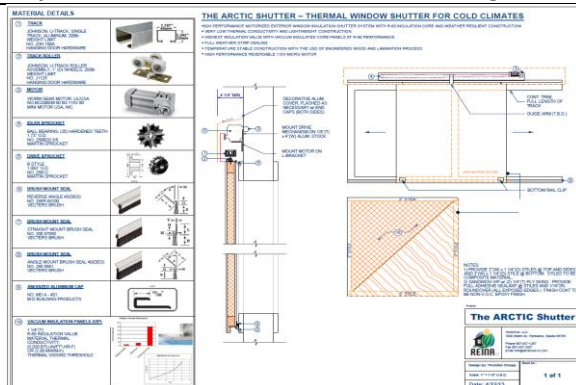
Award Amount: \$136,000

Arctic Sun, LLC proposes improving the energy efficiency of homes in colder climates through arctic doors, arctic shutters and blown-in insulation shutters.

Maintaining climate control in arctic high-efficiency housing has been challenging because of high condensation on doors and windows. The technological improvements proposed by Arctic Sun include improving R-values in the arctic doors; creating exterior arctic shutters that are controlled by an electric drive and use air-tight weather stripping; and shutters for retrofitted fixed-pane windows that can be automatically filled and emptied with insulating beads.

Year 1 Progress

The project team completed design, component selection and prototype construction of the arctic door and two shutter types. A fully instrumented dedicated testing structure was also designed and constructed into which the technology components will be installed and monitored. Collection of baseline data for the test box has begun in advance of installation of the shutters and doors. For the blown-in shutter cavity, solid extruded polystyrene (EPS) beads were selected as the fill material, and subjected to ultra-violet resistance testing over the course of the summer.



Arctic shutter design



Testing box under construction

What's Next

The second year of the project will be devoted to installation of the technology types in the test box and into actual residences and collection of performance data.



UV stability test of the EPS beads



Testing the blown-in shutter

Photos from Arctic Sun, LLC.

Cold Climate Heat Pump Demonstration

Project Lead: Cold Climate Housing Research Center

Location: Fairbanks

Project Type: Heat Pump

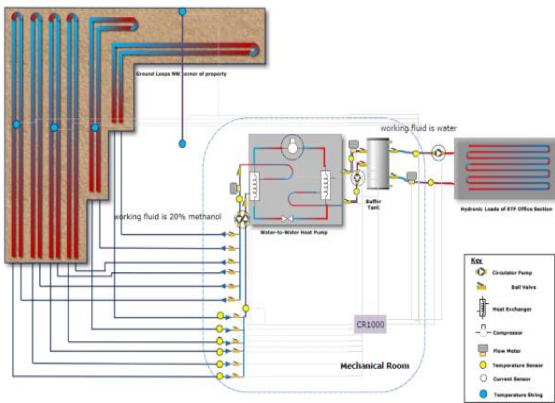
Award Amount: \$119,467

The Cold Climate Housing Research Center (CCHRC) is demonstrating the potential for ground source heat pumps (GSHPs) as an efficient and economic heat source in colder climates. This technology has not typically been used in arctic environments.

This project will install a GSHP at the Cold Climate Housing Research Center's research and testing facility in Fairbanks in a narrow band of thawed ground. Several different surface treatments will be modeled and tested to maximize surface heat capture during summer months and to prevent winter heat loss.

Year 1 Progress

The horizontal loop field was installed and buried along with a network of thermocouples at varying depths. The heat pump unit was then installed and fully commissioned. Different surface treatments have been installed above selected areas of the ground loop including gravel, sand, and a fence for snow drift prevention.



System layout



Digging the trench for the coil

What's Next

With installation complete, the remainder of the project will consist of data collection of the system's performance, monitoring the loop field for thermal degradation, and comparison of the effect of the different surface treatments on the thermal health of the loop field.



Installation of the slinky loop



Installed 3 ton heat pump

Photos from Cold Climate Housing Research Center.

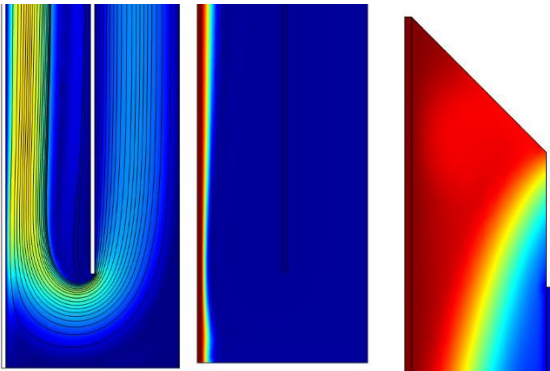
Safe and Efficient Exhaust Thimble**Project Lead:** University of Alaska Fairbanks - Institute of Northern Engineering**Location:** Fairbanks**Project Type:** Energy Efficiency**Award Amount:** \$ 87,889

The University of Alaska Fairbanks' Institute of Northern Engineering proposes to demonstrate a new design of ventilated exhaust thimbles for wood stoves, oil-fired furnaces, diesel generators and other high-temperature exhaust-generating sources.

Stove thimbles prevent wood framing from igniting from the hot exhaust as it passes through the chimney. In this project, the traditional thimble will be replaced with one that relies on thermal siphoning for passive cooling. The new design eliminates heat loss that accompanies traditional thimbles by maintaining integrity of the building's envelop.

Year 1 Progress

The project team has completed final design and computational fluid dynamics modeling of the exhaust thimble, modified a conex container for testing, and constructed prototypes of varying sizes. Testing of the smallest, two-inch diameters thimble is underway.



Modelled airflow and temperature distribution



Instrumented prototype

What's Next

The project team will continue testing with the remaining 4, 6, 8, and 10 inch thimble sizes.



Thimble in operation



Infrared image

Images from UAF. Photo credit Stephen Gemmel.

Wind-Diesel Battery Hybrid for Kwigillingok**Project Lead: Intelligent Energy Systems****Location: Kwigillingok****Project Type: Wind, Energy Storage****Award Amount: \$1,025,750**

IES proposes to demonstrate the use of high-performance lithium ion batteries, similar to those found in vehicles, to provide short-term energy storage.

Year 1 Progress

After a comparison of batteries from several well-known manufacturers, a lithium ion battery was selected and procured from LG Chem and delivered to Anchorage and after acceptance testing, barged to Kwigillingok. The unit was successfully unloaded from the barge, but an abnormally warm winter delayed freeze-up, and transport to the installation site was impossible across the muddy terrain. Severe storms also contributed to the poor conditions, bringing other projects in the area to a stop.



Battery and enclosure awaiting freeze up



Early winter storm aftermath

What's Next

While commissioning was delayed due to site conditions, LG Chem approached the project team with an offer to replace the battery at no cost with a newer model capable of faster charging and able to deliver a higher number of both short and deep cycles. The new battery will be flown in and commissioned this spring.



Site mats positioned awaiting the battery



Counterpoise installation

Biomass Reforestation of Boreal Forests

Project Lead: Alaska Division of Forestry

Location: Palmer and Delta

Project Type: Biomass

Award Amount: \$45,000

The Alaska Division of Forestry proposed to demonstrate forest regeneration after a biomass harvest by planting un-rooted poplar tree stem-cuttings. Although less energy-dense than other biomass fuel stocks, poplars have much faster growth rates. Stems will be collected in the winter and replanted in the spring.

Biomass is a renewable energy source that can be used to generate electricity or converted into biofuels.

Year 1 Progress

Poplar cuttings were harvested during the winter of 2013 which then underwent a pre-soak treatment in advance of planting in the late spring in sites in the Matanuska-Susitna Valley and near Delta. Abnormally hot and dry conditions for summer 2013 resulted in a high mortality rate of the planted cuttings. However, cuttings at the wettest site fared significantly better and the project team noted higher survival rates among hybrid species.



Winter poplar cuttings



Pre-soaking cuttings in preparation for planting

What's Next

In the second year of the project, the team will focus on more drought resistant varieties for a second round of planting, both at the Delta and Palmer sites and also at a rural village site that currently harvests for biomass. All plantations will be evaluated for growth at the end of the 2014 and 2015 growing seasons.



Mat-Su field site



First year poplar growth

BRI Cyclo-Turbine Energy Production

Project Lead: Boschma Research, Inc.

Location: Igiugig

Project Type: Hydrokinetic

Award Amount: \$728,630

Boschma Research, Inc. (BRI) plans to demonstrate a 5 kW River In-Stream Energy Conversion (RISEC) device in the Kvichak River at Igiugig demonstrating use at slower currents. The cycloidal turbine is housed within an open-ended venturi enclosure with a fish/debris guard at the entrance. Intended to be mounted on the river bottom in shallow water, the device's frame uses buoyancy chambers for river transport which are filled with water to submerge the device to its final position.

Year 1 Progress

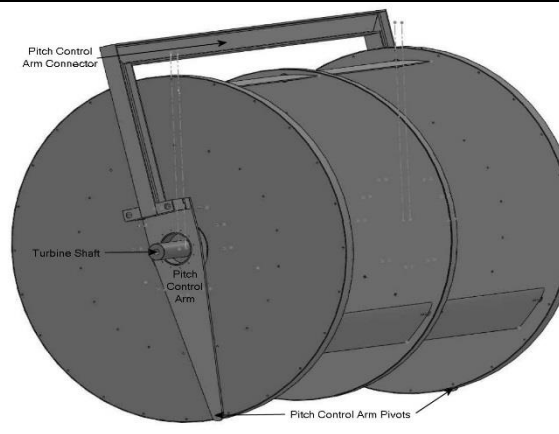
BRI has fabricated and assembled components that make up the venturi support box and mechanical components of the turbine assembly, and conducted an initial deployment and retrieval test in shallow water.

What's Next

Prior to shipping the device to Igiugig, the project team will demonstrate complete deployment, operation, and retrieval of the device in the Tennessee River. Deployment in the Kvichak River is scheduled for the summer of 2014.



Assembled venturi box and ballasts



Turbine assembly sketch

Photos from Boschma Research, Inc.

Application of Composite Flywheels

Project Lead: Hatch

Location: Fairbanks

Project Type: Energy Storage

Award Amount: \$672,500



Hatch is demonstrating a high-efficiency and lightweight flywheel which could be used to provide grid stability in wind-diesel systems.

Year 1 Progress

One month's worth of high resolution baseline data has been collected at Nome's wind-diesel system which will be used to assist in modelling and controller programming. The project team is identifying and procuring components that will be used to lab-test the flywheel.

What's Next

The unit will be extensively tested at UAF's Power Systems lab prior to deployment in a village.

RivGen Power System Commercialization Project	
Project Lead: ORPC Alaska, LLC Location: Nikiski, Igiugig Award Amount: \$1,491,750	Project Type: Hydrokinetic
<p>ORPC proposes to demonstrate the RivGen hydrokinetic device, a river bottom-mounted River In-Stream Energy Conversion (RISEC) device, mounted on a redesigned pontoon support structure. The buoyancy chambers which can be filled and emptied of air for controlled deployment and retrieval.</p>	
Year 1 Progress <p>ORPC has refurbished and dry-tested its first generation RivGen prototype and completed modeling and redesign of the support structure (shown below prior to redesign) that will be used to deploy and retrieve the turbine.</p>	
What's Next <p>The project team will complete construction of the Pontoon Support Structure; deployment and retrieval of the structure will be tested in Cook Inlet in the spring of 2014 where incoming tides will provide a river-like environment with the benefit of a slack tide for troubleshooting. When deployment and retrieval has been successfully demonstrated, the entire unit will be shipped for deployment and operation in the Kvichak River.</p>	
	
RivGen unit being refurbished	Early testing of the 1 st gen support structure

Photos from ORPC.

High Efficiency Diesel Electric Generator Set	
Project Lead: Marsh Creek, LLC Location: Anchorage, Fairbanks Award Amount: \$677,508	Project Type: Diesel Efficiency
<p>Marsh Creek is demonstrating the use of a permanent magnet “soft torque” coupling in a diesel genset to facilitate operation at speeds of both 1200 and 1800 rpm. Operating at a lower rotational speed when power demand is low could significantly increase fuel efficiency.</p>	
Year 1 Progress <p>The project team has modelled performance, designed the test system, and established plans for testing at different speeds and loads.</p>	
What's Next <p>After baseline testing, the team will conduct a battery of tests in their Anchorage facility to characterize the modified system. The unit will then be sent for performance validation test at the UAF's Power Systems Integration lab.</p>	

Enhanced Condensation for Organic Rankine Cycle

Project Lead: University of Alaska Fairbanks - Institute of Northern Engineering

Location: Fairbanks

Project Type: Heat Recovery

Award Amount: \$166,044

The University of Alaska Fairbanks seeks to increase the efficiency of an Organic Rankine Cycle (ORC) system by increasing the heat transfer rate of the condenser. The condenser is used to condense vapor into liquid and to remove heat from fluids. A hydrophobic coating will be patterned onto the condenser to create a heterogeneous surface, reducing film formation on the condensing surface.

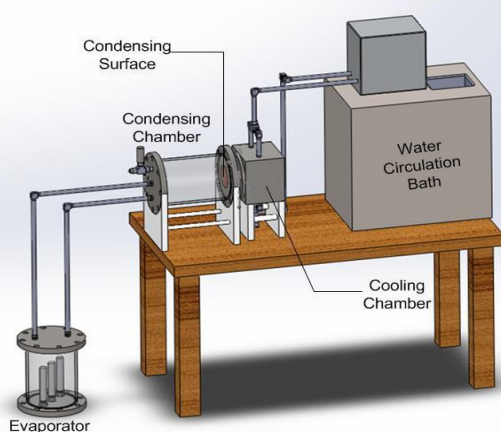
ORCs allow heat recovery from lower temperature sources, like biomass, industrial waste heat, geothermal heat and solar ponds. The low-temperature heat can be converted into electricity.

Year 1 Progress

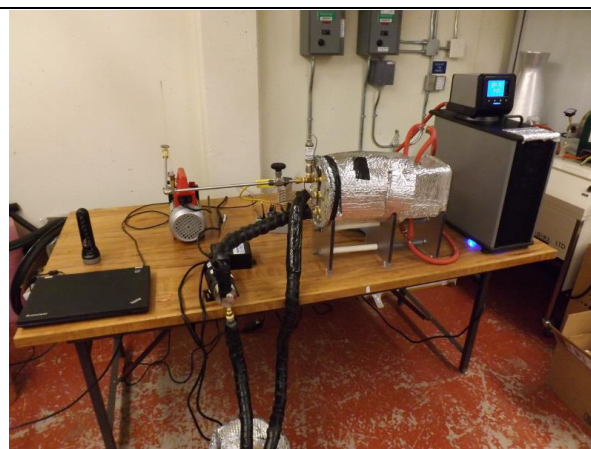
The project team has completed design and construction of a testing apparatus that will be used to measure the efficacy of the hydrophobic coating. Instrumentation calibration and preliminary baseline testing of the apparatus has begun.

What's Next

When instrumentation has been calibrated and baseline data collection completed, the effect of different hydrophobic coatings on heat transfer coefficient will be demonstrated.



Design of the test apparatus



Preliminary baseline testing

Photos from the Institute of Northern Engineering.

Small Community Self-Regulating Grid

Project Lead: Intelligent Energy Systems

Location: Tuntutuliak

Project Type: Wind, Energy Storage

Award Amount: \$465,634

Intelligent Energy Systems (IES) is demonstrating a method of electrical grid stabilization using an advanced control system with ceramic electrical heating units. A distributed network of Steffes heaters in the community will be equipped with modified controllers that respond individually to grid frequency, providing grid stability during times of high wind penetration rates.

Year 1 Progress

A modified controller has been independently tested and the team is preparing for field installations.

What's Next

Approximately 30 units will be retrofitted with the new controller and tested during 2014.

High Capacity Airborne Wind Turbine	
Project Lead: Altaeros Energies, Inc.	Project Type: Wind
Location: Fairbanks	
Award Amount: \$740,115	
Altaeros Energies, Inc. proposes to demonstrate a 30 kilowatt (kW) wind turbine suspended 1,000 feet above ground in a helium-filled shell. The project seeks to take advantage of higher and more consistent wind speeds and to demonstrate an improved capacity factor relative to tower-mounted wind turbines. By tethering to a portable trailer, a substantial decrease in installed capital costs is expected. Altaeros plans to commercialize both 30 and 100 kW models.	
Year 1 Progress	
Altaeros has identified candidate sites throughout Alaska, visited a selection of sites, and tentatively selected the Eva Creek wind farm as the deployment site. Construction and testing of a half-scale prototype has progressed in advance of full-scale construction.	
What's Next	
Permitting from FAA is the critical next step for the project. The agency has been drafting policy regarding airborne wind energy system deployment, and extended testing of any system cannot be permitted until the new policy is entered into the Federal Register. Meanwhile, deployment, retrieval, and limited operational testing is planned at the project team's Maine facility.	

Oceana In-Stream Hydrokinetic Device Evaluation	
Project Lead: Oceana Energy Company	Project Type: Hydrokinetic
Location: Nenana	
Award Amount: \$1,230,945	
The Oceana Energy Company is demonstrating a barge-mounted River In-Stream Energy Conversion (RISEC) device in the Tanana River. Originally intended for tidal power applications, the demonstration will verify performance under harsh the conditions typical of Alaska rivers. The turbine uses an open ring design, with blades located on both the inside and outside of the structural ring.	
Year 1 Progress	
After a delayed start, the project team is finishing a redesign of the first generation prototype (built and tested prior to this project) and has begun procurement and assembly of some components.	
What's Next	
Assembly of the redesigned unit will occur in the remaining winter and spring months, with testing scheduled in May and June using a tow carriage in the Carderock David Taylor Model Basin in Maryland. After initial testing, the device will be shipped to Nenana for testing at UAF's hydrokinetic test bed in the Tanana River.	