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

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.

Project	EETF Award	Committed Match
Biomass Reforestation for Boreal Forests	$ 45,000	$ 45,000
Arctic Thermal Shutters & Doors	$ 136,000	$ 34,000
Ultra-Efficient Generators and Diesel-Electric Propulsion	$ 247,036	$ 302,317
Cold Climate Heat Pump Demonstration	$ 119,467	$ 24,311
Enhanced Condensation for Organic Rankine Cycle	$ 166,044	$ 30,168
Safe and Efficient Exhaust Thimble	$ 87,889	$ 5,793
High Capacity Airborne Wind Turbine	$ 740,115	$ 620,010
Oceana In-Stream Hydrokinetic Device Evaluation	$ 1,230,945	$ 620,000
RivGen Power System Commercialization Project	$ 1,491,750	$ 379,889
Application of Composite Flywheels	$ 672,500	$ 517,000
Small Community Self-Regulating Grid	$ 465,634	$ 20,000
Wind-Diesel Battery Hybrid for Kwigillingok	$ 1,025,750	$ 30,000
BRI Cyclo-Turbine Energy Production	$ 728,630	$ 141,360
High Efficiency Diesel Electric Generator Set	$ 677,508	$ 75,278
Arctic Field Testing of the Eocycle 25/12 Wind Turbine	$ 293,300	$ 55,000

Arctic Field Testing of the Eocycle EO-25/12 Wind Turbine

Project Lead: Northwest Arctic Borough

Location: Kotzebue

The Northwest Arctic Borough is demonstrating the cold weather capabilities of a 25 kW wind turbine at the Kotzebue wind farm. The turbine is mounted on a tilt-up monopole tower that uses a winch to raise and lower the unit during installation and for maintenance, eliminating the need for a crane.

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

Genesis Machining and Fabrication is demonstrating its two core technologies, the Power Dense Motor and Universal Modular Inverter Controller, for use in both stationary power generation and propulsion applications. The technologies are being concurrently developed and demonstrated in stages using prototypes of increasing in size and capacity that will be used to power electric vehicles and gensets of varying sizes.

Year 1 Progress

In the first year, the team demonstrated the functionality of the inverter in an electric vehicle testbed which has logged over 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.

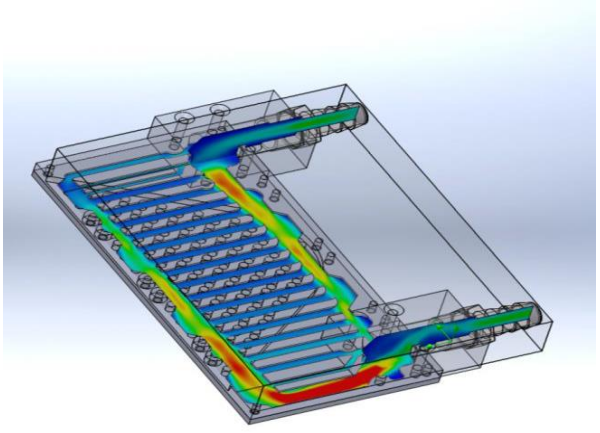
Converted ’97 Eagle Talon EV testbed

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

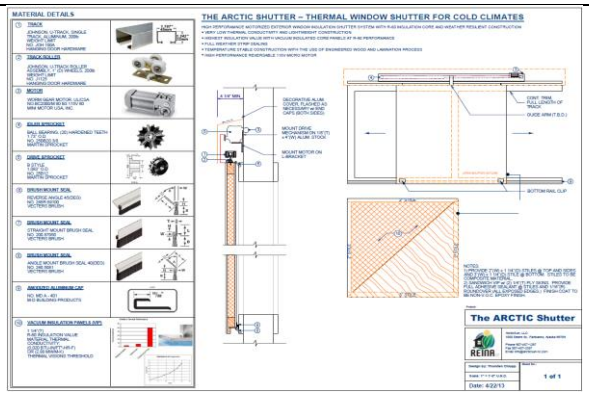
Project Lead: Arctic Sun, LLC

Location: Fairbanks

Arctic Sun, LLC is demonstrating energy efficiency improvements of homes in colder climates using 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

In the first year, 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. The units will be installed and tested individually in the testing box.

UV stability test of the EPS beads

Testing the blown-in shutter

Photos from Arctic Sun, LLC.

Cold Climate Heat Pump Demonstration

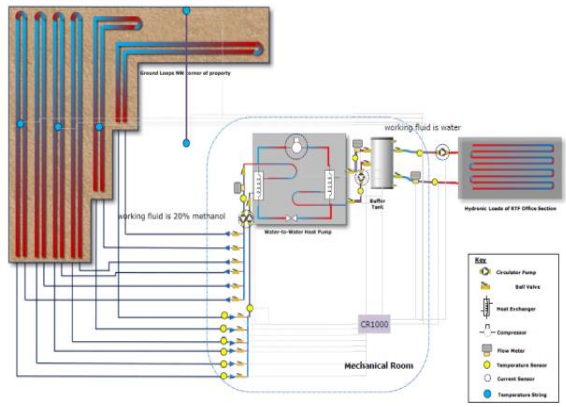
Project Lead: Cold Climate Housing Research Center

Location: Fairbanks

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 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 thermcouples at varying depths. The heat pump unit was then installed and fully comissioned. 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.

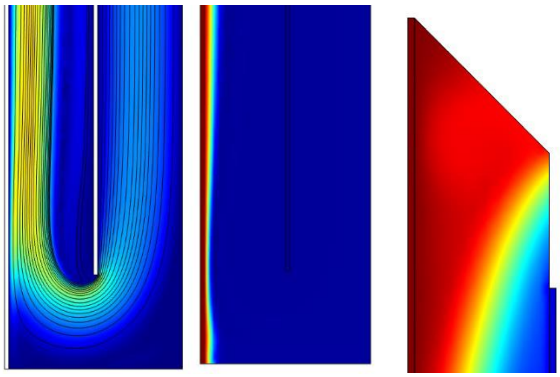
Safe and Efficient Exhaust Thimble

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

The Institute of Northern Engineering is demonstrating 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, 2-inch diamters thimlbe is underway.

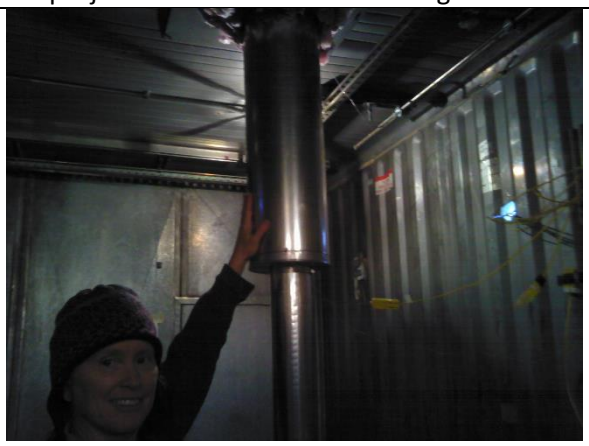


Modelled airflow and temperature distribution

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

Intelligent Energy Systems is demonstrating the use of high-performance lithium ion batteries, similar to those found in some electric vehicles, to provide short-term energy storage in Kwigillingok's wind-diesel electrical system.

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. After acceptance testing, the battery was 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

Photos from Intelligent Energy Systems.

Biomass Reforestation of Boreal Forests

Project Lead: Alaska Division of Forestry

Location: Palmer and Delta

The Alaska Division of Forestry is demonstrating a low cost planting technique intended for forest regeneration after a biomass harvest that uses un-rooted poplar tree stem-cuttings. Although less energy-dense than other biomass fuel stocks, poplars have much faster growth rates. The technique involves the wintertime collection of branch cuttings that are stored and then planted as stems after snowmelt. Stooling beds will also be planted to facilitate future stem harvests of species that are found to thrive over the course of the project.

Year 1 Progress

The project team harvested cuttings during the winter of 2013 which then underwent a pre-soak treatment in advance of planting in the late spring at sites in the Matanuska-Susitna Valley and near Delta. Unfortunately, abnormally hot and dry conditions during the summer of 2013 resulted in a very 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

Photos from AK Division of Forestry.

BRI Cyclo-Turbine Energy Production

Project Lead: Boschma Research, Inc.

Location: Igiugig

Boschma Research, Inc. (BRI) plans to demonstrate a 5 kW River In-Stream Energy Conversion (RISEC) device in the Kvichak River at Igiugig. 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.

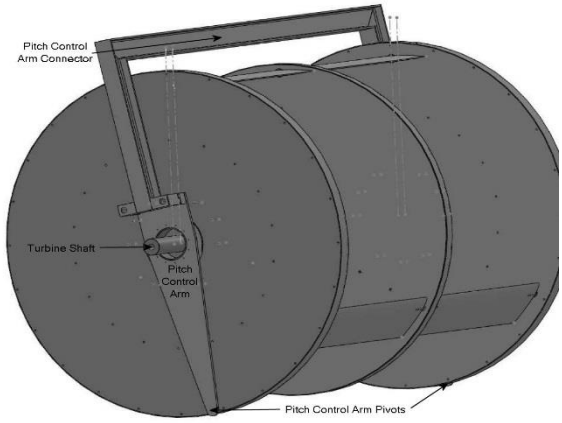
Year 1 Progress

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

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

ORPC proposes to demonstrate the RivGen hydrokinetic device, a river bottom-mounted River In-Stream Energy Conversion (RISEC) device. The device will be mounted on a redesigned pontoon support structure, which consists of a mounting frame which rests on buoyancy chambers which can be filled and emptied of air for controlled submerging during deployment and floatation during retrieval.

Year 1 Progress

ORPC has refursbished and dry-tested its first generation RivGen prototype and completed modeling and redesign of the support structure (shown below prioir to redesign) that will be used to deploy and retrieve the turbine.

What's Next

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.

RivGen unit being refurbished

Early testing of the 1st gen support structure

Photos from ORPC.

High Efficiency Diesel Electric Generator Set

Project Lead: Marsh Creek, LLC
Location: Anchorage, Fairbanks

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.

Year 1 Progress

The project team has modelled performance, designed the test system, and established plans for testing at different speeds and loads.

What's Next

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.

Enhanced Condensation for Organic Rankine Cycle

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

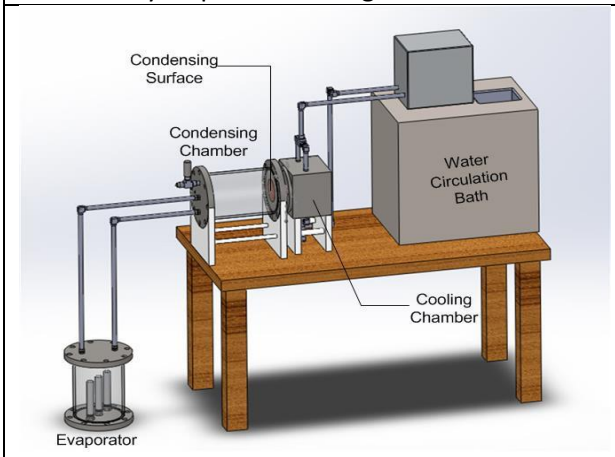
The Institute of Northern Engineering seeks to demonstrate a technology that could improve the efficiency of Organic Rankine Cycle (ORC) systems by increasing the heat transfer rate of the condenser. A hydrophobic coating will be patterned onto the condenser to create a heterogeneous surface, reducing film formation on the condensing surface.

Year 1 Progress

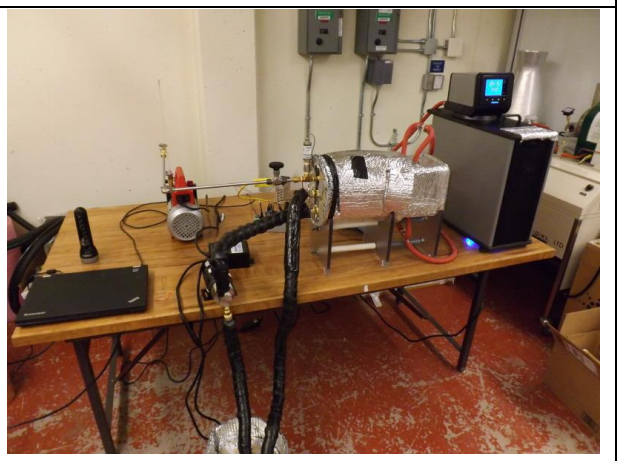
The project team has completed design and construction of a testing apparatus that will be used to measure the efficacy of the hydrophobic coating that will be applied to give the condenser a heterogeneous surface. Instrumentation calibration and preliminary baseline testing of the apparatus has begun.

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

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. **Location: Fairbanks** 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. In Maine, 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 **Location: Nenana** 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 protoype (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.