# Remote Energy Solutions in Alaska

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George Roe / Alaska Center for Energy & Power
(206) 454-9189 / gmroe@alaska.edu

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# Alaska Center for Energy & Power

***Mission: Fostering development of practical, innovative and cost effective energy solutions for Alaska and beyond***

- Applied energy research program, founded in 2008
- Primarily funded through grants and contracts
- Part of the University of Alaska in Fairbanks
- 20 staff, ~30 affiliated faculty, students
- Analysis, lab testing, product development


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# Is there an energy crisis, now or could there be one in the future?

能 Energy

危机 Crisis

Danger Opportunity

If so, would that be a bad thing, or a good thing?

# Alaska Realities

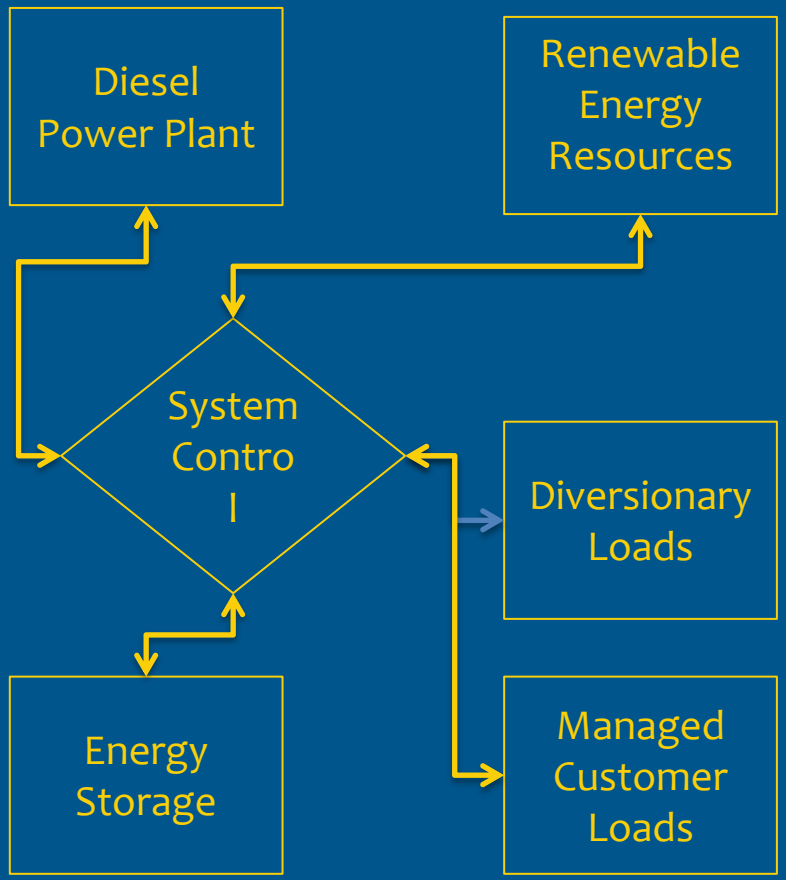

- High energy costs
- Fragmented electric grid
- Harsh & changing climate
- End of supply lines
- Stranded resources
- Dispersed population
- Limited road network
- Challenged economy

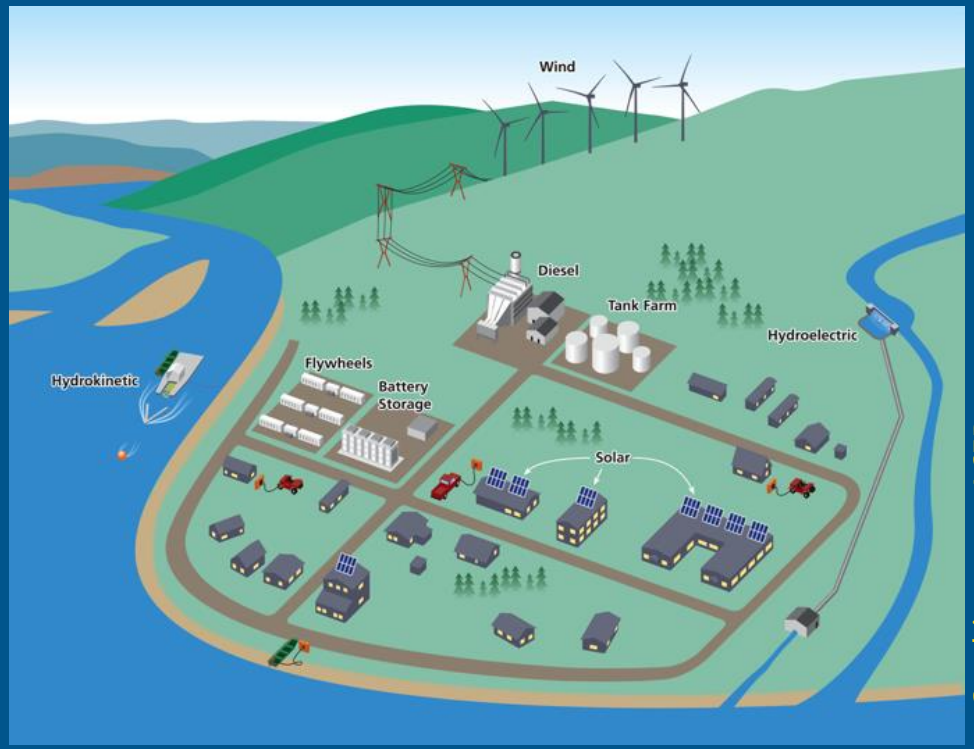
In rural Alaska:
- Electric power: 0.50-1.50 $/kWhr
- Heating fuel: 3.50-10.00 $/gallon

# Diesel, renewables, storage, loads, …



# Microgrids … integrate & manage




Graphic source: ACEP

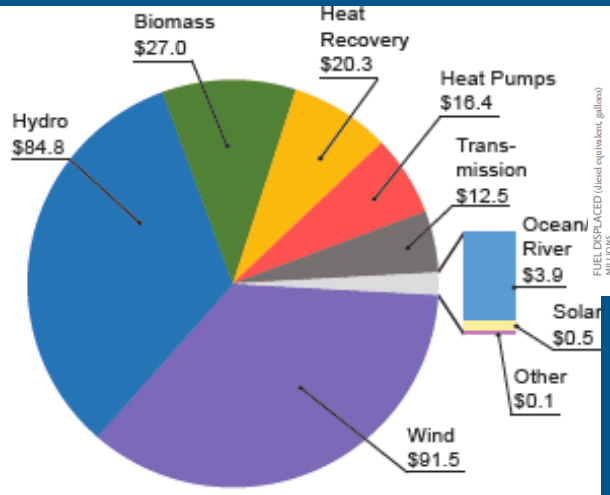
# AK energy investments – e.g., REF

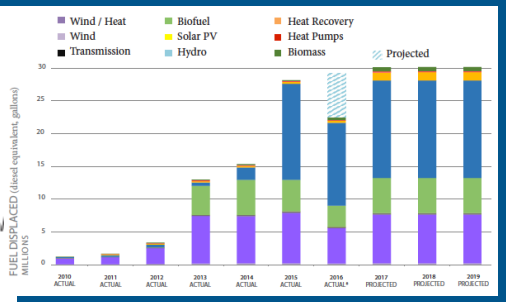
RENEWABLE ENERGY FUND

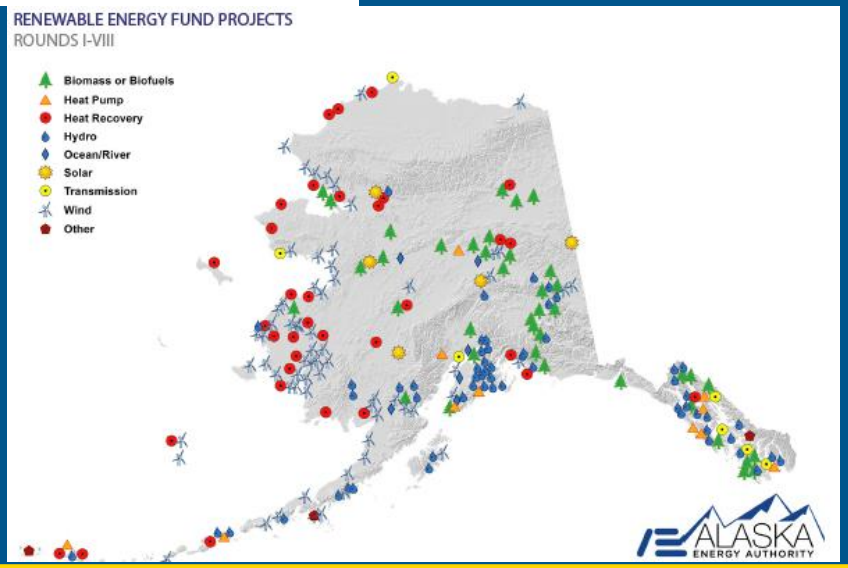
STATUS REPORT AND ROUND X RECOMMENDATIONS

January 2017

ALASKA ENERGY AUTHORITY



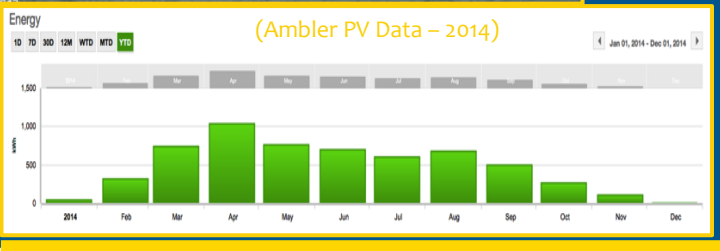

Source: akenergyauthority.org

# Kodiak Island: 100% renewable generation

*Hydropower + Wind + Energy Storage (Battery and Flywheel)*

# NW Arctic Borough – Solar PV


Photos: Northwest Arctic Borough




- Powering village water treatment plants
- Launched in Ambler, replicated to area
- 10,000 kWh/year from 10 kW array
- Peak production April-June
- Long sunlight in summer + 30% reflection off snow-covered ground in spring

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# Small Scale Biomass for Heat and Power

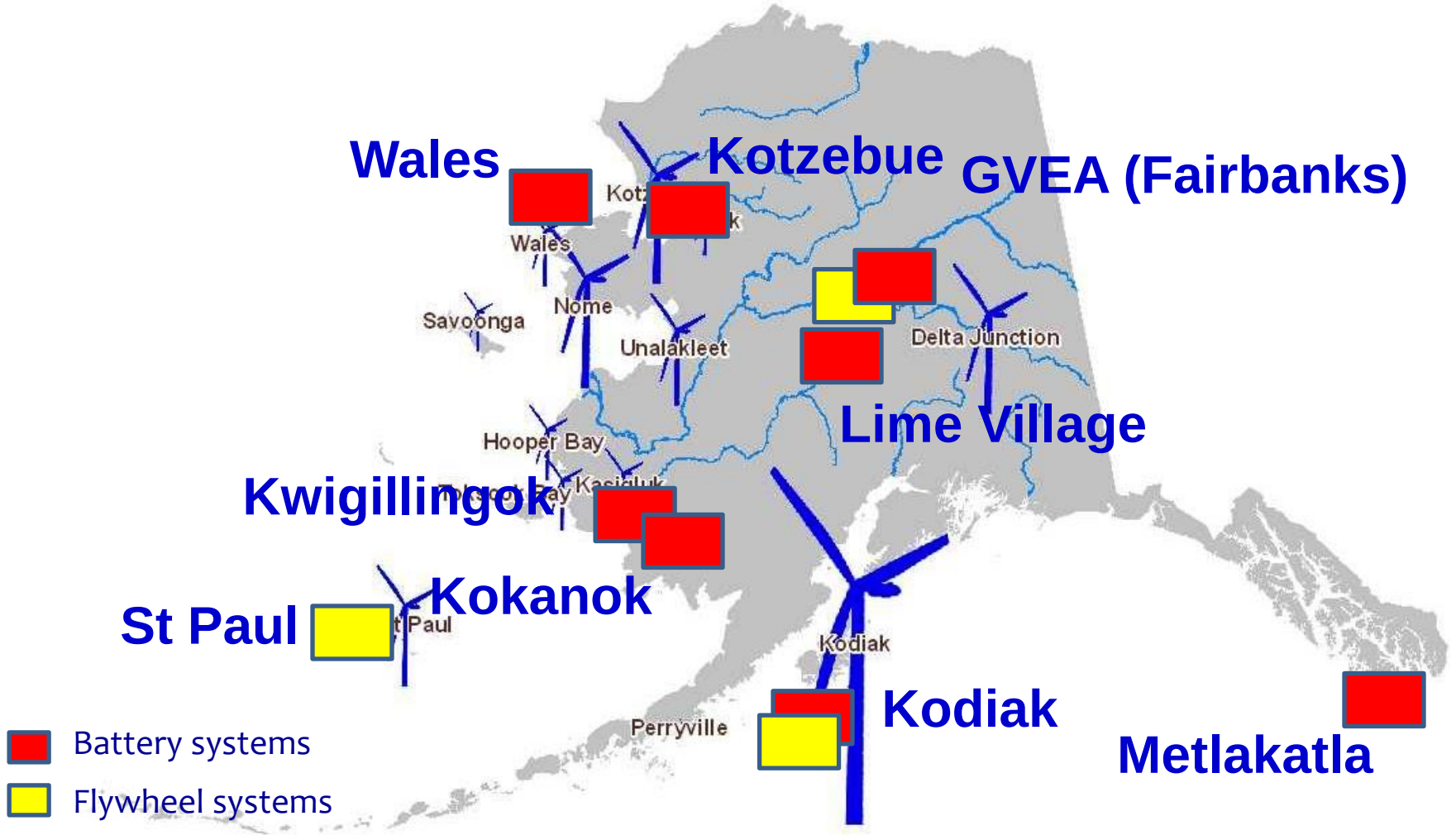
Tok School Biomass Project
(125 kW power + heating)

# Geothermal Power Plant (Chena Hot Springs)

# Eagle Hydrokinetic Energy Project

25 kW system provided diesel off 100% power to Eagle Village

# Existing Alaska Battery & Flywheel Projects



# Tuntiluliak, Kongiginak, Kwig: Wind Heat System

## Diesel off with wind + energy storage + distributed heating

**Images:** Left: *20+ thermal electric stoves installed in elder and low income homes; Windmatic direct drive turbines (30-40% wind penetration annually)*

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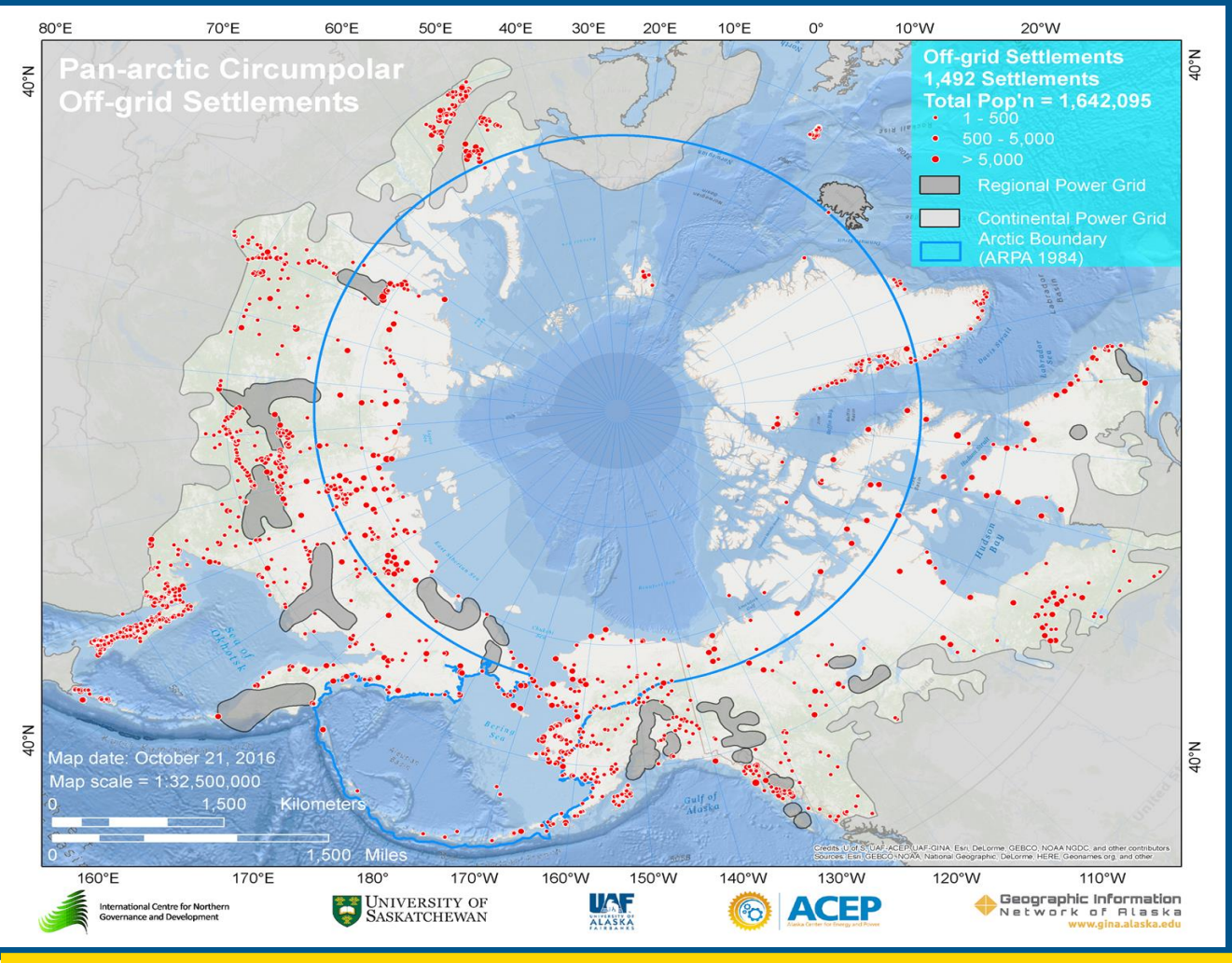
# Alaska is a global leader in microgrid development

***Alaska has ~12% of the worlds microgrids that incorporate grid scale renewable resources.*** *(data from Navigant Research)*

# Off-grid settlements in the North




Nearly 2 million people living in the Arctic.

About 80% without connection to the energy, gas, and often even the roads of their neighbors to the south.

Note: preliminary / in-progress (10/21/2016)
Credits: University of Saskatchewan, University of Alaska Fairbank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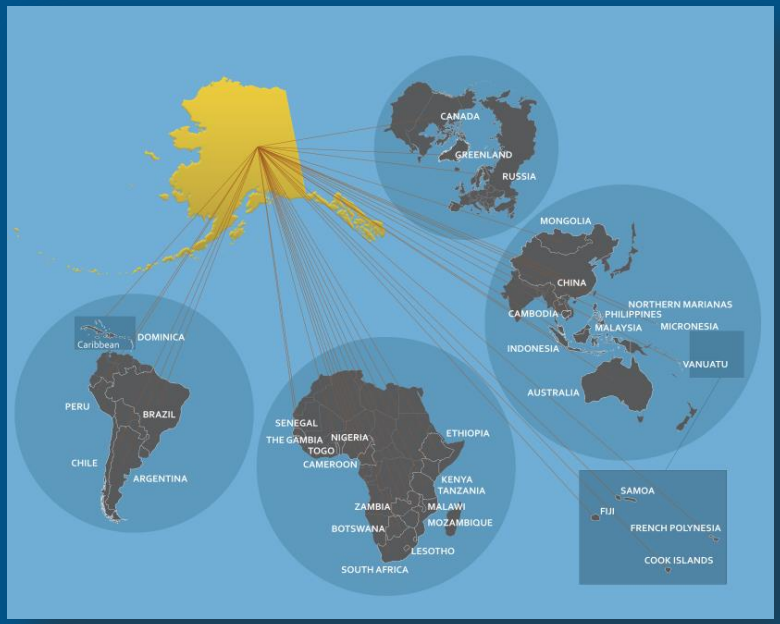
# Microgrids: multi-region knowledge sharing & collaboration opportunity

- 200+ AK remote microgrids
- 1,000,000+ hours annually
- $10B global market by 2024
  - Energy surety / security
  - Energy-water-food nexus
  - Climate change resilience
  - Rural & urban
  - Community-industry-military

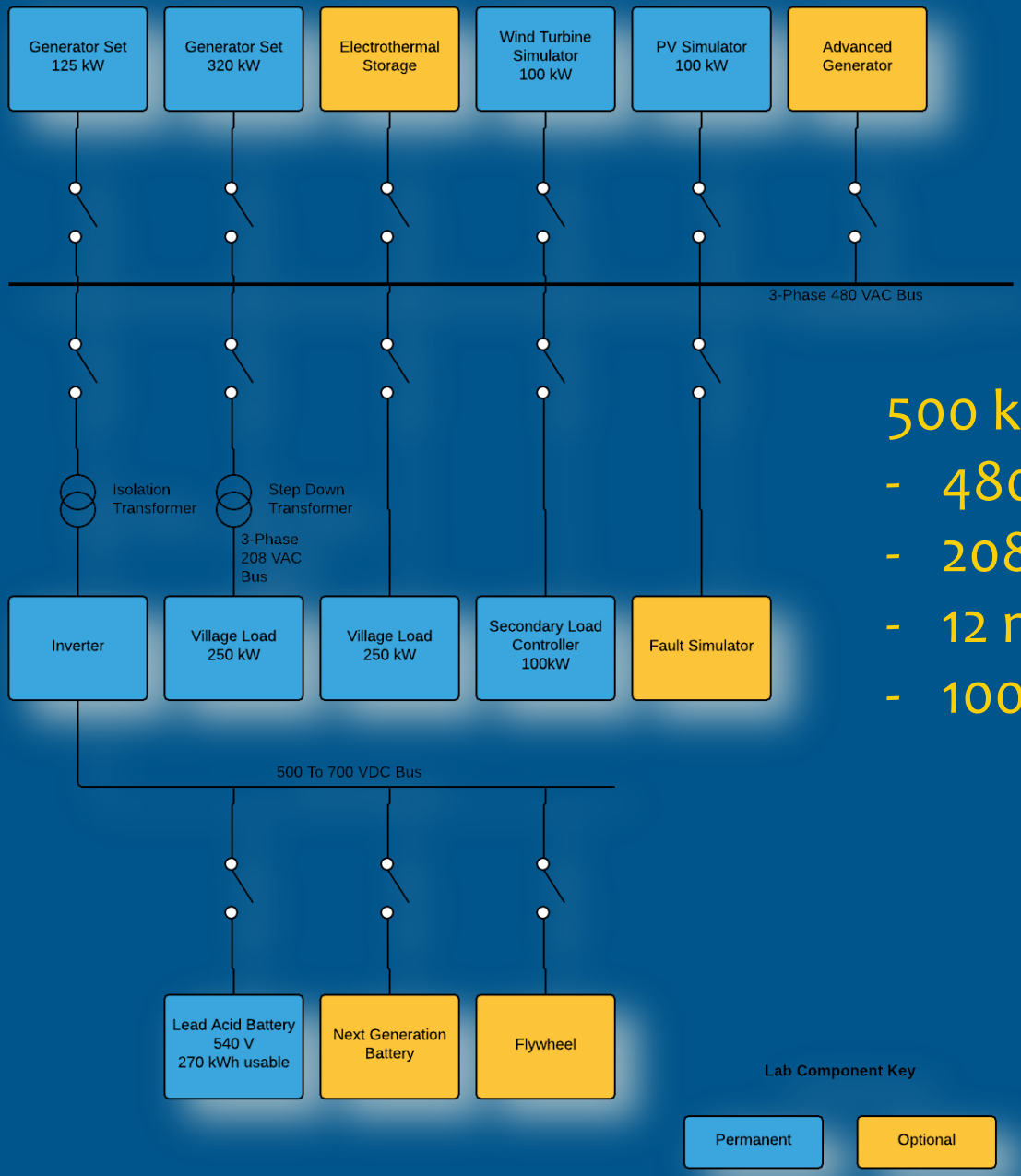


# Power Systems Integration Program

Goals:

- Reduce problems in the field
- Reduce the cost of energy (including heat and power)
- Turn diesel off when there is adequate wind, solar, etc.
- Training for system operators

Lab recreates a remote microgrid at full power levels (500 kW)




500 kW grid emulator:

- 480 VAC 600 A main bus
- 208 VAC 600 A secondary bus
- 12 main CB switch gear
- 1000 VDC 400 A DC bus

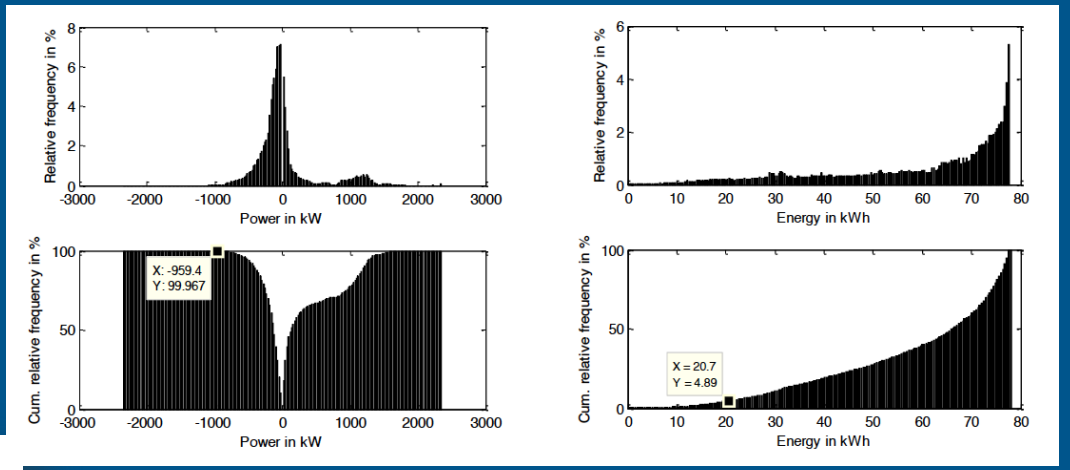
# Facilitating technology transition

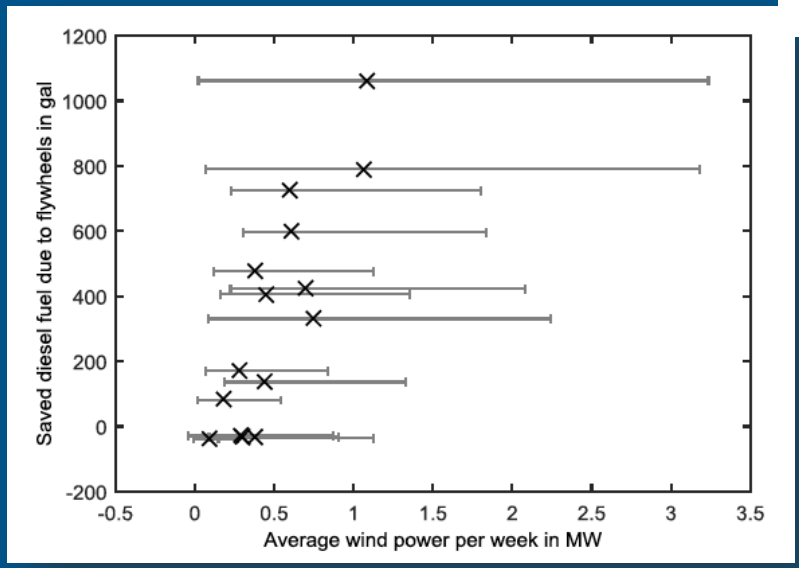


# Helping communities define needs

Required for meeting objective 99% of times:

- 959 kW power capacity
- 58 kWh energy capacity
- High cycle life



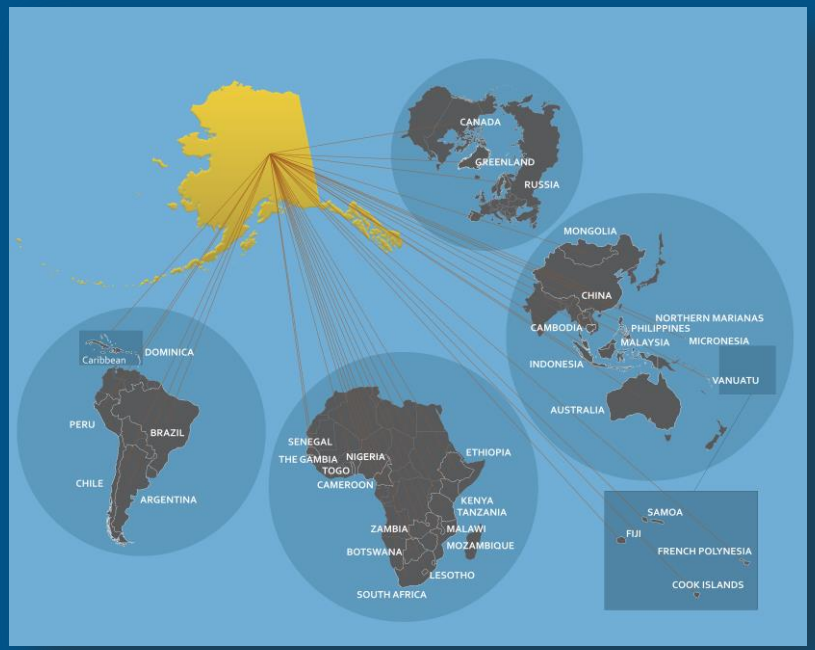

Fuel savings for primary objective:

- 430-1150 gal/wk (med-high wind)
- Slight increase in stand-by fuel

Potential value add:

- Diesel demand smoothing

# Where's the technology come from?

# AK Center for Microgrid Technologies Commercialization (ACMTC)

Objectives:

- Build microgrid economy
- Provide accelerated pathways to commercial products that work
- Ensure that companies with good products survive

ALASKA SBDC
ALASKA SMALL BUSINESS DEVELOPMENT CENTER

UAA Business Enterprise Institute
University of Alaska Anchorage

UAF INTELLECTUAL PROPERTY AND COMMERCIALIZATION
University of Alaska Fairbanks

university of alaska
Center for Economic Development
a university-based partnership promoting economic development in Alaska

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# AK Center for Microgrid Technologies Commercialization (ACMTC)

- Economic Development Administration i6 Challenge award
- 500K$ EDA / 500K$ UA, July 2015 – July 2018
- Providing technical and business assistance to accelerate commercialization, and implementation, of technologies for affordable and reliable microgrid energy systems.


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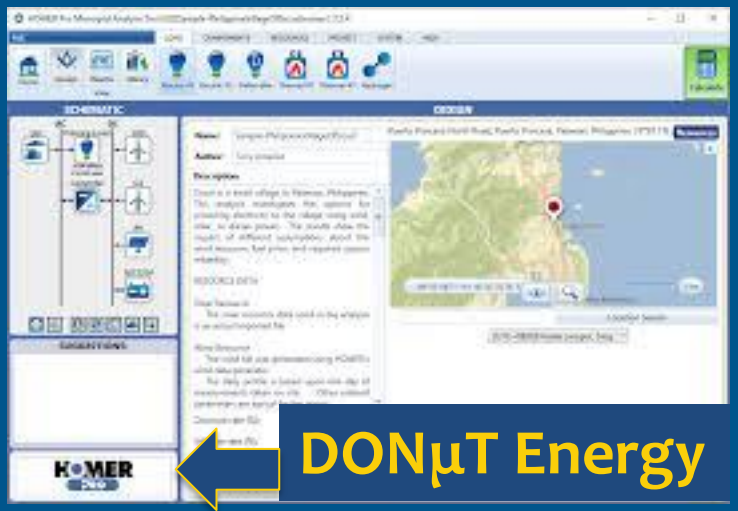
# Round 1 awardees – in-work!


DONµT Energy

Ocean Renewable Power Corporation

# Round 2 of competition is here

**Microgrid Project***

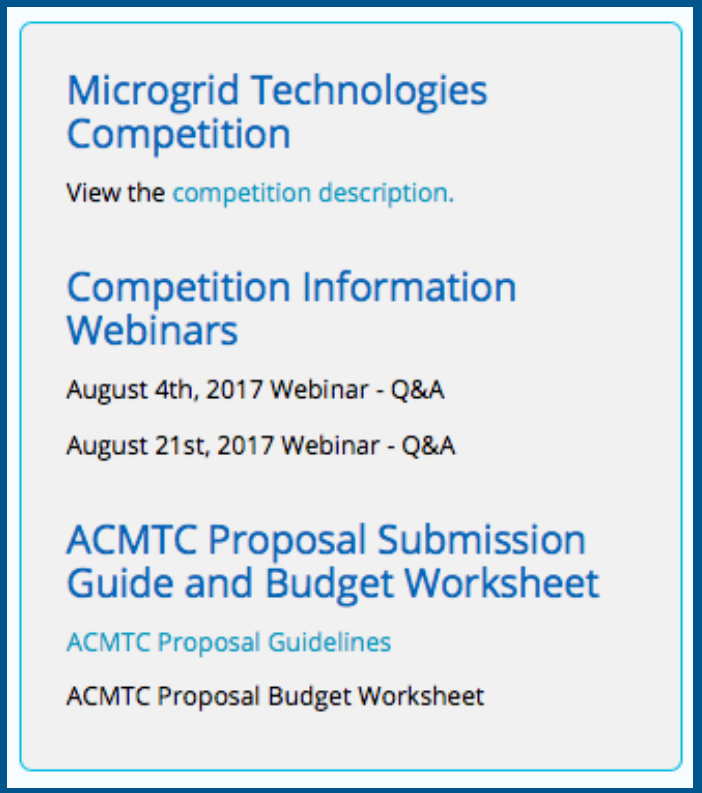
Up to 40 days R&D in the ACEP PSI (Power Systems Integration) Laboratory

(Lab days either going to 1 project or be split between 2 projects)

**Technology Seed Support****

R&D to commercialization review

3 small projects (for each with up to 125 man-hours)



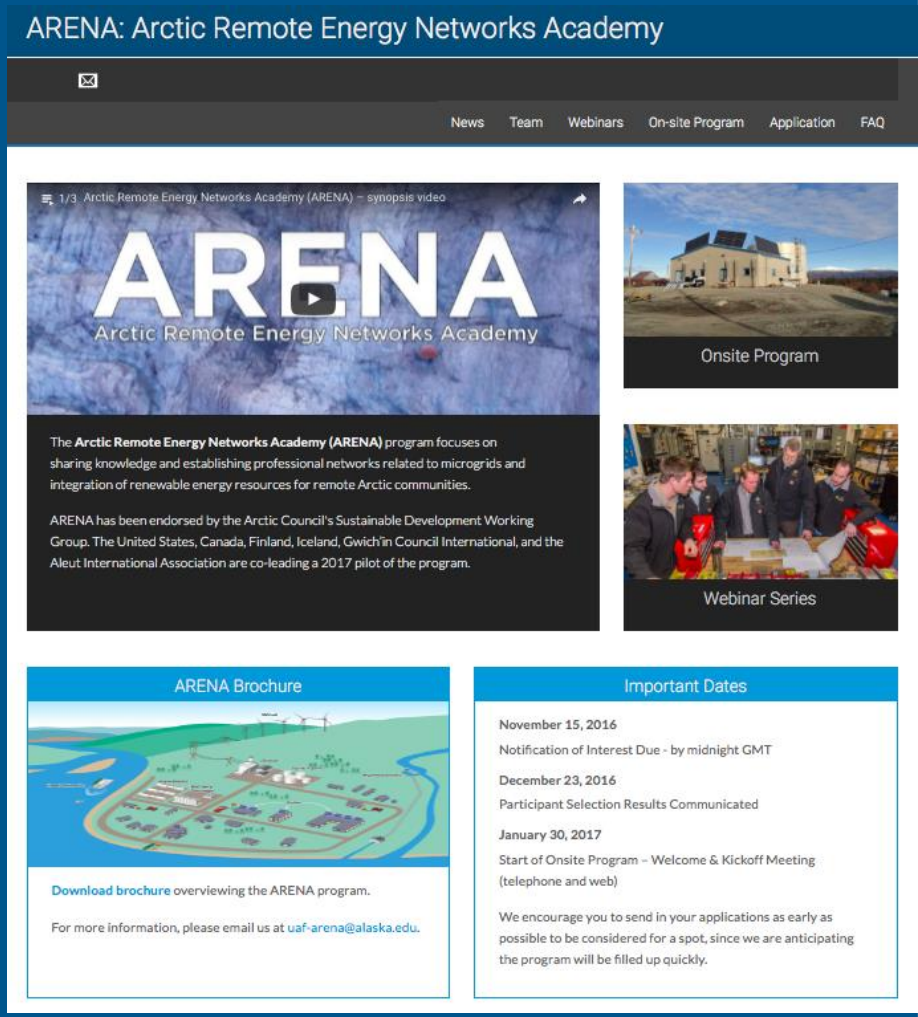

Link at: acep.uaf.edu

Send all inquiries to ACMTC.QUESTIONS@ALASKA.EDU

# Arctic Remote Energy Networks Academy (ARENA)

Putting the right information in the hands of the right people at the right stage of project development to accelerate viable local energy solutions

- Learning focused on real community energy projects
- Peer and industry interactions
- Tailored training & mentoring
- Visits to operating energy sites
- Pilot program: Jan-Sept 2017




arena.alaska.edu

Sustainable Development Working Group

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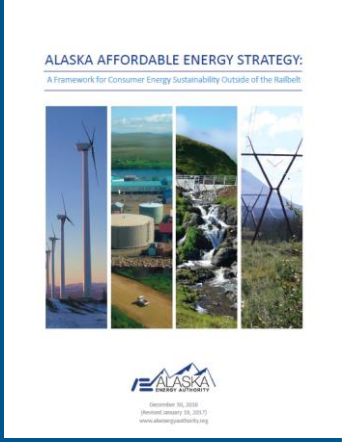
# Alaska Affordable Energy Study (AKAES)




**Reports available online at http://www.akenergyauthority.org/**

- Energy Efficiency Program Evaluation and Financing Needs Assessment
- LNG Feasibility for Alaska Affordable Energy Strategy Communities
- Documentation of Alaska-Specific Technology Development Needs
- Rural Utility Financial Analysis
- Fuel Transportation Improvement Report
- Barriers and Opportunities for Private Investment in Rural Alaska Energy Proje
- Sustainable Utilities Study
- True Cost of Electricity & Bulk Fuel In Rural Alaska
- Energy Costs & Rural Alaska Out-migration

"AEA investigated **opportunities for delivering more affordable energy** to non-Railbelt communities, the **efficacy of existing energy programs**, as well **as policy and/or regulatory change**s that have potential to contribute to more reasonably priced, safe, stable and reliable consumer energy."

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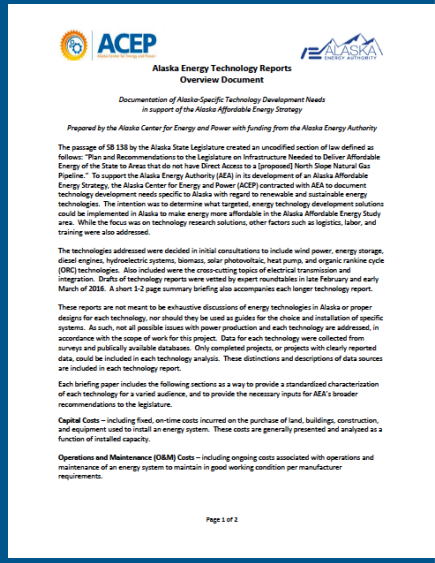
# Technology Needs

- Biomass
- Diesel Generator
- Energy Storage
- Heat Pump
- Hydroelectric Power
- Integration
- Organic Rankine Cycle
- Solar Photovoltaic
- Electrical Transmission
- Wind Power

- Summary
- Technology trends
- Gaps and Barriers to Successful Project Development & Operation
- Recommendations



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**Alaska Energy Technology Reports**
**Overview Document**

*Documentation of Alaska-Specific Technology Development Needs*
*in support of the Alaska Affordable Energy Strategy*

*Prepared by the Alaska Center for Energy and Power with funding from the Alaska Energy Authority*

The passage of SB 138 by the Alaska State Legislature created an uncodified section of law defined as follows: "Plan and Recommendations to the Legislature on Infrastructure Needed to Deliver Affordable Energy of the State to Areas that do not have Direct Access to a (proposed) North Slope Natural Gas Pipeline." To support the Alaska Energy Authority (AEA) in its development of an Alaska Affordable Energy Strategy, the Alaska Center for Energy and Power (ACEP) contracted with AEA to document technology development needs specific to Alaska with regard to renewable and sustainable energy technologies. The intention was to determine what targeted, energy technology development solutions could be implemented in Alaska to make energy more affordable in the Alaska Affordable Energy Study area. While the focus was on technology research solutions, other factors such as logistics, labor, and training were also addressed.

The technologies addressed were decided in initial consultations to include wind power, energy storage, diesel engines, hydroelectric systems, biomass, solar photovoltaic, heat pump, and organic rankine cycle (ORC) technologies. Also included were the cross-cutting topics of electrical transmission and integration. Drafts of technology reports were vetted by expert roundtables in late February and early March of 2016. A short 1-2 page summary briefing also accompanies each longer technology report.

These reports are not meant to be exhaustive discussions of energy technologies in Alaska or proper designs for each technology, nor should they be used as guides for the choice and installation of specific systems. As such, not all possible issues with power production and each technology are addressed, in accordance with the scope of work for this project. Data for each technology were collected from surveys and publically available databases. Only completed projects, or projects with clearly reported data, could be included in each technology analysis. These distinctions and descriptions of data sources are included in each technology report.

Each briefing paper includes the following sections as a way to provide a standardized characterization of each technology for a varied audience, and to provide the necessary inputs for AEA's broader recommendations to the legislature.

**Capital Costs** – including fixed, on-time costs incurred on the purchase of land, buildings, construction, and equipment used to install an energy system. These costs are generally presented and analyzed as a function of installed capacity.

**Operations and Maintenance (O&M) Costs** – including ongoing costs associated with operations and maintenance of an energy system to maintain in good working condition per manufacturer requirements.

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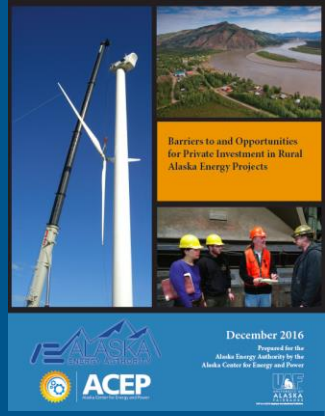
# Barriers to Investment




Barriers

- Scale & population density
- Oil & transportation markets
- Historic availability of subsidies & grants
- Utility structure
- Terrain & climate
- Diversity of stakeholders
- Institutional knowledge
- Heterogeneous nature of projects

Recommendations

- #2 Project Specification Process that Facilitates Public-Private Partnerships for Energy Projects
- #3 Rural Energy Project Development Portal
- #5Build Capacity & Mentorship to Improve "Bankability" of Communities
- #6 Use REF for High Risk, Early Stages of Project Development

"Private investment … is investment by financial entities and businesses rather than by government … includes both traditional loans, as well as direct private sector investment through public-private partnerships."

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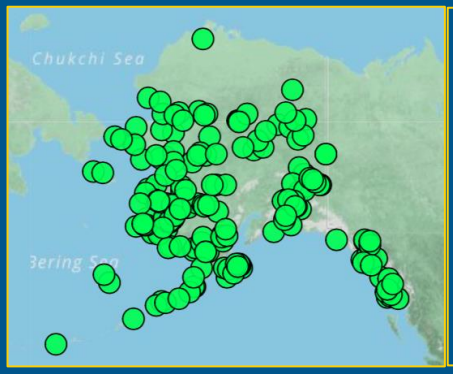
# AK Energy Efficiency Impact Forecast

- Alaska Energy Model - On-line resource
- Residential & non-residential, Power & heat
- Benefit & cost
- Community info

Alaska Affordable Energy Strategy




Non-residential energy efficiency forecast

- 151 of 265 communities have b/c > 1.0
- Total cost: $496M & **Net** savings: $418M
- Heating oil displaced: 12,517,468 gal/year
- Electricity displaced: 260,143,818 kWh/year

Source: http://model-results.akenergyinventory.org/current/Non-residential_Energy_Efficiency.html

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# Win-win opportunities?

- Shared challenges, needs & interests
- Related & complementary markets
- Places to start?
  - Use cases for Commercialization Center
  - Integrated testing & demonstration
  - Knowledge-sharing facilitation
  - Dual-use & net-zero synergies exploration
  - Technologies: energy storage, renewables, heat pumps, electric transportation, waste-to-energy, …

# North to the future!


http://www.akruralenergy.org

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# So, how about an energy crisis?

能 — Energy

危机 — Crisis

Danger Opportunity

"Never let a good crisis go to waste"
(Winston Churchill)

"Action springs not from thought, but from a readiness for responsibility." (Dietrich Bonhoeffer)

"Do what you can, with what you have, where you are." (Theodore Roosevelt)

# Thank you!

# Suvisi?

(Sü-vĭ-see) in the Iñupiaq language means:
"What are the many people doing?"

George M. Roe
Alaska Center for Energy & Power
University of Alaska - Fairbanks
acep.uaf.edu
Tel: (206) 454-9189
E-mail: gmroe@alaska.edu

"If you want to walk fast, walk alone. If you want to walk far, walk together." (African proverb)

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