National Renewable Energy Laboratory
Innovation for Our Energy Future

Overview of Alaska Energy Markets and System Performance

2009
International Wind Diesel Workshop

Ottawa, Canada

E. Ian Baring-Gould
National Renewable Energy Laboratory

June 1-2, 2009

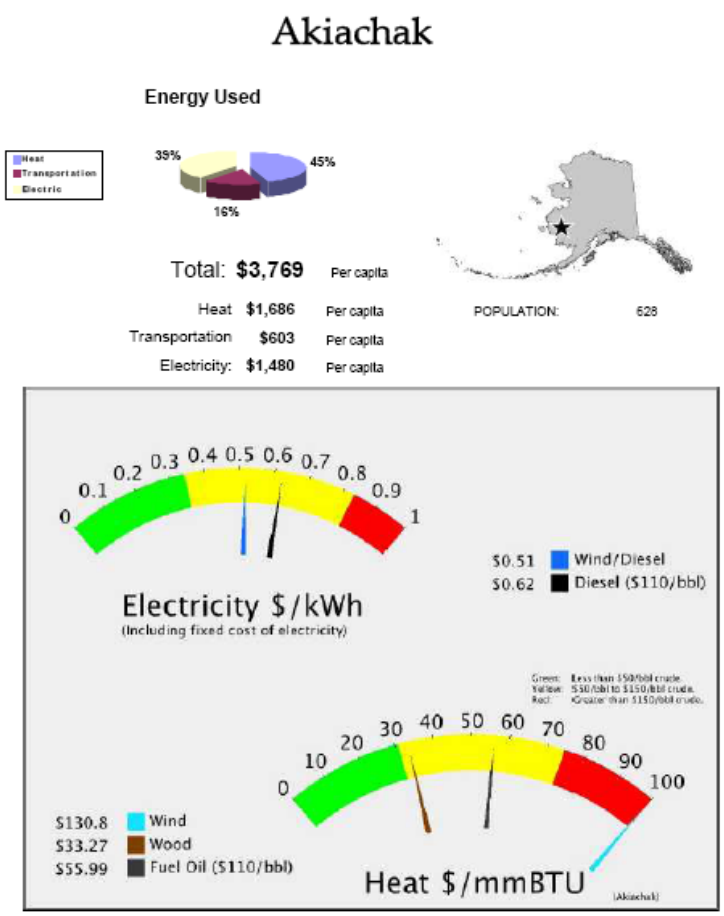
Alaskan Market Potential

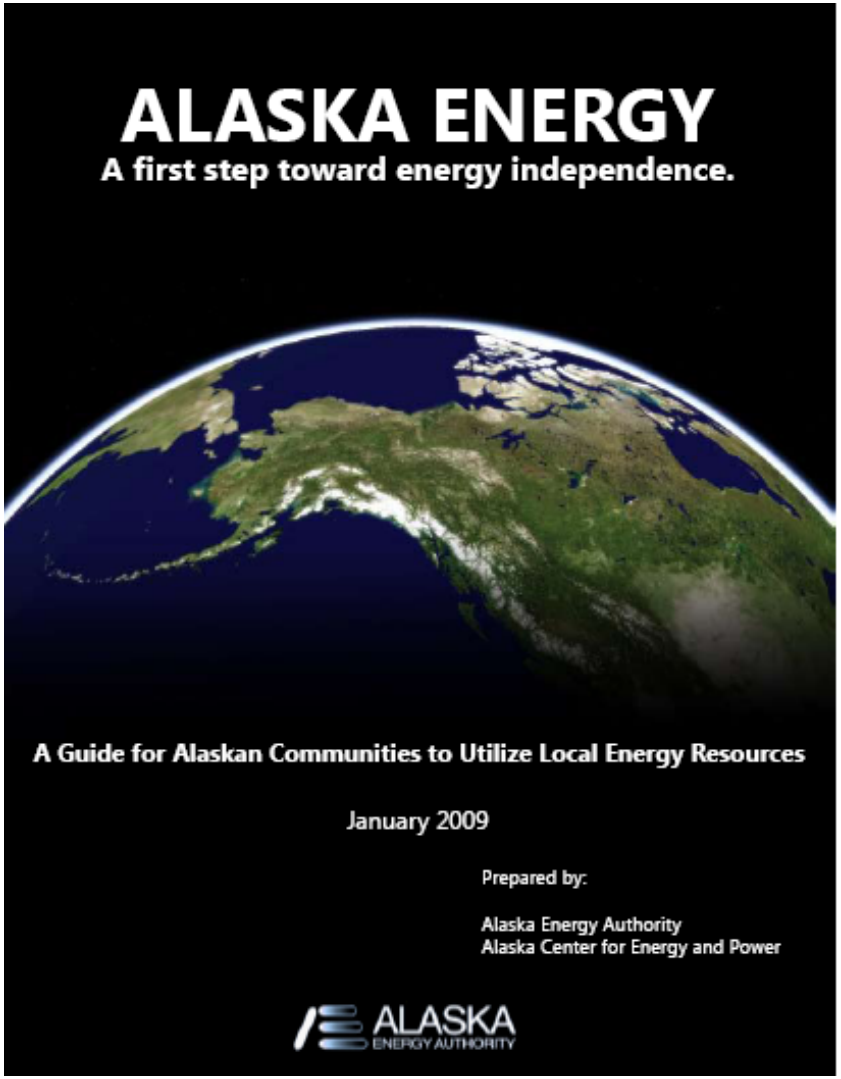
Study by Dabo of the Alaskan Energy Authority showing rural communities with high likelihood of economic wind potential

- **116 communities have a strong wind potential**
- **Rural communities have a potential between 90 & 240 MW of installed capacity**
- **$150 M USD renewable energy fund supporting RE projects and assessments**

Alaska Energy Report

Provides initial assessment of energy options for most Alaskan rural communities





www.aidea.org/aea

Alaska Renewable Energy Fund

At the point of high oil prices – State Legislators approved a new State fund to support the deployment of renewable energy technologies:

- Target of $50M USD a year for 5 years
- Initial year (Round 1) funded with $100M USD in late summer of 2009
- Solicitation conducted in the fall of 2008 for round 1 and round 2 projects
- Projects reviewed by AEA
- Projects selected by the Legislator

ALASKA ENERGY AUTHORITY

Round 1

- Funding provided $47.7M USD for wind projects or development support for 21 wind project, 18 of which were wind-diesel applications.
- Contracting on these projects currently underway

Round 2

- Identified 14 additional wind projects for support, 13 off grid, totaling over $14.6M USD

Alaska Wind Projects

Current Alaska Wind Diesel Projects

- Hooper Bay – AVAC – 4xNW100
- Kasigluk
- Kotzebue
- Nome – Local – 18-EW50's
- Saint Paul
- Savoonga - AVAC – 2xNW100
- Selawik
- Toksook Bay
- Wales

Additional projects being implemented

- Chevak – AVAC
- Tin City – TDX Power
- Kodiak - KEA
- Gamball - AVEC
- Kong & Kwig - Chininik Wind Group

Kotzebue, Alaska

Photo Credit: Kotzebue Electric Assoc.

Large coastal hub community in Northwestern Alaska with a population of ~3,100

- Operated by Kotzebue Electric Association
- 11 MW installed diesel capacity
- 2-MW peak load with 700-kW minimum load
- 915-kW wind farm comprised of 15, Entegrity e50, 50 kW; 1 remanufactured V17 75 kW; and 1 NW 100/19, 100-kW wind turbine.
- Instantaneous penetrations regularly above 50%
- Turbine curtailment used to control at times of high wind output

Photo Credit: Kotzebue Electric Assoc.

- Wind turbine capacity factor of 13.3%
- **Average penetration of ~5% with wind generating 1,064,242 kWh in 2007**
- Diesel fuel saving of more than 71,500 gal (270,600 l) in 2007
- **Good turbine availability (92.8% 1/02 to 6/04) due to strong technical support**

Selawik, Alaska

- Coastal community in Northwestern Alaska with a population of ~840 permanent residents
- Operated by the Alaska Village Electric Cooperative
- Average load around 330 kW
- **4 Entegrity e15, 50 kW turbines with thermal load used to help support system control**
- Turbines installed as part of a complete diesel plant retrofit project
- Initial reduced wind performance due to a number of issues – low wind resource, system integration issues, and turbine maintenance problems
- **Average Capacity Factor of 8.6% with an estimated fuel savings of 20,400 gal from Jan 06 to Aug 07**
- 07 PCE states a Capacity Factor of 10.5 while no data is given for 2008

Kasigluk, Alaska

- Y-K community with a population of ~540
- Power system operated by the Alaska Village Electric Cooperative
- Average load 240 kW
- **3 NW100kW turbines and resistive community heating loads**
- Installed in the fall and winter of Summer/fall of 2006
- **Just over 22.4% average wind penetration with much higher instantaneous penetration**
- Over 40 MWh monthly average wind generation, saving ~3000 gal/month
- First year turbine availability of 94.0% - currently under warrantee
- **Average Net Capacity Factor of 24.06% from Aug 07 to July 08**
- PCE 07 – Capacity Factor 14.7 (14.76% of load for 8 months of operation)

Toksook Bay, Alaska

Power system that supplies the ~800 people of the communities of Toksook Bay and Nightmute in coastal Southwest Alaska

- Power system operated by the Alaska Village Electric Cooperative
- Average load just under 370 kW (both Toksook and Nightmute)
- 3 NW100-kW turbines and resistive community heating loads
- Installed in the fall and winter of 2006
- **24.2% average wind penetration with much higher instantaneous penetration**
- Almost 700 MWh generated by wind last year, saving almost 46,000 gal (174,239 l) of fuel
- **First year turbine availability of 92.4% - currently under warrantee**
- **Average net capacity factor of 26.0% from Aug ‘07 to July ‘08**

Photo Credit: Northern Power Systems

Photo Credit: Northern Power Systems

St. Paul, Alaska

Airport and industrial facility on the island of St. Paul in the Bering Sea

- Owned and operated by TDX Power
- **High-penetration wind-diesel system; all diesels are allowed to shut off**
- One Vestas 225-kW turbine installed in 1999 and two 150-kW diesel engines with a synchronous condenser and thermal energy storage
- Current average load ~70kW electrical, ~50kW thermal
- **Since 2003, net turbine capacity factor of 31.9% and a wind penetration of 54.8%**
- System availability 99.99% in 2007
- **In March 2008, wind supplied 68.5% of the facility's energy needs and the diesels only ran 198 hours ~27% of the time.**
- Estimated fuel savings since January 2005 (3.5 years) is 140,203 gal (530,726 l), which at $3.52/gal is almost $500k
- Annual fuel saving between 30% and 40%

Wales, Alaska

Remote coastal community in northwestern Alaska with a population of about 150

- Average load of around 70 kW
- Two AOC 15/50 wind turbines
- High-penetration wind diesel with the ability to operate with all diesels turned off using short-term NiCad battery storage with a rotary converter to control frequency and voltage
- Resistive loads used for heating and hot water
- System has had many problems associated with complexity, maintenance, and confidence of the local population to operate with all diesel engines offline
- Operated by Alaska Village Electric Cooperative with the implementation assistance of Kotzebue Electric Association and NREL

Photo Credits: Steve Drouihet, Sustainable Automation

Photo Credits: Steve Drouihet, Sustainable Automation

Photo Credits: Steve Drouihet, Sustainable Automation

Alaska Focused Advances

Alaskan projects are still

Secondary dispatchable loads

- Ice making
- Electric or hybrid electric vehicles
- Electric heating through thermal loads
- Waste heat based power generation
- Alternative storage options

Wind Diesel Applications Center (WiDAC)

Advancements in software models

Improved foundation design for arctic areas

New ownership models including power purchase agreements

Resource assessment programs

Expanded intrest in pushing up wind penetrations

There are still limitations

System to report and publicize data from W-D applications

Vocal opposition to wind development in rural Alaska

Limited track record on wind-diesel

National Renewable Energy Laboratory
Innovation for Our Energy Future

Carpe Ventem!

E. Ian Baring-Gould

National Wind Technology Center & Deployment & Industrial Partnerships Centers

303-384-7021

Ian.baring.gould@nrel.gov