Path to Economic Sovereignty: Arctic Opportunities

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200 remote microgrids spread over large area

- Population: 735,000
- Area: 660,000 sq. miles
- 1.2 people/sq. mile
- New Jersey has 1,000 times the density
- About 200 stand-alone microgrid communities
Alaska Electrical Generation

- **Railbelt**
  - 72% of Pop
  - 76% of Energy
  - Natural Gas*

- **Southeast**
  - 10% of Pop
  - 13% of Energy
  - Hydro*

- The rest of AK
  - 18% of Pop
  - 11% of Energy
  - Diesel*

* Primary fuel type
Alaska’s Energy Costs Vary

Alaska Electricity Prices by Community

Heating Costs

- Nome: $6.00
- Anchorage: $10.00

Dollars per Gallon of Heating Fuel

Dollars per Mcf of Natural Gas

Anchorage, Fairbanks, Rest of Alaska
Energy Burden by Region

% of household income used for heat and electric

North Slope, Railbelt, Southeast, Aleutians, Kodiak, Copper River/Chugach, Bristol Bay, Northwest Arctic, Lower Yukon/Kuskokwim, Yukon-Koyukuk/Upper... Bering Straits
Lowering Energy Costs is the Governor’s Priority

- Monetizing Alaska’s natural gas – propane and LNG to villages, money to alternative energy

- All Hands on Deck
  - Alaska Energy Authority
  - University of Alaska – Alaska Center for Energy Policy
  - Alaska Housing Finance Corporation
  - Alaska Industrial Development and Export Authority
  - Alaska Departments of Natural Resources, Commerce and Community Development and Environmental Conservation
Lowering Energy Costs is the Governor’s Priority

- Not-for-profit
  - Cold Climate Housing Research Center
  - Renewable Energy Alaska Project

- Utilities
  - Alaska Village Electric Coop
  - TDX Power
  - Inside Passage Electric Coop

- Every tribe and local government

- The U.S. Government – DoE, DoI, State Department, Arctic Executive Steering Committee

- The Arctic Council
Alaska Energy Authority

- **Mission:** To Reduce the Cost of Energy in Alaska

- **Programs:**
  - Renewable Energy Fund
  - Emerging Energy Technology Fund
  - Rural Power Systems Upgrades
  - Energy Efficiency programs
  - Power Project Loans
  - Fuel Loans
Power Cost Equalization
  - Result of 1980s hydro projects

2008 Renewable Energy Fund Established
  - Intent to fund $50M per year for 5 years
  - Extended 10 extra years

2010 Energy Omnibus Bill:
  - “It is the intent of the legislature that the state remain a leader in petroleum and natural gas production and become a leader in renewable and alternative energy development.”
  - Emerging Energy Technology Fund created
State Goals

- 50% Renewable Electricity by 2025
- 15% Energy Efficiency improvement by 2020
Renewable Energy Grant Fund

- Grant **recommendation** program
- Helps achieve renewable goal
- Displaces volatile-priced fossil fuels
- Provides a vetting mechanism
- Capitalizes on local energy resources
- Expands Alaska’s RE knowledge base
- Provides local employment
- Benefits businesses not PCE eligible
- Reduces State expenses through Schools and PCE

Coffman Cove School Garn boiler.
*Photo courtesy of Karen Petersen*
Renewable Energy Grant Fund

- Emphasis on
  - Technically strong
  - Economically viable
  - High cost areas
  - Regional balance
  - Public benefit

- Eligible applicants:
  - Utilities, local governments, tribal councils, Independent Power Producers

- Eligible projects:
  - Wind, hydro, biomass, heat recovery, heat pumps, geothermal, solar, wave, tidal, river hydrokinetic, landfill gas, local natural gas, transmission of renewables

St. Paul Island Wind and Flywheel
Renewable Energy Fund

- State invested $259M in REF since 2008
- 800 Applications evaluated
- 300 Grants
- 200 Projects
- 50 Operating now
- 90 Operating by 2018

All numbers rounded
Abundant Energy Resources

- Oil & gas
- Hydro
- Wind
- Biomass
- Wave, tidal, river
- Geothermal
- Efficiency opportunities

Alaska wind resource map from Alaska Energy Atlas

- Biomass or Biofuels
- Heat Pump
- Heat Recovery
- Hydro
- Ocean/River
- Solar
- Transmission
- Wind
- Other
Diesel Savings from Renewable Energy Fund

![Graph showing diesel savings from renewable energy funds with categories like Wind / Heat, Wind, Solar Thermal, Solar PV, Heat Recovery, Heat Pumps, Hydro, Biomass, and Landfill Gas. The graph compares actual and projected fuel displaced from 2009 to 2017.](image-url)
Renewable Energy Fund: Value Generated

- For first 44 projects in operation
- Total NPV cost of $314M
- NPV Benefits: $889M

Overall Program Benefit/Cost Ratio: 2.8
Pelican Hydro Before, During & After

- Wood stave and blue tarp penstock before
- Aerial view of site during construction
- AEA project manager with new surge tank
Greenhouse Gas Reductions (estimates):

2014: 147,000 metric tons
2009-2014: 347,575 metric tons
Projected 2015-2017: 682,360 metric tons
Blue Lake Hydro in Sitka
Whitman Lake Hydro in Ketchikan
Chuniixsax Creek Hydro in Atka
Story: Kodiak, Alaska

- 99.8% Renewable in 2015
  - 79% Hydro
  - 21% Wind
- Terror Lake Hydro added 3rd turbine
- Wind: 9MW installed capacity
  6 GE 1.5MW turbines
- Battery
- Next: Flywheel to lengthen battery life and add electric crane at port

Pillar Mountain Wind
REF Summary

- Brilliant!
- Huge catalyst at a good time
- Approach: fund good projects to get built
- Mostly above 1.0 benefit/cost
- Greater focus on feasibility stage
- Blend with loans to extend grant reach?
Emerging Energy Technology Fund

“...make grants to eligible applicants for demonstration projects of technologies that have a reasonable expectation to be commercially viable within five years that are designed to:

- test emerging energy technologies or methods of conserving energy;
- improve an existing energy technology; or
- deploy an existing technology that has not previously been demonstrated in Alaska. “
EETF: Hydrokinetics

Three river in-stream energy conversion device deployments in 2014

- Ocean Renewable Power Company (ORPC) in the Kvichak River at Igiugig
- Boschma Research Inc. in the Kvichak River at Igiugig
- Oceana Energy Company in the Tanana River at Nenana
Lake Iliamna, Kvichak River, Igiugig, Alaska
EETF Solicitation

- May be focused on maximizing diesel savings on RE/diesel microgrid “Grid Bridging System”
- Goal 1: Fuel sipping
- Goal 2: Diesels off
- Control system, inverters, and storage enough to act as spinning reserve so smaller efficient diesel can be used with time to start larger diesel
- Q4 2015 or Q1 2016
Susitna Watana Hydro Project

- 600 MW Hydro Project
- 50% of Railbelt electrical demand
- 12,000 jobs between 2010 and 2028
- State seeking license
- $5.6 billion to construct
- Energy savings of $14 billion in first 50 years
Typical Permafrost Foundation – Thermopile with Concrete Cap
SpiDAR Evaluation

- Cold-weather evaluation to test equipment accuracy and survivability.
- Light detection and ranging system weighs 60 kg.
- Remote power module weighs 375 kg.
- Deployed at Delta Wind Farm – Latitude 64 deg
- Very limited winter performance data due to warranty repair.
- Possible option in lieu of met tower
Wind Datalogger for Alaska

- RFP issued with $20k to seed development of datalogger specifically designed to meet the needs of wind resource assessment in remote Alaska.

- Current offerings (12-15 data channels at $1800+ per unit) targeted at large wind farm resource assessment market.

- Winning design proposal has 3 anemometer channels and 1 vane, on-board temperature sensor, 1-sec logging interval of date & time, min, max, average and std. dev for anemometer/vane and min, max, avg for temperature. .CSV format.

- Data cable inputs are spring-clip, providing for fast and reliable connection in harsh weather installations.

- Halus Power Systems is designer, manufacturer and supplier.

- Unit sells for $500-$650 depending on exact configuration/options.

- Datalogger unit at field test site in Palmer, AK showing controller board with SD card, spring-clip connectors and water-tight seals around cable intrusions.
Investment Options

- Renewable energy and efficiency projects
- Emerging energy technologies
- Susitna-Watana Hydro
- Energy materials
  - Turbines, penstock, pipe, wood-fired boilers, inverters, controls, diesel engines
- Social investment directly into funds
Final Thoughts

- Do everything you can to get the greatest value out of remote renewable systems
- Perform good modeling and engineering!
- Quandary: High penetration, RE for heat; displaces more diesel, but economics erode
- Use public funds for their greatest good

Focus on community/global benefit, not individual
- Count benefit of avoided fuel, not whole bill.
- Fixed costs are not saved by utility, just spread to other users.

Help communities identify the best, most cost-effective energy system
- It might be efficiency measures (end user & generation efficiency)
Policy & Program Innovations

- Understand problem, facilitate controlled experimentation, enable market development for solutions

Policy & Regulations

- Solutions (products, services, technical systems)
- Market capacity
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