

Energy Solutions for Alaska

Innovative Technology, Policy, and Economic Development Strategies
to Support our Communities and Industries

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Alaska Center for Energy & Power

Fostering innovative energy solutions for Alaska and beyond by:

- ⚙️ Developing information for decision makers
 - ✓ Technology identification, testing and optimization (industry)
 - ✓ Energy analysis (policy makers, communities)
- ⚙️ Education and training
- ⚙️ Commercializing energy innovation



Current and recent research in Alaska

Power systems integration

River hydrokinetics

Energy analysis/economics

Low temperature geothermal

Remote sensing/thermal imaging

Waste heat utilization

Coal-to-liquids technology

Biomass energy

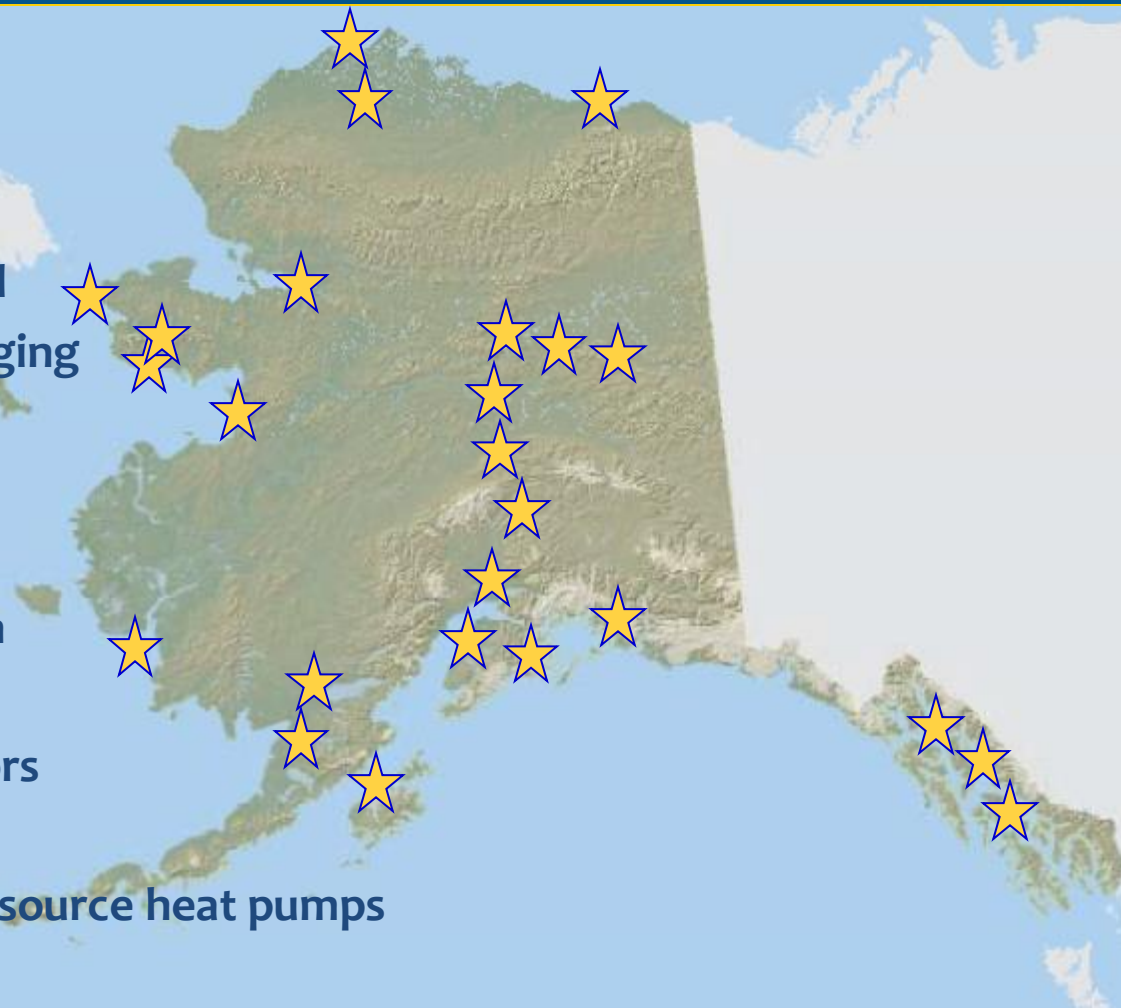
Transmission and distribution

Fuel additives assessment

Small modular nuclear reactors

Advanced energy storage

Ground source and seawater source heat pumps



Presentation Overview

Energy Technology Solutions for Alaska

- ✓ Solutions for communities (FNSB Volter example)
- ✓ Solutions for industry (Raglan mine example)
- ✓ Energy solutions for the future (hydrokinetics, energy storage, nuclear, next generation transmission strategies)
- ✓ Innovation through ACEP

Supporting Energy Policy

- ✓ Evolution of Alaska's Railbelt grid (RCA project example)
- ✓ Enabling private investment in AK energy projects (Cordova example of specification driven process)

Alaska Leadership in Microgrid Technologies

- ✓ Overview of Alaska's global leadership position
- ✓ Example of knowledge-export industry from Iceland
- ✓ ARENA (Arctic Remote Energy Networks Academy) as path forward



Energy Technology Solutions: Communities

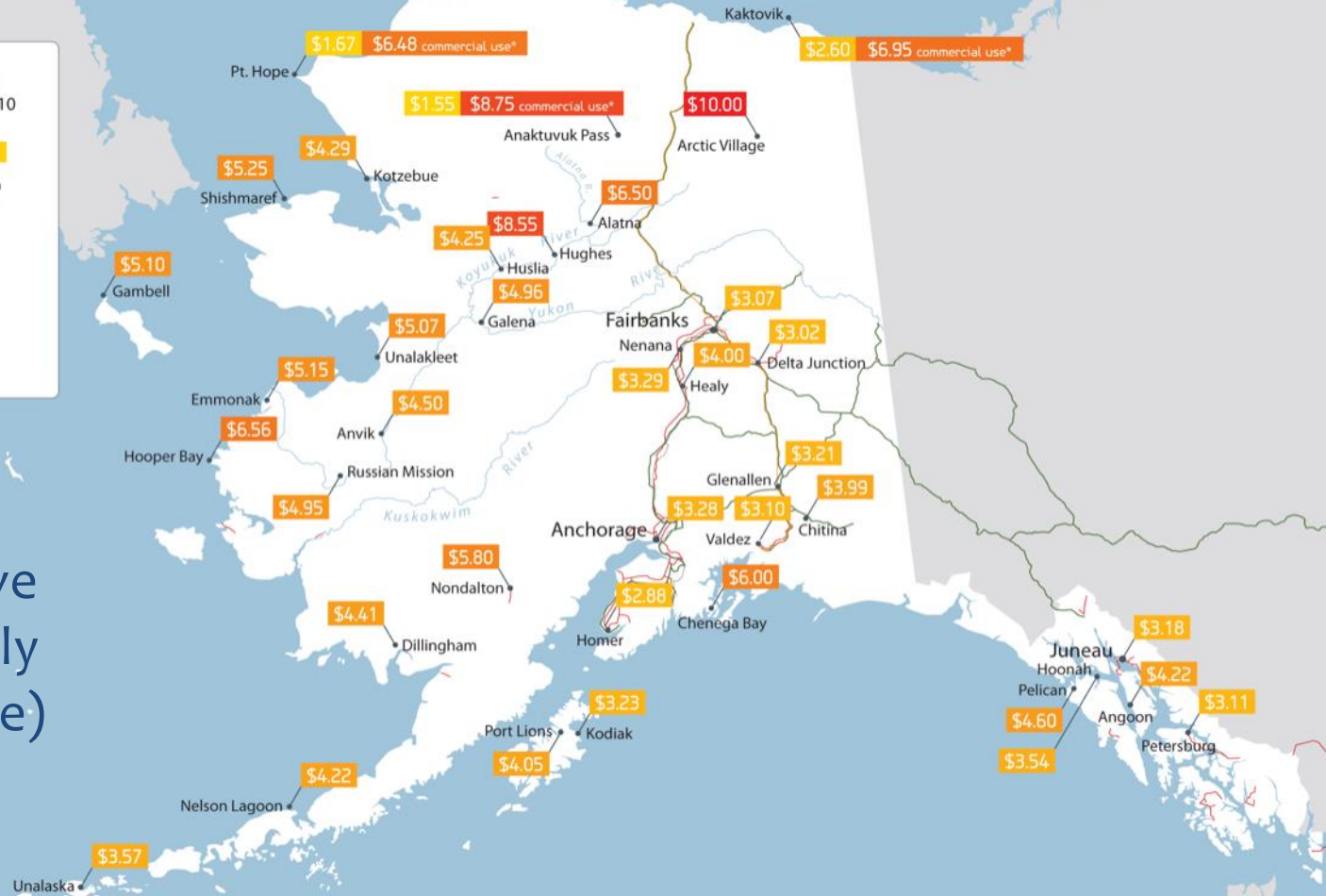
The price per gallon of heating oil in Alaskan communities, January, 2010

Highest Lowest

* Village corporations in the North Slope Borough distribute residential heating oil, charging only a delivery fee. Commercial heating oil is not subsidized.

Trans Alaska Pipeline
Alaska Railroad
Major roads
Electrical transmission lines

Many Alaskan communities have disproportionately high (and variable) energy costs



Energy Technology Solutions: Communities

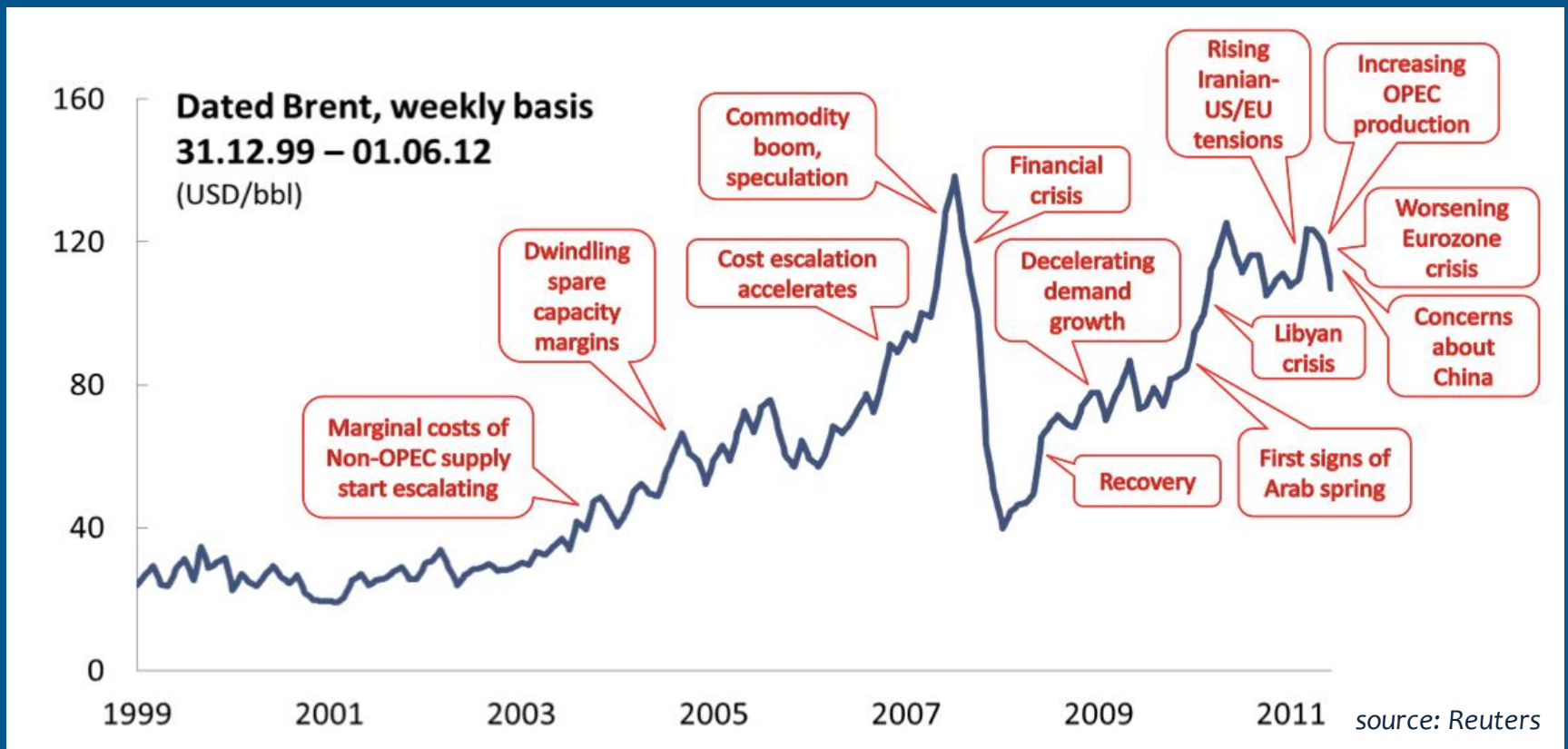


Most diesel fuel used for heat and power in rural Alaska is imported



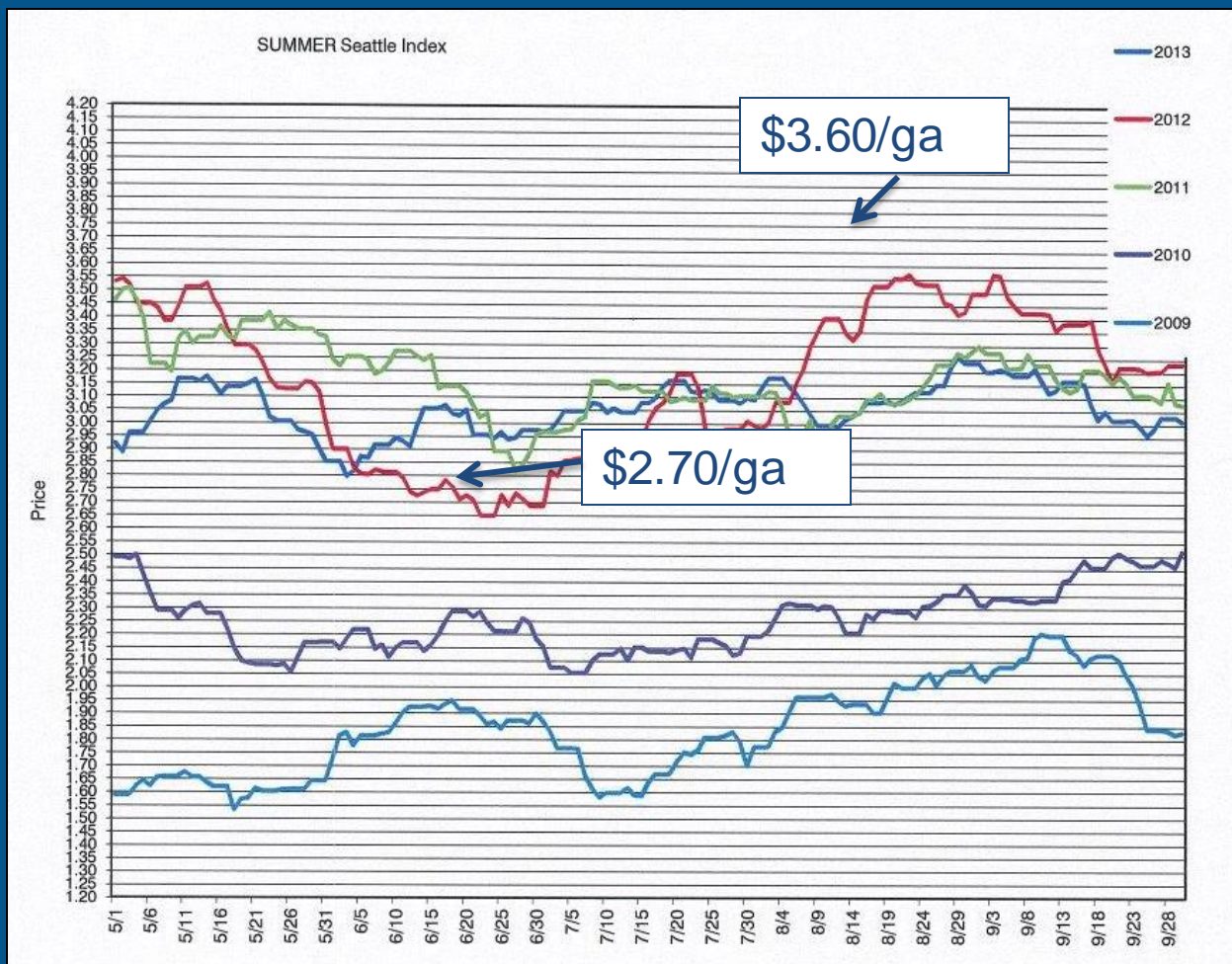
Energy Technology Solutions: Communities

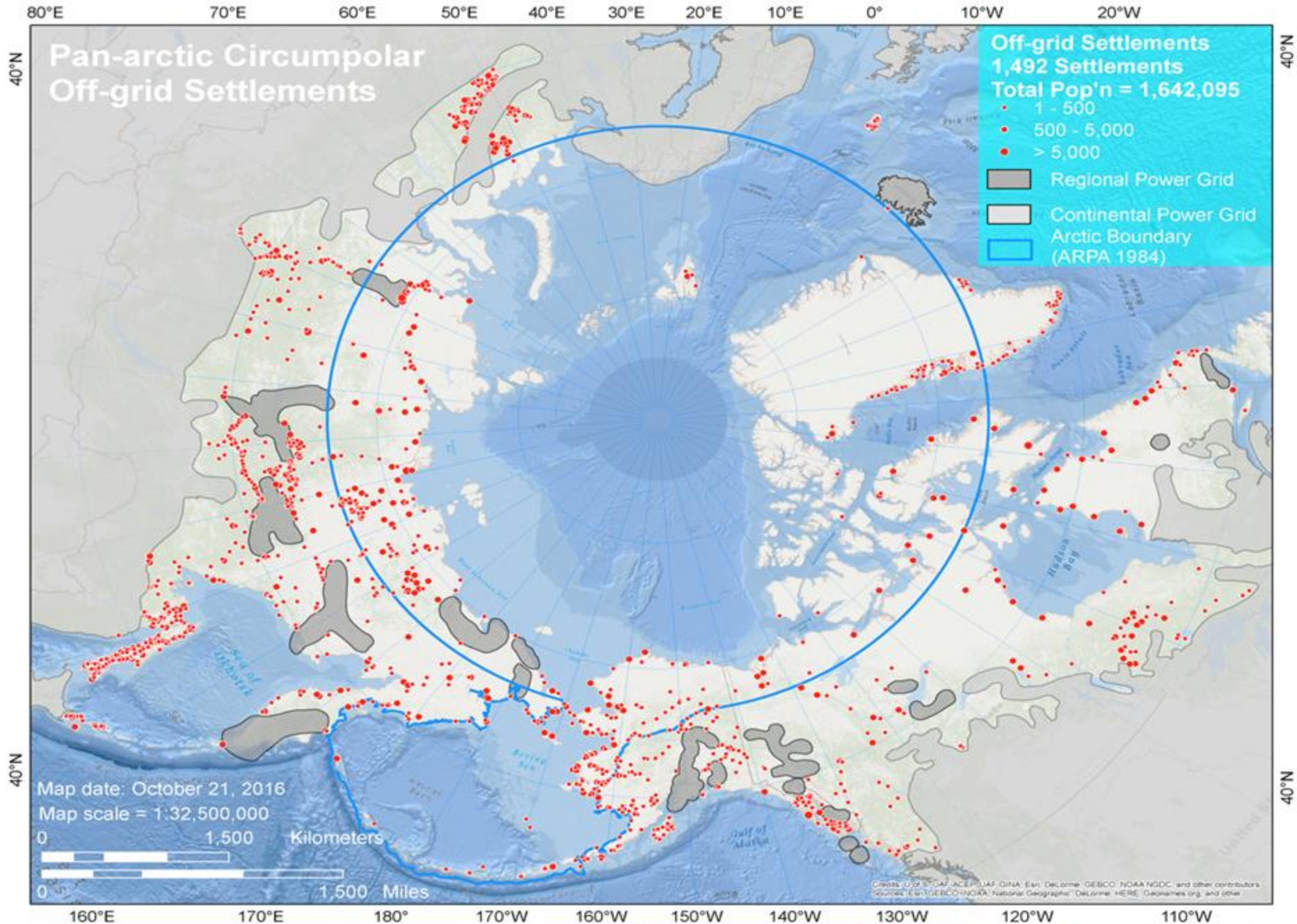
Global oil prices are driven by world events and not something Alaska communities have control over.



Energy Technology Solutions: Communities

Energy pricing can be even more volatile for rural Alaska communities (example from Nome analysis)





ACEP Partnership with FNSB

- ⚙️ A portion of ACEP funding is specifically designated to assist Alaska communities
- ⚙️ Based on mutual goal of reducing energy costs for the Borough and its residents, and diversify local economy
- ⚙️ Joint position based on prior collaborations with Tanana Chiefs Conference and UAA ISER
- ⚙️ Goal is to identify and implement strategies that can be deployed today



Volter Pilot Project at Big Dipper



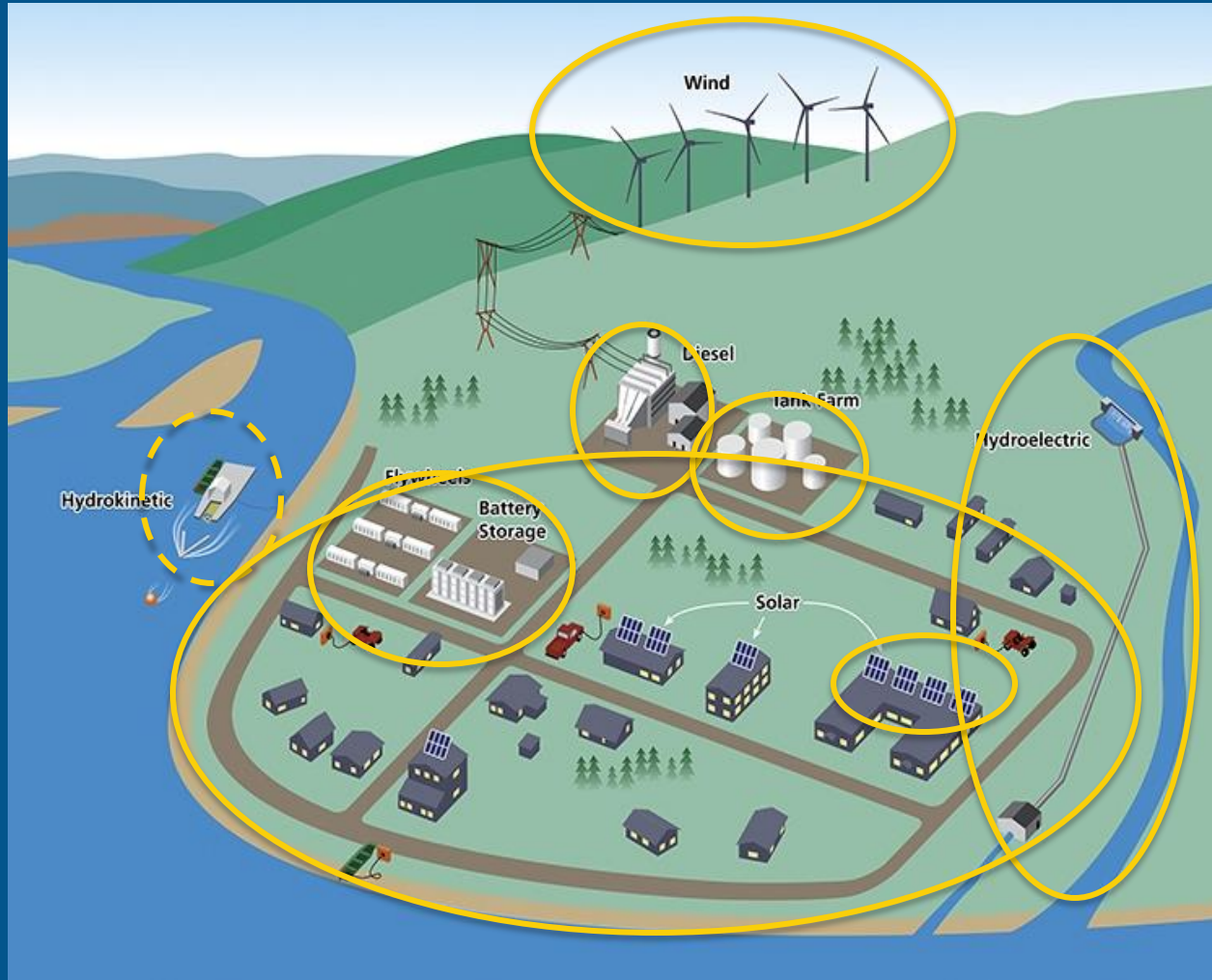
- ☀️ Small Finnish biomass CHP design
- ☀️ Fueled through locally sourced chips
- ☀️ Has not been deployed in North American market

Top: Volter unit - 45
 kW_e and 100 kW_{th}

Right: Big Dipper Ice
Arena in Fairbanks



Energy Solutions for Communities & Industry



- Firm generation
- Intermittent generation
- Energy storage
- Demand Response

ACEP Power System Integration Lab



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

ACEP Power System Integration Lab

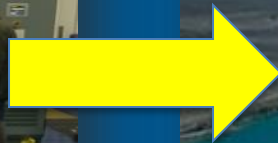
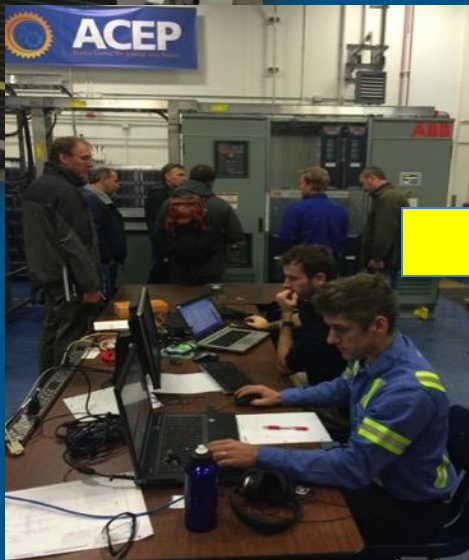
Goals:

- 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 (500kW)

Raglan Mine Flywheel Integration & Testing

ACEP conducted systems integration and testing of a Williams/KTSi flywheel prior to installation at the Raglan Mine in Quebec (to provide power quality mitigation strategies and power smoothing)



Analysis of Emerging Technologies: Storage



Examples of energy storage projects conducted by ACEP.

- ✓ Top L: Flow battery testing in collaboration with Kotzebue Electric Association
- ✓ Top R: Ambri liquid metal battery – project with Alaska Power and Telephone
- ✓ Bottom R: Grid bridge development with Alaska Village Electricity Coop



Analysis of Emerging Technologies: Nuclear

- ❶ Study commissioned by Alaska Legislature in 2009-10.
- ❷ Are small modular nuclear technologies technically and economically feasible for Alaska?
- ❸ Continued monitoring of this sector – new players entering the field such as Lead Cold and Oklo



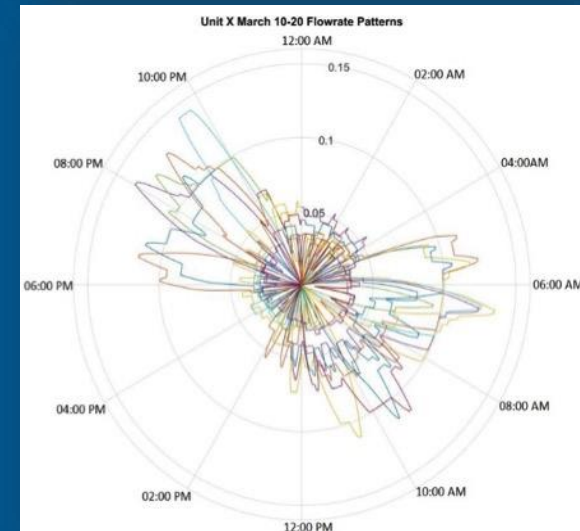
Emerging Technologies: Hydrokinetics



IP Disclosures by ACEP in past 2 Years

- UA Disclosure 354-15 Fuel Meter
- UA Disclosure 328-14 Battery Management System
- UA Disclosure 329-14 Fast Multi-Channel Data
- UA Disclosure 330-14 Power System Analysis Routine
- UA Disclosure 331-14 Dynamic Energy Balance Models
- UA Disclosure 332-14 Remote Power Supply
- UA Disclosure 355-15 Energy Reduction Savings Ap
- 2 additional disclosures pending

example: ACEP fuel meter for
vented oil heaters



Supporting Energy Policy

PROGRAM GOAL: Maximize the efficient use of government resources and private capital to sustainably meet Alaska's energy needs. Example projects:

- ⦿ Assessment of a Unified System Operator for the Alaska Railbelt Grid (RCA)
- ⦿ LNG market analysis for coastal communities (AEA)
- ⦿ Diesel Pricing Volatility for Rural Alaska
- ⦿ Enabling private financing for AK projects (AEA AKAES)
- ⦿ Program development (EETGF, AK Energy Smart, etc)



Assessment of a USO for the Railbelt Grid

PROJECT GOAL: Technical assistance provided to RCA to assess whether creating an independent system operator or similar structure for electric utilities in the Railbelt area is the best option for effective and efficient electrical transmission.

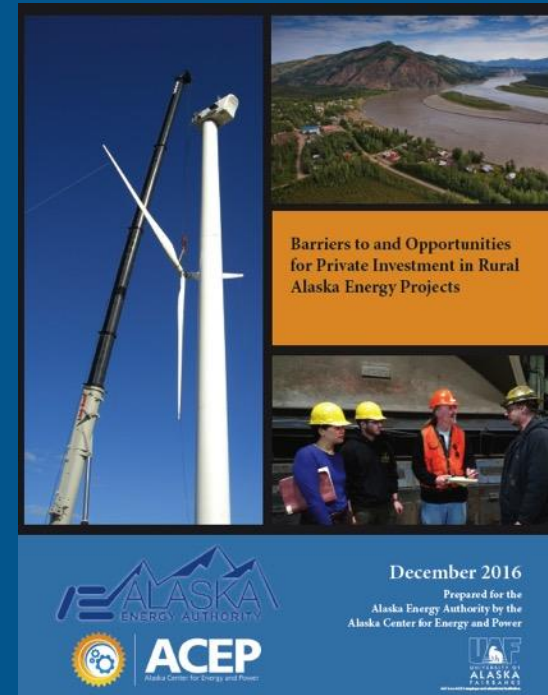
- ⚙️ Generically characterize what would an efficient Railbelt electricity system look like
- ⚙️ Assess whether there are reasons to think that the existing system could be more efficient
- ⚙️ Outline policy options for achieving efficiency
- ⚙️ Review other ISO/Transco models for local applicability



AK AES Project: Barriers to Private 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

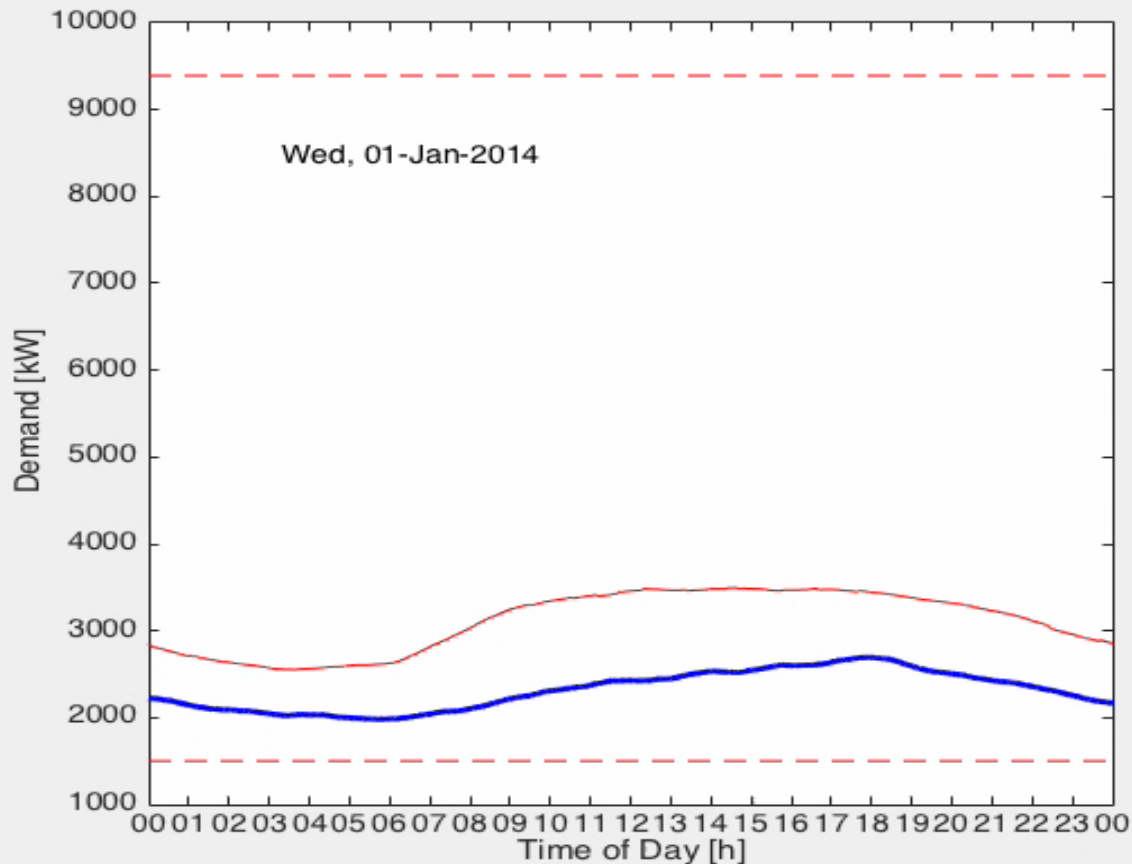


“Private investment ... is investment by financial entities and businesses rather than by government ... includes both traditional loans, as well as direct private sector investment through public-private partnerships.”

Cordova ESS (Specification Driven Project)



Cordova Storage Project (Proposed)



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Cordova Energy Mix (2011):

- 18 GWh Hydropower
- 10 GWh Diesel
- 781,000 Gal Diesel @ \$3.55/gal
 - \$2.77M Fuel bill
- Cost of generation:
 - Hydro: ~\$0.06/kWh
 - Diesel: ~\$0.35/kWh
- Estimate: **3.8 GWh spilled hydro**

Can some of the spilled hydro be recovered to displace diesel fuel?



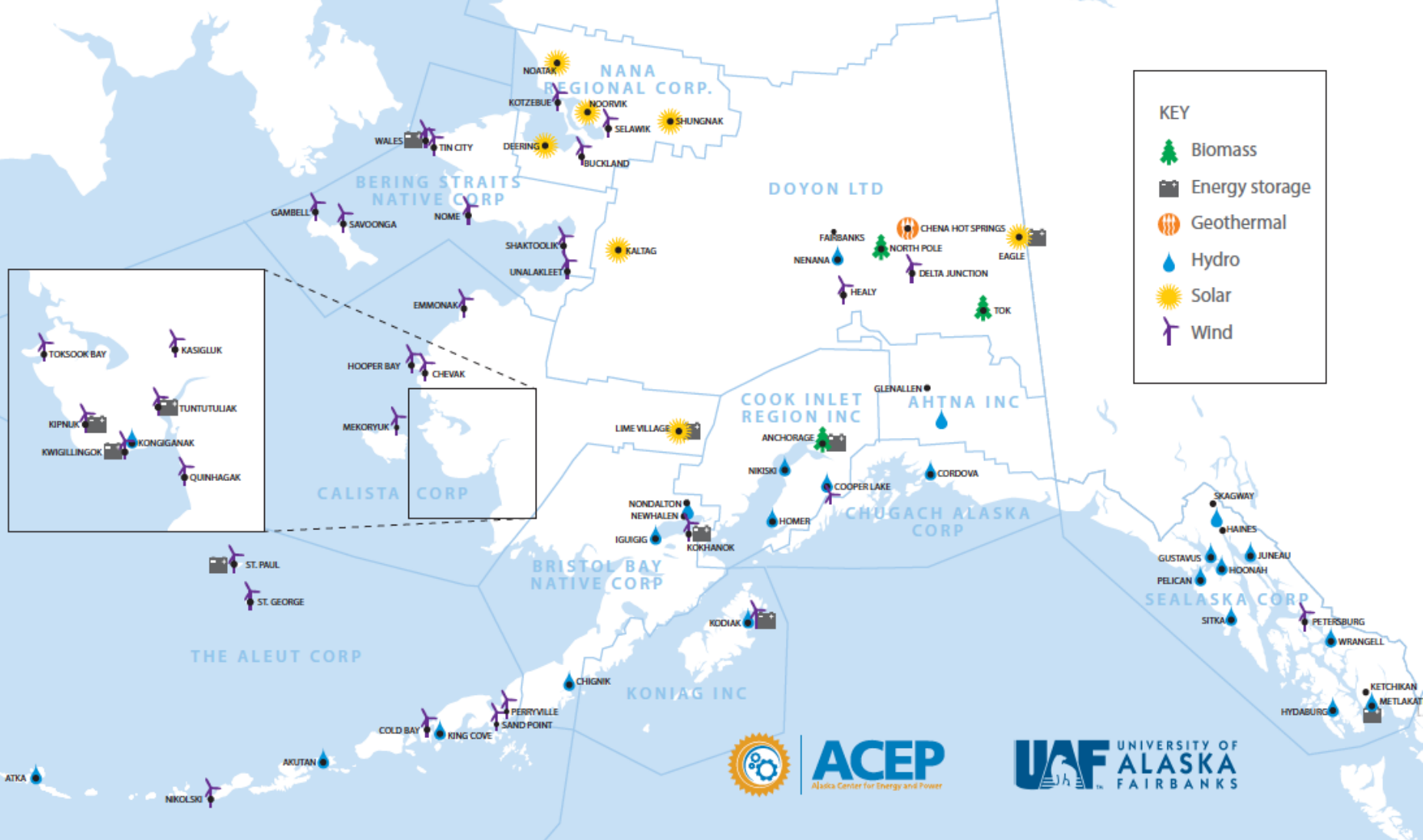
Cordova Energy Storage Project - Next Steps

- Analyze data for
 - Cycling of ESS
 - Ramping of ESS
- Merge with dynamic model results
 - Determine optimal location
- Complete development of technical specification
- CEC: Issue RFP with option to own/operate or bidirectional PPA



Alaska's Renewable Energy Systems

70 of ~200 communities have community-scale renewable energy projects




ACEP
Alaska Center for Energy and Power

UAF UNIVERSITY OF ALASKA
FAIRBANKS



ACEP
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Alaska is a leader in microgrid development



Alaska has ~12% of the worlds microgrids. This market is expected to grow to \$40B/year in revenue in the next decade (Navigant Research).

How can we capitalize on this first mover advantage to drive new revenue and economic development opportunities for the state?

Iceland: Global leader in geothermal energy



Iceland's Knowledge Export Industry

Hypothesis:

- 1) Export of geothermal expertise has resulted in new revenue and jobs for Iceland and its geothermal industry.
- 2) Development of a knowledge export industry has created more employment and revenue stability in Iceland's domestic geothermal market, as overseas activity can smooth out swings in exploration and construction in their home market.
- 3) There are 4 main policy drivers accelerating Iceland's global market penetration:
 - Investment in projects domestically
 - High R&D intensity over decades
 - Public sector advocacy and foreign aid (President, Ministries, Orkustofnun, ISOR)
 - United Nations University Geothermal Training Program



Overseas activities of Icelandic companies



Iceland UNU Geothermal Training Program



1021 Participants from 98 Countries since 1979

ARENA: Arctic Remote Energy Networks

Putting the right information in the hands of the right people at the right stage of project development through targeted knowledge exchange, development of peer networks, and individualized mentoring.

- ⚙️ Combined field visits, laboratory demonstration, and classroom lectures
- ⚙️ Project-oriented
- ⚙️ Tailored mentoring program
- ⚙️ Development of peer networks
- ⚙️ Broadly accessible webinars



ARENA: Arctic Remote Energy Networks

March 18-25, 2017 in
Yellowknife, Colville Lake,
Lutsel K'e in Canada's
Northwest Territories



Project under US
Chairmanship of Arctic
Council, included 20
participants from around
the Arctic



Alaska Center for Energy and Power

VISION: *Alaska leading the way in innovative production, distribution, and management of energy*



Marsh Creek
STG, Inc
TDX Power
Alaska Power and Telephone
Electric Power Systems
Cordova Electric
Cook Inlet Regional Corporation
Bering Straits Development Corp.
Benthic Geosciences
Ocean Renewable Power Corporation
Coffman Engineers
Dalson Energy
Golden Valley Electric Cooperative
Polar Consult
Chenega Energy
Intelligent Energy Systems
Nome Joint Utility Services



Thank you

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