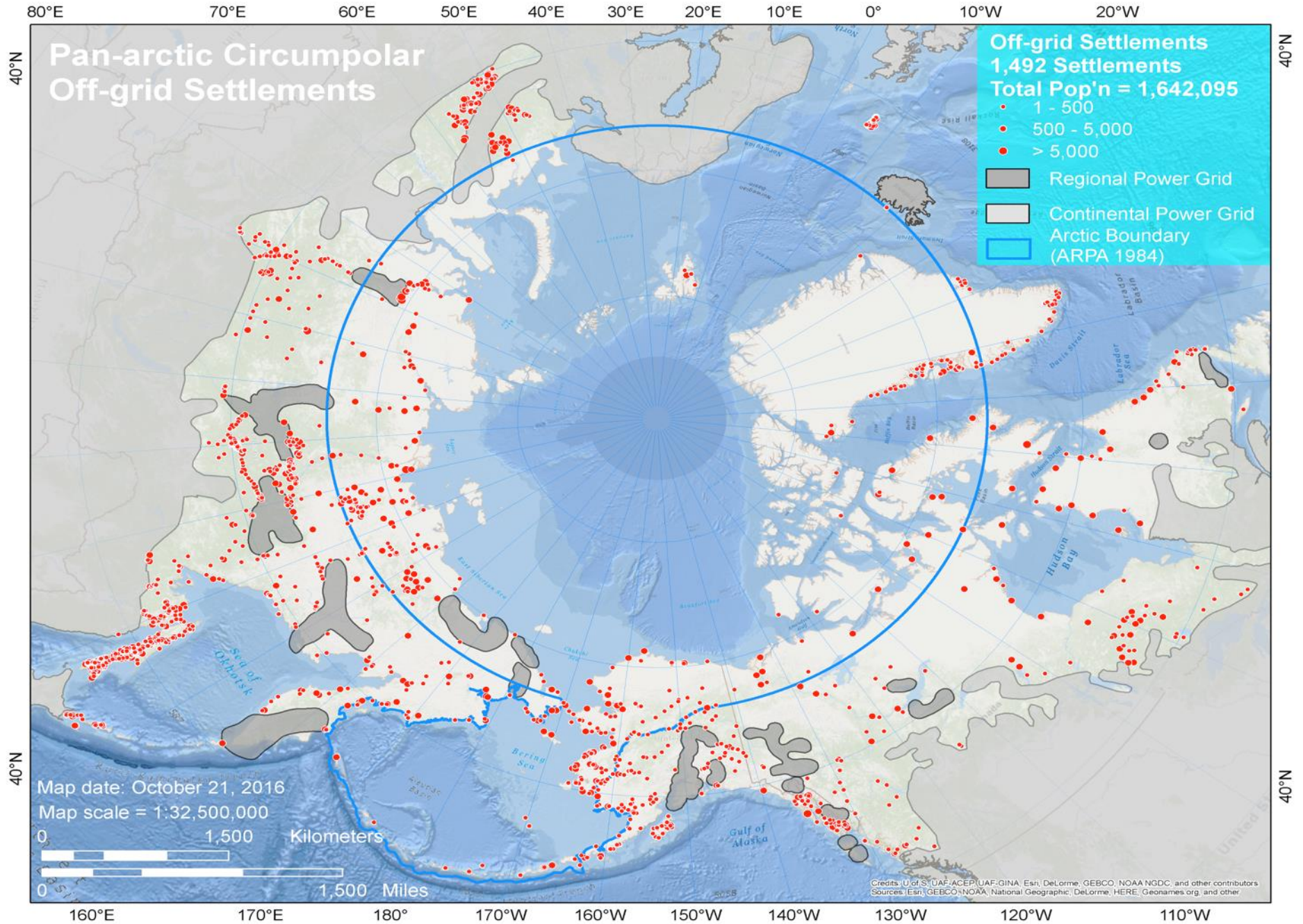


Alaska's Experience in Renewable Energy Development

*Gwen Holdmann, Director
Alaska Center for Energy and Power
University of Alaska Fairbanks*





The State of Alaska



- ✓ 586,412 square miles (more than twice the size of Texas)
- ✓ Larger than all but 18 sovereign nations
- ✓ More coastline than all other US states combined
- ✓ Half of the world's glaciers
- ✓ Least densely populated state at 720,000 residents



Alaska Realities

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



Alaska Realities

- ▶ **High energy costs**
- ▶ Fragmented electric grid
- ▶ Limited road network
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Electric power in rural Alaska costs .25-1.50/kWhr

Diesel for heating costs \$2.50 to \$10/gallon



Alaska Realities

- ▶ High energy costs
- ▶ **Fragmented electric grid**
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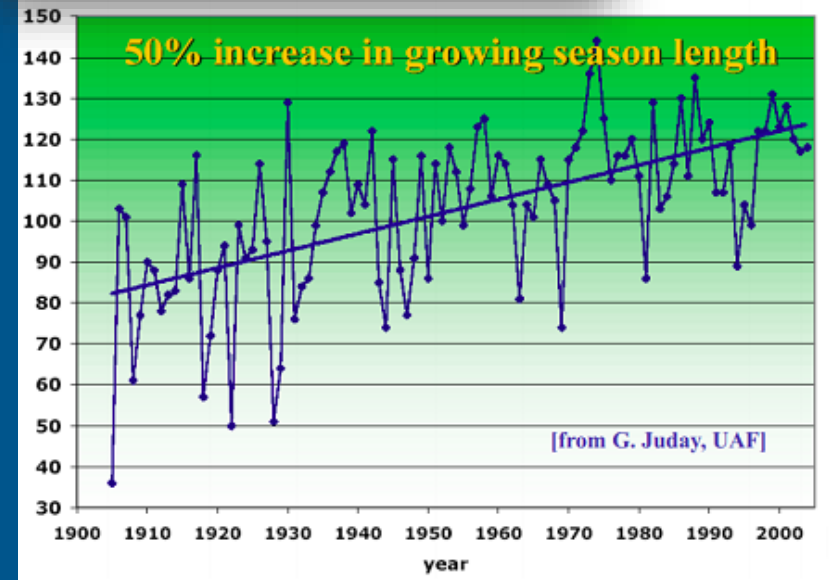
Alaska Realities

- ▶ High energy costs
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- ▶ **Harsh & changing climate**
- ▶ End of supply lines
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Erosion from fall storms - Shishmaref

Growing season in Fairbanks has increased 50% in the past century



Alaska Realities

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



Icebreaker supported fuel delivery to Nome

Alaska Realities

- ▶ High energy costs
- ▶ Fragmented electric grid
- ▶ Limited road network
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- ▶ End of supply lines
- ▶ **Stranded resources**
- ▶ Dispersed population



Pilgrim Hot Springs (near Nome)

Alaska Realities

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



Teller, Alaska –Population 350; largely subsistence based economy; basic infrastructure lacking

Alaska has been investing in Energy Infrastructure

Over the past decade, Alaska has invested more money per capita in renewable energy projects than any other state in the country. Here are some examples of the 70+ systems operating in Alaska today:



Kodiak has achieved 97% renewable penetration with hydro-wind-battery-flywheel system (above)



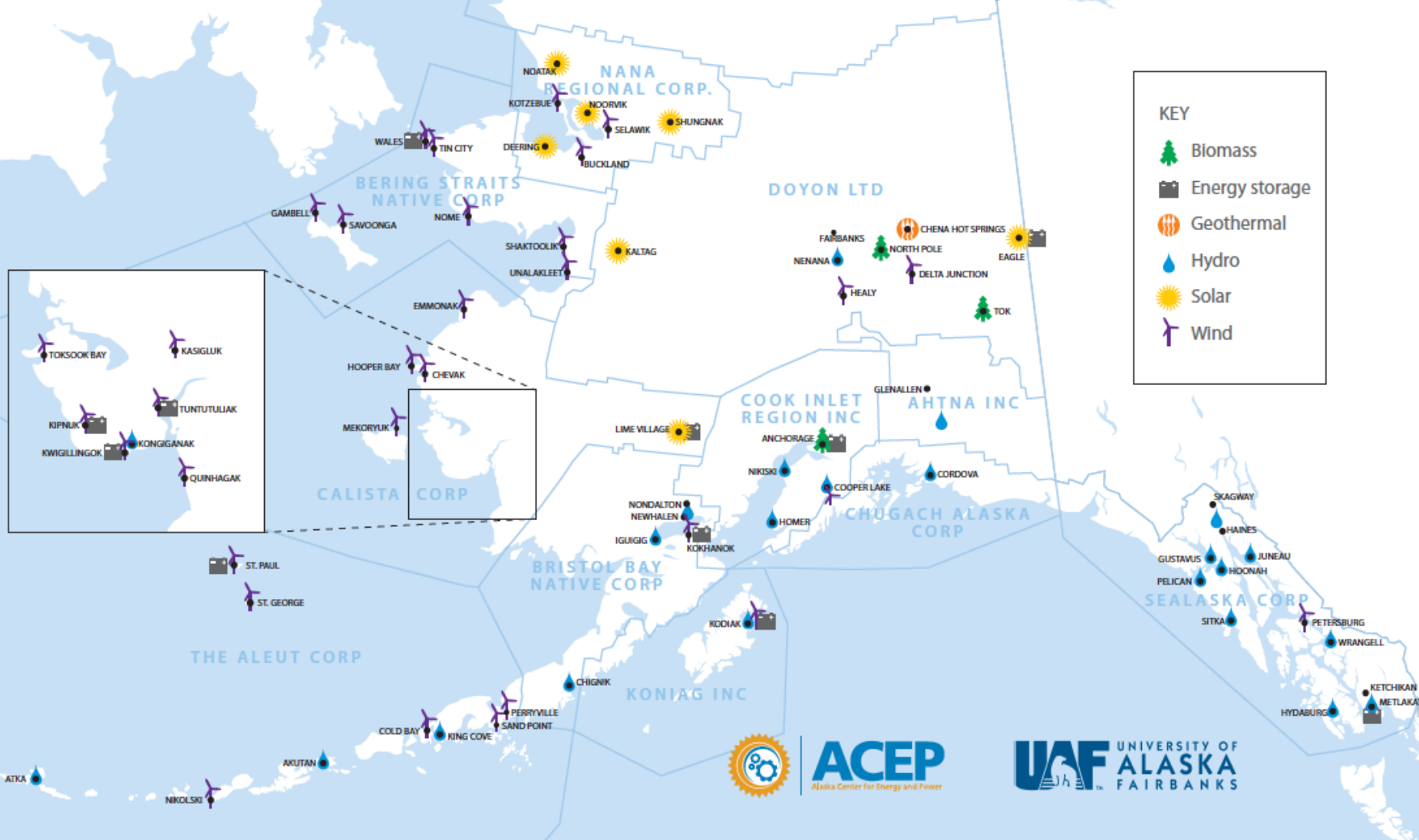
Hydrokinetic turbine installed the community of Igiugig (above)

St Paul wind farm – operating on 100% wind at times for 15 years (right)



Alaska's Renewable Energy Systems

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



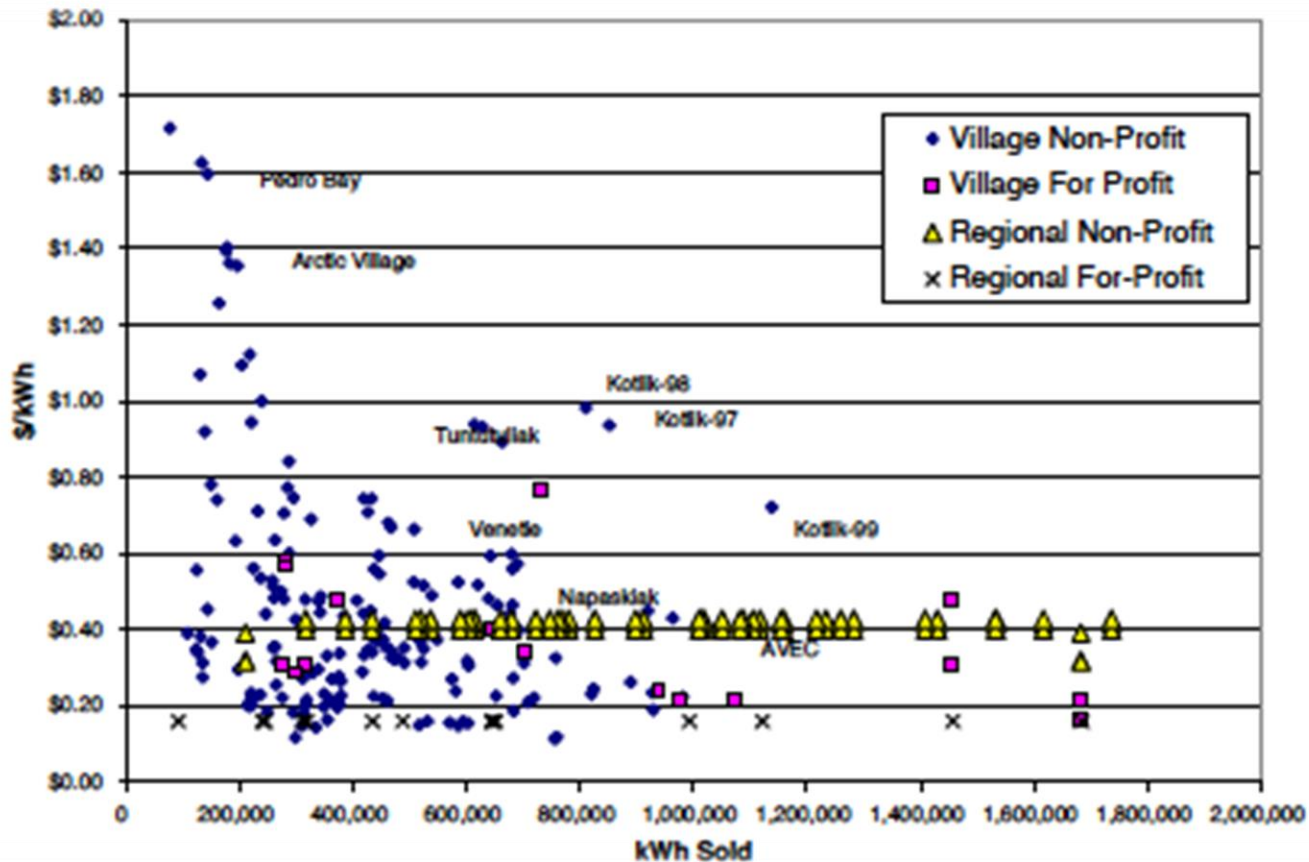
Some things you should know about Alaska ...

- ☀ We have 92 utilities REALLY!



Some things you should know about Alaska ...

True non-fuel cost versus annual sales for different management structures.
Data based on Power Cost Equalization reporting, 2003 data compiled by ISER



Some things you should know about Alaska ...

- ⦿ We have 92 utilities
- ⦿ Performance and economic data is publically available and easily accessible



Some things you should know about Alaska ...

Community Data Summary

Adak

Select another community

Adak

Overview

Geography

Borough/Census area	Aleutians West Census Area	map
Energy region (AEA)	Aleutians	map
Alaska Native Regional Corporation	Aleut Corporation	map
Latitude, Longitude	51.8800000, -176.6580556	

Population and Employment [Details](#)

Population (2014)	247
Residents age 16 and over (2011)	64
Residents employed (2011)	47
Unemployment insurance claimants (2011)	15
Population by Age and Sex	2000 2010

Education [Enrollment by School](#)

Number of Schools 1 Total Enrollment 21

View more information about Adak in the DCRA Community Database Online

Fuel Prices

Diesel [Details](#)

Retail	\$4.69 per gallon – No. 1, AHFC/DCRA Jul 2016	History
	\$4.69 per gallon – No. 2, AHFC/DCRA Jul 2016	History
Power Sector	\$4.98 per gallon – PCE Dec 2013	History

Alaska Energy Data Gateway:
akenergygateway.alaska.edu

Electricity

Utility

Utility	TDX Adak Generating LLC
PCE status	PCE Eligible Active

Rates [Details](#)

Residential Rate	\$1.46 per kWh, Dec 2013
PCE Rate	\$0.82 per kWh, Dec 2013
Effective Rate	\$0.64 per kWh, Dec 2013

Fuel 2013 [Details](#)

Fuel Type	Fuel Used	Emissions
Distillate Fuel Oil	214,285 gallons	2,174 metric tons CO ₂

Production 2013 [Details](#)

Gross Generation	2,681 MWh
Net Generation:	Total 2,681 MWh
	Oil 2,681 MWh

Sales, Revenue and Customers 2013 [Details](#)

Customer Type	Sales	Revenue	Customers
Residential	377 MWh	\$436,000	133
Commercial	668 MWh	\$773,000	86
Other	582 MWh	\$674,000	25

We ask that you include the following citation in publications that make use of this data:
Alaska Energy Data Gateway, developed by the Institute of Social and Economic Research, University of Alaska Anchorage, is supported by the U.S. Department of Energy (DOE), Office of Science, Basic Energy Sciences (BES), under EPSCoR Award # DE-SC0004903 (database and web application development), and by Alaska Energy Authority (Renewable Energy Fund data management and reporting). Database and web hosting is provided by Arctic Region Supercomputing Center, University of Alaska Fairbanks.

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ACEP
Alaska Center for Energy and Power

Some things you should know about Alaska ...

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residential rate = \$1.46/kWh,
\$0.64/kWh after subsidy

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Fuel cost (\$4.69 per gallon in July 2016)



Some things you should know about Alaska ...

- ⚙️ We have 92 utilities
- ⚙️ Data is publically available and easily accessible
- ⚙️ Simple and minimal subsidy structure that only applies to residential customers (funded through a \$1B endowment)



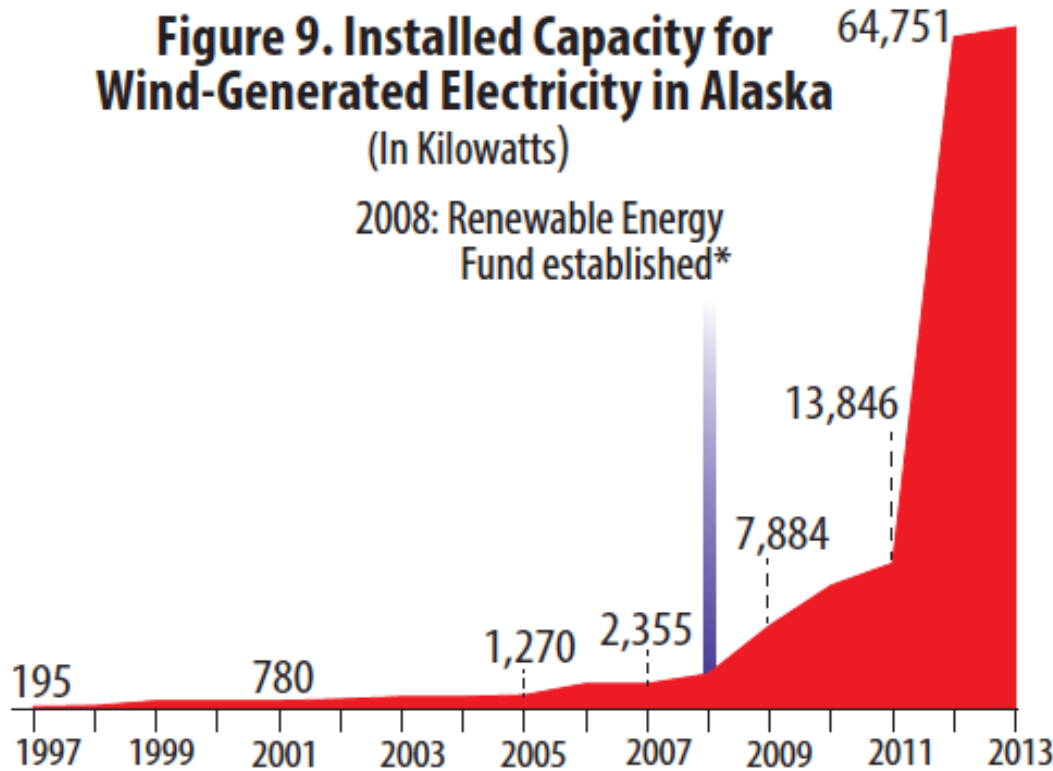
Some things you should know about Alaska ...

- ⚙️ We have 92 utilities
- ⚙️ Performance and economic data is publically available and easily accessible
- ⚙️ Subsidy only applies to residential customers (but we put some money in the piggy bank)
- ⚙️ Most policies and programs were grass-roots initiatives



Some things you should know about Alaska ...

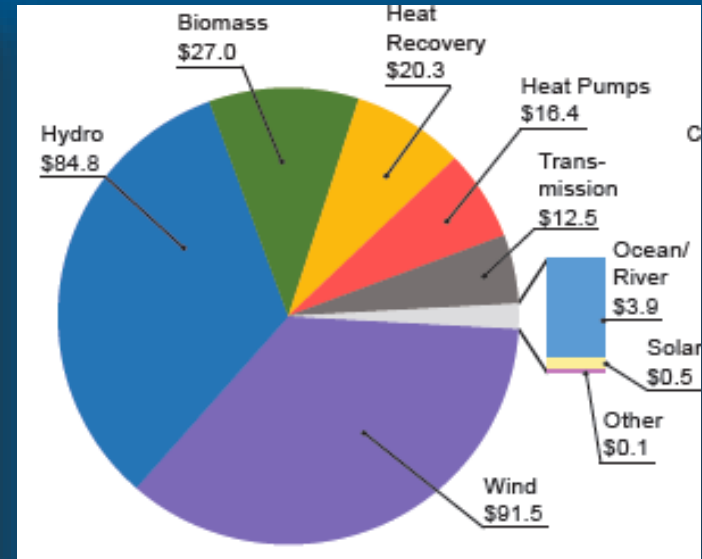
Figure 9. Installed Capacity for Wind-Generated Electricity in Alaska
(In Kilowatts)



2008: Renewable Energy Fund established*

* Administered by the Alaska Energy Authority, this program offers state grants for projects developing renewable energy sources in Alaska.

Sources: Sources: U.S. DOE, EIA; Alaska Energy Authority, PCE program data; authors' estimates



Impact on RET development during first 5 years of the Alaska Renewable Energy Fund (based on installed capacity, Fay et. Al 2013)



Some things you should know about Alaska ...

- ⦿ We have 92 utilities
- ⦿ Data is publically available and easily accessible
- ⦿ Simple and minimal subsidy structure
- ⦿ Most policies and programs were grass-roots initiatives
- ⦿ **Most projects are community or utility-driven**



Projects Champions



Project champions
are not important ...
they are essential



Renewable Energy Grant Fund

- Established in 2008 through a grass roots initiative led by Renewable Energy Alaska Project
- \$259 million in state appropriations have leveraged another \$200 million in federal and private dollars
- In 2016, more than 60 completed projects displaced the equivalent of 30 million gallons of diesel fuel
- Organized in 5 phases across the entire range of project development



Other Programs

- ⦿ Power Project Loan Fund
- ⦿ Emerging Energy Technology Grant Fund
- ⦿ Community and regional energy planning
- ⦿ Rural Energy Conference
- ⦿ Circuit rider program (maintenance)
- ⦿ Alaska Network of Energy Educators
- ⦿ Wind for Schools, Kid Wind, AK Energy Smart



Thank you

Gwen Holdmann
Alaska Center for Energy and Power
University of Alaska Fairbanks
Gwen.Holdmann@alaska.edu





St Paul Island Microgrid up to 100% wind power – 15 yrs of operation



Tuntutuliak, Kongiginak, Kwigillingok, Kipnuk: Wind/heat microgrid:



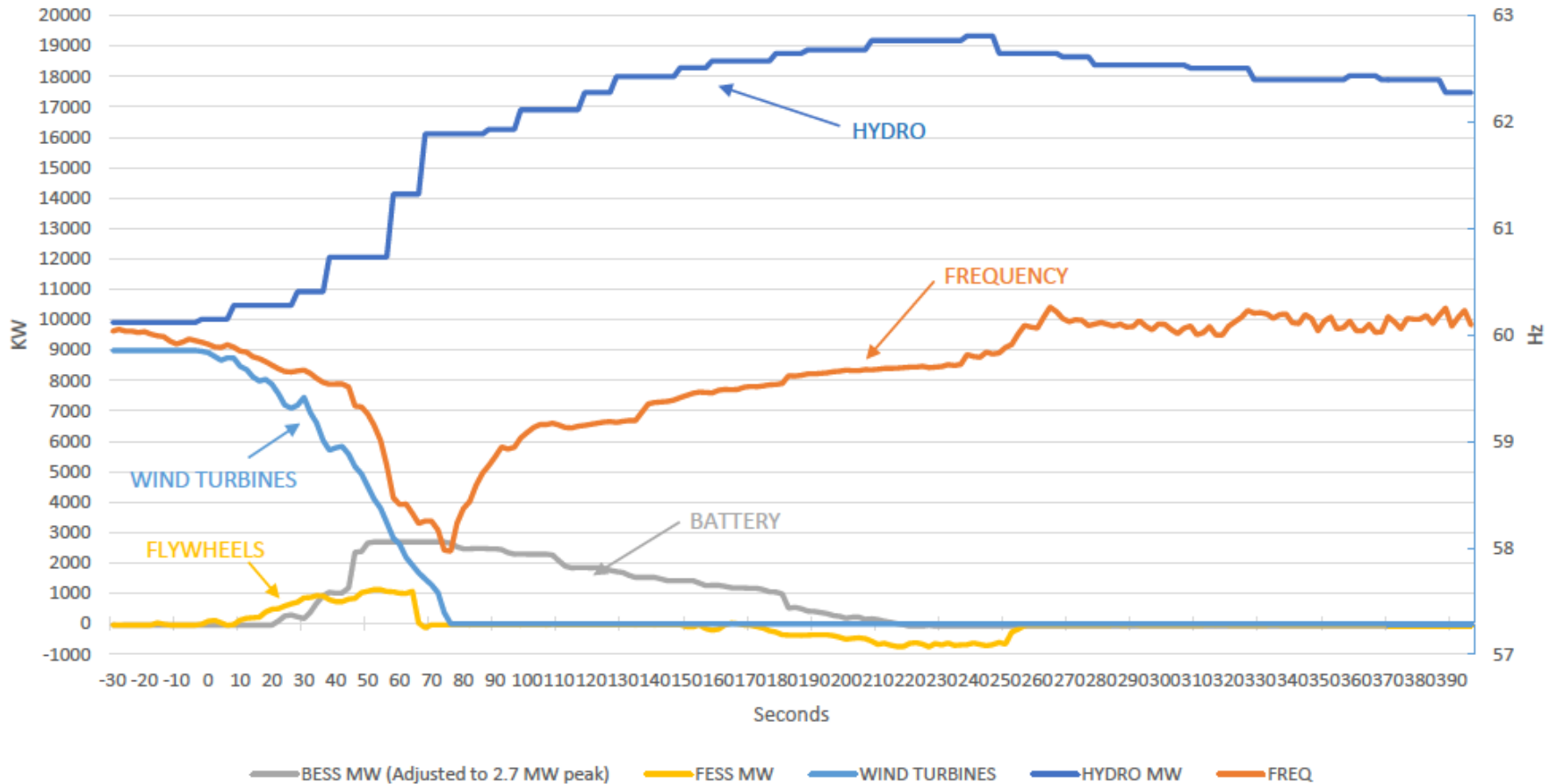
Kodiak Island: Microgrid with 100% renewable generation year round



Kodiak Island: 100% renewable generation

Hydropower + Wind + Energy Storage (Battery and Flywheel)

SYSTEM RESPONSE TO WIND EVENT 11/11/2015 12:53 PM



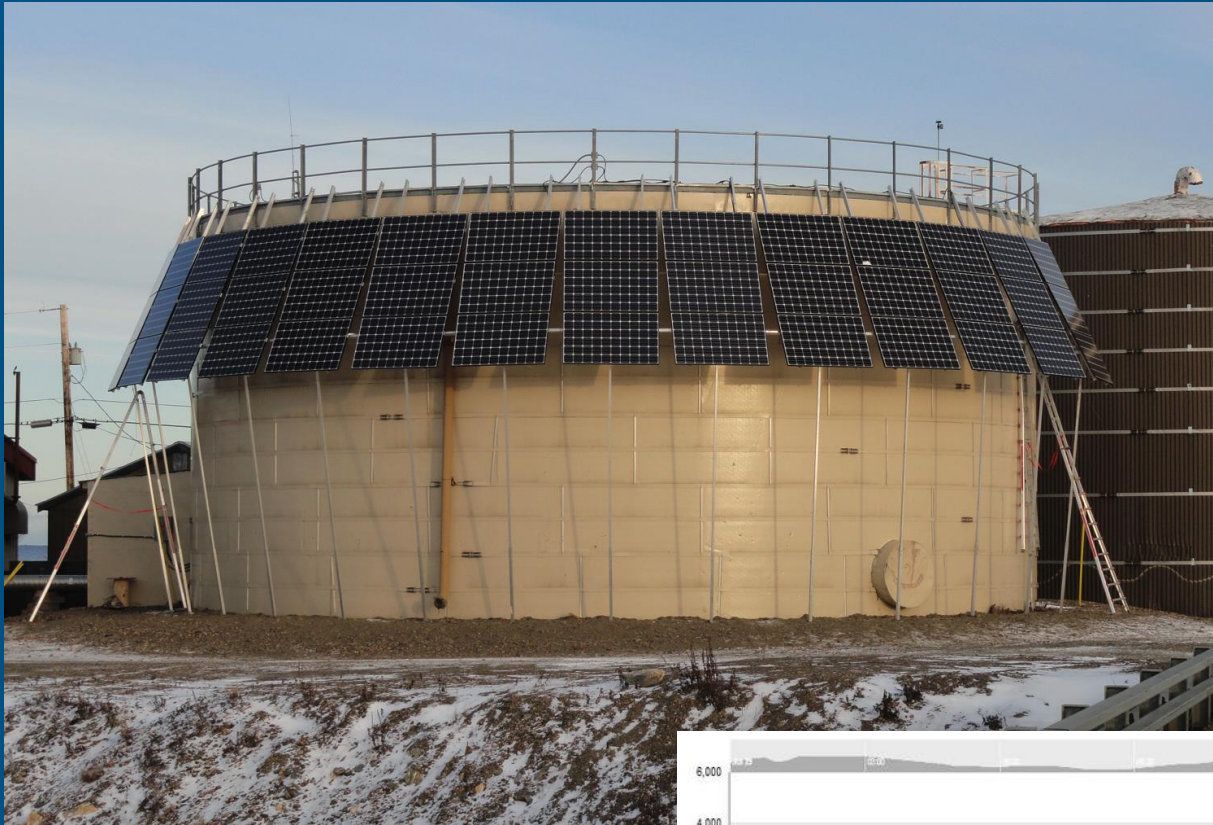
Eagle Hydrokinetic Energy Project



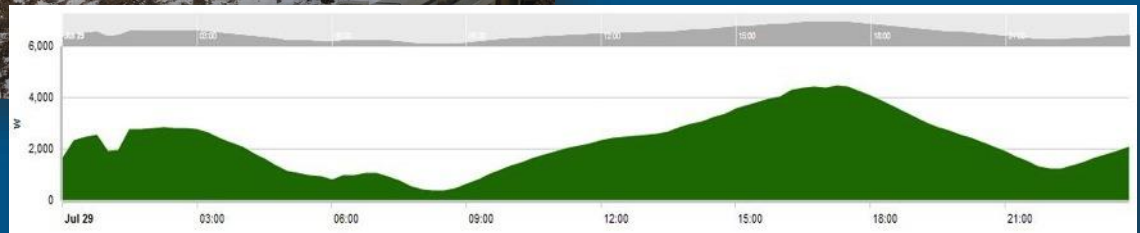
25 kW system
provided diesel off
100% power to
Eagle Village



Solar energy – gaining in popularity



Deering, Alaska
Population = 125
residents , 10 kW. Multi-
directional array produce
consistent power
throughout day (and
night)



24 hours output in July



Small Scale Biomass for Heat and Power



Tok School Biomass Project
(125 kW power + heating)

Low Temperature Geothermal



400 kW Power Generation
from ORC with 72 C



Chena Hot Springs



Refrigeration

ACEP Power System Integration Lab



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

ACEP Power System Integration Lab



Williams flywheel testing for Hatch Engineering prior to installation at Raglan Mine

A few closing thoughts ...



- ⚙️ Important to understand human-technology interface

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- ⚙️ Project benefits should be clearly defined and articulated – *who wins and how?*

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- ⚙️ Use appropriate technology

A few closing thoughts ...



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- ⚙️ Project benefits should be clearly defined and articulated – *who wins and how?*
- ⚙️ Efficiency first ... at all levels
- ⚙️ Appropriate training and support critical
- ⚙️ Use appropriate technology
- ⚙️ Take advantage of lessons learned – there are plenty!

Thank you

Gwen Holdmann
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