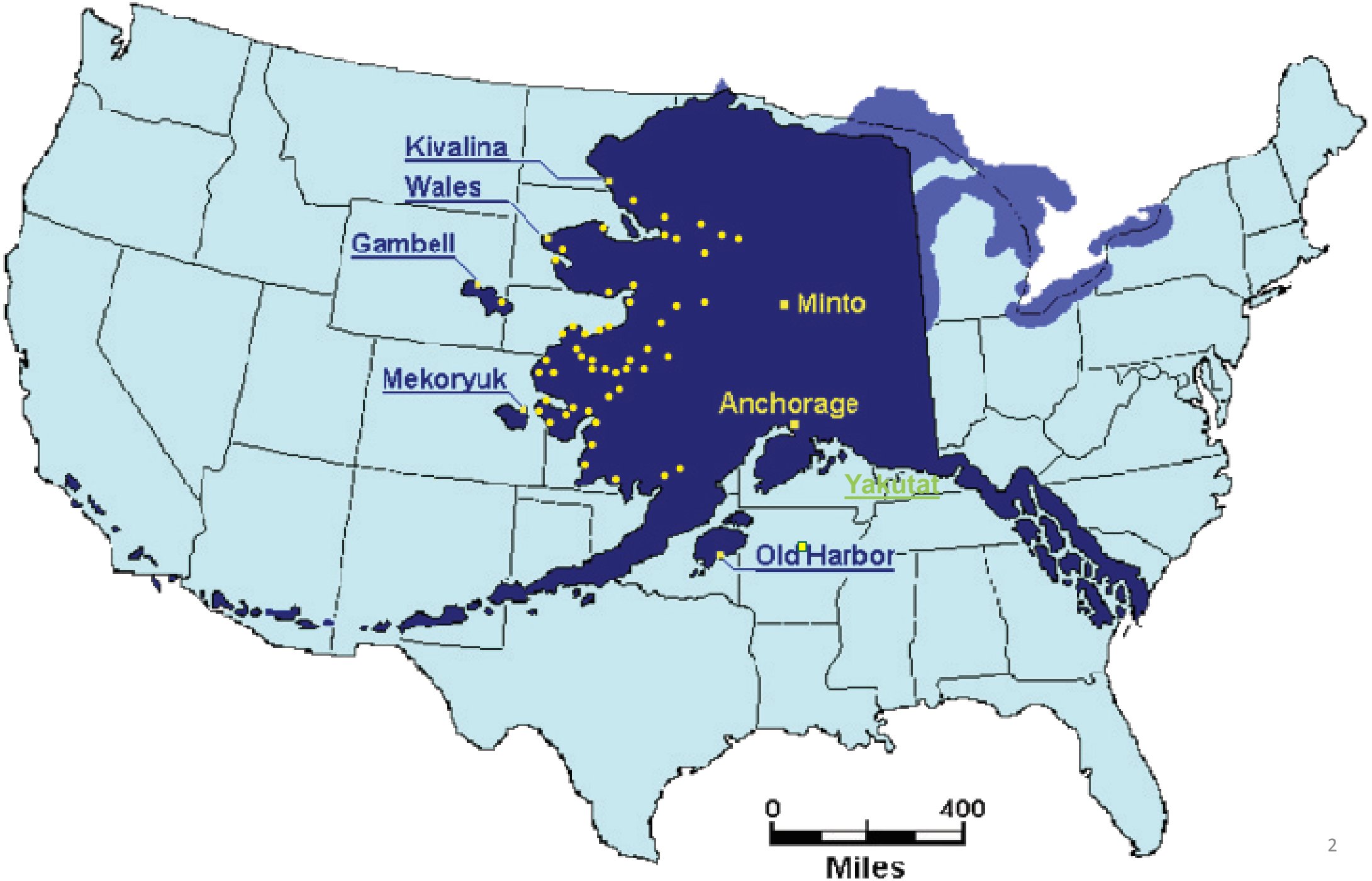
Tribal Energy Conference
Denver, Colorado
December 2018

Alaska Village Electric Cooperative, Inc./
Bethel Native Corporation
Renewable Energy Joint Venture

Bethel Wind Energy Construction Project

Forest Button
Manager, Project Development
& Key Accounts

AVEC
ALASKA VILLAGE ELECTRIC COOPERATIVE


Kivalina
Wales
Gambell
Minto
Mekoryuk
Anchorage
Yakutat
Old Harbor
0
400
Miles

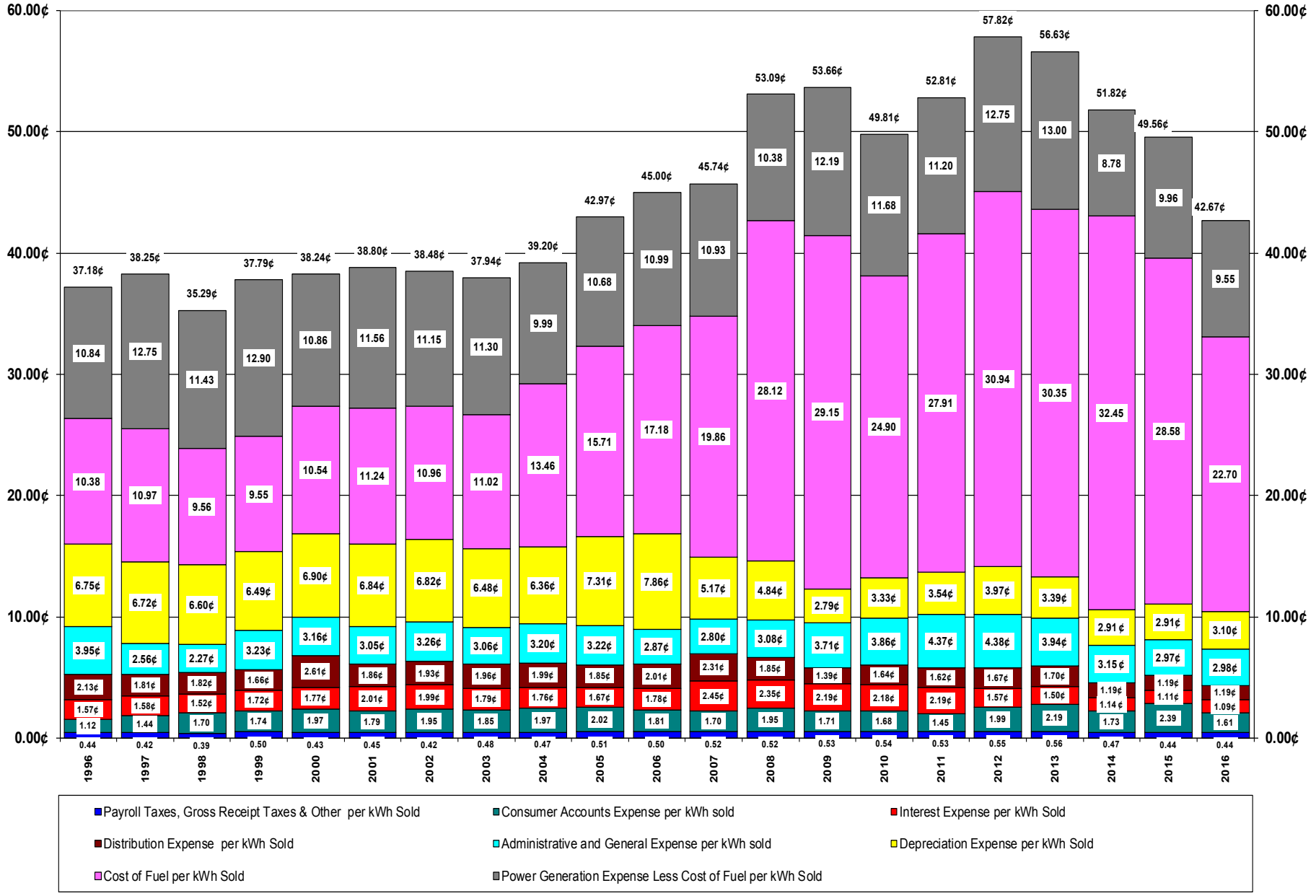
Alaska Village Electric Cooperative

Member owned, not-for-profit

Energizing Rural Alaska since 1968

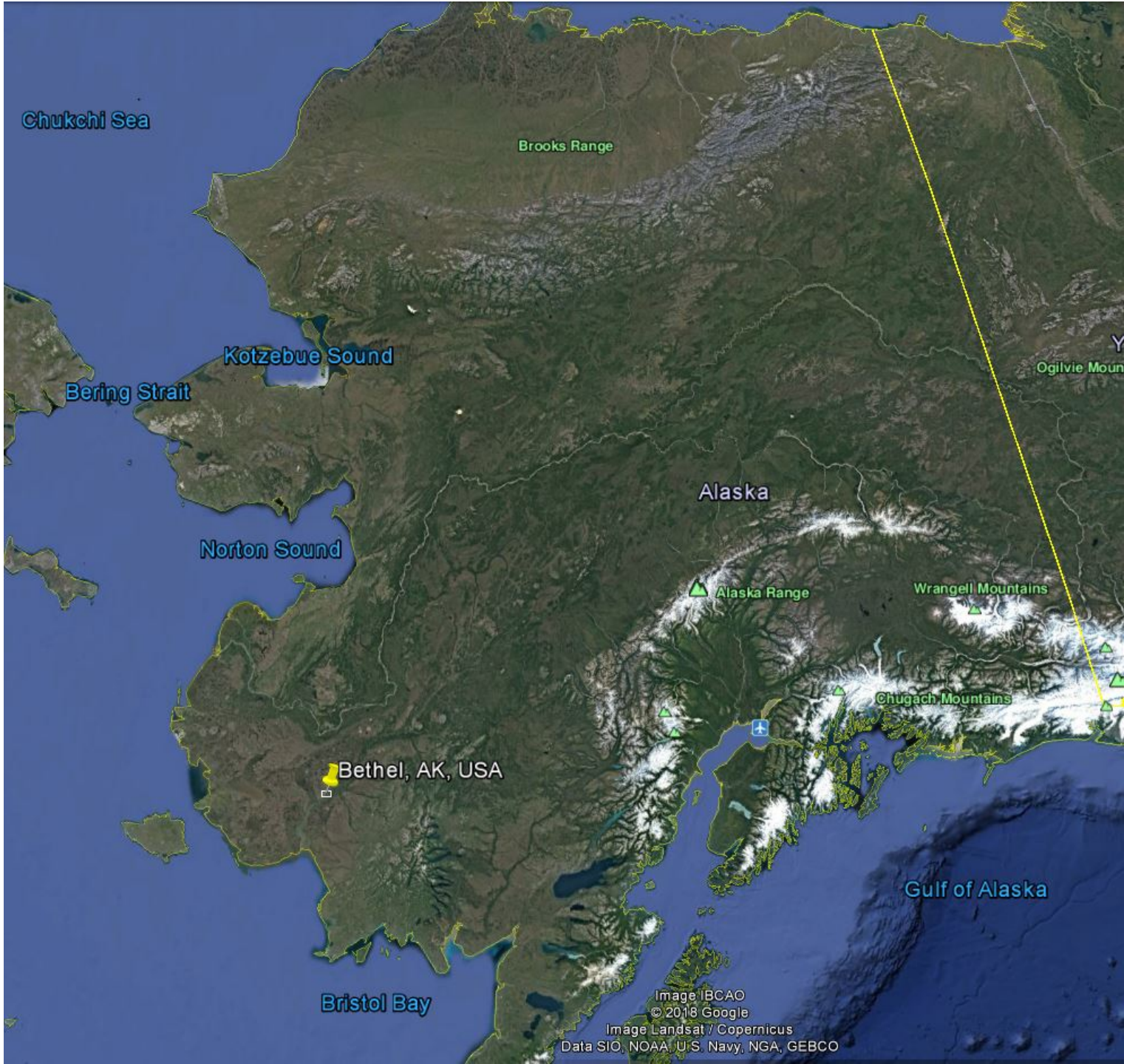
- 58 Member Communities
- 11,500 Services
- Population Served: 30,194
- 94% Alaska Native
- Smallest: Shageluk 71 ➡ Largest: Bethel 6,205
- 9 million gallons of diesel / $31 million ($3.45)
- 90 FT / 95 PT Employees
- 48 Power Plants
- 36 Wind turbines serving 20 communities
- 2 Solar arrays serving 2 communities
- Two tug and barge sets

Alaska Village Electric
Cost Components per Kilowatt-hour Sold



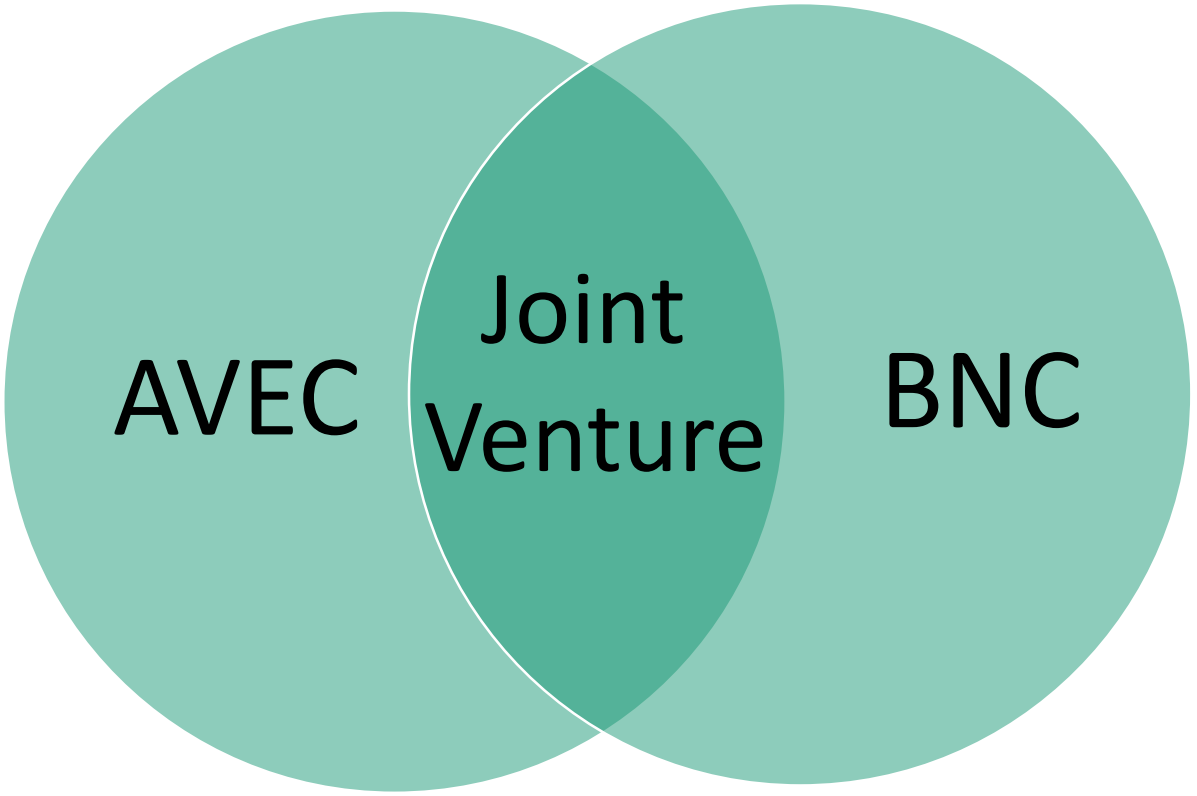
Bethel Native Corp.

- ANCSA village corporation
- Construction, Environmental, Logistics
- Alaska, Washington, California
- Serves 1,800 shareholders
- Mostly Yup'ik Eskimo



Joint Venture

- Partnership between AVEC and BNC - ABRE
  - To benefit the communities of Bethel and Oscarville



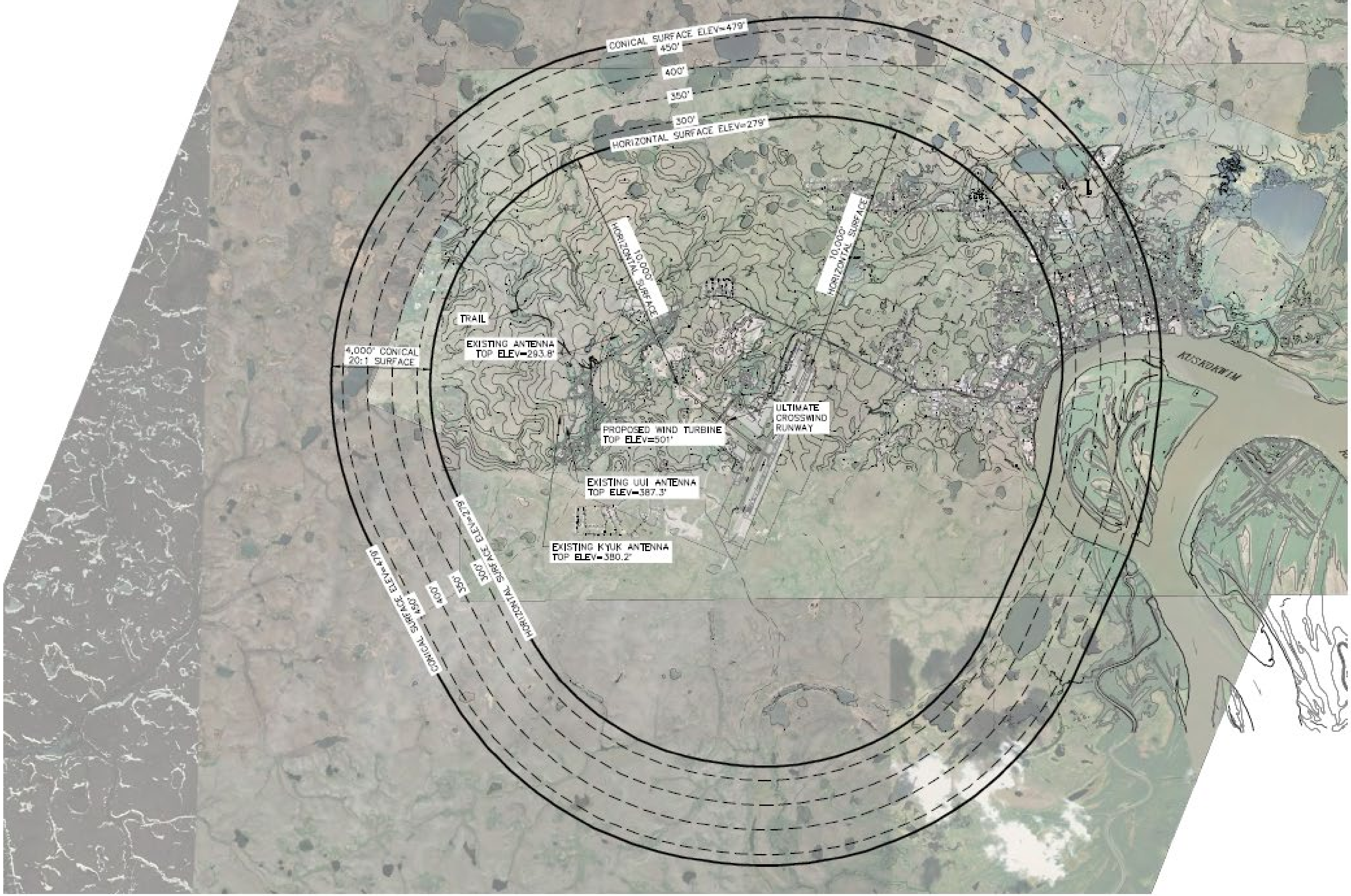
Project Participants

AVEC – Electric Utility
BNC – Local native corporation

State of Alaska
DOE Tribal Energy
AVEC
Denali Commission

CRW Engineering
Golder
STG /EWT

Project Location



1 **PART 77 AIRSPACE**
SCALE: GRAPHIC

2000 0 2000 4000
SCALE IN FEET

BETHEL, ALASKA
WIND TURBINE PROJECT
PART 77 AIRSPACE

CRW ENGINEERING GROUP LLC

AVEC

NO.	REVISION	BY	DATE

Plot Date 4/21/17
Designed KRH
Drawn CB
Approved JVS

Sheet No. FIG 3

Project Overview

Upgrade power plant to accept wind energy

- Automated governors –actuators
- Voltage Regulators

Installation of one Emergya Wind Technologies (EWT) 900 kW direct drive wind turbine.

- 52 meter diameter rotor
- 50 meter high tower

Project Objectives

- Generate 2,604 MWh / Year
- Offset 200,000 gallons fuel consumption per year
- Save approx. $700,000 per year on fuel
- Eliminate 2,238 tons of CO2 / year

- Energized September 14, 2018
- 446,698 kWh
- Offset 32,000 gallons of diesel
- Savings $111,674
- 358 tons of CO2 eliminated

2017-2018 Construction

Road, pad, and pile foundation winter 2017/2018

Turbine ship to Alaska May 2018

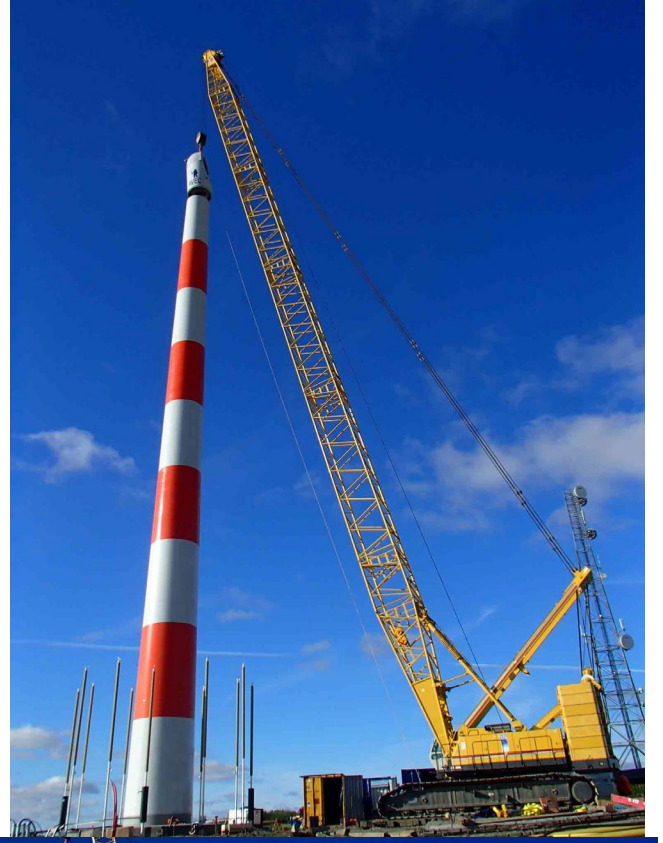
Concrete foundation June / July 2018

Erect turbine, install transformers connect to grid
August – September 2018

Commission bring on line September 2018

Construction

Construction



Alaska Village Electric Cooperative, Inc./ Pitka's Point Native Corporation Renewable Energy Joint Venture

Pitka's Point/Saint Mary's Wind Energy Construction Project

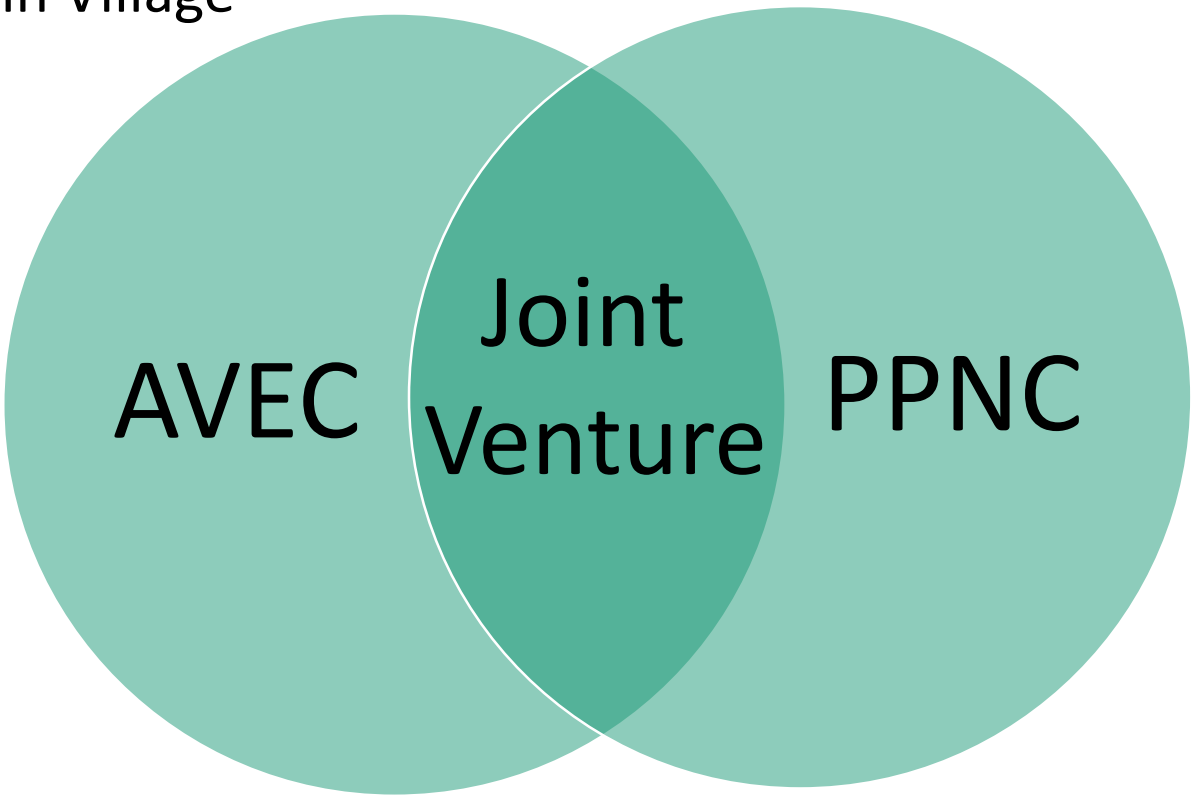
AVEC
ALASKA VILLAGE ELECTRIC COOPERATIVE

Pitka's Point Native Cooperation

- ANCSA village corporation
- Serves 426 shareholders

Joint Venture

- Partnership between AVEC and PPNC - APPRE
  - To benefit the communities of Pitka's Point, Saint Mary's, and Mountain Village



Project Participants

AVEC – Electric Utility
PPNC – Local native corporation

State of Alaska
DOE Tribal Energy
AVEC

CRW Engineering
Golder
STG / NPC / EWT

Project Overview

- Installation of one Emergya Wind Technologies (EWT) 900 kW direct drive wind turbine.
  - 52 meter diameter rotor
  - 50 meter high tower
- Upgrade electrical distribution line to three-phase between St. Mary's and Pitka's Point
- Upgrades at the Saint Mary's power plant to effectively utilize wind
- Wind-to-heat component

Project Location

Project Objectives

Wind Generation

- Replace approximately 202,000 gallons fuel/year
- Save an estimated $874,000/year
- Generate around 2,525 MWh/year
- Eliminate roughly 2,100 Metric tons of CO2/year

Wind-To-Heat

- Replace approximately 4,220 gallons fuel/year
- Save an estimated $11,250/year

Together

- Strive to stabilize future energy costs
- Reduce risk of environmental damage

Progress:

Road, pad, and foundation complete in 2017

Electrical upgrade complete 2018

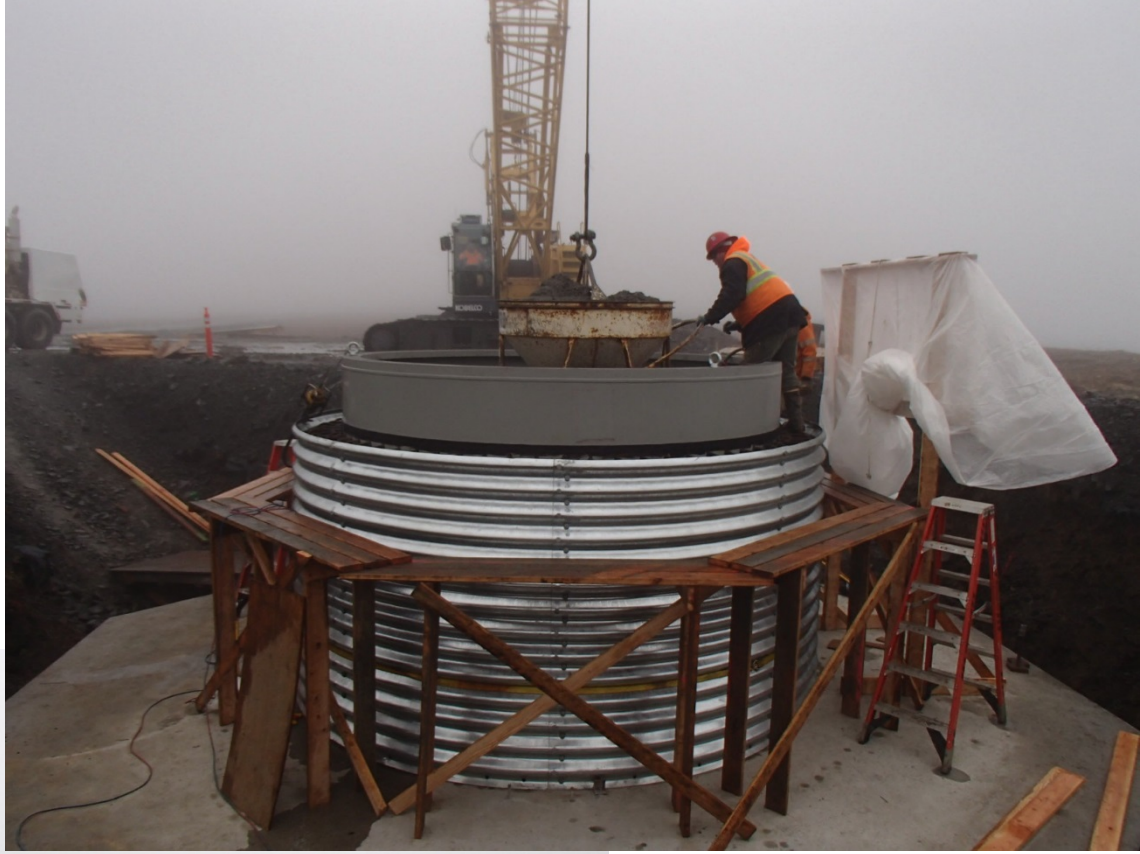
Turbine installed 2018

Next steps…

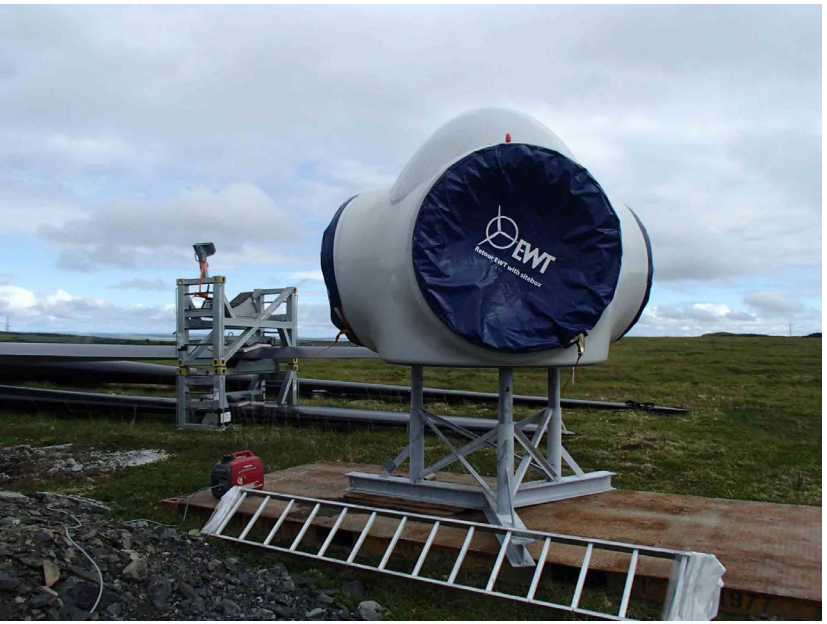
Commission Turbine and bring on line - December

Intertie Mt. Village with St. Mary's - 2019

Foundation Construction 2017

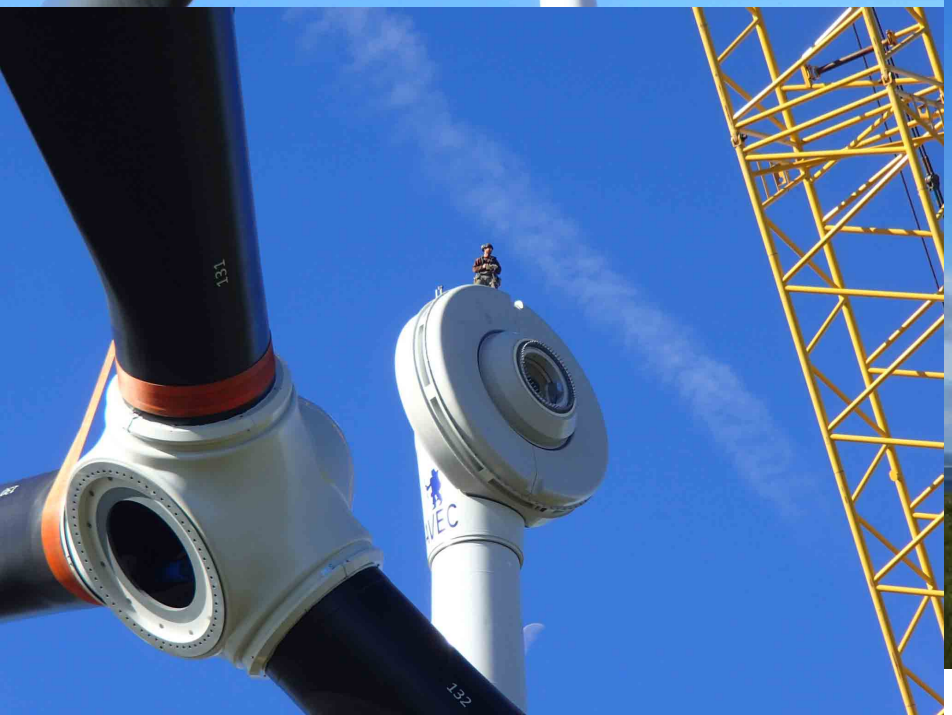


Turbine Construction 2018



Turbine Construction 2018

Turbine Construction 2018



Alaska Village Electric Cooperative, Inc./ Stebbins Native Corporation Renewable Energy Joint Venture

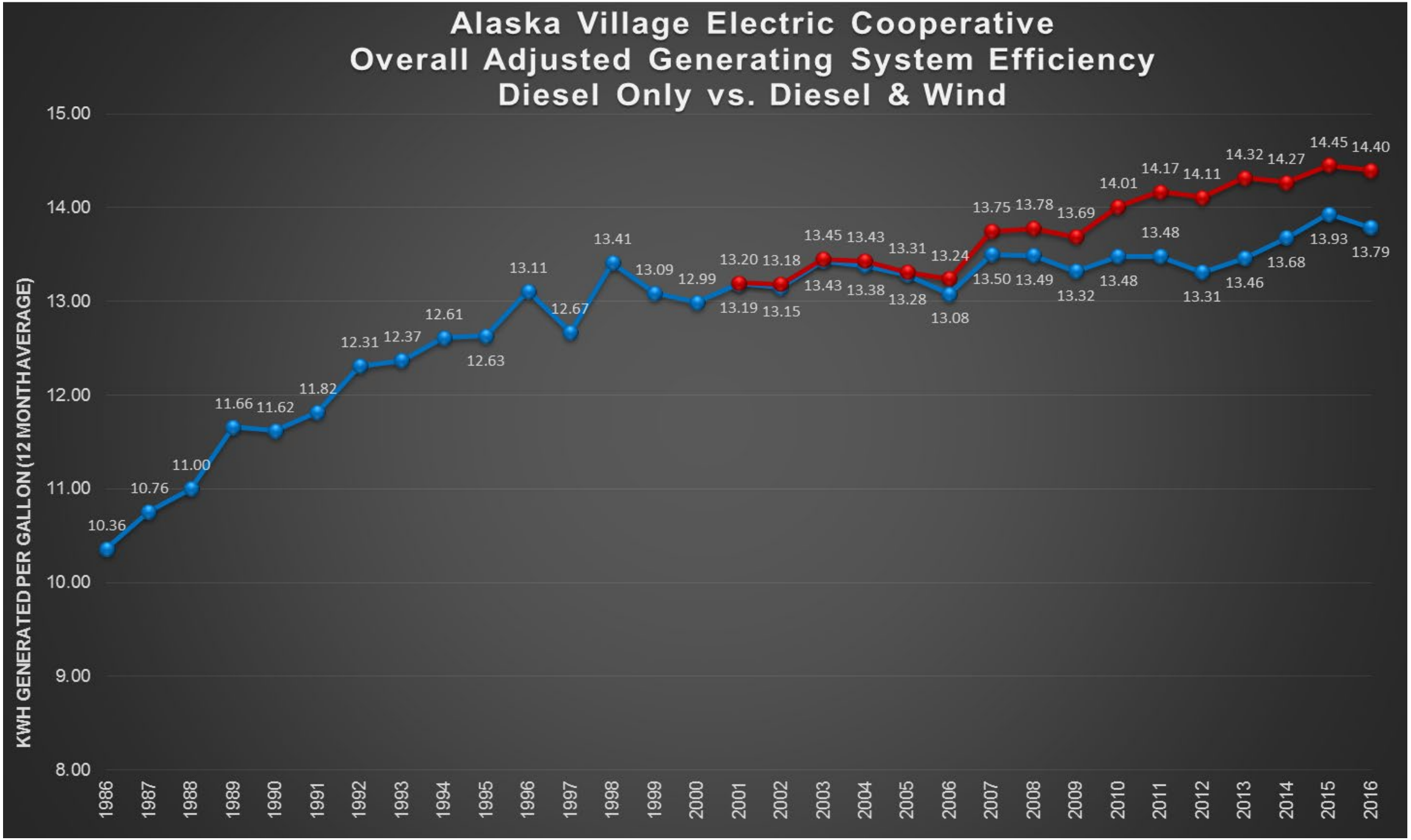
Stebbins / St. Michael Renewable Energy Construction Project

AVEC
ALASKA VILLAGE ELECTRIC COOPERATIVE

Figure 1. Project Vicinity

Install EWT 900kW Turbine

- Offset 104,700 of diesel
- Savings in first year $365,403
- Life time savings $11.4 million
- Project life 25 years
- NPV benefit $6.694 million
- Provide wind to heat


Alaska Village Electric Cooperative
Overall Adjusted Generating System Efficiency
Diesel Only vs. Diesel & Wind
KWH GENERATED PER GALLON (12 MONTH AVERAGE)
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
10.36
10.76
11.00
11.66
11.62
11.82
12.31
12.37
12.61
12.63
13.11
12.67
13.41
13.09
12.99
13.19
13.15
13.43
13.38
13.28
13.08
13.50
13.49
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13.48
13.48
13.31
13.46
13.68
13.93
13.79
13.20
13.18
13.45
13.43
13.31
13.24
13.75
13.78
13.69
14.01
14.17
14.11
14.32
14.27
14.45
14.40