MORE THAN A PIPE DREAM

AN ALASKA GRID

HOUSE SPECIAL COMMITTEE ON ENERGY

APRIL 16, 2019

Meera Kohler, President/CEO
Alaska Village Electric Cooperative

About Alaska Village Electric Cooperative

A non-profit member-owned electric cooperative

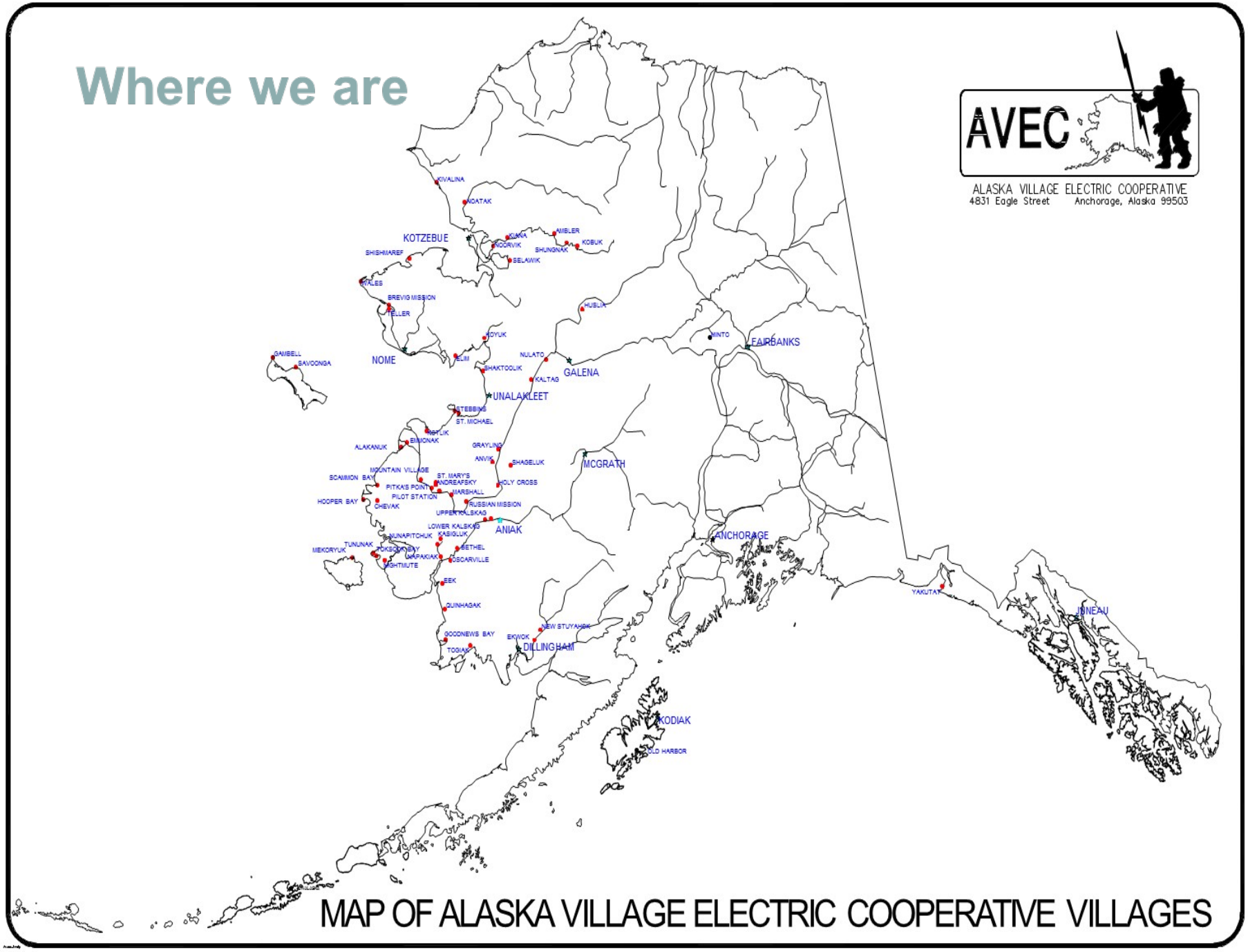
Electric service to 58 villages - 32,000 population

38% of Alaska's PCE population

System Information

- 90 full time employees
- 90+ part time employees
- 11,400 services
- 50 power plants
- 170+ diesel generators
- 500+ fuel tanks
- 8.6 million gallons of diesel
- 36 wind turbines serving 20 villages
- Two tug and barge sets

Where we are



MAP OF ALASKA VILLAGE ELECTRIC COOPERATIVE VILLAGES

The Cost of Rural Power

- 11,400 Services – residential and commercial
- 118 million kWh sales
- $52 million revenues
- $28 million Total Fuel Cost
- $25 million non-fuel cost
- 44¢ - Total revenue per kWh
- 397 kWh - Average residential usage per month
- 48¢ - Residential revenue per kWh
- Power Cost Equalization $10.7 million,
  - 21% of revenue, 41% of total PCE disbursed

What Alaska Spends on Heat and Power

From 2011 Alaska Power Statistics:

Electricity revenue	$1,024 million
Gas revenue – Southcentral	$564 million

Diesel – Fairbanks area	150 mm gallons
Diesel – Kodiak, Copper Valley, SE	68 mm gallons
Diesel – Rest of state	163 mm gallons
TOTAL	381 mm gallons

Diesel value at $4.00/gallon	$1,524 million
Annual cost of electricity/heat	$3,084 million
Expenditure in 20 years	**$61.7 billion**

Why an Alaska Grid?

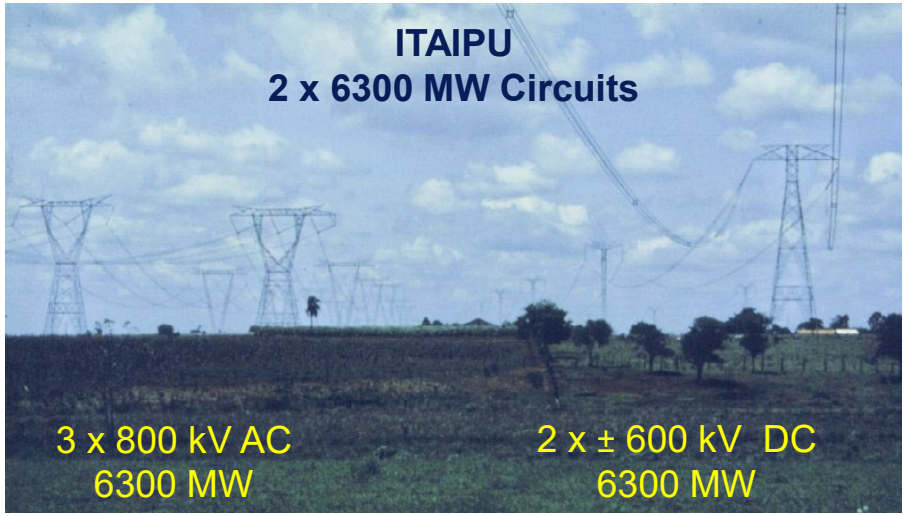
- Large scale, high efficiency gas-fired generation
- HVDC transmission to move power across Alaska
- Lower emissions with large-scale renewables for distant end-users
- Abundant power for
  - North Slope operations
  - Fairbanks and other Railbelt communities
  - Remote mines, military and processors
  - Heat and power for rural communities

HVDC has been in use since 1954

	Power (MW)	Voltage (kV)	Length (Miles)	Year Built
Cahora Bassa	1930	±533	887	1979
Pacific Intertie (WA to CA)	3100	±500	850	1985
Utah-California	1920	±500	490	1986
Quebec-N. England	2000	±450	925	1992
Three Gorges-Shanghai	3000	±500	662	2007
Xiangjiaba-Shanghai	6400	±800	1294	2010

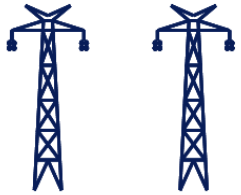
HVDC: CONNECTING THE WORLD

The Footprint of HVDC is Smaller than AC

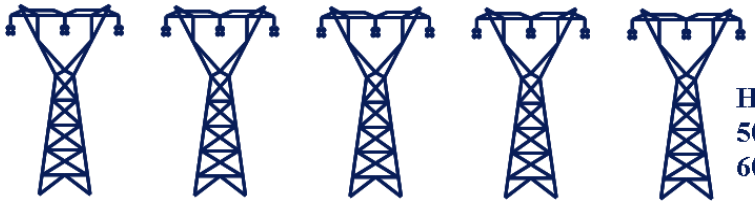


400 MW AC 3,000 MW DC

China: Three Gorges HVDC v AC



HVDC
500 kV
6000 MW



HVAC
500 kV
6000 MW

IN EUROPE

HVDC:
CONNECTING THE WORLD

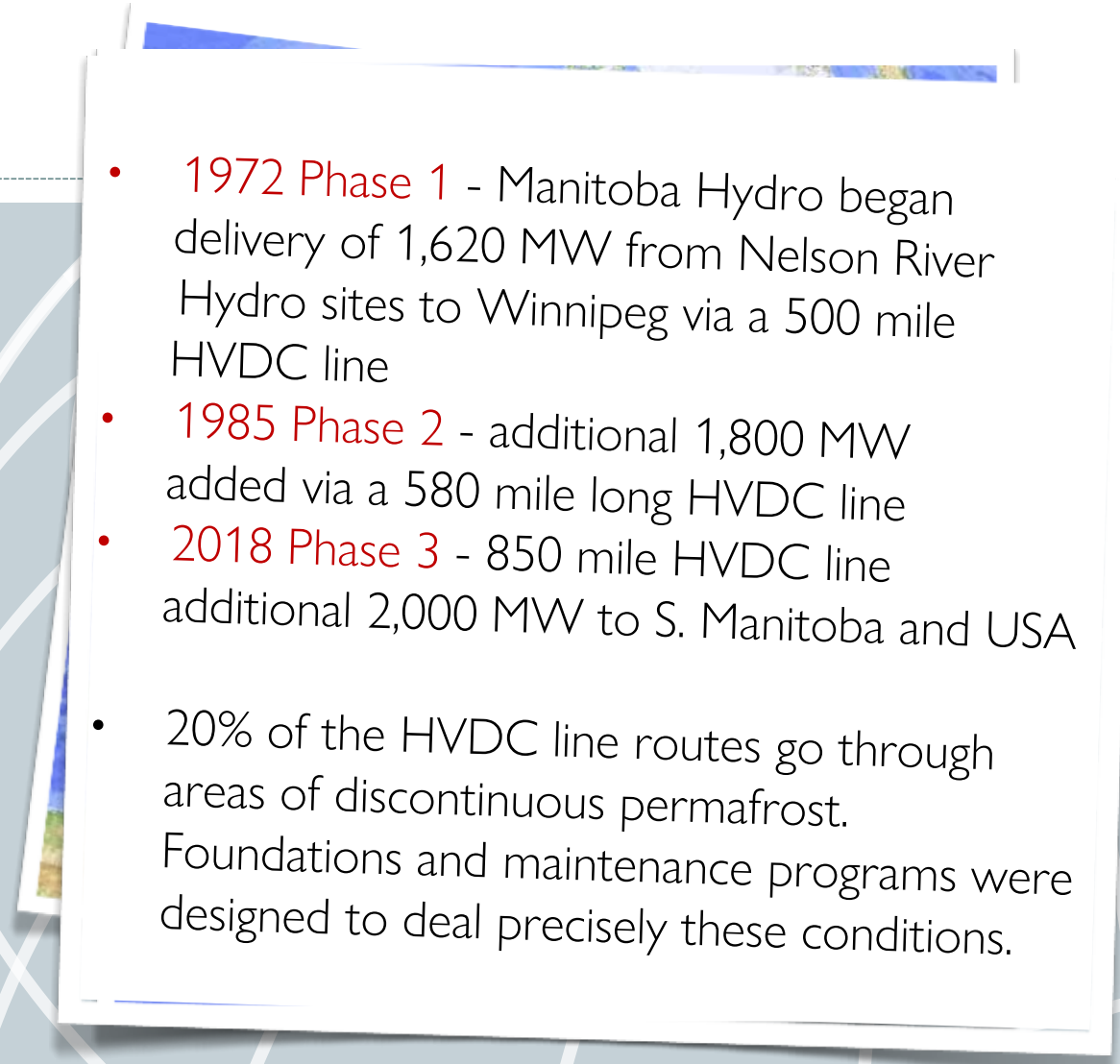
IN NORTH AMERICA

HVDC:
CONNECTING THE WORLD

IN CANADA

Manitoba Hydro

- Similar dimension/scale
- 500+ miles
- 68% of all power transmitted via HVDC



- 1972 Phase 1 - Manitoba Hydro began delivery of 1,620 MW from Nelson River Hydro sites to Winnipeg via a 500 mile HVDC line
- 1985 Phase 2 - additional 1,800 MW added via a 580 mile long HVDC line
- 2018 Phase 3 - 850 mile HVDC line additional 2,000 MW to S. Manitoba and USA

- 20% of the HVDC line routes go through areas of discontinuous permafrost. Foundations and maintenance programs were designed to deal precisely these conditions.

HVDC:

CONNECTING THE WORLD

IN ASIA

Xiangjiaba-Shanghai

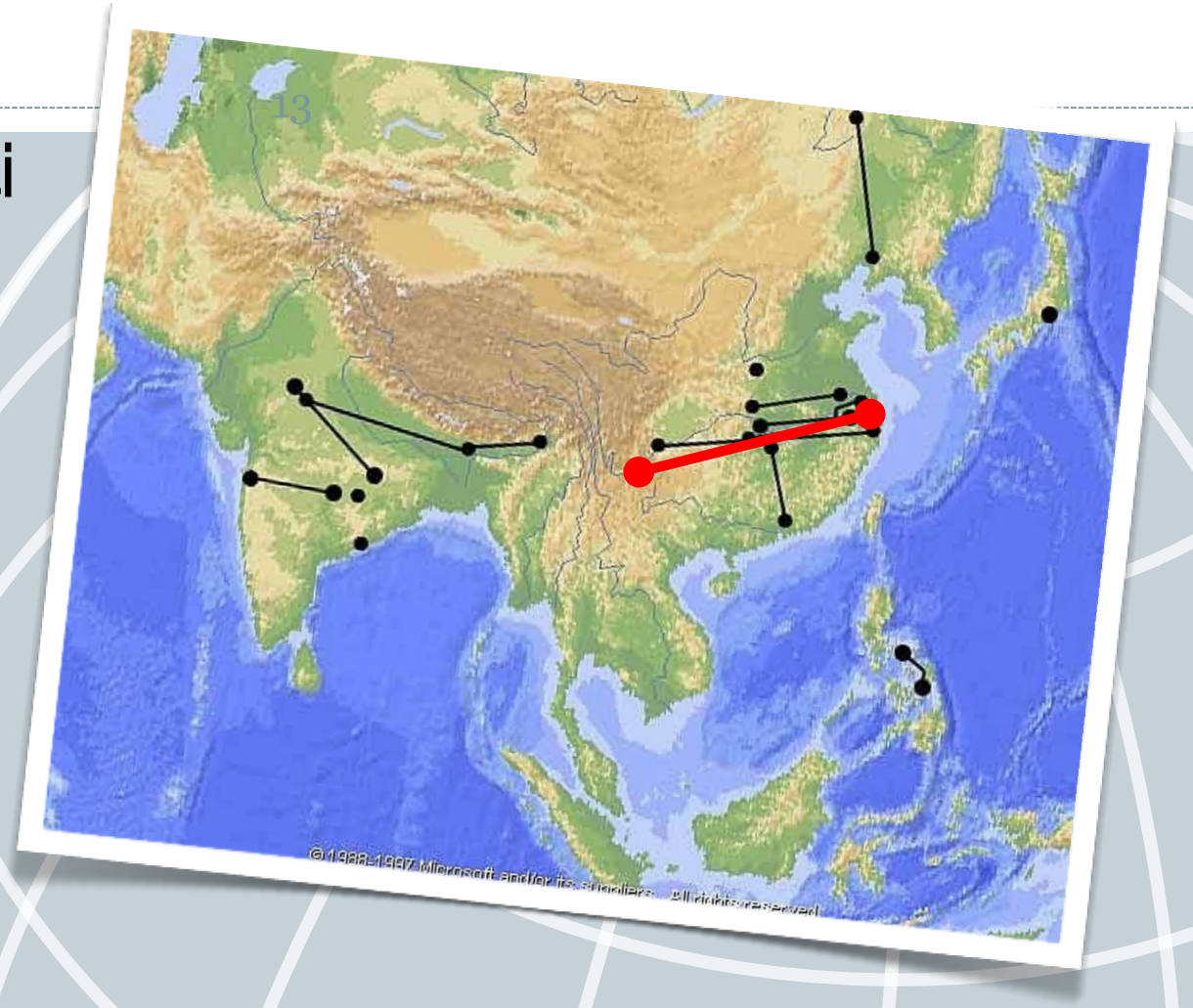
- 1,250+ miles
- 6,400 MW 800 kV
- Commissioned 2010

2013-2014:

- 27,400 MW
- 4,200 miles 800kV

2015:

- 58,000 MW
- 8,700 miles 800+kV



HVDC:

CONNECTING THE WORLD

Alaska Grid – Phase 1

2,000 MW Power Plant at the North Slope

- Provide electricity for North Slope activities
- Replace mechanical gas-fired systems with electric
- Provide avenue to integrate Arctic wind power

- Capital Cost: $2.5 Billion
- Delivered cost of power: $0.05/kWh

Alaska Grid Phase 2

HVDC transmission to Fairbanks

- Power for GVEA – adequate to provide space heat
- Adequate energy for Fort Knox
- Adequate energy for Livengood mining district

- Capital Cost: $1.65 Billion
- Delivered cost of power: $.05 + $.015 = $.065/kWh
- $18/mcf gas at 85% efficiency = $.072/kWh

Alaska Grid Phase 3

HVDC transmission to West Coast

- Adequate energy supply for Ambler mining district
- Power for Red Dog mine
- Power for Kotzebue/Nome area (electricity and heat)
- Pathway for West Coast wind power

- Capital Cost: $900 Million
- Delivered cost of power: $.065 + $.107 = $.172 (40% of capacity) $.12 (85% of capacity)
- $4.00 diesel with 85% efficiency for heat = $.125/kWh

Alaska Grid Phase 4

HVDC transmission to Y-K area

- Adequate power for Donlin Gold
- Adequate power for Bethel and surrounding area

- Capital Cost: $510 million
- Delivered cost of power: $.065 + $.058 = $.123 (40% of capacity) $0.098 (85% of capacity)

Alaska Grid Phase 5

HVDC transmission to South-Central

- Adequate power to supplement local generation
- Pathway to move hydropower from Susitna
- Pathway to integrate tidal/geothermal power

- Capital Cost: $1.2 Billion
- Delivered cost of power: $.065 + $.022 = $.087

COMBINED PROJECT COSTS

2GW Power Plant

$3/MCF gas; 7%/30 year money
@ 80% capacity = 14 billion kWh

Current Alaska Sales = 6.5 billion kWh

5GW Power Plant

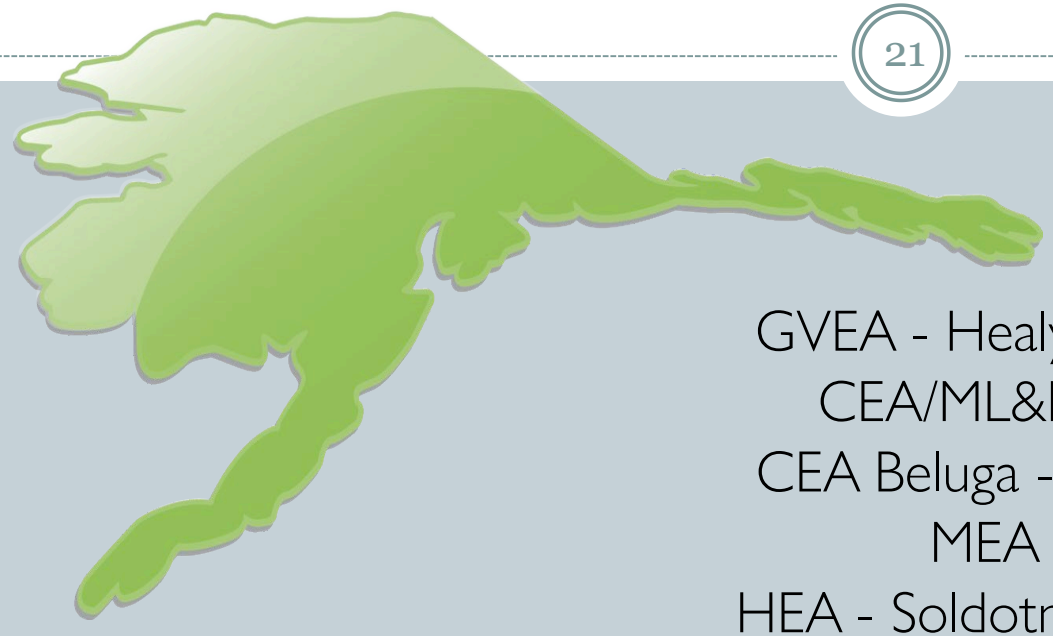
Phases 1-5	$6.76B
+ 3GW increase in capacity	$3.75B
	$10.5B

@ 80% capacity = 35 billion kWh

What Else is Under Consideration?

Susitna-Watana Dam	$6.50B
Susitna Access	$0.50B
Railbelt Transmission Upgrades	$1.00B
Fairbanks LNG Trucking	$0.43B
Bullet Gas Line from NS	$8.20B
	$16.63B

RECENT UTILITY PROJECTS



GVEA - Healy Restart	50MW	$100M
CEA/ML&P - SCPP	183MW	$359M
CEA Beluga - Standby	(200MW)	
MEA - Eklutna	180MW	$250M
HEA - Soldotna/Nikiski	90MW	$150M
ML&P Plant 2 - Replacement	120MW	$225M
ML&P Plant 2 - Standby	(220MW)	
	203MW	$1,084M

Almost no additional electric generation capacity

A lot of stranded generation capacity

POSSIBLE UNMET ENERGY NEEDS

North Slope Operations	300 MW
Gas Turbine Conversion	1000 MW
Pipeline Operations	100 MW
Ambler Mining District	300 MW
Red Dog/Nome	100 MW
Donlin Creek	180 MW
Refining/Smelting	500 MW
Processors	100 MW
Value-Add	200 MW
Server Farm	500 MW
Electric Heat	500 MW
	3780 MW

Affordable cost of energy is the answer!

HOW MUCH GAS WOULD IT TAKE?

North Slope gas reserves are
235 trillion cubic foot (tcf)

- 0.8 MW project uses 38 bcf/year - **1.14 tcf** in 30 years (0.5%)
- 1.7 GW project uses 76 bcf/year - **2.28 tcf** in 30 years (1.0%)
- 2.5 GW project uses 113 bcf/year - **3.4 tcf** in 30 years (1.5%)
- 5.0 GW project uses 226 bcf/year - **6.8 tcf** in 30 years (2.9%)

We can have our cake and eat it too!

The Benefits of Connecting Alaska

- Reduce the number of power plants
- Consolidated loads improve economics of interconnection.
- Larger loads make renewables like wind or hydro feasible
- A grid allows large scale development of renewables to serve loads across the state

Toksook Bay – Tununak intertie

Let's ship "Made in Alaska" not "Pieces of Alaska"

Meera Kohler
President and CEO
Alaska Village Electric Cooperative
(907) 565-5531
mkohler@avec.org