MORE THAN A PIPE DREAM

THE ALASKA GRID

RESOURCE DEVELOPMENT COUNCIL
DECEMBER 19, 2013
ANCHORAGE, ALASKA

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Alaska Village Electric Cooperative

About Alaska Village Electric Cooperative

A non-profit member-owned electric cooperative

Electric service to 55 villages – soon to be 56 with Bethel

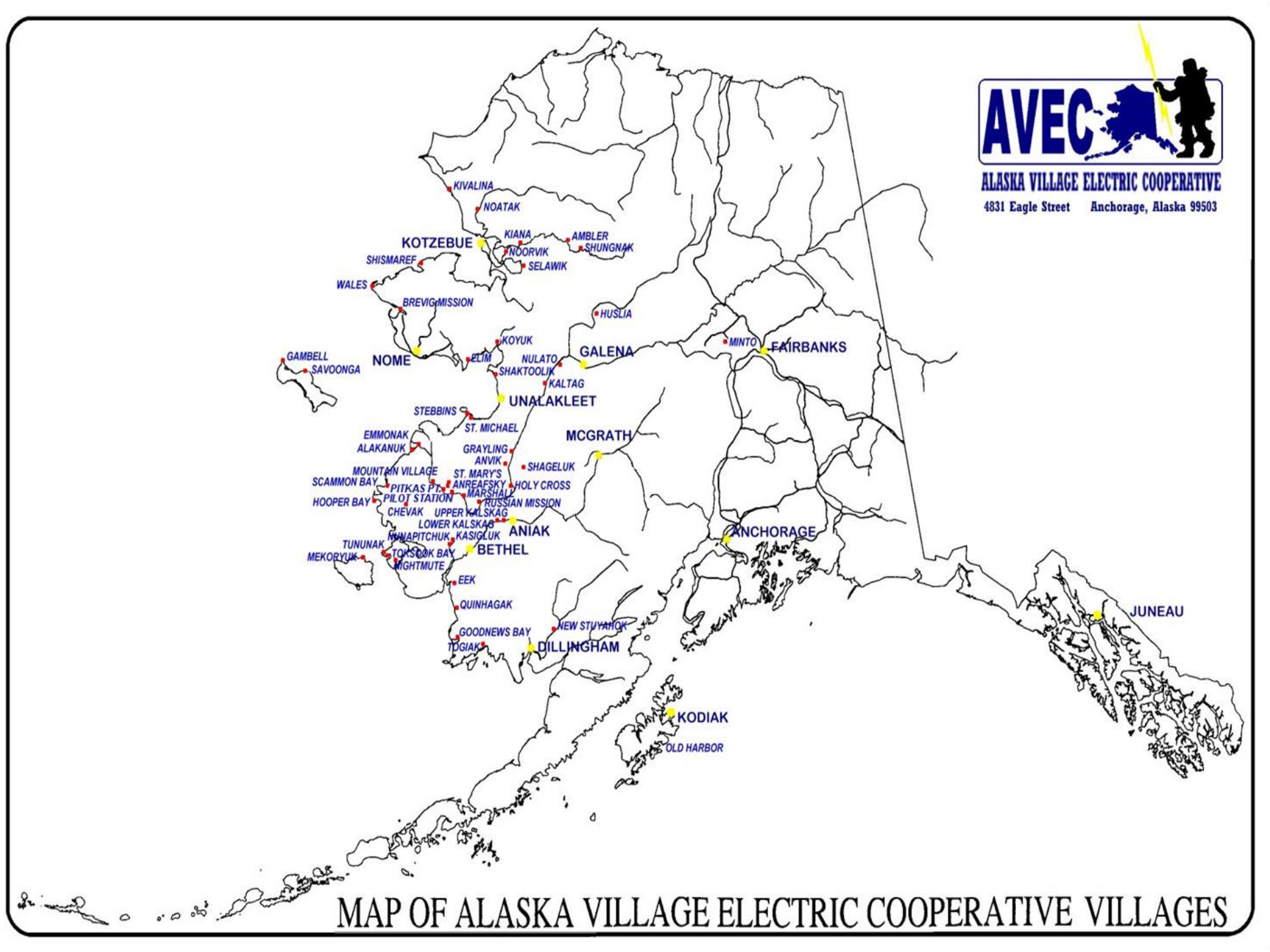
Population of 22,800 – 4th largest community in Alaska
44% of Alaska's village population

Shageluk – 69
Hooper Bay – 1,114
Average 415

Anchorage – 298,610

System Information

- 73 Anchorage-based employees
- 8,000 services
- 48 power plants
- 165+ diesel generators
- 95 village technicians
- 500+ fuel tanks
- 5.5 million gallons of diesel
- 34 wind turbines serving 14 villages
- Two tug and barge sets



MAP OF ALASKA VILLAGE ELECTRIC COOPERATIVE VILLAGES

Putting it in Perspective

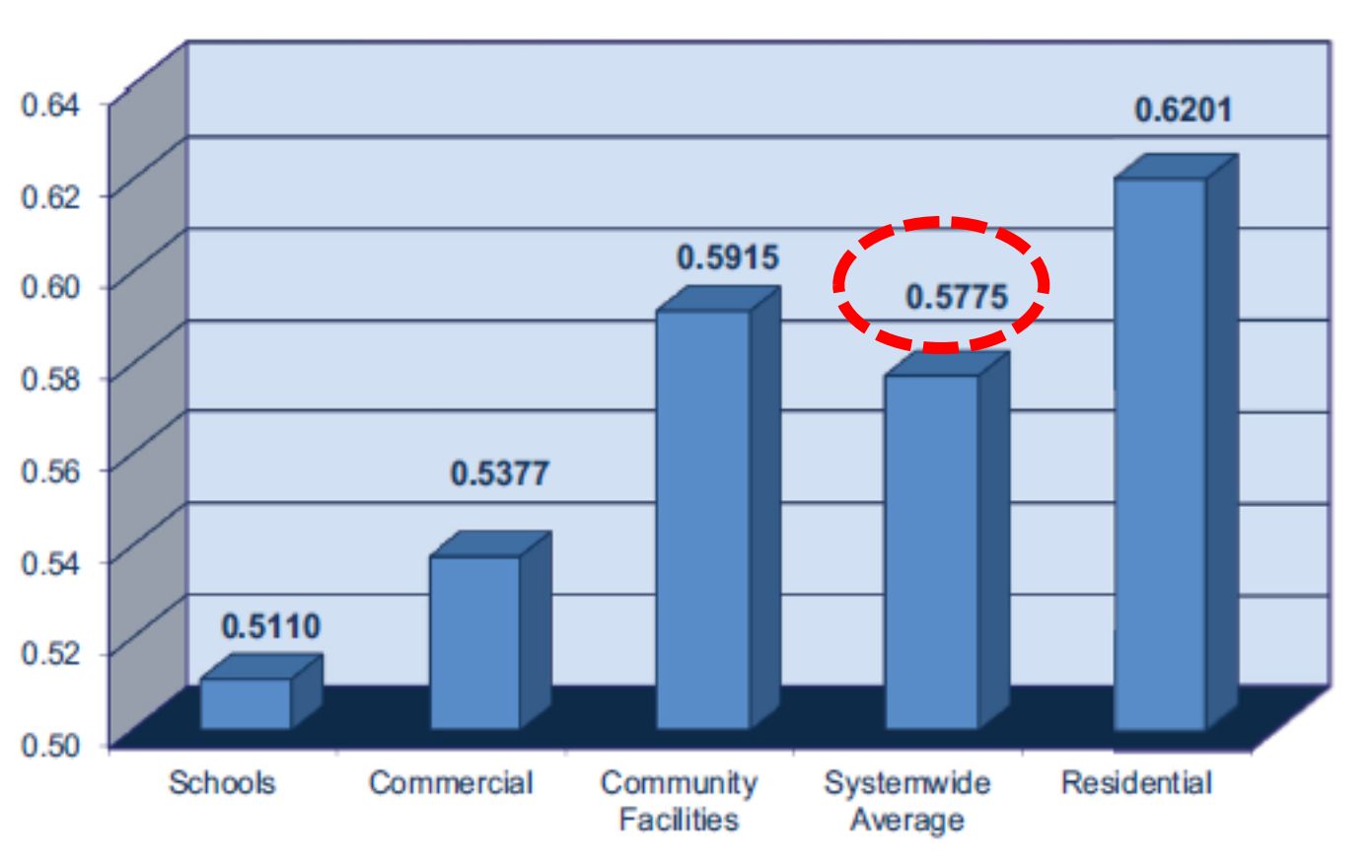
AVEC's kWh Sales in 2012

KWh sales in all 55 villages

Residential	31.1 million
Commercial	13.8 million
Street Lights	0.6 million
Public Buildings	28.5 million
TOTAL	74.0 million
Revenue	$42.7 million

Average sales per village 1,345,000 kWh

What Does Our Electricity Cost?



Anchorage $0.14 (AVEC = x 4.5)
Fairbanks $0.185 (AVEC = x 2.5)

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**

Alaska has an Energy Problem

Southcentral Alaska is running out of gas and must import LNG or pay 2 – 3 x Henry Hub rates to provide for utility needs.

Rural communities use diesel for almost all of their energy needs. No other technology is as reliable or well tested.

Fairbanks uses diesel for half their electric generation and much of their space heating needs. Home energy expenditures now rival the mortgage – especially in winter. Air quality is a major issue.

Growing energy demands in emerging economies will continue to apply upward pressure on the cost and supply of petroleum fuels.

Energy is scarce and expensive and will become even more so

A Solution: The Alaska Grid

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

What is HVDC?

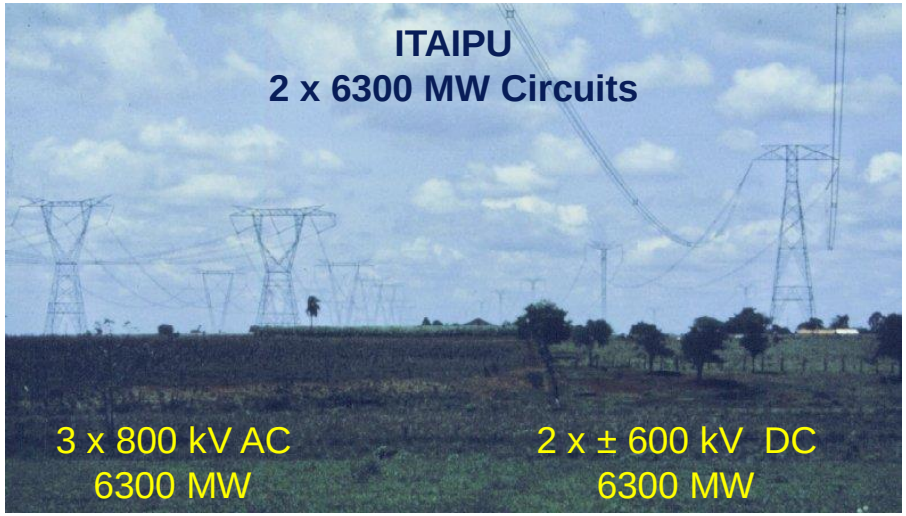
- A highly efficient means to move electrical power over long distances. The technology has evolved tremendously in recent decades.
- The transmission line is inexpensive but the converter stations are expensive. The original technology made it impractical for distances of less than 300 miles.
- Recent technology advances have greatly reduced the cost of converter stations, making HVDC a viable option to move bulk power in many applications. Technically, it offers many attributes not practical in AC transmission systems.
- Low Losses - similar to those of a gas pipeline.

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

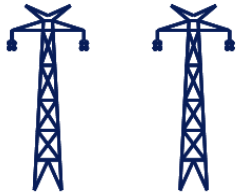
HVDC: CONNECTING THE WORLD

The Footprint of HVDC is Smaller than AC

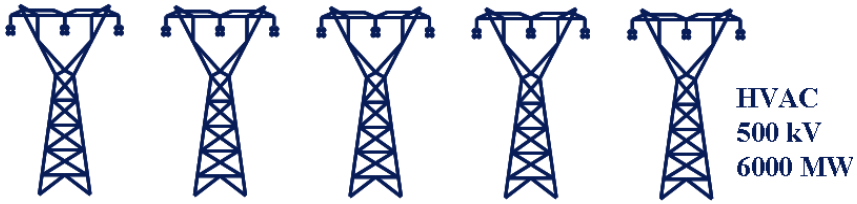


400 MW AC 3,000 MW DC

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
- 2017 Phase 3 - 800 mile HVDC line 5 GW from Hudson Bay to Winnipeg

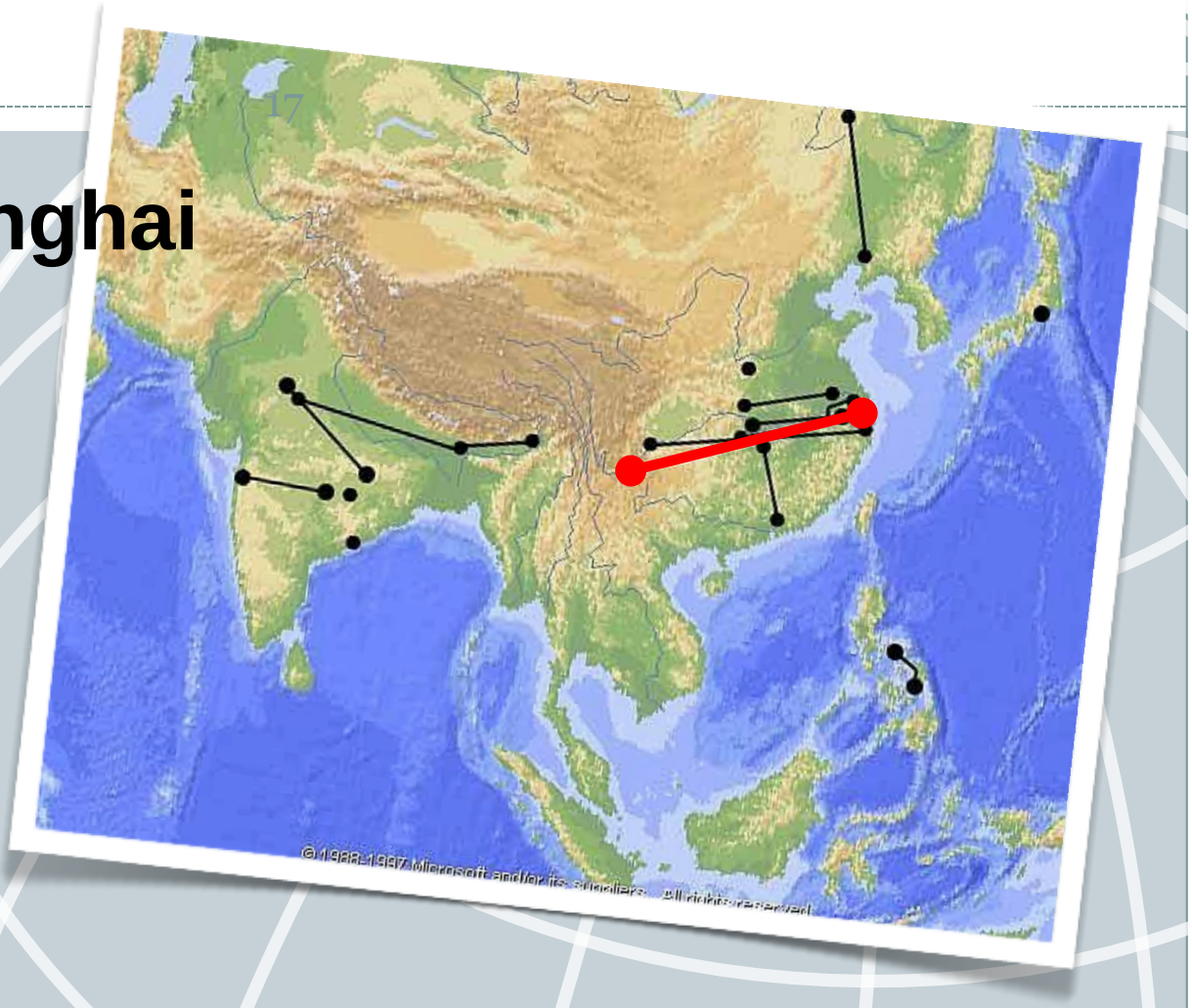
- 20% of the HVDC line routes go through areas of discontinuous permafrost. Foundations and maintenance programs were designed to deal precisely these conditions.

HVDC:
CONNECTING THE WORLD

IN ASIA

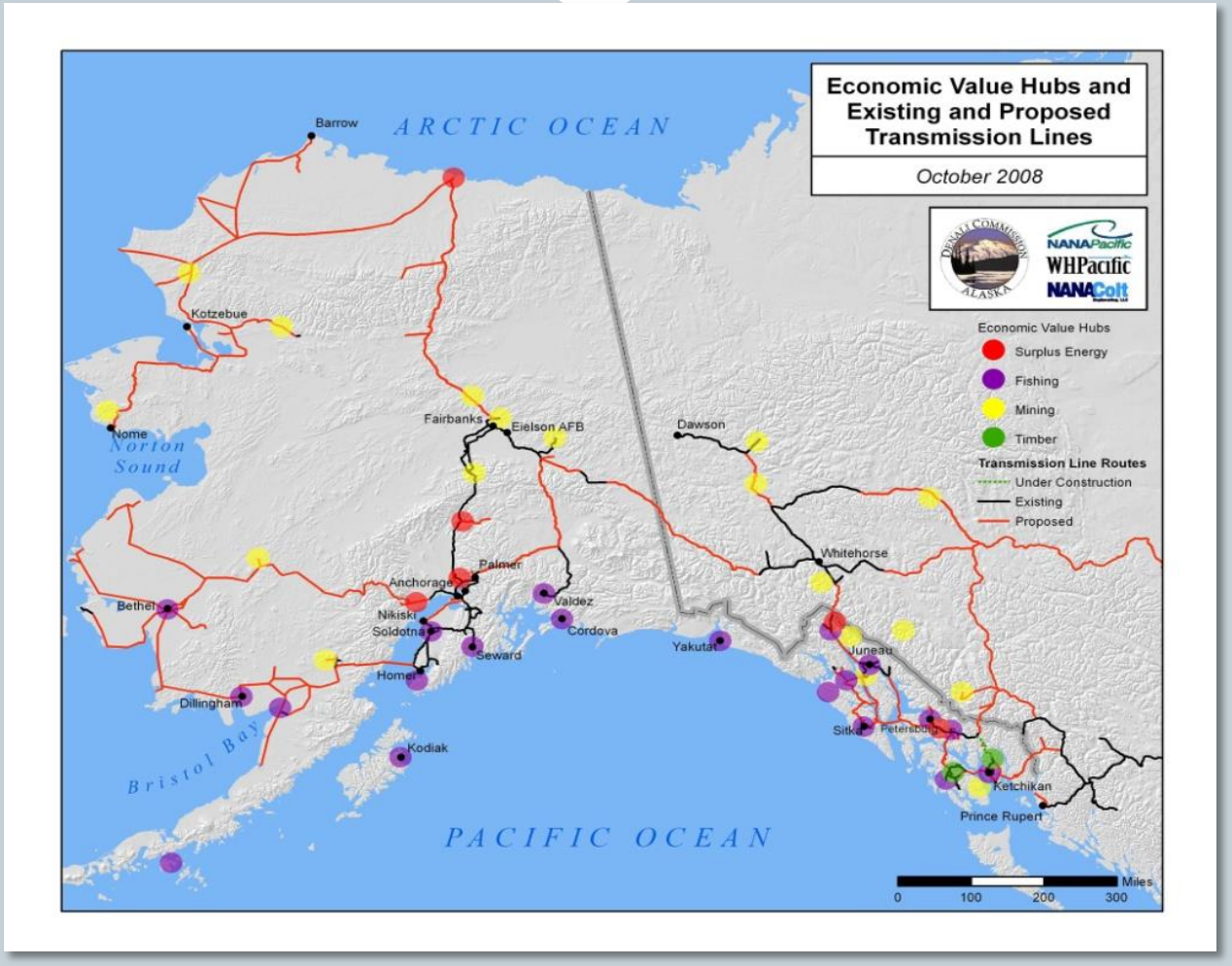
Xiangjiaba-Shanghai

- 1,250+ miles
- 8,000 MW
- $3.7 Billion
- Planned for 2014



HVDC:
CONNECTING THE WORLD

From a 2008 Study for the Denali Commission



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

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)

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)

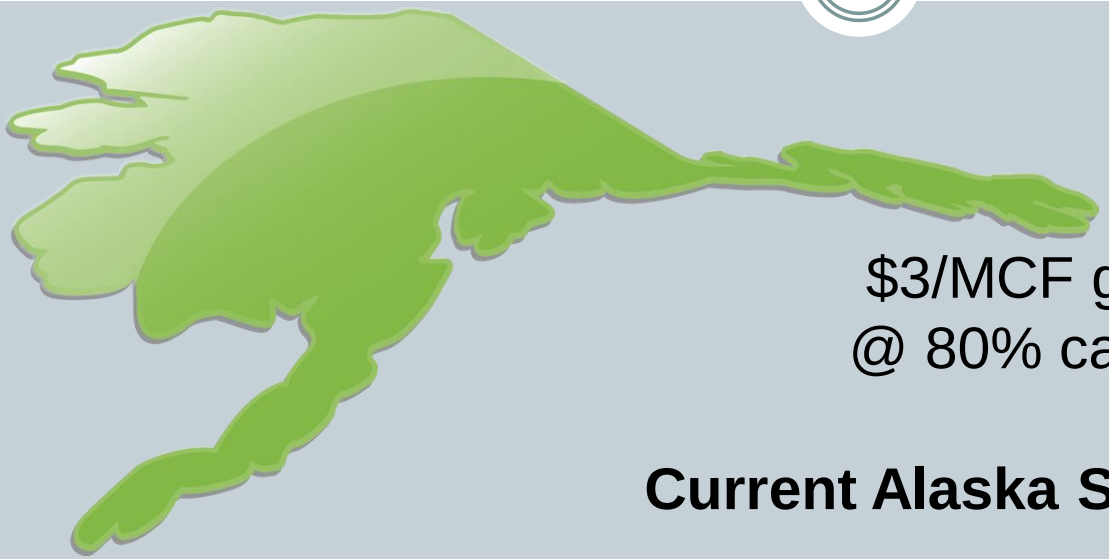
Alaska Grid Phase 5

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

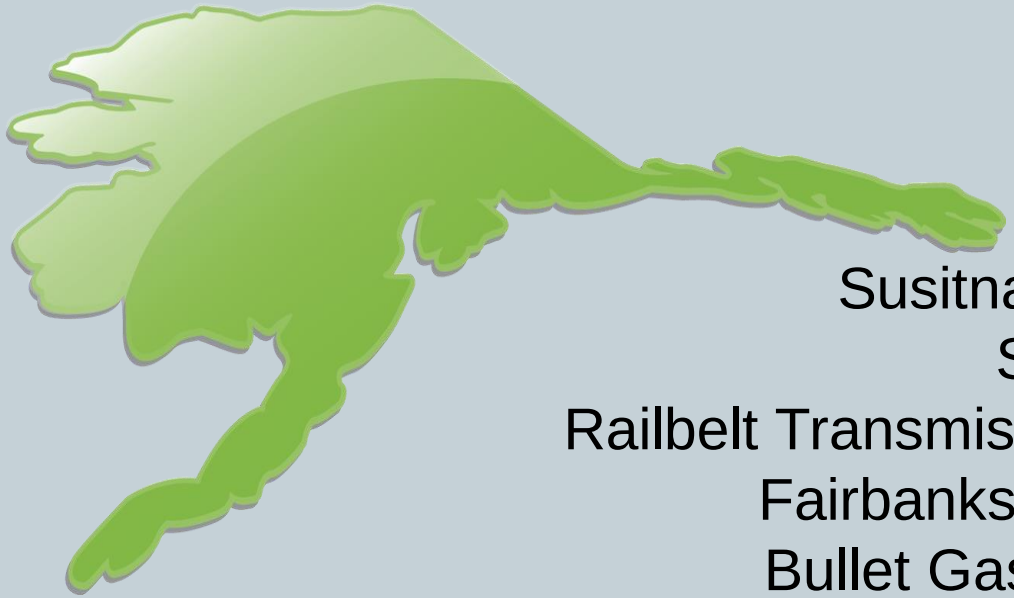
Current Alaska Sales = 6.5 billion kWh

5GW Power Plant

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

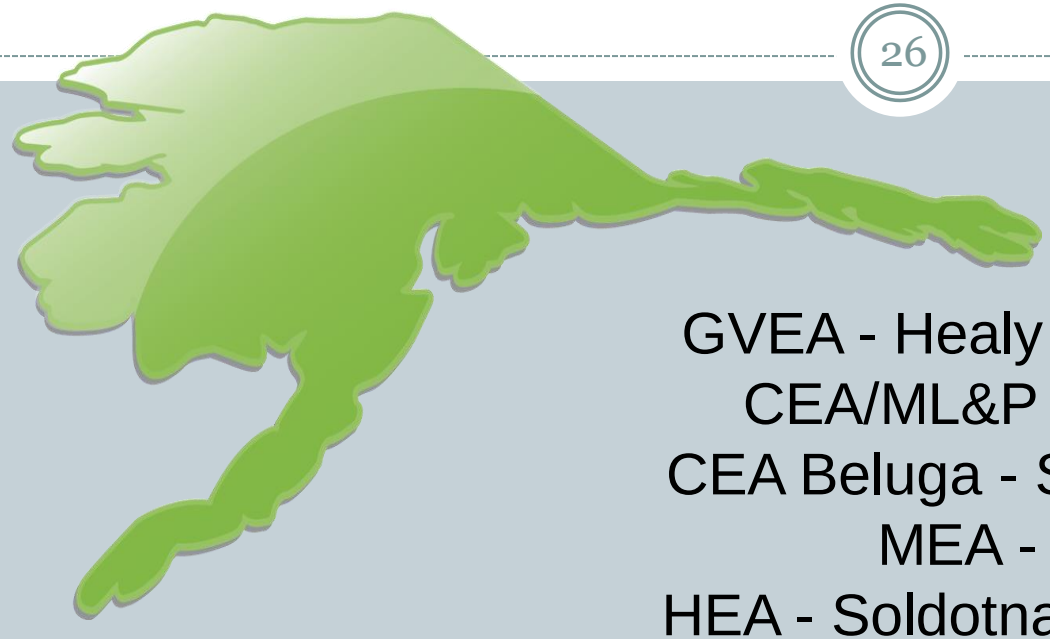
@ 80% capacity = 35 billion kWh

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

CURRENT 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

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!

DO WE COMPETE WITH GAS EXPORTS?

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 connecting to other generation sources such as the Railbelt or a statewide grid
- Larger loads make renewables like wind or hydro feasible locally
- A transmission grid allows large scale development of wind, hydro, geothermal etc. to serve loads across the state

Toksook Bay – Tununak intertie

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

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