04/04/14 INFORMATIONAL HEARING: ALASKA COAL AND CLEAN COAL TECHNOLOGY

<TARGET><BILL></BILL><SUBJECT>04-04-14 INFORMATIONAL HEARING ALASKA COAL AND CLEAN COAL TECHNOLOGY</SUBJECT><COMM>SRES28</COMM></TARGET>

ALASKA STATE LEGISLATURE

Sen. Cathy Giessel, Chair
Sen. Fred Dyson, Vice Chair
Sen. Lesil McGuire
Sen. Anna Fairclough
Sen. Click Bishop
Sen. Peter Micciche
Sen. Hollis French

State Capitol, Room 427
Juneau AK 99801-1182
907-465-4843
Fax: 907-465-3871
800-465-4843

Senate Resources Committee

Butrovich Room 205
Friday, April 04, 2014
3:30 p.m. – 5:30 p.m.

AGENDA

Informational Hearing: "Alaska Coal and Clean Coal Technology"

- **Alaska Coal: Abundance and Composition**
  - Dan Graham, President, Alaska Coal Association
  - Lorali Simon, Secretary and Treasurer, Alaska Coal Association

- **Coal Power Generation and Coal Conversion Technology**
  - Brent Sheets, Deputy Director, Alaska Center for Energy and Power

- **The Healy II Power Plant and Obstacles of Technology Usage (via Teleconference)**
  - Cory Borgerson, CEO/President, Golden Valley Electric Association
  - Mike Wright, Vice President Transmission and Distribution, Golden Valley Electric Assoc.

- **Cutting Edge Clean Coal Technology and Future Possibilities in Alaska**
  - Buddy Paul, Chief Science Officer, Vivify Inc.
  - Jason Herring, Chief Executive Officer, Vivify Inc.
  - Bruce Fomhoff, Chief Operating Officer/Chief Technology Officer, Vivify Inc.
  - Justin Potts, Vice President, Vivify Inc.

ALASKA COAL ASSOCIATION

Potential Opportunities – Alaska's Coal Industry

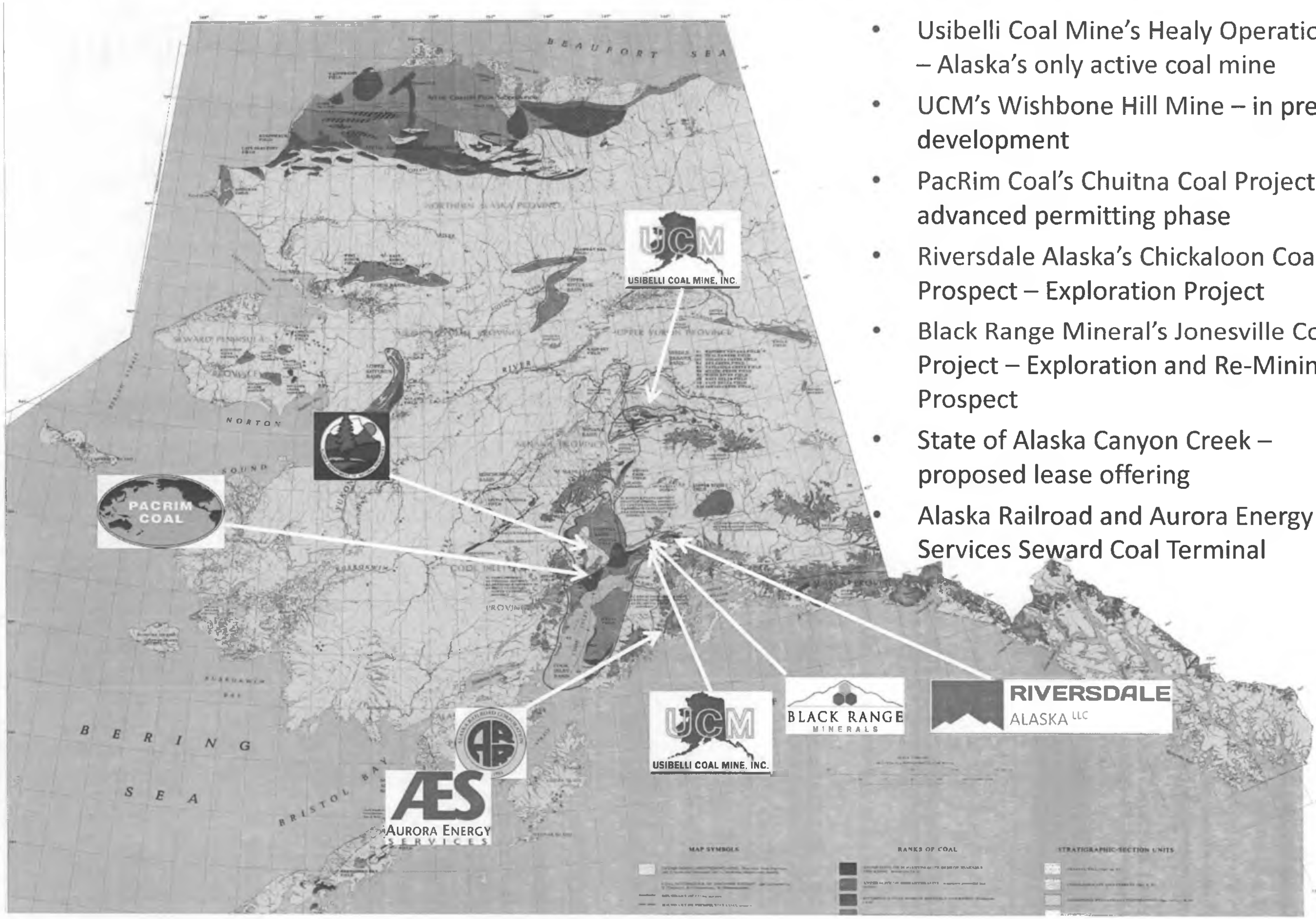
Senate Resources Information Hearing
April 4, 2014

Dan Graham, PE, President
Lorali Simon, Vice-President
Alaska Coal Association

UCM USIBELLI COAL MINE, INC. · PACRIM COAL · BLACK RANGE MINERALS · AES AURORA ENERGY SERVICES · RIVERSDALE ALASKA LLC · GVEA Golden Valley Electric Association

ALASKA COAL ASSOCIATION

Alaska's Coal Resources



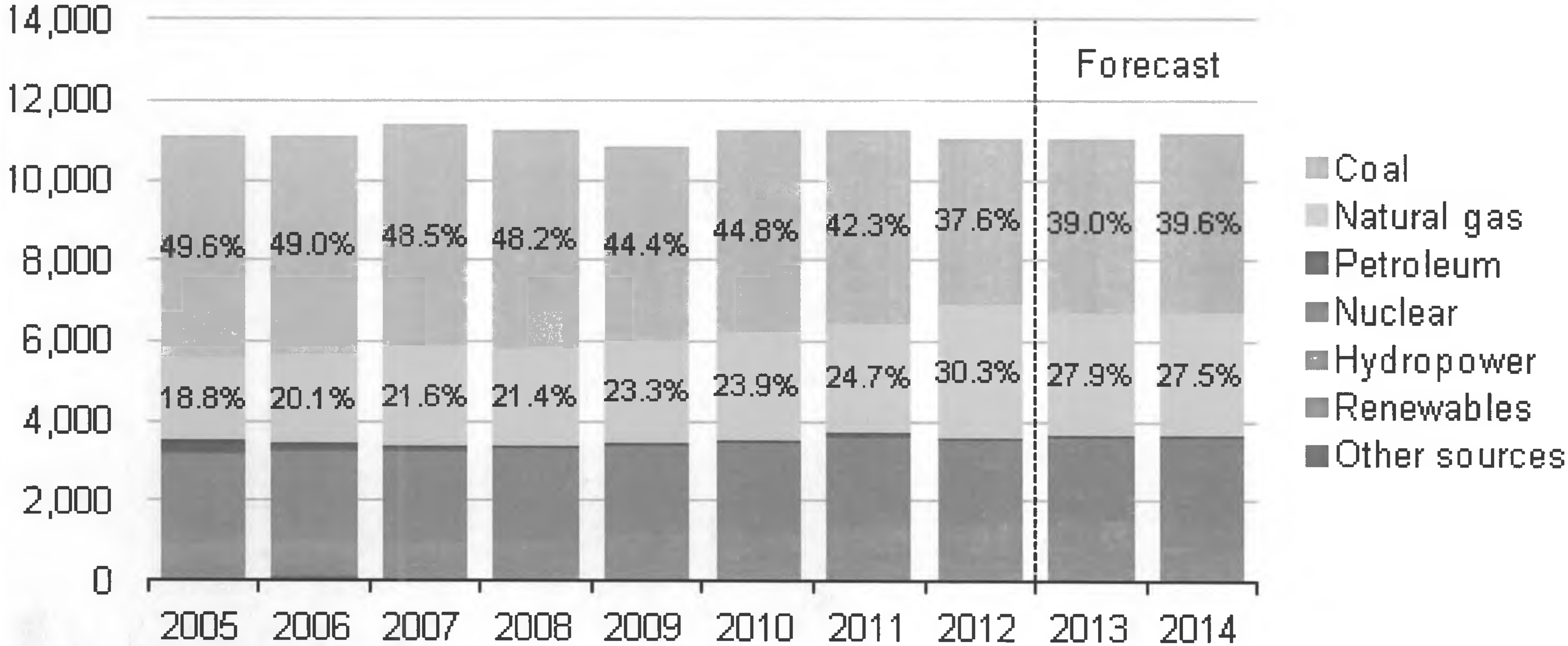
- Usibelli Coal Mine's Healy Operations – Alaska's only active coal mine
- UCM's Wishbone Hill Mine – in pre-development
- PacRim Coal's Chuitna Coal Project – in advanced permitting phase
- Riversdale Alaska's Chickaloon Coal Prospect – Exploration Project
- Black Range Mineral's Jonesville Coal Project – Exploration and Re-Mining Prospect
- State of Alaska Canyon Creek – proposed lease offering
- Alaska Railroad and Aurora Energy Services Seward Coal Terminal

ALASKA COAL ASSOCIATION

Why Coal Now?

U.S. Electricity Generation by Fuel, All Sectors

thousand megawatthours per day



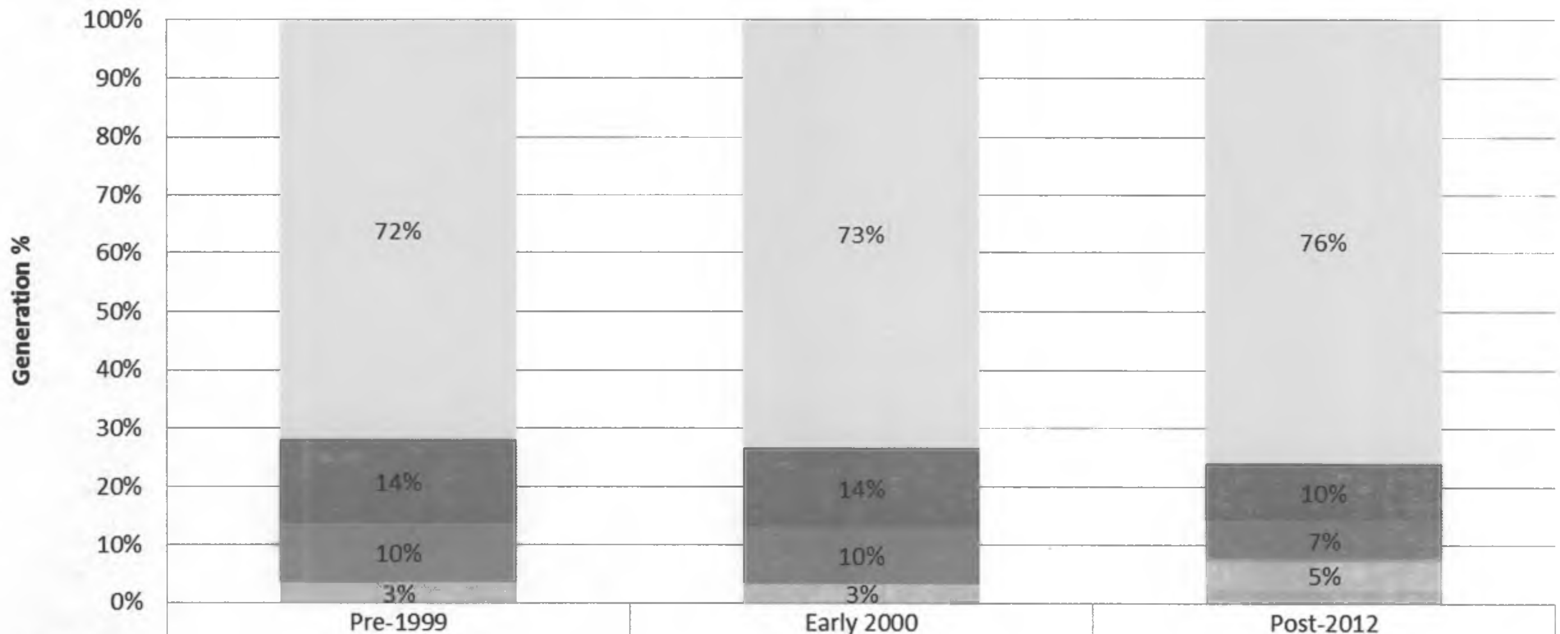
Note: Labels show percentage share of total generation provided by coal and natural gas.

Source: Short-Term Energy Outlook, January 2013

ALASKA COAL ASSOCIATION

In-State Coal Use

Alaska Railbelt Electric Generation Mix

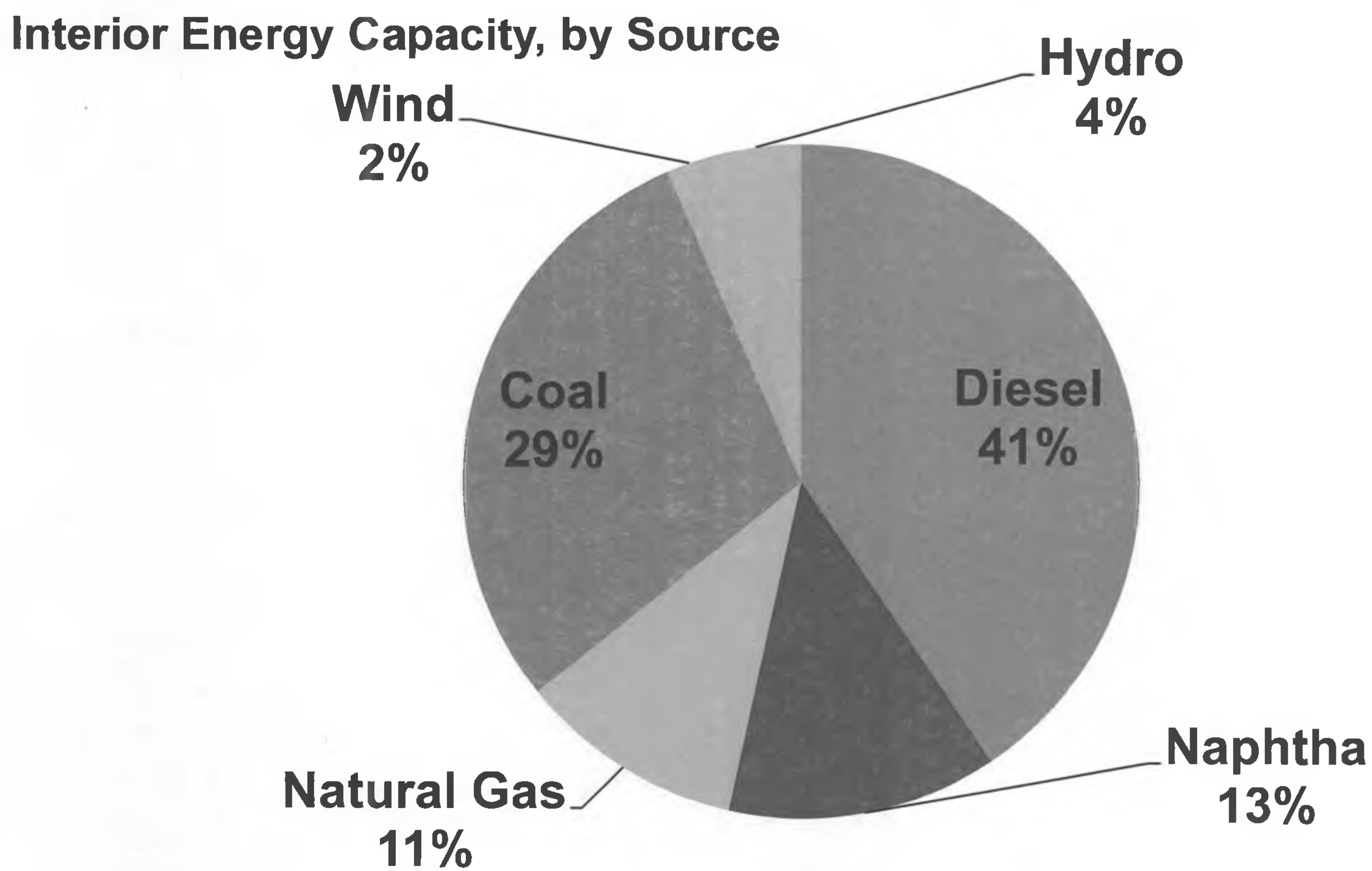


	Pre-1999	Early 2000	Post-2012
Gas	72%	73%	76%
Hydro	14%	14%	10%
Petroleum	10%	10%	7%
Coal	3%	3%	5%
Wind	0%	0%	2%

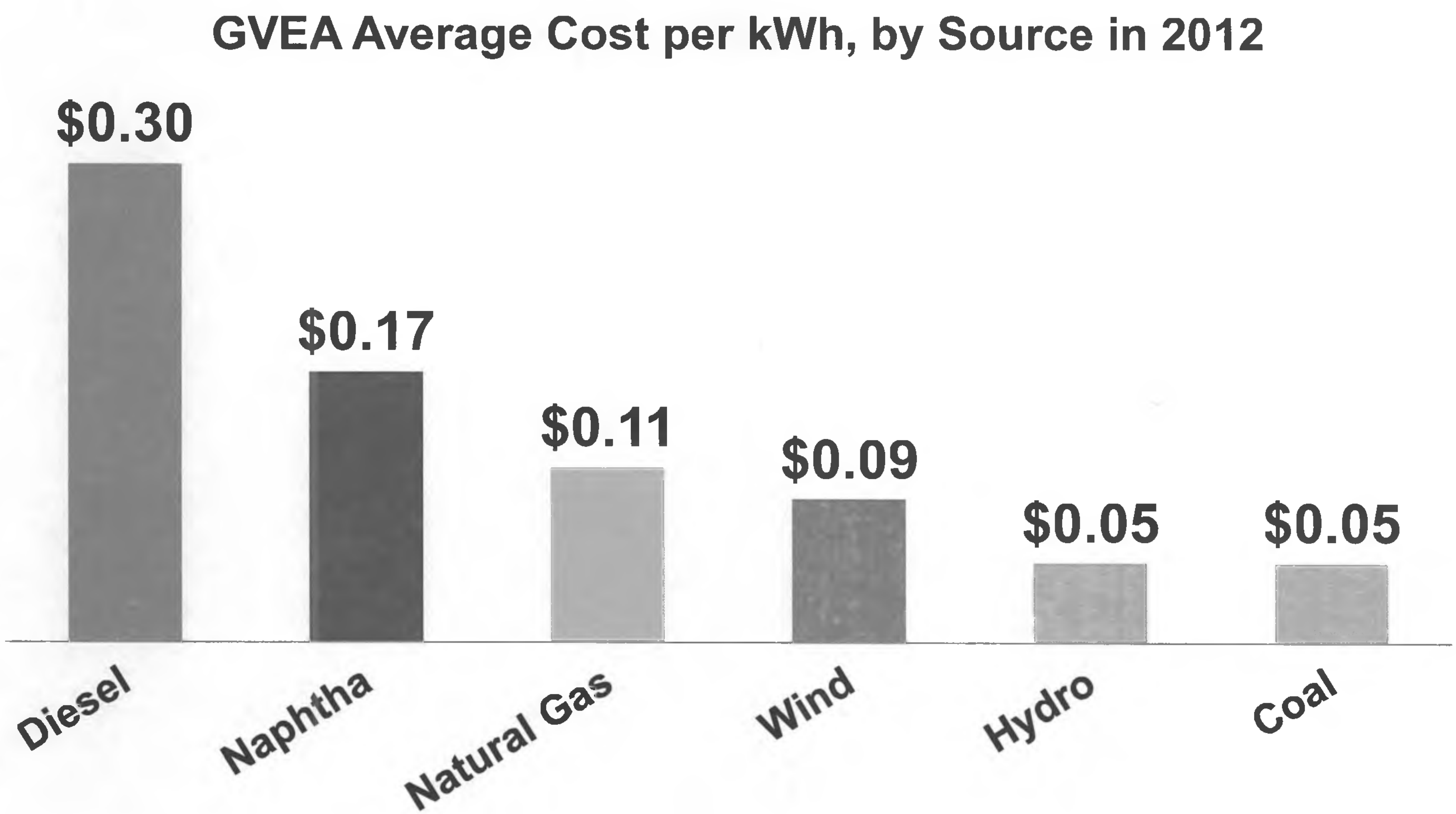
*Data Sources: Railbelt Energy Study, January 2004, RW Beck; Personal Communications, utilities

ALASKA COAL ASSOCIATION

Coal is a critical source of Interior Alaska energy.

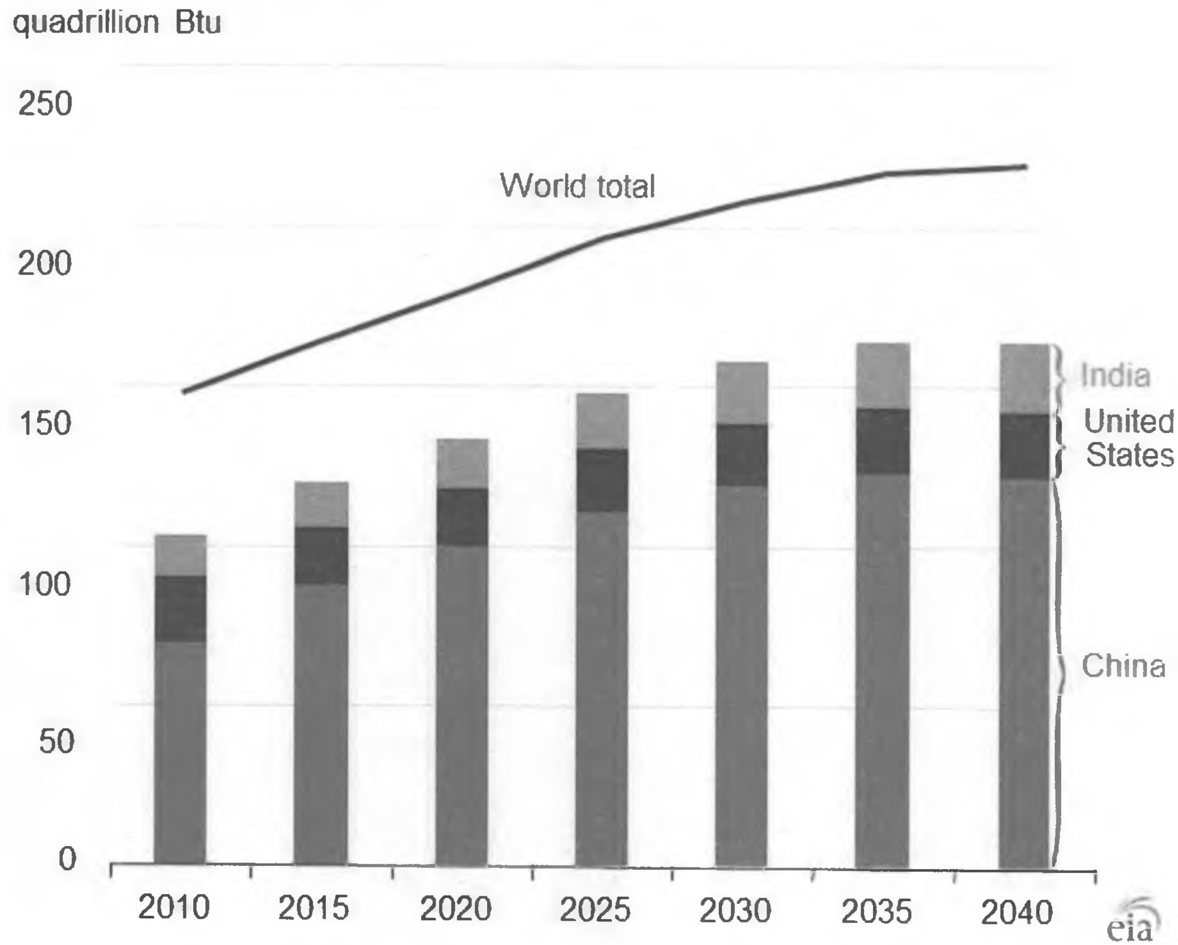


Coal is the Interior's lowest-cost source of energy.



Markets for Alaska Coal

Figure 71. World coal consumption by leading consuming countries, 2010-2040

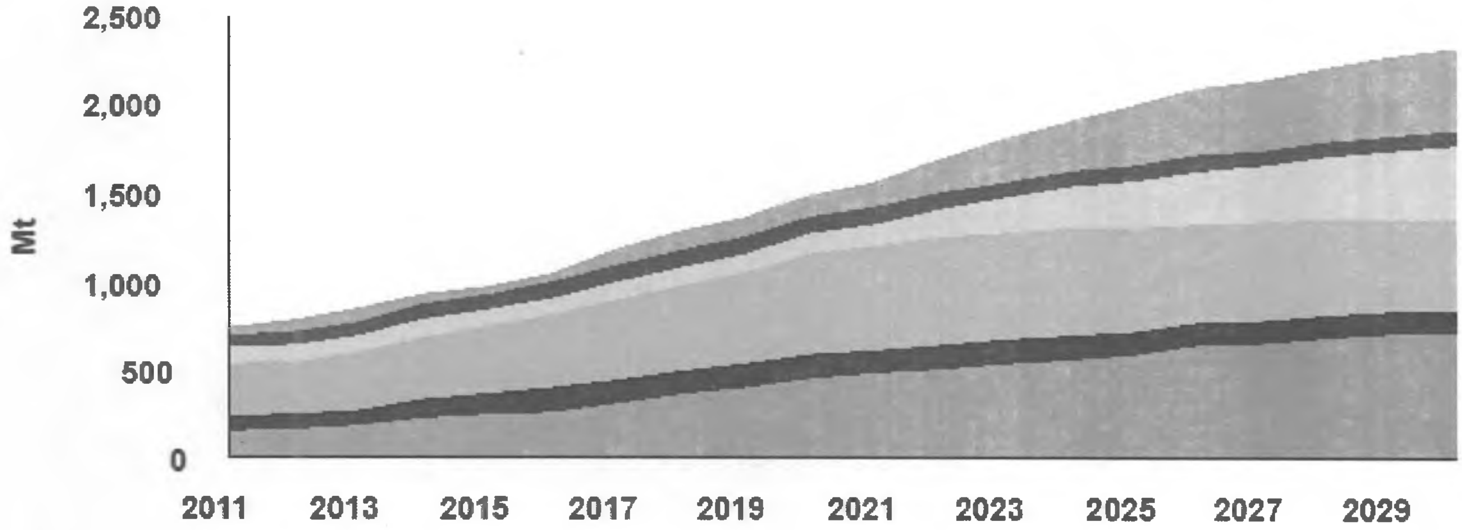


ALASKA COAL ASSOCIATION

Future Coal Supplies

www.woodmac.com

Major suppliers – great expansion required



Source: Wood Mackenzie Coal Market Service

Wood Mackenzie

Strategy with substance

ALASKA
COAL ASSOCIATION

Benefits of the Coal Industry to Alaska

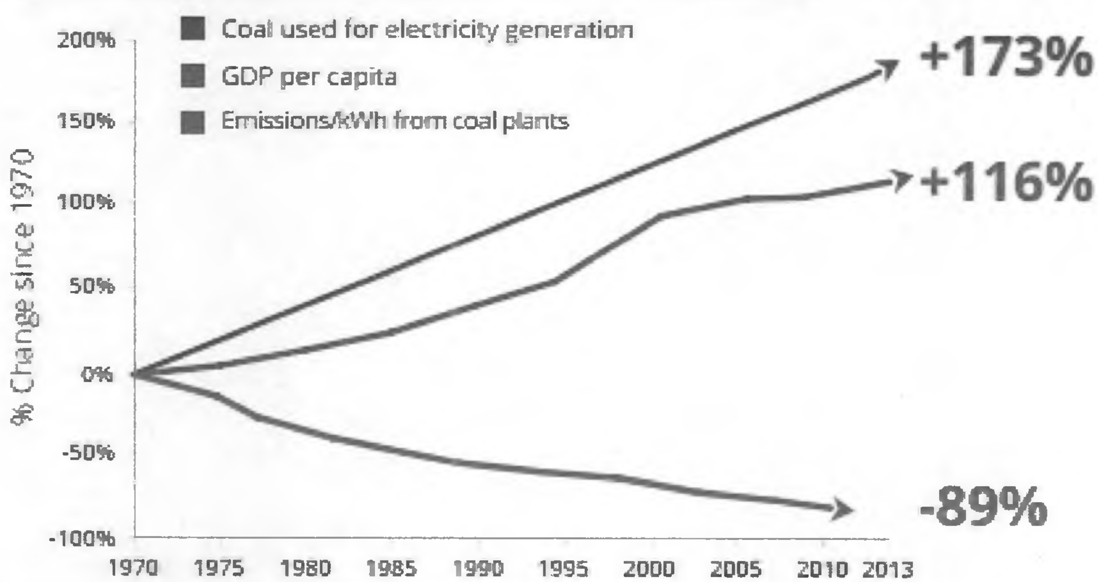
- Statewide, 692 jobs (direct and indirect) and $52 million in payroll
- Absence of coal in interior Alaska would raise energy costs $200 million annually
- Coal is Interior Alaska's lowest-cost source of energy
  - Half the cost of natural gas, one-third the cost of naphtha

*Figures based on McDowell Group 2013 study

ALASKA COAL ASSOCIATION

Meeting the Challenges

U.S. Coal Use Dramatically Increases, Key Emissions Decline 89%



Source: U.S. Energy Information Administration (EIA) 2014 Annual Energy Outlook, 2013; EIA Annual Energy Review, 2012; U.S. Department of Agriculture, 2013; U.S. National Energy Technology Laboratory, 2012; U.S. Environmental Protection Agency, "Clean Air Markets," 2013.

Emissions Reduced due to:

- Changes in Fuel Source
- Scrubbing Technology
- Bag Houses
- Burning Technology (i.e. Fluidized Beds)

ALASKA COAL ASSOCIATION

Alaska's Clean Coal

- Ultra-low in sulfur – 0.1 %, compared to PRB coals at 0.5% and bituminous grade coals with up to 6.0% sulfur
- Low mercury – Alaskan coals contain up to 2/3's less mercury per pound than most other coals in the Pacific Rim thermal coal market

Alaska's clean coal helps our international neighbors reduce their emissions.

ALASKA COAL ASSOCIATION

Thank You

Dan Graham dan@pacrimcoal.com

Lorali Simon lorali@usibeili.com

ACEP

Alaska Center for Energy and Power

ACEP Mission: Develop and disseminate practical, cost-effective, and innovative solutions for Alaska and beyond

Primer on Coal Conversion Technology

April 4, 2014

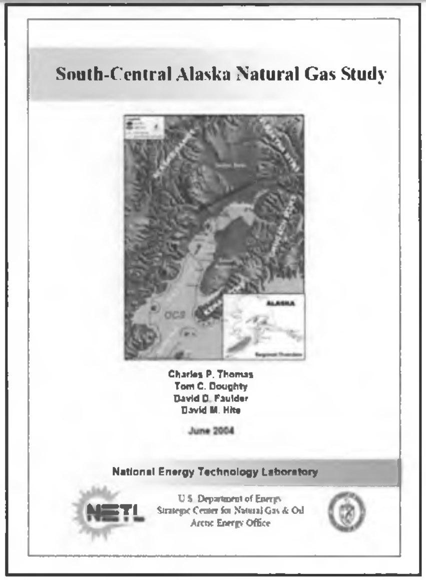
Brent J Sheets

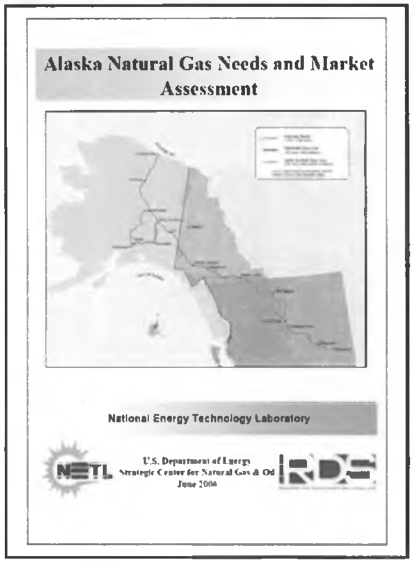
Alaska Center for Energy and Power

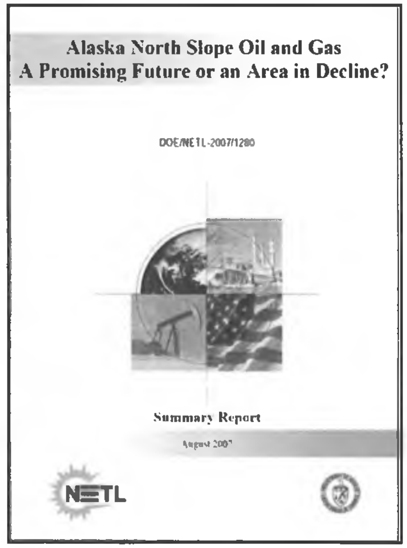
UNIVERSITY OF ALASKA FAIRBANKS

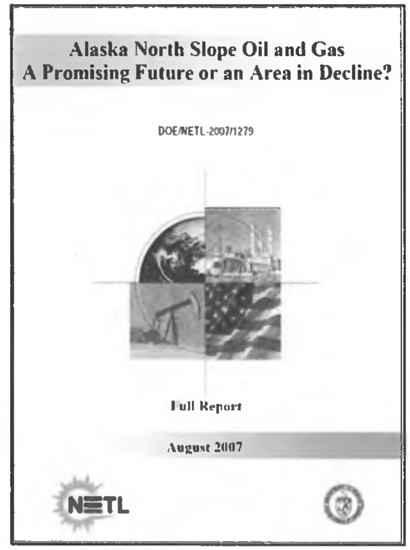
Presentation Agenda

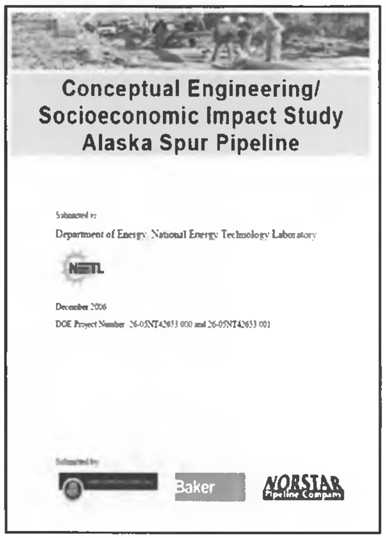
- About ACEP
- Power Generation Technology and Alaska
- Gasification Technology
- Coal Seam Natural Gas

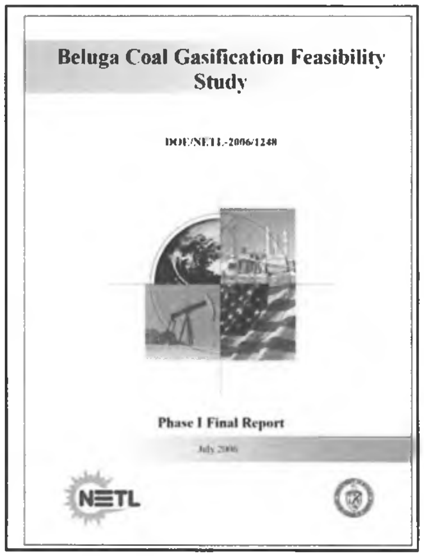

South-Central Alaska Natural Gas Study
Charles P. Thomas
Tom C. Doughty
David D. Faulder
David M. Hite
June 2004
National Energy Technology Laboratory
NETL
U.S. Department of Energy
Strategic Center for Natural Gas & Oil
Arctic Energy Office

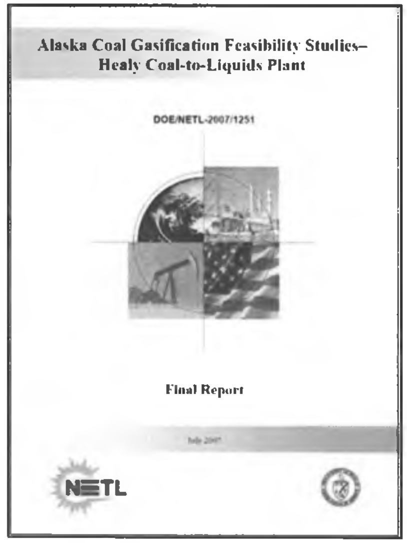

Alaska Natural Gas Needs and Market Assessment
National Energy Technology Laboratory
NETL
U.S. Department of Energy
Strategic Center for Natural Gas & Oil
June 2006


Alaska North Slope Oil and Gas
A Promising Future or an Area in Decline?
DOE/NETL-2007/1280
Summary Report
August 2007
NETL


Alaska North Slope Oil and Gas
A Promising Future or an Area in Decline?
DOE/NETL-2007/1279
Full Report
August 2007
NETL


Conceptual Engineering/
Socioeconomic Impact Study
Alaska Spur Pipeline
Submitted to
Department of Energy National Energy Technology Laboratory
NETL
December 2006
DOE Project Number 26-05NT42653 000 and 26-05NT42653 001
Submitted by
Baker
NORSTAR Pipeline Company


Beluga Coal Gasification Feasibility Study
DOE/NETL-2006/1248
Phase I Final Report
July 2006
NETL


Alaska Coal Gasification Feasibility Studies–
Healy Coal-to-Liquids Plant
DOE/NETL-2007/1251
Final Report
July 2007
NETL


Nome Region Energy Assessment
DOE/NETL-2007/1284
First Draft Report
February 2007
NETL
ALASKA

Selected reports during my tenure with the U.S. Department of Energy, National Energy Technology Laboratory's Arctic Energy Office, Fairbanks, AK

Alaska Center for Energy and Power

ACEP Mission: Develop and disseminate practical, cost-effective, and innovative solutions for Alaska and beyond

Who we are:

- Organized 6 years ago under the Institute of Northern Engineering as 'Gateway' to Energy Research for UA
- Based at UAF with a satellite office in Anchorage
- 20 dedicated staff (mostly engineers)
- 35 affiliated faculty and 50 students

ACEP
Alaska Center for Energy and Power

Role of ACEP and the University of Alaska

- Developing information for decision makers
  - Technology testing and optimization (industry)
  - Energy analysis (policy makers, communities)
  - Data management
- Preparing students to work in energy-related disciplines
- Commercializing energy innovation

ACEP
Alaska Center for Energy and Power

Alaska Center for Energy and Power

ACEP is a revenue center (not a cost center)

- ACEP has received a total of $3.1M through UA operating budget (over 6 years)
- ACEP has received a total of $26M in grants and contracts during this period
- Where has this funding gone?
    - ~40% to fund 100+ small Alaska-based businesses to support research enterprise
    - ~40% to fund researchers throughout UA system (not just within ACEP)
    - ~20% to fund base University operating costs ($6M)

Technology Perspectives

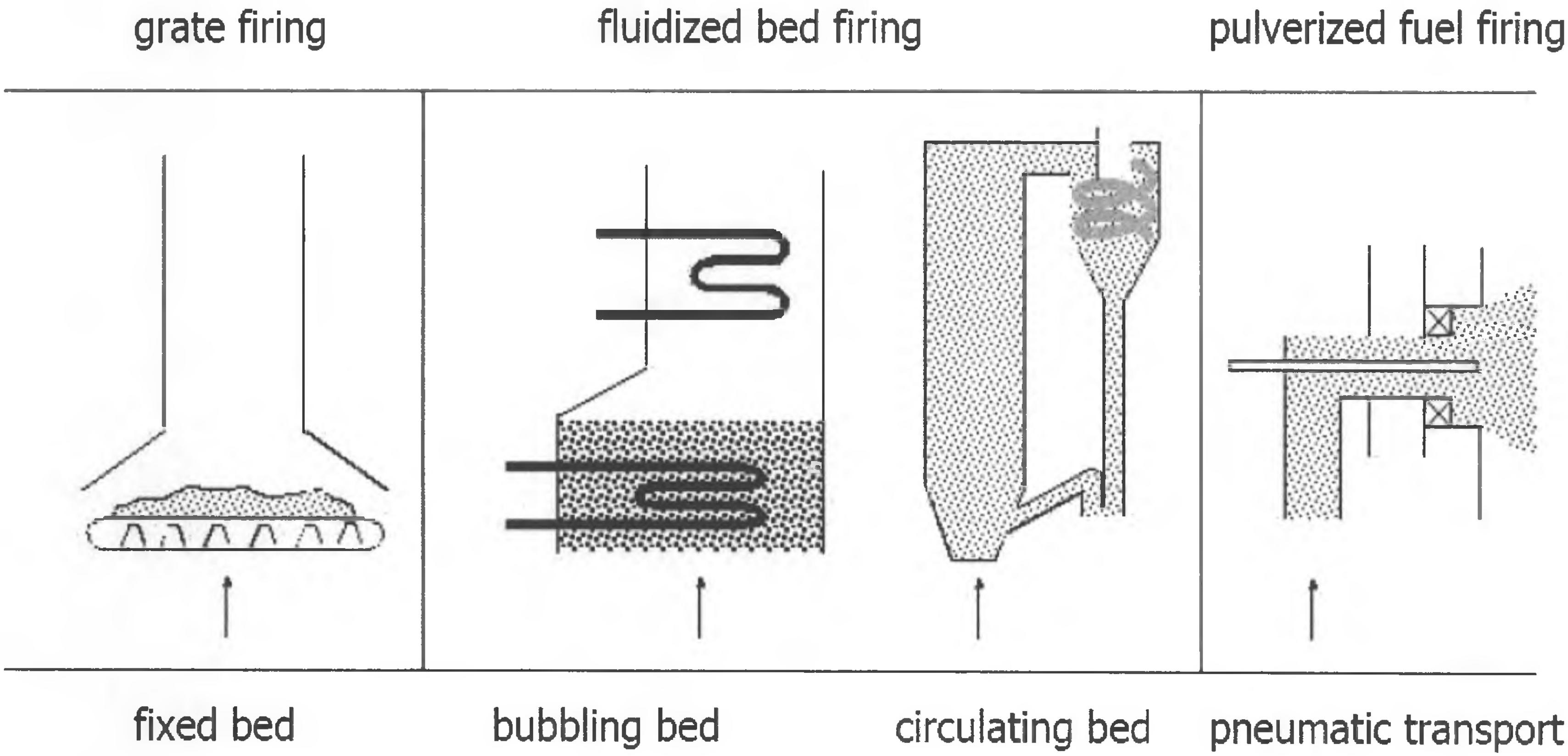
- Pulverized Coal (PC) Boilers
  - Commercialized in 1920s-1930s
  - 5000 units world-wide; >1100 in US
  - Unit sizes up to ~1400 MW

- Fluidized Bed Combustion (FBC) Boilers
  - Commercialized in 1970s-1980s
  - 500 units world-wide; 150 in US
  - Unit sizes up to ~300 MW
  - Costs ~5-10% higher than PC units

- Integrated Gasification Combined-Cycle (IGCC) Power Plants
  - Commercialized in 1980s-1990s
  - 7 coal-based units world-wide; 2 in US
  - Unit sizes several hundred MW up to Gigawatts
  - Costs ~ 10-20% higher than PC units

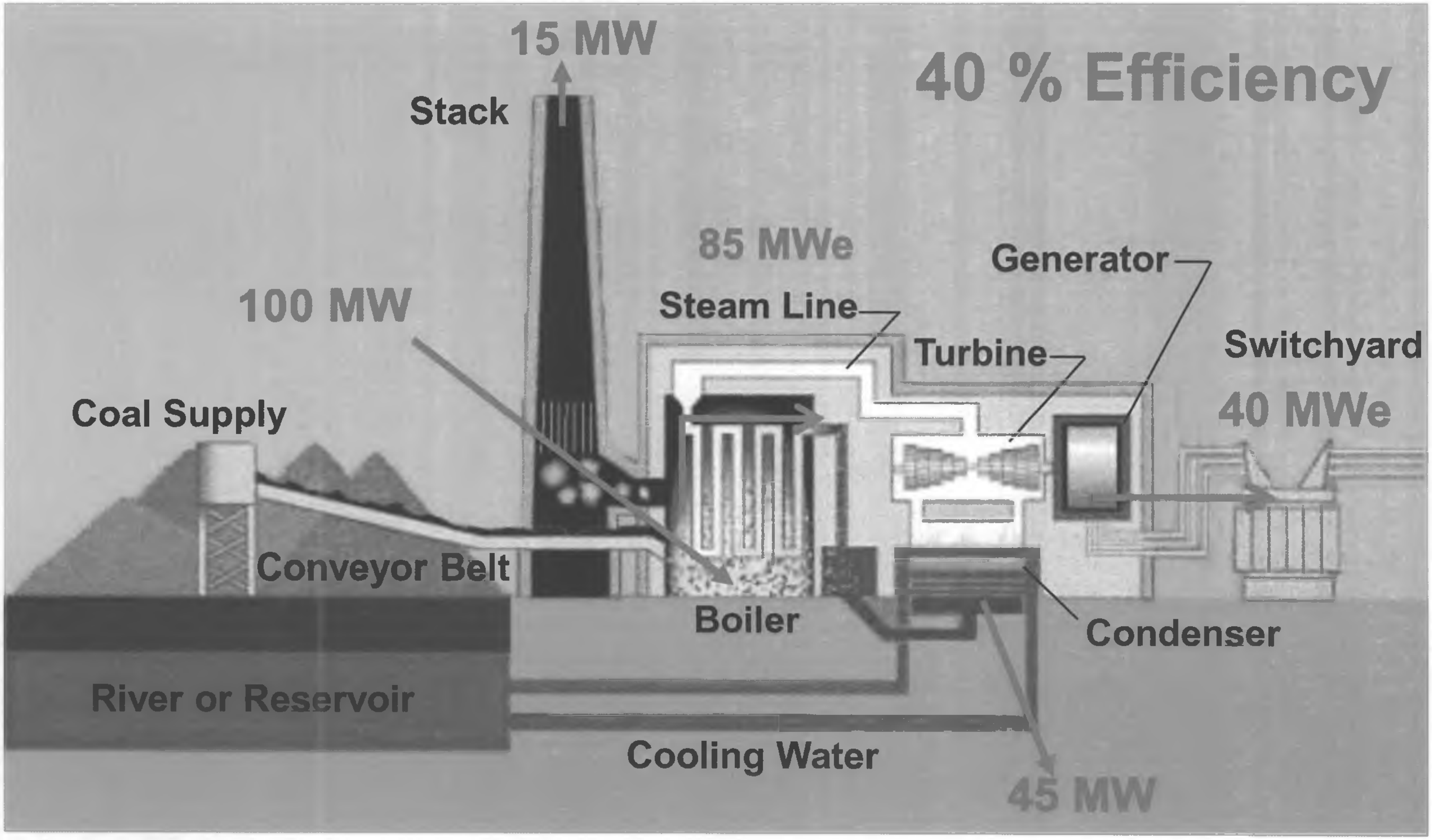
ACEP
Alaska Center for Energy and Power

Comparison of Coal-Based Power Generation Platform Technologies



Conventional Coal Plant

(Illustration only)

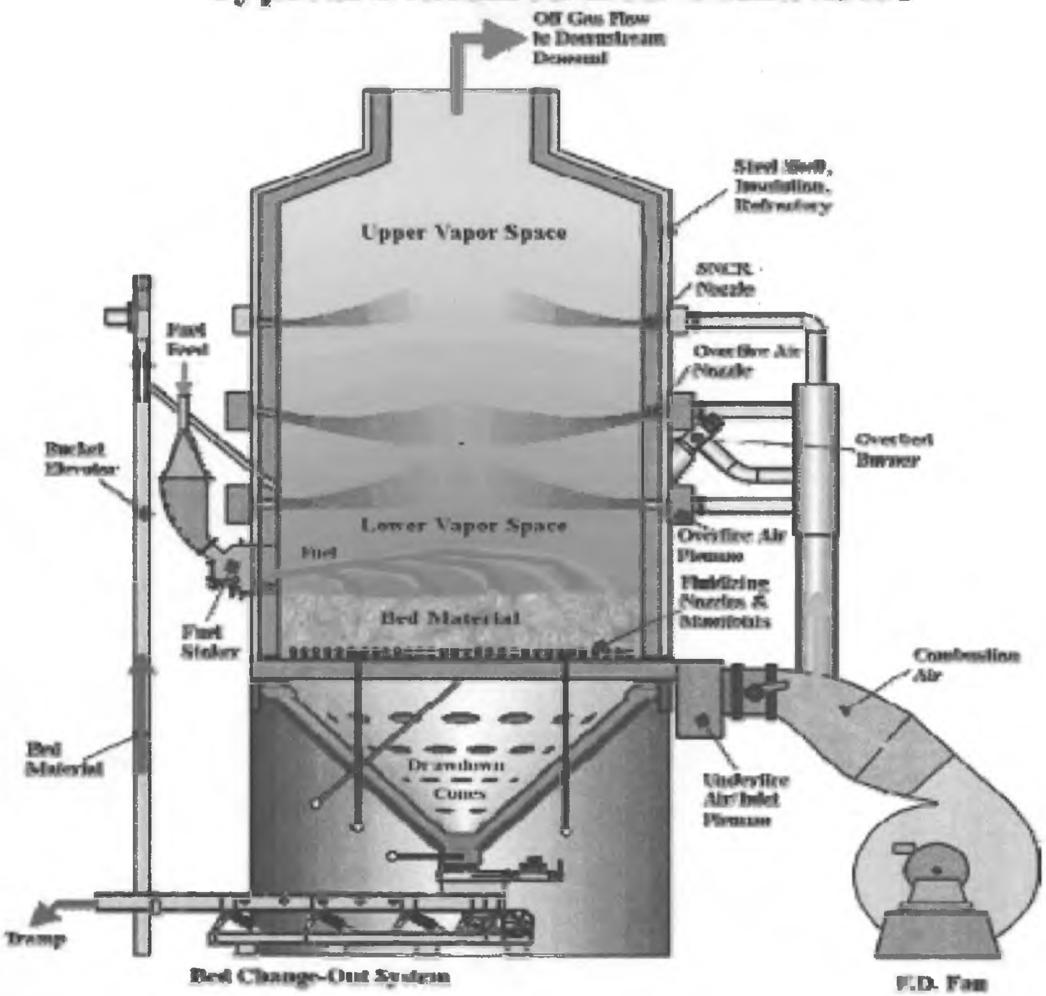


Source: EPRI

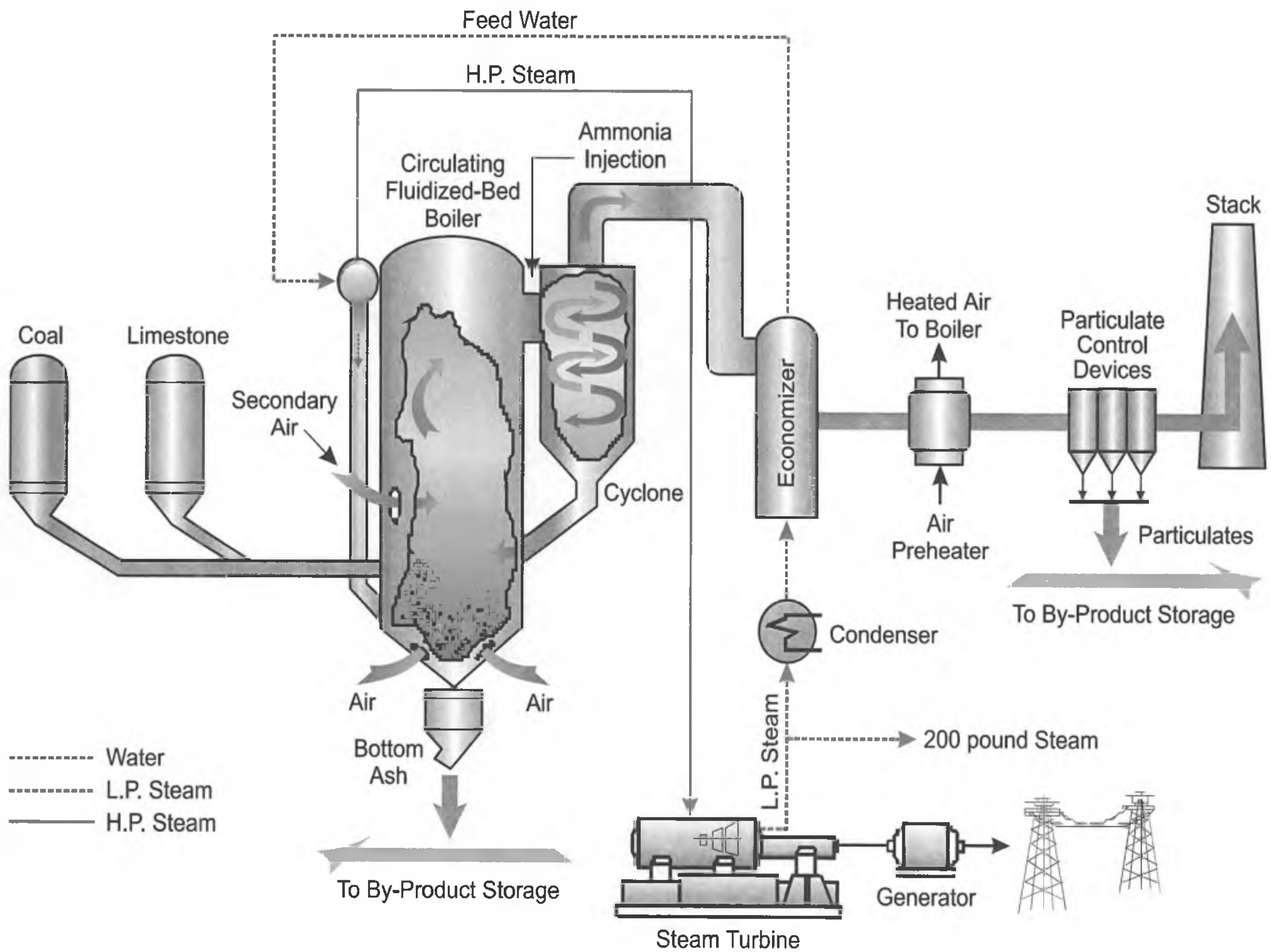
ACEP
Alaska Center for Energy and Power

Fluidized Bed Combustion

Typical Fluidized Bed Combustor



FBC Power Plant-Schematic



SCHEMATIC DIAGRAM OF FBC COGENERATING PLANT

ACEP
Alaska Center for Energy and Power

Major plant upgrade for UAF

A diversified energy portfolio

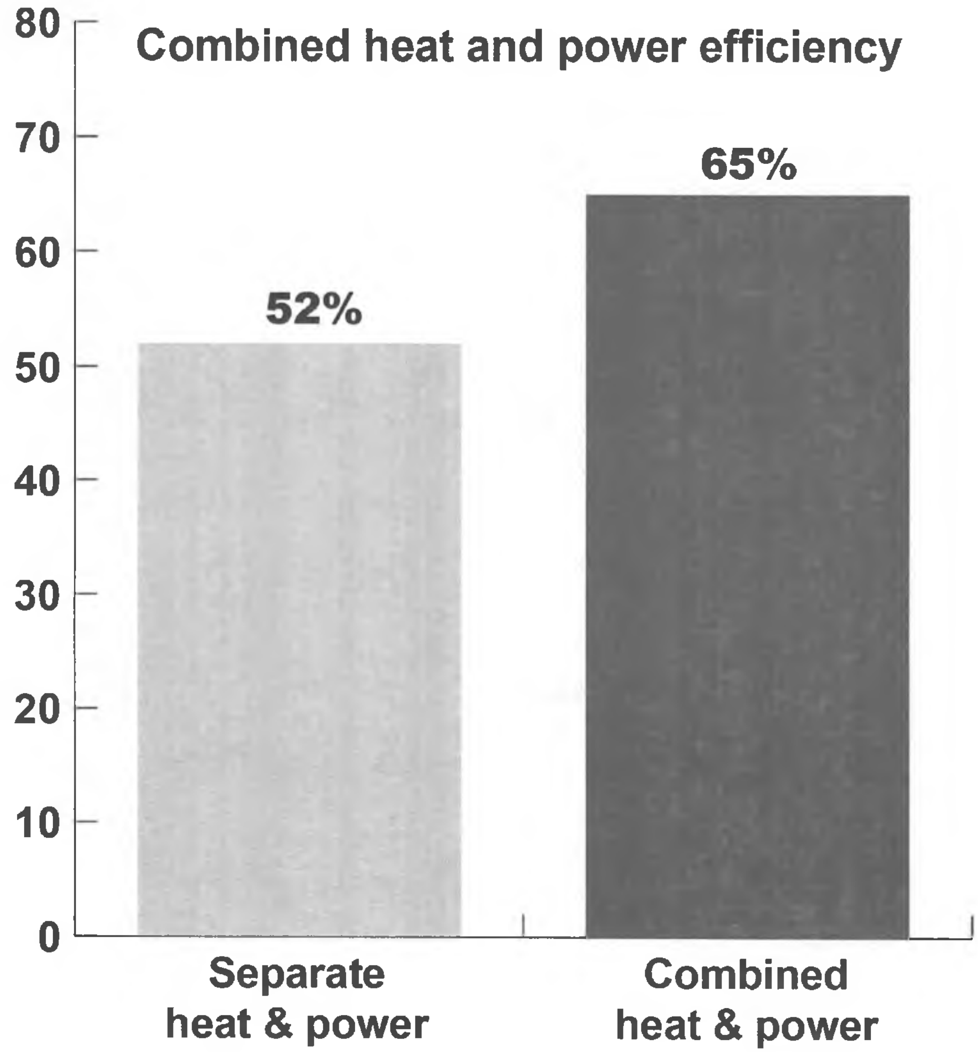
- New circulating fluidized bed (CFB) boilers
  - *Flexible solid fuel, proven technology*
  - *Coal with up to 15 percent biomass*
  - *Capable of generating 17 MW of power*
- Oil/natural gas backup boilers
- Purchase renewable energy, when available
- Energy conservation on campus
- Small renewable projects on campus

Flexible, sustainable, fiscally responsible

ACEP
Alaska Center for Energy and Power

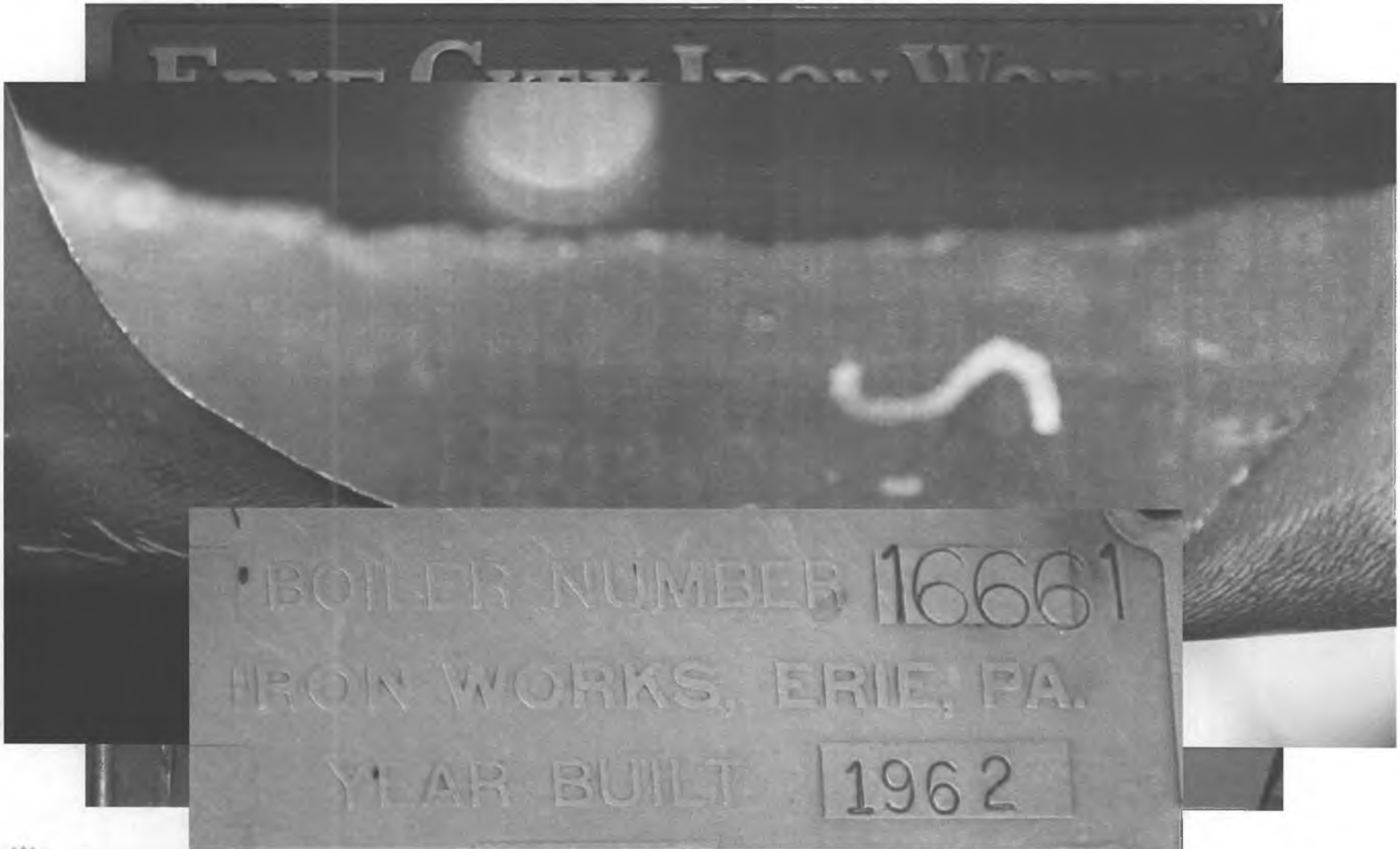
Energy is the Foundation

- UAF has 3.1 million square feet of public facilities
- Average age of building: 34 years
- All these things need heat and power
- More than 500 schools and universities have their own heat and power plants



ACEP
Alaska Center for Energy and Power

Our foundation looks like this

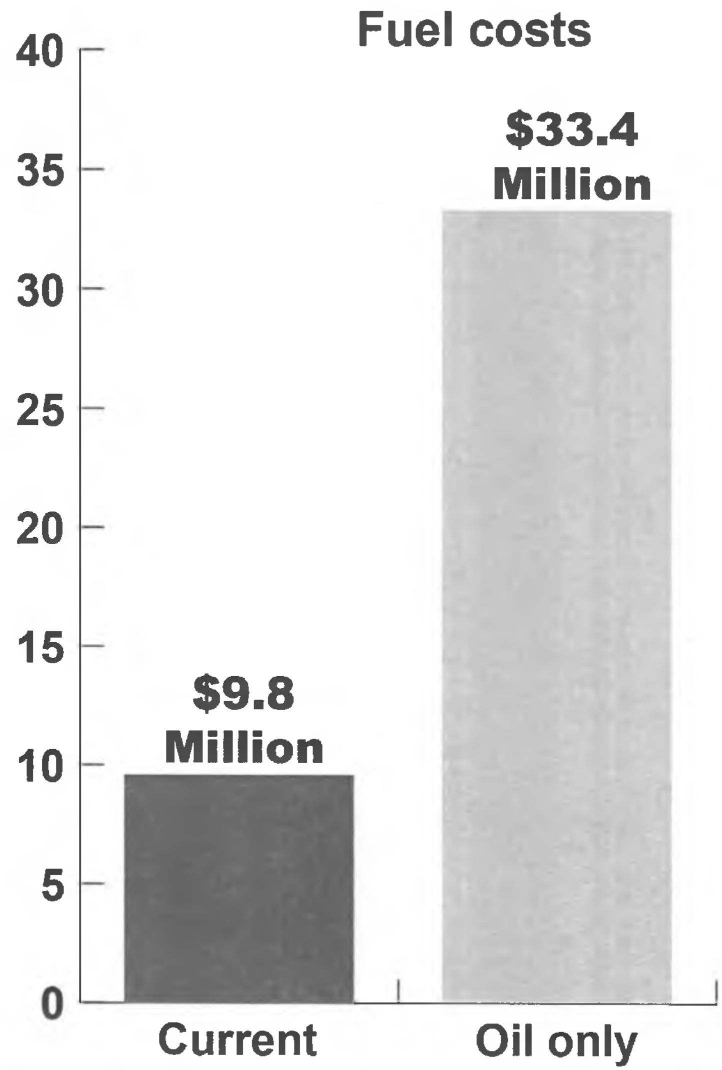


ACEP
Alaska Center for Energy and Power

What if the Coal Boilers fail?

That could mean firing up the backup oil/gas boilers.

- *An adequate supply of gas is not available.*
- *Using only diesel would more than triple fuel costs.*
- *The university's existing operating budget cannot absorb that.*



ACEP
Alaska Center for Energy and Power

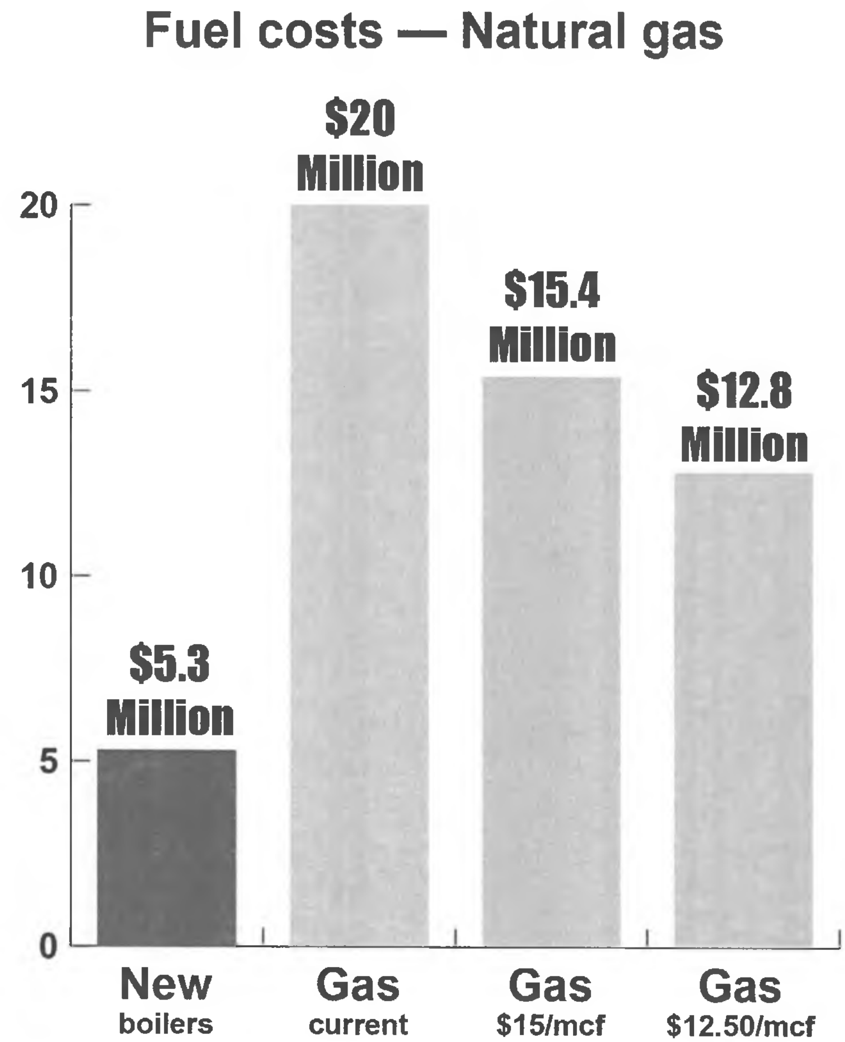
What if the entire plant fails?

- Billions of dollars in public infrastructure at risk of freezing. More than $1 billion to repair.
- Students need alternate housing.
- Research stops. Education stops. Service stops.
- Enrollment and funding impacted for years in the future.

ACEP
Alaska Center for Energy and Power

Why don't you ___________?

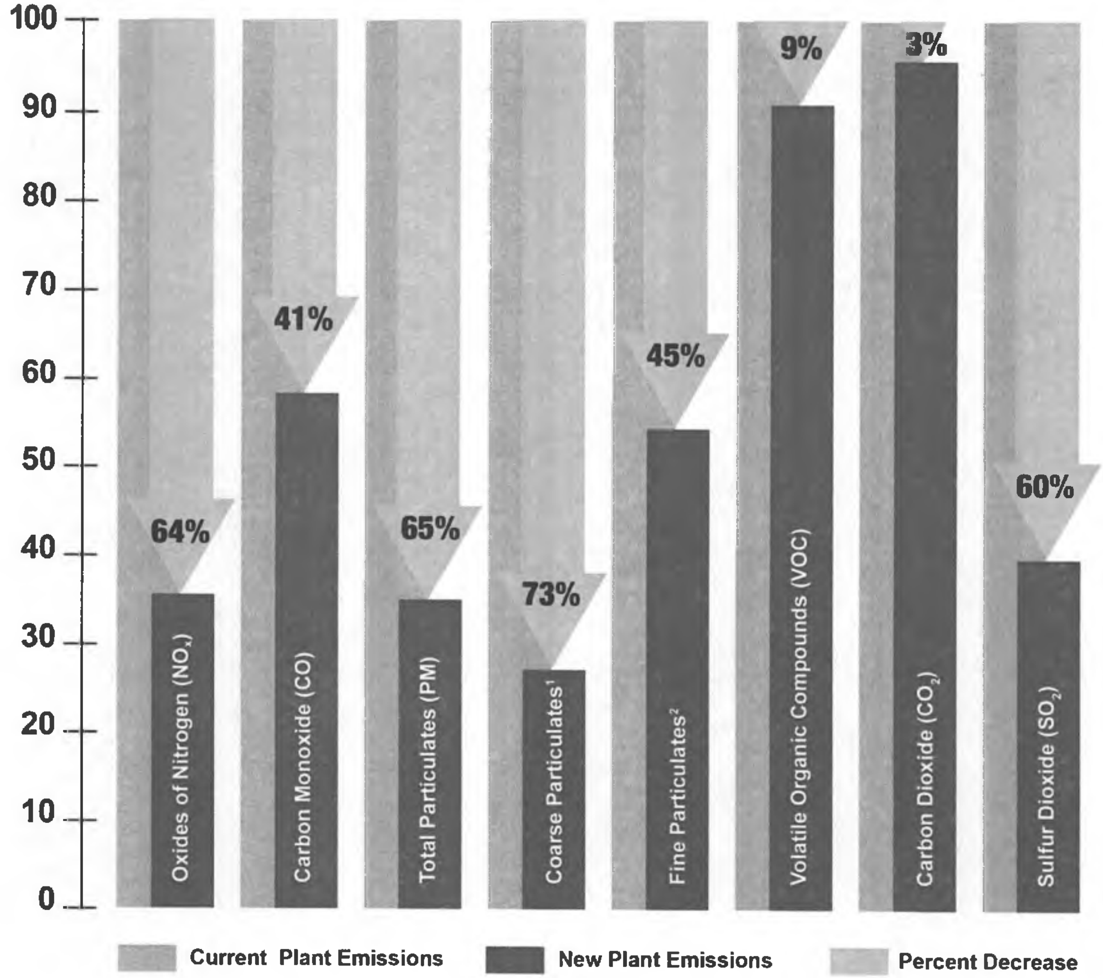
- Buy power from GVEA
  - *We need **heat** and **electricity**.*
  - *Not cost effective to heat with electricity*
- Build a natural gas plant
  - *A reliable supply of gas is not available*
  - *Lower capital cost*
  - *Double to more than triple the fuel cost*



ACEP
Alaska Center for Energy and Power

Environmental Benefits

- Current main boilers are 1890's technology
- Plant burns coal, diesel and gas
- Newer technology is more efficient
- Current load and upgraded plant reduces emissions



[1] 2.5 – 10 micrometers (PM 10)   [2] < 2.5 micrometers (PM 2.5)

ACEP
Alaska Center for Energy and Power

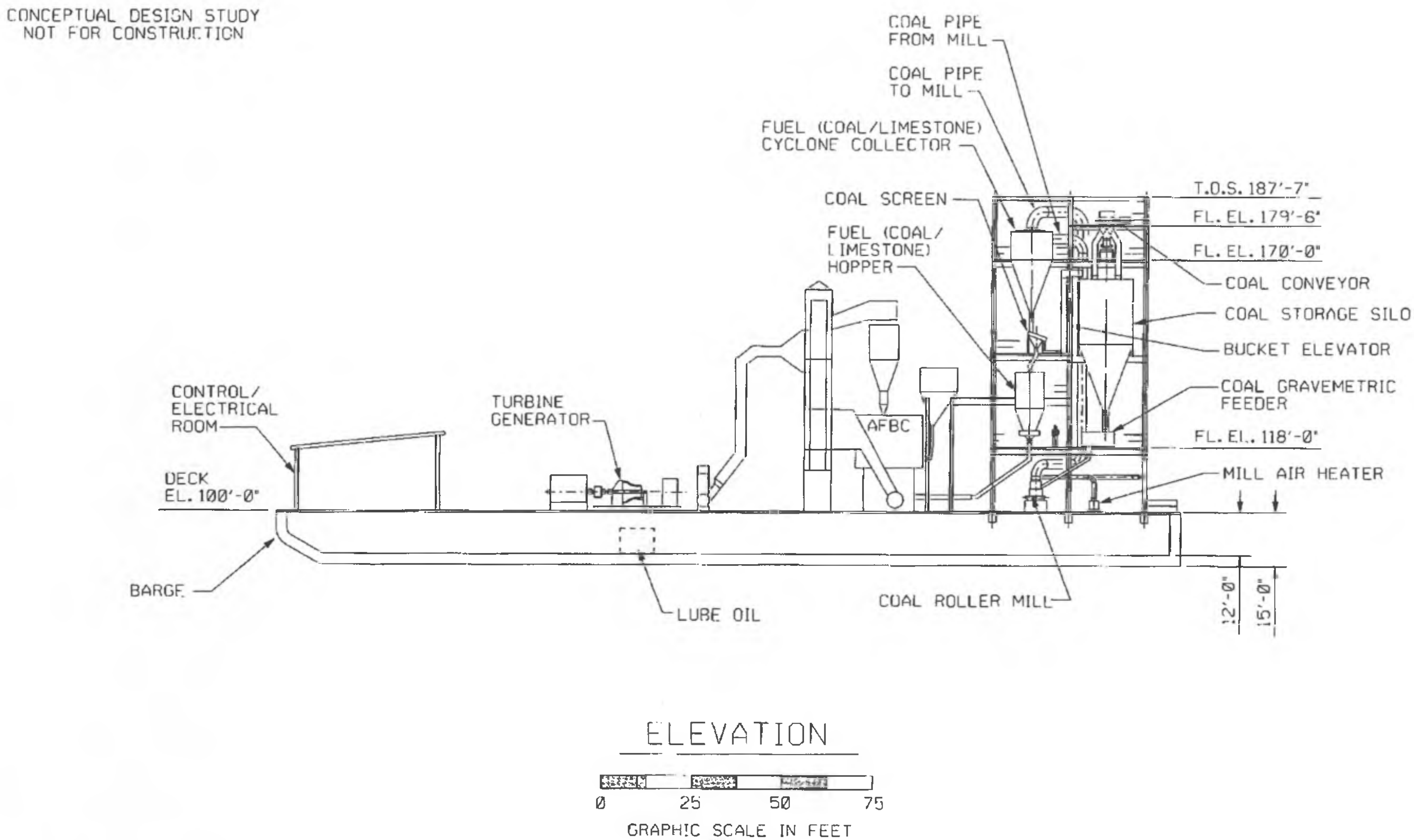
Additional Benefits

- Increase in available construction jobs for Alaskans
- Increase in economic activity during 2015-2018 time period
- Public safety
    - *UAF historically serves as a place of shelter during emergencies.*
    - *Upgraded plant could heat and power campus independent of the grid.*

Timeline

- Current: $3 million for preliminary design and permitting
- FY15: Requesting $245 million for full design, boiler and equipment purchase, and construction
    - $195 million state funding
    - $50 million in bonding authority
        - *UAF can make the bond payment with fuel cost savings*
- Target completion and opening: Winter 2018

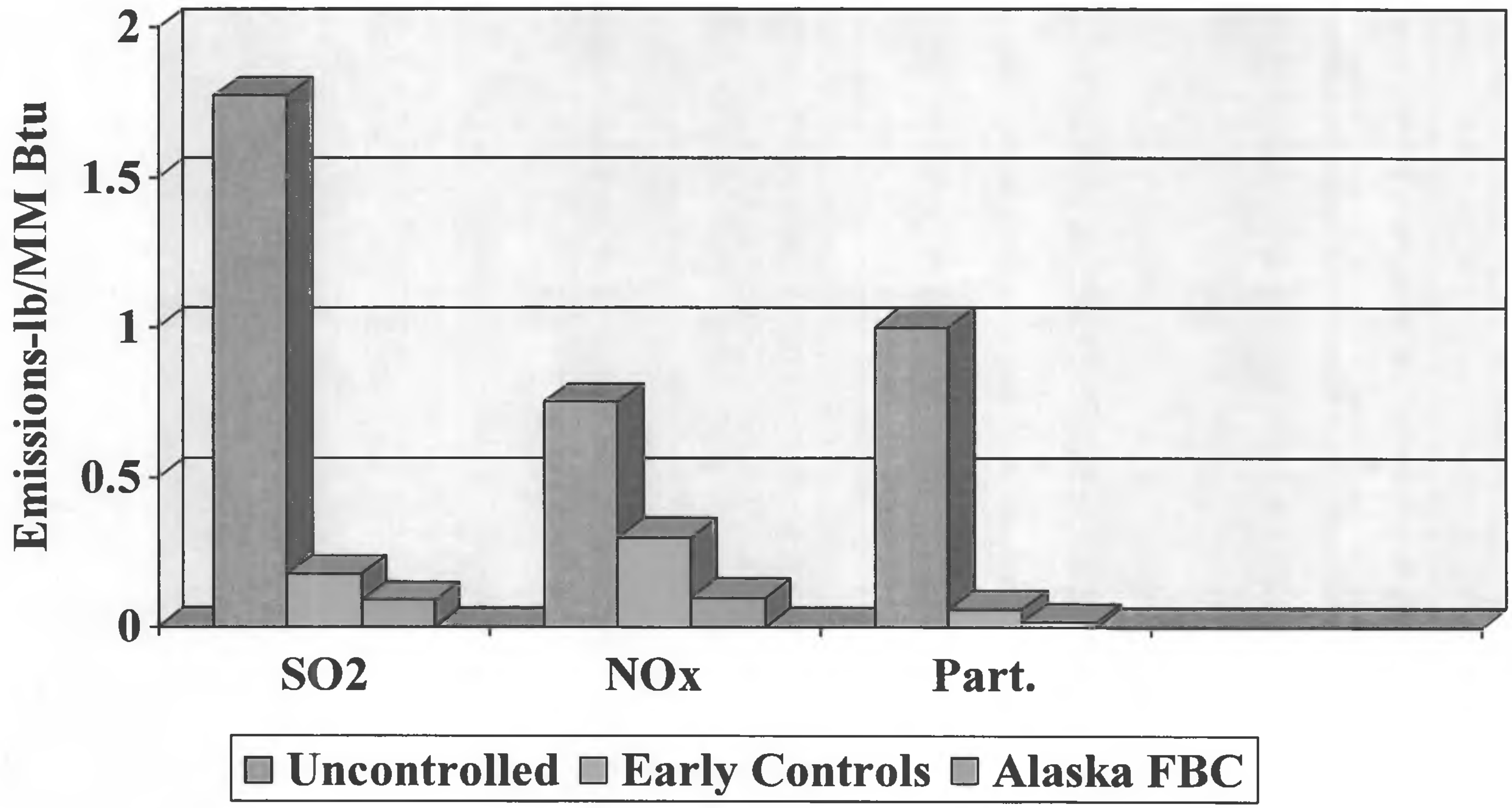
Yukon River FBC Unit Elevation View



ACEP
Alaska Center for Energy and Power

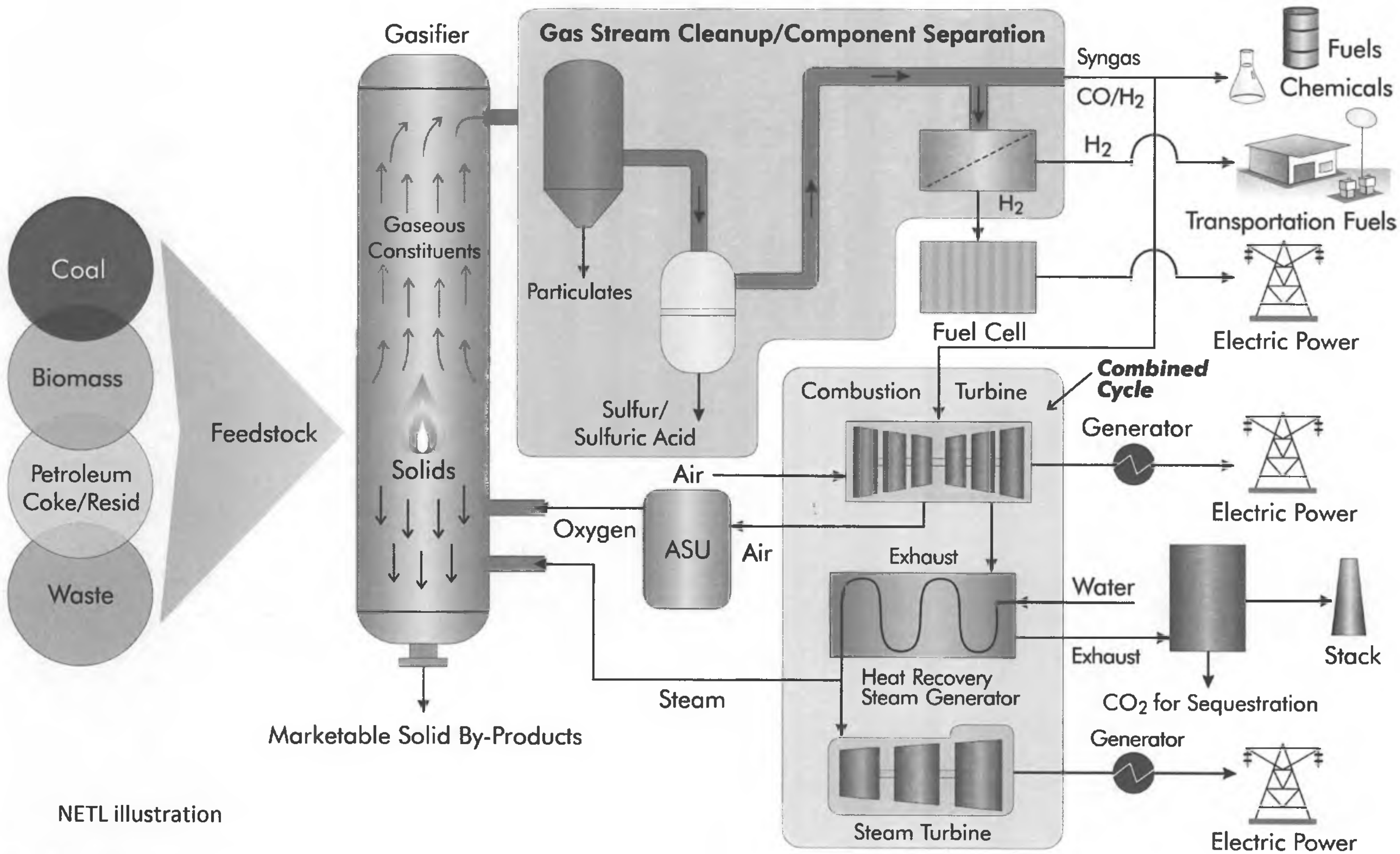
Emissions Comparison Chart

Alaska FBC vs. Technology Maturity



ACEP
Alaska Center for Energy and Power

Gasification Plant Options



NETL illustration

What is Gasification?

- Gasification converts any carbon-containing material into synthesis gas, composed primarily of carbon monoxide and hydrogen (referred to as syngas)

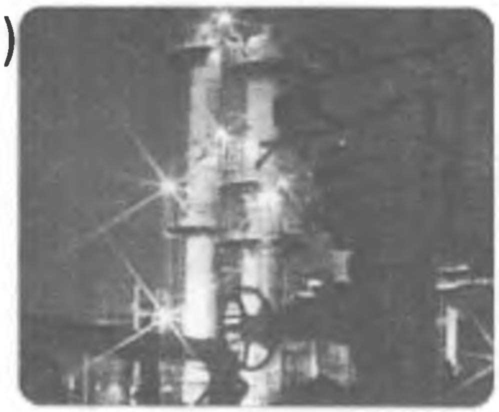
- Syngas can be used as a fuel to generate electricity or steam, as a basic chemical building block for a large number of uses in the petrochemical and refining industries, and for the production of hydrogen.

- Gasification adds value to low- or negative-value feedstocks by converting them to marketable fuels and products.

ACEP
Alaska Center for Energy and Power

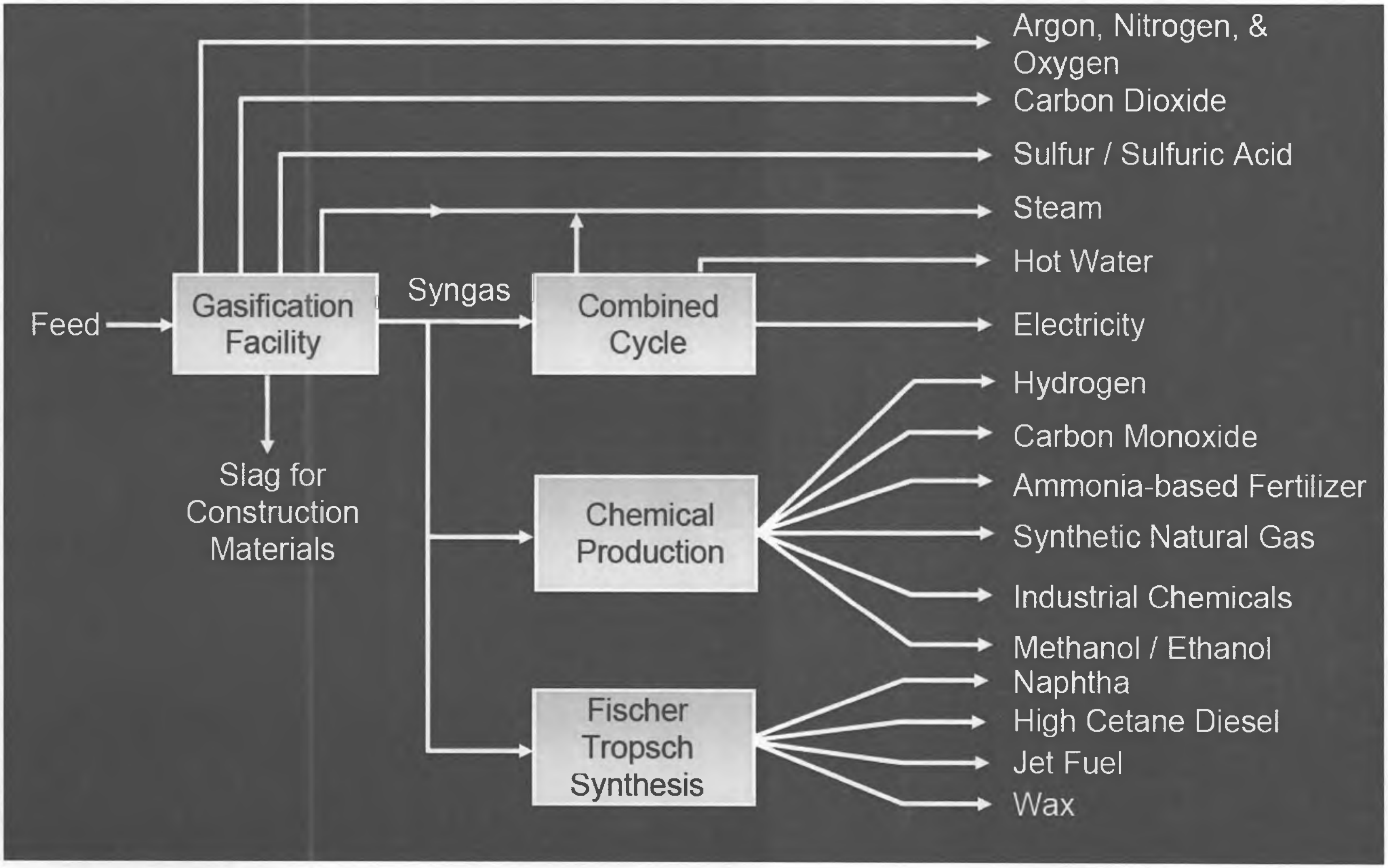
History of Gasification

- Used during World War II to convert coal into transportation fuels (Fischer – Tropsch)
- Used extensively in the last 50+ years to convert coal and heavy oil into hydrogen – for the production of ammonia/urea fertilizer
- Chemical industry (1960's)
- Refinery industry (1980's)
- Global power & CTL industries (Today)



ACEP
Alaska Center for Energy and Power

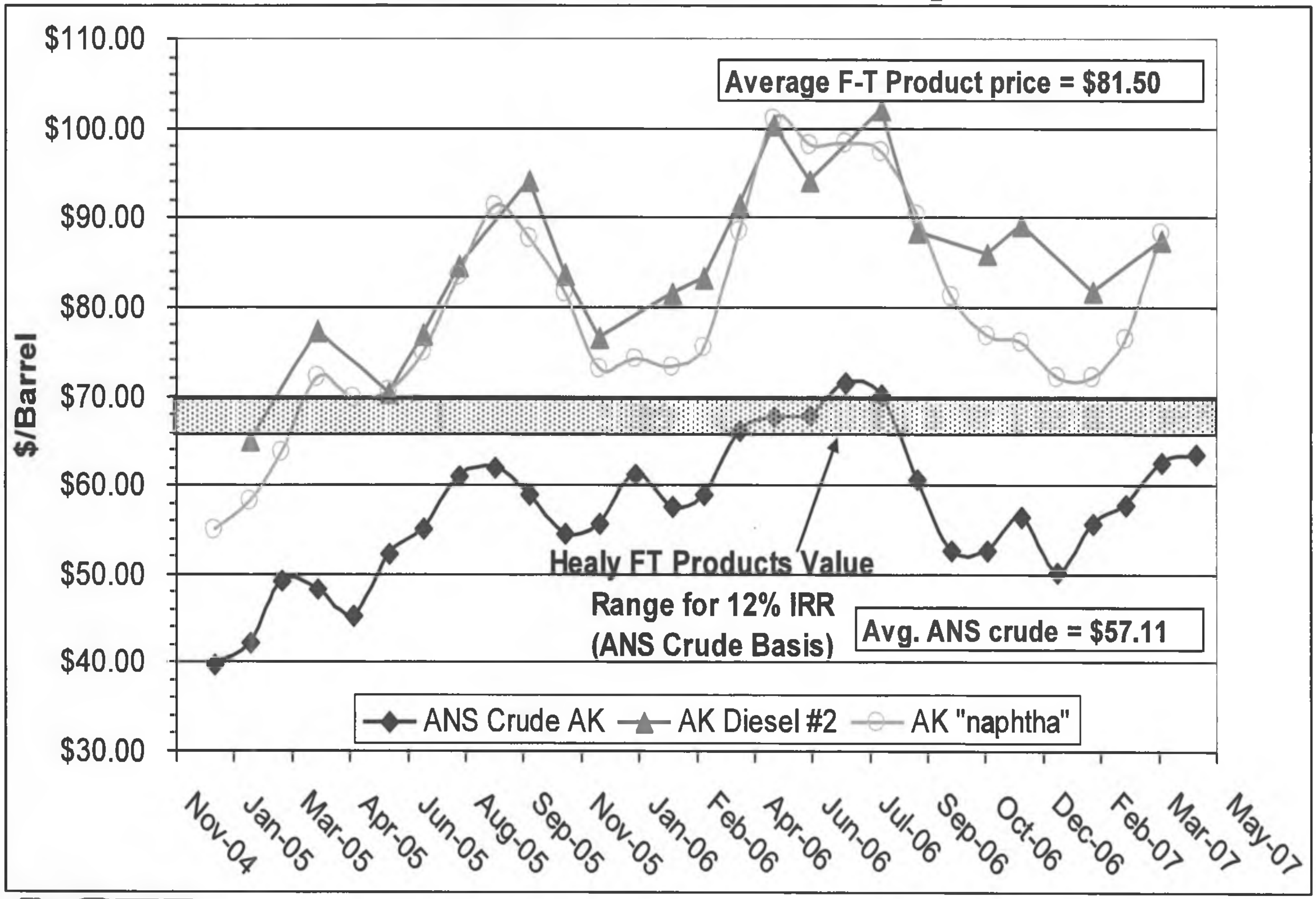
Gasification Products



Source: FLUOR®

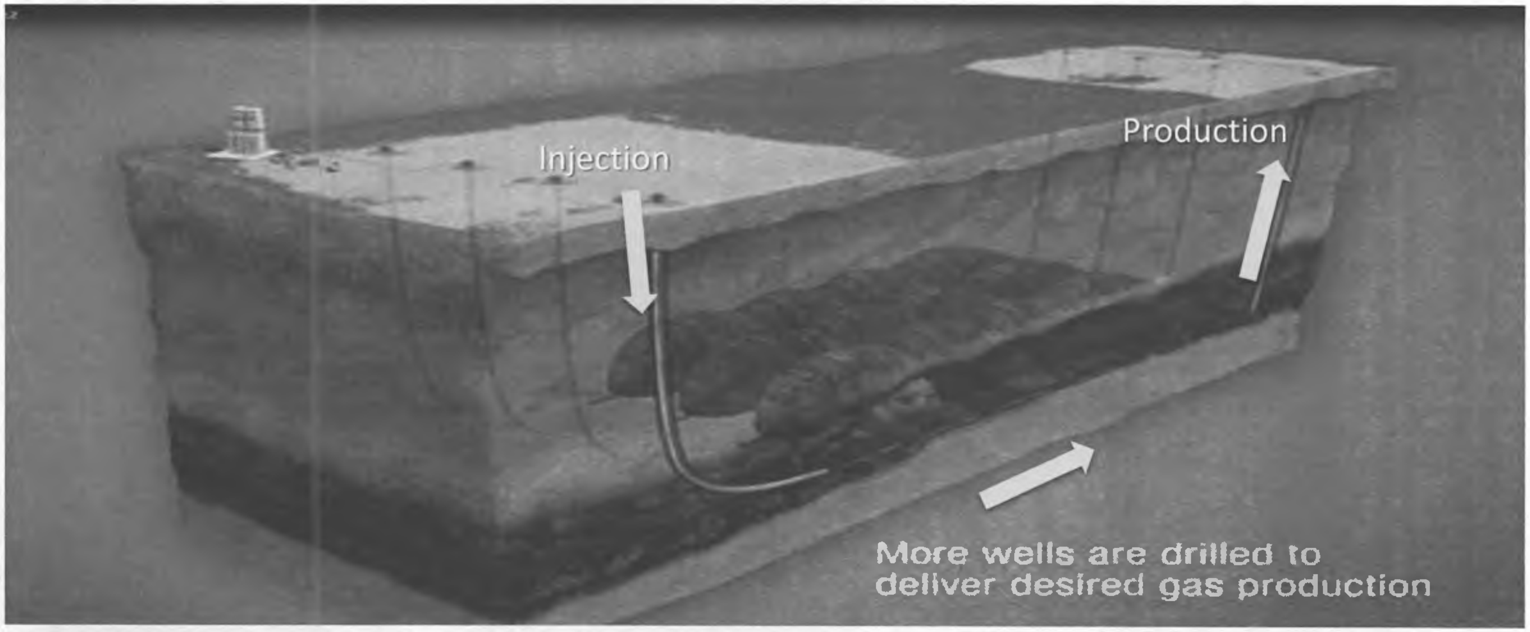
ACEP
Alaska Center for Energy and Power

Healy Economics – 2007 (and outdated)



ACEP
Alaska Center for Energy and Power

Underground Coal Gasification



1. Combustion of Coal with oxidant
2. Heat is generated
3. Coal + Water + Heat → Syngas (H_2+CO) through Gasification
4. Other reaction:
   Water Gas Shift ($CO + H_2O \leftrightarrow H_2 + CO_2$)
   Methanation ($CO + 3H_2 \leftrightarrow CH_4 + H_2O$)
   Pyrolysis (Coal → CH_4 + H_2O + Hydrocarbons + Tars + Volatile gases)

ACEP
Alaska Center for Energy and Power

Illustration courtesy of Linc Energy

Linc UCG License Areas

Illustration courtesy of Linc Energy

DGGS: At least 37 Communities Near Potential Coal Seam Methane

Source: DGGS public presentation, 2002

Alatna
Allakaket
Ambler
Atqasuk
Beaver
Bettles
Birch Ck
Chalkyitsik
Chignik
Chignik Lg
Chignik Lk
Deering
Evansville
Fort Yukon
Galena
Kaltag
Kiana
King Salmon
Kobuk
Koyuk
Koyukuk
McGrath
Mekoryuk
Naknek
Nightmute
Nikolai
Noatak
Nulato
Perryville
Point Lay
Rampart
Selawik
Shungnak
Toksook Bay
Unalakleet
Venetie
Wainwright

ACEP
Alaska Center for Energy and Power

Thank You

- NETL – U.S. Dept of Energy
- Linc Energy
- DGGS
- UAF
- State of Alaska

ACEP
Alaska Center for Energy and Power

www.uaf.edu/acep

For more information contact:

Brent J Sheets
Alaska Center for Energy & Power
University of Alaska
Tel: (907) 474-1194
E-mail: gwen.holdmann@alaska.edu

ACEP
Alaska Center for Energy and Power

HEALY UNIT 2 &

OBSTACLES TO CLEAN COAL TECHNOLOGY USAGE

Mike Wright
VP, Transmission & Distribution

Senate Resource Committee
April 4, 2014

Golden Valley Electric Assn.

What is Clean Coal Technology?

- Definition of Clean Coal Technology = moving target
  - 1993 – focused on reduction of Criteria Pollutants (NOx, SOx, PM, CO, Ozone, Lead)
  - Current focus – reduction of Green House Gases (GHGs) or CO2
    - EPA also currently addressing Criteria Pollutants and Hazardous Air Pollutants (HAPS) reduction but CO2 in forefront

GVEA
Golden Valley Electric Association
Your Touchstone Energy® Cooperative

Healy Unit 2 History

- Was an official Department of Energy Clean Coal Technology Project that received DOE funding
- Underwent full NEPA and New Source Review (NSR) review prior to construction

Outfitted or met with the most stringent pollution controls/limits at the time

- NOx control – TRW advanced combustion technology (slagging combustor/boiler air staging)
- SO2 control – Spray Dryer Absorber (lime)
- PM control – combustion technology - removes mineral content before ash can enter the boiler followed up with bag house technology

GVEA
Golden Valley Electric Association
Your Touchstone Energy Cooperative

Benefits of Healy 2

- Fuel Diversity
- Mine mouth coal plant
- Long term stable rates
- Significant coal reserves

GVEA
Golden Valley Electric Association
Your Touchstone Energy® Cooperative

GVEA Generation Assets

HARACTERISTICS	NORTH POLE 1	NORTH POLE 2	ZEHNDER 1	ZEHNDER 2	DELTA POWER PLANT	HEALY 1	BRADLEY LAKE[2]	BESS[3]	NORTH POLE 3 & 4	AURORA
Location	North Pole	North Pole	Headquarters	Headquarters	Delta[1]	Healy	Homer	Fairbanks	North Pole	Fairbanks
Type	CT Frame 7	CT Frame 7	CT Frame 5	CT Frame 5	CT Frame 5	ST-Coal	Hydro	Energy Storage	CC-LM6000	ST
Year Installed	1976	1977	1971	1972	1976	1967	1991	2003	April, 2006	-
Fuel	HAGO	HAGO	HAGO	HAGO	No. 2	Coal	Hydro	Battery	Naphtha	Coal
Peak Winter Ratings	62.6 MW	60.6 MW	19.2 MW	19.6 MW	25.8 MW	25.5 MW	15.2 MW	46 MW (for 5 min)	63.3 MW	24.8 MW
Full Load NPHR (Btu/kWh)[4]	10,010	9,720	14.030	14,190	13,210	13,441	0.0	NA	6,620	10,000
Forced Outage Rate	0.78%	0.88%	0.23%	1.9%	0.2%	3.69%	0.0%	0.0%	0.83%	-

Heat Rate – Thermal Efficiency

Healy 2 NPHR – 12,500 Btu/kWh (1999 test results)

GVEA
Golden Valley Electric Association
Your Touchstone Energy® Cooperative

Environmental Groups Opposed Restart

- Environmental group opposition resulted in Consent Decree with EPA. Pertinent results:
  - Unit 2 must install Selective Catalytic Reduction (SCR) for additional NOx reduction by introduction of ammonia to flue gas coupled with catalyst
  - Unit 1 must install Selective Non-Catalytic Reduction (SNCR) for additional reduction in NOx and either shutdown in 2024 or install SCR
  - Retrofitting plants with pollution control devices is much more challenging and costly than installation at initial construction

GVEA
Golden Valley Electric Association

Projected Pollution Reduction due to Consent Decree

Combined Unit 1 & Unit 2 Permit Limits

Pre-CD controls NOx = 1366 tons/yr

Post-CD controls NOx = 533 tons/yr

Pre-CD emission limits SO2 = 720 tons/yr

Post-CD emission limits SO2 = 701tons/yr

Primary target was NOx and application of current Best Available Control Technology (BACT). Current SO2 and PM Controls is BACT.

GVEA
Golden Valley Electric Association
Your Touchstone Energy Cooperative

Current Healy 2 Activities

- In November 2012the joint Consent Decree between GVEA, AIDEA and the Environmental Protection Agency (EPA) was approved.
- Jan thru Dec 2013 – GVEA began engineering effort on the SCR and SNCR and began planning restart activities
  - Black and Veatch selected as EPC for SCR and SNCR and also selected as project manager for restart and commissioning activities
- December 2013 – GVEA closed on the purchase of Healy 2

GVEA
Golden Valley Electric Association
Your Touchstone Energy® Cooperative

Current Healy 2 Activities (continued)

- Long lead restart items have been ordered
- Update to the Digital Control System underway
- Developing training plans
  - Operation of Healy 2 results in a staffing increase
    - Training on Healy 1 for new employees
    - Training on Healy 2 for all employees
- Contracting for a Work Camp in progress
- Civil work and foundations planned for this summer
- Begin system testing after DCS work is completed

GVEA
Golden Valley Electric Association
Your Touchstone Energy® Cooperative

Obstacles - Future Regulatory Challenges

Coal is the primary target

- Utility Mercury and Air Toxics Standards (UMATS)
- Green House Gasses
- Additional coal regulation
- Ultimately leads to increased cost of power

GVEA
Golden Valley Electric Association
Your Touchstone Energy Cooperative

Utility Mercury and Air Toxics Standards (UMATS)

- Must comply by April 2015.
- Target non-mercury hazardous air pollutants, mercury and select acid gases.
- Anticipate compliance without additional controls
- Additional cost for monitoring, frequent stack tests, reporting.

GVEA
Golden Valley Electric Association
Your Touchstone Energy® Cooperative

Green House Gases Reporting & Proposed NSPS

- GHG Reporting Rule – EPA began annual reporting requirement beginning for calendar year 2010. Select industries must report GHG emissions (CO_2, CH_4, N_2O).
- EPA's most recently proposed GHG's New Source Performance Standards in January 2014. Still out for public comment. When final will apply to <u>new</u> fossil fuel-fired electric steam generating units (mostly coal boilers), IGCC and NG-fired stationary combustion turbines.
- For comparison, no current GVEA coal or oil plant can meet standards without Carbon Capture and Sequestration (CCS).

GVEA
Golden Valley Electric Association
Your Touchstone Energy Cooperative

Proposed GHG NSPS

- Proposed Utility boilers and IGCC Units limit
  - 1,100 lb CO_2/MWh
  - limit based on partial implementation of CCS
- Proposed Natural Gas Combined Cycle Units
  - 1000 lb CO_2/MWh large units
  - 1100 lb CO_2/MWh small units
  - no control required to meet limit

GVEA
Golden Valley Electric Association
Your Touchstone Energy Cooperative

GVEA GHG Emissions

- Approximate CO2 Emissions from GVEA Units
  - Healy U1- 2900-3000 lb/MWh (PC)
  - North Pole GT1 & 2 – 1800-2000 lb/MWh (oil)
  - North Pole GT 3 – 1100-1200 lb/MWh (naphtha)
  - Zehnder GT 1 & 2 – 3000-3800 lb/MWh (oil)

(depends on efficiency of unit/fuel type)

GVEA
Golden Valley Electric Association
Your Touchstone Energy® Cooperative

CCS Major Challenges

- Cost of Equipment
- Modification to Units
- Energy Penalty
- Sequestration Location: transportation to where?

GVEA
Golden Valley Electric Association
Your Touchstone Energy® Cooperative

Coal Regulation on the Horizon

- GHG Guidelines for Existing Plants – EPA developing strategy now. Plan to propose guidelines (regulation) this summer. Impacts unknown.
- Proposed CCR rule – coal combustion residual rule
  - Impacts disposal/recycling of coal ash/ash impoundments
  - Initial proposal - coal will be regulated either as hazardous waste or solid waste. EPA appears to be leaning towards solid waste regulation or regulation by citizen suit.
- CWA 316b rule – impacts water intake structures for protection of fishery resources
  - May require cooling towers, larger intake structures or alternate mechanism

GVEA
Golden Valley Electric Association
Your Touchstone Energy Cooperative

Coal Regulation on the Horizon

(continued)

- <u>Effluent limitation guidelines</u> – may ban or apply limits to certain wastewater discharges. Target air pollution and ash related wastewater discharges

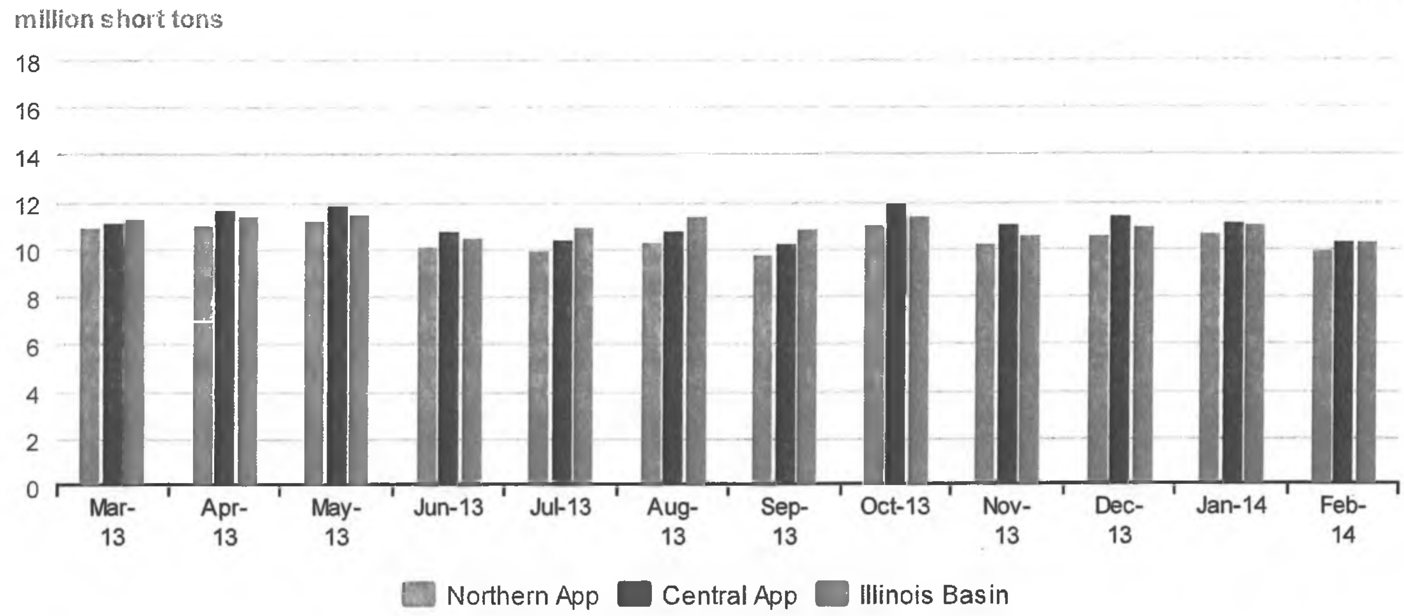
GVEA
Golden Valley Electric Association

Key Take-Aways

- Coal provides fuel diversity
- Coal generation provides long term stable rates
- Significant coal reserves exist in Alaska
- Future regulatory challenges are the major obstacle to Clean Coal Technology Usage
  - Increased cost of power production to meet regulatory requirements makes coal fired generation less economic

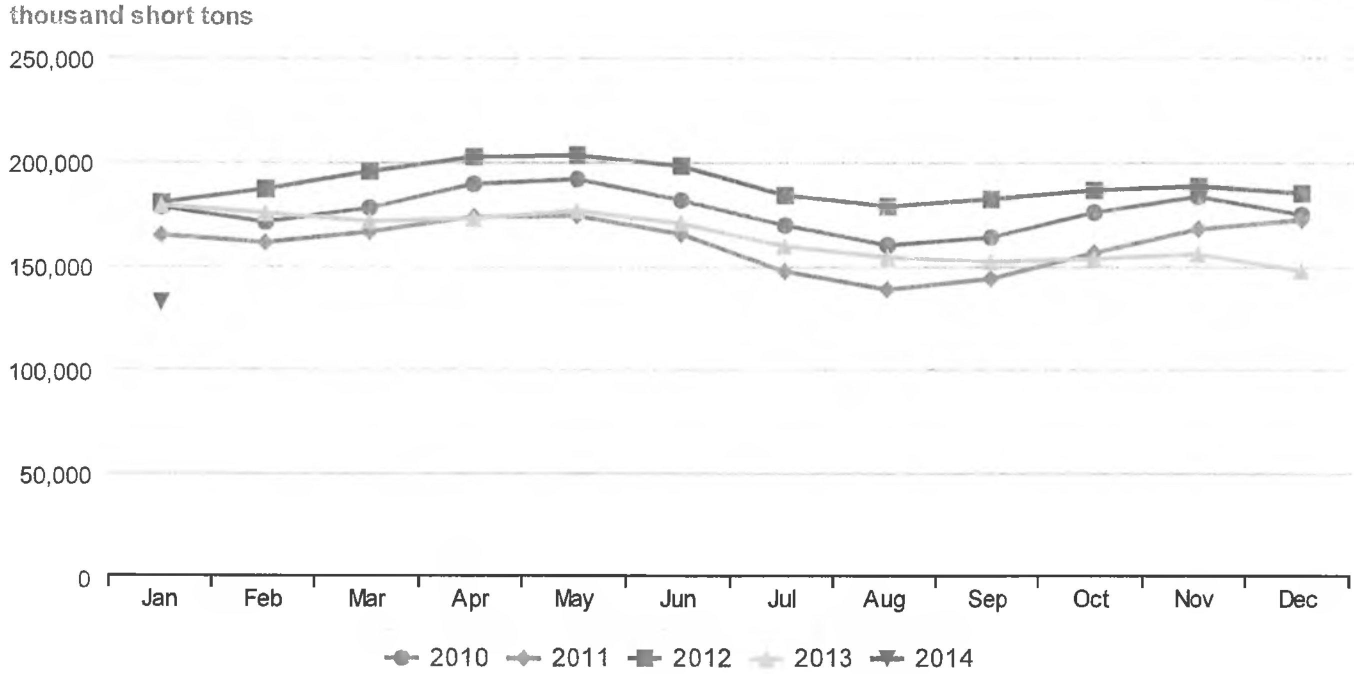
GVEA
Golden Valley Electric Association
Your Touchstone Energy® Cooperative

U.S. eastern monthly coal production, March 2013 through February 2014



Source: Mine Safety and Health Administration (MSHA), U.S. Department of Labor, Form 7000-2.

Electric power sector coal stocks, January 2010 through January 2014



Source: U.S. Energy Information Administration, Form EIA-923, "Power Plant Operations Report."

U.S. Energy Information Administration

Coal

Coal News and Markets

Release date: March 31, 2014 | **Next release date:** April 7, 2014

"Coal News and Markets Report" summarizes spot coal prices by coal commodity regions (i.e., Central Appalachia (CAPP), Northern Appalachia (NAPP), Illinois Basin (ILB), Powder River Basin (PRB), and Uinta Basin (UIB)) in the United States. The report includes data on average weekly coal commodity spot prices, total monthly coal production, eastern monthly coal production, electric power sector coal stocks, and average cost of metallurgical coal at coke plants and export docks. The historical data for coal commodity spot market prices are proprietary and not available for public release.

Average weekly coal commodity spot prices
(dollars per short ton)

Week Ended	Central Appalachia 12,500 Btu, 1.2 SO2	Northern Appalachia 13,000 Btu, <3.0 SO2	Illinois Basin 11,800 Btu, 5.0 SO2	Powder River Basin 8,800 Btu, 0.8 SO2	Uinta Basin 11,700 Btu, 0.8 SO2
28-February-14	$63.00	$68.65	$46.65	$12.50	$36.00
7-March-14	$60.06	$68.65	$46.65	$12.50	$36.00
14-March-14	$60.06	$68.65	$46.65	$12.50	$36.00
21-March-14	$59.06	$67.90	$47.06	$12.65	$36.25
28-March-14	$59.06	$67.90	$47.06	$12.65	$36.25

Source: With permission, SNL Energy
Note: Coal prices shown are for a relatively high-Btu coal selected in each region, for delivery in the "prompt quarter." The prompt quarter is the quarter following the current quarter. For example, from January through March, the 2nd quarter is the prompt quarter. Starting on April 1, July through September define the prompt quarter. The historical data file of spot prices is proprietary and cannot be released by EIA; see SNL Energy.

U.S. Energy Information Administration

Coal

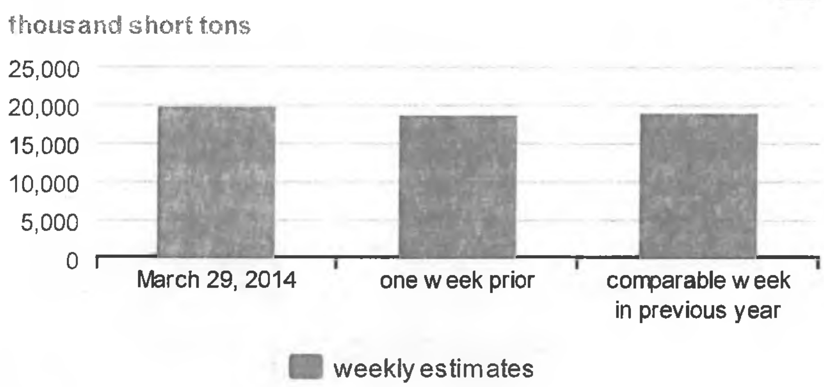
Weekly Coal Production

Data for week ended: March 29, 2014 | **Release date:** April 03, 2014 | **Next release date:** April 10, 2014

For the week ended March 29, 2014:

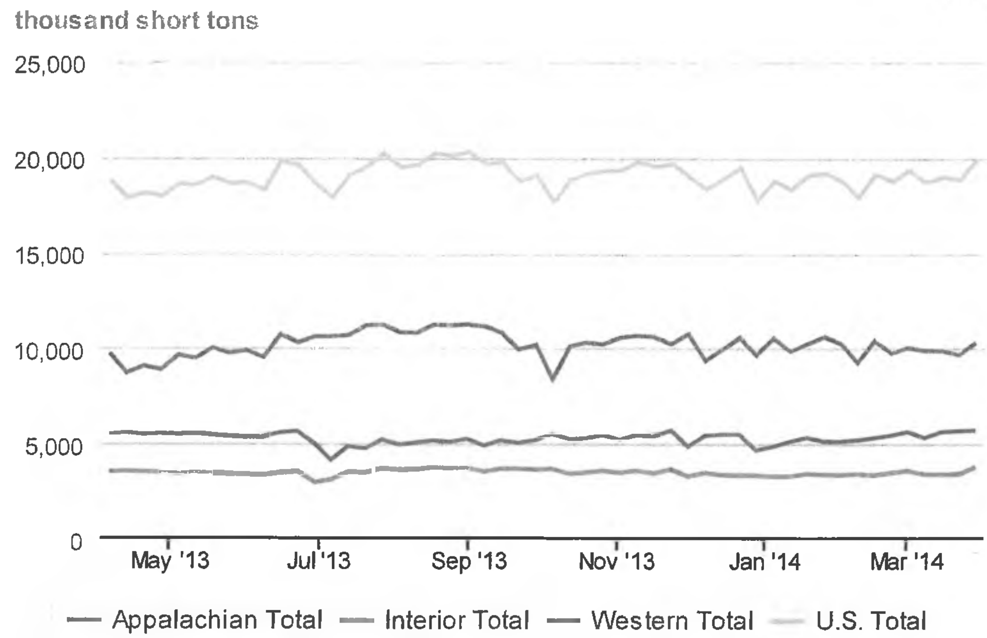
- U.S. coal production totaled approximately 19.9 million short tons (mmst)
- This production estimate is 5.4% higher than last week's estimate and 4.7% higher than the production estimate in the comparable week in 2013
- Coal production east of the Mississippi River totaled 8.5 mmst
- Coal production west of the Mississippi River totaled 11.4 mmst
- U.S. year-to-date coal production totaled 237.7 mmst, 1.9% lower than the comparable year-to-date coal production in 2013

Weekly U.S. coal production overview



Source: U.S. Energy Information Administration

U.S. weekly coal production for the last 52 weeks



Source: U.S. Energy Information Administration

EIA revises its weekly estimates of state level coal production using Mine Safety and Health Administration (MSHA) quarterly coal production data. After revision, EIA's state level weekly numbers summed for the quarter match the MSHA data.

Data for January through December 2013 are revised to match MSHA. Data for January through March 2014 are preliminary EIA estimates.

vivify

Bringing Technology to Life

Bringing Technology To Life

www.vivifyinc.com
800-559-8090

Bringing Technology To Life

SOLVING THE WORLDS ENERGY CHALLENGES

Vivify is tackling the largest energy challenges facing the world with a brand new perspective. By combining forward thinking technology with cutting edge science & engineering, we create paradigm shifting clean energy solutions.

CLEAN AIR TECHNOLOGY

The next generation of carbon capture and emissions control called Clean Air Technology is a revolutionary technology that allows power plants to achieve zero emissions while producing low cost electricity - providing affordable green energy.

vivify

Clean Affordable Energy

CLEAN AIR TECHNOLOGY + ALASKAN COAL POWER PLANTS = THE RIGHT CHOICE FOR ALASKA

- ✔ Utilize Alaska's vast natural coal resources.
- ✔ Provide low cost electricity to the people of Alaska.
- ✔ Enable Alaska to create thousands of high quality jobs.
- ✔ Protect Alaska's pristine environment and natural eco-system.

vivify

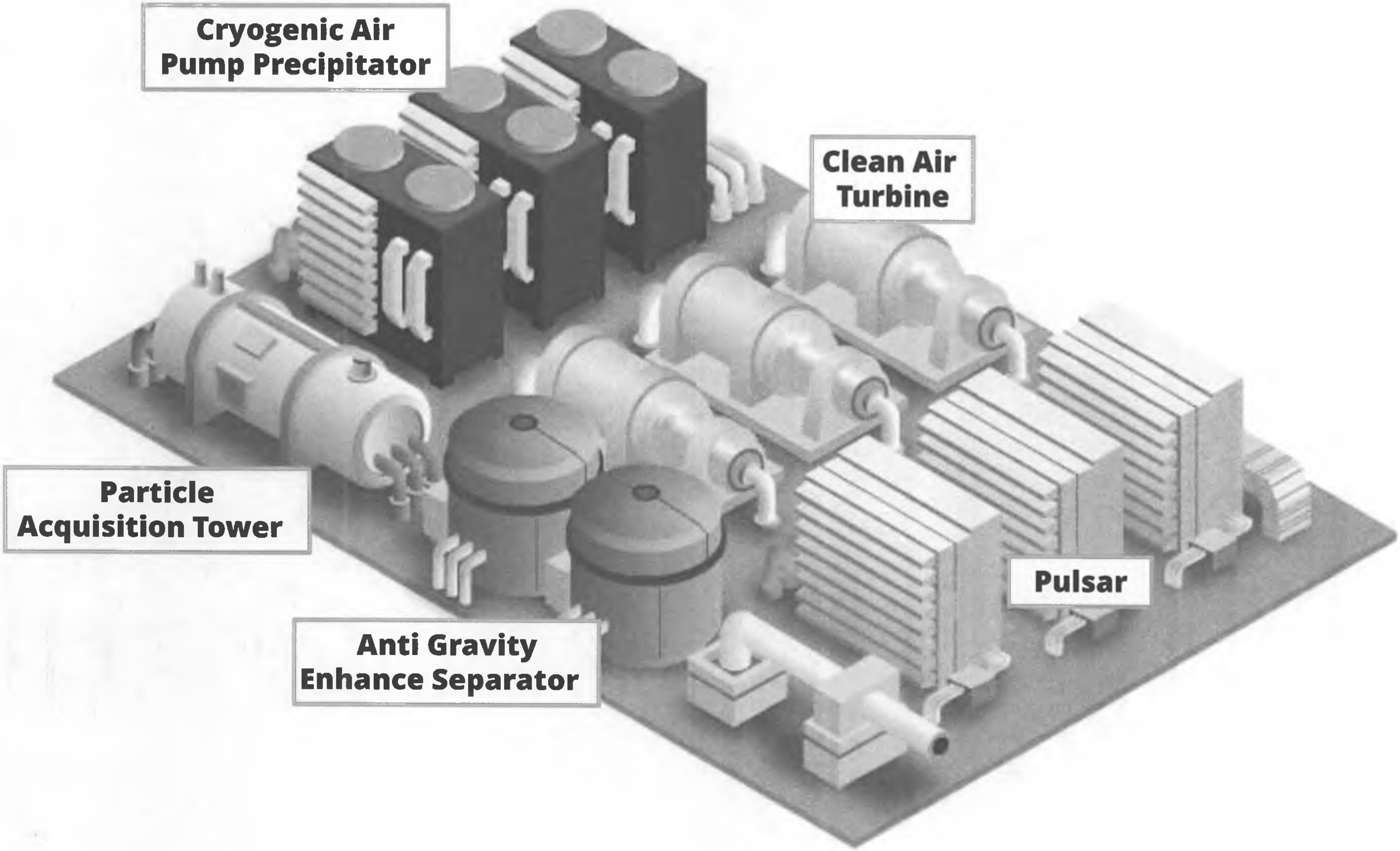
CLEAN AIR TECHNOLOGY PROTECTS ALASKA'S PRISTINE NATURAL ENVIRONMENT

OUR CLEAN AIR TECHNOLOGY provides complete pollution control and carbon capture for coal fired, diesel and natural gas power plants, removing 100% of pollutants from exhaust emissions, exceeding ambient air quality - achieved by unique patented processes of super-heating hydrogen to vaporize volatile organic compounds, and capturing carbon dioxide and other air compounds via super-cooling methods.

- ✓ Carbon Dioxide (CO2)
- ✓ Carbon Monoxide (CO)
- ✓ Nitrogen Oxide (NOx)
- ✓ Mercury & Arsenic
- ✓ Sulfur Dioxide (SO2)
- ✓ Sulfur Dioxide (SO2)

vivify

Vivify Clean Air Technology

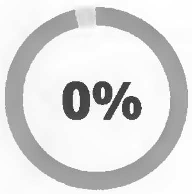


vivify

Zero Parasitic Load

PROVIDE LOW COST ELECTRICITY TO THE PEOPLE OF ALASKA.

CONVENTIONAL POLLUTION CONTROL and carbon capture technology uses 30%-40% of a power plants energy capacity, which increases the cost of electricity to the consumer by a staggering 130%-140%.

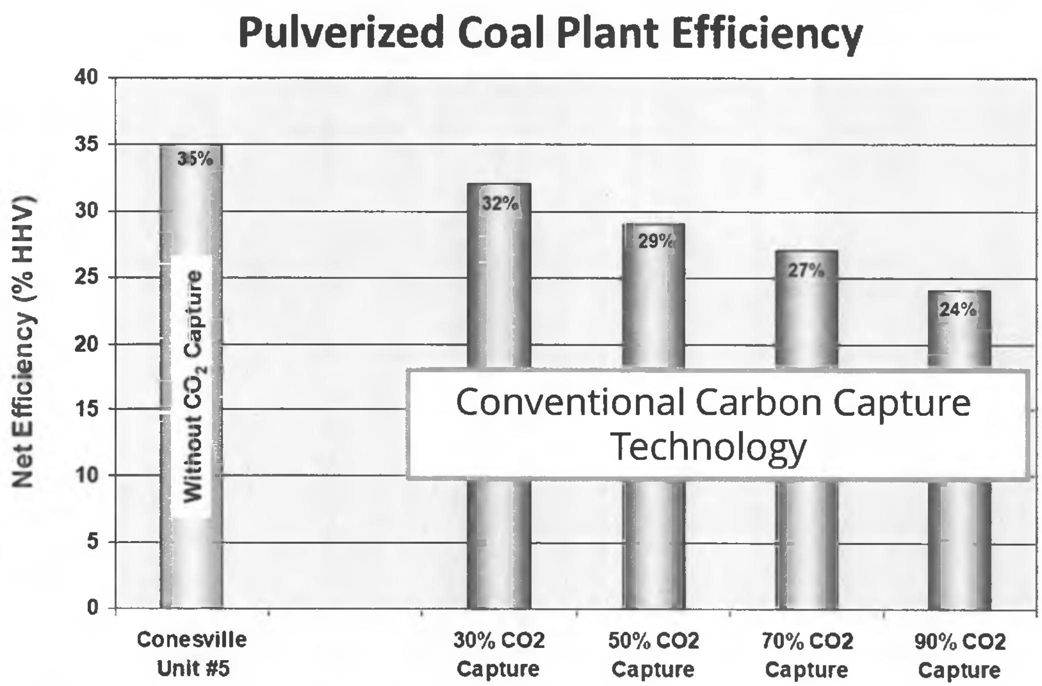


CLEAN AIR TECHNOLOGY generates its own electricity, increasing a power plants capacity and dramatically lowering the cost of electricity as compared to convention pollution control systems. Vivify's Pulsar, an exclusive patented on-demand hydrogen creation solution, powers the entire pollution control and carbon capture process.

Note: 0.001% of a plants capacity maybe required for ancillary processes - estimated 2000 watts connection.

vivify

Zero Parasitic Load



Reference: CO2 Capture From Existing Coal-Fired Power Plants, U.S. Department of Energy/National Energy Technology Laboratory, Revised Final Report, November 2007.

Vivify Clean Air Technology has zero parasitic load does not reduce the net efficiency of the plant, keeping electricity costs low.

vivify

Low Cost Implementation

REDUCE THE COST OF POLLUTION CONTROL & CARBON CAPTURE

- Clean Air Technology costs dramatically less than inefficient conventional pollution control and carbon capture technology.
- Clean Air Technology can be implemented in new power plant construction or integrated into existing power plants or even retired plants.
- Does not require costly absorbents or chemicals. Can be implemented with zero downtime or retrofit required, utilizes the plant existing infrastructure. Clean Air Technology does not impede the current plant operations.

vivify

Clean Air Turbine

- Vivify uses a series of turbines, compressors and generators in the operation of our technology.
- By utilizing the heat from the flue exhaust, coupled with pressure, we generate additional heat to power the generators, we create electricity to offset the operating and maintenance cost.
- We employee heat exchangers to extract the heat and precipitate the contaminates from the pressurized gas
- The captured Carbon Monoxide (CO) and Volatile Organic Compounds (VOCs) are combusted to generate additional electricity.
- The simplicity of our technology is the answer to a cost-effective advanced complete Emissions Control and Carbon Capture Solution

vivify

Vivify Cryogenic Air Pump Precipitator

- Cryogenic chamber and pump used to separate air compounds.
- Leverage pressure and temperature (cryogenic) to separate, precipitate and capture gases.
- Separate Carbon Dioxide (CO_2), Sulfur Dioxide (SO_2), Nitrogen Oxide (NO_x) and Mercury Compounds (Hg) - as required.
- Each Compound will precipitate at its own ideal temperature and pressure within their own respective chambers.

vivify

Vivify Particle Acquisition Tower

- Water Filled Hydroponic towers in which exhaust mixes with water to remove heavy particulates.
- Heavy particulates condense and separate as it is filtered at high pressure.
- Works in conjunction with Anti Gravity Enhance Separator to filter heavy and light particulates.
- Utilized based on current power plant configuration. May not be needed with new power generating technology.

vivify

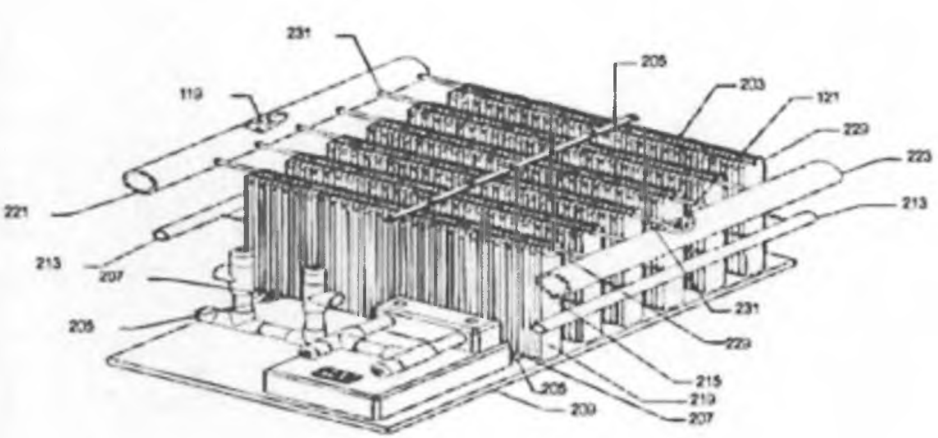
Vivify Anti Gravity Enhance Separator

- Removes fine particulates, including Mercury (if not being separated in Cryogenic chamber).
- Rotating chamber users centrifugal force to separate particles by weight.
- Used in conjunction with Particle Acquisition Tower to filter heavy and light particulates.
-

vivify

Vivify Pulsar

300 Cell Pulsar™ Array

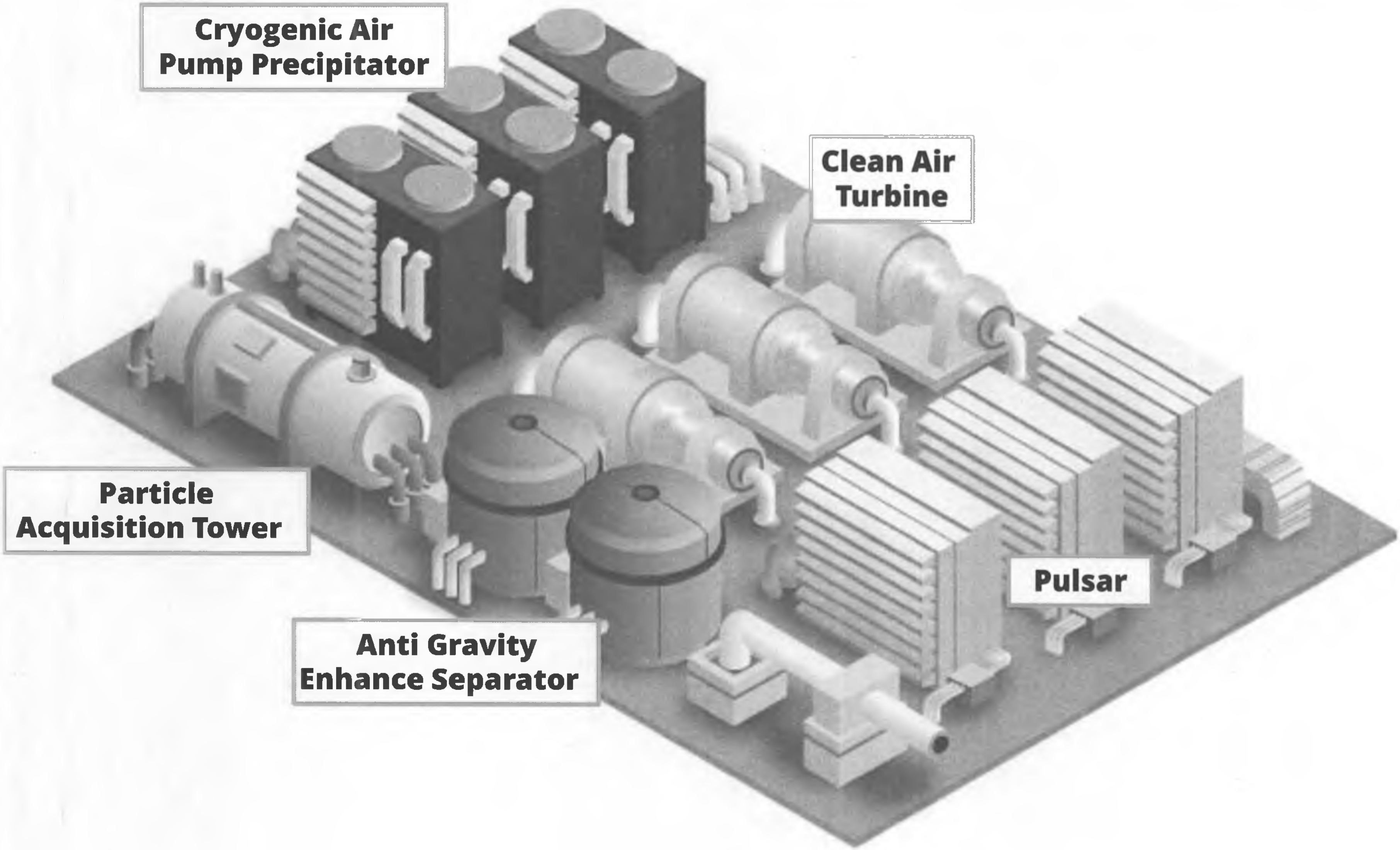


100 cell array can produce 1 cubic ft of hydrogen per hour with an input of 200 watts of electricity. Cells can be combined in any number to produce the desired amount of hydrogen.

- On demand hydrogen generation which provides a low cost, high yield fuel source.
- Water electrolysis produces hydrogen and oxygen .
- Concept developed in mid-1800s, but very inefficient and expensive - until now.
- Vivify Pulsar's patented technology is dramatically more efficient than historical electrolysis hydrogen generation.

vivify

Vivify Clean Air Technology



vivify

vivify

Bringing Technology to Life

Bringing Technology To Life

www.vivifyinc.com
800-559-8090