



# Meet Alaska 2018

## Brent Sheets

*Acting Director*

Petroleum Development Lab,  
Institute of Northern  
Engineering



# OIL & COAL ENERGY FOR AMERICA & ALASKA!

BRENT J SHEETS  
ACTING DIRECTOR  
PETROLEUM DEVELOPMENT LAB

MEET ALASKA  
SUPPORT INDUSTRY ALLIANCE  
ANCHORAGE, JAN. 19, 2018



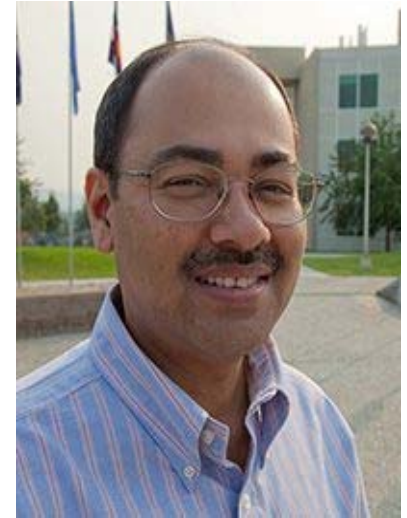
Hidden in Plain Site

# PETROLEUM DEVELOPMENT LAB

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# OUR TEAM



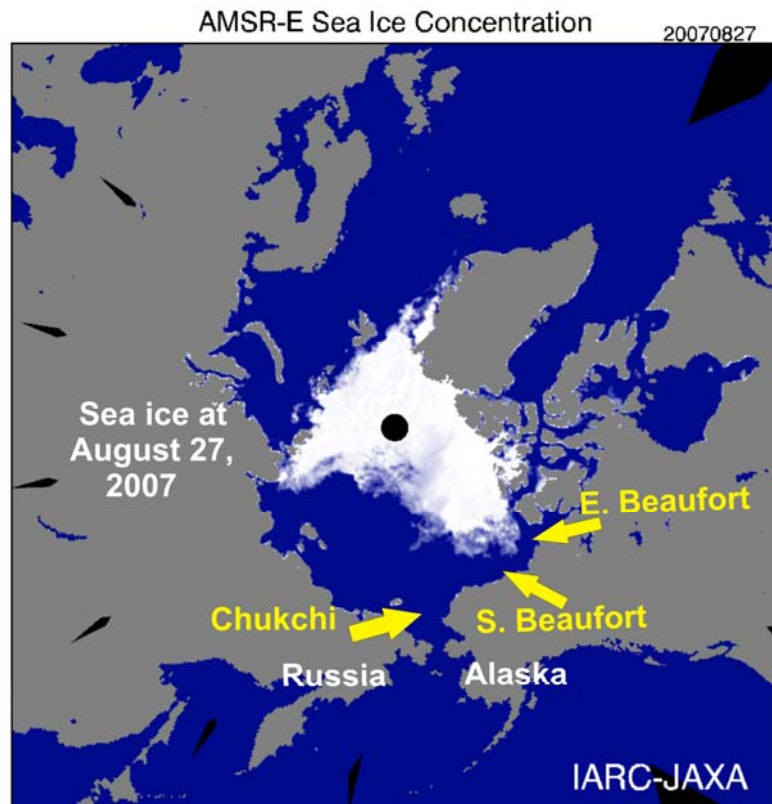


# ENERGY RESEARCH CONSORTIA OF ALASKA



- Provide researchers & in-state facilities
- Collaboratively address research needs
- Promote technology that shapes the future of energy
- Utilize the assets of **YOUR** local University

# ERCA RESEARCH THEMES



- Surface & Subsurface Exploration Research
- Resource Production, Infrastructure and Other Engineering-related Research
- Arctic Environmental and Climate Modeling



# ALASKA LAB DAY MAY 30-31

## Four Themes (Draft):

- Developing locally and globally relevant energy solutions (with ACEP & NREL)
- Exploring and accessing the energy field of the future (with PDL & NETL)
- Navigating the changing Arctic (with IARC & SNL)
- Diversifying the economy (with BEI & LBNL)



Modular Gasification for  
Syngas/Engine Combine Heat and Power Applications in  
Challenging Environments

# MAKING COAL RELEVANT FOR SMALL SCALE APPLICATIONS

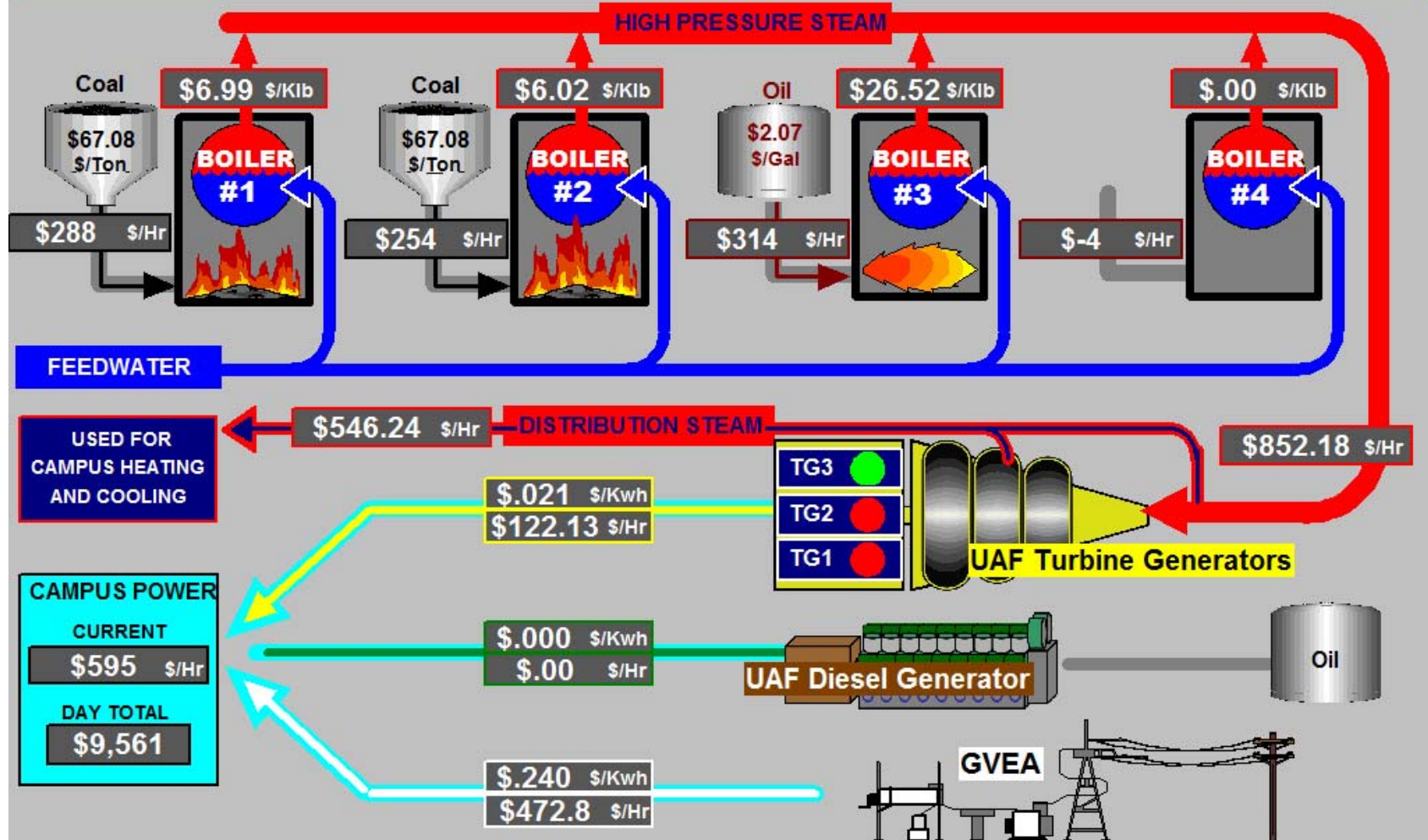
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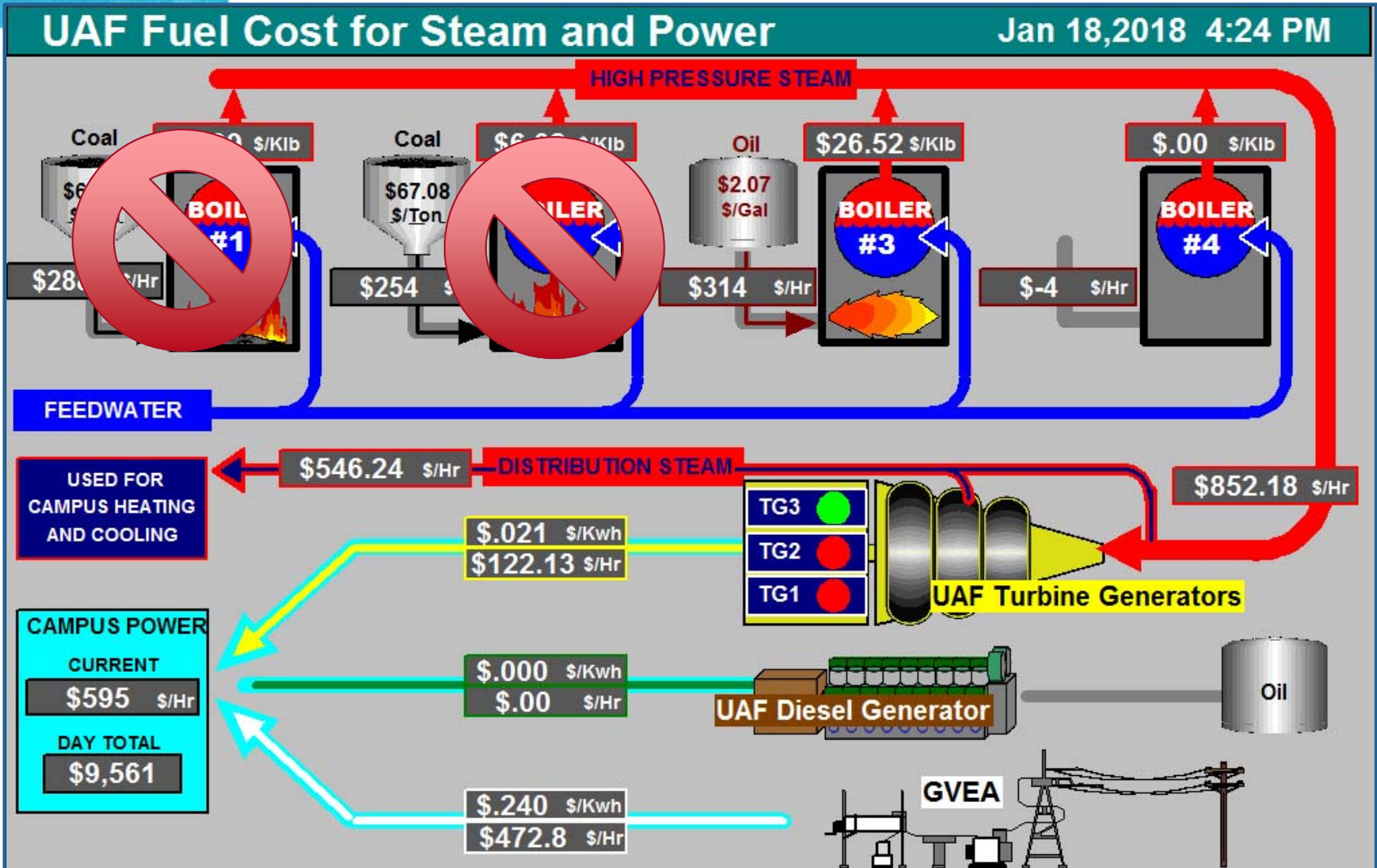
# UAF POWER PLANT

## UAF Fuel Cost for Steam and Power

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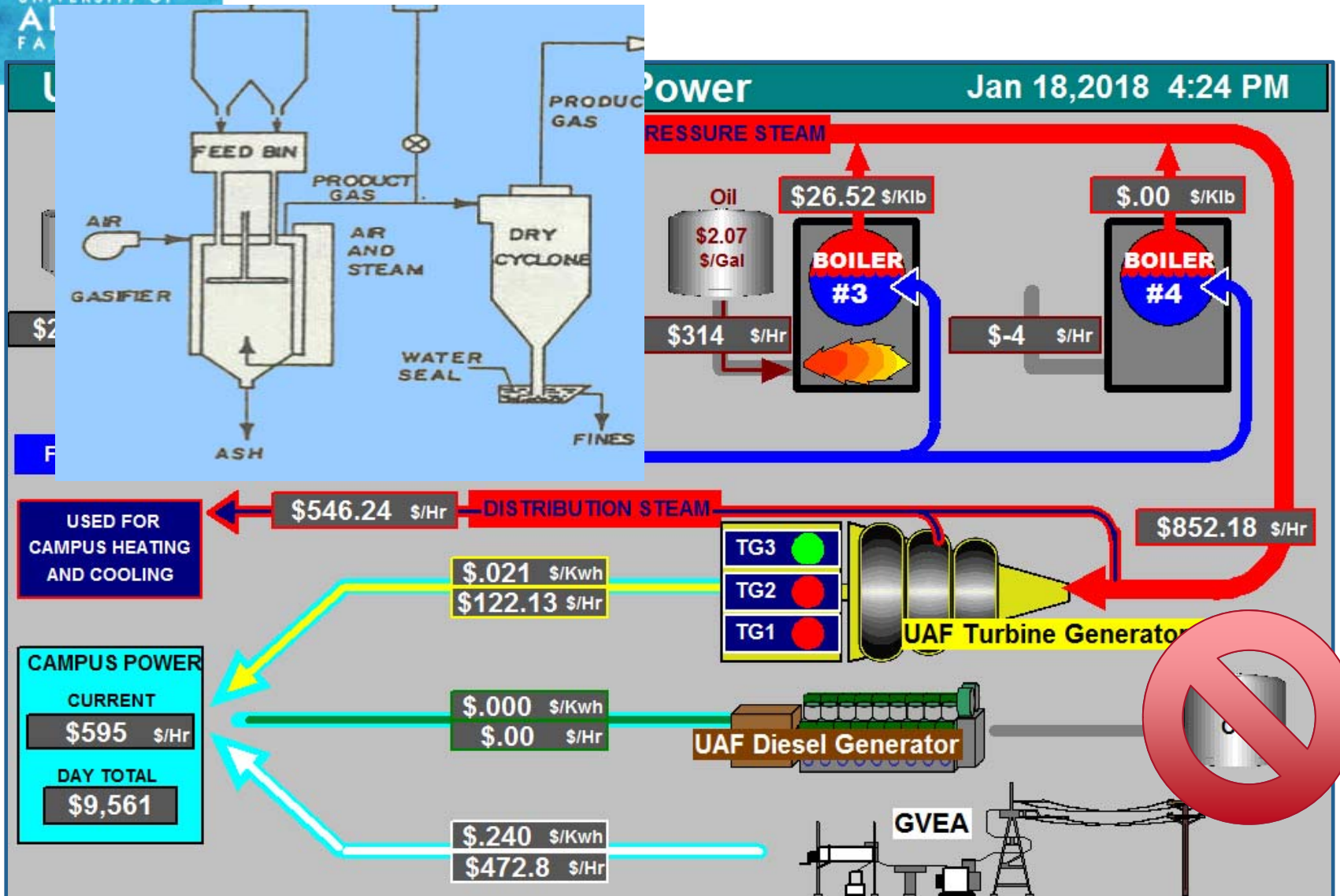


# UAF POWER PLANT

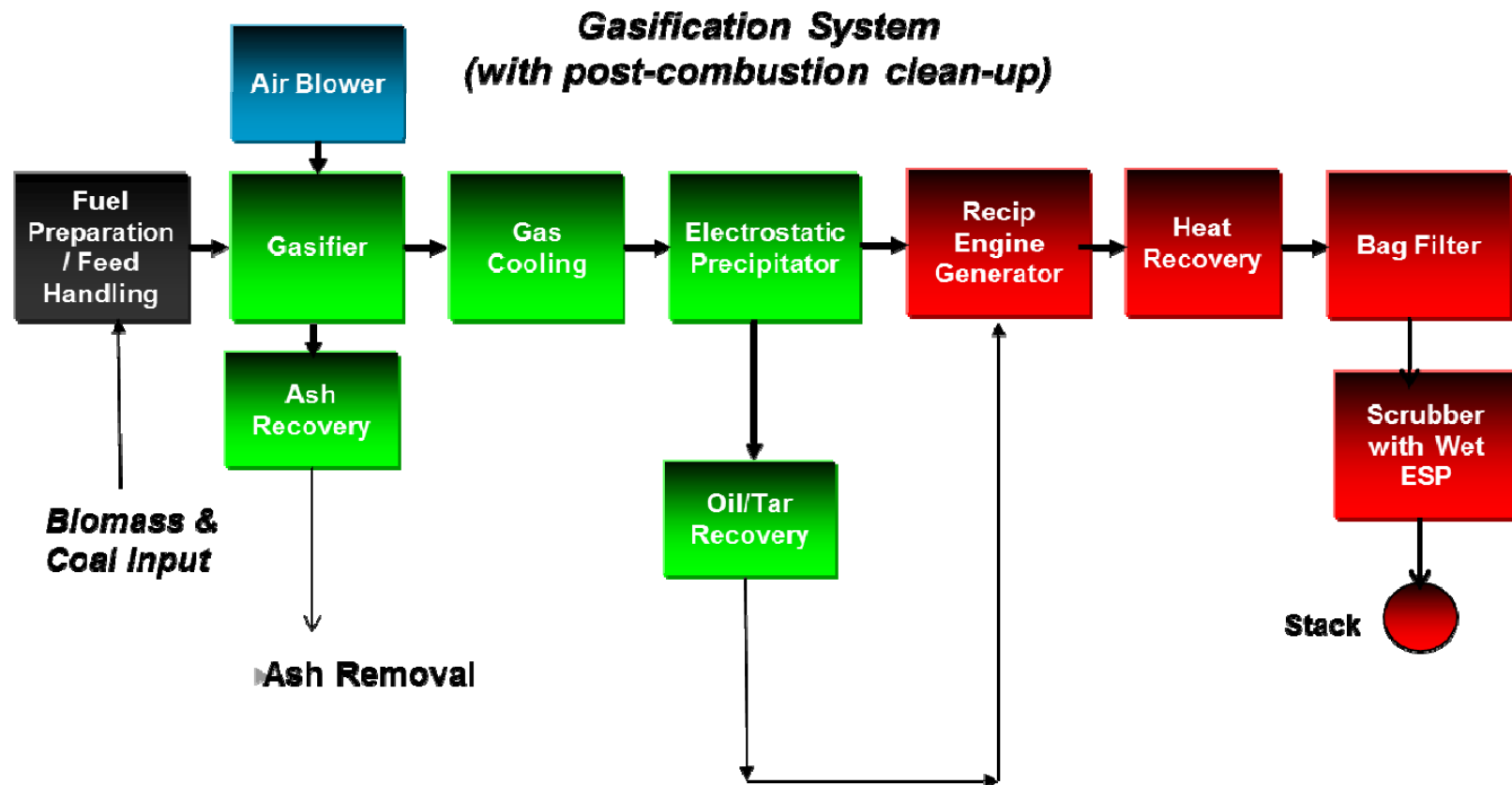




# UAF POWER PLANT



# UAF'S GASIFICATION SYSTEM

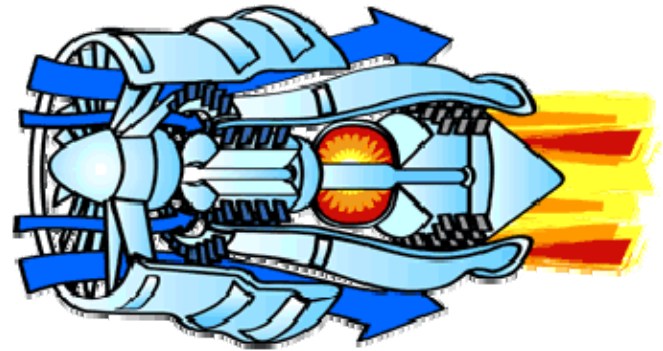




# WHY COAL GASIFICATION?

Fuel	Coal	Oil	Natural Gas
Fuel Cost, \$/MMBtu	\$4.47	\$17.17	\$17.30 \$15.20-\$20.20
Capital Cost, \$	\$15 MM	\$0	Unknown
Efficiency, %	34 LHV	40 LHV	40 LHV
Annual Fuel Cost, \$	\$2 million	\$10 million	\$11 million
Simple Payback, yr.	2 to 3	Base	Comp to oil

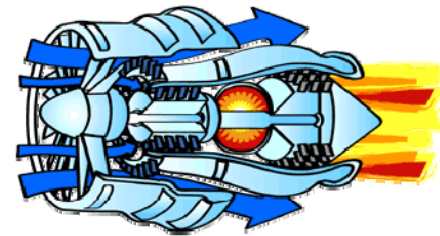
# LOAD FOLLOWING



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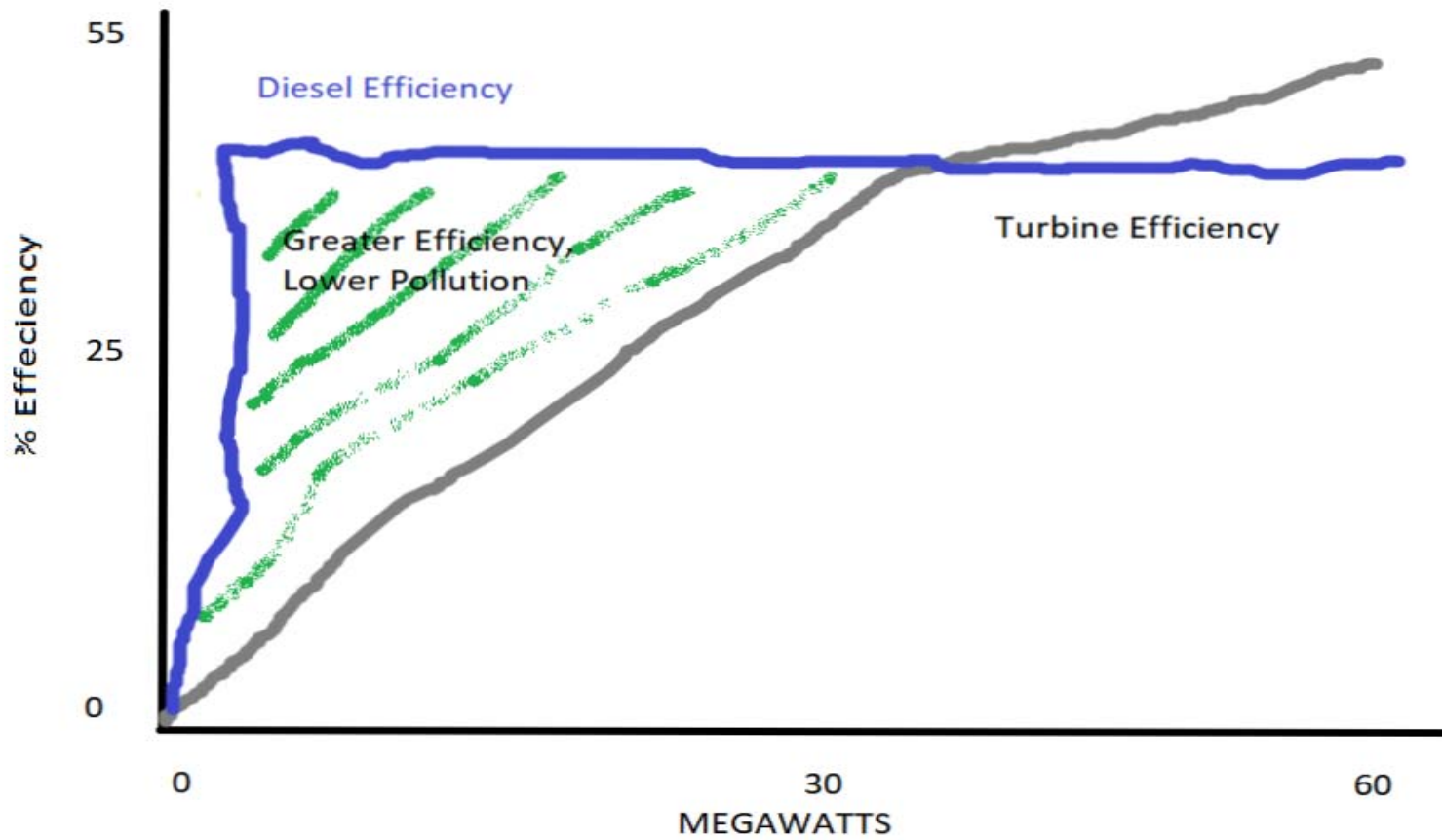


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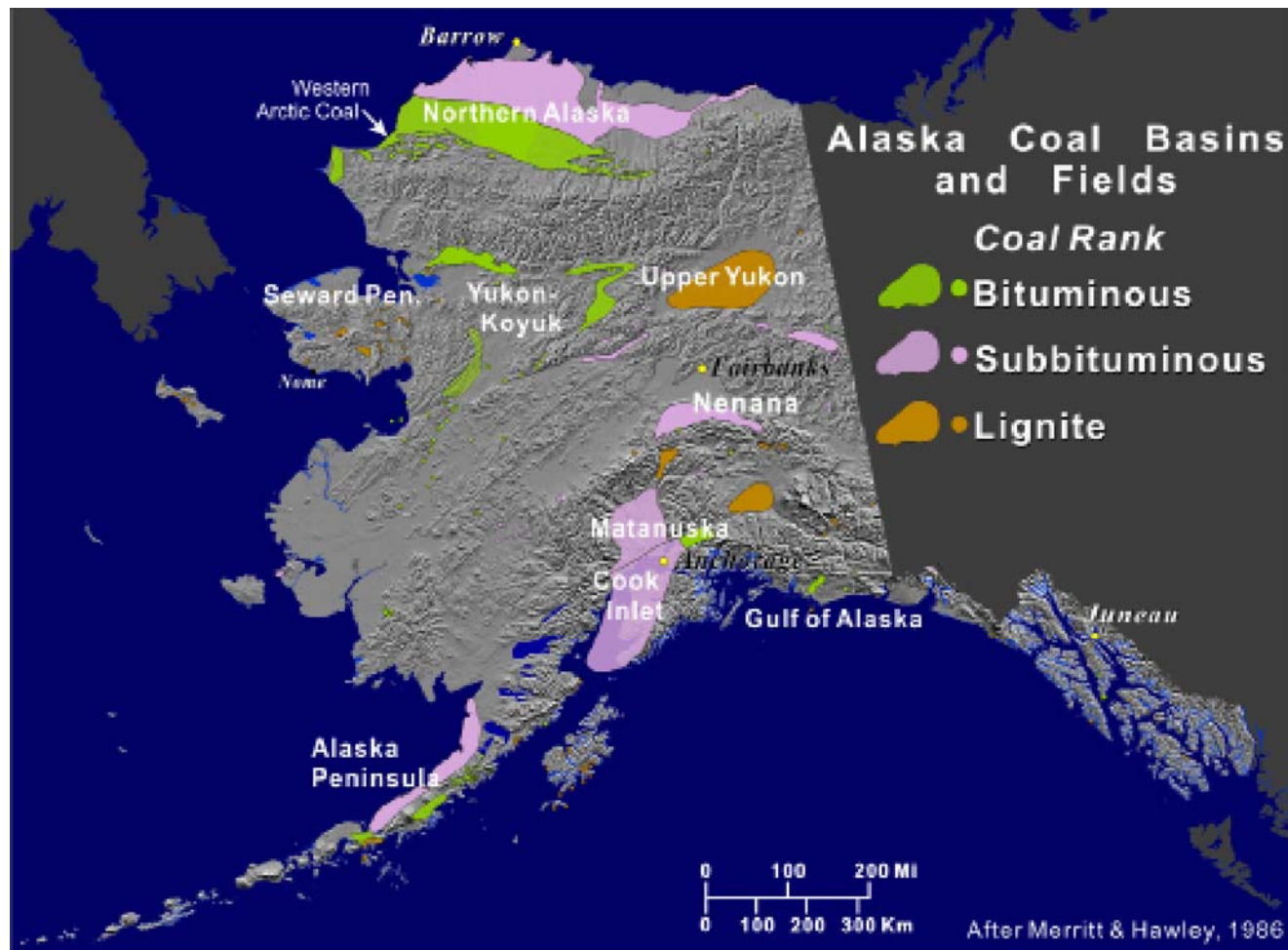


# MY PATHETIC ATTEMPT AT ART





# AK-DGGS IDENTIFIED 37 VILLAGES WITH COAL NEARBY





# RADICALLY ENGINEERED SYSTEM



- Make it work at 5 to 10MWe
  - Economies of Scale working against us
- Make it work at village scale <1MWe
- Integrate with diesel infrastructure



## USEFUL IN LOWER-48, TOO!



- Coal plants are best suited for baseload operation because it requires a long period to ramp up and to ramp down
- Syngas/Engine combinations has the potential for making coal a cost competitive resource meeting flexible energy demand and fluctuating generation

# 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.

# GASIFICATION CHEMISTRY



## Gasification with Oxygen



## Combustion with Oxygen



## Gasification with Carbon Dioxide



## Gasification with Steam



## Gasification with Hydrogen



## Water-Gas Shift



## Methanation

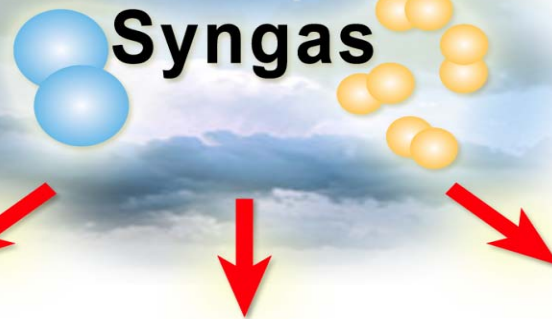


## Gasifier Gas Composition (Vol %)

H <sub>2</sub>	25 - 30
CO	30 - 60
CO <sub>2</sub>	5 - 15
H <sub>2</sub> O	2 - 30
CH <sub>4</sub>	0 - 5
H <sub>2</sub> S	0.2 - 1
COS	0 - 0.1
N <sub>2</sub>	0.5 - 4
Ar	0.2 - 1
NH <sub>3</sub> + HCN	0 - 0.3

Ash/Slag/PM

# SO WHAT CAN YOU DO WITH H<sub>2</sub> AND CO?



**Building Blocks for  
Chemical Industry**

**Clean  
Electricity**

**Transportation Fuels  
(Hydrogen)**

# PRODUCTS FROM COAL

It is likely that you have recently used a product based on coal gasification

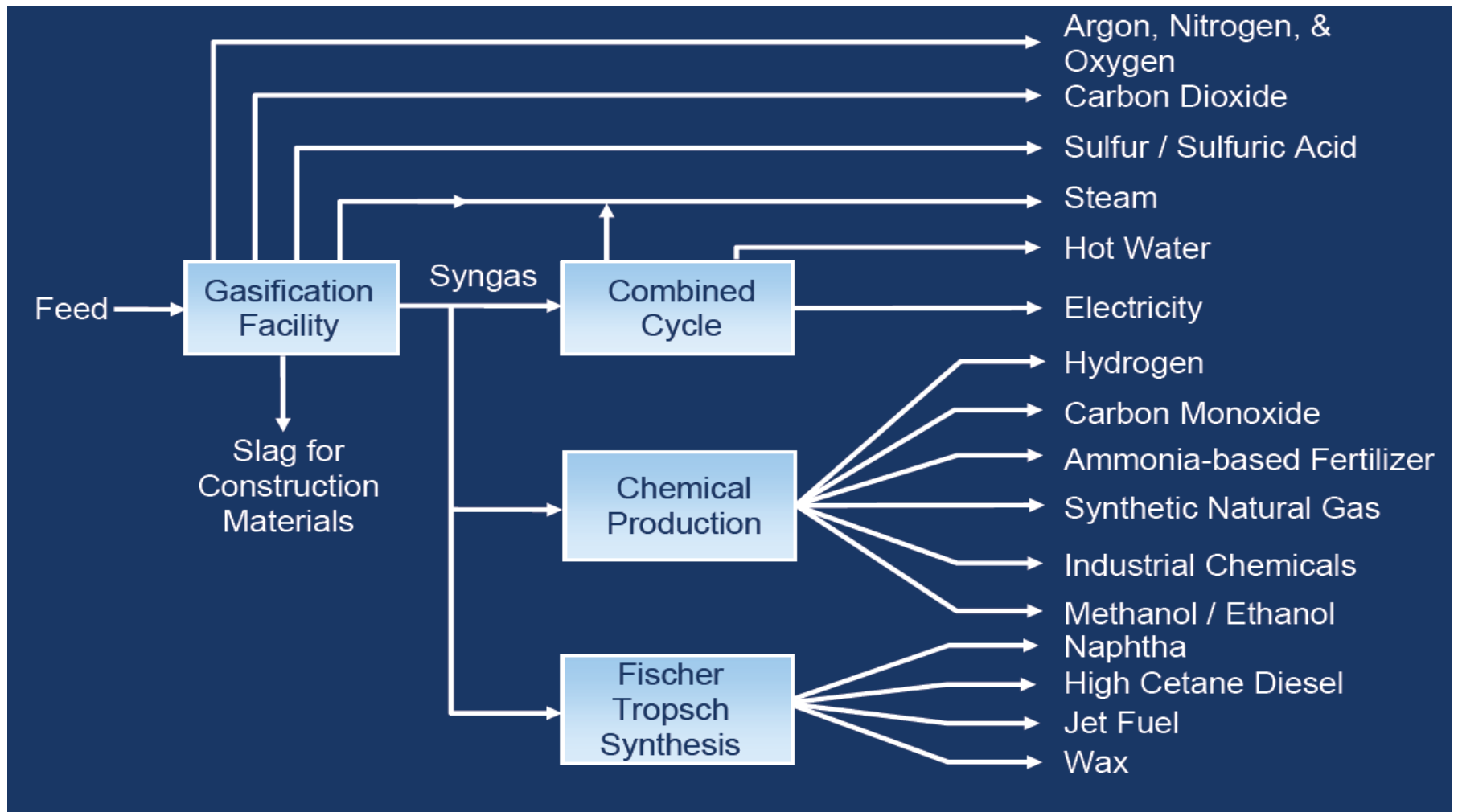


Acetic Anhydride  
Acetic Acid



Source: Eastman Gasification Services  
Company

# GASIFICATION PRODUCTS







# BUT MOST IMPORTANTLY ...POWER ALASKA'S INTERIOR





# CALL ME SOMETIME



**Brent J Sheets**

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<http://pdl.uaf.edu/>

# USIBELLI SUB-BITUMINOUS COAL COMPARED WITH MIFGA LOW-RANK COALS GASIFIED

Proximate Analysis - Comparisons	Vol Matter	Fix Carb	Ash	Moisture	Sulfur	BTU content	Air/Fuel Ratio(lb/lb )
Lignite Coals....							
Benton Lignite	34.87	25.93	6.43	32.77	0.56	8,081	1.067
Subbituminous Coals....							
Kemmerer	35.13	42.44	5.67	16.76	0.79	10,513	1.966
Rosebud	26.81	40.12	11.82	21.25	0.87	8,881	1.87
Leucite Hills	29.63	45.55	8.07	16.75	0.55	10,209	1.78
ABS-ROB	29.56	40.72	6.26	23.46	0.31	9,187	1.8
USIBELLI	36	26.5	9	29	0.2	7,560	~ 1.2

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# HMI/ARI GASIFIER FAGGIO WOODCHIP FEED

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