Modular Gasification for Syngas/Engine Combine Heat and Power Applications in Challenging Environments (Funding by DOE/NETL Contract DE-FE0031446)

MAKING COAL RELEVANT FOR SMALL SCALE APPLICATIONS

UAF is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: www.alaska.edu/nondiscrimination/.
WHERE IS FAIRBANKS?
PROJECT PARTNERS

UAF:
Plant & Expertise
Diesel Generator

HMI:
Intellectual Property
Decades Experience

WorleyParsons:
Detailed Engineering
Cost Estimating Service

Cost Share: Sotacarbo, HMI, UAF, GVEA, Aurora Energy
Demonstrate small scale coal gasification to fuel reciprocating engine generators

- Cost effective coal generating capacity for small applications
- Provides load following services
- Ideal for islanding systems
- Local jobs
UAF POWER PLANT

Power

Jan 18, 2018 4:24 PM

Pressure Steam

Boiler #3

Oil

$2.07 $/Gal

$26.52 $/Klb

$314 $/Hr

$0 $/Klb

$0 $/Hr

Boiler #4

UAF Turbine Generator

UAF Diesel Generator

GVEA

Used for:

Campus Heating and Cooling

$595 $/Hr

$546.24 $/Hr

Distributed Steam

$122.13 $/Hr

Campus Power

Current

$9,561

Day Total

$0 $/Kwh

$0.00 $/Hr

$0.021 $/Kwh

$0.00 $/Kwh

$0.240 $/Kwh

$472.8 $/Hr
UAF’S ORIGINAL DESIGN

Gasification System
(with post-combustion clean-up)

- Air Blower
- Fuel Preparation / Feed Handling
- Gasifier
- Gas Cooling
- Electrostatic Precipitator
- Recip Engine Generator
- Heat Recovery
- Bag Filter
- Scrubber with Wet ESP
- Stack

Biomass & Coal Input

Ash Recovery

Oil/Tar Recovery

Ash Removal
WHERE DOES FAIRBANKS POWER COME FROM?
## WHY COAL GASIFICATION?

COSTS FOR REGULATING 27 MWe OF WIND POWER

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Syngas Project (UAF)</th>
<th>Diesel (GVEA)</th>
<th>Natural Gas (not an option)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Cost</td>
<td>$46 million</td>
<td>--</td>
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</tr>
<tr>
<td>Fuel Costs + other O&amp;M</td>
<td>$114.6/MWh $8/MMBtu</td>
<td>$161.5/MWh $18/MMBtu</td>
<td>$17/MMBtu ($15.20-$20.20)</td>
</tr>
<tr>
<td>Wind Regulation Costs</td>
<td>$11.8M syngas/engine + tars/oils/DEG</td>
<td>$23.7M (oil)</td>
<td>--</td>
</tr>
<tr>
<td>Efficiency, LHV</td>
<td>34%</td>
<td>17.9% (turbines)</td>
<td>--</td>
</tr>
<tr>
<td>Simple Payback</td>
<td>&lt;4 years</td>
<td>Base Case</td>
<td>--</td>
</tr>
</tbody>
</table>
THE PROBLEM: INTERMITTENT GENERATION

Eva Creek

“Free” Energy

Combustion Turbine

Expensive Energy

Coal

Curtailed Energy

Cheapest Energy
THE SOLUTION: COAL ENABLING WIND

Eva Creek + Recip. Generator + Coal = Cheapest Energy + Expensive Energy

“Free” Energy + Coal Syngas = Cheapest Energy

Combustion Turbine + Curtailed Energy

Cheapest Energy

Expensive Energy
EFFICIENCY vs. LOAD

Combined Cycle LM6000 Gas Turbine Plant – NPEP
Efficiency Curve – Compared to Diesel Recip Units
In Wind Load Following Application

- Peak Efficiency: 52% @ -30°F, 68 MW, 72 GPM
- Typical Average Load: 50% Eff, 85.8 gallons per MWh
- Reduction in Gas Turbine Efficiency to Load Follow Wind ~ 18%
- 34% Eff, 128.4 gallons per MWh

Fuel Savings & Reduced Emissions

Generator Output MW

Fuel %

- Jet A Fuel Below 17 MW
- Lower Cost Naphtha Fuel 17 MW and up
- Steam Turbine Risks Tripping Below ~20 MW

Efficiency %

- Starting
- 10 MW, 20 MW, 30 MW, 40 MW, 50 MW, 60 MW

Fuel 100%

50%

44%

40%

30%

20%

10%

0%
MODULARITY and SCALING

Gasifier/Engine System is Modular and Scalable

Multiple gasifier trains and engines can create powerplants from 1 MWe to 30 MWe+
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 <2MWe
- 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.
BUT MOST IMPORTANTLY

...POWER ALASKA’S INTERIOR
NEXT STEP: COMPETE FOR CONSTRUCTION FUNDING (DE-FE00031601)

Phases:
I. Team Formation
   - $1M maximum award per team
   - 8-10 awards
   - UAF team already counts
II. Prepare FEED & Environmental
   - $3M maximum award per team
   - 4-5 awards anticipated
   - UAF’s project has FEED already
III. Detailed Design, Construction, and Commence Operation
   - $80M maximum award per team
   - 2 awards
   - UAF’s project needs to compete
RISK FACTORS

• Except for the HMI Gasifier, all components are available commercially
  – HMI gasifier components are well understood and documented

• Emission controls could be the key factor to be addressed
  – Fairbanks is in an EPA designated “Serious non-attainment area for PM 2.5”
MEET THE TEAM

- Diane Revay Madden, NETL
- Brent J Sheets, UAF
- Rolf Maurer & Team, HMI
- Harvey Goldstein & Team, WorleyParsons
- Chilkoot Ward, UAF
- Frances Isgrigg, UAF
- Russ Steiger, UAF
- Trish Winners, UAF
- Paul Morgan, GVEA
- Pete Saurer, GVEA
- Randy Hobbs, Hobbs Industries
- Alberto Pettinau, Sotacarbo
CALL ME SOMETIME

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