How to Make Biomass-to-Energy Work in Rural Alaska

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Al Randall

April 29, 2014

www.tetratech.com
Tetra Tech Alaskan Project Experience

3 Office Locations – Anchorage, Fairbanks, Juneau

HelioTech JV – Alaska Native Corporation 8(a)
<table>
<thead>
<tr>
<th>Tribal Group</th>
<th>Other Tribal Group</th>
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<tbody>
<tr>
<td>Cherokee Nation</td>
<td>Northern Arapaho</td>
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<tr>
<td>Cheyenne River Sioux</td>
<td>Northern Cheyenne Tribe</td>
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<tr>
<td>Cheyenne-Arapaho Tribes of Oklahoma</td>
<td>Oglala Sioux Tribe</td>
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<td>Chippewa Cree Tribe of the Rocky Boys Reservation</td>
<td>Omaha Tribe of Nebraska</td>
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<td>Crow Creek Sioux Tribal Council</td>
<td>Osage Nation</td>
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<td>Flandreau Santee Sioux Tribe</td>
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<td>Fort Peck Tribes</td>
<td>Ponca Tribe of Nebraska</td>
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<td>Ho-Chunk Nation</td>
<td>Prairie Band Potawatomi Nation</td>
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<tr>
<td>Iowa Tribe of Kansas &amp; Nebraska</td>
<td>Prairie Island Indian Community</td>
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<td>Keweenaw Bay Indian Community</td>
<td>Red Cliff Band of Lake Superior Chippewa Indians of Wisconsin</td>
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<tr>
<td>Kickapoo Tribe of Kansas</td>
<td>Red Lake Band of Chippewa Indians of Minnesota</td>
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<td>Kickapoo Tribe of Oklahoma</td>
<td>Sac &amp; Fox Tribe of the Mississippi in Iowa</td>
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<td>Lac Courte Oreilles Band of Lake Superior Chippewa Indians</td>
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<td>Lac du Flambeau Band of Lake Superior Chippewa Indians</td>
<td>Shakopee Mdewakanton Sioux Community of Minnesota</td>
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<td>Lac Vieux Desert Band of Lake Superior and Chippewa Indians</td>
<td>Shawnee Tribe</td>
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<td>Leech Lake Band of Ojibwe</td>
<td>Spirit Lake Nation</td>
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<td>Lower Brule Sioux Tribe</td>
<td>Standing Rock Sioux Tribal Council</td>
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<td>Lower Sioux Indian Community of Minnesota</td>
<td>Turtle Mountain Band of Chippewa</td>
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<td>Menominee Indian Tribe of Wisconsin</td>
<td>Three Affiliated Tribes</td>
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<td>Miami Tribe of Oklahoma</td>
<td>Upper Sioux Community of Minnesota</td>
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<td>Mille Lacs Band of Ojibwe Indians</td>
<td>White Earth Tribal Council</td>
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<td>Ysleta del Sur Pueblo</td>
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Selecting the Correct Boiler

**Project Pillar**

- **Feedstock Supply**

- **Optimal Plant Sizing**

**Key Project Attribute**

- Source and Impacts
- BTU content vs moisture content
- Consistency vs. variety of materials
- Toxics / carcinogens

- Energy Off Takes
- Electrical Loading
- Thermal Loading
- Mass & Energy Balance
- Site and Project Footprint
Feedstock - Categories

• Waste Biomass
  ▪ Municipal Solid Waste (MSW)
  ▪ Organics – Food waste
  ▪ Fiber – Paper, Cardboard, Wood (RDF)
  ▪ Construction & Demolition (C&D)

• Woody Biomass
  ▪ Chip wood (pulp-and-paper industry standard chip spec)
  ▪ Stewardship & stand thinning
  ▪ Logging slash
  ▪ Mill residues (sawdust & other waste)
  ▪ Fuel wood
Feedstock – MSW

• Unsorted MSW
  ▪ Widely available
  ▪ Difficult to handle / process

• Separation Steps Needed!
  ▪ Higher quality of Feedstock - consistent, homogenous
  ▪ Difficult to implement / reduced capture volume

• Construction & Demolition Waste and Urban Wood
  ▪ Wood, paper, cardboard focus
  ▪ Potential for EPA ‘Biomass’ Designation
Material Recovery Facility (MRF)

• MSW MRF
  ▪ 20,000 tons/yr min throughput
  ▪ Metals recycling primary

• C&D MRF
  ▪ Aggregate recycling
  ▪ Shingles to hot mix

= Value-added Recycling
Feedstock - Construction & Demolition

- 30-50% woody material
- Negative-cost feedstock
- Value-added byproducts
  - Metals, aggregate, shingles

Source: Illinois Sustainable Technology Center
# Feedstock – Woody Biomass

<table>
<thead>
<tr>
<th>Product</th>
<th>Image</th>
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<tbody>
<tr>
<td>Logging Residue</td>
<td>![Image of logging residue]</td>
</tr>
<tr>
<td>Mill Residue</td>
<td>![Image of mill residue]</td>
</tr>
<tr>
<td>Thinning / Stewardship</td>
<td>![Image of thinning / stewardship]</td>
</tr>
<tr>
<td>Chip wood</td>
<td>![Image of chip wood]</td>
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</tbody>
</table>

- Logging Residues - Slash Mitigation
- Forest Hazard Mitigation
- Secondary Growth Market
- Beetle Kill
Biomass to Energy Technology

- Technology spectrum

- Products Produced
  - Thermal Heat
  - Combined Heat and Power (CHP)
    - Electricity for Operations (<1 to 10+ MW)
    - Heating / Hot Water / Cooling
  - Syngas / Pyrolysis Oils / Liquid Fuels
Multi-Fuel Boilers (Wood / Oil / Coal)

Courtesy: Alternate Heating (E100 WoodGun)

Courtesy: ATMOS (DC 18 SPL, DC 25 SPL, DC 32 SPL)

Courtesy: Biomass NExtGen
Community-Scale Gasifiers

Simple, Efficient, Durable

GARN WHS-1000 • PERFORMANCE and SPECIFICATIONS

- Maximum Heat Output (with 20% MC Oak): 180,000 (BTU/H)
- Tested Efficiency (LHV) (using 20% MC Oak): 80.0%
- Gallons of Storage: 980 Gallons
- BTUs Stored (based on 65°F temperature rise): 540,000 BTUs
- Weight [Empty] • [Full]: 2,200 lbs • 8,150 lbs
- Recommended Wood Dimensions: 16" - 20" long • 3"-10" diameter
- Combustion Chamber Dimensions: 36" long • 24" diameter
- Pipe Connections: 1.5" NPT Supply • 1" NPT Return
- Induced Draft Fan: 1/2 Horsepower (115vac, 15amp)
- Flue: 6" Duratech Class A
- Off-peak Electric Backup (Optional): Up to 33kw [5.5KW elements]
- Solar Storage Connections: Optional
Hybrid Gasification

Optional Air Pollution Control (Wet Scrubber Shown) additional cleansing of gases if required
Secondary Chamber combustion of gases from Primary Chamber
Primary Chamber solid waste combustion

scrubbing of gases

rapid quench cooling gases

high temperature and turbulent environment

movement of gases to secondary chamber

Courtesy: Eco Waste Solutions
Hybrid Gasification

Pro’s
- Accepts plastic and contaminants
- Higher efficiency over combustion

Con’s
- Higher CapEx $10MM +
- Minimum size ~ 2MW CHP
- More complex

Courtesy: Envikraft
The photos below depict 4,000 lbs of unsorted MSW before and after processing:

Courtesy: Eco Waste Solutions
Drivers for Bioenergy & Waste to Energy

Energy, Savings & Jobs

- Electricity in remote locations >> $$$ (Kotzebue – 42 ¢ / kWh)
- Diesel Prices - $6 to $10 / gallon
- Landfills >> High operation costs & tipping fees
- SE AK – secondary growth markets

Secure Power and Landfill/Waste Diversion

- Local, Base load Power
- Recycling, Landfill diversion, value-added byproducts
- Job Creation & “Economic Clusters”
- Funding Sources Available
Take Home Message!

• Bioenergy / WtE are proven technologies

• Bioenergy / WtE uses local waste resources

• Systematic Evaluation process is required
  One size does not fit all…

Bioenergy / WtE can work in many rural towns !!
Thank you!

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