Feasibility for Wood Heat

Collaborative Integrated Wood Energy Program for Yukon Flats Villages

DOE Tribal Energy Program

20 November 2008
Council of Athabascan Tribal Governments (CATG)

- Non-Profit Consortium of Ten Tribal Governments within the Yukon Flats.
- CATG Administers several Tribal Programs on behalf of the Tribes.
- CATG also applies for and administers several other grants.
  - IHS, Regional Clinic (Fort Yukon), Health Aids in Each Village, drug and alcohol programs, and other health related programs.
  - Natural Resources, EPA/IGAP, ANA (Traditional Land use Planning and Mapping), GIS, USDA RC&D, Contracts/Compacts with the USF&W (first tribal entity in U.S.), and many other NR related projects.
  - Education, NACTEC, NAVTEP, Early Head Start, Facilitate/Cooperate with UAF on other education programs.
Gwichyaa Zhee Gwich’in Tribal Government (GZGTG)

Federally recognized tribe 1200+ Tribal Members. Administers all 638 tribal programs and many other grants to include:


Gwitchyaa Zhee Corporation (G.Z. Corporation)

For-profit organization formed under the Alaska Native Claims Settlement Act (ANCSA) 1971. G.Z. is the village corporation, under ANCSA they also created 13 Regional Corporations, ours is Doyon Inc. G. Z. has 600+ shareholders, not all tribal members are shareholders, because the corporation hasn't voted to enroll children born after 1971.

Some of the economic projects the corporation has:

Fuel Station, rental buildings, land leases, 7i funds, mutual funds, gravel sales, timber sales, and hopefully Bio-mass.
10 Athabascan villages in Yukon Flats
8 Gwich'in villages and 2 Koyukon villages.
55,000 sq. mi. Size of Wisconsin.
1500 people
Fort Yukon largest Hub Village 650 people.
Smallest Village Birch Creek 25 people.
Fort Yukon and Circle are the only Villages with a City Government.
There is no organized Borough in the Yukon Flats.
Only one village on road system.
• All electricity is generated by diesel.
• 4 villages have to fly fuel in, no barge service.
• 2 villages cut their generators off at 10 pm and back on again at 8am. Venetie and Arctic Village.
• One Village has Pre-paid Meters. Chalkyitsik
• 80% of homes in Fort Yukon are heated by wood. Most use wood and fuel heat.
• All other villages heat by wood with a few that use fuel. All Village buildings are heated by fuel.
• Fort Yukon is only village that has piped water and is currently installing piped sewer.
• Chalkyitsik and beaver has some piped water and are developing septic tanks. All other villages have to haul own water and use honey buckets and outhouses. All Village Schools have running water and sewer.
• All villages have a washeteria where they get their water, shower, and wash clothes.
Fuel cost in Fort Yukon $7.00 gal.
Fuel Cost in Arctic Village $14.00 gal.
Some of the alternative energy programs Fort Yukon has looked at:
Wind, not Feasible only 7mph
Hydro, not enough stream flow maybe as technology advances, pilot project in eagle.
Solar, we have two projects one in Fort Yukon on a Elders building and one in Arctic Village on their water treatment plant. Between May and August we have 24 hours of daylight, so we need to look at more solar projects.
No geothermal, Stevens Village has a Hot Springs but too far away.
Coal Bed Methane, not giving off enough methane.
Oil/Natural Gas, Alpine Size Oil Field and 83,000,000 cu.ft. Natural Gas, but Villages/Residents are opposed to drilling.
• Fort Yukon Received 226,000 acres Under ANCSA.
• Checker boarded with lands owned by Doyon Regional Corporation.
• Venetie/Arctic Village didn’t participate in ANCSA and they claimed 1.9M acres which they thought was a reservation, but own land in fee.
• Within the Yukon Flats National Wildlife Refuge.
• Adjacent to Arctic National Wildlife Refuge.
Subsistence Life Styles

Subsistence Resources:
Moose, Caribou, Dall Sheep, Black Bear, Brown Bear, Wolves, Beaver, Muskrat, Otter, Fox, Salmon (Chinook, Coho, summer and fall Chum), White Fish, Sheefish, Pike, lake trout, grayling, Grouse, Spruce Hen, Waterfowl from 5 different countries, blueberries, raspberries, rosehips, wild onions, rhubarb, and many other natural resources that we utilize and depend on.
Bio-Mass is not a new concept to the Yukon Flats. We Currently Utilize wood for Heating our Homes and back in the Steamboat Days we sold cordwood to power the steamboats.
Old & New Housing

More info on Yukon Flats:

www.catg.org
www.fortyukon.org
Fire Driven Ecosystem
12MM acres statewide in 2004-2005

Fires 1950-2004

Fires in 2004
**Typical Example of Seral Stages of Black Spruce Forest in Interior Alaska**

<table>
<thead>
<tr>
<th>Age</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Years</td>
<td>3 Years Old</td>
</tr>
<tr>
<td>15 Years</td>
<td>15 Years Old</td>
</tr>
<tr>
<td>43 Years</td>
<td>43 Years Old</td>
</tr>
<tr>
<td>81 Years</td>
<td>81 Years Old</td>
</tr>
</tbody>
</table>

![Forest Stages](image)
Displacement of Fuel Oil, Local Economic Develop, Energy Self-Sufficiency & Sustainability

15 tons per acre

Summer 2005 Porcupine Burn 79,762-acre
Community Wood Energy Program

- Rural Economic Development
- Energy Cost Reduction
- Environmental Improvement
- Community Biomass Utilization Program
- Habitat Enhancement
- Wildfire Mitigation
Wood Energy Program
Scales of Penetration

• Village scale – create a wood energy utility
• Commercial buildings – economic driver
• Households – secure relatively inexpensive consistent supply

• Local Management Capacity Development
Heating Systems
Stick Fired
Heat Systems
Chip Boilers
Chalkyitsik
Wood Energy Heating Program
## Chalkyitsik Feasibility Stick Fired

<table>
<thead>
<tr>
<th>Summary of Results</th>
<th>School</th>
<th>Water Treat</th>
<th>Sch Housing</th>
<th>DH Plant</th>
<th>Comm CenterCC + Village Off</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stick-fired Performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>baseline oil consumption</td>
<td>20,586</td>
<td>7,304</td>
<td>4,977</td>
<td>32,866</td>
<td>14,404</td>
</tr>
<tr>
<td>proposed biomass, cords/yr</td>
<td>179</td>
<td>63</td>
<td>43</td>
<td>285</td>
<td>129</td>
</tr>
<tr>
<td>fraction of oil displaced</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Gam model</td>
<td>WHS 3,200</td>
<td>WHS 2,000</td>
<td>WHS 1,500</td>
<td>WHS 3,200</td>
<td>WHS 3,200</td>
</tr>
<tr>
<td>No. of boilers</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Maximum wood loads per day req.</td>
<td>4.0</td>
<td>3.8</td>
<td>3.9</td>
<td>4.0</td>
<td>2.7</td>
</tr>
<tr>
<td><strong>Stick-fired Cost and Savings</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>boilers, shipped and installed</td>
<td>$268,221</td>
<td>$125,959</td>
<td>$118,307</td>
<td>$402,331</td>
<td>$268,221</td>
</tr>
<tr>
<td>Slab/Building for Boilers</td>
<td>$20,000</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$25,000</td>
<td>$15,000</td>
</tr>
<tr>
<td>direct buried piping</td>
<td>$16,400</td>
<td>$16,400</td>
<td>$16,400</td>
<td>$117,650</td>
<td>$16,400</td>
</tr>
<tr>
<td>interconnection</td>
<td>$35,000</td>
<td>$35,000</td>
<td>$35,000</td>
<td>$105,000</td>
<td>$35,000</td>
</tr>
<tr>
<td>other</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$60,000</td>
<td>$15,000</td>
</tr>
<tr>
<td>subtotal</td>
<td>$354,621</td>
<td>$207,359</td>
<td>$199,707</td>
<td>$709,981</td>
<td>$349,621</td>
</tr>
<tr>
<td>soft costs</td>
<td>$112,592</td>
<td>$65,836</td>
<td>$63,407</td>
<td>$225,419</td>
<td>$111,005</td>
</tr>
<tr>
<td>total</td>
<td>$467,213</td>
<td>$273,195</td>
<td>$263,114</td>
<td>$935,400</td>
<td>$460,625</td>
</tr>
<tr>
<td>baseline oil cost</td>
<td>$164,688</td>
<td>$58,429</td>
<td>$39,814</td>
<td>$262,931</td>
<td>$115,232</td>
</tr>
<tr>
<td>final oil cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cord wood cost</td>
<td>$44,853</td>
<td>$15,783</td>
<td>$10,791</td>
<td>$71,341</td>
<td>$32,222</td>
</tr>
<tr>
<td>total savings</td>
<td>$119,835</td>
<td>$42,646</td>
<td>$29,023</td>
<td>$191,590</td>
<td>$83,010</td>
</tr>
</tbody>
</table>
### Chalkyitsik Feasibility Chip Fired

#### Chip-fired Performance

<table>
<thead>
<tr>
<th></th>
<th>Pyrot 220</th>
<th>Pyrot 100</th>
<th>Pyrot 100</th>
<th>Pyrot 300</th>
<th>Pyrot 150</th>
<th>Pyrot 150</th>
</tr>
</thead>
<tbody>
<tr>
<td>baseline oil consumption</td>
<td>20,586</td>
<td>7,304</td>
<td>4,977</td>
<td>32,866</td>
<td>14,404</td>
<td>17,881</td>
</tr>
<tr>
<td>proposed biomass, tons/yr</td>
<td>235</td>
<td>59</td>
<td>11</td>
<td>398</td>
<td>165</td>
<td>220</td>
</tr>
<tr>
<td>fraction of oil displaced</td>
<td>0.769</td>
<td>0.543</td>
<td>0.155</td>
<td>0.815</td>
<td>0.769</td>
<td>0.829</td>
</tr>
<tr>
<td>No. of boilers</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

#### Chip-fired Cost and savings

<table>
<thead>
<tr>
<th>Item</th>
<th>Pyrot 220</th>
<th>Pyrot 100</th>
<th>Pyrot 100</th>
<th>Pyrot 300</th>
<th>Pyrot 150</th>
<th>Pyrot 150</th>
</tr>
</thead>
<tbody>
<tr>
<td>boilers, shipped and installed</td>
<td>$228,898</td>
<td>$202,537</td>
<td>$202,537</td>
<td>$259,347</td>
<td>$216,184</td>
<td>$216,184</td>
</tr>
<tr>
<td>Slab/Building for Boilers</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>direct buried piping</td>
<td>$16,400</td>
<td>$16,400</td>
<td>$16,400</td>
<td>$117,650</td>
<td>$16,400</td>
<td>$58,500</td>
</tr>
<tr>
<td>interconnection</td>
<td>$20,000</td>
<td>$20,000</td>
<td>$20,000</td>
<td>$60,000</td>
<td>$20,000</td>
<td>$40,000</td>
</tr>
<tr>
<td>other</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$60,000</td>
<td>$15,000</td>
<td>$40,000</td>
</tr>
<tr>
<td>subtotal</td>
<td>$285,298</td>
<td>$258,937</td>
<td>$258,937</td>
<td>$501,997</td>
<td>$272,584</td>
<td>$359,684</td>
</tr>
<tr>
<td>soft costs</td>
<td>$90,582</td>
<td>$82,213</td>
<td>$82,213</td>
<td>$159,384</td>
<td>$86,545</td>
<td>$114,200</td>
</tr>
<tr>
<td>total</td>
<td>$375,880</td>
<td>$341,150</td>
<td>$341,150</td>
<td>$661,382</td>
<td>$359,129</td>
<td>$473,884</td>
</tr>
</tbody>
</table>

- baseline oil cost: $164,688, $58,429, $39,814, $262,931, $115,232, $143,047
- final oil cost: $38,031, $26,705, $33,662, $48,546, $26,669, $24,445
- chip cost: $41,181, $10,315, $2,000, $69,704, $28,795, $38,562
- total savings: $85,476, $21,410, $4,152, $144,681, $59,768, $80,040

#### Net Simple Payback

- stick-fired: 3.9 yrs, 6.4 yrs, 9.1 yrs, 4.9 yrs, 5.5 yrs, 5.8 yrs
- chip-fired: 4.4 yrs, 15.9 yrs, 82.2 yrs, 4.6 yrs, 6.0 yrs, 5.9 yrs
Venetie
Wood Energy Heat Program
Venetie Airport and Washeteria

- CLINIC 1500 gpy
- COUNCIL 1500 gpy
- TRIBAL OFF 1500 gpy
- ELDERS ASSN 600 gpy
### Venetie Feasibility Stick Fired

<table>
<thead>
<tr>
<th>Summary of Results</th>
<th>Washeteria</th>
<th>School</th>
<th>Sch Housing</th>
<th>DH Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stick-fired Performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>baseline oil consumption</td>
<td>8,122</td>
<td>18,073</td>
<td>7,195</td>
<td>33,390</td>
</tr>
<tr>
<td>proposed biomass, cords/yr</td>
<td>72</td>
<td>159</td>
<td>64</td>
<td>290</td>
</tr>
<tr>
<td>fraction of oil displaced</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Gam model</td>
<td>WHS 3,200</td>
<td>WHS 3,200</td>
<td>WHS 3,200</td>
<td>WHS 3,200</td>
</tr>
<tr>
<td>No. of boilers</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Maximum wood loads per day req.</td>
<td>2.8</td>
<td>3.5</td>
<td>2.6</td>
<td>4.1</td>
</tr>
<tr>
<td><strong>Stick-fired Cost and savings</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>boilers, shipped and installed</td>
<td>$134,110</td>
<td>$268,221</td>
<td>$134,110</td>
<td>$402,331</td>
</tr>
<tr>
<td>Slab/Building for Boilers</td>
<td>$15,000</td>
<td>$20,000</td>
<td>$15,000</td>
<td>$25,000</td>
</tr>
<tr>
<td>direct buried piping</td>
<td>$16,400</td>
<td>$16,400</td>
<td>$16,400</td>
<td>$227,500</td>
</tr>
<tr>
<td>interconnection</td>
<td>$35,000</td>
<td>$35,000</td>
<td>$35,000</td>
<td>$105,000</td>
</tr>
<tr>
<td>other</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$60,000</td>
</tr>
<tr>
<td>subtotal</td>
<td>$215,510</td>
<td>$354,621</td>
<td>$215,510</td>
<td>$819,831</td>
</tr>
<tr>
<td>soft costs</td>
<td>$68,425</td>
<td>$112,592</td>
<td>$68,425</td>
<td>$260,296</td>
</tr>
<tr>
<td>total</td>
<td>$283,935</td>
<td>$467,213</td>
<td>$283,935</td>
<td>$1,080,127</td>
</tr>
<tr>
<td>baseline oil cost</td>
<td>$64,976</td>
<td>$144,586</td>
<td>$57,558</td>
<td>$267,120</td>
</tr>
<tr>
<td>final oil cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cord wood cost</td>
<td>$17,991</td>
<td>$39,719</td>
<td>$16,096</td>
<td>$72,411</td>
</tr>
<tr>
<td>total savings</td>
<td>$46,986</td>
<td>$104,867</td>
<td>$41,462</td>
<td>$194,709</td>
</tr>
</tbody>
</table>
### Venetie Feasibility Chip Fired

#### Chip-fired Performance

<table>
<thead>
<tr>
<th></th>
<th>Pyrot 100</th>
<th>Pyrot 150</th>
<th>Pyrot 300</th>
</tr>
</thead>
<tbody>
<tr>
<td>baseline oil consumption</td>
<td>8,122</td>
<td>18,073</td>
<td>7,195</td>
</tr>
<tr>
<td>proposed biomass, tons/yr</td>
<td>78</td>
<td>219</td>
<td>62</td>
</tr>
<tr>
<td>fraction of oil displaced</td>
<td>0.648</td>
<td>0.816</td>
<td>0.582</td>
</tr>
<tr>
<td>Kcb model</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of boilers</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

#### Chip-fired Cost and savings

<table>
<thead>
<tr>
<th></th>
<th>Pyrot 100</th>
<th>Pyrot 150</th>
<th>Pyrot 300</th>
</tr>
</thead>
<tbody>
<tr>
<td>boilers, shipped and installed</td>
<td>$202,537</td>
<td>$216,184</td>
<td>$202,537</td>
</tr>
<tr>
<td>Slab/Building for Boilers</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>direct buried piping</td>
<td>$16,400</td>
<td>$16,400</td>
<td>$16,400</td>
</tr>
<tr>
<td>interconnection</td>
<td>$20,000</td>
<td>$20,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>other</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
</tr>
<tr>
<td>subtotal</td>
<td>$258,937</td>
<td>$272,584</td>
<td>$258,937</td>
</tr>
<tr>
<td>soft costs</td>
<td>$82,213</td>
<td>$86,545</td>
<td>$82,213</td>
</tr>
<tr>
<td>total</td>
<td>$341,150</td>
<td>$359,129</td>
<td>$341,150</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Pyrot 100</th>
<th>Pyrot 150</th>
<th>Pyrot 300</th>
</tr>
</thead>
<tbody>
<tr>
<td>baseline oil cost</td>
<td>$64,976</td>
<td>$144,586</td>
<td>$57,558</td>
</tr>
<tr>
<td>final oil cost</td>
<td>$22,872</td>
<td>$26,658</td>
<td>$24,032</td>
</tr>
<tr>
<td>chip cost</td>
<td>$13,690</td>
<td>$38,343</td>
<td>$10,901</td>
</tr>
<tr>
<td>total savings</td>
<td>$28,415</td>
<td>$79,585</td>
<td>$22,626</td>
</tr>
</tbody>
</table>

#### Net Simple Payback

<table>
<thead>
<tr>
<th></th>
<th>stick-fired</th>
<th>chip-fired</th>
</tr>
</thead>
<tbody>
<tr>
<td>yrs</td>
<td>6.0 yrs</td>
<td>12.0 yrs</td>
</tr>
<tr>
<td>yrs</td>
<td>4.5 yrs</td>
<td>4.5 yrs</td>
</tr>
<tr>
<td>yrs</td>
<td>6.8 yrs</td>
<td>15.1 yrs</td>
</tr>
<tr>
<td>yrs</td>
<td></td>
<td>5.5 yrs</td>
</tr>
</tbody>
</table>
# Fort Yukon Feasibility

## Summary of Results

### Financial

<table>
<thead>
<tr>
<th></th>
<th>Base P A</th>
<th>Base P B</th>
<th>Int P A</th>
<th>Int P B</th>
<th>Max P A</th>
<th>Max P B</th>
</tr>
</thead>
<tbody>
<tr>
<td>estimated project cost</td>
<td>$1,536,292</td>
<td>$1,856,504</td>
<td>$2,011,062</td>
<td>$2,331,274</td>
<td>$2,671,124</td>
<td>$3,033,012</td>
</tr>
<tr>
<td>estimated annual savings</td>
<td>$227,748</td>
<td>$262,568</td>
<td>$263,777</td>
<td>$307,764</td>
<td>$380,381</td>
<td>$440,387</td>
</tr>
<tr>
<td>net simple payback, yrs</td>
<td>6.75</td>
<td>7.07</td>
<td>7.62</td>
<td>7.57</td>
<td>7.02</td>
<td>6.89</td>
</tr>
</tbody>
</table>

### Performance

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. buildings connected</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>8</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>peak load heating, kBTU/h</td>
<td>2,295.0</td>
<td>2,295.0</td>
<td>2,645.6</td>
<td>2,645.6</td>
<td>3,450.3</td>
<td>3,450.3</td>
</tr>
<tr>
<td>peak losses to heating fuel, kBTU/h</td>
<td>40.0</td>
<td>40.0</td>
<td>40.0</td>
<td>40.0</td>
<td>40.0</td>
<td>40.0</td>
</tr>
<tr>
<td>fraction</td>
<td>0.017</td>
<td>0.017</td>
<td>0.015</td>
<td>0.015</td>
<td>0.012</td>
<td>0.012</td>
</tr>
<tr>
<td>peak piping losses, KBTU/h</td>
<td>72.1</td>
<td>72.1</td>
<td>115.9</td>
<td>115.9</td>
<td>198.4</td>
<td>198.4</td>
</tr>
<tr>
<td>fraction</td>
<td>0.031</td>
<td>0.031</td>
<td>0.044</td>
<td>0.044</td>
<td>0.057</td>
<td>0.057</td>
</tr>
<tr>
<td>total losses, as a fraction of load</td>
<td>0.049</td>
<td>0.049</td>
<td>0.059</td>
<td>0.059</td>
<td>0.069</td>
<td>0.069</td>
</tr>
<tr>
<td>current oil consumption, gal/yr</td>
<td>71,764</td>
<td>71,764</td>
<td>84,734</td>
<td>84,734</td>
<td>119,988</td>
<td>119,988</td>
</tr>
<tr>
<td>proposed consumption, gal/yr</td>
<td>9,644</td>
<td>343</td>
<td>12,514</td>
<td>756</td>
<td>15,870</td>
<td>105</td>
</tr>
<tr>
<td>estimated savings, gal/yr</td>
<td>62,120</td>
<td>71,421</td>
<td>72,219</td>
<td>83,978</td>
<td>104,118</td>
<td>119,883</td>
</tr>
<tr>
<td>fraction displaced</td>
<td>0.866</td>
<td>0.995</td>
<td>0.852</td>
<td>0.991</td>
<td>0.868</td>
<td>0.999</td>
</tr>
<tr>
<td>estimated wood chips, tons/yr</td>
<td>1,134</td>
<td>1,303</td>
<td>1,318</td>
<td>1,533</td>
<td>1,900</td>
<td>2,188</td>
</tr>
</tbody>
</table>
Gwitchyaa Zhee Corporation

CATG – AWEA

A Collaborative Integrated Wood Energy Program for Fort Yukon Implementation

DOE Tribal Energy Program

20 November 2008
For-Profit Wood Energy Business Model Fort Yukon

- Forest Management Service – CATG
- For-Profit Wood Utility Company – Vertically Integrated
- Gwitchyaa Zhee Native Corporation
  - Wood Harvest Company
  - Village Wood Yard/Distribution Company
  - Wood Energy Utility – Diesel Biomass
  - Wood diesel hybrid power plant CHP – still dreaming for 200-700 Kwh technology
Wood Harvest Company

- Harvests wood from GZ lands summer and winter – start with recent fires
- Delivers to Village Wood Yard
- Paid upon delivery of wood by weight and dryness formula
- Requires harvest equipment with capacity for 5-7,000 tons production per year sticks and chips
Village Wood Yard/Distribution Company

- 2-3 acre wood yard - capacity to deliver split fire wood, boiler round wood, wood chips for chip boilers;
- Small sawmill for production of dimension lumber for village use;
- Commercial buildings do not want to own or operate boilers;
- GZ owns heat boilers and sells BTUs of heat and is responsible for feeding boiler
Forest and land management plan

CATG

Harvest
Contractual agreements with timber owners = GZ

Harvest Company
contractual agreement with Wood Yard = GZ

Village Wood Distribution and Heat BTU Utility Company

Contractual agreements with BTU consumers = school etc.

Wood consumed for energy for heat and power generation
Acreage Harvested for Heating

- 3,000 tons / year heat
- 18 tons/acre
- 60 year rotation
- 167 acres / year
- 10,020 acres / rotation
- Moose habitat for 20 years
- Historical wildfire events have burned 80,000 acres in one month
We estimate that the Yukon Flats Region will require more than 6,000 tons of wood annually to fuel their heat and electrical power consumption.
Three concurrent projects

- Boiler installation and operation
  - 2 boilers 2009 one at clinic and one at Voc ed
  - District heating system downtown 9 buildings 2010.
- Wood harvest system equipment purchase and operations/training 2009
- NRCS fire rehabilitation contract $450,000
- Capacity development:
  - 5 year harvest plan
  - Equipment and harvest system integration = harvesting wood to chips to feeding boilers
  - Boiler operations
  - Annual harvest operations plans and implementation
  - Community communications and coordination across organizations
2 boilers and one district heating systems

Potential neighborhood district heat site.

New CATC Clinic. Site for boiler. Estimate annual fuel oil use 70,000 gals.

Vocational Education facility. Annual fuel oil use 15,000 gals. Opportunity to capture heat from new biomass generator.

Site for future biomass diesel hybrid power plant. Owned by G2 Corporation.

One of two sites proposed for Wood Yard. Owned by G2 Corporation.

Second site proposed for Wood Yard. Owned by the Tribe.

School and Gym. Annual fuel oil use 30,000 gals. Opportunity for district heat for downtown as well.

Site for wood landing, storage and improved coal offloading capacity. Owned by the City of Fort Yukon.
## Equipment Wish List

**Biomass Harvest Start Up Equipment**

<table>
<thead>
<tr>
<th>Wood Harvest Equipment to Be Purchased</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fecon FTX100L</td>
<td>$115,000</td>
</tr>
<tr>
<td>Kubota KX080 Excavator</td>
<td>$84,000</td>
</tr>
<tr>
<td>Kesla Processor head</td>
<td>$39,000</td>
</tr>
<tr>
<td>Vermeer BC 1400TX Chipper</td>
<td>$85,000</td>
</tr>
<tr>
<td>Kubota M125X Tractor w/loader</td>
<td>$57,000</td>
</tr>
<tr>
<td>Fecon/Kubota Attachments</td>
<td></td>
</tr>
<tr>
<td>Bucket</td>
<td>$2,500</td>
</tr>
<tr>
<td>Tree Shear</td>
<td>$12,000</td>
</tr>
<tr>
<td>Brush Rake</td>
<td>$3,800</td>
</tr>
<tr>
<td>Rear Fecon Grapple</td>
<td>$5,800</td>
</tr>
<tr>
<td>Excavator log grapple</td>
<td>$4,500</td>
</tr>
<tr>
<td>Backhoe</td>
<td>$7,000</td>
</tr>
<tr>
<td>Guarding for Excavator</td>
<td>$12,000</td>
</tr>
<tr>
<td>Aluminum Chip Bin</td>
<td>$12,000</td>
</tr>
<tr>
<td>Kelsa Forwarder Trailer with loader</td>
<td>$55,000</td>
</tr>
<tr>
<td>20 foot skiff</td>
<td>$30,000</td>
</tr>
<tr>
<td>Firewood Processor (Blockbuster model 1820)</td>
<td>$34,000</td>
</tr>
<tr>
<td>Firewood Elevator</td>
<td>$7,500</td>
</tr>
<tr>
<td>Sawmill</td>
<td>$75,000</td>
</tr>
<tr>
<td>Freight</td>
<td>$45,000</td>
</tr>
<tr>
<td><strong>Total Equipment Cost</strong></td>
<td><strong>$686,100</strong></td>
</tr>
</tbody>
</table>
Harvest System Development

- A complete harvest system capable of producing 6-8,000 tons of woody biomass annually will cost approximately $650,000.
Ground Harvest Systems

- Small scale harvest systems with proven reliability will be employed
Fort Yukon Power Barge
# Harvest Production Model

## Cost and Revenue Data

### In Tons and Cordwood Units

#### Cordwood Production Cost Summary

<table>
<thead>
<tr>
<th>Species</th>
<th>Annual Tons Produced</th>
<th># Cords (9' logs)</th>
<th>Logging Cost/Ton</th>
<th>Harvest Days Required</th>
<th>$/Cord Short Logs</th>
<th>Total Annual Harvest Cost</th>
<th>Annual Markup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spruce</td>
<td>2,000</td>
<td>1,657</td>
<td>$128.39</td>
<td>89</td>
<td>$154.97</td>
<td>$256,782.72</td>
<td>$64,195.68</td>
</tr>
</tbody>
</table>

#### Cordwood Energy Value

<table>
<thead>
<tr>
<th>Species</th>
<th>BTU/Cord</th>
<th>BTU/Gal-Diesel</th>
<th>Gal Diesel/Cord</th>
<th>Diesel $/Gallon</th>
<th>Diesel $ Value/Cord</th>
<th>Mark Up (20%)</th>
<th>Distributor Costs</th>
<th>Delivered Cost/Cord</th>
<th>Del Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spruce</td>
<td>15,900,000</td>
<td>138,000</td>
<td>115.22</td>
<td>$3.50</td>
<td>$403.26</td>
<td>$154.97</td>
<td>-</td>
<td>$154.97</td>
<td>$154.97</td>
</tr>
</tbody>
</table>

#### Annual Savings From Cordwood

<table>
<thead>
<tr>
<th>Species</th>
<th>Annual Cords Consumed</th>
<th>Annual Cost Cordwood</th>
<th>Efficiency Loss Wood Boiler</th>
<th>Value-Diesel Displaced</th>
<th>Annual Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spruce</td>
<td>1,657</td>
<td>$256,783</td>
<td>25%</td>
<td>$143,186</td>
<td>$501,153</td>
</tr>
</tbody>
</table>

#### Biomass Acreage Requirements

<table>
<thead>
<tr>
<th>Tons/Acre</th>
<th>Acres Required Annually</th>
<th>Rotation Age Assumption</th>
<th>Total Sustained Acres Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>2000</td>
<td>133</td>
<td>8,000</td>
</tr>
</tbody>
</table>

#### Biomass Harvest Assumptions

<table>
<thead>
<tr>
<th>Annual Harvest-Acres</th>
<th>Pieces Per Acre</th>
<th>Acres/Day Harvested</th>
<th>Pieces/Day Harvested</th>
<th>Tons/Day Harvested</th>
<th>Total Harvesting Days/Year</th>
<th>Cords/Day Harvested</th>
</tr>
</thead>
<tbody>
<tr>
<td>133</td>
<td>500</td>
<td>1.5</td>
<td>750</td>
<td>23</td>
<td>89</td>
<td>19</td>
</tr>
</tbody>
</table>

#### Biomass Harvest Costs Work-up

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$152,000</td>
<td>$3,000</td>
<td>4,750</td>
<td>$3.55</td>
<td>$16,863</td>
<td>$25,500.00</td>
<td>$182,116.05</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Man-hrs Per Day</th>
<th>$/Man-hr (All Inclusive)</th>
<th>Labor Cost Per Day</th>
<th>Labor Cost Per Acre</th>
<th>Labor Cost Per Ton</th>
<th>Machine Cost Per Ton</th>
<th>Annual Payroll</th>
<th>Logging Cost Per Ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>35</td>
<td>840</td>
<td>$560.00</td>
<td>37</td>
<td>$91.06</td>
<td>$74,667</td>
<td>$128.39</td>
</tr>
</tbody>
</table>
Economies of Scale
Annual Production Influence on Cost

Cordwood Production Costs Economies of Scale

Cost Per Cord

Tons Produced Annually @ 23 Tons Daily Production
Woody Biomass Advantages

- Stabilizes village energy costs
- Energy import substitution
- Local employment
- Self-sufficiency
- Subsistence based culturally sound jobs 1@ $30/hr 2@$20-25/hr 3@$15/hr
  All jobs are 6-8 months with time off for fishing hunting!!!!!
- Village sustainability
Funding Partners

- USDA NRCS
- DOE Tribal Energy Program
- Division of Forestry – DNR
- Denali Commission
- Alaska Wood Energy Development Task Group
- Alaska Energy Authority
- USDA Rural Development
- State and Private Forestry – USFS