Biomass Workgroup of the Energy Task Force Meeting

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Yearly availability of biomass fuel sources in FNSB

There are four primary potential sources of biomass feedstock available or potentially available in the FNSB. These include:

1. Raw harvested timber as part of wildfire mitigation planning and right-of-way clearing
2. Byproduct of lumber industry (wood residue)
3. Landfill and municipal waste
4. Short rotation woody biomass crop, such as willow or aspen

At this time, there is little demand for biomass as a fuel or processed lumber in Interior Alaska. For this reason, with the exception of municipal waste, there is not an established supply of material which can serve as a feedstock for large scale power generation or heating using biomass material. For this reason, we have considered current land uses and availability when assessing potential biomass available for power generation and heating. The FNSB has a total land area of 4,764,160 acres, of which roughly 1% is water and significant additional sections are wetlands or are areas of low productivity. Assuming an average total biomass per acre of 11 tons[4] in the FNSB and a conservative regrowth rate of 40 to 70 years, it would require just under 7,000,000 acres, harvested on a rotational basis, to generate 200 MW, which would be required to supply all the electric power needed in the Fairbanks area. This is nearly double the land area of the entire borough, and so this is clearly not a feasible solution on its own.

Another alternative would be growing a short rotation woody biomass crop with potentially higher yields. Averaged biomass production of farmed willow coppice has been reported as 3.56 tons/acre/yr in the U.S[5]., 4.23 tons/acre/yr in Canada[6]**,** and 6.23 tons/acre/yr[7] in Sweden[8]**,**. To maximize productivity, above ground biomass is harvested on a multi year rotation, with 3 years being common. This would require somewhere from 309,000 to 540,000 acres to generate the same 200MW, which represents 6.5 to 11.3% of the total land area of the FNSB. The University of Alaska has been conducted preliminary research into a number of varieties of potential biomass crops, however this program will need to be substantially expanded to determine species and cultivation techniques which are effective in our climate and latitude as initial results have not been able to duplicate yields reported from other regions.

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[4] From Department of Forestry 'Analysis of Wood Volume Available from Hazardous Fuel Reduction Program and Development of Wood Residue Markets in the Fairbanks Area', Douglas Hanson, 2007

[5] Kopp, RF; White, EH; Abranhamson, LP; Nowak, CA; Zsuffa, L and Burns, KF 'Willow biomass trials in Central New York State'. 1993. Biomass and Bioenergy 5:2, pages 179-187.

[6] Roberston, A. 'Willow plantations in Agroforestry'. Span. 1984, 27: 1, pages 32-34

[7] Beale, CV. and Heywood, MJ. 'Productivity of commercial crops of short rotation coppice at six sites in southern England'. Aspects of Applied Biology No.49, pages 181-188

[8] Hytonen, J. 'Effects of fertilizer application rate on nutrient status and biomass production in short rotation plantations of willows on cut away peatland areas'. Suo. 1994 45: 3, pages 65-77

When considering supplying biomass as a feedstock to produce a more modest 20MW of electric power generation[9], the land requirements are reduced to 31,000 to 54,000 acres of willow biomass, 680,000 acres of harvested wood from forest lands, or 105,000 tons of municipal waste. This takes rotation into effect to allow for a sustainable yield. Alaska currently has 900,000 designated as farmland, however this includes large tracts used for Reindeer herding on the Seward Peninsula and other grazing lands. Actual traditional croplands currently in production is estimated at 30,000 for the entire state, of which approximately half is located in the Tanana Valley. There are an additional 28,000+ acres in the Delta area, which are listed in the Conservation Reserve Program (CRP) and not in current production.

There is an effort being made to remove much of this land from the CRP program, which, coupled with USDA incentives to farmers for growing bio-energy crops, may encourage local farmers to consider willow and other short rotation woody biomass crops provided there is an established market. It is further estimated that the average crop value on currently farmed land is $300/acre, which would equate to a short rotation woody biomass crop value exceeding $84 per ton at the lower end of productivity, and $49 at the high end, in order to displace other crops. However displacing local agriculture is not a desired effect and for this reason the biomass subsection focused on assessing existing fallow farm fields which are currently part of the CRP program. Additionally, the thousands of acres of existing and planned fire breaks around communities could be used to grow biomass crops, and other land such as acreage located in the Tanana River Floodplain or within the flood control project would be ideal for this type of crop. In fact, the flood control project is periodically mowed to reduce growth and as such has a negative value to the local economy at this time. There are additional consequences, which should be assessed, including stream bank stabilization potential on the positive side and potential discharge of fertilizer into local waterways on the negative side, although some research indicates fertilizing does not increase total biomass production anyway[10].

The Borough also has 10,500 acres of allowable harvest from State lands that is not currently being utilized in any quantities. The ideal and lowest cost way of obtaining biomass from this acreage would be to encourage the growth of sustainable local timber harvest and use residue from that harvest as an inexpensive fuel stock. Additionally, the FNSB Landfill Eielson waste paper program collected 1500 tons per year of waste paper and cardboard until the program was discontinued in 2006. Estimates of total recoverable paper and cardboard are 14,000 tons based on national averages. Presumably any fuel diverted from the landfill would have a zero or negative fuel cost associated with it. Processing and transportation costs are TBD. While a mixed source of feedstock is expected, priority should be given as follows based on lowest cost and impact to the environment and community:

1. Landfill and Municipal Waste
2. Wood residue or wood harvested as a byproduct of other beneficial activity
3. Short rotation wood biomass crops
4. Raw lumbered harvested solely for the purpose of use as a biomass feedstock

[9] Assuming 30% efficiency

Cost of producing fuel and energy content (delivered):
All biomass sources will require some transportation, processing, and storage of fuel or inventory maintenance to manage a uniform continual feed. Expenses vary based on distance to market and degree of processing or separation (in the case of municipal waste) required. For harvested wood, a good first order estimate can be obtained from the Department of Forestry Report issued in 2007[1]. In this report, a value of $51.51/ton is estimated for green biomass from fire mitigation program in Fairbanks area, assuming biomass production of 7500 tons/year. For willow biomass, $25-50 per ton is the delivered fuel cost estimate based on other projects. Both of these values represent minimal processing, such as size reduction and drying, which may be necessary to prepare a feedstock for certain uses such as co-firing and pelletizing for heating.

Process efficiencies that could impact cost of end product:

- We have assumed a total efficiency of 30-35% for gasification to power (e=70% for gasification, e=50% for gas turbine)
- We have assumed total efficiency of 20% for boiler (heat) to power (e=85% for boiler, e=24% for power cycle)
- We have assumed a capacity factor of 85% for a biomass CHP plant

Strategies to reduce weaknesses and threats from SWOT analysis
A number of weaknesses and threats were identified as part of the biomass SWOT analysis. Below are some suggestions for mitigating or eliminating potential issues.

- Use farming to control distances (fuel source to end use)
- Export techniques and equipment design to other parts of state
- Use waste heat in process applications (drying feedstock)
- Low density fuel and high handling costs increases job opportunities, particularly in winter months
- Use modular approach to mitigate chicken and egg problem
- Tap large land owners as project participants
- Use diversified crop strategy
- Long term power sales contract to stabilize fuel cost
- Encourage devolvement of fallow farmland (CRP land) through incentives
- Include Usibelli by tapping them as a potential biomass producer on remediated lands

Recommendations for next steps:
It is evident that a multi-fuel approach must be taken for any large scale project, as any single fuel source is inadequate for a larger scale project (20+ MW). Additionally, near term uses for biomass, which can drive development of a future supply include:

1. Co-firing in existing power plants
2. Support the installation of small, privately owned CHP biomass systems
3. Support the growth of a sustainable harvest lumber industry in the interior

In particular, the co-firing of a biomass fuel in existing coal plants in the interior was identified as a low cost option for building a market for biomass fuels and should be further assessed. This has already been done in the past at the University of Alaska and the Eielson Air Force Base coal fired plants. Both programs were discontinued when the feedstock (densified paper-based municipal waste) was discontinued. In order to be able to use biomass as a co-fired fuel, a coal plant must operate as traveling grate boiler or fluidized bed. For this reason, biomass cannot be co-fired at either power plant in Healy (Clean coal or Healy 1).

Any biomass to electric power installation must be coupled with an industrial or residential use for low grade rejected heat. This could boost overall CHP cycle efficiency to as high as 80% and greatly improve project economics. Biomass industries could support one another, for example heat produced as a byproduct of biomass combustion in a CHP system could be used to dry pellets which in turn could be used for space heating.

Finally, a technology option review should be completed and biomass should be considered as a potential feedstock for any future combustion or gasification systems designed for use in the FNSB. Also an assessment of potential air quality issues, including $PM_{2.5}$, would need to be completed for the Fairbanks vicinity.