

Assessing Opportunities for a Sustainable Wood-biomass Energy System in Southeast Alaska

Munish Sikka

Abstract: *In Southeast (SE) Alaska, the local communities based on different islands are dependent on oil for heating and are therefore facing enormous challenges due to globally increasing oil prices. The high cost of energy in the far North has constrained the local economy and is a major roadblock in the development of the region. The present study looks at the potential benefits of developing a local wood-pellet industry in Southeast Alaska by utilising residues from local saw-mills and logging operations. The study explores the economic, environmental and social benefits of developing a sustainable wood-pellet industry that displaces fossil-fuel for heating energy in the region. It also briefly discusses the Alaska's historic land settlement act of 1971 that gave land rights to local communities by organising them into corporations. These corporations can further play important role in the development of local wood-pellet industry.*



Introduction

The region of Southeast (SE) Alaska is a resource-dependent economy with communities relying primarily upon hunting, fishing, timber, mining, and tourism for their livelihood. The region comprises of more than a dozen communities with populations from as low as 50 and to over 30,000 (Juneau, the state capital) residents located throughout the archipelago. These communities draw their energy either from local hydro-power stations or fossil-fuels (oil/diesel-oil) imported via sea-routes. Whilst hydro energy is a major source of electricity in the region, for heating buildings, most communities rely upon oil (Alexander, Henderson,&Coleman, 2010, p.84).

The increase in global oil prices has therefore left these rural communities to face an energy crisis, threatening their very survival. Therefore a concerted effort to promote small-scale, self-sustaining energy options in rural areas is required to meet the energy needs of the region and the entire state of Alaska. Besides the high cost of oil, there is an environmental risk involved in shipping, handling and storing the petroleum products, especially the potential for spills in the harsh Alaskan climate and ocean conditions (Alexander et al.,2010,p.8). While exploring avenues for alternative energy, it is important to note that the region is home to the Tongass National Forest spread over 17 million acres of land. Under the Tongass Land Management Plan developed for the region, 576,000 acres is designated as suitable for timber harvest. Therefore, an enormous potential lies in converting locally available forest-biomass into wood-pellets or other forms of clean and affordable biomass-energy.

One unique feature associated with Alaska is the “Alaska Native Claims Settlement Act” (ANCSA) of 1971 that aimed to settle Native Americans’ claims to virtually all of Alaska’s roughly 400 million acres of land. This was done by organising Alaska’s hunting and gathering peoples into 13 regional and 220 village corporations. The corporations were devised as an institutional means to give the native tribes the capital, infrastructure and incentives to develop and manage

their own natural assets, thereby increasing their self-sufficiency and reducing the government's trust responsibility (Thornton, 2007).

The Sealaska Corporation is one of the regional corporations formed under ANCSA and is involved in the land and natural resource management in SE Alaska (Sealaska - Who We Are, 2011). Sealaska recently installed a wood-pellet based heating system in their office building in Juneau as a potential step in biomass energy development. The Corporation is further taking steps to develop a regional industry for wood-pellets including through:

- Spreading awareness amongst the native community members and policy makers, regarding the benefits of switching from oil to wood-pellets to heat buildings; and
- Capacity building of existing saw-mills to start a wood-pellet production facility.

Developing a biomass-energy industry in the region that produces wood-pellets to be consumed as heating fuel is expected to benefit the region in several ways. These wood-pellets could be made from current saw-mill and logging residues in SE Alaska and does not require any new tree to be harvested particularly for biomass-energy.

The fact that residues often have low or even negative costs and therefore could be utilised for development of biomass-energy is also supported by Rosillo-Calle et al.(2007,pp.6-7). These authors suggest that residues from forestry and agricultural activities are a large and underexploited potential energy resource, almost always under-estimated and represent many opportunities for better utilisation. Globally the energy potential available from residues is about 70 Exa Joules⁹ (EJ) including 36 EJ from forestry residues alone. However, these estimates are regarded as rough indications only with considerable variation estimated.

The present study attempts to identify potential economic, environmental and social benefits of establishing a wood-pellet industry in the region. These three types of benefits together constitute the Triple Bottom Line framework of sustainability (Slaper & Hall, 2011). In order to demonstrate the environmental benefits, the study uses the emission factor values published by Obernberger & Thek (2010,p.305) to calculate the potential savings in Carbon Dioxide (CO₂) emissions that could be achieved by displacing oil with wood-pellets as heating fuel in residential and commercial buildings. The study further examines a potential demand-supply scenario using the available literature and conducts the price sensitivity analysis of wood-pellet and oil. This sensitivity analysis is based on a methodology developed by Brackley, Barber, & Pinkel (2010,p.19) where the price per unit of energy is determined at different prices of oil and wood-pellets.

Methods

The current study is based on an in-depth literature review, participant observation and semi-structured interviews with key informants on the existing energy situation and trends in the forest industry in Southeast Alaska. Semi-structured interviews are composed of predetermined questions, but the order and content of the questions can be modified based upon the

⁹ 1 EJ = 10¹⁸ Joules

interviewer's responses. Moreover, the questions' wording can be changed and particular questions which seem inappropriate with a particular interviewee can be omitted, or additional ones included (Robson, 2002,p.270). One benefit of semi-structured interviews, as opposed to formal surveys or questionnaires, is that they enable respondents to express perspectives in their own words, with the opportunity to elucidate and clarify their response through follow-up dialogue with the interviewer (Thornton, et al.,2010,p.23).



Figure 1. **Top Left:** Forest Residue Site in Sitka, Alaska. **Top Right:** Mr. Nathan Soboleff, a young Tlingit business leader, showing wood-pellet based heating system installed at Sealaska's corporate office site. **Bottom Left:** Tlingit Community Members narrating stories – Hoonah, Alaska. **Bottom Right:** Tongass National Forest- Juneau, Alaska.

Photo Courtesy: Munish Sikka

Currently, there is no existing wood-pellet manufacturing facility in SE Alaska. The present study attempts to consolidate the efforts of various individuals and entities working on this issue. Therefore, the semi-structured interview approach was especially useful in carrying out the present study as the respondents shared their knowledge about local-context and individual perception on wood-biomass energy. In-depth interviews were conducted with researchers and field staff associated with the US forest services, Sealaska executives, and representatives from non-governmental organisations working on the issues related to conservation in SE Alaska.

Calculations: While doing the economic and environmental calculations, the quantity of wood-pellets has been represented in tons. It is a popular measurement unit in USA and various regional studies consulted have used this unit for analysis. For environmental benefit analysis, the emission quantities of various gases have been calculated in ‘tonnes’¹⁰ which is a different unit from ‘tons’¹¹ representing wood-pellets. The quantity of various gases emitted by burning wood-pellets and oil for centralised heating systems has been taken from Obernberger & Thek (2010,p.305). These values are based on the Austrian framework conditions concerning fuel supply, distribution and utilisation. Therefore, minor differences are expected in these values in a different country due to possible differences in energy consumption during the production of fuels. However, this is presumed to have minimal absolute influence and has been ignored in the calculations.

Global Climate Change Mitigation and Tongass National Forest

Around the world, forests are seen as an important source of mitigating climate change through carbon sequestration. On the other hand, burning wood-biomass for energy would lead to the release of stored carbon into the atmosphere. Therefore, it is important to consider climate change related impacts of promoting wood-biomass in SE Alaska. In this regard the Intergovernmental Panel on Climate Change (IPCC) has expressed that, “In the long term, a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fibre, or energy from the forest, will generate the largest sustained mitigation benefit” (IPCC,2007). Another study by Lippke et al (2011) uses the life cycle carbon accounting approach to compare the emission impacts of using fossil-fuel and biomass for energy. Whilst fossil-fuel emissions flow one way from deep reserves to the atmosphere, carbon emitted by burning biomass could be absorbed by the regenerating forests, thereby making the latter a renewable source of energy.

In SE Alaska, the saw-mill and sort yard residue produced from timber industry is currently unutilised. It eventually decays and emits CO₂ during that process. Therefore, using those residues to displace fossil-fuels could significantly reduce greenhouse gas emissions through avoided burning of oil for heating (JEDC, 2011, p.173).

Results and Policy Recommendations

The study attempts to explore the potential benefits of wood-biomass industry in SE Alaska. It includes literature on the historic land settlement act- ANCSA and the Native Corporations established for the overall development of local communities. The major findings of the study are:

- Potential demand for wood-biomass exists in SE Alaska and could increase with an increase in international oil prices.
- Supportive policy instruments such as a carbon-tax on fossil-fuels, the investment subsidies and feed-in tariffs could facilitate quick adoption of wood-pellets as has happened in several European countries such as Netherlands, Belgium and Sweden (Obernberger & Thek, 2010). These policy instruments are likely to address regional energy security and community vulnerability issues and provide environmental benefits

¹⁰ Tonne is known as the metric ton; 1 tonne = 1000 Kilograms

¹¹ Ton is also referred to as short ton; 1 ton = 2,000 pounds (907.18474 kg). (source: internet)

by displacing oil in SE Alaska and similarly in other parts of the world especially where biomass is a locally available resource.

- A regional wood-pellet industry that utilises a range of raw materials such as sawmill and logging residue could lead to optimal resource use in the forest industry of SE Alaska.
- Currently, utilising saw-mill residue and other economically available biomass could meet almost 65% of estimated heating fuel demand in the region. Promoting sustainable wood-biomass energy opens up an opportunity to achieve multiple benefits on all three pillars of sustainability – Economic, Social and Environmental;
 - Economic: Access to affordable energy for heating, possible revival of forest industry
 - Environmental: Huge savings in CO₂ expected
 - Approximately 23,000 tonnes avoided by consuming 15,000 tons of wood-pellets and displacing oil for heating [proposed production capacity of an upcoming facility in SE Alaska].
 - Approximately 264,395 tonnes avoided by consuming 174,400 tons of wood-pellets and displacing oil for heating [economically available quantity of residue-biomass as estimated by Mater and Miles (2009)].
 - Social: Reduced energy vulnerability due to rising oil prices as well as increased and sustainable employment in the region.
- Rosillo-Calle et al.(2007,pp.10-11) reports that biomass-energy is difficult to quantify and the task of obtaining information related to production and use of biomass-energy is considerably difficult due to the paucity of reliable long-term data. In order to overcome these issues and to put biomass-energy on a comparable basis with fossil-fuels there is a need to develop certain standardised measures. In this regard, the present study utilised the supply and demand information on biomass local to SE Alaska and calculated the environmental benefits using a framework developed by Obernberger & Thek(2010). **The formulae generated within the scope of this study could be used to conservatively calculate environmental benefits of promoting wood-biomass over oil in other regions of Alaska and possibly in other parts of the world.**

Conclusion

The ANCSA provided opportunities for economic and social development of Alaskan Natives. This is a unique feature of the place where native corporations exists and seek to achieve overall sustainability by addressing issues related to native population and natural resource management. Currently, access to affordable and clean energy is an issue in SE Alaska, similarly to many other remote parts of the world. One advantage SE Alaska has is the presence of access rights in the form of resources (land) and capital for Native communities to develop alternative energy systems to fossil-fuels, for their overall development. This could be one important message for other parts of the world where property-rights for native communities still remain a distant reality. Another important message is the need for supportive policies and grants at a national level which promote alternative energy systems like wood-biomass. Despite having access to biomass, additional incentives are required for its conversion and adoption as a heating fuel.

The study concludes that a sustainable wood-biomass energy industry could be developed in SE Alaska. It relies on residues from existing forestry operations including saw-mill residue

and logging waste generated in the region. It is also observed that an economic incentive exists for users to switch to wood-pellet based systems at the current oil prices of over \$4.00/gallon. However, initial investment costs remain high in the present situation which could discourage the switch. Therefore, some policy support in the form of carbon tax or investment subsidies is required to facilitate a switch to wood-pellets. These initiatives have been implemented in many countries including Netherlands, Belgium and Sweden and could be replicated in SE Alaska and other places around the world.

References

- Alexander, S. J., Henderson, E. B., & Coleman, R. (2010). *Economic Analysis of Southeast Alaska: Envisioning a Sustainable Economy with Thriving Communities*. Juneau: Forest Service, Alaska Region Publication R10-MB-725.
- Brackley, A. M., Barber, V., & Pinkel, C. (2010). *Developing Estimates of Potential Demand for Renewable Wood Energy Products in Alaska*. Portland: USDA - Forest Service.
- Frank Rosillo-Calle, Sarah Hemstock, Peter de Groot and Jeremy Woods (Eds.). (2007). *The Biomass Assessment Handbook: Bioenergy for a sustainable environment*. London: Earthscan.
- IPCC. (2007). *Climate Change 2007 Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the IPCC*. IPCC.
- JEDC. (2011). *Southeast Alaska Action Initiatives For Key Economic Clusters*. Juneau: Juneau Economic Development Council.
- Lippke, B., Oneil, E., Harrison, R., Skog, K., Gustavsson, L., & Sathre, R. (2011). Life cycle impacts of forest management and wood utilization on carbon mitigation: knowns and unknowns. *Carbon Management*, 303-333.
- Mater, C. M., & Miles, T. (2009). *Feasibility Assessment of Producing a Wood Waste Alternative Fuel Product on Prince of Wales Island*. MATER Ltd.
- Obernberger, I., & Thek, G. (2010). *The Pellet Handbook: The Production and Thermal Utilisation of Pellets*. London: Earthscan.
- Robson, C. (2002). *Real World Research: A Resource for Social Scientists and Practitioner-Researchers*. Oxford: Blackwell Publishing.
- Sealaska - Who We Are . (n.d.). Retrieved 03 11, 2011, from: [www.sealaska.com: http://www.sealaska.com/page/who_we_are.html](http://www.sealaska.com/page/who_we_are.html)
- Slaper, T. F., & Hall, T. J. (2011). *The Triple Bottom Line: What is it and how does it work?* Retrieved 07 25, 2011, from: <http://www.ibrc.indiana.edu: http://www.ibrc.indiana.edu/ibr/2011/spring/article2.html>
- Thornton, T. F. (2007). *Alaska Native Corporations and Subsistence: Paradoxical Forces in the making of sustainable communities*. In C. A. (Ed.), *Sustainability and Communities of Place* (pp. 41-62). New York - Oxford: Berghahnbooks.
- Thornton, T. F., Butler, V., Funk, F., Moss, M., Hebert, J., Elder, T., et al. (2010). *Herring Synthesis: Documenting and Modelling Herring Spawning areas within Socio-ecological Systems over time in the Southeastern Gulf of Alaska*. North Pacific Research Board Project #728.