IEA Bioenergy

Innovative approaches for mobilization of forest biomass for bioenergy

Summary Series

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Introduction

Increasing global demand for energy, a push by governments and industry to reduce greenhouse gas (GHG) emissions, and a desire to increase energy independence are driving the demand for renewable alternatives to fossil fuels. As a source of renewable carbon that can be used in the existing energy infrastructure, forest (woody) biomass is an attractive feedstock for the production of bioenergy for production of heat, power and liquid biofuels.

Due to various logistical, social, market and policy challenges, forest biomass resources are often left behind in forest value streams of various jurisdictions around the world: they usually end up in open burning, landfill or burned up in boilers with low efficiency for heat and power generation, or left on forest sites. However, they represent opportunities to increase production of bioenergy and therefore contribute to the global energy transition towards renewable sources, and also opportunities to revitalize and diversify regional industrial networks in forest regions.

This report builds on knowledge on the valorization of forest biomass for bioenergy (including heat, power and biofuels) with the aim of providing insights and recommendations for the development of pathways to maximize the value from often underutilized sources of forest biomass. It is presented around case studies that deal with supply, logistics, conversion, social, environmental, market and policy aspects of forest biomass mobilization:

- Mobilization of unmerchantable and non-commercial trees in Quebec
- Mobilization of low-quality sawmill residues and urban wood waste for heat and power production in British Columbia Coastal region
- Supply of wood pellets to coal-fired power plants in Alberta
- Production of biojet from woody biomass in Western Canada
- Integrating economic and environmental values into forest supply chain management for timber and bioenergy production from beetle-killed biomass in Colorado
- Vertically-integrated small-scale operations in Italy

Key recommendations

A compilation of the developed knowledge from case studies indicate how taking advantage of modern technologies and innovations in supply chain management can help to valorise underutilized biomass resources. Commercial quantities of underutilized woody biomass resources are available that are currently left behind in the forest, such as the degraded woods in Quebec, or burnt inefficiently by the local sawmills and pulp mills for heat and power generation, as seen with the processing residues in the Vancouver region. These biomass resources traditionally have not been considered as feedstock for biofuels and bioproducts markets due to a combination of logistical disadvantages (high procurement costs) and quality issues (e.g. high moisture content and ash content). **Supply chain development, such as the use of adequate pre-treatment technologies for biomass, or a closer integration of forest biomass supply chains within larger forest management systems**, can create significant new opportunities for the utilization of this material.

A key element of successful biomass deployment is to **connect the right biomass to the right value market**, based on supply chain management and appropriate pre-processing technologies. In the case presented from Vancouver, very low-quality biomass that could be sourced locally and did not have competing uses, was considered as an adequate feedstock to secure cost-effective supply that could be managed through a well-planned chain to meet energy production needs. In the Italian case, more mature bioenergy markets had been established and local small-scale supply was matched to the local market where the advantages of the location and supply form existing land management used novel supply chain technology and design to meet the specific local market needs.

A combination of **pre-processing solutions can contribute to upgrade the value of the underutilized woody biomass resources**, through managing moisture content, limiting contamination and creating a consistent particle size for energy production systems. Strategies around storage and mixing of resources were used to bring low quality biomass sourced for the Vancouver gasification case to a level that provided a consistent and reliable energy production, while the Italian case used specific chipping technology as an effective solution at small scale to meet a high-quality biomass supply demand. Pre-processing solutions will add to the cost of biomass delivered to the downstream users and therefore needs to be carefully considered and integrated in the supply chain management. The selection of the pre-processing solutions depends on understanding the feedstock specifications of the bio-processing technology and biomass characteristics. Fractionation, size reduction, drying, densification, torrefaction, blending and washing are examples of pre-processing solutions.

The location of the upgrading operations is critical to reduce the cost of inbound and outbound transportations and to ensure the right qualities are created and delivered to the bioenergy use of greatest value. In the Italian case, logistics were reduced with localised pre-processing of microchips to displace imported pellets, a pre-processing technique that unlocked a local supply. Multiple transportation modes (i.e. road, rail and water) can significantly reduce the biomass delivered cost and, where possible, it can be effective to introduce value adding pre-processing operations where these modes of transportation intersect. The Alberta case of pellets for co-firing in coal power energy generation added value to the feedstock through pelletization and then used the now point sources of higher value biomass to leverage cost benefits of rail transport to access more biomass at an acceptable cost. Where multiple modes of transportation are not required, pre-processing will be better placed either at the point of harvest (roadside storage to reduce moisture, infield chipping and grinding, etc.) or within the facility of the final energy producer (active drying with waste heat, pelletization, torrefaction, etc.).

Agility and flexibility are important to the efficient execution of supply chain plans. The reality in the forest sector, and more so in forest biomass supply chains, is that there is a continual need to adapt to changing conditions (e.g. mill closings/openings; natural disturbances). An agile and flexible biomass business case will be able to adapt to multiple sources of feedstocks, and continually move up the technological learning curve through learning-by-doing, as seen in the example of the gasification plant in Vancouver.

The priority is to **displace currently inefficient energy solutions where a biomass feedstock is local to an otherwise remote site**. Where the situation does not provide obvious advantages for bioenergy production and use, it is important to work with the identified strengths of bioenergy, such as direct heat production, and capitalise on other benefits such as regional development, improved forest management outcomes and reliable local energy source. All these strategies for successful biomass supply are enhanced by supportive policy and legislation that underpin changes in the current forest management practices, organizational behaviour and business models of the forest companies towards supplying a bioenergy industry.

Integration of supply to existing industry and land management needs is key to success. The biojet project in British Columbia relies heavily on integration with existing forest supply chains to source biomass suited to the specific need as well as downstream supply chain integration to get to market, using existing and reliable infrastructures. In Colorado, the recovery of pine beetle killed wood was a key tool in the integrated land management strategy to direct suitable wood to high value timber markets and at the same time provide a viable market to low-quality trees and residues for energy use. In Alberta the traditional energy source of coal is a very low-cost solution so high levels of integration with existing supply chains and transport infrastructure like rail were needed to deliver bioenergy at acceptable costs as a renewable component of the co-firing solution.

While biomass supply chains remain complex and challenging, the key elements for success can be quite simple. The first element is to understand the biomass supply including the amount, locations and quality. It then falls on the supply chain to realise the best value by connecting that biomass to the right market and use, while adding the right value at the right place along the supply chain with pre-processing, amalgamations and volume efficiencies. Scaling and integration with existing supply chains that both leverage expertise and create synergistic efficiency is often the difference between success and failure.

The full report is available at: http://task43.ieabioenergy.com/wp-content/uploads/2019/01/TR-2018-06.pdf