

Title: **“Feasibility of Adapting Existing Forestry Practices for Improved Biomass Production”**

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Extended abstract

The analysis, described in detail in Jessup & Walkiewicz (2012), is presented for three European regions that substantially differ in forestry and economic conditions, Northern Europe, Central Europe and Southern Europe and is therein based on a detailed level analysis of several different forest biomass supply chains and their estimated costs of production are presented by region, separated by the different process related cost components.

In terms of natural characteristics, the northern European areas are characterized with dense forest cover, certainly relative to population density, whereas central and southern Europe has areas of very dense forest cover but generally higher population density per geographical space. In terms of species, the northern countries are predominately conifers, whereas mixed species are common throughout central and southern Europe, with some countries have predominately hardwoods (France). Mountainous forest conditions are more evident for a broader geographic region across central Europe and the northern portions of southern Europe. In terms of forest's productivity, as measured by annual increment, four countries dominate, including Sweden, Finland, Germany and France. In terms of total felling as a percent of annual increment, the three countries with the highest are Austria, Sweden and Switzerland. Those with the lowest include Spain, Italy, Ukraine and Germany. In terms of economic/cultural characteristics, there are equally divergent attributes across Europe relative to the country specific economic significance of the forestry sector to gross value added, economic well-being as measured by purchasing power index, total employment in the forestry sector and the labour productivity measured in total roundwood removals per forestry/logging employee. In the northern EU, the forestry/logging sector is a vital component of the economy, certainly compared to all other regions of the EU. The North is also a region of relatively strong economic affluence, particularly in those regions where the majority of habitants reside. And the forestry and logging sector is extremely productive, particularly as measured in roundwood removals per employee which is ten times that of many central and southern European countries. It is also a region where the proportion of forest lands in private ownership is particularly high, especially for the southern half of Finland, Sweden and Norway, and these parcels are relatively larger size holdings than those in private ownership in the central and southern EU areas. In the central EU, the forestry/logging sector is important, but in terms of contribution to gross value added,

significantly less important given the greater industrial and economic diversity of these countries. In terms of economic affluence, central Europe has greater diversity, going from very affluent regions in Germany, Switzerland, Netherlands and Belgium to relatively low affluence for many eastern European countries. And except for western France, most of central Europe has relatively low proportion of forests in private ownership, and most of this is in holdings that are very small size holdings, making the coordination of all forest supply chain activities (harvesting, extracting, processing, chipping, transport/delivery) more challenging and often costly. The southern EU countries, to some extent are similar to the Central EU region in terms of high degree of diversity. The contribution of the forest/logging sector to gross value added is mostly lower than other EU regions with the exception of Italy, Croatia, Portugal and Romania. And the economic affluence is mostly lower in the southern EU, with the exception of central/northern Italy. The productivity of the forestry/logging sector is lower throughout the southern EU and the proportion of forest lands in private ownership varies significantly depending on the country and region.

It is these combined natural, environmental, economic and cultural characteristics that have contributed to the shape of the existing forest biomass supply chains and the respective costs of production relative to market conditions throughout Europe. These forest biomass supply chains have many variations, but may be generally categorized by where the comminution of forest material occurs resulting in 1) bulk and 2) chipped forest biomass supply chains. The variation in both process attributes and location of material flow can significantly influence costs of productions and the variations in each of these are described within this report. The estimated costs of production for different forest biomass supply chains common to each region are also provided, by process related activity and in total relative to current market price for wood chips within each region. These estimated costs of production help illuminate areas where potential for innovation and adaptation offers opportunity for cost reduction and market expansion. The northern European biomass supply chains collectively have the lowest cost of production compared with the central and southern European region, with all six supply chains having cost of production below €15/MWh. But the northern region also has the lowest market price for wood chips at approximately €22/MWh. The two supply chains from industrial roundwood residues exhibited the lowest cost of production, below €7/MWh.

The four central European biomass supply chains varied significantly in total costs of production, going from the most costly €34/MWh of industrial roundwood residues in steep terrain to €10.50/MWh with industrial roundwood residues in flat terrain. However, the average market price for wood chips in the central region is the highest across all regions at approximately €32/MWh, partly reflective of a predominately smaller scale end customer with higher quality and lower moisture requirements as compared to the northern region supplying mostly large heat plants. Also, the proportion of supply chain costs attributed to chipping and transport/delivery in the central region is prominent, considerably larger than that in the North.

The southern European region supply chains also have the highest costs of production with steep terrain harvesting at €28/MWh and the lowest cost of production with the stump/root extraction at just under €15/MWh. Felling/harvesting costs play a prominent role in pre-commercial thinning operations, as they do in all regions, whereas forwarding/extraction costs play a dominate role for industrial roundwood residues and stump supply chains. The average market price in the southern European market is between the central and northern regions at €26/MWh. The expected surplus potential by 2030, as bounded by the European Forest Sector Outlook Study II model of expected change in forest supply (total), varies by region and policy assumptions. In the North, the total expected increase in forest supply is predicted between 47 M m<sup>3</sup> and 139 M m<sup>3</sup> following the reference and promote wood energy scenarios respectively. However, only including forest biomass and 50% of the stemwood volume produces a more realistic range between 35 and 100 M m<sup>3</sup>. In central Europe, the total expected increase in

forest supply is predicted between 123 M m<sup>3</sup> and 245 M m<sup>3</sup>, but this presumes a large increase in stump/root volume in the promote wood energy scenario (53 M m<sup>3</sup>). If we again only include forest biomass residues and 50% of the stemwood volume, this produces a range of 63 to 92 M m<sup>3</sup> in central Europe. In southern Europe, the total range between the reference and promote wood scenario is 44 to 93 M m<sup>3</sup>. Again only including forest biomass residues, stumps and 50% of the stemwood volume produces a range 20 to 44 M m<sup>3</sup>. Collectively, this totals a realistic range of 118 – 236 M m<sup>3</sup> increase in forest supply for Europe.

The feasibility of adapting existing forestry and supply chain activities relative to equipment and information technology innovation and process type are summarized in Table 1. The potential for cost reduction is a qualitative assessment based upon a combination of current supply chain production costs and relative to the various forests attributes comprising each region.

Table 1: Summary of Potential Cost Reduction from Equipment and Information Technology

Process Type	Technology Focus	Potential for Cost Reduction		
		North	Central	South
Harvest/Felling	<ul style="list-style-type: none"> <li>• Equipment</li> <li>• Information</li> </ul>	<ul style="list-style-type: none"> <li>• High</li> <li>• Medium</li> </ul>	<ul style="list-style-type: none"> <li>• Medium</li> <li>• High</li> </ul>	<ul style="list-style-type: none"> <li>• Medium</li> <li>• High</li> </ul>
Forwarding/Extracting	<ul style="list-style-type: none"> <li>• Equipment</li> <li>• Information</li> </ul>	<ul style="list-style-type: none"> <li>• High</li> <li>• Medium</li> </ul>	<ul style="list-style-type: none"> <li>• High</li> <li>• Low</li> </ul>	<ul style="list-style-type: none"> <li>• High</li> <li>• Medium</li> </ul>
Chipping/Crushing	<ul style="list-style-type: none"> <li>• Equipment</li> <li>• Information</li> </ul>	<ul style="list-style-type: none"> <li>• Medium</li> <li>• Medium</li> </ul>	<ul style="list-style-type: none"> <li>• High</li> <li>• High</li> </ul>	<ul style="list-style-type: none"> <li>• High</li> <li>• High</li> </ul>
Processing (Drying/Sieving)	<ul style="list-style-type: none"> <li>• Equipment</li> </ul>		<ul style="list-style-type: none"> <li>• High</li> </ul>	
Transport	<ul style="list-style-type: none"> <li>• Equipment</li> <li>• Information</li> </ul>	<ul style="list-style-type: none"> <li>• High</li> <li>• Medium</li> </ul>	<ul style="list-style-type: none"> <li>• Low</li> <li>• High</li> </ul>	<ul style="list-style-type: none"> <li>• Low</li> <li>• High</li> </ul>

Jessup & Walkiewicz (2012) describe various favorable organizational market structures that could enhance and expand the market for forest biomass, but also provide for greater market pricing efficiency in the forest biomass supply chain, resulting in improved forest management/harvesting to reflect downstream industrial and energy market attributes. These favorable organization structures include:

- Promoting competitive markets using information technology (development of European wide online auction/clearinghouse)
- Expand market throughout cooperative organization structures
  - Forest biomass supply cooperatives (medium to large scale customers)
  - Forest biomass energy firms partnering with agriculture biogas producers
  - Forest biomass trade centers (small to medium scale customers)

#### References

Jessup, E., Walkiewicz, J. (2012): ADAPTED FORESTRY PRACTICES FOR IMPROVED BIOMASS RECOVERY. INFRES Project report. 72p. <http://www.infres.eu/openfile/1167>

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