Forest Feedstock Supply Curves

In the systems analysis sub-project of Forest Refine, we have calculated supply curves for novel assortments from the forest to potential biorefineries located in the cities of Storuman, Umeå and Örnsköldsvik. The supply curves show the amount of feedstock that can be offered to the market at a given market price. According to economic theory, the market price and the amount of goods supplied to the market depend on the supply curve and its interaction with the corresponding demand curve. This info-sheet presents methodological approaches used in the calculation of the supply curves for forest feedstocks. The results of the calculations will be presented in separate info-sheets.

Background

The purpose of the systems analysis performed within Forest Refine project has been to indicate costs and energy efficiency improvement potentials when innovative supply chains from the forest to biorefinery industries are implemented. The selected approach has been to divide the supply chains into operations and to model the cost and energy use for each operation. The supply included harvesting, forwarding, transportation, feedstock processing at terminals and delivery to industry. The focus has been on innovative systems for integrated harvest of stem wood and residual biomass (such as tops, branches and stumps), as compared to the presently dominating system in the region, where stemwood and residual assortments are separated at the forest site and handled in separate supply chains The present info-sheet gives an introduction to the concept of supply curves, which is used to present the results from the systems analysis in subsequent info-sheets. A more detailed presentation of the supply curves and energy use calculations will be given in a separate publication (Joelsson et al., forthcoming).

Supply curves

The supply curve illustrates the relation between the market price and the amount of product offered to the market. According to conventional economic theory, the market price of a product is a result of the interaction between supply and demand. In this context, supply is the amount of the product that is offered to the market as a function of the market price, as illustrated in Figure 1. A smaller quantity (Q1) of the product can be expected to be offered to the market if the market price is low (P1), while a larger quantity (Q2) can be offered to the market if the price is high (P2), all other conditions equal. Similarly, the demand describes the amount of product that is demanded for on the market as a function of the market price. At a low market price, the demanded quantity can be expected to be bigger than at a high market price.

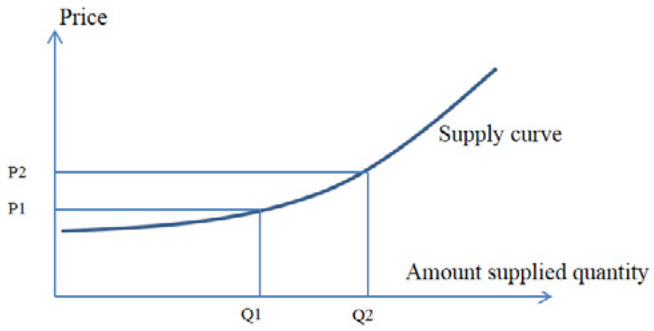

Figure 1. Schematic illustration of the supply curve.

Supply of forest feedstock

Forestry is a co-production system. That is, several products are produced at the same time, such as saw logs, pulpwood and logging residues. Therefore, the potential amounts of the different assortments are not independent. Calculation of production costs for one product in a co-production system is not straight forward. In general, there is no unambiguous way to allocate costs between the different products in an operation. For example, the cost of harvesting a tree and cut it into pulpwood and saw logs is not easily split into pulpwood production costs and saw logs production cost, although saw logs constitute the most valuable assortment in terms of revenues for the land owner.

The supply of forest feedstock depends on a number of factors. In the short term, the quantity of feedstock supplied to the market depends on the decision of individual forest owners whether to perform harvesting operations or not. Also, the existing forest stock puts limitations on the amount that can be supplied in the short term. Forestry is also regulated by legislation that aims to secure the productivity of the forest land as well as environmental values with specific restrictions in the sensible cases. In the longer term, factors influencing forest growth are important. In addition to domestic wood, imported wood can also contribute to the amount available on the market. Forest owner decision making is influenced by several factors of which the market price of forest products is only one. For example, the present economic situation of the individual forest owner is also an important factor. For a more detailed discussion on the economics of forest feedstock supply, see for example Lundmark (2004, 2009).

SUPPLY CURVES IN FOREST REFINE

Within the Forest Refine project, we created supply curves for forest feedstock assortments by modelling the costs involved in acquiring the feedstock from the forest. The supply curves were created for three locations: Storuman, Umeå and Örnsköldsvik and included forest biomass supply from areas within a radius of 120 km around each of the three locations. The cost information was combined with data on the available forest resource amounts and the feedstock geographical distribution derived from the National Forest Inventory for the study Region.

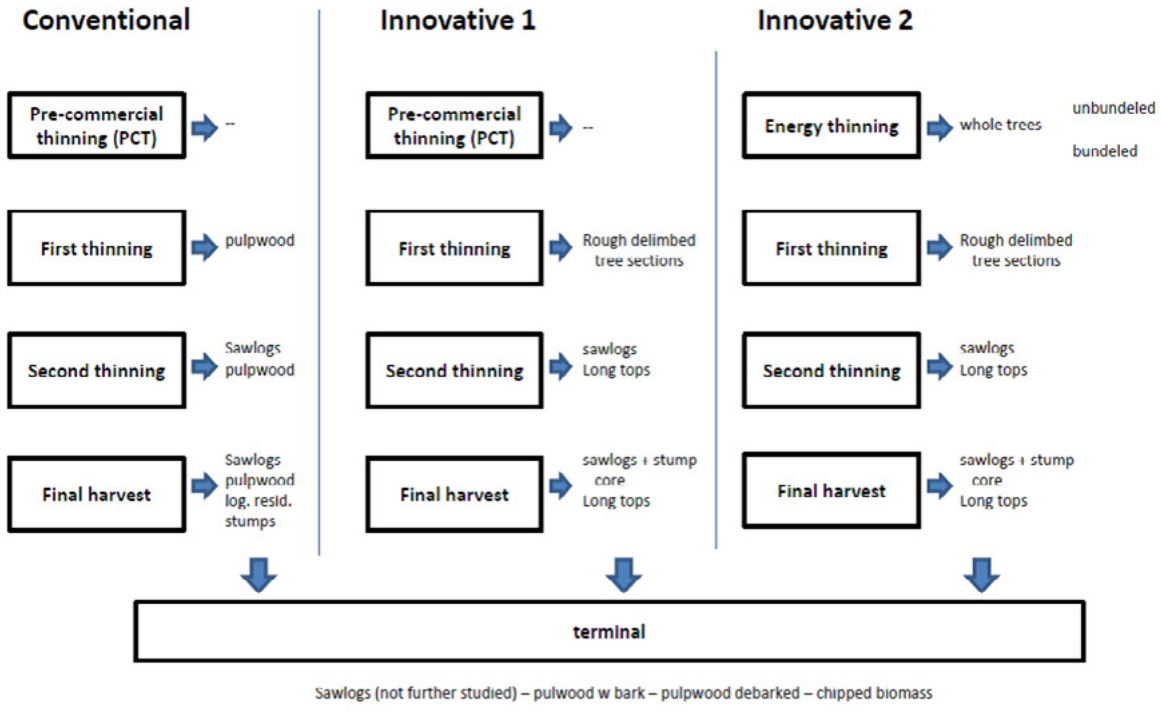

Figure 1. Studied forestry regimes, operations and assortments.

We focused on estimation of supply curves for novel assortments obtained by modification of forest operations and/or forestry regimes (Fig. 2 & Table 1). At the same time we also calculated supply curves for conventional assortments, such as pulpwood, logging residues and stumps obtained in the case of conventional forest operations and by applying the conventional forest management (Fig. 2 & Table 1). The resulting supply curves are reported in separate info-sheets.

Table 1. Description of conventional and novel assortments considered in the analyses.

Conventional (reference) assortments	Novel assortments
• Pulpwood from first, second thinnings and final fellings (logs with a minimum top diameter of 5 cm under bark) • Logging residues from final fellings (branches and tops) • Stumps from final fellings (obtained in a conventional separate stump harvest	• Rough-delimbed tree sections from first thinnings (stemwood including a 50% of branches mass) • Long tops from second thinnings and final fellings (stemwood with a diameter below 12 cm including branches) • Stump cores harvested together with saw logs in final fellings • Small whole trees from early thinnings (stemwood including all branches)

LITERATURE

Joelsson et al., n.d. Integrated supply of stemwood and residual biomass to forest-based biorefineries. Manuscript.

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