CASE STUDY

Acquisition and logistics of biomass from marginal land, including agricultural land overgrown with self-seeding trees and shrubs

In recent years, vacant land parcels, including agricultural fields where typical crop production has been abandoned, exposed to the natural succession of various species of shrubs and trees, have turned into an important source of woody biomass. Such plants are known as self-seeded shrubs and trees, and the species composition in each site (e.g., pine, birch, spruce, willow, poplar and others) depends on the environmental conditions, including the habitat, climate, the vegetation growing around the site, and others. Harvesting biomass from such areas plays a dual role because firstly it is a source of woody biomass and secondly it enables the restoration of agricultural production or use for another purpose, for example development.

In areas overgrown with self-seeded plants, shrubs and trees may be of different age, from a few years up to a few dozens of years old, although most often they are around 10 years old. The harvest of self-seeded trees or shrubs is done on commission, depending on the ordering party's needs, and practically can be carried out continuously, regardless of the season. However, the optimal period is from 15 October to 1 March, outside the breeding season of birds, pursuant to the Regulation of the Minister for the Environment of 16 December 2016, on the protection of animal species. Because a land plot from which self-seeded trees and shrubs are harvested is most often restored to agricultural production or for other purposes (residential, recreational, commercial, industrial or transportation), all plants should be cut at the ground level, so as not to leave any stumps. Besides, depending on the age and number of self-seeded shrubs and trees, rootstocks can also be harvested (pulled out from the ground). Quercus offers a technological line, a set of machines and equipment, dedicated to this kind of work.

COUNTRY

Poland

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The first stage employs a hydraulic harvester head Westtech Woodcracker C450 or C350 mounted on a Volvo EC 250 or EW 160 excavator, which can cut trees with the diameter of up to 500 mm. The operator performs several operations at the same time – grasps the plant right above the ground, grips it and cuts it with the cutting mechanism. Next, using the gripper, the operator holds the cut tree, and then grips and cuts another plant. Once, the head container is filled with an appropriate amount of biomass, the operator unloads it in a regular row of heaps. Using this machinery, it is possible to clear completely an area of 1 ha in about 20 working hours on average and obtain ca 100 Mg of biomass. Noteworthy, however, every site is different, and the above average value may differ considerably. This also depends on the atmospheric conditions, type of terrain, species structure and age of self-seeded trees as well as the experience of the harvester's operator.

Once the whole area has been cleared, the biomass is most often transported to one site (heap, pile) using a forwarder or a tractor with a trailer and crane, to be stored and possibly air dry, which increases its calorific value. The biomass collected in piles, depending on its volume and the distance to the company's logistic facilities, can be shredded to chips using a mobile chipper type Bruks 805.2 STC mounted on a forwarder or Albach Diamant 2000. The chips are then transported in vehicles equipped with containers or moving floors to the end user.

Below there are photographs illustrating consecutive stages of this technology.

Figure 1. Felling trees, bushes using a Westtech Woodcracker hydraulic shear head

Figure 2. When the shear head's collector is filled up, the operator deposits the biomass in regular rows or load.

Figure 3. Chipping and transporting chips to the final destination.

PRACTITIONERS' FEEDBACK & MOTIVATION FOR DEVELOPMENT

The added value of the proposed technology for a variety of potential clients lies in the fact that:

- after cutting, plants are typically transported from the whole area and can be stored in heaps for as long as two years, and then can be processed to wood chips in batches, as the demand for solid fuel occurs.
- during the storage, depending on the season of the year, atmospheric conditions, size of the heap, and duration of this period, the moisture content in cut plants decreases from about 50-60% on harvest to about 30-40% after a few weeks, which means a rise in the biomass calorific value from ca 8 to 12 GJ/Mg.
- the wood chips produced in this technology are a valuable solid biofuel, which is most often used locally in district heat or heat and electricity plants.
- the technology enables the restoration of land to agricultural or investment use, while maintaining or improving the continuity of biomass supplies to the end user, irrespective of the time passing from the harvest of plants.

TRADE-OFFS BETWEEN ECONOMIC, ENERGY AND ENVIRONMENTAL EFFECTS FOR CONVENTIONAL AND IMPROVED BIOMASS HANDLING APPROACHES

As regards this technology, it is not possible to talk about specific, repeating economic, energy or environmental effects, nor to compare it directly with the traditional methods of obtaining wood chips, for example from forest felling or sawmill residues. The reason is that every land parcel overgrown with self-seeded plants is unique. They can have different relief and location, area, age of self-seeded trees and shrubs, plant density per area unit, species composition of the plant community, morphology of the plants, type of soil, season of harvest, climatic conditions, time taken to harvest the plants, the required deadline for clearing the land plot, the way the harvest is carried out, only aerial parts or also roots of shrubs and trees, the intended use of biomass and the technology applied to process it, the availability of machines and human labour at a given time, etc.

The overall economic gains for potential clients consist of the income from selling the biomass and clearing of the land plot, which can be used then for agricultural, forest or development purposes.

The overall energy benefits for potential clients consist of the obtained biomass, which is a renewable energy source for local producers and recipients of heat energy or heat and electric energy.

The environmental benefits include the planned and targeted management of the land plots, which can correspond to the local policies of spatial management in a given area.

Economically, production of wood chips from self-seeded shrubs and trees is always an added value because this is an additional stream of biomass, which can be either occasionally or periodically used as supplementary to the traditional sources of wood chips from forest felling or sawmill waste.

KNOWLEDGE TRANSFER POTENTIAL TO OTHER REGIONS

A direct transfer of the know-how and the entire technology proposed above to any region in Poland or in any other European country is possible. Obviously, the exact costs and benefits from using the technology will depend on the factors mentioned above and local economic factors as well as the logistics used in each case.

CASE STUDY

SUMMARY

The proposed technology „Harvesting and logistics of biomass from marginal land, including agricultural land, overgrown with self-seeded trees and shrubs" is a fully developed and applicable technology with TRL 9. It is completely mechanized and practically applicable in different geographical and environmental conditions. The added value of this technology for potential clients, such as farmers, companies, and other land-owning entities, lies mainly in the possibility to restore land for agricultural or investment purposes while maintaining or improving the continuity of supplies of biomass to the end-user, regardless of the season of harvesting the plants. Moreover, once all cut shrubs and trees are transported from a given land plot for storage, they can be stored in heaps or piles for up to two years and then processed into wood chips as a demand for solid biofuels arises. Moreover, while being stored, depending on the season of the year, atmospheric conditions, size of a pile or heap, and duration of the storage period, the moisture content in the plants decreases from about 50-60% on harvest to around 30-40% after a few weeks, which means that the calorific value of the biomass increases from around 8 to 12 GJ/Mg. In consequence, the wood chips produced in this technology are a valuable solid biofuel, which is most often used for energy generation locally in distric heat or heat and electricity plants.

ABOUT BRANCHES

BRANCHES is a H2020 "Coordination Support Action" project, that brings together 12 partners from 5 different countries. The overall objective of **BRANCHES** is to foster knowledge transfer and innovation in rural areas (agriculture and forestry), enhancing the viability and competitiveness of biomass supply chains and promoting innovative technologies, rural bioeconomy solutions and sustainable agricultural and forest management.

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THE PARTNERSHIP