



AGRO-BIOMASS

Residues and waste from agriculture - biomass potential refers to the maximum amount of biomass that can be expected to be available for various uses, including energy production, organic fertilizers, composting and other industrial applications. This potential varies depending on the type of crop, growing conditions and technologies used in harvesting and processing. This can be straw, corn pulp, husks, seeds, etc. They can be used as fuel in our own boiler rooms or as raw material for the production of products such as briquettes and pellets (so-called agro-pellets made of straw).¹

The bioeconomy strategy is one of the policies of the European Union, which aims to strengthen economies through greater efficiency in the use of biomass through numerous innovations and to facilitate the transition to green policies through the supply of renewable carbon to society. Agriculture as the primary production sector plays an important role in the development of a circular and sustainable bioeconomy.²

AGRICULTURAL BIOMASS IS DIVIDED INTO³:



- 1 Biomass of crop production (hay, straw, stalks, corn stalks, husks, husks of agricultural crops),
- 2 Biomass of fruit and viticulture production (pruned remains of permanent plantations),
- 3 Biomass from the processing of agricultural raw materials in the food industry (grape pomace, olive pomace, oilseed pomace, fruit pits, lupine fruit shells),
- 4 Biomass from vegetable growing and ornamental horticulture (remainder from gardens and parks),
- 5 Livestock production biomass (manure, slurry, slaughterhouse waste, fishery waste, meat and bone meal),
- 6 Agricultural biomass of crops for energy production on separately established plantations (Miscanthus sp., Sudanese grass).

¹ Circular economy and economic potential of agricultural residues <https://zir.nsk.hr/en/islandora/object/pfos%3A3145/datastream/PDF/view>

² Potentials and obstacles of agricultural development through bioeconomy in the Republic of Croatia, <https://hrcak.srce.hr/clanak/405448>

³ The Bioeconomy in Europe: An Overview, <https://www.mdpi.com/2071-1050/5/6/2589?frbrVersion=6>





THE ADVANTAGES OF USING BIOMASS AS AN ENERGY SOURCE ARE:

- 1 Huge energy potential,
- 2 Renewable and sustainable form of energy,
- 3 Reducing dependence on the import of fossil fuels (energy independence),
- 4 Possibility of storage,
- 5 Reduction of emissions of harmful gases into the atmosphere (CO₂, SO₂, NO_x),
- 6 CO₂ emissions are equal to zero,
- 7 Increase of arable land under the cultivation of energy crops,
- 8 Socio-economic aspects (creation of new jobs, development of rural communities and increase of local and regional economic activity).



BIOMASS OF AGRICULTURAL PRODUCTION

In agricultural production, the most important material that bioenergy resources can be made of is the biomass of wheat, corn, barley, followed by oilseeds and grain legumes, with special emphasis on the dedicated production of oilseeds for biofuel. The energy value of biomass is different and depends on the amount of water in the mass and its chemical composition. The fuel value of wheat straw, biomass of oilseeds and legumes with approximately 15% water is about 14.5 MJ/kg. A part of the biomass is returned to the soil as organic matter, and a part is lost during collection and manipulation, and the utilization is calculated at 30%.

Collection of pruning residues is done in two ways, manually and mechanically. As for manual harvesting, it is most often done using human labor or rakes on smaller areas and narrow rows, and the biomass is brought to the end of the rows. In the second case, mechanical collection, it is carried out with the help of connected and carried machines and is also brought to the end of the rows. Machines mean shredders that shred the cut mass and leave it in the inter-row spaces.

In addition to shredders, there are also machines for baling the pruned mass, where the end product of the so-called „bale“ is put into a furnace and thermal energy is obtained. The worst scenario is to burn the pruning residues, thus losing a valuable source of energy and polluting the atmosphere and destroying the microflora and fauna in the arable soil layer and consequently reducing the proportion of soil organic matter. ⁴



BIOMASS PELLET

Straw after the harvest of wheat, barley, oats, corn husks after harvesting corn or any other residues after field crops can be used for pellets. These are desirable raw materials that farmers normally burn or plow.

⁴ AGRICULTURAL BIOMASS FROM HARVEST RESIDUES, https://projekt-klima.eu/wp-content/uploads/2021/05/Brosura_Poljoprivredna-biomasa-iz-zetvenih-ostataka.pdf



In the production of agricultural crops, the amount of wheat, corn or other cereals you have harvested is estimated to be approximately the same amount of remaining biomass. So, if you removed five tons of wheat, you also have about five tons of straw. In some varieties, it is 10 to 15% more, in others a little less.

However, even when the costs of collection of harvest residues, transport and processing are deducted, it should be a profitable production and a solid additional income in agriculture. ⁵

BIOMASS FROM FRUITS AND VEGETABLES

Pruning products are pruned branches or pruning residues that need to be disposed of. A significant amount of agricultural biomass comes precisely after the pruning of orchards and olive groves. The energy potential from fruit and viticulture production includes the amount and energy value of pruned wood material in apple, pear, peach, olive, plum, cherry and vine plantations.

The processing of fruits and vegetables into a semi-finished or finished product leaves a large amount of „waste“, where a significant part consists of pits (plums, sour cherries, cherries and olives) and ljuska (walnuts, hazelnuts and almonds). ⁶

BIOMASS FROM THE PROCESSING OF AGRICULTURAL RAW MATERIALS

OLIVE PITS

It is a cheap energy source, not a waste produced by processing the fruit. In addition to its high energy value, it is also significantly cheaper than, for example, heating oil or pellets. Instead of throwing it away as biological waste, some oil mills in Istria sell it and use it for heating.

They are separated from pomace with a special machine during fruit processing and olive oil production. Ten to 12 percent of the total mass at the entrance means that if we have a ton of olives, we have 100, 120 kilos of pits, which are currently thrown away in most oil mills and not pitted, and most houses on the Adriatic, buildings, schools, can be heated with that pit. Because 2 kilos of seeds have the same energy value as one liter of heating oil. ⁷

They need about 7 tons of olive pits to heat the 300-square-meter house and the large oil mill.

The price of the olive pit is 0.13 cents per kilo, that is still in the experimental phase of distribution. They are taken by people who have pellet stoves that they have adapted to be able to burn stone.

⁵ Energy potential of biomass agriculture in Croatia, <https://hrcak.srce.hr/file/223346>

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⁷ 5 portal, https://5portal.hr/vijesti_detalj.php?id=16107



Some have already acquired specialized boilers for biomass, which burn stone without problems.

Separating the stone from the pomace reduces the biomass that oil producers have to dispose of, and composting the pomace is faster and simpler.

GRAPE POMACE

Pomace as a by-product of winemaking has a valuable raw material potential, and almost one hundred percent of the pomace can be used, and grape seed oil, grape seed flour, and skin flour can be produced from it. It is a valuable raw material for the production of biomass in the process of obtaining „clean“ energy. It is used as an organic fertilizer in gardens, olive groves and vineyards. Compost can be an excellent fertilizer because it contains nitrogen, phosphoric acid, potassium. It is suitable for improving soil structure. Grape pomace is also used to obtain biofuel because wine pomace is a good source of thermal energy. This mainly involves the production of pomace pellets. By burning wine pomace, there is no sulfur that affects environmental pollution and the formation of slag after burning, so a wider application of pomace is expected in the production industry of pellets, which are considered to be the energy source of the future. As an energy source, pellets are environmentally friendly and not expensive, so their production is safe and profitable in the long term. ⁸



Picture 1. Grape pomace, family winery Pervino ↑

LIVESTOCK PRODUCTION BIOMASS

The energy utilization of biomass from animal husbandry is significant for the production of biogas. Biogas can be used in the household for heating, cooking and lighting. The production of biogas from manure ensures the preservation of the environment and good technological solutions for the disposal of waste that is converted into usable energy. This way of processing waste reduces the cost of importing energy and petroleum products. There are several important roles of biogas, but the most important is that it represents a renewable source of energy. By producing biogas from cow and pig manure, farms can become producers of electricity and thermal energy, thus reducing the emission of greenhouse gases and preventing the release of methane into the atmosphere. Biogas can be considered an alternative fuel, because its production requires animal waste, which is in excess in agriculture.

Through the process of anaerobic fermentation in biogas plants, both solid and liquid residues are formed in the form of decomposed organic matter, i.e. digestate. Digestate, which contains useful ingredients, is a quality fertilizer obtained after aeration, squeezing and drying for several weeks. Its values are manifested in ecological, economic and

⁸ Gospodarski list, Compost from pomace of olives and grapes, <https://gospodarski.hr/rubrike/vinogradarstvo-rubrike/kompost-od-komine-grozda-i-maslina/>



agronomic terms. Applying digestate improves the level of humus in the soil and reduces the risk of soil erosion. Its advantage is also manifested in the maximum utilization of nutrients, high speed and lower costs of application, as well as improvement of soil pH and high microbiological activity. The energy utilization of biomass from animal husbandry is significant for the production of biogas. Biogas can be used in the household for heating, cooking and lighting. The production of biogas from manure ensures the preservation of the environment and good technological solutions for the disposal of waste that is converted into usable energy. This way of processing waste reduces the cost of importing energy



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Picture 2. An example of a biogas plant in Pisarovina ↑

AGRICULTURAL BIOMASS CROPS FOR ENERGY PRODUCTION ON SEPARATELY FORMED PLANTATIONS - MISCANTHUS

The energy possibility of using *Miscanthus x giganteus* is that it is mostly used as firewood, i.e. for co-combustion with coal and/or independent direct combustion for the production of heat and/or electricity. By using different compaction technologies, the produced biomass is refined into solid biofuels (briquettes and pellets) and after the briquetting/pelleting process, it can be used more efficiently for the production of „green energy“.

⁹ PRODUCTION OF BIOGAS FROM STAGE MANURE, <https://ips-konzalting.hr/blog/ips-novosti-8/post/proizvodnja-bioplina-iz-stajskog-gnoja-605>





GOOD EXAMPLE

Agrobioheat project (www.zez.coop/agrobioheat)

The AgroBioHeat project aims to initiate the mass implementation of improved and market-ready solutions for the use of agricultural (agrarian) biomass for heating in Europe. Agricultural biomass is a significant, insufficiently researched and locally available energy source, which can contribute to the achievement of European energy and climate goals, and at the same time promote rural development and circular economy.

OBJECTIVES:

- To increase agrobiomass for heating deployment accompanying 8 flagship projects and triggering more than 80 initiatives.
- To raise trust among stakeholders in agrobiomass heating solutions.
- To provide guidance and recommendations to policy makers at local, regional and national level to understand and set the instruments that will overcome the barriers for the advancement of the agrobiomass heating sector.
- To influence the review of the Ecodesign Regulation for solid biofuels boilers and the implementation of emissions limits for heating facilities of 500 kW to 1 MW.
- To understand the social acceptance factors and local specificities behind the success or hindering the development of agrobiomass heating solutions.
- To promote changes in the mind-set of the value chain actors and clusters as well as to empower them for the deployment of agrobiomass heating solutions.
- To enhance the competitiveness position of the European biomass heating solutions manufacturers and installers.
- To promote the visibility of agrobiomass heating to a large audience, including target and key actors as well as the general public.

WOOD CHIPS IN THE PRODUCTION OF ELECTRIC AND HEAT ENERGY

Wood chips can be used as fuel in boilers for the production of electricity and heat in houses and residential buildings, and therefore represents a more environmentally friendly alternative to fossil fuels. Wood chip heating equipment has been modernized, so the process of adding fuel to the boilers is easier, can be automated and adapted to the individual needs of the user.¹⁰



Picture 3. Wood chips as fuel in boilers →

¹⁰ Many faces of wood chips, <https://www.jutarnji.hr/domidizajn/d-d-vrt/mnoga-lica-drvne-sjecke-jeftina-i-pristupacna-sirovina-koju-mozete-koristiti-na-bezbroj-nacina-15046694>

WOOD CHOPS IN THE GARDEN AND AGRICULTURAL PRODUCTION

In addition to hobby garden decoration, wood chips also have their place in intensive agricultural production and are often present on areas that are managed according to the principles of ecological or regenerative agriculture.

In the case of a large previous weediness of the surface and consequently a large wealth of weed seeds in the soil, it would be good to put a barrier like cardboard under the wood chips that would prevent the penetration of light to the soil. Nevertheless, it can be expected that in the conditions of the garden where it is grown organically, due to the high microbiological activity, in two, and certainly three years, the wood chips will decompose so much that it will be difficult to recognize individual pieces of wood, it would be good in the garden reapply as needed to achieve adequate weed control. ¹¹

WOOD CHOPS AS FERTILIZER AND SOIL IMPROVEMENT

Some gardeners worry that wood chips could negatively affect the availability of nitrogen in the soil precisely because of the work of microorganisms that could use the nitrogen that should be available to plants for the development of their own organism. However, until the so-called nitrogen depression occurs when plant residues are plowed into the soil, and by imitating natural processes such as those in the forest, where leaf biomass is deposited in layers on the surface and animals and microorganisms in the soil bring it into deeper layers, it does not pose a threat to the successful cultivation of crops. That is why wood chips added to the surface of the soil are used as organic fertilizer, which microorganisms then break down and make nutrients available to plants. ¹²



Picture 4. Blue sheep brand from Krk whose products are made exclusively from wool ¹³ ↑

Wool waste - use of wool for washing and drying

- Using wool to create wool balls - the balls are used in the dryer to reduce drying time and save energy.
- Balls are dripped with essential oil to obtain scented laundry without fabric softener. Raising awareness and educating people to reduce waste and use ecological products.
- In addition to wool dryer balls, a wool car diffuser and an anti-stress ball with a lavender scent are also produced.

¹¹ Many faces of wood chips, <https://www.jutarnji.hr/domidizajn/d-d-vrt/mnoga-lica-drvne-sjecke-jeftina-i-pristupacna-sirovina-koju-mozete-koristiti-na-bezbroj-nacina-15046694>

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¹³ OPG Tohoraj, <https://opgtohoraj.com/pocetna/>

