Interreg CENTRAL EUROPE

Co-funded by the European Union

BIOECO-UP

BIOMASS AND ITS VALORIZATION

Adequate management of biomass has become a very important social challenge in recent years, and the bioeconomy itself is an important part of the country's economy today. Proper assessment of the availability of biomass in the country and the possibility of using it in the country's economy is becoming a key challenge for them. An important element of a proper bioeconomy is the skillful use of biomass resources and flows without sacrificing environmental or economic sustainability which may often not fully coincide (Camia A. et al., 2018).

SOURCES OF BIOMASS

Agriculture, forestry, fisheries and aquaculture, and algae are the main suppliers of biomass (Camia A. et al., 2018). Agricultural biomass is one of the most important biomass producing sectors. It provides valuable sources for the EU bioeconomy, producing an estimated 956 million tonnes (Mt) of agricultural biomass per year, of which 54% is primary (e.g. cereals, fruits, roots and tubers) and 46% is secondary products (e.g. leaves and stems).

Another important biomass producing sectors is forestry biomass. 38% of the EU's land area is covered by forests. Forests form a very large area that has high potential for biomass use. Forested area throughout Europe are very diverse by the multitude of tree species, differences in soil, climate or legal conditions in a particular area, so forest ecosystems in different areas cannot be evaluated equally. However, most forest area have high potential for woody biomass used in, for example bioenergy. One of the more commonly used wood biomass products is wood chips (Camia A. et al., 2018).

Biomass in EU countries is also very often obtained from residues from fishing and aquaculture. The fishing area has been an extremely important source of food for years, and thus also influences the country's economy and income. In 2014, the global per capita supply of fish was 20kg. Such a high supply of fish also generates a very large waste that can be used as biomass. (Camia A. et al., 2018)

CROPS AND CROP GROUPS

The total average agricultural biomass that was produced in the EU-28 in 2006-2015 was 956 Mt of dry matter per year, of which 54% was primary products (such as grains, fruits, roots, tubers) and 46% are secondary products (residue production). Cereals and plants harvested green are the main contributors to economic production in the EU, with a share of 50% and 30% respectively. While the residue production is dominated by cereals with a share of 74%, followed by oilseed crops which contribute 17%.

The total forest area of the EU-28 was 161 Mha in 2015, of which 84% (134 Mha) was considered to be FAWS (Forest Available for Wood Supply). Between 2000 and 2015, a significant increase in forest area was observed (413,000 ha per year), but this rate has slowed since 2010 (339,000 ha per year). The total AGB (Above Ground Biomass) of FAWS that was produced in the EU-28 in 2013 was estimated to be 16 000 Mt of dry weight, of which 68% is stemwood and 32% is other wood components.

Fisheries and aquaculture are also an important source of food, nutrition and income. In global terms, the EU is not a significant producer, accounting for only 3.2% of world production (6.8 Mt live weight). World fish production is mainly used for human nutrition (87%) and almost all the rest is used for non-food products. Fishery biomass can also be used for ornamental purposes, culture, bait, pharmaceutical uses and as raw material for direct feeding in aquaculture, livestock and fur animals. The majority of the total technical potential biomass in the EU comes from Denmark, the UK, Spain, France and the Netherlands, while the aquaculture production comes mainly from Spain, the UK, France, Italy and Greece.

FOOD WASTE

Food waste in the EU-27, which accounted for 30 Mtdm in 2018, comes from many sources, including household and food service consumption, processing and manufacturing, retail and distribution stages, and animal-based food waste at the production stage. The largest amounts of food waste are generated in countries with the largest populations, such as Germany, France, Italy, Spain, Poland and the Netherlands. 55% of food waste is destined for waste disposal, 19% for waste composting, 18% for waste anaerobic digestion and 8% for other uses such as home composting or pet food (Gurria et al., 2022). It is also possible to digest food residues for the production of biogas. FAME/HVO (Fatty Acid Methyl Ester/Hydrotreated Vegetable Oil) may be produced from discarded oilseeds, used cooking oil and animal fats. It is also possible to use waste water from washing vegetables, fruit, etc. for biogas or bioethanol production, but this is very costly.

https://roadmap2050.report/biofuels/biofuels-technologies/#2-3-3-industrial-and-municipal-wastes

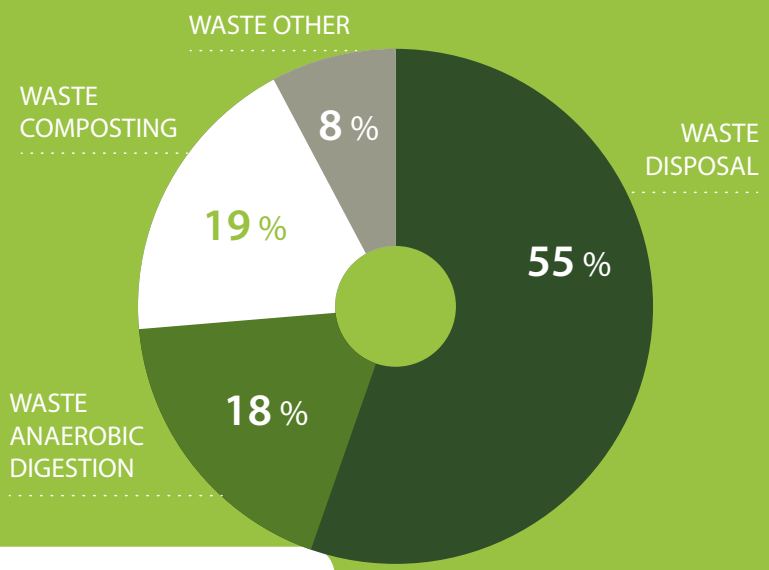


Figure 1. Food waste by destination (DataM, 2022)

Interreg CENTRAL EUROPE
Co-funded by the European Union
BIOECO-UP

EU BIOMASS FLOWS

The EU Biomass Flows tool is a visualisation of the results of a JRC-developed methodology for quantifying biomass and analysing its sources and uses. The tool presents the biomass flows for each sector of the bioeconomy in the form of Sankey diagrams. Agriculture, followed by forestry, is the largest producer of domestic biomass with 69% of the total and 31% of the dry matter content, respectively. Crop production is the main source of biomass in the agricultural sector, with biomass from grazing and residues from harvested crops. Most biomass is used for food and feed, almost all of which is of agricultural origin.

As the example, in Poland, 82% of the total agricultural biomass supply was used as food and feed, while 18% was used as plant-based food supply. The woody biomass is mostly use as biofuels (Gurria et al., 2022).

Biomass flows in 1000T of dry matter for EU-27 based on latest available data (agriculture – year 2020, fisheries and aquaculture – year 2016 and forestry – year 2017) are shown in Figure 1. Production is the sum of domestic biomass production from agriculture, aquaculture and forestry. It includes all types of biomass (e.g. main product, co-products and by-products, residues, etc.) and some recovered or recycled biomass (e.g. post-consumer wood). Supply is the sum of available biomass, including both domestic production and imports. Most biomass is used for food and feed purposes, with the remainder used to produce energy and materials for non-food and non-energy purposes. Net exports are the sum of agricultural biomass exports. Food waste includes food waste from all stages: primary production, processing and manufacturing, retail and distribution and, consumption.

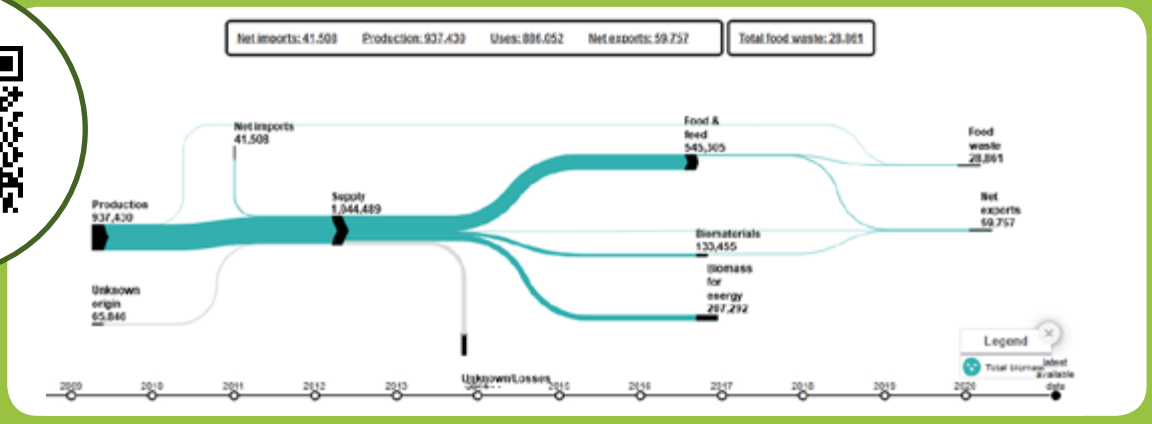


Figure. 2 *Biomass flows in 1000T of dry matter for EU-27 based on latest available data (agriculture - 2020 year, fisheries and aquaculture - 2016 year and forestry - 2017 year) https://datam.jrc.ec.europa.eu/datam/mashup/BIOMASS_FLOWS/index.html*

SOCIO-ECONOMIC INSIGHTS

In 2015, the bioeconomy employed 18 million people in the EU, while 7.4 million people were employed in this sector in the BIOEAST countries. Most bioeconomy jobs are created in agriculture and in food, beverages and tobacco. It is estimated that the BIOEAST countries account for 9% of the turnover and 9.5% of the value added of the EU bio-economy, with Poland being the main contributor (Ronzon et al., 2018).

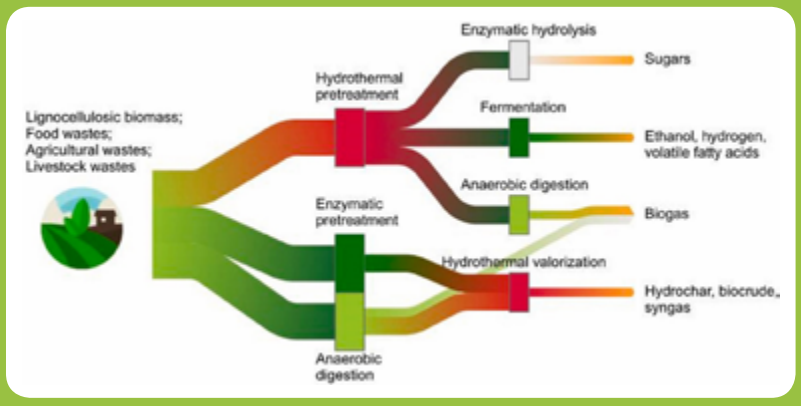
BIOREFINERIES

The use of biorefineries to produce bioenergy from agro-industrial biomass residues can be a solution for sustainable energy supply combined with greenhouse gas (GHG) emission reduction. Due to their versatility than focusing on the production of a single product, biorefineries can generate multiple products (i.e. fuels, animal feed, electricity, heat or nutrients). Thanks to their broad spectrum, biorafineries appear to be a very good alternative to conventional methods due to which the output product is only one (Tonini D. et al., 2015).

BIOMASS FOR ENERGY

Biomass, derived from organic material such as trees, plants and agricultural and urban waste, is an important renewable energy source in the EU. It is mainly uses for heating and cooling sector. Forestry is the most important source of biomass used for energy, but agricultural crops represent the largest source used to produce biofuels. There are three main categories of bioenergy provided by agriculture: biogas, biodiesel and bioethanol. Bioethanol is produced by yeast fermentation of sugar and starchy crops (mainly EU cereals and sugarbeet). Vegetable oils and animal fats are the raw materials used to make biodiesel. In EU, almost half of biogas is made from agricultural crops, crop residues, and animal manure.

BIOMASS VALORIZATION



A combination of both hydrothermal and biological techniques can be used for biomass valortization for lignocellulosic biomass (Figure 3), food wastes, agricultural wastes and livestock wastes pretreatment for biomass valorization. Hydrothermal pretreatment (such as hydrothermal conditions, catalysts, solvents) followed by subsequent enzymatic hydrolysis, fermentation, anaerobic digestion (AD) or composting for production of sugar monomers, alcohols, volatile fatty acids (VFAs), biogas and fertilizers. Biological techniques (such as enzymatic pretreatment, anaerobic digestion) followed by hydrothermal valorization for the production of biochar, biocrude or syngas (Song et al., 2021). Biomass can be traded and distributed as it is produced (e.g. exporting apples). It may also be processed into intermediate products to achieve the highest possible added value (Figure 4).

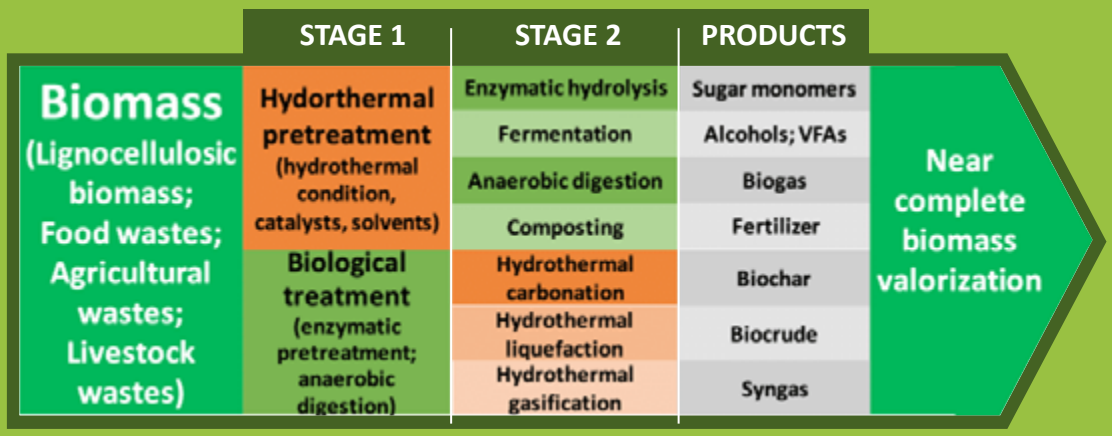
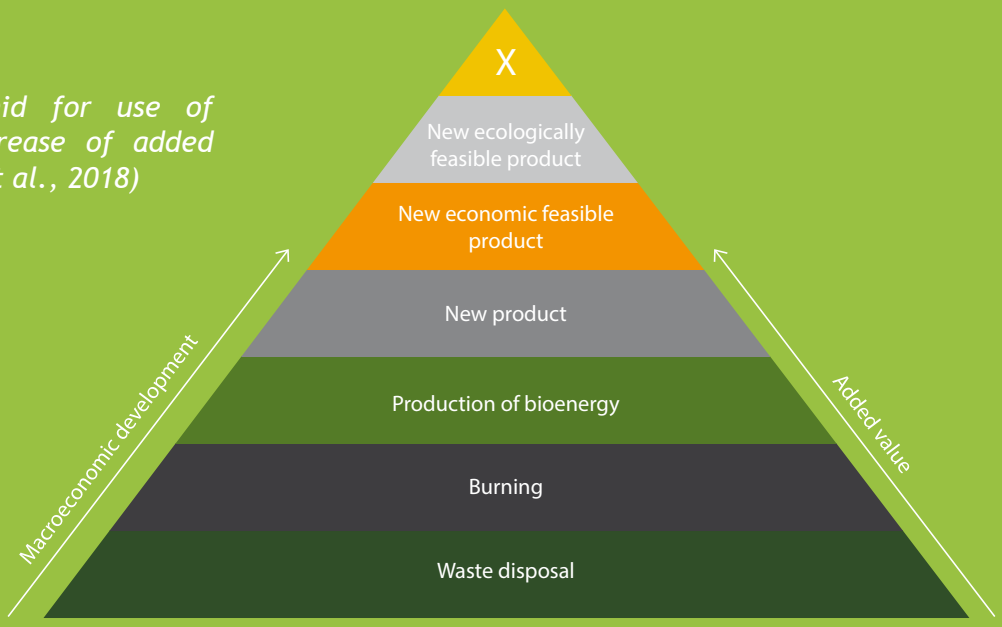


Figure 3. Schematic representation of biomass valorisation using hydrothermal and biological treatment techniques (Song et al., 2021).

Interreg CENTRAL EUROPE
Co-funded by the European Union
BIOECO-UP

Figure 4. *Pyramid for use of biomass with increase of added value (Gravelins et al., 2018)*



X - New product: environmentaly and climate friendly, socioeconomic and economic feasible

Source: A. Gravelins, 2018. Biotechonomy for agriculture sector: a system dynamics model

SUSTAINABILITY OF BIOMASS

Increased use of biomass in the EU can contribute to the diversification of Europe's energy supply, the creation of growth and jobs and the reduction of greenhouse gas emissions. In order to achieve the goal of reducing greenhouse gas emissions, biomass has to be produced and processed in a sustainable way. At each stage of biomass production, from growing the feedstock to final energy conversion, different suitability challenges need to be addressed. All biofuels and bioliquids consumed in the EU must meet sustainability criteria. The sustainability criteria include large-scale biomass for heat and electricity, agricultural waste and residues, forest biomass, new biofuel plants and bioelectricity.

SOURCES:

Garcia Condado, S., Lopez Lozano, R., Van Der Velde, M., Lusser, M., Sanchez Lopez, J., Klinkenberg, M., Avraamides, M., Camia, A., 2018. Brief on agricultural biomass production. Luxembourg (Luxembourg). https://doi.org/10.2760/142177 (online),10.2760/96290 (print)

Gurria, P., Gonzalez Hermoso, H., Cazzaniga, N., Gediminas Jasinevicius, G., Mubareka, S., De Laurentiis, V., Caldeira, C., Sala, S., Ronchetti, G., Guillén, J., 2022. EU Biomass Flows. Publ. Off. EU Luxemb.

Ronzon, T., Gurria, P., Parisi, C., Philippidis, G., M'Barek, R., 2018. Socio-economic insights into the bioeconomy in BIOEAST countries. Res. Brief Eur. Comm.-Jt. Res. Cent. Seville.

Song, B., Lin, R., Lam, C.H., Wu, H., Tsui, T.-H., Yu, Y., 2021. Recent advances and challenges of inter-disciplinary biomass valorization by integrating hydrothermal and biological techniques. Renew. Sustain. Energy Rev. 135, 110370.

Camia, A., Robert, N., Jonsson, K., Pilli, R., Garcia Condado, S., Lopez Lozano, R., Van Der Velde, M., Ronzon, T., Gurria Albusac, P., M`barek, R., Tamosiunas, S., Fiore, G., Dos Santos Fernandes De Araujo, R., Hoepffner, N., Marelli, L. and Giuntoli, J., Biomass production, supply, uses and flows in the European Union: First results from an integrated assessment, EUR 28993 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-77236-8 (print),978-92-79-77237-5 (pdf), doi:10.2760/539520 (online),10.2760/181536 (print), JRC109869

Tonini, D., Hamelin, L. and Astrup, T.F. (2016), Environmental implications of the use of agro-industrial residues for biorefineries: application of a deterministic model for indirect land-use changes. GCB Bioenergy, 8: 690-706.

https://doi.org/10.1111/gcbb.12290

https://energy.ec.europa.eu/topics/renewable-energy/bioenergy/biomass_en

https://agriculture.ec.europa.eu/sustainability/economic-sustainability/bioeconomy_en

Interreg CENTRAL EUROPE

Co-funded by the European Union

BIOECO-UP