National Action Plan for the Development of Bio-economy in Hungary

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Key points for bioeconomy in the Hungary

Bioeconomy in Hungary is at initial stage of development.

Hungary is rich in biomass resources, high expertise and good education in biomass, forestry and waste management skills. Biomass production/harvesting/collection is a challenge.

There is good potential in local arrangements and regulations as they can influence access and ownership rights to lands where biomass resources are available.

A key issue apart from the availability of the feedstock is the mobilisation of biomass and the role of land managers' willingness and capabilities is critical.

Opportunities mainly relate to the increase of public support for the use of biomass and more employment in this sector.

Bioeconomy must be considered with its complexity exploitable potential, environmental and economic point of view. Main utilization is for energy purposes in the country, however more complex utilization must be considered.

Within the value chains different the highest ecological risks can be anticipated without sustainable practices in agricultural residues, because of high biodiversity loss when harvesting too many crop residues.

The main considerations are flexibility, cost effective policy support and sustainability and enhanced connection and communication between stakeholders. Improvement of interest level of small-scale investors.

1. Introduction

The aim of the report is to present a set of specific, attainable, relevant biobased value chains and time-based Action Plan for the development of bioeconomy in Hungary. The work has capitalised on the findings of the work in CELEBIO[1] and is structured in four sections.

The first presents the current state of bioeconomy, discusses the country's comparative strengths and opportunities, and provides an overview of the existing policy regime per value chain stage (i.e. biomass production, conversion, distribution, end use).

The second introduces the Bioeconomy Vision, the value chains selected by national stakeholders and outlines how they fit to the three main priorities[2] from the 2018 Update of the European Bioeconomy Strategy[3]:

- Strengthen and scale-up the bio-based sectors, unlock investments and markets
- Deploy local bioeconomies rapidly across Hungary
- Understand the ecological boundaries of the bioeconomy

The third provides facts tailored to each value chain in terms of current exploitation of biomass raw materials, future actions that could steer innovative and resource efficient market uptake for biobased products, potential interventions and expected added value. This information has resulted from the consultation with national stakeholders within the duration of the project. This section also includes information on the relevance to the UN Strategic Development Goals (SDGs), selected relevant projects and markets for the biobased products that will derive from each value chain.

Finally, the fourth part provides an implementation plan, jointly developed with stakeholders, which includes time specific goals for reaching the Vision.

[1] https://celebio.eu/wp-content/uploads/2020/07/Hungary-Country-Report.pdf
[2] https://ec.europa.eu/research/bioeconomy/pdf/bioeconomy_line_actions.pdf#view=fit&pagemode=none
[3] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018DC0673&from=EN

2. Bioeconomy in Hungary

Current state

Bioeconomy in Hungary had an annual turnover of thirty billion Euros in 2017 which translates to 80,000 Euros per person employed in the sector with the EU27 average figure being 127,000 Euros.

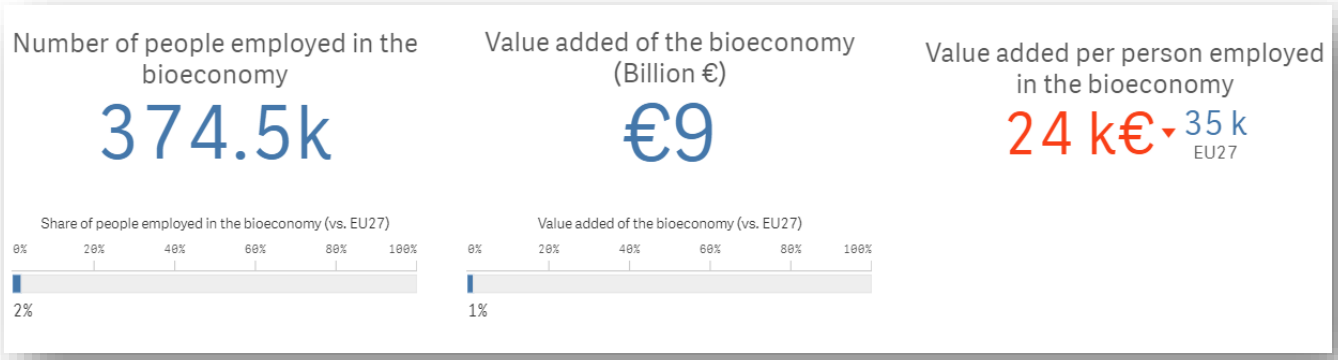


Figure 1 Jobs and wealth in the Hungarian bioeconomy (source: datam.jrc.ec.europa.eu)

The value added from the bioeconomy sector in the country was nine billion Euros and in the same year there were 374,500 people employed.

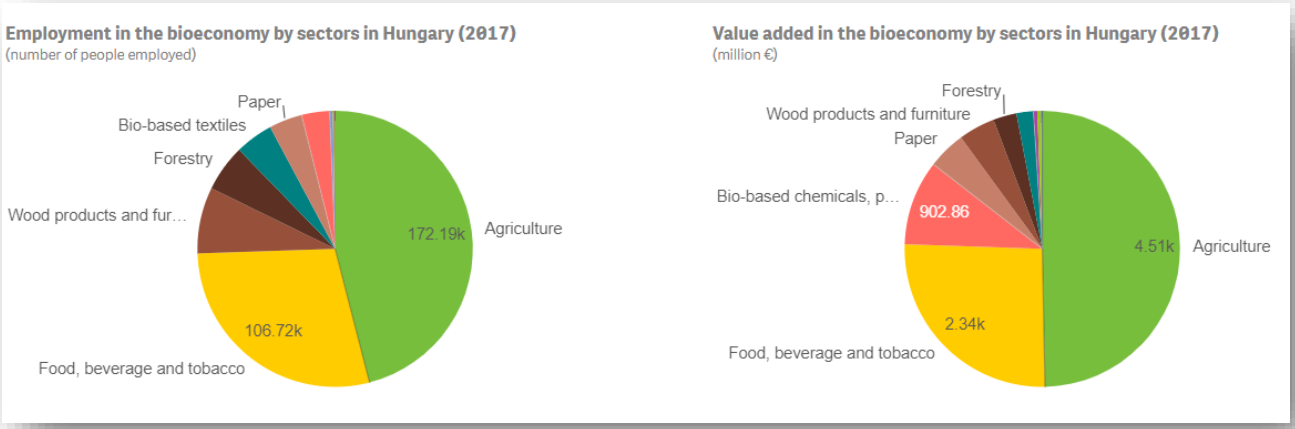


Figure 2 Employment and value added in the bioeconomy by sectors in Hungary in 2017 (source: datam.jrc.ec.europa.eu)

Agriculture remains the biggest sector in terms of employment (46% of the total number of people employed) with food, beverage, and tobacco following with similar share (28.5%). In terms of value-added agriculture leads with 4.51 million Euros and food, beverage and tobacco follow with 2.34 million Euros. Biobased chemicals and products have a turnover of approximately 1 million Euros annually.

Strengths, opportunities and barriers

	• Regularly higher amounts of cellulose-based raw material (20 mio t/year) • Oil plants are on 0,9 mio ha- the crop and byproducts of crop could also be used for biodiesel • Semi- Warm-demanding plant species may also be involved in the production in extensive areas (e.g. Sorghum species) for bio-ethanol • Secondary biomass of livestock means 5-6 mio t manure • Feedstock price is low by cereal production with low quality • There are biogas industries in the country • High expertise regarding to using biomass (e.g. biogas) • There are worker training and engineer education in biomass skills • There are labors where MSZ EN ISO 17025:2005 standard used for analyzation of biomass • There are research projects of biomass sector at the universities and research institutes • A lot of employment opportunities Investors in biomass-processing: poultry farms, biogas-industries • Own biomass processing by livestock-farmsto risk minimization	• Public support for the use of biomass • Discount on fuel oil tax on vegetable oil • There are official regulations for productions and the market • Clarified legal and ownership system • Low rates of loan (good CAPEX possibility)	• General organic matter deficiency in soils • Increased imports of biodiesel into the EU due to tariff -it can influence the economical sustainability • The product range is scarce, only the biomass used • for heating is widely known Just on a few areas of land is infrastructure available • Transport are mostly on route in Hungary, tariffs of cargo are relatively high in the country • Additional land use might lead to in- direct land use changes, in worst case to deforestations • Low price of biomass-based energy 0,1 Eur/kWh- (OPEX min.0,13 kFh)
	• New Forestry Act (potential of forest residues for energy purposes) • The volume of green trees increased continuously • Regularly higher amounts of raw material (3-4 mio t/year) • There are wood-based industries with high capacity in the country (300-360 MVH/year (Ajka, Pécs, Dorog) • High expertise regarding in using biomass • There are worker training and engineer education in forestry skills • There are laboratories (MSZ EN ISO 17025:2005 standard) for analyzation of biomass • There are research projects of biomass-sector at the universities and research institutes • Forestry biomass boilers available in the market • Clarified legal and ownership system	• Public support for the use of biomass • Stable internal market • Available regulations for productions and the market • Reduces soil erosion • More employment opportunities • Low interest rates of loan (good CAPEX possibility)	• Biomass is competitive with other sectors • Investor interested in biggest investments • General organic matter deficiency in soils • Infrastructure are available just a few areas of land (Biomass-industries and depos) • Transport are mostly on route in Hungary, tariffs of cargo are high in country • Additional land use might lead to in- direct land use changes, in worst case to deforestations • Low price of biomass-based energy in valuechange 0,1 Eur/kWh-(OPEX min.0,13 kFh)
	• Well-organised solid communal waste collection • Infrastructure are available most areas of land (Biomass-industries and depos) • Collection of hazardous household waste Collection of green household waste • Container supply is also organized for individuals and industry. • There are waste incinerators throughout the country (24) • Both civil society and business organizations are becoming increasingly aware of need for waste separation at source and separated collection and waste management	• Developing integrated waste management through national and EU financing. • Developing the waste utilization industry • The waste management sector has become a public organization	• Biomass is s competitor with other sectors • Increased transportation costs can occur due to rising fuel prices • In Hungary 67% of the waste is in landfill. • Infrastructure are available just a few areas of land (Biomass-industries and depos) • Low price of biomass-based energy in value-change 0,1 Eur/kWh-(OPEX min.0,13 kFh)

Policy mechanisms relevant to bioeconomy in Hungary

The following table summarizes the relevant bioeconomy related policy mechanism.

	Production	Conversion	Distribution	End-use
Agriculture, Forest, Waste	CAP: Rural Development Programmes			
	Carpathian Convention	Operational Programme Environment and Energy (KEOP)		
	Nitrate Forest Act Forest Strategy	Hungary's first National Environmental Technology Innovation Strategy (NETIS) National Forest Strategy (NES)		
	Act expropriation - National Land Fund	Act on Sustainable biofuels; Biofuel quota		
	Waste Management Act National waste management plan 2014-2020			Excise duty Territorial and Settlement Development Operational Programme (TOP) Competitive Central Hungarian Operational Programme (CCHOP)
				Act on the sustainability criteria and certification for biofuels and liquid bio-energy carriers; Biofuel Quota
			Training programme for RES Installers	
			RES-H building obligations Certification programmes for RES Installation	
	Decree on Air protection Environmental Protection Act BIOEAST (H2020 RUR-2019-1) Vision for 2030 and Action Plan.			
	The National Energy Strategy 2030 (NES 2030) The National Climate Change Strategy 2018-2030; Food Industry Program if Hungary 2016-2050 The Second National Climate Change Strategy (2018-2050) National Renewable Energy Action Plan 2010-2020 transposes EU Directive 2009/28/EC The National Strategy of Biodiversity (2015-2020)			

Figure 3 Policy mechanisms relevant to bioeconomy in Hungary (green: regulations; blue: financing; beige: information provision)

3. Vision and implementation plan

Vision for sustainable and circular bio- economy.

The actors of the biomass sector (raw material producers, biomass users) cooperate on the basis of common interests, in a stimulating and supportive economic environment, in order to make sustainable and efficient use of the special agro-ecological potential of the Carpathian Basin.

Research and innovation performance in agriculture, aquaculture, forestry and the food industry in the EU's Central and Eastern European Member States lags far behind that of Western European countries. Regions that perform poorly in research and development find it difficult to exploit their potential for excellence, face obstacles in establishing transnational collaborations, and are less able to lobby for their specific research topics. Bridging the gap can be facilitated by addressing the specific challenges of the sector within a biomass-based economy. To this end, the biomass-based economy must be equipped with an appropriate strategy, a strategic research and innovation framework, considering the following details:

- Reconciling economic growth and job creation with economic sustainability.
- Value creation, application of biotechnology, research and commercialization of technology.
- Development of integrated production systems and high-quality products with a territorial identity.
- Development of agricultural, food and municipal waste management, development of mechanization of biomass treatment.
- Utilization of the capacity of the existing power plants suitable for biomass utilization, increasing and expanding their efficiency.
- Exploiting the human and infrastructural potential of research and development in Hungary, connecting science and the market.
- Ecological sustainability, biodiversity, preservation of ecosystems, avoidance of soil degradation.
- Conversion and development of biological resources, optimized land use, involvement of less-favored areas in biofuel production, expansion and use of biomass-based resources, identification of "best practice", dissemination of circular and self-sustaining production methods.

Socio-technical visions are important element in innovation and transformation processes, especially for complex new and emerging technologies and for the transformation of well-established large socio-technical systems.

Effective communication and coordination, addressing actors is key element. Broadening Portfolio of Research and Competing Value Chains is also important.

Strengthen and scale-up the bio-based sectors, unlock investments and markets

This section focuses the Hungarian Action Plan on value chains selected by national stakeholders as promising ones that have significant potential for market uptake of domestic raw materials and are suitable to foster innovation for the existing industrial infrastructure.

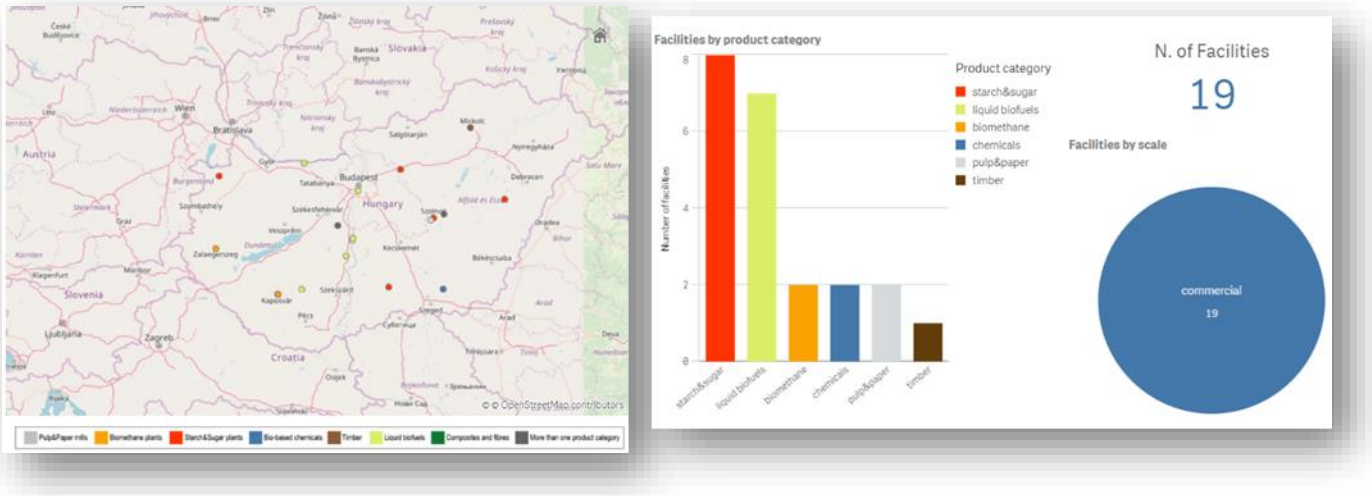


Figure 4 Biorefineries in Hungary (source: https://datam.jrc.ec.europa.eu/datam/mashup/BIOBASED_INDUSTRY/index.html)

Figure 4 Biorefineries in Provides and overview of the biorefineries in Hungary. There are currently nineteen commercial facilities operating in the country within the starch and sugar, liquid biofuels, biomethane, chemicals, pulp and paper and timber.

CELEBIO has also engaged with national stakeholders to understand their perspectives of the Hungarian bioeconomy and select value chains with strong potential to uptake indigenous raw materials, foster the development of innovative products and contribute to the development of Hungarian bioeconomy.

Deploy local bioeconomies rapidly across Hungary

The value chains mentioned in this section and selected by national stakeholders fit well the regional distribution of biomass raw materials across Hungary.

Value chains from agriculture

In 2019, 3.2 million tons of biomass were used for energy purposes in Hungary, of which 123.4 thousand tons were imported. (Source: NAIK-AKI)

There are currently 26 operating and 7 non-operating power plants operating for electricity and heating. In the case of non-operating power plants and heating plants, production stopped because the boilers were shut down due to expensive raw materials and a mild winter. Of the biomass generated in agriculture, the use of sunflower husks and grain straw was the most common, at 7.7 and 7.3 percent, respectively. Other raw materials accounted for 21.9 percent. Agricultural products and paper waste contributed 11.7 percent to energy production.

The use of agriculture residues for bioenergy today include mainly straw (bales or bundles) or agro-pellets produced from straw and other agricultural residues such as sunflower husks. The figure shows the total agricultural residues potential including permanent crops too. The value chain fits to the regional distribution.

In the case of biogas plants, there were 35 operating and 8 non-operating. The main raw materials for biogas production are agricultural products with 56.1 % (632.3 thousand tons), of which 86.9 % were animal manure. The second most important raw material group is manufacturing raw materials with 37.7 % (435.8 thousand tons), of which 11.5 % were spirits by-products in 2019[4].

The use of biomass raw materials used for renewable electricity generation decreased from 54% to 48% between 2014 and 2018, while the biomass production capacity of agriculture did not change. The use of rapeseed straw or grape seed is not typical either, partly due to the lack of mechanical capacity at the producers, partly due to the lack of compaction technology suitable for the automatic feeding of the biomass plant. Addressing these shortcomings will require significant investment, the design and efficient operation of which will depend on the amount of raw material available and the distance from the place of use.

The value chains selected by the national stakeholders are:

Unused potential of cereal straw – straw residues for electricity
Corn stover for biofuel

[4] http://repo.aki.gov.hu/3581/1/Statisztikai%20Jelentes%20Biomassza%20felhaszn%C3%A1l%C3%A1s.pdf

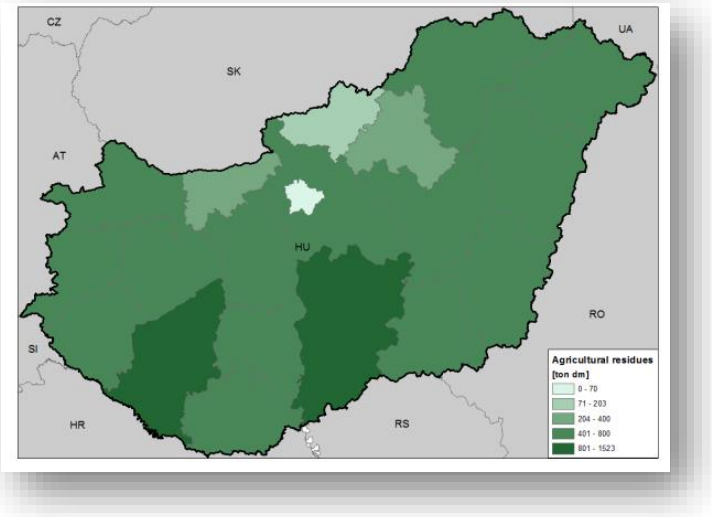


Figure 5 Total primary residual biomass potential from agriculture in ton d.m/year (S2Biom Base 2020 potential)

Value chains from forestry

The official supervision of forest planning and management is performed by the Forestry Directorates of the County Government Offices. The most significant part of Hungary's forestry performance is in state-owned forest areas. State forest areas are typically managed by forestry companies (22 companies) and a smaller part by other state organizations.

The importance of community-owned forest areas is much smaller than that of public and private forest areas. Managers of community-owned forest areas can typically be municipalities, churches, foundations, associations, forest managers belonging to other sectors. Private forest areas are of similar importance to state-owned forests. To date, there are a number of regulatory, ownership, expertise, and technology deficiencies associated with the management of private forests.

For forestry activities, the law requires compliance with the criteria of so-called sustainable forest management. Extraction can be carried out by different methods depending on the different topographic conditions and species composition.

Sources of wood and wood chips are mainly concentrated in forestry areas (South-West, North and East Hungary). The trade in wood chips with neighbouring countries is significant. A very significant amount of wood chips arrives in Hungary from Slovakia, Romania, Ukraine and Croatia for fiber and energy use. Austria is a significant buyer in Transdanubia due to the high price of electricity produced using renewable energy sources and the demand for raw materials from pelletizing facilities. Significant sources of wood chips are still available in the region covered by forests in the Northern Great Plain. The chips available in this area had previously moved towards Kazincbarcika (closed) and Vásárosnamény (closed).

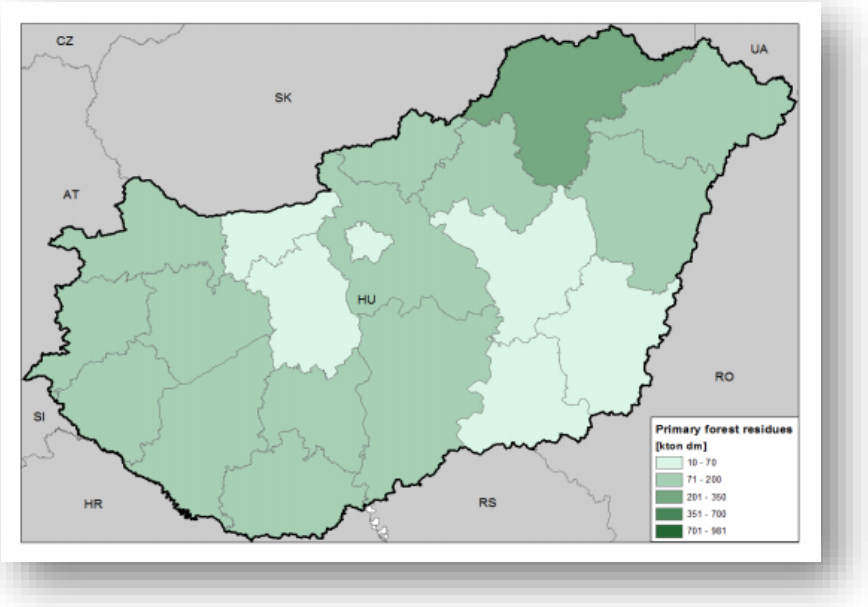
Currently, the most important domestic recipients of energy-utilized forest biomass products, such as wood chips and other firewood assortments, are chipboard factories, the population, power plants and heating plants.

The particle board and fibreboard mills (Falco, KRONOSPAN-MOFA) purchase a total of about 1.1 million tons of firewood, fiber wood and bulk goods annually. The use of cylindrical firewood is dominated by household consumption, which according to the CSO data accounts for 71% of the total use of firewood (approximately 2 million m3). Thermal power plants buy 22% of the firewood and the remaining 7% is exported.

The small size of wood waste is fiber and chip wood, paper wood and firewood. Forestry extracts and classifies wood waste and then sells it according to market demand. The wood industry / wood fiber, fibreboard and pulp production / and the firewood market, and secondarily the energy sector (heating and power plant wood chips market) also compete for wood waste.

The value chains selected by the national stakeholders are:

According to the information registered in the National Forestry Database, in 2006, at the beginning of the National Forest Program cycle, one fifth or 19.9% of Hungary's territory was covered by forests. By the end of 2014, the country's forest cover reached 20.8 percent, which is 1,939,263 hectares. The country's total forest management area is 2,059,678 hectares, or 22.1 percent. Most of the forest area (89%) is occupied by deciduous species, with acacia (24%) and oak (21%) accounting for the largest share. 63 percent of the forests are indigenous, and 37 percent are non-native species or breeds. Due to the afforestation, the forest area of Hungary has increased further in the last ten years. Spontaneous



afforestation of unused agricultural land also contributes to this.

Figure 6: Distribution of primary residues potential from forests Kton d.m (S2Biom Base 2020 potential)

In the forest sector stemwood, primary residues and secondary residues from forest industries are available. For bioenergy and bio-material potential assessment we particularly focus on availability of primary and secondary residues as stemwood conversion to energy is not the most resource efficient and therefore preferable use.

Primary forestry production accounts for an additional 4.8 mio dry tonnes / year. Estimated sustainable potential can reach up to 6.3 mio dry tonnes/ year.

Value chains from biowastes

The proportion of communal waste that is disposed in Hungary still close to 50%, and that of industrial waste is less than 50%. On average in the European Union, the proportion of communal waste is deposited below 30%, with a decreasing trend. In order to comply with circular management and the waste hierarchy, the EU intends to reduce the amount of deposited waste, which has also been set as a goal in Hungary's long-term strategic ideas.

Waste analysis carried out in several different settlements showed that in Hungary the proportion of paper in waste is 20-25%, that of plastics and composites 8-10%, that of textiles 3-5%, that of metals 2-5%, while that of decomposing organic matter reaches 30-50%. It is not possible to separate a coarse fraction from the crude waste by sieving directly, which is a finished fuel product or a part of it, as the decomposing biomaterial content is> 20%. Biodegradable organic matter must be stabilized for both manageability and deposition. Aerobic biostabilization is best suited for this[5].

On July 1, 2020, the elimination of illegal landfills will begin. From then on, a waste management authority will also be set up, which will be responsible, among other things, for supervising the waste management sector. They radically transform the system of using plastic bottles, metal cans and bottles, allowing them to be replaced.

The biodegradable fraction of municipal solid waste falls within the definition of biomass according to the EC Directive. The utilization of biomass with the help of waste incineration plants is therefore a waste recovery activity and the energy produced is renewable energy. (According to the International Energy Agency, 50% of the energy produced in an incinerator can be considered as renewable energy for both heat and electricity.)

To deploy bioeconomy in Hungarian forestry the following actions must take place[6]:

- creation of new energy facilities,
- conversion-modernization-expansion of existing recovery facilities,
- strengthening the regulatory-support side of recovery
- rethinking KÁT-METÁR (mandatory energy transfer price),
- support for "green / brown" electricity generation,
- an increase in the landing levy,
- social acceptance of waste as a renewable resource
- the intention to provide central support,

The value chains selected by the national stakeholders are:

Communal waste for recycling plants

[5] lib.unideb.hu 2FIJEMS%%% 2Farticle 2Fdownload% 2F4991% 2F4734 & USG = AOvVaw1-c2x2kkBnLLtnMZ687oHK
[6] https://www.eszk.org/attachments/l321/ea/szilard_hulladekok_eloadas_eszk.pdf

Hungary has recently introduced major waste sector reforms. A state-owned company called the National Waste Management Coordination and Asset Management Company (NHKV - Nemzeti Hulladékgazdálkodási Koordináló és Vagyonkezelő Zrt.) has been coordinating and overseeing the delivery of waste services at local level since 2016. NHKV is responsible for distributing waste fees to the relevant operators and also for selling recyclable materials, supervising infrastructure spending and the use of EU funds.

Municipal waste is the most important type of waste generated by the consumption of society with the consequent increase in the standard of living. One of the most important constituents of municipal waste is packaging waste, whose volume, weight and proportion are also constantly increasing.

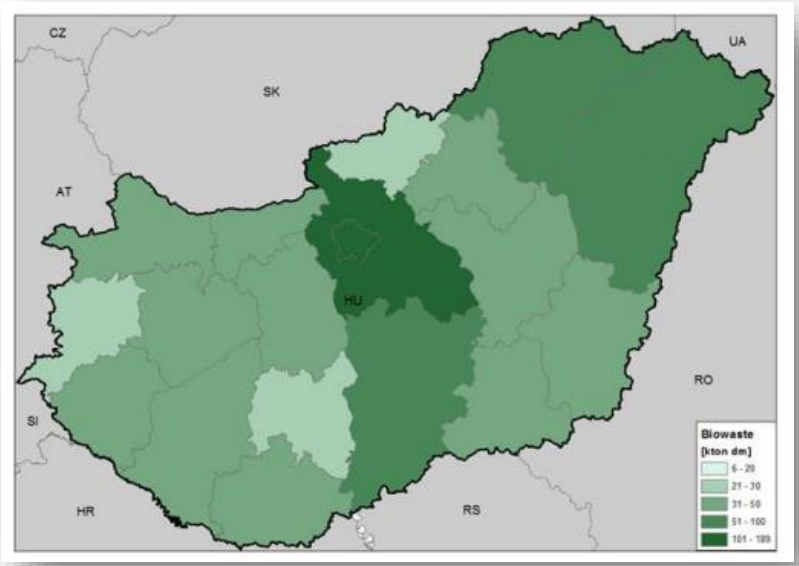


Figure 7 Distribution of total bio waste potential over country Kton d.m (S2Biom Base 2020 potential)

Understand the ecological boundaries of the bioeconomy

Land use change

Land use is related to raw material production. Emissions from land use change can be significant in some circumstances, however, the simple notion of land use change emissions is not sufficient reason to exclude biomass from the list of worthwhile technologies for climate change mitigation, bioeconomy and circular economy.
The value chains selected for the Hungarian bioeconomy comprise mainly of residual and waste fractions so there is no risk expected from their mobilisation and future exploitation.

Biodiversity

Forest biomass: moderate risks can be anticipated. Loss of dead wood and stumps may negatively influence species diversity and soil fauna. Contrary to this, leaving them all on the ground may result in increased fertilisation (N and wood ash) and negative impacts on vegetation

Agricultural biomass: High risks can be anticipated without sustainable practices, because of high Biodiversity loss when harvesting too many crop residues
Absence of fertilisation with animal manure would reduce microbiological activity

Biowastes: Positive in regions where it avoids landfill

Soil & Carbon stock

Forest biomass: Increased risk of soil erosion; risk to lose soil organic carbon; risk to lose nutrients and risk of reduced soil fertility and soil structure when overharvesting forest residues
There are debates that using the wood in panel boards, creates a carbon stock in comparison to combustion of the wood

Agricultural biomass: Moderate risk to lose soil organic carbon when overharvesting crop residues; risk to loose nutrients when overharvesting
Absence of fertilisation with animal manure would reduce soil organic matter and soil nutrients,
Reduction of soil organic matter and soil nutrients

Biowastes: Positive in regions where it avoids landfill;
Digested organic waste is a source of soil improving material.

Water

Forest biomass: No effect on the quantity; If no removal leads to increased fertilisation the leaching on N to water may increase

Agricultural biomass: Reduction of soil water retention capacity, increasing risk of water erosion
Reduction of soil water retention capacity due to lower microbiological activity

Biowastes: Lower risk of water pollution in regions where it avoids landfill

Air pollution

Forest and wood processing biomass: Burning wood increases CO2 emission. Utilizing wood processing industry residues as a fuel results greater air pollution, this represents increased risks.

Sustainability risks from the exploitation of biomass raw materials for bioeconomy in Hungary (red: high risk; yellow: moderate risk; green: no/ positive impact)

Feedstock		Sustainability risks (high- red; moderate- yellow; low- green)				
		Land use (iLUC risk)	Biodiversity	Soil & Carbon stock	Water	air pollution
Primary forestry production	Stemwood from thinnings & final fellings	None	Loss of dead wood and stumps may negatively influence species diversity and soil fauna. Contrary to this, leaving them all on the ground may result in increased fertilisation (N and wood ash) and negative impacts on vegetation	Increased risk of soil erosion; risk to loose soil organic carbon; risk to loose nutrients and risk of reduced soil fertility and soil structure when overharvesting forest residues	No effect on the quantity; If no removal leads to increased fertilisation the leaching on N to water may increase.	Burning wood increases the CO2 content of the air
Primary forestry production	Stem and crown biomass from early thinnings					
Primary forestry residues	Logging residues from final fellings					
Secondary residues from wood industries	Saw mill residues	None	None	There are debates that using the wood in panel boards, creates a carbon stock in comparison to combustion of the wood	None	Non-uniform quality wood waste as a fuel results in greater air pollution
Secondary residues from wood industries	Other wood processing industry residues					
Agricultural residues	Straw/stubbles	None	Biodiversity loss when harvesting too many crop residues. This may also have adverse effect on soil biodiversity	Moderate risk to loose soil organic carbon when overharvesting crop residues; risk to loose nutrients when overharvesting	None	none
Secondary residues of industry utilising agricultural products	By-products and residues from food and fruit processing industry	None	None	Less organic matter returned to the fields	None	none
Biodegradable municipal waste	Biodegradable waste	None	Positive in regions where it avoids landfill	Positive in regions where it avoids landfill; Digested organic waste is a source of soil improving material.	Lower risk of water pollution in regions where it avoids landfill	none

4. Value chains for the Hungarian bioeconomy

The third provides facts tailored to each value chain in terms of current exploitation of raw materials, future actions that could steer innovative and resource efficient market uptake for biobased products, potential interventions and expected added value. This information has resulted from the consultation with national stakeholders within the duration of the project. This section includes information on the relevance to the UN Strategic Development Goals (SDGs), selected relevant projects and markets for the biobased products that will derive from each value chain.

Agriculture

Main aim of the selected value chains is to:

- Support livestock and crop production; Involvement of rural citizens in rural development
- Exploit high straw residue potential; Local food processing industries offer opportunities as the negative balance of food export and import is growing

Forestry

Main aim of the selected value chains is to:

- Development of rural business activities by mobilising new value chains in the context of circular economy

-New legislation divide State and non-state forests and makes access to funds from state easier (?)

-Research and Innovation activities towards higher added value products from forest biomass and to increase the share of RES

Wastes

Main aim of the selected value chains is to:

-Increase efficiency of waste recovery methods in municipalities

Straw for biobased products, heating and as a fuel & corn stover for biofuel

Value chain	SDGs	Examples of relevant projects
Straw for heating and as a fuel		Optisochem Web site http://optisochem.eu/
Corn stover for biofuel		EXCornSEED Web site https://www.excornseed.eu/

Current exploitation of biomass raw materials

- There is a well-developed practice to utilise a considerable portion of the straw from harvested crops and use it in horticulture and livestock breeding.
- Low-level of utilisation of agro residuals for biogas and electricity production.

Future actions

- Promotion the efficient, sustainable use of available natural resources respecting ecological burdens
- Optimise the efficient use of straw
- Displace fossil-based resources in the agri-food supply chain
- Support for machinery and storage facilities for biomass harvesting
- Support for sustainable farming (fertilization in the areas concerned). Development of grant applications

Potential interventions

- Extension of regulatory and funding instruments of the Ministry of agriculture and food for rural areas for the bioeconomy.
- Further development of technologies for the conversion of straw to higher value products

Expected added value

- Securing the supply of raw materials for a sustainable circular bioeconomy and exploiting future-oriented opportunities for creating added value and employment in rural areas.
- Contribution to the reduction of greenhouse gasses and other pollution environmental, social, economic benefits

Product Group	Market size
Agro-chemicals Fertilisers	M 1,000 – 10,000 kt
Sustainable Energy	L >10,000 kt

Forest based value chains

Value chain	SDGs	Examples of relevant projects
Dendromass for electricity and heat		

Current exploitation of biomass raw materials

- Dominating publicly owned pattern - large share of state ownership of the forest is a good prerequisite for sustainable management
- A long tradition in forest management, uniform forest management system
- Availability of 10-years local/regional forest plans, good planning of biomass flow balance,

Future actions

- Development of Regional action plans for utilisation of forest biomass
- Establishment of regional/local biomass logistic centres
- Promotion of efficient and effective biomass generation and bioeconomic value creation chain trough digital options in the areas of forestry
- Wide campaign for replacement of old inefficient stoves with alternative efficient heating devices based on modern wooden biofuels and bio-heat
- Developing suitable concepts for harvest, decentralised processing, logistics and warehousing, minimizing post-harvest losses, and ensuring that biomass quality is maintained during storage and processing.
- Integration of R&D activities related to paper industry waste into Regional Innovation Centres for clean technologies in the field of circular bioeconomy

Potential interventions

- Forest Certification
- Introduce innovation financing for food SMEs and industries
- Regulation on forest raw materials for bioeconomy

Expected added value

- Increase sustainable utilisation of biomass
- Reduction of air pollution, including PM10 and PM2,5
- Decrease of energy poverty

Product Group	Market size Europe
Cosmetics Paints & coatings	S <1,000 kt
Plant based-chemicals	M 1,000 – 10,000 kt
Sustainable Energy	L >10,000 kt

Value chains based on biowastes

Value chain	SDGs	Examples of relevant projects
Communal waste for recycling plants		B-Ferst Web site https://bferst.eu/ ; DEEP PURPLE Web site http://deep-purple.eu/ ; PERCAL Web site http://www.percal-project.eu
Communal waste for electricity and heat		

Current exploitation of biomass raw materials

More than a hundred companies in Hungary are engaged in the recycling of waste, and large investments have been made in Hungary. The share of separately collected waste in total quantity increased from 22% in 2011 to 23% in 2016, while the volume (846 thousand tons) increased by 9 thousand tons. This is due to the collection method in a separate door to large-scale spread.

Future actions

- Acceleration of introduction of end of waste legislation to facilitate utilisation of some of biowastes
- Stimulate the turning of bio-waste, residues, and discards into valuable resources

Potential interventions

- Incentives for the use of waste for biogas production (subsidies) and fostering the development of clean and renewable energy production. This could include penalties and rewards for energy production, depending on their environmental impact.
- National wide recycling and waste separation campaign and implementation of this type of education in the schools.

Expected added value

- Increased use of urban/municipal waste, cleaner energy, reduced environmental impact, potential to improve revenue of all stakeholders
- Efficient system of urban waste collection, improvements possible in higher share of energy utilisation (biogas)
- New opportunities for eco-construction options in integration of renewable energy

Product Group	Market size Europe
Cosmetics Paints & coatings	S <1,000 kt
Plant based-chemicals Fertilisers	M 1,000 – 10,000 kt
Sustainable Energy	L >10,000 kt

5. Implementation plan

	2020	2025	2030
Technology	Waste prevention is achieved, hazardousness of the generated waste is reduced. Development of waste recycling (plastic, metal, organic), agricultural and dendromass row material tecnology (harvesting, logistic, processing)	Regional logistics systems, mechanization, storage, preparation for use in power plants and for recycling, constant quality of raw materials Organised regional waste and bio-based Plant industry	Waste/plant industry network in country and with neighboring countries (Recycling 60 % of the communal waste) The efficiency of the power plants is optimal The use of biomass for district heating is doubled
Environment	Diverse, sustainable crop rotations include high-mass biomass crops, direct energy crops in rudimentary areas The afforestation program will continue	The degradation of rudimentary areas and the pollution of waste incineration are reduced The use of fossil fuels is decreasing, the amount of green energy produced is increasing. Afforestation is 23 % of the country area	Environmentally friendly, productive land use Afforestation is on the ecological optimum (27 % of the country area Hazardous waste (eg manure pollution) is neutralized during green energy production
Economy	Sustainable biomass management for stakeholders in agriculture and forestry Positive discrimination for the biofuel tax	Investor groups for regional logistics centers with appropriate technical equipment for communal biomass collection and degradable waste in agrar sector, food and feed industry and forestry	Maximizing of the capacity of biomass power plants, reintegration of non-operating power plants Less tax on biofuels-less price Price premium for biomass-based energy
Society	Raising awareness of the need for biomass recirculation Separately collected biowaste Avoid the use of non-degradable materials	State and civil initiatives, active local groups to raise awareness of environmental awareness and local biomass management opportunities Sensitization strategies in education for sustainable organic matter management Biomass management is part of vocational training	Applying environmental management to everyday life Preference for products made from recycled materials Requiring sustainability certifications from the consumer side as well
Policy	Utilization plan in line with regional biomass potential, encouraging integration into energy systems Encouraged sectoral cooperation between actors in biomass value chains	Specific action plans to reduce the non-degradable waste emissions in certain sectors and to build sustainable energy management systems Encouraging regionalism based on the type and potential of biomass	Sustainability certifications by raw materials and energy in industry 30% increase in bioenergy consumption (Hungarian Climate and Energy Plan)

Txt

Actors and funding opportunities

Action[7]	Actors involved	Indicative cost	Funding instruments
Development of waste recycling, agricultural and forest biomass technology (harvesting, logistic, processing) (T)		2020-2025: 20 million € 2025- 2030: 40 million €	Territorial and Settlement Development Operational Programme (TOP) Competitive Central Hungarian Operational Programme (CCHOP)
Regional logistics systems (T)		2025- 2030: 20 milion €	Next Generation EU Action Plan on financing sustainable growth
Diverse, sustainable crop rotations include high-mass biomass crops, direct energy crops in rudimentary areas The afforestation program will continue (Env)		2020-2025: 20 milion €	Action Plan on financing sustainable growth CAP
Less tax on biofuels-less price Price premium for biomass-based energy (Econ)		2020-2030: 10 milion €	Auction-based green premium subsidy scheme
State and civil initiatives, active local groups to raise awareness of environmental awareness and local biomass management opportunities (S)		2020-2030: 5 milion €	Action Plan on financing sustainable growth
Based on the regional priorities (smart specialisation), develop thematically oriented financial vehicles to invest in demonstration and flagship projects, such as biotech funds. (P)		2020-2030: 1 milion €	Action Plan on financing sustainable growth
Stimulate EU and international co-operation. Remove regulatory obstacles to share pilot facilities with other regions to scale up investments in bio-economy (example Smart Pilot) (P)		2020-2030: 10 milion €	Action Plan on financing sustainable growth

[7] T: Technology; Env: Environment; Econ: Economy; S: Society; P: Policy

6. Potential socio- economic impact of Hungarian Bioeconomy Action Plan

 **JOBS**	Create 3,000 new jobs in agriculture, forestry and food processing industry
 **LEVERAGE INVESTMENTS**	Leverage 100 million € private investments within ten years
 **FOSTER COLLABORATIONS**	Cluster creation At least twenty new collaborations between raw material providers and industrial actors
 **BOOST INNOVATION**	Eight new biobased value chains embedded in agriculture, food, and forest industries. Produce ten new patents and IP rights, Support the creation of ten spin-offs and start-ups.

7. Potential environmental impact of Hungarian Bioeconomy Action Plan

	Reduce emissions in food industry by 25% Reduce emissions in agriculture by 30%
	Contribute to the sustainable management of natural resources and foster efficient water use. Support a circular and sustainable bioeconomy in Europe.
	Biodiversity
	Local resources for products, energy and fuels