



CEE2ACT

**Empowering Central and
Eastern European Countries to Develop
Bioeconomy Strategies and Action Plans**

D6.3 National Roadmap for Hungary



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DOCUMENT HISTORY

V	Date	Author	Significant changes
1	17.10.2024	Luke / AK	Document created
2	28.02.2025	Peter Bori	Draft roadmap finalized and submitted to Geonardo Ltd.
3	06.03.2025	GEO team: Maria Rosell, Dániel Ganszky, Dóra Leitner, Dalma Versitz	Revised draft
4	13.05.2025	Peter Bori	Revised draft
5	26.01.2026	GEO team: Dániel Ganszky, Dóra Leitner, Dalma Versitz	Revised draft based on three deep interviews with relevant stakeholders





EXECUTIVE SUMMARY

The multiple crises facing society today demand a new approach to economic, social, and cultural organization. Our current economic model—based on linear growth and unrestricted resource use—both contributes to and fails to address the challenges of climate change, food and water scarcity, population growth, and broader environmental degradation.

Circular bioeconomy offers a viable alternative. It transitions resource use from non-renewable fossil-based energy sources to regenerated biomass, keeping resources at their highest value for as long as possible through cascading biomass use and recycling, while preserving natural capital.

Countries worldwide are developing and implementing bioeconomy strategies. However, Central and Eastern European nations lag behind and have yet to establish comprehensive bioeconomy strategies. CEE2ACT aims to support countries in this region as they develop national strategies on circular bioeconomy through innovative governance models.

Using a bottom-up, cross-country collaborative approach, the objective is to achieve better-informed decision-making, stronger societal engagement, and greater innovation in these national contexts. This Roadmap provides a practical yet forward-looking strategy for Hungary, developed through CEE2ACT workshops, cross-border collaborations, and expert contributions.

Drawing on previous CEE2ACT project results, input from national stakeholders (including the Ministry of Agriculture, research institutes such as ÖMKi and Bay Zoltán, industrial players in the biogas and biomass sectors, and civil society organizations), an international site visit, and consultations by project partners, six strategic areas were identified for development in the Hungarian context:

- Biomass for Energy (Solid, Liquid and Gas)
- Sustainable Agriculture
- Sustainable Forestry
- Waste Valorisation
- Nature Tourism
- Sustainable Healthy Diets

This is not an exhaustive list. While the Roadmap prioritizes these six areas as most viable for immediate progress, the bioeconomy encompasses a broader range of sectors—including bio-based materials, biochemicals, and bio-based textiles—which merit further exploration and expansion.

Each area presents specific opportunities alongside distinct challenges and risks. This report details these factors and provides 35 concrete Actions that stakeholders across the bioeconomy value chain can implement. The report also outlines Short-term (2025–2027), Medium-term (2027–2030), and Long-term (2030 and beyond) steps to advance the bioeconomy transition. Beyond specific legislative, economic, and cultural measures, the Roadmap proposes Monitoring Mechanisms and Digital Knowledge Sharing Tools to enable cross-border collaboration and help avoid common pitfalls. The Roadmap seeks to generate momentum across political, economic, and societal spheres, contributing to an ecosystem that supports a flourishing bioeconomy in Hungary and the broader CEE region.



ACKNOWLEDGEMENTS

This National Bioeconomy Roadmap was developed by Geonardo Environmental Ltd. within the framework of the CEE2ACT project. It is the result of a collaborative process, building upon the collective intelligence and inputs of Hungarian bioeconomy stakeholders gathered during the CEE2ACT national workshop series. We would like to extend our special gratitude to the following experts for their detailed review and strategic guidance: Rita Soós, Department for Agricultural Modernization, Ministry of Agriculture (Agrárminisztérium, Agrármodernizációs Főosztály); Amb. Dr. Barbara Wassen, PhD, Ambassador at large for Climate, Secretariat of Circular Economy and Climate Policy, Ministry of Energy (Energiaügyi Minisztérium, Klímaügyekért és Klímadiplomáciáért Felelős Utazó Nagykövet, Körforgásos Gazdaságért és Klímapolitikáért felelős Államtitkárság); and Dr. Nóra Hatvani, Researcher, Project & Research Manager, Bay Zoltán Research Centre.

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Background

Ambition of CEE2ACT project

We are living in an age of multiple crises, where climate change, ecosystem degradation, food insecurity, population growth, and rising demands for food and energy require a transition to new ways of producing and consuming.

More immediate crises, such as the war in Ukraine and related disruptions to value chains, energy supplies, and prices for both producers and consumers, are placing additional pressure on national economies. These challenges underscore the urgent need for systemic change away from our current linear economic model.

A circular bioeconomy is essential to such a transition, offering a sustainable economic model that shifts resource use from non-renewable fossil-based energy sources to regenerated biomass. While bioeconomy initiatives are proliferating globally, Central and Eastern European countries currently lag behind other European nations in developing national strategies that enable the transition to a circular bioeconomy.

CEE2ACT was established to support Central and Eastern European countries in developing comprehensive national circular bioeconomy strategies through innovative governance models. Using a bottom-up, cross-country collaborative approach, the project aims to achieve better informed decision making, stronger societal engagement, and enhanced innovation in these national contexts.

A central element of CEE2ACT is the establishment of National Bioeconomy Hubs, which bring together key stakeholders from industry, government, research, and civil society. These Hubs serve as spaces where knowledge and best practices can be shared, enabling stakeholders to collectively develop national strategies and action plans. In Hungary, the Hungarian Bioeconomy Forum fulfills this role alongside the National Bioeconomy Hubs in other CEE2ACT target countries.

This document presents the outcome of these processes: a National Bioeconomy Roadmap specifically for Hungary. It draws on consultations with bioeconomy stakeholders conducted by project partners, CEE2ACT national and international events including a visit to Wageningen University, national workshops, and information gathered at external events attended by GEO representatives. It also incorporates desk research conducted by bioeconomy experts.

This Roadmap presents our vision for a Hungarian bioeconomy and is structured as follows. The first chapter briefly outlines the CEE2ACT project, defines the bioeconomy, and provides a baseline assessment of the current state of the Hungarian bioeconomy. The second chapter presents an overall vision and formulates strategic focus areas that balance forward looking ambition with realistic, achievable goals. The Roadmap then provides more detailed, concrete steps in an Action Plan. The report also outlines the main evaluation and monitoring tools and processes required, and concludes with a discussion on implementation.



What is the bioeconomy?

According to the official European Union definition, the bioeconomy covers all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles. It includes and interlinks: land and marine ecosystems and the services they provide; all primary production sectors that use and produce biological resources (agriculture, forestry, fisheries and aquaculture); and all economic and industrial sectors that use biological resources and processes to produce food, feed, bio-based products, energy and services (European Commission, 2018). In the CEE2ACT project, refers to an economy that relies on renewable, natural resources from all parts of the ecosphere in a sustainable manner to produce food and feed, pulp and paper, wood and wood products, as well as other biobased products and bioenergy (including biofuels). This includes the circular use of organic residues and waste (BOKU, 2023).

More specifically, the bioeconomy can be divided into five parts that form its systems: ecosystems, primary production, processing (processes and products), use, and end-of-life. Ecosystems include terrestrial, freshwater and marine ecosystems and the services they provide. Primary production involves all sectors that use and produce biological resources as agriculture, forestry, fisheries, aquaculture, and other sources including insects, algae, yeasts, fungi and microorganism. Processing consists of all economic and industrial sectors that use biological resources and processes (e.g. biorefinery and ecosystem services) to produce food, feed, wood, wood products and furniture, bioenergy (including fuels) and other bio-based products (chemicals, fibres, pharmaceuticals, bio-polymer). Use related to the society and end-of-life refers to organic residues and waste (BOKU, 2023; European Commission, 2018).

In CEE2ACT, we think beyond simply the bioeconomy and envision a circular bioeconomy, which aims to keep resources at their highest value for as long as possible through cascading biomass use and recycling, while ensuring that natural capital is preserved (De Schoenmakere et al, 2018). Therefore, there is a significant focus in circular bioeconomy on the sustainable and resource-efficient valorisation of biomass in integrated, multi-output value chains, complemented by the use of waste, residues, and by-products, as well as the optimization of biomass value over time.

In the Hungarian context, the concept of bioeconomy (or 'biomassza alapú gazdaság') follows much the same definition as described above, but national scientific circles generally prefer to talk of a 'biomass-based economy' (Oláh, 2023). According to this understanding, a biomass-based economy focuses on the efficient exploitation of the organic carbon source of biomass, including all soil- and sea-based biological materials. Sources of biomass can be primary (directly from the resource); secondary (derived from the processing of the primary resource); or tertiary (derived from waste products) (ibid).



Current state of bioeconomy

A number of initiatives can act as building blocks and warrant an optimistic outlook in Hungary, despite the fact that the country lags behind other European countries in developing a sustainable bioeconomy. The following baseline assessment briefly outlines the current state of the bioeconomy in three broad categories: **Political Support and Governance, Economy, and Active Stakeholders.**

Political Support and Governance

Experts interviewed as part of the CEE2ACT project have indicated that Hungary is in the process of developing a broader National Bioeconomy Strategy as is also shown at the Bioeconomy Country Dashboard, Knowledge Centre for Bioeconomy (European Commission, 2025). This follows from a strategic bioeconomy concept paper published in the framework of the BIOEASTsUP project (2019-2023). The aim of the paper was to serve as a basis for a cross-sectoral and multidisciplinary dialogue on sustainability issues within biomass-related sectors. In 2023, an active effort was made to introduce the concept paper to interested parties, including universities, businesses, farmers, investors, as well as representatives of different bio-based sectors. This took place through several in-person and online workshops and info days. Experts have also noted that there was a close cooperation between organisers of the Circular Economy Technology Platform (CETP) – Circular Hungary and the Prime Minister’s Office, the latter of which was responsible for the elaboration of a national circular economy strategy with support from the OECD. The Circular Economy Strategy was published in March 2023 and in part focused on the circularity of biomass (OECD, 2023).

Over the last decade, Hungary has seen a reorganisation of its environmental governance framework, involving changes to the structure and roles of institutions responsible for environmental management. In response to the European Union’s increasing emphasis on the Green Transition, recent years have seen a renewed policy focus in Hungary on expanding renewable energy production and storage infrastructure. Electrification plays a key role in advancing a sustainable and circular bioeconomy; nevertheless, recent analyses (Wu, 2024) highlight potential environmental, financial, and long-term sustainability risks associated with current investment patterns. Strengthening institutional and policy support frameworks for the bioeconomy, with an integrated approach to sustainability, will be essential to ensure coherence with long-term development objectives.

The prospect of a comprehensive National Bioeconomy Strategy is promising, but it must align with the rapidly evolving European context. This includes the upcoming EU Biotech and Biomanufacturing Strategy (expected in 2025) and the Tech Act (2026), which will position the region for a new wave of industrial innovation, supported by the emerging Biotech HUBs.

Stakeholders warn that the current governance structure is insufficient for such a systemic transition. While the Ministry of Agriculture acts as the primary strategic thinker, it is operationally subordinated to the Common Agricultural Policy (CAP), which often limits its ability to drive a cross-sectoral bioeconomy that transcends agriculture. Policy fragmentation remains a critical barrier, with over 30 different strategies touching upon biomass usage without a unified vision.

To resolve this, experts strongly recommend the establishment of a Sustainable Development Coordination Body (or a dedicated State Secretariat) within the central administration. Unlike a



single ministry, this body would possess the overarching authority to vet investments and harmonize policies across the Ministries of Energy, Innovation, and Agriculture, ensuring that sectoral logic does not stifle the broader bioeconomy potential.

Economic - Overall

Hungary is a structurally dependent economy with a relatively strong manufacturing sector that performs above the EU average. At the same time, its spending on Research and Development is generally small and below the EU average, which presents challenges for the country's transition to a bioeconomy. According to data by the European Commission, JRC and BioReg, in 2020 the bioeconomy of Hungary was worth over €9.6 billion. Given that Hungary's GDP in the same year was approximately €155 billion, the bioeconomy roughly contributed 6.2% to the country's total GDP. In addition, the bioeconomy employed over 374.500 individuals (Bio-based Industries Consortium, 2024). These numbers are slightly above the regional averages, with Poland's bioeconomy contributing 4.1 %, Czechia's 2.6% and Slovakia's 3.1% to the respective country's GDP (Lakner et al., 2021).

Lazorcakove et al (2022) calculated that the proportion of Hungary's total Gross Value Added (GVA) coming from the bioeconomy is approximately 10.19%, while all revenue coming from bioeconomy-related activities (total production share) is approximately 12.29%. The authors also attempt to forecast the potential future contribution of the bioeconomy to the value of total production and argue that in the V4 region Hungary has one of the highest potential shares (18.94%). According to Lazorcakove et al this is due to the country's 'stronger position of primary biological resources in their total economic output' (ibid).

Broken down by specific sectors, the two economic areas contributing most to Hungary's total bioeconomy turnover are the broad categories of Agriculture and Food, Beverage, Tobacco, followed by Bio-based chemicals and materials; Pulp and Paper; Wood, wood products and furniture; Forestry; Bio-based textiles; Liquid Biofuels and finally Bio-based Electricity (European Commission, 2025).

Agriculture, Forestry and Fisheries

Agriculture contributes approximately 3.5% to Hungary's GDP. Despite this fairly small share of the overall Hungarian economy, it is a crucial part of the bioeconomy. With more than 4.3 million hectares of arable land and permanent crops, agricultural lands make up more than half of the country's territory. The country's main agricultural outputs are wheat, corn, oilseeds, as well as planting seeds and horticultural products. In addition, Hungary has a sizeable animal husbandry sector mainly focusing on pigs, poultry and cattle (ITA, 2024). A majority of the country's agriculture is dominated by traditional monocropping, with only about 6% of arable land being under organic cultivation (Fontos, 2024). The country's pesticide usage is moderate compared to EU standards but has steadily increased until 2021 and – apart from a brief decline due to shortages induced by the war in Ukraine – has remained steady in recent years (The Global Economy, 2022). There are ambitions at the government level to promote organic farming, and the National Action Plan for Supporting Organic Farming aims to achieve 10% organic cultivation of all Hungarian arable lands. In addition, there are promising new waves of alternative farming practices and communities emerging across the country, but they face significant economic and policy bottlenecks (Tudatos Vásárlók Egyesülete, 2023).



Forests cover 20.9% of the country's territory with approximately 1.95 million hectares of woodlands (KSH, 2022). Almost half of these forests are protected, while the remaining areas are used for fuelwood (53.6%), sawlogs and veneer logs (18.2%) and pulpwood (16.8%) (Bio-Based Industries Consortium, 2024). However, inadequate forest protection policies and climatic challenges are threatening forest health, requiring more focused policy attention on improving forest management practices (Zsuppán, 2025). Experts warn that while statistical data shows an increasing forest ratio, this potential must be weighed against growing biological risks. The sector faces rising threats from invasive species and pests, exacerbated by climate change and drought. Therefore, simply increasing forest cover is insufficient; the strategy must focus on resilience and ecosystem health, not just surface area.

A further challenge identified by stakeholders is the historical legacy of Hungarian forests. Many forest stocks were planted in the 1950s specifically for soil protection (e.g., sand binding) rather than timber production. However, current regulations often force these "protective forests" to meet economic profitability targets (timber extraction) that they were never designed to sustain. This paradox degrades the forest's primary ecological function. Future policy must distinguish between "Production Forests" and "Soil Protection Forests," exempting the latter from rigid timber profitability pressures.

Hungary also has a small freshwater aquaculture sector that accounts for 0.03% of the GDP and produces approximately 22.000 tonnes of produce worth €29 million (European Commission, 2016).

Energy (biomass)

Hungary's current energy mix relies heavily of fossil-based sources. In 2023 oil and natural gas contributed 32.3% and 30.8% respectively, while nuclear energy contributed 18.3% to the country's total energy supply. Nevertheless, there is a slow, but steady growth in using renewable energy sources (geothermal, wind, solar) (3.9%) moreover, biofuels and waste (11%) (IEA, 2023). The latest available data from 2020 shows that there are at least 50 biogas industries in the country and existing expertise on utilising biomass (Buday et al, 2020). Agricultural products (including animal manure) and manufacturing raw materials (including spirit by-products) comprised the main raw materials from biogas production. There is little publicly available data on the exact amount of biofuel production facilities, but several large players and commercial biorefineries exist in the country, most often using starch and sugar processing, liquid biofuels, biomethane, chemicals, pulp and paper, and timber (Buday et al, 2020).

In addition to the country's agricultural sector and underutilised waste management processes (see below), Hungary is uniquely positioned in the region for its vast and largely untapped geothermal energy potential. Currently more than 5% of renewable energy in the country originates from geothermal sources (CEE2ACT, 2023).

Utilisable Waste

Waste is an integral part of the bioeconomy and is inseparable of most relevant bioeconomy sectors. Valorising organic waste, food waste, crop residues, liquid manure and a variety of different waste sources is crucial for developing biorefineries and the bio-based industry in general. The most relevant types of waste for a circular bioeconomy are agricultural and forestry biomass and organic wastes (OW) (Mahjoub and Domscheit, 2020). According to the European Environment Agency, since 2012 there is an overall decreasing trend in waste generation in Hungary and the per capita waste generation remains under the EU average (403 kg per capita



compared to the EU average of 517 kg) (EEA, 2023). That being said, research conducted by Farkas et al. (2023) highlights that at least 5.8% of annual waste produced in Hungary comes from the crop and animal farming sector (290.000 tons) and the food industry (421.000 tons). Almost 90% of farm-based waste is liquid manure, while a majority of the remaining 10% comes from animal tissues. The fact that at least 4 of the 100 largest waste-producing companies are situated in the agri-business sector highlights the fact that a significant restructuring is needed in the way farm waste is utilised.

In terms of food waste, the National Food Chain Safety Office (NÉBIH) estimates that Hungarians produce approximately 1.8 million tons of food waste per year, translating to 68 kg of food waste per capita (EEA, 2023, NÉBIH, 2023). It is slightly more challenging to identify what share is exactly lost at what stage of the value chain. According to NÉBIH (2023), about a quarter of food waste originates from households, which aligns with earlier findings by Bori (2018), who claims that approximately 62% of food is wasted during production and processing, while 38% is attributed to household consumption and retail activities. Project Wasteless (2023) conducts regular food waste measurement studies and in their latest report conclude that at least 25.80% of household food waste is avoidable, while 4.35% is potentially avoidable. NÉBIH (2023) is slightly more optimistic and argues that at least half of this waste is completely avoidable.

Active Stakeholders

An important part of the baseline assessment is assessing the currently active stakeholders in the country's bioeconomy sector. The Ministry of Agriculture is the main governmental actor driving the bioeconomy policy and decision-making process in Hungary as well as establishing strategic cooperation among local, national and international actors, and identifying strategic focus on Hungarian agriculture and bioeconomy as well as supporting research and development and innovation.

There are also a number of public and academic entities working on bioeconomy initiatives. This includes the Hungarian Bioeconomy Cluster (Bay Zoltán Research Institute), the HUN-REN Centre for Agricultural Research, the University of Art and Design in Budapest, the Bioeconomy Research Group at MATE University, the Hungarian Innovation Agency, the Research Institute of Organic Agriculture (ÖMKi),

The members of the Hungarian Bioeconomy Forum (HBF) include the above-mentioned organizations, the National Biomethane-Biogas Green Energy Industry Union, the Regional Centre for Information and Scientific Development (RCISD), and the FAO, are also active in the bioeconomy sphere. In the civil society sector notable stakeholders include WWF, the HUMUSZ Association, the Hungarian Association of Environmental Enterprises and CEEweb for Biodiversity, which are also part of the HBF.

As mentioned earlier, there are a number of active bioenergy plants in the country. For instance, Hungrana Bioeconomy Company and Pannoniabiobio belong to the country's largest bioethanol producers. In addition, Bácsvíz Water Management, Pilze-Nagy Kft (mushroom composting and biogas), Bioreaction.tech (biotechnology startup), Smapp Lab (digital insect monitoring for agriculture) and Biopolus (urban metabolic hubs) are also important private actors partaking in the bioeconomy.



Intertwined with many of these actors, BIOEAST (and its subsequent BIOEASTsUP continuation) plays an important role in developing knowledge-based agriculture, aquaculture, and forestry within the bioeconomy.

Main takeaways

Political Support and Governance

- Hungary is developing a National Bioeconomy Strategy, building on previous BIOEASTsUP initiatives and stakeholder consultations
- Despite past reductions in environmental governance capacity, recent developments – such as the Circular Economy Strategy – signal renewed commitment to solve sustainability challenges

Economy

- Hungary's bioeconomy contributes approximately 6.2% of GDP and employs over 374.000 people, outperforming regional peers, yet remains constrained by low R&D investment
- The agricultural sector is a key bioeconomy pillar, but is dominated by monoculture and low organic farming
- Hungary possesses significant underutilized biomass, forestry, and geothermal resources, with growing infrastructure in biogas, biofuels, and biorefineries
- The national energy mix remains heavily reliant on fossil fuels, but there is an increase in bio-based energy production
- Waste from agriculture and food processing is substantial; improving organic waste valorisation and reducing avoidable food waste represent major bioeconomy opportunities

Stakeholders

- The Ministry of Agriculture is the lead policy actor, alongside several research institutes and civil society organisations
- Key public, academic, and private stakeholders are organized under the Hungarian Bioeconomy Forum
- Innovative companies in bioethanol, biogas, biotech, and sustainable agriculture are emerging actors in the sector



Our vision of bioeconomy and strategic goals

The vision for this Roadmap is simple: to facilitate a realistic, well-planned and well-monitored transition towards a circular bioeconomy in Hungary. The bioeconomy covers a wide range of subsectors, ranging from fungi farming through multi-feedstock biorefineries to sustainable buildings (for a full list, see [CEE2ACT D2.3 report on Sustainability Assessment of Bioeconomy Concepts](#)). While in an ideal setting, most of these subsectors are addressed, a realistic roadmap should focus on sectors most viable for change and development. As such, we have limited the focus of the Roadmap to a number of key areas, listed below. In the following sections, we outline in detail the basis for selecting each of these categories. We then provide concrete actions to achieve innovation within the sectors, followed by listing the relevant actors required for the transition. The section closes with a detailed Timeline, indicated short-term (2025-2027), medium-term (2027-2030) and long-term (2030 and beyond) ambitions.

Strategic goals and focus areas

Selecting what strategic sectors this report should focus on was the result of a careful consultation process. This includes in-depth interviews with experts, organising stakeholder workshops, drawing on BIOEAST working groups and complementing this with academic research using internal and external expertise. The six sectors listed below were selected based on criteria deeming them *most viable for progress*, with viability encompassing probable support from the government, private sector and society, as well as broader economic incentives enhancing investments.

1. Biomass for Energy (solid, liquid and gaseous)
2. Sustainable Agriculture
3. Sustainable Forestry
4. Waste Valorization
5. Nature Tourism
6. Sustainable Healthy Diets

While we have identified these six sectors as most viable for progress, we also recognise that there are other sectors that are still in their infancy but would be worth focusing on in the long-term. The chapter after this moves on to explain the specific challenges related to these sectors and suggest specific actions to be undertaken to further integrate them into the bioeconomy.

Biomass for Energy (Solid, Liquid and Gaseous)

As explained in the Baseline Assessment, biomass is an important part of Hungary's renewable energy landscape and has significant potential for development. However, stakeholders emphasize that this development must adhere strictly to the cascading principle, where energy generation is the final step in the value chain rather than the primary focus. To avoid an inverted pyramid where high-quality resources are burned inefficiently, energy use should be prioritized for waste valorisation only after higher value material uses have been exhausted. It aims to achieve part of this decarbonisation by utilising biomass and tripling biogas production (both in individual heating units and in central heating systems) (Hungarian Government, 2020a; 2024). However, biomass use in itself is not sustainable ipso facto and indeed, the National Energy Strategy recognises that biomass use in the heating sector heavily relies on the combustion of solid firewood (ibid). It is therefore vital that biomass use is combined with clear sustainability measures and criteria, including in its sourcing, use and regeneration.



Accordingly, government plans to decrease solid biomass use in household heating, increase in industrial heating, and growing the share of biofuels to 15% by 2050 provide an optimistic outlook. In its current iteration, the National Energy Strategy expects solid biomass to be a bridge in the transition to more long-term sustainable renewable energy sources (such as geothermal, solar, etc.). Indeed, it forecasts that by 2030 the use of solid biomass will fall to 74% of its current levels and subsequently drastically decrease as a result of energy efficiency and fuel switching. Such an outlook, in combination with a significant agricultural sector that can provide a steady source of agricultural residues for biomass as well as an already well-developing biomass industry makes it an important strategic sector to focus on.

Sustainable Agriculture

Sustainable agriculture is integral to preserving Hungary's rich biodiversity and ensuring long-term agricultural productivity. Research suggests that there is a greater need for support among small-scale farmers in Hungary, and that the current land ownership structure is mainly characterized by large landholdings (EIB and EC, 2019; Birtalan et al, 2022). One consequence of this is an overwhelming focus on monoculture-based farming relying heavily on pesticides and chemical fertilisers. Such agricultural practices have been proven to lead to long-term soil degradation, water depletion and biodiversity loss – and are therefore not easily compatible with a circular bioeconomy model (Demirdogen et al, 2023).

In its National Biodiversity Strategy (2015-2020), the Hungarian government highlighted the importance of expanding the share of organic farms in the country and increasing the amount of areas under organic cultivation. A number of subsidy programs target the transformation of conventional farming areas into organic production units in an effort to increase agrobiodiversity, fight climate change through the protection of grasslands and the stabilization of carbon storage (Hungarian Government, 2020b). Hungary has experienced notable growth in terms of its organic production, with areas under organic cultivation having doubled between 2012 and 2019. Yet, organic farms still represent only 5.91% of all agricultural land, indicating significant room for organic expansion. There is also a growing demand for healthy and sustainable organic products from consumers (Gonda, 2023). In addition to a shift to organic farming, there is also an increasing adoption of alternative farming practices, including Community Supported Agriculture, regenerative farming, agroforestry and permaculture initiatives (Balázs et al, 2012; Climate Farm Demo, 2025). These factors combined suggest that focusing on sustainable agriculture is a strategic choice for Hungary's bioeconomy ambitions.

Sustainable Forestry

Forests cover roughly one-fifth of Hungary, or an approximate 2.2 million hectares, with new funding programs aiming to expand forest cover to 27% by 2030 (CEPF, 2024; Bráder, 2025). Forests provide a renewable source of biomass for materials and energy, but their value extends beyond simply wood production. Indeed, they act as significant carbon sinks, crucial for mitigating the negative effects of climate change: through carbon sequestration and storing carbon in long-lived wood products. At the same time, ensuring sustainable forest landscapes increases the region's climate resilience by stabilising soils, regulating water cycles, and reducing the impact of extreme weather (European Commission, 2021). Finally, the intrinsic value of a diverse forest ecosystem adds further weight to implementing a sustainable forest management plan (Sandler, 2012).



Hungary's forests face significant challenges that need to be addressed in order to comply with truly sustainable bioeconomy standards. According to recent studies, the country is largely relying in 20th century industrial forest management practices, which allows logging even in national parks and Natura 2000 zones (Zsuppán, 2025). In addition, Hungarian forest management prioritises timber production over ecological values, with old-growth or natural forests only accounting for 0.75 % of forested land – limiting biodiversity and ecosystem resilience. Legal contradictions further complicate the situation: although environmental laws mandate the protection of certain areas, forestry regulations often allow logging to proceed within those same zones (ibid).

Despite these challenges, there are several forward-looking initiatives that signal a commitment to integrating sustainable practices within Hungary's bioeconomy. The country's National Forest Strategy emphasises the multifunctional role of forests, aiming to balance environmental, social, and economic objectives. Simultaneously, large-scale reforestation and afforestation programs focus on combating desertification, improving soil quality and addressing climate change through proactive forestry initiatives (EUSTAFOR, 2016; Bráder, 2025; Hungarian Presidency of the Council of the EU, 2024). Forests will continue to play a central role in the development of a bioeconomy, and the combination of existing initiatives with specific Actions (see next Section) targeting the challenges described above warrant an optimistic outlook in sustainable forest management.

Waste valorisation

Effective waste management, particularly the reclaiming and valorisation of organic waste is pivotal for Hungary's transition to a circular bioeconomy. According to the OECD (2023), Hungary has a long-established policy and legal framework for waste management but is significantly behind in financing high-quality municipal waste management and more broadly integrating principles of circular economy into its waste policies. As the baseline assessment showed, there is considerable potential in the valorisation of biomass and food waste and implementing strategies for nutrient recovery, composting, and biochar production can contribute to a reduction in landfill use, lower GHG emissions and improve soil conditions.

According to the Bio-based Industries Consortium (BIC, 2024) 'a significant amount of residual biomass from agri-food industries, agricultural crops cultivation and forest-based value chains is available for potential further valorisation into bio-based value chains'. BIC estimates that more than 9000 kton d.m. could be repurposed annually and that focusing on this sector could foster cooperation between industry and farmers, while also contributing to an increase in green jobs and soil regeneration.

Nature Tourism

Experts identified nature tourism as a strategic sector to focus on in Hungary's bioeconomy transition. Indeed, tourism is one of the largest and fastest growing economic sectors worldwide. Tourism's contribution to the worldwide gross domestic product is estimated at some 5% (for more details, see CEE2ACT Report D2.3 Sustainability Assessment of Bioeconomy Concepts). Similarly, tourism is a central component of Hungary's economy and accounts for 13% of its GDP (MTÜ, 2020). Tourism's environmental impact is significant and with dramatic growth expected by 2030 in the sector globally as well as in Hungary, there is a pressing need to adopt more sustainable and nature-based iterations (Gössling and Peeters, 2015, Misrahi, 2016, Halaska, 2025).



Such a ‘bioeconomy-based tourism’ can contribute to a more sustainable economic model through placing emphasis ‘on the effective use of natural resources and maximum effort not to waste these resources, as well as to support economic growth’ (Rinn et al, 2023). Agritourism or community-based tourism offers one such avenue and it is a subset of rural tourism that is expected to undergo significant growth globally (10% annually). Following this trend, the Hungarian government has commissioned the creation of a National Agritourism Strategy that aims to combine facets of tourism with agrarian and rural development as well (NAK, 2024). As such, nature tourism could prove to be an exciting sector to focus on in the transition.

Sustainable Healthy Diet

Experts also identified transitioning to more sustainable dietary choices as a key bioeconomy aim in Hungary (CEE2ACT Report D2.3 Sustainability Assessment of Bioeconomy Concepts). In general, individuals in industrialized countries tend to consume more protein than needed in the daily nutritional requirements and most of it comes from animals. While meat and dairy products can be sources of high-quality protein and essential nutrients, their intensive production is paired with significant environmental problems (see D2.3 Report for further details). Sustainable diets, on the other hand, promote human health and well-being while ensuring environmental sustainability and cultural acceptability (FAO, 2019). These diets must be nutrient-rich and free from harmful substances, providing food that is accessible and affordable for all, while minimising negative environmental impacts such as greenhouse gas emissions, land degradation, and water use. In essence, sustainable diets aim to balance health, environmental, and socio-economic goals, ensuring that they are culturally appropriate and resilient to the challenges posed by urbanization and climate change (BOKU, 2024).

In Hungary, dietary patterns reveal a significant intake of animal-based proteins and per capita meat consumption is approximately 69 kilograms (Statista, 2023). Simultaneously, in 2019 agriculture was responsible for 86% of Hungary’s nitrous oxide (N₂O) emissions and 0.4% of carbon dioxide emissions, with livestock being a significant contributor (Farkas et al., 2023). Furthermore, meat consumption is currently growing in Hungary annually, and the Hungarian government encourages the production and consumption of more meat (KSH, 2021; Adamowsky, 2018). Current data highlights that diet is a decisive factor in climate compliance. A high meat diet generates approximately 2,633 kg CO₂eq/year, whereas a local, organic plant-based diet generates only 746 kg CO₂eq/year, a reduction of roughly 72%. Given that the Paris Agreement necessitates limiting total individual emissions (including transport and housing) to approximately 2 tons (2,000 kg) CO₂eq per year by 2050, a high meat diet alone consumes the entire annual carbon budget. A shift to a more sustainable diet therefore provides a politically and culturally challenging, but environmentally and public health-wise high return intervention.



Action plan

Main actions of the Roadmap

Biomass (general)

In order to achieve a measurable improvement in the share of renewable energy sources in Hungary's overall energy mix, an increased focus on solid-, liquid- and gaseous biomass is needed. A number of specific action plans are recommended below for these categories. However, for the overall development of the sector some broad action plans are also recommended.

1. Broad Actions for Biomass Use

1.1. Strengthen the National Innovation Capacity (NIC) of the country to be able to produce and commercialize sustainable biomass technologies: *this could include supporting localized research into the ecological costs and benefits of biomass sourcing, use and regeneration; creating an open-access platform mapping the country's biomass resources; as well as supporting studies mapping the domestic and third-country availability of biomass products.*

1.2. Promote decentralized biomass-based energy hubs and communities to shorten the supply chain and increase the sustainability measures of biomass: *urban and rural bio-energy hubs are a novel way of thinking of localized energy use and public-utility systems and combine clean energy, recycling, public functions and landscape features.*

1.3. Enhance public awareness and workforce training to ensure that the switch to biomass use takes place within a just transition framework: *this could include the implementation of educational programs, awareness raising campaigns and vocational training for professionals in bioenergy technologies.*

1.4. Create a Legal Framework for Energy Communities: To operationalize the "Small is Beautiful" principle, the government must integrate "Energy Communities" into national law as distinct legal entities capable of decentralized production and grid balancing. A robust legal framework will allow local communities to manage small-scale solar and bioenergy (biogas) assets to fill generation gaps (e.g., night/cloudy days), enhancing energy security and reducing reliance on large-scale centralized infrastructure.

Solid Biomass

As mentioned earlier, in order to consider the biomass industry as an efficient and ecological way to reduce carbon emissions, stringent sustainability criteria need to be met (Gent, 2022). This is because uncontrolled and poorly planned biomass production carries the risk of deforestation, biodiversity loss, habitat destruction, as well as increased carbon emissions, air pollution, water- and soil degradation (Garson, 2023). In addition, it may also stand in conflict with food production needs. Indeed, in the Hungarian context, solid biomass (firewood) use contributes to a significant proportion of household and industrial heating, without clear sustainability indicators ensuring the reliability of biomass as a sustainable resource (Hungarian



Government, 2023). As such, the following action plans are recommended to ensure that expanding the use of solid biomass in Hungary truly contributes, rather than negates efforts at transitioning to a circular bioeconomy.

2. Actions for solid biomass

2.1. Promote research on solid biomass availability: *current statistics on the supply and consumption of solid biomass do not align, indicating that Hungary uses more biomass than what is officially available (WWF, 2024). This raises fundamental concerns on sustainability and highlights the need for more accurate data collection.*

2.2. Phase-out state subsidies and green energy labeling for solid biomass power plants: *solid biomass is expected to increase significantly until 2030, partly due to state subsidies and green energy incentives. It is imperative that while sustainability standards cannot be guaranteed, these financial support schemes are reassessed.*

2.3. Promote the sustainable integration of agricultural residues: *agricultural by-products (i.e. straw, corn stalks, pruning residues) are crucial for maintaining soil quality, preventing nitrogen depletion and limiting carbon emissions. Hungary produces millions of tons of agricultural residues, but clearer limits need to be established on the amount of biomass that can be extracted without damaging agricultural land (Lukács, 2014).*

2.4. Long-term transition away from primary solid biomass in energy use: *prioritizing the use of biomass in industrial sectors with limited alternatives to fossil fuels, such as steel and chemical production, is more sustainable than its use for electricity and heat production*

2.5. Establish a National Firewood Drying Program: *To address the low calorific efficiency and high emissions caused by burning high moisture wood, which currently constitutes 70% of renewable energy usage, the government must incentivize or mandate a one year drying period. Shifting the supply chain logistics (such as harvesting and supplying wood in May for use in the following October) will significantly improve heating value and reduce particulate emissions without requiring new infrastructure.*

Liquid Biomass

There is rapid growth in biofuel production in Hungary: while there is no recent data on the country's total output, reports suggest that one of the country's largest private sector players can produce up to 200.000 tons of biofuels (Szendőfi, 2024). Nevertheless, biofuels – similar to solid biomass -, are not inherently sustainable as they often require large tracts of land for fuel crops and are dependent on fossil-based agricultural inputs (Greenfo, 2013). First-generation biofuels are made from food crops, second-generation biofuels are derived from agricultural waste, by-products, algae and switchcrops, and novel technologies have also begun to focus on microbe-derived biofuels (Padder et al., 2024). Each of these categories presents significant sustainability challenges. As such, we recommend the following actions for incorporating biofuels into a circular bioeconomy system.

3. Actions for liquid biomass (biofuels)

3.1. Enhance sustainable cultivation practices for first-generation biofuel crops: *first-generation biofuels that rely on intensive monocrop farming (specifically maize, rapeseed, etc.) require large amounts of fossil-fuel based inputs. It is imperative that the cultivation of biofuel crops does not compromise food security and environmental health. Comprehensive guidelines for farmers on sustainable practices, and implementing a monitoring system to track land allocation for biofuels can prevent the excessive diversion of arable land from food production.*

3.2. Promote the production of second-generation biofuels through more coordinated waste collection and local supply chains: *specific actions can help increase the organized collection and processing of biowaste (including agricultural residues, lignocellulosic materials and waste). For instance, expanding the availability of biowaste collection points; introducing regulation requiring large-scale food producers, restaurants and retailers to separate and collect biowaste for biofuels; and developing public awareness raising campaigns.*

3.3. Expand the production of advanced biofuels: *through supporting the construction and retrofitting of bio-refineries.*

Gaseous biomass

Hungary imports up to 85% of the natural gas it uses and a majority of this comes from Russia. Given the socio-economic and political contexts of the war in Ukraine, it is crucial to move away from this dependence and diversify its gas consumption. Biogas provides an important alternative, and such ambitions are indeed part of the country's National Energy Strategy.

The revised National Energy and Climate Plan (NEKT, October 2024) sets more ambitious targets. It aims for renewable energy to account for 30% of gross final energy consumption by 2030, contributing to a 50% reduction in GHG emissions (compared to 1990 levels). Solar capacity is targeted to reach 12 GW by 2030 (with current capacity already nearing 6.8 GW). The target for biogas production has been significantly increased to 600 million m³ per year by 2030. To support this, the "Jedlik Ányos Plan 2.0" mobilizes RRF funds (approx. 40 billion HUF in 2025) specifically for biogas and bioenergy plant operations.

These numbers are, however, conservative and there is significantly more potential to achieve, indeed, some reports estimate a feasible increase of up to 25% by 2040 (Toldi and Bera, 2022). Achieving such a rate of growth nevertheless requires stringent sustainability measures. The strategy must clearly distinguish between Biogas, utilized primarily for local heat and power generation, and Biomethane, which is upgraded to higher purity for injection into the natural gas grid (targeting a 10 to 15% mix). Biomethane represents a higher value output, commanding a market price three times higher than standard biogas, justifying the investment in upgrading technology. As such, we recommend the following actions for biogas production.



4. Actions for gaseous biomass (biogas)

4.1. Redirect organic waste streams to biogas production: *similar to 3.2. it is important to better coordinate the collection and use of organic waste by diverting current chains that lead to landfill and incineration. This requires adopting policies and regulations, incentive programs and public awareness campaigns.*

4.2. Streamline permitting process while maintaining stringent environmental requirements: *actors have noted that establishing a biogas plant is currently riddled with complicated and long bureaucratic processes. Streamlining this process, while not compromising on environmental requirements would nurture the development of further biogas facilities.*

4.3. Addressing sustainability challenges in biogas production: *as for biofuel and biomass, it is important to transition away from food crops to waste-based and residue-based feedstocks. In addition, methane leak detection, monitoring excessive nutrient depletion from digestate use and regulating wastewater management need to be better incorporated into biogas plant creation and maintenance.*

Sustainable Agriculture

Growing food in an environmentally sustainable manner that strives to mitigate its ecological impacts is a cornerstone of a circular bioeconomy. Not only because current mainstream agricultural practices come with widespread environmental degradation and biodiversity loss, but also because their heavy reliance on chemical fertilisers and pesticides requires vast amounts of fossil fuels (Demirdogen et al., 2023). Promoting a transition to more sustainable ways of farming contributes to the bioeconomy through incorporating an ecological perspective, while also having the potential to lead to better social cohesion, public health, and foster the revitalization of local economies (Hennchen and Schäfer, 2022).

Hungary has significant potential when it comes to expanding its organic agricultural production. As mentioned earlier, only around 6% of arable land is currently under organic cultivation, and a majority of the country's farmers continue to practice non-organic monocrop-based agriculture. The Government's National Action Plan for Supporting Organic Farming has set the goal that by 2027, 10% of all arable land should be under organic cultivation (Hungarian Government, 2022). While this is an ambitious target, the country's fertile soils, diverse agroecosystems, and growing consumer demand for affordable organic products suggest that there is room for even more ambitious targets. In addition, there is also ample room for integrating farming practices that provide an alternative to existing monoculture-based agriculture, such as agroforestry, Community Supported Agriculture, permaculture, regenerative farming, and more. While some support schemes exist for such initiatives, the current institutional environment (including education, subsidies, and economic incentives) does not yet foster the proliferation of these practices. Stakeholders emphasize that sustainable agriculture must prioritize soil restoration and water management above all else. A critical challenge is the removal of biomass for energy purposes, which risks becoming counterproductive if it strips the land of necessary organic cover. Soil covering (talajtakarás) is essential for retaining moisture and fertility.



Financial viability is already evident in the Hungarian market. Local case studies demonstrate companies that invested in composting services to treat their soil, resulting in increased crop yields that not only covered the composting costs but eventually allowed them to replace expensive artificial fertilizers entirely. This creates a self-sustaining cycle of soil regeneration that policy should aim to replicate. As such, we suggest the following actions:

5. Actions for Sustainable Agriculture

5.1. Restore Soil Structure in Conventional Farming & Expand Organic Impact: While expanding Certified Organic land is a key target, the strategic priority, as emphasized by stakeholders, must be the restoration of soil structure. Experts warn that conventional monocultures have lost significant water-soluble organic matter, rendering irrigation ineffective. Therefore, this action focuses on transferring organic best practices (such as continuous soil cover and biodiversity lanes) to the conventional sector to halt soil collapse. This aligns with the BIOEAST SRIA, which designates soil organic matter management as the prerequisite for sustainable yields.

5.2. Ensure organic transition takes place in just ways: a shift to organic farming can still perpetuate unequal land relations. Transition efforts should make sure that subsidy programs support small- and medium-scale farmers, family farms, and young people and therefore contribute to rural development.

5.3. Strengthen organic supply chains: currently, 85% of organic produce is exported as raw materials (OrganicTargets4EU, 2023). There is a strong need to boost domestic organic processing capacity by providing grants and low-interest loans and establishing regional storage and distribution centers.

5.4. Raise awareness of the health and environmental benefits of organic and locally grown foods: by launching public awareness campaigns, educational packages, etc.

5.5. Integrate alternative farming practices into vocational and higher education training and support conventional farmers in transitioning to bioeconomy: current agricultural educational programs provide limited focus on alternative practices such as agroforestry, regenerative farming, permaculture, or CSA. More collaboration between existing initiatives and educational institutions, as well as state support for such curricula, is needed.

Sustainable Forestry

As mentioned earlier, Hungary's forests play a pivotal role in the bioeconomy. When managed adequately, they can provide valuable renewable sources for bioenergy, sustainable construction, and more. Additionally, they provide invaluable functions for mitigating the effects of climate change, desertification, and biodiversity loss through carbon storage and sequestration, providing wildlife habitats, and preventing soil erosion (UNDP, 2023). However, the country's forests face several challenges that need to be addressed: overharvesting, weak enforcement, legal contradictions, a lack of diversity in predominantly monoculture forests, as well as shortcomings in implementing sustainability standards limit the extent to which forests can be regarded as a sustainable part of the bioeconomy (Zsuppán, 2025). To realise the full potential of Hungary's forests within a sustainable bioeconomy, the following targeted and



evidence-based actions are proposed. These address both structural challenges and leverage current momentum from existing national programs.

6. Actions for Sustainable Forestry

6.1. Modernize forest management practices: by updating Hungary's forest legislation to reflect multifunctional and ecologically sustainable forestry principles; establishing strict limits or bans on logging in protected areas; and integrating cross-ministerial legal harmonization to reconcile contradictions between forestry and environmental laws.

6.2. Expand and diversify forested areas according to ecological principles: continue with reforestation and afforestation programs to increase forest cover to 27% by 2030 by prioritizing native, climate-resilient species and mixed-species plantations.

6.3. Strengthen biodiversity protection within forest management: expand the proportion of forest under strict protection and old-growth conservation, with the goal of reaching 10% by 2030 (from the current 0.75%).

6.4. Improve transparency, enforcement, and monitoring: by implementing a centralized digital monitoring system that integrates remote sensing, field reports, and biodiversity data (including citizen science initiatives).

6.5. Support innovation and high-value wood utilization: by promoting the cascading use of forest biomass, prioritizing long-lived wood products (e.g., construction, furniture) over energy combustion (Le Pierrès, 2023).

6.6. Promote sustainable forest management and agroforestry initiatives: ensuring that practices maintain forest health and productivity. Forest-based biomass use should be tied to strict reforestation rules, making sure that Hungary doesn't use more trees than it can reproduce. In addition, more research is needed on the biodiversity and climate impacts of forest-based biomass use.

Waste valorisation

In our biomass action recommendations above, we focused on reclaiming and redirecting waste avenues for better use in the production of biogas, biofuels, and biomass for heating. However, there are additional areas in which waste could be transformed into valuable resources and contribute to reducing the country's environmental footprint, improving soil fertility, and promoting sustainable agricultural practices. As of January 2024, there is an ongoing initiative led by MOHU MOL Hulladékgazdálkodási Zrt. to incorporate selective organic waste collection from households. However, the initiative has faced significant implementation challenges, including low participation rates, logistical issues, and an overall lack of awareness from the public (Thüringer, 2024a; Thüringer, 2024b). Implementation challenges are often due to practical restrictions rather than a lack of political will. Experience in dense urban areas (such as Budapest District 8) suggests that the blanket introduction of brown bins can exacerbate sanitation and pest control issues (such as cockroaches) if not managed correctly. Therefore, instead of an immediate national rollout, the Roadmap recommends establishing MOHU Pilot Projects (such as mini community hubs) to test logistical viability and sanitation protocols in controlled environments before scaling up. In addition, experts have noted that Hungary is currently underperforming in waste processing infrastructure.



Hungary currently lacks approximately 110 million cubic meters of soil annually, and an efficient and effective waste valorisation scheme could contribute to the recovery of this much-needed resource (ÖMKi, 2023). While a top-down waste collection scheme is useful, especially in major urban areas, we also believe that the decentralization of local organic waste collection and use is important. Legislation implemented in July 2023 significantly reduced the autonomy of local municipalities in implementing waste collection and management systems, leaving the sector vulnerable to the shortcomings of a highly centralized system (MOHU, 2024). A truly sustainable circular bioeconomy requires the shortening and localization of entire supply chains, and localized organic waste collection and subsequent use in local agricultural practices is a crucial component of this chain.

While a top-down waste collection scheme suits urban density, this Roadmap advocates for localizing organic waste chains. However, stakeholder feedback urges caution regarding the economic viability of decentralized models. Evidence from the Hungarian plastics processing sector shows that decentralized waste processors often face insolvency due to the high costs of managing heterogeneous waste streams without the economies of scale present in globalized markets. Therefore, while we recommend decentralization (see Action 7.1), it must be paired with rigorous standardization and financial safeguards to avoid the bankruptcies seen in other waste sectors.

Stakeholders consistently identify contamination, particularly plastics, as the main barrier to circular use. Without strict source separation requirements, compost quality remains unreliable, limiting uptake in agriculture. Furthermore, while biochar presents significant potential for soil improvement and carbon sequestration, current market prices make general biochar too expensive for widespread use. Therefore, future development should focus on high-value innovations for phosphorus recovery.

Therefore, we recommend actions in four specific areas: Organic Waste Treatment, Nutrient Recovery/Side-stream Valorisation.



7. Actions for Waste Valorisation

7.1. Enable legal, policy, and financial reforms to foster sustainable decentralization: There is a need to reform current waste management regulations to allow local municipalities and communities to establish independent or co-operative-based organic waste collection systems. Currently, organic waste management is dominated by a single market actor (MOL MOHU Zrt.). To address this, regulations should enable a more competitive market through open tenders for local waste management and grants for small-scale composting facilities. However, these decentralized models must be designed to withstand market volatility. Reforms should therefore encourage "smart decentralization," ensuring that local processing handles homogenous agricultural waste, while complex heterogenous waste streams remain integrated into larger, more efficient industrial loops to avoid the economic failures seen in other sectors.

7.2. Improve the outreach of organic waste collection initiatives through raising awareness and improving organic waste collection infrastructure: Organizing workshops, public talks, advertising, community events, and building apps similar to ShareWaste (a platform connecting locals with nearby composters to recycle kitchen scraps) to educate residents on the importance of organic waste separation and using brown bins. In addition, case studies from other countries show that having the availability of indoor kitchen bins and easily accessible drop-off points increases residents' willingness to separate compost (EEA, 2022). The "Milan Zero Waste" model serves as a key reference point here, demonstrating how intense public engagement and door-to-door collection can successfully drastically reduce residual waste in a dense urban environment. Adopting similar mindset-shaping methodologies is crucial. However, we do not need to look solely abroad for solutions; successful domestic models already exist. The Szegedi Komposztáló Üzem demonstrates that urban green waste can be processed into high-quality potting soil that is 100% sold on the market, proving the financial viability of large-scale processing when quality is maintained. The Komposztfutár (Ökotengely) initiative utilizes bicycle couriers to collect kitchen waste for local community composting. This decentralized model effectively closes the nutrient loop within neighbourhoods, reducing logistics costs and engaging the community directly.

7.3. Foster research and innovation in the development of nutrient recovery and side-stream valorisation technologies: there is a need for better R&I in nutrient extraction technologies, such as phosphorus and nitrogen from agricultural runoff, wastewater, and food waste. In addition, there is a need for increased focus on recovering value from by-products generated during primary production or processing (i.e., fruit peels and pulp for fibre-rich food ingredients, sawdust for bioenergy, spent grain as animal feed), and processing invasive fish species (e.g., dwarf catfish) into fertilizer. Making these approaches viable requires streamlined permitting, which could be achieved through simplified regulations for low-risk by-products, fast-track approvals, and clear safety and quality guidelines.

7.4. Promote the use of recycled organic compost in the agricultural sector: Hungarian farmers still overwhelmingly rely on synthetic and chemical fertilizers (Ács, 2018). Training programs, demonstration projects, and further subsidies can enable the uptake of organic compost and therefore create new avenues for commercializing this waste. The viability of these compost markets depends entirely on the purity of the input material. Stakeholder feedback emphasizes that "cleanliness" is the single biggest barrier to circularity; if compost is contaminated with non-biodegradables (e.g., plastics, rubber), the final product is unusable for agriculture. Strict enforcement of source separation is required to rebuild farmer trust, which is currently low due to visible contamination in existing market products.

Nature Tourism

Transitioning to effective nature tourism requires a holistic approach that incorporates a number of key actions. This includes the responsible use of natural resources; modern waste management; incorporating renewable energy use; supporting alternative transportation options; the protection of cultural heritage; education on sustainable tourism practices; reducing seasonality; supporting environmentally friendly forms of tourism; and supporting local economic and social attractions (Hungarian Parliament, 2017). It is a multifaceted approach that needs to think of tourism as part of a broader system of economic actors, supply chains, and educational institutions. As such, we recommend the following actions.

8. Actions for Nature Tourism

8.1. Support the development of sustainable infrastructure: including promoting the development of lodgings utilizing renewable energy, waste reduction systems, and eco-friendly building materials; as well as improving public transportation connections and other transport options (i.e., bicycle paths) to rural and nature areas.

8.2. Empower local communities and farmers to benefit from sustainable tourism initiatives: including workshops and training sessions on sustainable tourism practices and integrating tourism activities into farmscapes; as well as subsidy packages for tourism initiatives that meet certain sustainability criteria.

8.3. Promote sustainable tourism at the national level: creating and promoting a national brand that emphasizes sustainable and nature-based tourism.

Sustainable Healthy Diet

Hungary has a rich culinary tradition that is an important part of the national identity and often forms the backbone of family and social life (Benkhard and Halmai, 2017). While this is an important feature of Hungarian culture that should be fostered, the country also faces significant endemic health crises caused by the excessive consumption of processed meats and fatty foods. Indeed, six-tenths of Hungarians aged 15 and over are overweight or obese, and chronic illness is prevalent in these populations (KSH, 2019). Addressing a change to the country's meat consumption is a challenging endeavour, both because of the cultural ties to meat consumption, but also because of the strong political support for meat production. A transition to a circular bioeconomy requires a gradual shift away from dietary practices that are harmful both to human health and the natural environment. In Hungary, there is significant room for change in three categories: public catering, meat production, and awareness. As such, we propose the following actions.



9. Actions for Sustainable Healthy Diet

9.1. Integrate healthy, organic, and locally grown foods into public catering (including kindergartens, schools, hospitals, and universities): current public catering relies on outdated 2014 regulations, which struggle to adapt to modern nutritional principles and individual dietary needs. In addition, rising ingredient costs, long value chains, and limited budgets make it difficult for institutions to provide high-quality, diverse, and sustainable meals. Regulations need to be updated to reflect modern nutritional and environmental standards, and increased funding is required. In addition, community gardens can play a key role in supplying healthy and local produce to public institutions.

9.2. Phase out subsidies for meat production and support the transition of meat producers to other agricultural practices: the Hungarian government heavily subsidizes the meat and dairy industry, despite both sectors making massive losses (Mizsur, 2023). Phasing out these subsidies and redirecting funds to assist the transition of meat producers to other agricultural practices allows both an increase in the availability and affordability of healthy foods and ensures the livelihoods of affected farmers and stakeholders.

9.3. Raise awareness of the health and environmental risks of excessive meat consumption: studies suggest that there is still inadequate public awareness of what constitutes healthy diets (KSH, 2019). Incorporating nutritional knowledge into public awareness can encourage dietary shifts towards more sustainable and healthy food choices.

Additional sectors / A continuous reassessment of the Roadmap

The sectors listed above were identified as areas that have a certain amount of existing economic, political, and cultural support, upon which further development and innovation can be based. Nevertheless, bioeconomy comprises a much wider range of sectors, sub-sectors, practices, and organizational models that should be taken into consideration when thinking of a completely circular bioeconomy model. Indeed, a key principle we advocate for in achieving bioeconomy is constantly reassessing the changing needs of the given context and adapting the Roadmap and selected Actions and Targets accordingly.

CEE2ACT's D2.3 report on the Sustainability Assessment of Bioeconomy Concepts provides a comprehensive list of bioeconomy options. While many of these are covered in one way or another in our Action recommendations, we further recommend that more long-term efforts are directed at developing R&I in the fields of bioplastics and biodegradable plastics.

In addition, experts gathered at the CEE2ACT Workshop held in Budapest in March 2025 noted the overarching role water management and soil structure improvement can play in furthering all aspects of the bioeconomy. Establishing more water retention systems and reservoirs; expanding rainwater collection for agricultural use; as well as implementing novel ways of river management planning was widely noted as a prerequisite for combating desertification, increasing biodiversity, and providing better water supply for agriculture and other bioeconomy sectors. Improving soil structure is embedded in most bioeconomy sectors: properly utilizing residues and leftovers from waste valorization, biomass-based energy, agriculture, and forestry, as well as implementing organic and alternative farming practices based on ecological principles all contribute to returning nutrients to the soil and ensuring long-term sustainability. This is especially relevant for sustainable forestry and agriculture, but spills over to other relevant areas.



Finally, most stakeholders and experts agreed that the foundational structures of a bioeconomy transition require a central focus on education in all sectors and segments of society. As such, efforts to improve awareness, build skills, implement specific vocational and higher education courses targeting bioeconomy sectors, and cross-border and cross-sector knowledge sharing appear throughout the Action Plan recommendations.



Role of Different Actors

Achieving these actions requires a clear division of labor between market players to overcome current fragmentation. Stakeholders emphasize that small and medium enterprises (SMEs) should be viewed as the engines of flexibility and innovation, capable of piloting new technologies (such as alternative farming and specialized waste processing) that are too risky for rigid structures. In contrast, large industrial players must shoulder the responsibility for financing high capital expenditure investments (such as biorefineries and infrastructure), providing the stability and market access that smaller innovators lack. Cooperation between these two groups is not optional; it is the prerequisite for scaling the bioeconomy.

The following table outlines how different stakeholders, actors, and institutions can play a role in implementing the Actions set out in this Roadmap. The left column includes specific actors such as the Ministry of Agriculture and Ministry of Energy, as well as broad categories of actors, such as Other Governmental Bodies, Regional Authorities, Research Institutions, Industry Players, and Civil Society. The top row contains the different sectors, while the corresponding boxes outline the overall tasks these actors should play.

	Biomass	Sustainable Agriculture	Sustainable Forestry	Waste Valorization	Nature Tourism	Sustainable Healthy Diets
Ministry of Agriculture	<i>Oversees forestry and agricultural residue use. NÉBIH (Permitting Authority)</i>	<i>Setting targets for expanding organic farmland, administers CAP funds. Coordinates subsidy schemes for alternative farming initiatives</i>	<i>Oversees sustainable forest management, conservation, reforestation programs, and ensures compliance with national and EU regulations.</i>	<i>Enable more decentralized and innovative waste valorisation schemes</i>	<i>Managing National Park Directorates</i>	<i>Adjust agricultural subsidies and programs to favour healthy foods</i>
Ministry of Energy	<i>Steers renewable energy policy and integrates biomass into energy planning. Jedlik Ányos Plan & RRF Funds</i>					
Other Governmental Bodies	<i>Prime Minister's Office: Coordinating role</i>	<i>NÉBIH: regulates organic standards and certifications</i>	<i>National Land Centre (NFK): maintains forest databases, provides technical and administrative</i>		<i>Hungarian Tourism Agency (MTÜ): incorporate sustainability into national tourism</i>	<i>State Secretary for Health: directing nutrition policy and public health campaigns</i>

			<p>support, issues permits</p> <p>NÉBIH: ensures compliance with forest protection, maintains national forest map</p> <p>National Park Directorates: managing protected areas, biodiversity conservation, Natura 2000 site management, environmental education</p>		<p>branding and grant programs</p>	<p>NÉBIH: Food safety oversight, food waste reduction campaigns</p>
Regional authorities	<p>Implementation: facilitating local bioenergy projects and enforcing sustainability criteria for biomass sourcing</p>				<p>Handling land-use planning and investing in visitor amenities</p>	
Research Institutions	<p>Hungarian Bioeconomy Cluster: linking academia and industry to develop bio-based technologies</p> <p>Universities</p>	<p>ÖMKi: improving organic farming competitiveness through practical research, advisory services</p> <p>Universities (MATE, Gödöllő): creating and maintaining</p>	<p>Universities (MATE/ERTI, Sopron): focusing on forestry education and research, forestry sciences, silviculture, forest ecology, climate change adaptation</p>	<p>General: researching topics like nutrient recovery, improving compost quality, biochar production</p>	<p>General: researching visitor behaviour, carrying capacity, tourism's economic and environmental impact</p>	<p>General: quantifying environmental and health impacts of dietary habits.</p>



	<p>(MATE Bioeconomy Research Group, BME, etc.): conducting studies on biomass production, sustainability and circular use.</p> <p>General: improving biomass yields, ecological impacts, creating open data, training workforce, collaborative R&D programs</p>	<p>agricultural science programs focusing on agroecology, soil health, pesticide-free farming</p>				
Industry Players	<p>Major bioenergy and biofuel companies: investing in technology to convert biomass into fuels, animal feed, materials</p> <p>Forestry sector: supplies wood biomass for energy and is responsible for</p>	<p>Farmers: growing certified organic crops, raising animals under organic standards</p> <p>Biokontroll Hungária: main certification body</p> <p>Food processing industry: building domestic organic value chains</p>	<p>State forest companies: operating under supervision of MoA, engaging in logging, conservation, recreational services and sustainable forest management</p> <p>Private forest owners: private individuals and companies</p>	<p>MOHU (MOL Group): Scale up composting, anaerobic digestion and other technologies to turn organic waste into valuable products</p> <p>Innovative companies (general): focusing on waste-to-resource solutions, biochar development</p>	<p>Rural tourism businesses: providing sustainable accommodations and experiences</p> <p>FATOSZ: setting quality standards, training service providers</p>	<p>Small and large food producers: innovate and adjust product lines in line with dietary transition goals</p> <p>Retail chains and supermarkets: influencing consumer choices based on how they stock and promote foods</p> <p>Public foodservice industry: implement improvements in menus</p>



	<p>replanting and sustainable forest management</p> <p>Hungarian Biogas Association: provides a forum for exchanging expertise and bringing together agriculture, industry and technical experts</p> <p>Innovative Start-ups: developing new ways to harness organic waste</p>	<p>Chamber of Agriculture (NAK): providing advisory services and lobbying for favourable policies</p>				
<p>Civil Society Organisations and Professional Associations</p>	<p>General: ensure biomass use is sustainable and beneficial.</p> <p>Environmental NGOs: advocate for sustainable forestry and caution against overexploitation, pushing for strong</p>	<p>Hungarian Bioculture Association: promoting organic agriculture, organize farmers' markets, trainings for farmers</p> <p>Environmental NGOs: campaigning for reduction in chemical use</p>	<p>Hungarian Forestry Association (OEE): advises on forestry policy and education, links professionals and policy-making</p> <p>Hungarian Furniture and Wood Product Association (FABUNIO): focusing on sectoral development,</p>	<p>General: promoting waste reduction and valorization at the grassroots level.</p> <p>Humusz Association: educating citizens on waste prevention, composting campaigns, lobbying.</p> <p>Community initiatives: setting up community composting sites</p>	<p>General: empower local communities, running ecotourism center, hosting annual eco-festivals</p> <p>Environmental NGOs: campaigns for sustainable tourism</p>	<p>Health-focused NGOs: promoting dietary improvements for better health, organizing campaigns, workshops</p> <p>Environmental NGOs: advocating dietary shifts as a climate and environmental strategy</p> <p>Conscious Consumers Association (TVE): providing guides on sustainable eating</p>



	sustainability criteria	Conscious Consumers Association (TVE): educating public, helping growing market demand	<i>creative progress, knowledge sharing</i> Private Forest Owners National Alliance (MEGOSZ): represents private forests Environmental NGOs (MTSZ, WWF, Greenpeace): nature conservation, forest biodiversity, forest protection campaigns	Hungarian Water Utility Association (MAVIZ): focusing on wastewater treatment technologies and nutrient recovery		Community-supported Agriculture (CSA): connect consumers directly with local sustainable produce
Other/Overarching	Environmental Protection Services and Producers Alliance (KSZGYSZ): largest Hungarian environmental interest group, covering industrial actors, political decision-making and environmental protection. Business Council for Sustainable Development in Hungary (BCSDH): coalition of CEOs and companies, working on accelerating system transformations towards climate-neutrality, nature-positivity and fairness.					



Timeline

This table outlines general steps for implementing the specific Actions set out in the Roadmap across three timelines: Short term (2025-2027), Medium term (2027-2030), and Long term (2030 and beyond). The steps are designed in a way that each timeline builds on the previous one and that over time, specific short-term steps allow for merging actions in the medium- and long term.

		Short term (2025-2027)	Medium term (2027-2030)	Long term (2030 and beyond)
	Action	Immediate and High Priority Actions	Scaling Up and Integrating Actions	Maintaining Momentum and Achieving Vision
BROAD BIOMASS ACTIONS	Strengthen National Innovation Capacity	<i>Establish R&D programs and open data platforms to map biomass resources. By 2027, Hungary should see new research on biomass sustainability.</i>	<i>Continuous innovation: the strengthened NIC yields applied technologies being adopted by industry.</i>	<i>By 2030+, biomass use is subject to rigorous sustainability criteria and plays a bridging role in energy while greener alternatives scale up. Looking forward to 2040-2050, Hungary gradually phases out primary biomass burning for energy altogether. Solid biomass in home heating is largely replaced by heat pumps or geothermal (ending reliance on firewood), and any remaining biomass power is limited to utilizing waste biomass only. Liquid biofuels and biogas become crucial for sectors hard to electrify.</i>
	Promote Decentralized Bio-Energy Hubs	<i>Pilot local bio-energy hubs that integrate clean energy and waste recycling. Early hubs (by 2026) will inform a wider rollout in the next term.</i>	<i>Use lessons from pilot hubs to establish decentralized biomass energy hubs in more regions. By 2030 several local bioenergy centers are operating, supplying heat/power from local biomass and organic waste.</i>	
	Enhance Awareness and workforce training	<i>Implement education campaigns and vocational training on bioenergy to build a skilled workforce. By 2027 there is growth in the availability in core technicians and public awareness of biomass benefits.</i>	<i>Continuous training: Biomass/bioenergy is standard part of vocational training curricula and public awareness efforts continue.</i>	
SOLID BIOMASS	Research on Solid Biomass Availability	<i>Fund multiple research projects conducting a comprehensive assessment of sustainable biomass supply – to inform policy limits.</i>	<i>Use the improved biomass availability data to continuously adjust extraction limits. Hungary's solid biomass consumption aligns with what can be sustainably supplied annually. Forest biomass use is increasingly limited to by-products and dead wood, with live-tree felling for energy significantly reduced.</i>	



	Phase out state subsidies	<i>Begin phasing out state “green energy” subsidies or labels for unsustainable biomass power plants. By 2027 no new large biomass power projects should receive incentives unless they meet strict sustainability criteria (to curb subsidy-driven rise in solid biomass use)</i>	<i>Fully remove or redirect remaining state subsidies for unsustainable solid biomass power generations. Any biomass plants still receiving support must meet stringent sustainability criteria.</i>
	Sustainable Integration of Agricultural Residues	<i>Set clear limits on removing crop residues for fuel. Guidelines developed with farmers will ensure enough residues remain on fields to protect soil quality</i>	<i>With guidelines in place, continuously monitor soil health where residues are removed.</i>
	Long-term transition Away from Primary Solid Biomass in Energy Use		<i>Begin long term transition away from primary firewood for heating.</i>
BIOFUELS	Sustainable Cultivation Practices for First-Generation Biofuel Crops	<i>Issue guidelines for first-generation biofuel crops (e.g. maize, rapeseed) to prevent conflict with food production. By 2026 a better monitoring system tracks land use for food vs biofuels, ensuring there is no excessive diversion of arable land</i>	<i>Use the monitoring system to annually report the land used for biofuel crops and the volume of biofuels produced.</i>
	Promoting the Production of Second-Generation Biofuels	<i>Kickstart biofuels from waste and residues and expand biowaste collection points. Enact regulations requiring large food producers/retailers to separate organic waste for biofuel use. Early action here ensures feedstock availability for advanced biofuel production.</i>	<i>With a steady supply of separated biowaste (Waste actions 8.1 and 8.2.), ramp up second-generation biofuel production.</i>
	Expand the Production of Advanced Biofuels	<i>Begin feasibility studies and investment incentives for advanced bio-refineries using non-food inputs.</i>	<i>Support the construction or retrofitting of advanced bio-refineries.</i>



BIOGAS	Redirect Organic Waste Streams to Biogas Production	<i>Implement policies to reroute organic waste streams away from landfills/incineration into biogas plants.</i>	<i>Following permitting reform, new biogas plants (i.e. on farms, municipal waste sites) come online. These plants chiefly use manure, food waste, and other organic discards as feedstock. Integrate biogas into local energy systems.</i>	
	Streamline Permitting Process	<i>Simplify and accelerate the permitting process for biogas installations. Reduce the number of permits and time required without lowering environmental standards.</i>		
	Address Sustainability Challenges	<i>Update regulations so all new biogas facilities meet strict sustainability criteria. Ensure feedstocks are primarily waste-based and require methane leak controls and proper digestate management from the outset.</i>	<i>Continuously improve regulations on biogas operations.</i>	
SUSTAINABLE AGRICULTURE	Expand Organically Cultivated Land to 15% by 2027	<i>Increase subsidies and technical support for farmers to convert to organic. This involves covering certification costs and initial yield losses.</i>	<i>With organic production expanded, focus on building better domestic value chains. Construction of regional organic warehouses, processing plants and farmers' market networks.</i>	<i>After 2030 the initial target of 15% organic land is the baseline to further build upon. The long-term goal is to make sustainable farming the norm. Continuous support and market development will be needed.</i>
	Strengthen Organic Supply Chains	<i>Begin establishing domestic organic processing and distribution centers. Plan grants and loans by 2027 for building regional organic food processing facilities.</i>		
	Ensure Organic Transition Takes Place in Just Ways	<i>Design and better implement subsidy programs to favor family farms, small- and medium farms and young farmers. Ensure new organic support schemes are inclusive so that the organic boom also reduces rural inequalities.</i>	<i>Continued support for small- and medium farmers, family farms and young farmers.</i>	
	Raise Awareness	<i>Launch public-awareness campaigns on the health and environmental benefits of organic food. By 2027 integrate organic</i>	<i>Building on awareness campaigns, domestic demand grows. Labelling schemes and public</i>	



		<i>education in schools and media so that consumer demand rises in parallel with increased organic supply.</i>	<i>procurement quotas for organic food in public catering.</i>	
	Integrating alternative farming practices into vocational- and higher education trainings:	<i>Create synergies between existing national and international alternative farming courses and formal educational trainings. Integrate field visits into trainings and fund research projects in local adaptation of such practices.</i>	<i>With a continuous cohort of young alternative farmers, implement subsidy schemes that incentivise farmer careers.</i>	
SUSTAINABLE FORESTRY	Modernise forest management practices	<i>Revise forestry legislation to include multifunctional forest use and ecological priorities. Ban logging in protected areas. Begin legal harmonisation between ministries.</i>	<i>Enforce updated legislation. Monitor implementation and adjust based on ecological outcomes. Fully integrate forestry and environmental law planning.</i>	
	Expand and diversify forested areas	<i>Launch afforestation schemes focused on native, climate-resilient species and mixed forests. Introduce ecological criteria into funding mechanisms.</i>	<i>Scale up reforestation with biodiverse plantings. Ensure full monitoring of ecological success and survival rates.</i>	<i>After 2030, Hungary has a steady and reliable legal system in place to protect old-growth forests, excluding them from logging practices. This is further strengthened by a citizen engagement in monitoring and evaluating forest management. In non-protected forests, agroforestry initiatives dominate and there is a process of restoring degraded lands and increasing structural diversity. Biomass use is maintained within structural ecological limits, and practices are continually adapted based on emerging climate realities.</i>
	Strengthen biodiversity protection	<i>Set national target for strict forest protection at 10%. Identify priority areas and initiate protection for old-growth forests.</i>	<i>Expand protected forest areas to 10%. Mainstream biodiversity criteria in forest certification and management practices.</i>	
	Improve transparency, enforcement and monitoring	<i>Pilot national digital monitoring system. Begin integration of remote sensing, train enforcement staff and fund citizen science research projects to assess effectiveness.</i>	<i>Operationalise national forest monitoring system. Publish annual transparent reports on forest condition and compliance.</i>	
	Support innovation and high-value wood utilisation	<i>Promote cascading use in national bioeconomy strategy. Fund R&D into long-lived wood product innovation.</i>	<i>Support commercial adoption of high-value products. Develop standards for circular wood-based industries.</i>	



	Promote sustainable forest management	<i>Define sustainable harvest levels and link biomass use to reforestation requirements. Launch research projects on biodiversity and climate impacts of biomass.</i>	<i>Implement regional agroforestry pilots. Adjust biomass policies based on monitoring results and scientific findings.</i>	
WASTE VALORIZATION	Enable Decentralization of OW Management	<i>Change waste regulation to end current monopoly. Introduce open tenders and permits so that municipalities or cooperatives can run local organic waste collection and composting.</i>	<i>With legal barriers removed and awareness high, Hungary should see a growth in community-level composting and waste valorization projects. Mid-term evaluations are useful to provide additional funding or technical support to regions lagging behind. A large share of organic waste is being composted or converted to energy locally.</i>	<i>The vision is a near-circular economy for organic materials, where virtually all organic waste is recycled into useful products: compost, biogas, biofuels, biochar, animal feed, or nutrients.</i>
	Improve Collection and Infrastructure	<i>Rapidly expand the reach and ease of organic waste separation. By the end of 2025 launch nation-wide outreach to educate citizens on using brown bins. Provide households with kitchen compost bins.</i>		
	Foster Research and Innovation	<i>Fund research and innovation into technologies for recovering nutrients, side stream valorisation and biochar production.</i>	<i>Construct first biochar production facilities. Work with (agricultural) research institutes to develop guidelines for biochar application on Hungarian soils.</i>	
	Establish Biochar Production Facilities and Integrate Use into Agri Practices			
	Promote the Use of Recycled Organic Compost in the Agri Sector	<i>Launch promotional campaigns and free courses on soil structure improvement, including through using organic compost</i>	<i>Launch full-scale programs to return organic matter to soils. Offer incentives (i.e. subsidy bonus or tax credit) for farmers using certified compost on their fields.</i>	
NATURE TOURISM	Support Development of Sustainable Infrastructure	<i>Create incentive programs for eco-friendly tourism facilities. Launch grants and tax breaks for lodgings that use</i>	<i>Implement larger-scale sustainable infrastructure projects. Most major national parks and rural tourist regions should have</i>	<i>The long-term aim is for Hungary to become a leading example of sustainable nature tourism in Central Europe. Tourist growth and</i>



		<i>renewable energy and waste reduction systems.</i>	<i>eco-friendly lodging options and improved connectivity.</i>	<i>nature conservation go hand in hand. Local communities benefit consistently, profits from tourism fund local conservation and community projects, creating a positive feedback loop.</i>
	Empower Local Communities and Farmers	<i>Organize workshops and training for rural communities and farmers on developing sustainable tourism offerings. Roll out a first wave of subsidies or micro-grants to local eco-tourism initiatives that meet sustainability criteria.</i>	<i>Expand support programs for community-based tourism. Evaluate which communities succeeded and why. Scale the program with more funding rounds, certification scheme.</i>	
	Promote Sustainable Tourism	<i>Create and promote a national “Nature Tourism” brand. Launch marketing campaigns highlighting Hungary’s nature tourism in a sustainable light.</i>	<i>Solidify brand and adjust strategy to ensure tourism growth remains sustainable (avoiding overtourism in fragile areas)</i>	
SUSTAINABLE HEALTHY DIETS	Integrate Healthy and Organic Foods into Public Catering	<i>Update 2014 public catering standards by 2026 to reflect modern nutrition and sustainability. Increase government funding for public canteens to afford higher quality local ingredients.</i>	<i>Following new regulation and funding, monitor and assist public institutions in providing healthier menus. Aim for at least 50% of public canteens to meet updated nutrition and sustainability standards by 2028 and 100% by 2030.</i>	<i>Cultural and dietary shifts are slow but noticeable changes are taking place. The long-term goal is permanent improvement in public health and environmental impact from diets.</i>
	Phase Out Subsidies for Meat Production and Support Transition to Other Agricultural Practices	<i>Develop a roadmap by 2026 to gradually redirect subsidies. Starting in 2027, incrementally reduce subsidies for industrial meat production and fund programs that help affected farmers shift to alternative production.</i>	<i>Gradually execute phase-out plan for meat and dairy subsidies. Reduce certain percentage of subsidies with saving reallocated to support vegetable growers, pule proteins or other farming. The gradual approach cushions the economic impacts on farmers.</i>	
	Awareness Raising	<i>Implement nationwide campaigns about healthy eating and the environmental impacts of excessive processed meat consumption. Use school curricula, media and public health initiatives to improve nutritional knowledge.</i>	<i>Continue and expand healthy and sustainable diet campaigns.</i>	



Financing the transition

The Actions outlined above require a combination of institutional, societal, and economic support. The latter is a core component, without which a sustainable bioeconomy cannot be achieved. As such, in this subsection we outline the main financing mechanisms that could enable such a transition. Financing Hungary's bioeconomy transition takes place at three levels: EU funding sources; National Budget and Domestic Financing; and Private Investments and Public-Private Partnerships.

Funding from the European Union is available through the Common Agricultural Policy (CAP) rural development programs and Cohesion Policy Funds. The former provides support for organic farming, while the latter has funding opportunities for biomass heating plants and waste recycling. Horizon Europe offers continuous research grants for bioeconomy projects. The Just Transition Fund and Innovation Fund both target green energy and net-zero investments. Hungary's fraught relationship with the European Union has somewhat limited its ability to access funds; therefore, it is vital that the country ensures compliance with EU transparency standards, develops strong project pipelines, and improves its administrative capacity.

National spending on sustainability has been relatively low in Hungary. There are existing national funds supporting organic farming and rural development, and the National Research, Development and Innovation Fund (NKFI) has occasionally funded bio-based innovation research. However, there are also various state subsidies for environmentally harmful practices, including the meat and dairy industry, large-scale infrastructural development, and so on. A reallocation of these subsidies towards the sectors mentioned in this Roadmap would help facilitate the shift to a circular bioeconomy. In addition, state-owned banks such as MFB could offer targeted loans for bioeconomy projects.

Private capital is crucial for upscaling bioeconomy initiatives such as biogas plants, biorefineries, and eco-tourism infrastructure. Expanding green finance options, tax breaks, and green public procurement would act as incentive mechanisms for successful private investments.

In general, Hungary faces several financing challenges, including low domestic green spending, regulatory uncertainty that discourages bioeconomy investment, over-reliance on EU funds without strong national co-financing, and misaligned subsidies that support unsustainable practices. Overall, the country should increase its national funding for bioeconomy programs, reallocate agricultural and energy subsidies to bioeconomy sectors, and better use EU financial instruments. We suggest the setting up of a Bioeconomy Transition Fund to support the successful development of the circular bioeconomy.

Evaluation and monitoring

Identified risks for implementation

There are several risks and challenges that may hinder the implementation of Hungary's bioeconomy roadmap. The following chapter outlines these challenges, along with recommended actions for mitigation.

Financial Barriers: as mentioned in the Financing chapter, limited funding, hesitant investor attitudes, a lack of adequate green financing mechanisms, and banks not playing a significant role in fostering the bioeconomy can inhibit bio-based investments and start-ups from emerging. This is further complicated by overly complex administrative burdens and subsidy programs that do not directly target bioeconomy sectors.

Mitigation: It is therefore important to develop supportive funding schemes, leverage EU funds, and provide state-supported mobilization of capital to de-risk bioeconomy projects. In addition, targeted subsidy programs with simplified administrative burdens would further enable investments.

Data and Knowledge Gaps: There is also a significant lack of data on key bioeconomy indicators, such as the true availability of biomass; bioenergy sustainability; environmental, societal, and economic impacts of the bioeconomy transition; and more. Furthermore, a lack of national expertise and information sharing can further slow down innovation. Experts have also identified the lack of clarity on who is responsible for data collection, as well as the lack of a common platform connecting different bioeconomy sectors (in addition to the existence of too many atomized platforms and initiatives).

Mitigation: Establishing a robust knowledge base and information-sharing network that maps national biomass resources, value chains, and stakeholders and using digital tools for data collection (see below) will enable fact-based decision-making and enhance innovation. Cross-sector cooperation can focus on establishing common knowledge-sharing platforms, such as annual conferences, while involving young researchers could contribute to building in-house expertise.

Low Awareness and Engagement: There is currently inadequate public awareness about the importance of the bioeconomy, as well as of the opportunities within such a transition. Many stakeholders – including market actors – are not fully informed of the various bioeconomy aspects explained above (i.e., organic waste collection, organic farming, sustainable diets), limiting not only the support for such initiatives, but also the bottom-up demand for transforming our current systems. Short-termism, reactivity, and a lack of follow-up projects, as well as a lack of involving younger generations and elderly populations are additional barriers to developing the bioeconomy.

Mitigation: Launching awareness campaigns, hubs, education programs, and strengthening multi-stakeholder platforms including young and elderly populations – such as the Hungarian Bioeconomy Forum working together with other project initiatives and sectoral working groups – will foster awareness, trust, and understanding of the value of the bioeconomy. In addition, adopting best practices from partner countries with successful bioeconomy roadmaps, LEADER projects, as well as local action groups can help avoid common pitfalls.

Policy Gap and Political Support: Although it is currently under development, as of yet Hungary still lacks a dedicated bioeconomy strategy and a common bioeconomy terminology used by all sectors. In addition, there also seems to be an overall lack of political support for the bioeconomy transition. The lack of strong policy drivers, inconsistent policies, a fragmented legal framework, and a focus on financial penalties instead of incentives weakens the feasibility of bio-based initiatives. This also trickles down to a lack of support for civil society organizations who could play a crucial role in the bioeconomy.



Mitigation: The finalization and adoption of a National Bioeconomy Strategy, as well as streamlining regulations, policies, and financial instruments, will help create an enabling environment. In addition, increasing support for civil society organizations could foster healthy collaboration between societal groups, industry, and governance.

Monitoring and Evaluation: currently there are inadequate monitoring and evaluation tools to assess the effectiveness and progress within bioeconomy sectors.

Mitigation: Creating a single collaborative platform and implementing the monitoring and evaluation tools suggested in the next section can assist in keeping track of progress within the bioeconomy.

Competition of Bioeconomy Sectors: An additional challenge may arise because various bioeconomy sectors compete for the same limited resources. For instance, agricultural by-products are simultaneously crucial for organic agriculture (as compost), bioenergy (as feedstock), or other forms of waste valorization (as biochar, etc.). However, there are also serious shortages of skilled and unskilled labor that require addressing.

Mitigation: Up-to-date data, efficient policy regulation, cross-border and cross-sectoral cooperation can ensure that strict limits are imposed on certain bioeconomy inputs and that procuring such inputs is diversified. Fiscal programs preventing brain drain and labor shortages are vital.

Monitoring the progress of the roadmap and recommended actions

The transition to a circular bioeconomy is incredibly challenging precisely because it requires a transformation of entire economic systems, value chains, knowledge networks, societal and cultural norms, and governance schemes. Therefore, robust monitoring is essential for success. By setting measurable targets and regularly evaluating progress, stakeholders can ensure that the transition stays on track. Monitoring also provides an early-warning system that allows for timely intervention and subsequent adjustments. In addition, the bioeconomy transition is a transition that spans many years and electoral cycles. In such a changing and volatile context, political and public support is very much dependent on being able to demonstrate tangible progress over time.

The following key progress indicators could provide the first step in building a comprehensive, stakeholder-based monitoring framework.

1. **Biomass for energy:** a. Solid fuels: percentage of biomass sourced from certified sustainable forestry operations. Baseline: currently lacking b. Liquid biofuels: share of liquid biofuels derived from non-food or second-generation feedstocks. Baseline: currently lacking c. Gaseous biofuels: volume of biogas produced annually from agricultural and organic waste. Baseline: currently lacking d. Renewable energy in transport: share of renewable bio-based energy in the transport sector. Baseline: Currently approximately 8% of transport energy comes from renewables (mainly biofuels). e. Renewable energy in heating: share of renewable energy in heating and cooling. Baseline: Current share approximately 20%.
2. **Sustainable Agriculture:** a. Share of organic farmland: percentage of agricultural land under organic farming. Baseline: currently 6% of the country's farmland is under organic



- cultivation. b. Percentage of farmland under agroecological or regenerative practices. Baseline: currently lacking.
3. **Sustainable Forestry:** share of forest area under certified sustainable management. Baseline: approximately 15% (Corticeiro et al., 2024)
 4. **Waste valorization:** a. Waste-to-energy or bioproduct output: quantity of energy or products generated from biowaste (i.e., biogas in GWh, tons of biofuel/compost/biochar). Baseline: currently lacking. b. Biowaste recovery rate: percentage of total biological waste that is recycled or reused. Baseline: Two-thirds of total waste is not recovered currently.
 5. **Sustainable Healthy Diets:** annual per capita consumption of locally sourced foods. Baseline: currently lacking.
 6. **Bioeconomy contribution to GDP and jobs:** the economic and employment share from bio-based sectors. Baseline: approximately 6.2% of the country's total GDP and employs around 374,500 individuals.
 7. **Number of bioeconomy initiatives:** an up-to-date database keeping up with active bioeconomy projects, enterprises, and organizations. Baseline: currently lacking.



Moving forward with the implementation

Knowledge transfer opportunities

The CEE2ACT findings presented in this Roadmap so far have highlighted that the availability, accessibility, and state-of-the-art of knowledge is a crucial determining factor in the success of the circular bioeconomy transition. While fostering and developing 'in-house' national expertise through better funding mechanisms and research grants is crucial, concerted cross-country knowledge transfer and capacity-building initiatives are equally important. National Bioeconomy Hubs and other multi-actor collaborations – such as innovation hubs, living labs, and regional demonstration sites – play a vital role in this process. Through facilitating structured knowledge exchange and practical training, they bridge research with real-world application. These hubs emphasize the importance of including bioeconomy know-how into formal and vocational education programs. Furthermore, by sharing best practices and aligning stakeholder efforts, such mechanisms limit the risks associated with a lack of expertise.

Digital tools available

In a world where technological change takes place with increasing speed, digital tools are essential components of monitoring and evaluating the bioeconomy progress. CEE2ACT has developed four such digital tools that can assist decision-makers and other stakeholders:

1. The [CEE2ACT online inventory of good practices](#) promotes existing projects, initiatives, and best practices to inspire potential new ideas and knowledge exchange. The inventory serves as a dynamic knowledge hub for stakeholders across all Roadmap focus areas. By showcasing successful practices from Hungary and other EU regions, it supports the scaling and replication of tested solutions – such as biomass cascade models, biodiversity-friendly afforestation, etc. Furthermore, it can provide policymakers with reference models for policy alignment, as well as providing innovation pathways for farmers, entrepreneurs, and researchers.
2. The [CEE2ACT self-assessment tool](#) for bioeconomy promotion supports administrative bodies to evaluate the current state of the bioeconomy in their region and provide them with recommendations and additional information to support bioeconomy initiative implementation. The tool enables local and regional authorities to assess their readiness and performance across the Roadmap's priority sectors. It supports evidence-based planning by identifying policy gaps, governance bottlenecks, and sectoral strengths. For instance, a region with high biomass potential but weak valorization infrastructure can use the tool to prioritize such investments.
3. The [CEE2ACT e-learning platform](#) that promotes bioeconomy and sustainable governance practices for capacity building and knowledge transfer. The platform addresses the Roadmap's cross-cutting need for education, skills development, and inclusivity (of younger generations, elderly, skilled and unskilled labor, etc.).
4. The [CEE2ACT matchmaking online tool](#) that fosters business collaboration aimed at bringing together relevant stakeholders from different European regions and countries. It directly supports the Roadmap's ambition to create a collaborative and innovation-driven bioeconomy by connecting Hungarian actors with peers, technologies, and markets across Europe. It is especially relevant for sectors like Waste Valorization, Biomass for Energy, and High-value Wood Utilization, where circular business models rely on industrial cooperation.



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