BioReCer

# Biogenic Waste and Residues – A Valuable, Renewable Resource

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**Biogenic waste, residues and wastewater sludge hold valuable components, such as carbon, omega-3 fatty acids, enzymes, antioxidants and vitamins. They are valuable resources for bio-based products that can substitute fossil feedstocks, and should therefore not be wasted. However, biogenic waste, residues and wastewater sludge are often discarded and incinerated or end up as landfill, which causes pollution and greenhouse gas emissions.**

**The valorisation and use of biogenic waste and residues as resource, if managed properly, can significantly contribute to the transition of a linear economy to a sustainable circular bioeconomy. This way, greenhouse gas emissions are reduced and the EU can become more independent of third-country suppliers of fossil resources.**

**This factsheet describes the characteristics of biogenic waste and residues as valuable resources, explains the challenges and benefits of their valorisation and use for bio-based products, and gives an overview over current European legislation.**

## What are Biogenic Waste and Residues?

Biogenic waste is any waste of biological origin including waste derived from living organisms (plants, fungi and animals) and waste composed of organic matter, i.e. remains of dead plants and animals, and faeces. Residues, on the other hand, are materials that are not deliberately created in a production process. They can be classified as either waste or by-products, depending on their characteristics and intended use.

### Characteristics of Biogenic Waste and Residues:

- Biogenic waste and residues represent a renewable/ regrowing carbon-based feedstock. This distinguishes them from finite resources such as fossil carbon (oil, gas, coal).
- This biological feedstock differs in nature due to the fact that biogenic waste and residues can come in liquid or solid state, with more or less water content.
- Due to being waste, by-products or residues from upper production streams, these resources are not only cheap but also widely available. Nevertheless, the quality and content of this resource can vary and is also dependent on climate, weather, seasonality, soil composition and other variable environmental conditions.
- Biogenic waste and residues are biodegradable, meaning that they can be broken down by microorganisms into simpler compounds.

### Common Examples[1]:

- **Food waste** (kitchen and canteen leftovers, spoiled food, peeling and trimming)
- **Garden waste** (grass clippings, leaves, branches, and flowers)
- **Forestry by-products from wood processing industries** (branches from tree pruning, spruce and pine cones, fallen leaves, bark, black liquor)
- **Agricultural residues** (crop residues, wastes from fruit and olive processing, manure, and straw)
- **Industrial biogenic waste** (residues from milk processing, food- and vegetable-processing, biodiesel production, fishery industry)
- **Industrial and municipal sewage sludge** (biogenic matter separated from wastewater during treatment processes)

Across the European Union, between 118 and 138 million tons of biogenic waste arise annually, of which currently only about 40 % (equivalent to 47,5 million tons per annum) is effectively converted into high-quality compost and by-products. As up to 50 % of municipal solid waste is biogenic, the biogenic fraction plays an important role in recycling and the advancing circular bioeconomy.[2]

## Benefits of Using Biogenic Waste and Residues as Resource

Valorising and utilising biogenic waste and residues as sustainable, renewable feedstocks offer a multitude of benefits across various sectors. By embracing biogenic waste and residues as feedstock, waste is no longer viewed as a burden but rather as an opportunity for innovation and transformation.

- The wide adoption of biological resources **lowers greenhouse gas emissions.** Also, it **reduces landfill and prevents eutrophication and pollution** caused by the spilling of nutrients and harmful toxic pollutants into the environment.
- Sustainable sourcing of biogenic waste and residues **supports biodiversity conservation and responsible land use practices** like reforestation and habitat protection as less primary biomass derived from agriculture and forestry is used.
- The problem of **food waste** is tackled by valorising municipal organic waste and using it **as a valuable resource for bio-based products.**
- Using biogenic waste and residues instead of food crops for the production of bio-based products raises **no unsubstantiated concerns about competition with food production and potential impacts on food security and land use.**
- **Valuable metabolites** such as vitamins, fatty acids, antioxidants and lignin are not lost or discarded but **can be extracted and used.**
- By utilising locally and regionally sourced biological resources, **industries can reduce their dependence on foreign suppliers,** enhancing resilience and promoting economic self-sufficiency, while **reducing transport emissions.** Also, utilisation of biological feedstock reduces reliance on fossil-based resources, diversifies feedstock sources and enhances supply chain resilience.
- Technologies used in biogas plants and for co-processing **enable the conversion of waste biomass into high-value products** such as biofuels or biochemicals or cellulose-based fibres for the textile industry.
- The use of biological resources **promotes the growth of the circular bioeconomy.** Investments in bio-technologies drive research and development in sustainable waste management practices, contributing to economic growth and competitiveness, which also offers social benefits by **creating new green jobs.**
- Supporting small-scale farmers and local communities involved in biomass production **promotes fair trade and sustainable livelihoods.**

Overall, the valorisation and use of biological resources derived from biogenic waste and residues enhances resource efficiency and environmental protection, leads to economic growth, reduces reliance on fossil feedstocks and offers social benefits.

# Challenges of Valorisation and Use

The valorisation and use of biogenic waste and residue streams face several challenges, despite their potential environmental and economic benefits:

## Availability

The availability of biogenic residues is often only seasonal and can fluctuate based on factors such as agricultural cycles and weather or climate conditions. This seasonality can pose challenges for industries that need a steady supply of feedstock and may require the development of storage or preservation methods to bridge gaps in supply. Also, while biogenic waste and residues may be abundant on a small scale, increasing their production to meet commercial demand can be challenging. Factors such as land availability, infrastructural requirements, and national regulatory constraints may limit the scalability of biomass related processes.

## Certification

The gaps in current certification and labelling schemes (LCS) regarding biological waste and resources can hinder market acceptance and thus the overall growth of the circular bioeconomy. LCS provide assurance that biomass sources, their value-chains and derived bio-based products meet certain sustainability criteria, such as environmental performance, social responsibility and safe working conditions. The lack of suitable LCS makes it difficult for the industry to take up biogenic waste and residues as sustainable feedstock. Also, due to insufficient certification and labelling, businesses, consumers and policy makers find it difficult to differentiate between sustainable bio-based products and products with unsubstantiated green claims. Adapting LCS by adding standards for biological waste streams based on relevant sustainability and circularity indicators is essential for building trust, fostering market development and uptake, and promoting sustainable practices throughout the bio-based value chains.

## Collection

Biogenic waste and residues are not necessarily collected in all EU countries. There are heterogenous national waste management regulations across the European Union, which hinders the development of an EU wide organic residues market. Furthermore, across the EU organic residues are marketed and used for low value-added applications and managed with the least favourable waste management options, i.e. for energy generation in the form of biogas or incineration and composting for soil amendment. Furthermore, biogenic waste and residues can vary significantly, e.g. in volumes and nature (solid or liquid). This variability makes it difficult for collection and waste management, to standardise processes and may require complex pre-processing steps to ensure consistent output.

## Nature of Biogenic Waste and Residues

This biological feedstock often has a high weight due to its usually high moisture content or its liquid form. This makes transportation and utilisation more difficult.

## Regulatory and Policy Frameworks

Regulatory and policy frameworks governing the collection, treatment, and utilisation of biomass residues can vary widely even between regions as well as countries and pose barriers to implementation. Harmonising regulations at EU level and incentivising sustainable practices are essential for promoting the widespread adoption of conversion technologies.

## Storage and Handling

Due to quick microbial decomposition, biogenic waste and residues may require specialised storage and handling facilities to prevent spoilage, degradation, or the release of harmful gases such as methane. Managing these logistics of collecting, transporting, and storing large quantities of these materials can be complex, costly and limit reach.

## Technological Development

Developing efficient and cost-effective technologies to convert biogenic waste and residues into valuable products remains an ongoing challenge. Research and development efforts are needed to improve conversion efficiencies, reduce costs, and enhance the overall sustainability of biological conversion processes.

## Tracking and Traceability

The current destination for most of the biological resources is a low added-value market. This is because their way through the value-chain is often not tracked and untransparent. This lack of traceability information continues to hinder their availability, use and profitability for the industry. Also, traceability information is often not accessible for bio-based industries leaving them unaware of the potential of the biological resources produced in their regions.

## Underestimation

Biogenic waste and residues are often underestimated or dismissed as inferior feedstock. Contrary to this misconception, the chemical composition often mirrors that of primary feedstock. Additionally, unfounded concerns regarding health and hygiene persist. It is imperative to acknowledge that biogenic waste and residues undergo rigorous purification processes, adhering to stringent health and safety standards, occasionally even surpassing those of fossil-based materials.[3]

## Variability and Quality

Biogenic waste and residues can vary significantly in composition and quality. In rare cases, biogenic waste can contain contaminants such as heavy metals, pesticides and pathogens. Removing these contaminants can be challenging and may require advanced treatment methods, resulting in higher costs.

## Infobox: Bio-based Products and their Applications

Bio-based products derived from conversion of renewable bio-genic sources find applications in a variety of different sectors – from agriculture to household items and transportation – providing alternatives to traditional fossil-based products.

**Examples include:**

- Bio-based chemicals, adhesives and coatings
- Bio-based plastics and bio-composites
- Biodiesel and biogas
- Cellulose-fibres for the textile industry
- Fertilisers such as compost, wastewater sludge or biochar
- Nutra- and pharmaceuticals

## EU Directives and Regulations Governing Biowaste

Several EU directives address and include biogenic waste and residues as a valuable resource with high potential for use in various industries.

### Waste Framework Directive (2008/98/EC)[4]

Sets the legal framework for waste management in the EU. It defines bio-waste as a separate waste stream and demands its separate collection and treatment. Emphasises the hierarchy of waste management, prioritising prevention, reuse, recycling, and energy recovery over disposal.

### Landfill Directive (1999/31/EC)[5]

Limits the landfilling of biodegradable municipal waste, including biogenic waste, to reduce methane emissions and groundwater pollution. Encourages diverting bio-waste away from landfills towards more sustainable treatment options such as composting and anaerobic digestion.

### Circular Economy Action Plan[6]

Aims to transition to a circular economy model where resources are used more efficiently and waste is minimised. Promotes separate collection and high-quality recycling of biogenic waste and residues to retain its value and reduce reliance on landfilling or incineration.

### European Green Deal[7]

Seeks to make the EU's economy sustainable by reducing greenhouse gas emissions and promoting resource efficiency. Supports initiatives to increase the recycling and valorisation of bio-waste as part of broader efforts to mitigate climate change and environmental degradation.

## The BioReCer Project

The BioReCer project aims to assess and complement current certification schemes for biological resources according to the new EU sustainability goals to enhance bio-based circular systems. This will be achieved by including new criteria that align with EU taxonomy and EU corporate due diligence regulations into guidelines for certifying biological resources' sustainability, origin, tracking and traceability (T&T), and by ensuring applicability at EU and global scale. By promoting the sustainability and trade of biological resources, BioReCer will increase the added value, use, as well as social acceptance of bio-based products.

The findings will be validated in four European case studies, each focusing on a specific bio-waste value-chain: Forestry waste and residues in Sweden, waste, wastewater and algal sludge from fishery in Spain, organic fraction of municipal solid waste and wastewater in Italy and agricultural waste and residues in Greece.

## References


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3 https://cefic.org/a-solution-provider-for-sustainability/chemistrycan/driving-the-circular-economy/replacing-fossil-fuels-with-bio-based-feedstock/

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5 https://eur-lex.europa.eu/eli/dir/1999/31/oj/eng

6 https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en

7 https://www.consilium.europa.eu/en/policies/green-deal/


For more factsheets, the BioRecer policy brief on valorisation and use of biogenic waste and residues, the project video and more information on the BioReCer project, please visit

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