



CELEBio

D.3.1 NATIONAL ACTION PLAN: SLOVENIA

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Summary

Slovenia has an excellent resource base and can use bioeconomy as an opportunity to optimise productivity and potential from existing natural resource assets. This will offer significant prospects for improved circularity, optimal use of resources and meeting the needs of modern society in terms of health and well-being, the environment, food, energy, materials, and chemicals.

The Slovenian chemical industry is particularly inclined towards biobased economy. The spectrum of bio-based products is quite broad, covering polymers for textile industry, various coatings, resins, wood-derived chemicals, plant extracts, biological drugs etc. One of the most vital issues impeding extension of bio-based industry is lack of commercial bio-refineries in Slovenia.

A few regional bio-based initiatives are already in place, among whom SRIP Circular Economy is in the lead, while CEL.CYCLE is the largest research, development and innovation project; beside CELEBio also Bridge2Bio is performing the mapping of bioeconomy, the latter is also linked to the BIOEAST etc. However, there are no international flagship bio-based projects at present or even domestic at high TRLs.

Slovenia does not have a strategy for the purpose of fostering bioeconomy, however there are regulations, developmental goals and priorities that are encompassed in the nation strategy called the Slovenian Smart Specialization Strategy (S4).

The Vision for the Slovenian Bioeconomy developed with national stakeholders in CELEBO aims to:

- Boost productivity and value added in lagging bioeconomy sectors
- Consolidate economic and environmental performance of conventional biomass manufacturing sectors (food & drinks, wood processing, pulp & paper) by technological advancing and by closing local biomass flows and cascading use of biomass.
- Capitalise R&D excellence in technological innovations ready to deploy by biobased industries in Slovenia, in particular for more efficient biomass uses and low- bulk & high-value applications.
- Establish a modular network of biorefinery capacities to increasing the level of industrial symbiosis between conventional and novel bioeconomy sectors.



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1. Introduction

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

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

The second introduces the Bioeconomy Vision, the value chains selected by national stakeholders and outlines how they fit to the three main priorities² from the 2018 Update of the European Bioeconomy Strategy³:
Strengthen and scale-up the bio-based sectors, unlock investments and markets.
Deploy local bioeconomies rapidly across Slovenia.
Understand the ecological boundaries of the bioeconomy.

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

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

¹ [Slovenia-Country-Report.pdf \(celebio.eu\)](#)

²

https://ec.europa.eu/research/bioeconomy/pdf/bioeconomy_line_actions.pdf#view=fit&pagemode=none

³ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018DC0673&from=EN>

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2. Bioeconomy in Slovenia

Current state

Bioeconomy in Slovenia had an annual turnover of seven billion Euros in 2017 which translates to 67,000 Euros per person employed in the sector with the EU27 average figure being 127,000 Euros.

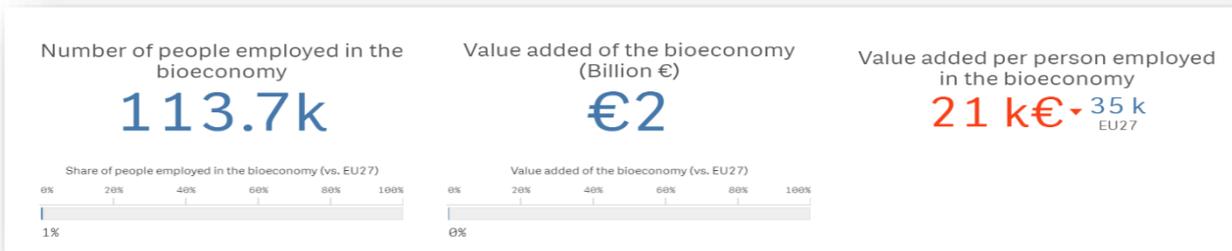


Figure 1 Jobs and wealth in the Slovenian bioeconomy in 2017 (source: datam.jrc.ec.europa.eu)

The value added from the bioeconomy sector in the country was 2 billion Euros and in the same year there were 113,700 people employed.

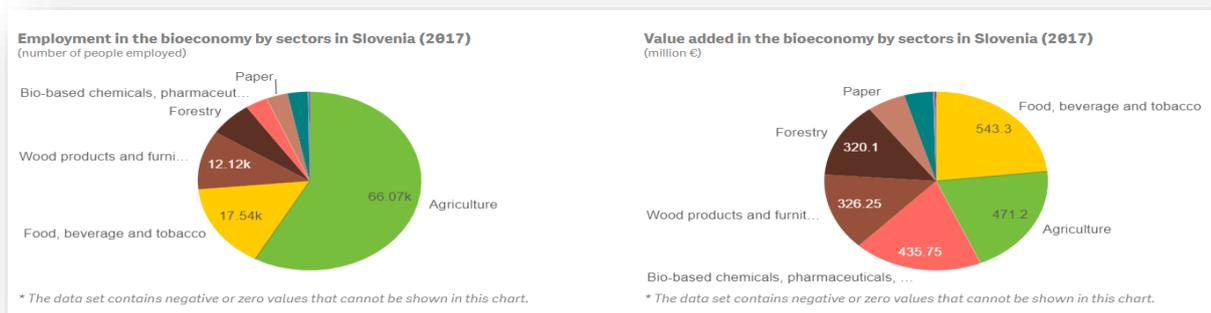


Figure 2 Employment and value added in the bioeconomy by sectors in Slovenia in 2017 (source: datam.jrc.ec.europa.eu)

Agriculture remains the biggest sector in terms of employment (59% of the total number of people employed) with food, beverage, and tobacco as well as wood products and furniture following with much smaller shares (15.4% and 10.7% respectively). In terms of value added the aggregate category of forestry, wood products and furniture is first with 0,65 billion Euros (32% of total value added- TVA) food, beverage, and tobacco contribute follow with 0.54 billion Euros (27% of TVA), agriculture is third with 0.47 billion Euros (23.6% of TVA) and biobased chemicals, pharmaceuticals follow with 0.44 billion Euros (21.7% of TVA).

Based on JRC biomass balances (https://datam.jrc.ec.europa.eu/datam/mashup/BIOMASS_FLOWS/index.html) the main biomass supply (quantities below are all expressed in million tons of dry matter) is primary wood biomass (2.65), crops (2.33) and grazed biomass (0.682). The production of biomaterials and bioenergy is not as prevalent in Slovenia as food production. Wood biomass is the main export and greatest supply in Slovenia. Biofuels are not produced from crop residuals. Almost half of the wood produced is exported as roundwood (1.17) and the other half is converted to heat and power bioenergy (1.32), solid wood products (0.939) and wood pulp (0.33).

Strengths, opportunities and barriers



- Accelerated generational renewal – improved age and education/skills structure
- Accelerated investment cycle – improved technological and economic performance
- Quality professional institutions and organizations in the field of research, education and consulting
- Suitable conditions for irrigation (availability of water, precipitation)
- Production systems with moderate intensity, resulting in quality products and solid environmental performance

- Promoting access to specialized advisory services
- Increasing demand for sustainably produced local product of higher quality and products from above standard breeding.
- Promotion of organic farming
- Weak horizontal (eg. producer organisations) and vertical (eg. Value chains) integration in agri-food sector renders it difficult to organise biomass efficiently

- Agriculture in general is not very attractive to younger generations
- Poor economic and environmental performance and high exposure to climate change
- Restructuring is slow due to lack of own resources to co-finance investments



- Forestry abundance (58 % of surface is covered by forest)
- Good accessibility (forest roads)
- Availability of up-to-date data on forests (Slovenian Forest Service, Slovenian Forestry Institute, Wood Chain Manager) and strong support at sustainable management of forests

- Development of innovative and high-added value products
- Job creation
- Consolidation of local markets
- Increased competitiveness of the country

- High dispersion and fragmentation of forest ownership hampering devoted management
- Extensive export of wood instead of creating high value-added products within the county
- Lack of owners' willingness to mobilise forest feedstock



- Awareness and willingness of citizens to separately collecting waste
- Presence of the most modern regional waste management centre in Europe (RCERO)

- Development of innovative and high-added value products
- Job creation
- Increased competitiveness of the country
- Reduction of landfill costs
- Extension of landfill's lifetime

- Lack of better capabilities to treat broader spectrum of waste
- Waste accumulation

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Policy mechanisms relevant to bioeconomy in Slovenia

Slovenia does not have a strategy for the purpose of fostering bioeconomy, however there are regulations, developmental goals and priorities that are encompassed in the nation strategy called the Slovenian Smart Specialization Strategy (S4). It directs the use of funds in the context of Operational Programme for the execution of the European cohesion policy for the 2014-2020 period. The S4 also applies to other funds and instruments of the developmental policy. An important document is "Transition signpost towards a green economy (2018)"⁴ (Slo. "Kažipoti prehoda v zeleno gospodarstvo (2018)"), which is more recent and up to date. It deals with bioeconomy as an integral part of the circular economy; another noteworthy program is the Rural Development Program.

There are several other frameworks that serve as a general support for bioeconomy in Slovenia, and they include both funding from the EU, as well as from the Ministries⁵.

Errore. L'origine riferimento non è stata trovata. the policy mechanisms that are currently operational in Slovenia.



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

⁴ Lovec M, Juvancic L, Mesl M. Družbeni kontekst prehoda v biogospodarstvo / Social context of the transition into bioeconomy. BRIDGE2BIO.

⁵ Brkanovic S. Case Study Report [Slovenia]. Mapping the EU Member States' / regions' Research and Innovation plans & Strategies for Smart Specialisation (RIS3) on Bioeconomy.

3. Vision and implementation plan

The aim of the Vision for the Slovenian Bioeconomy is to:

Boost productivity and value added in lagging bioeconomy sectors (in particular agricultural production)

Consolidate economic and environmental performance of conventional biomass manufacturing sectors (food & drinks, wood processing, pulp & paper) by technological advancing and by closing local biomass flows and cascading use of biomass.

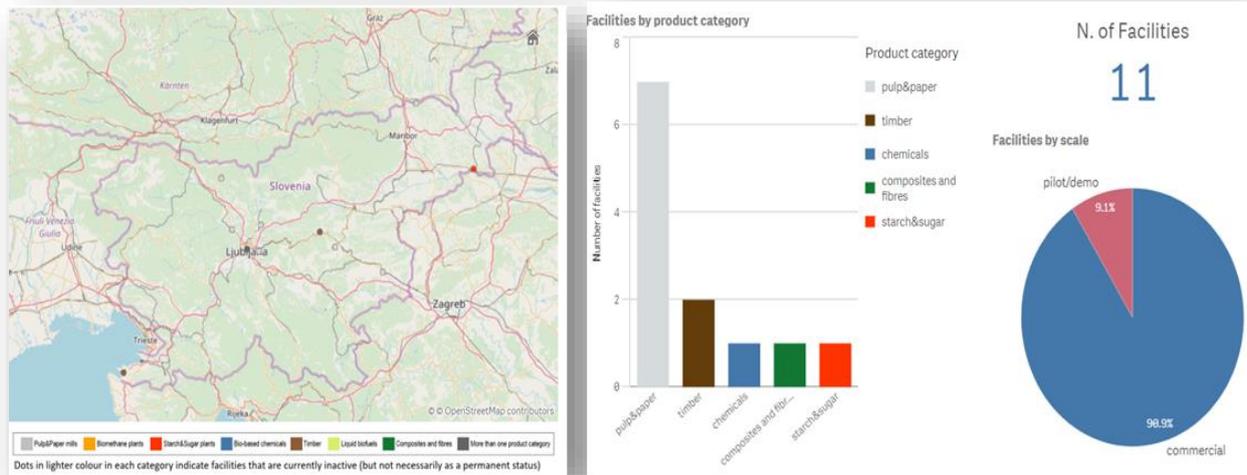
Capitalise R&D excellence in technological innovations ready to deploy by biobased industries in Slovenia, in particular for more efficient biomass uses and low- bulk & high-value applications.

Establish a modular network of biorefinery capacities to increasing the level of industrial symbiosis between conventional and novel bioeconomy sectors.

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

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



the existing industrial infrastructure.

Figure 4 Biobased industry plants in Slovenia

(source: https://datam.jrc.ec.europa.eu/datam/mashup/BIOBASED_INDUSTRY/index.html)

Figure 4 Biobased industry plants in Slovenia Provides and overview of the biobased industry plants in Slovenia. There are currently eleven facilities operating in the country within the pulp and paper, timber, chemicals, composites and fiber. In addition to other industrial sectors, domestic chemical industry is particularly inclined towards going biobased. Spectrum of bio-based product is quite broad, covering polymers for textile industry, various coatings, resins, wood-derived chemicals, plant extracts, biological drugs etc. One of the most vital issues impeding extension of bio-based industry is lack of commercial bio-refineries in Slovenia.

A few regional bio-based initiatives are already in place, among whom SRIP Circular Economy is in the lead, while CEL.CYCLE is the largest research, development, and innovation project. Similarly to CELEBio project, the nationally funded project Bridge2Bio provides the quantitative evidence on various biomass potentials, motivates stakeholders to better exploit the bioeconomy potentials, and develops recommendations to decision-makers (policy, industry associations). This effort is integrated with macro-regional activities, most notably the BIOEAST initiative and its BIOEASTsUP CSA project. However, there are few international flagship bio-based projects (InnoRenew CoE, <https://innorenew.eu/sl/>) at present or even domestic at high TRLs. According to future biomass valorisation the bio-refining is much of an interest. A Slovenian (additional) „Valley of death“ is due to lacking basic/commodity chemicals.

Work in CELEBIO has suggested that a large-scale biomass bio-refinery may not be optimal for Slovenia. Better fit seems to be achieved by local (hence smaller) bio-refinery concept. There is an ongoing initiative led by NIC and PPI, promoting a network of local (modular, potentially mobile) biorefinery operations, capable of processing diverse and

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mixed residual (lignocellulosic) biomass as a feedstock for locally-sourced materials' production. The technological platform has been developed and is ready for installation at demo-scale.

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

Deploy local bioeconomies rapidly across Slovenia

The value chains mentioned above and selected by national stakeholders fit well the regional distribution of biomass raw materials across Slovenian regions.

Value chains from agriculture & food industry

Agricultural production in Slovenia is determined by natural conditions for agricultural production. Grassland is by far the prevailing land use with 58%, followed by arable area (36%) and perennial crops (6%). For this reason, ruminant-based livestock production prevails in agricultural production (predominantly cattle breeding – dairy, beef). Another livestock sector with significant output and solid organisation is poultry. As for the plant production, the most widely cultivated crops are maize (fodder) and cereals while leguminoses (soya) and oil crops (sunflower, rape and turnip rape seeds) are cultivated in a smaller area. The predominant permanent crops are fruit crops, grapes, and olives.

Southern Slovenia is the region with the highest concentration of forest biomass (almost 8 million tonnes per year), central Slovenia, Savinja and Gorizia (with almost 7 million tonnes per year) and Drava and Upper Carniola and Gorizia following with quantities ranging around 6 million tonnes per year.

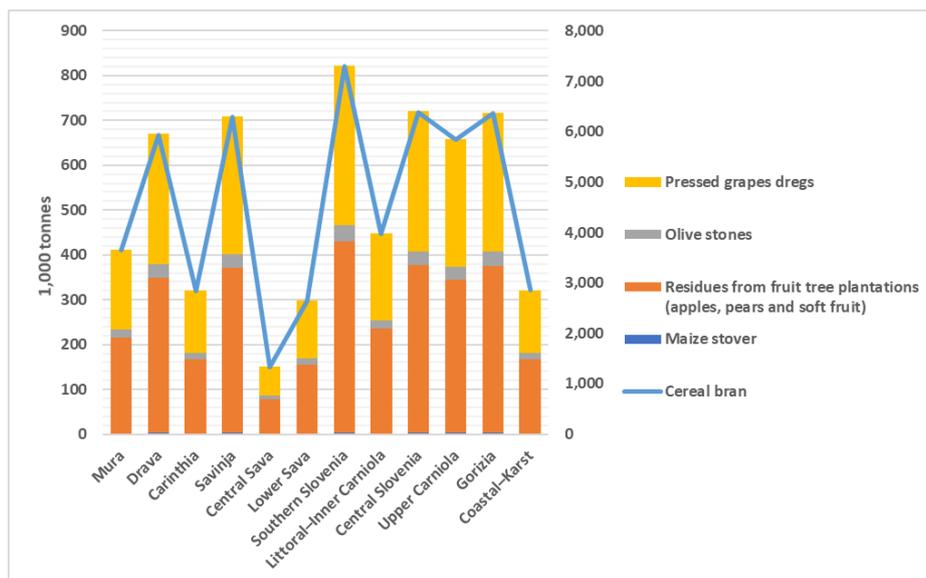


Figure 5 Biomass potential from agriculture and food industry in Kton d.m. (S2Biom Base 2020 potential)

Slovenia had over seven hundred (733) registered food processing enterprises in 2017, and this number has been growing for at least the last five years. The most common types of such enterprises are in the field of Manufacture of bread, manufacture of fresh pastry goods and cakes (322/733), followed by production of meat and poultry meat products (53/733), processing and preserving of meat (42/733) and manufacture of beer (32/733). The biggest employer is Perutnina Ptuj d.d. (poultry production), the enterprise with the highest net sales revenue in Slovenia and in foreign markets is Droga Kolinska d.d.(food-processing) and the enterprise with the highest total added value is Pivovarna Laško d.o.o. (brewery).

Residues from food and fruit processing represent an excellent opportunity to improve cost efficiency of agro-food processing companies. While food processing industry is generally well-adapted and able to keep up the pace with the technological development, the strongest potentials for valorisation of biomass side-streams are in the largest and most consolidated sectors, ie. the brewing industry, dairy industry and manufacture of grain mill products.

The value chains selected by the national stakeholders are:

- manure (550,000 t d.m. annually) -> biogas installations -> energy -> organic fertilisers
- residues from cereal processing (e.g. beer pomace, residues in the processing of cereals) -> extraction / biotechnological processes -> enzymes, bioactive compounds -> food & feed additives, ; biorefinery (bioactive compounds, platform chemicals) -> biobased materials (bioplastic, bio-composites) -> biogas plants -> energy
- residues from dairy production (mainly sour whey) -> extraction / biotechnological processes -> food additives, enzymes / biorefinery -> platform chemicals -> biobased materials
- slaughter residues, residues from meat processing -> thermal processing -> processed fats (oleochemical industry, cosmetics) / proteins (animal feed) -> biogas installations -> energy -> organic fertilisers

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Value chains from forestry

Southern Slovenia is the region with the highest concentration of forest biomass (almost 1.2 million tonnes per year), Savinja (with almost 0.8 million tonnes per year) and Drava, central Slovenia, Upper Carniola and Gorizia following with quantities ranging around 600,000 ktonnes per year.

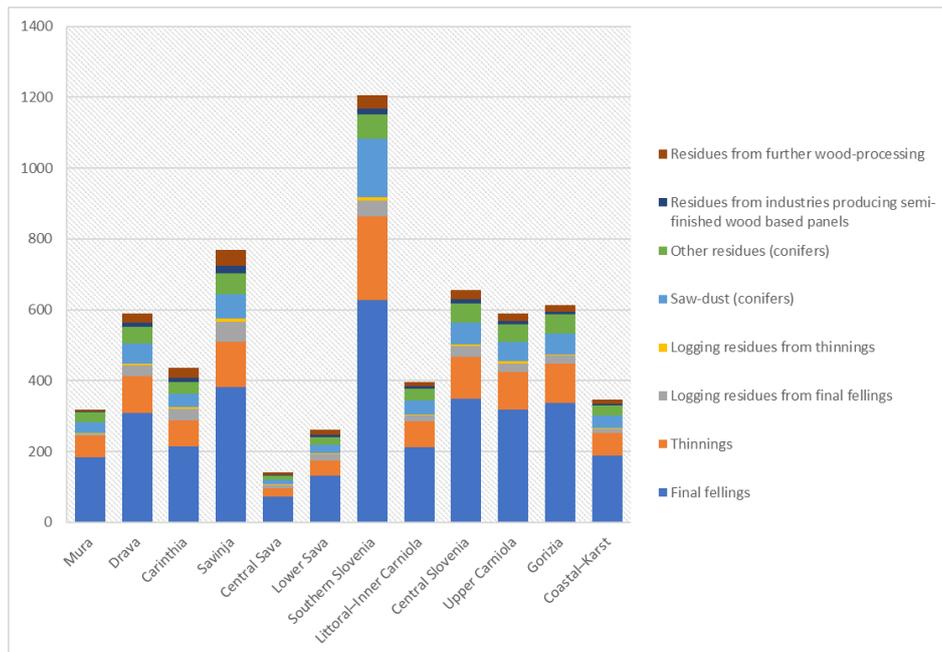


Figure 6: Biomass potential from forests and forest industry in Kton d.m. (S2Biom Base 2020 potential)

With regard to the fact that 58% of the country area is covered with forests and that the annual felling reaches up to 6 million m³ (70% of which is attributed to conifers), wood biomass represents by far the most perspective biomass stream. In national economy terms, the current use of wood biomass is unfavourable. 75% of conifers is exported as logs, logs, pulpwood and boards account for a further 20%. More than half of deciduous wood (56%) is currently used for firewood, the rest is evenly divided between cellulose wood and boards and logs. The most important exporting countries are Italy and Austria¹⁸. Only a small fragment is exported as added-value products such as chemicals, pulpwood, fibreboard, and particleboard. The sector offers great opportunities for bioeconomy in the field of replacing products of the fossil fuel industry with bio-based products mainly through the development of chemical digestion of lignocellulosic biomass. With the introduction of modern chemical wood processing, changes in the market are also expected, in terms of resource efficient and innovative consumption of low-quality wood and wood residues, as well as investments in bio-refineries.

The value chains selected by the national stakeholders are:

- Logging residues (tree bark, tree knots) -> extractives (eg. tannins, polyphenols) -> green chemistry, food additives
- Wood processing residues (industrial processing eg. plywood / pulp & paper industry / biorefinery -> platform chemicals for biobased materials)

Value chains from wastes

Slovenia is among the countries with the highest percentage of separately collected waste and management of recycling. In 2016, 386 facilities for waste recycling, 180 facilities for backfilling and 10 facilities for waste energy recovery operated in Slovenia. Waste was disposed of in three incineration plants and landfilled at 17 (legal) landfill sites.

The highest potential of biowaste source was assigned to Osrednjeslovenska region. Since Ljubljana is located in that region, the estimates seem to be logic, because of the high population density in this area a lot of waste is generated. Distribution of biowaste potential across the country is also presented on figure 8

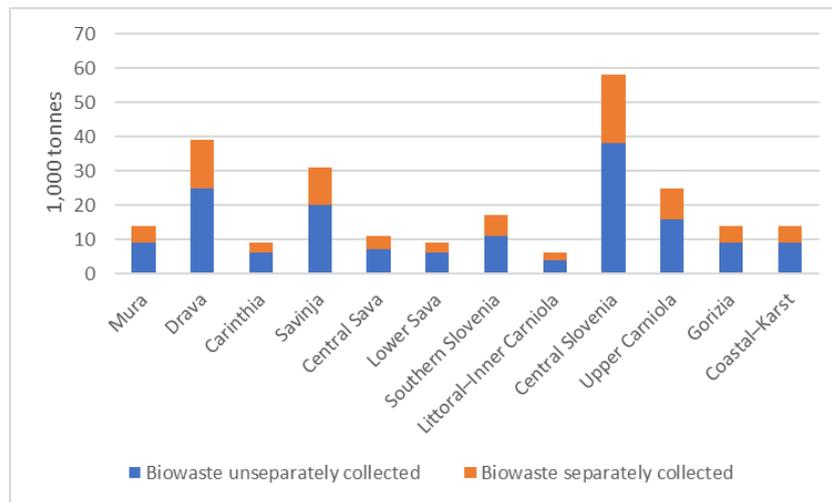


Figure 7 Biomass potential from biowastes in Kton d.m. (S2Biom Base 2020 potential)

The value chains selected by the national stakeholders are:

- urban waste -> biogas installations -> energy -> composting
- food waste -> minimizing food waste -> the inclusion of usable discarded food for human consumption -> use of discarded food for animal consumption -> use of discarded non-food related food / biogas plant as probably the most rational alternative

Understand the ecological boundaries of the bioeconomy

Land use change

Land use is related to raw material production. Emissions from land use change can be significant in some circumstances, however, the simple notion of land use change emissions is not sufficient reason to exclude biomass from the list of worthwhile technologies for climate change mitigation, bioeconomy and circular economy.

The value chains selected for the Slovenian bioeconomy comprise of residual and waste fractions so there is no risk expected from their mobilisation and future exploitation.

Biodiversity

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

Agricultural biomass: medium risks can be anticipated without sustainable practices.

Biodiversity loss when harvesting too many crop residues

Absence of fertilisation with animal manure would reduce microbiological activity

Biowastes: Positive in regions where it avoids landfill

Soil & Carbon stock

Forest biomass: Increased risk of soil erosion; risk to loose soil organic carbon; risk to loose nutrients and risk of reduced soil fertility and soil structure when overharvesting forest residues

There are debates that using the wood in panel boards, creates a carbon stock in comparison to combustion of the wood

Agricultural biomass: Moderate risk to loose soil organic carbon when overharvesting crop residues; risk to loose nutrients when overharvesting

Absence of fertilisation with animal manure would reduce soil organic matter and soil nutrients,

Reduction of soil organic matter and soil nutrients

Biowastes: Positive in regions where it avoids landfill;

Digested organic waste is a source of soil improving material.

Water

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

Agricultural biomass: Reduction of soil water retention capacity, increasing risk of water erosion

Reduction of soil water retention capacity due to lower microbiological activity

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

4. Value chains for the Slovenian bioeconomy

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

Agriculture

Main aim of the selected value chains is to:

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

Forestry

Main aim of the selected value chains is to:

- Development of rural business activities by mobilising new value chains in the context of circular economy
- -New legislation divide State and non-state forests and makes access to funds from state easier (?)
- -Research and Innovation activities towards higher added value products from forest biomass and to increase the share of RES

Wastes

Main actions (based on Opportunities):

- -Increasing efficiency of metal processing and of electricity generation from waste could increase overall resource efficiency

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Manure for biogas & organic fertilisers

Value chain	SDGs	Examples of relevant projects
Manure for biogas & organic fertilisers		<p>https://www.4p1000.org/</p>

Current exploitation of biomass raw materials

- Manure utilization is approximately 10% of the known potential.
- The existing network of biogas plants (those of the order of 1 to 4 MW predominate) consists of oversized installations, causing excessive environmental loads (too little area for fertilization with digestate of biogas plants)

Future actions

Establishment of smaller biogas installations (range of 250 kW) on larger agricultural holdings, or in cooperation with other users (eg local communities) in collective investments

Potential interventions

- Climate & Energy Fund: Subsidy schemes for biogas installations
- Standards for agricultural biomass
- Introduce premiums for manure
- Regulation on agricultural raw materials for biofuels and bioliquids

Expected added value

- Reduced nitrates in the soil.
- Sustainable energy
- Soil carbon sequestration

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

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Residues from agri- food industries

Value chain	SDGs	Examples of relevant projects
dairy production (mainly sour whey) -> extraction / biotechnological processes -> food additives, enzymes / biorefinery -> platform chemicals -> biobased materials		<p>AgriChemWhey Web site https://www.agrichemwhey.com/</p> <p>agrimax Web site http://www.agrimax-project.eu</p> <p>DEMETER Web site http://www.demeter-eu-project.eu</p> <p>EXCornsEED Web site https://www.excornseed.eu/</p>
slaughter residues, residues from meat processing -> thermal processing -> processed fats (oleochemical industry, cosmetics) / proteins (animal feed) -> biogas insallations -> energy -> organic fertilisers		
residues from cereal processing (eg. beer pomace, residues in the processing of cereals) -> extraction / biotechnological processes -> enzymes, bioactive compounds -> food&feed additives, ; biorefinery (bioactive compounds, platform chemicals) -> biobased materials (bioplastic, biocomposites) -> biogas plants -> energy		

Current exploitation of biomass raw materials

Currently most of the dairy residues end up as waste, putting strong pressure on the water treatment facilities

Future actions

- Processing of dairy production residues: extraction of individual fractions (eg lactose, proteins, bioactive peptides), or through biotechnological processes, related extraction of platform chemicals (eg alcohols, polysaccharides, organic acids, biosurfactants, biologically active components and enzymes) or as a raw material for microbial production biomass (eg meat substitute)
- Specialised installation for management of side streams from meat productions, technologically advanced processing with relatively high added-value products; currently, the main challenge is more efficient and environmentally sustainable use of digestate from biogas plant.

Potential interventions

Standards for agricultural biomass

Introduce innovation financing for food SMEs and industries

Regulation on agricultural raw materials for bioeconomy

Expected added value

- Less wastes from food-processing, use of side streams and reduction of negative impact on the environment. Subsequently, improved revenues of all the involved stakeholders.
- Untapped potentials in obtaining functional components and materials (bioactive components, fibrous materials) before energy use

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

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Forest based value chains

Value chain	SDGs	Examples of relevant projects
<p>Lower quality wood assortments (industrial processing eg. plywood / pulp & paper industry / biorefinery -> platform chemicals for biobased materials)</p>		<p>Web site https://www.bioforever.org</p>
<p>Quality wood assortments (furniture production / construction -> wood composites / biorefinery use of side streams -> platform chemicals for biobased materials -> energy)</p>		<p>Web site https://www.luke.fi/efforte/</p>

Current exploitation of biomass raw materials

- Increased logging (5-6 mill. m3 annually), largely on account of emergency logging due to damaged forest stands (climatic events, pests), emergency logging. 75% of coniferous wood (70% of timber harvested) sold as logs, other pulp&paper, plywood. 56% of deciduous wood used as firewood; From the point of view of the long-term perspective, this is a category that will gain in importance with changes in forest stands (growing share of beech). On the long-run (due to climate change), beech production will increase, bringing additional potential for biorefining processes and the subsequent production of new bio-based materials.
- Low value-added of timber harvested in Slovenian forests;
- Fragmented ownership structure, which makes it difficult to establish efficient supply chains; 76% of forests in Slovenia are privately owned, 314,000 owners, average size of forest holding is 2.9 hectares.

Future actions

- Increased commercial use of roundwood within Slovenia, strengthening technologically more advanced alternatives to the energy use of lower quality wood assortments; optimization of logistics flows, primary processing at the local level and biorefining.

Potential interventions

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

Expected added value

- Bring lower quality wood to better use than energy use, i.e. bio-based processes (biorefinery)

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

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Value chains based on biowastes

Value chain	SDGs	Examples of relevant projects
<p>residues in the paper industry (primary sludge, in particular) -> biofuels / fertilisers (in case of primary sludge with high carbohydrate contents) / construction materials (in case of primary sludge with prevailing inorganic fraction)</p> <p>urban waste -> biogas installations -> energy -> composting</p> <p>food waste -> minimizing food waste -> the inclusion of usable discarded food for human consumption -> use of discarded food for animal consumption -> use of discarded non-food related food / biogas plant as probably the most rational alternative</p>		

Current exploitation of biomass raw materials

High cost of disposal of sludge due to cross-border transport (no disposal capacity in Slovenia)

Future actions

- Awareness raising about waste sorting and collection.
- Development of biogas plants that would utilize untapped waste streams. Communication with all relevant stakeholders on improving the legislative framework

Potential interventions

- Incentives for the use of waste for biogas production (subsidies) and fostering the development of clean and renewable energy production. This could include penalties and rewards for energy production, depending on their environmental impact.

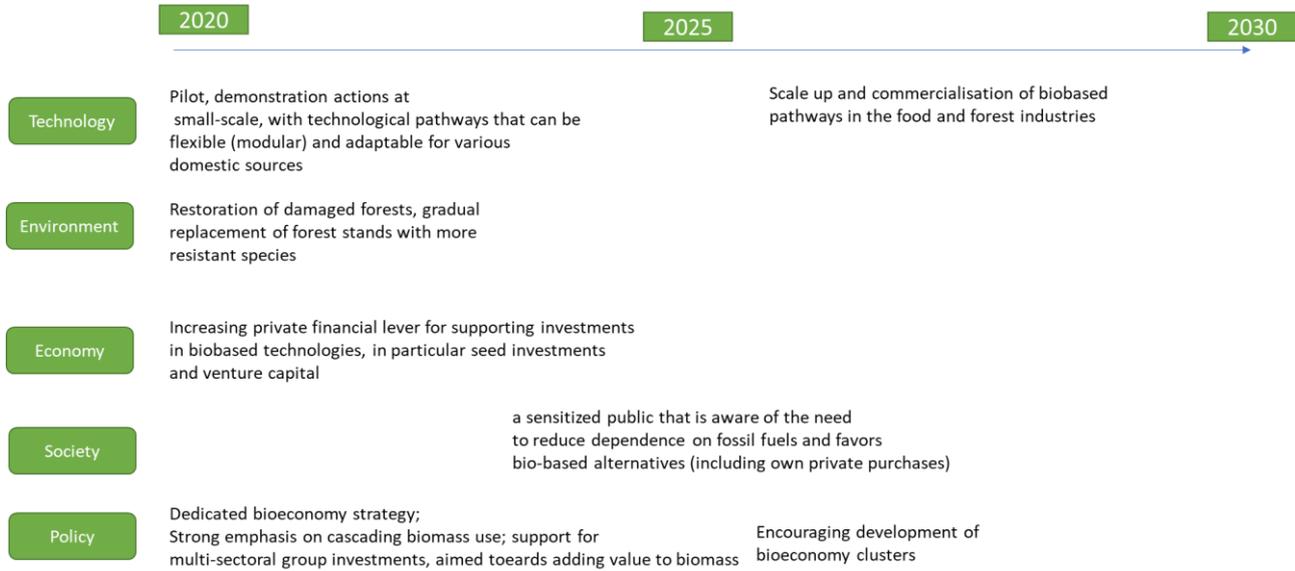
Expected added value

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

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

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5. Implementation plan



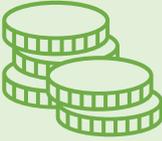
Actors and funding opportunities

Action ⁶	Actors involved	Indicative cost	Funding instruments
Pilot, demonstration actions at small-scale, with technological pathways that can be flexible (modular) and adaptable for various domestic sources (T)		2020-2025: 10 million € 2025- 2030: 20 million €	Eco-Fund: Loan, subsidy and tender for RES-E RES-H new building obligation
Scale up and commercialisation of biobased pathways in the food and forest industries (T)		2025- 2030: 50 million €	Next Generation EU Action Plan on financing sustainable growth
Restoration of damaged forests, gradual replacement of forest stands with more resistant species (Env)		2020-2025: 10 million €	Action Plan on financing sustainable growth CAP
Increasing private financial lever for supporting investments in biobased technologies, in particular seed investments and venture capital (Econ)		2020-2030: 50 million € private funds	
Informed citizens that are aware of the need to reduce dependence on fossil fuels and favors bio-based alternatives (S)		2020-2030: 5 million €	Action Plan on financing sustainable growth
Dedicated bioeconomy strategy; Strong emphasis on cascading biomass use; support for multi-sectoral group investments, aimed towards adding value to biomass (P)		2020-2030: 1 million €	Action Plan on financing sustainable growth
Encouraging development of bioeconomy clusters (P)		2020-2030: 10 million €	Action Plan on financing sustainable growth

⁶ T: Technology; Env: Environment; Econ: Economy; S: Society; P: Policy

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

 <p>JOBS</p>	<p>Create 1,000 new jobs in agriculture, forestry and food processing industry</p>
 <p>LEVERAGE INVESTMENTS</p>	<p>Leverage 50 million € private investments within ten years</p>
 <p>FOSTER COLLABORATIONS</p>	<p>Cluster creation At least ten new collaborations between raw material providers and industrial actors</p>
 <p>BOOST INNOVATION</p>	<p>Eight new biobased value chains embedded in agriculture, food, and forest industries. Produce ten new patents and IP rights, Support the creation of ten spin-offs and start-ups.</p>

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7. Potential environmental impact of Slovenian Bioeconomy Action Plan

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