Circular economy country profile 2024 – Slovenia

European Environment Agency
European Topic Centre
Circular economy and resource use

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European Topic Centre on
Circular economy and resource use
https://www.eionet.europa.eu/etcs/etc-ce

Contents

Introduction

The European Commission requested the EEA to produce EU country profiles that offer an updated view of the following elements:

- what circular economy policies are being implemented at a national level with a particular focus on elements that go beyond EU mandatory elements, and
- what are best practices with a focus on policy innovation.

With the EU Circular Economy Action Plan (CEAP 2020) "the Commission [..] encourages Member States to adopt or update their national circular economy strategies, plans and measures in the light of its ambition".

These country profiles originate in the work leading to the EEA More from less report (2016)[1], that presented an overview of approaches to material resource efficiency and to circular economy in thirty-two European countries. The More from Less report was followed by the 2019 EEA Report 'Resource efficiency and the circular economy in Europe 2019 – even more from less: An overview of the policies, approaches and targets of 32 European countries'[2].
It presented an updated and extended assessment of approaches and identified trends, similarities and new directions taken by countries in the connected policy areas of resource efficiency and the circular economy.
These reports, comprising a compilation of extensive survey responses from countries, were accompanied by 32 country profiles.

In the second quarter of 2022 a new survey with questions and guidelines was launched. Based on information reported by the Eionet network, in particular, the Eionet Group on Circular Economy and Resource Use, and after review and editing by the European Topic Centre on Circular economy and resource use (ETC CE), the 30 2022 CE country profiles[3] were published alongside the EEA report 'Circular Economy policy innovation and good practice in Member States'[4] (2022).

These 2024 CE country profiles are an update of the 2022 ones and based on the responses of 29 countries to the survey questions and guidelines that were launched in March 2024. The information in the countries' responses was again reviewed and edited by the European Topic Centre on Circular economy and resource use. A selection of Eurostat data was made to further complement these country profiles.

The main objectives of these assessments and its updates are to: • stimulate exchange of information and share good practice examples among country experts; • support policymakers in Eionet countries, the European institutions and international organisations by providing an updated catalogue of circular economy actions being undertaken in European countries.

This circular economy country profile is based on information reported by the Eionet network and, in particular, the Eionet Group members on Resource Efficiency and Circular Economy in the second quarter of 2024. Proposals for the further development or amendment of policies represent the view of the reporting country. For Slovenia, all input was provided by the Ministry for the Environment, Climate and Energy of Slovenia and Slovenian Environment Agency. The information was reviewed and edited by the European Topic Centre on Circular economy and resource use. A selection of Eurostat data was made to further complement this country profile.

[1] More from less — material resource efficiency in Europe — European Environment Agency (europa.eu)
[2] Resource efficiency and the circular economy in Europe 2019 — European Environment Agency (europa.eu)
[3] Country profiles on Circular Economy in Europe — Eionet Portal (europa.eu)
[4] draft-report-for-dg-env_final.pdf (europa.eu)

The information is current as of September 2024, when members of Eionet verified the content of this profile.

Slovenia – facts and figures

GDP: EUR 63.1 billion (0.4 % of EU27 total in 2023)

GDP per person: EUR 29,750 (purchasing power standard) (91 % of EU27 (from 2020) total per person)

Use of materials (domestic material consumption (DMC))
31 million tonnes DMC (0.5 % of EU27 total in 2022)
14.6 tonnes DMC/person (103.1 % of EU27 average per person in 2022)

Structure of the economy (2023):
Agriculture: 2.1 %
Industry: 32.8 %
Services: 65.1 %

Employment in circular sectors:
15,816 people employed in CE sectors (0.4 % of EU total in 2021)
People employed expressed as a percentage of total employment: 1.5 % (compared to 2.1 % for EU average in 2021)

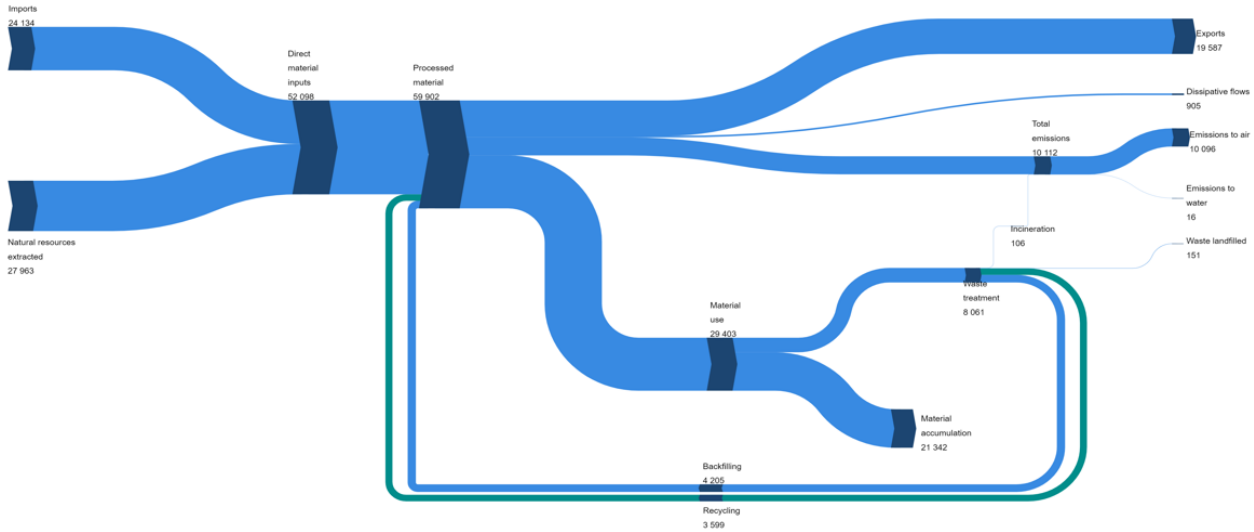
Surface area: 20,273 square kilometres (0.5 % of EU27 total)

Population: 2,116,972 (0.5 % of EU27 total in 2023)

Note: all definitions and metadata used in this profile are taken, as shown, from Eurostat

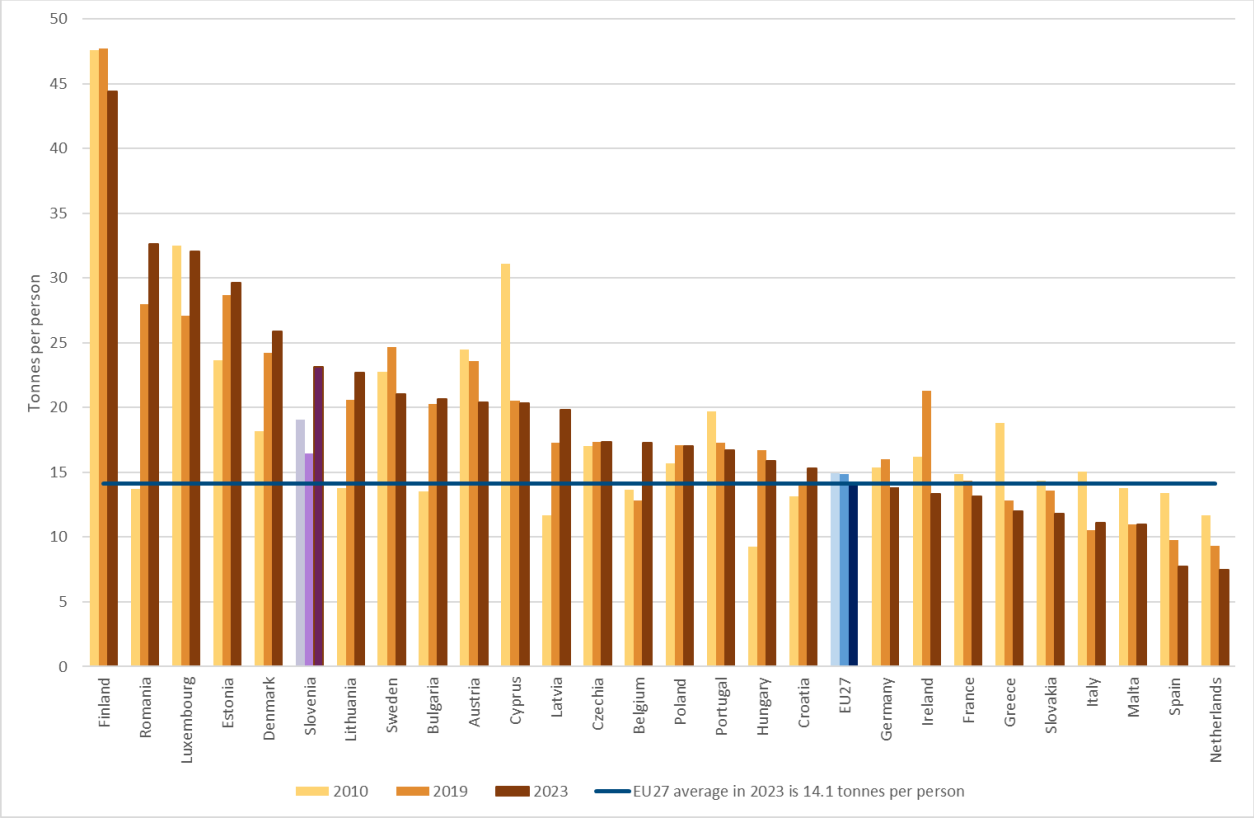
Source: Eurostat datasets, EU27 2021 EU27 2022 and EU27 2023 (accessed 21 August 2024)

Figure 1 Material flow diagram for Slovenia in 2022, thousand tonnes



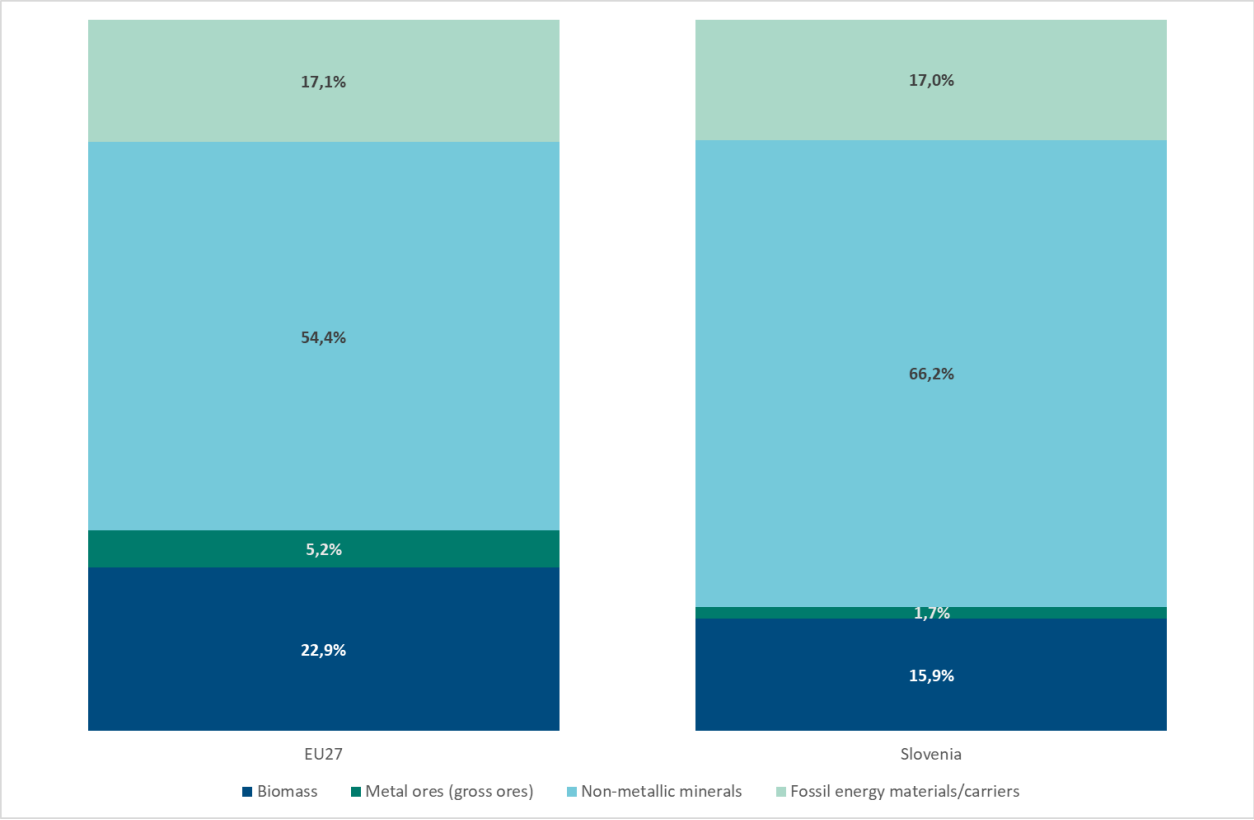
Source: Eurostat (2024) [env_ac_mfa], [en_ac_sd], [env_wassd] (accessed 21 August 2024)

Figure 2 Material footprint (raw material consumption), 2010, 2019 and 2023, tonnes per person



Source: Eurostat (2024) [env_ac_rme] (accessed 21 August 2024)

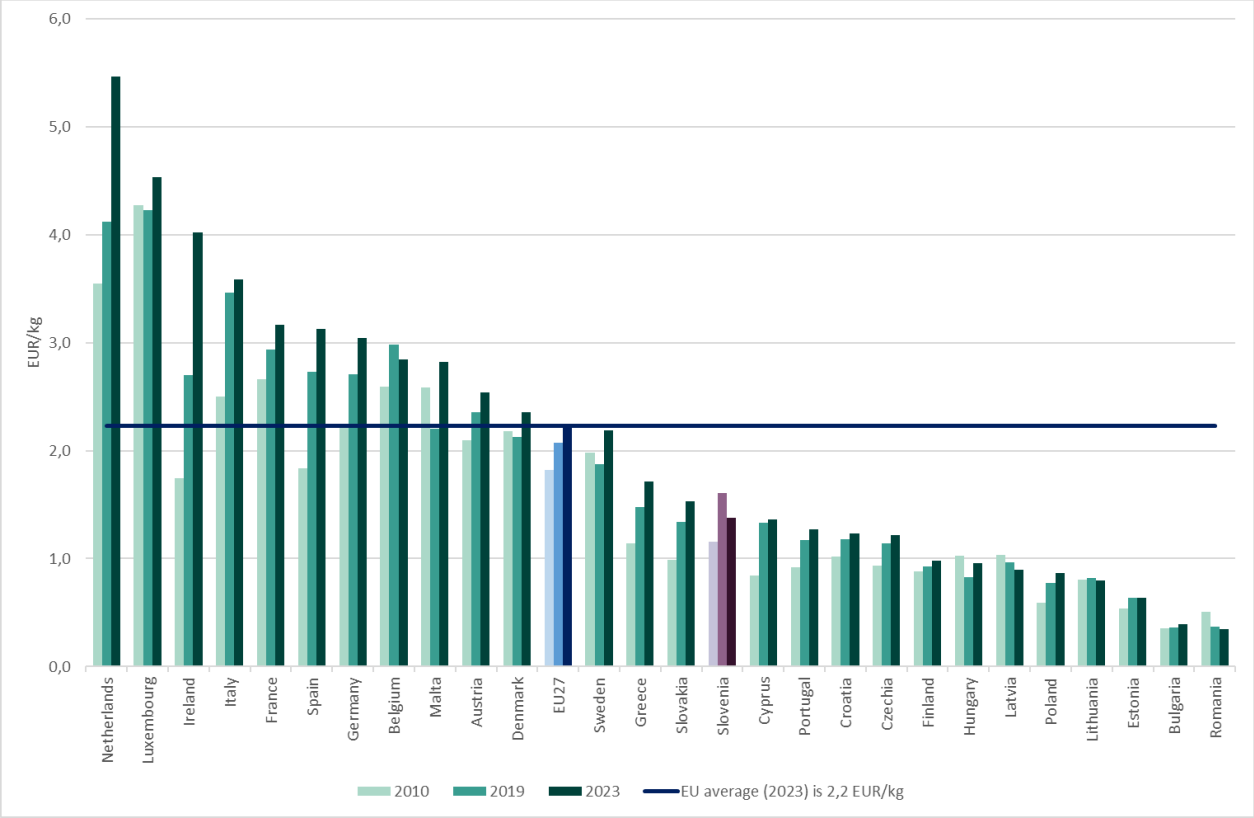
Figure 3 Domestic material consumption by selected material category, EU and Slovenia, 2023, per cent



Note: totals may not sum to 100 % due to rounding

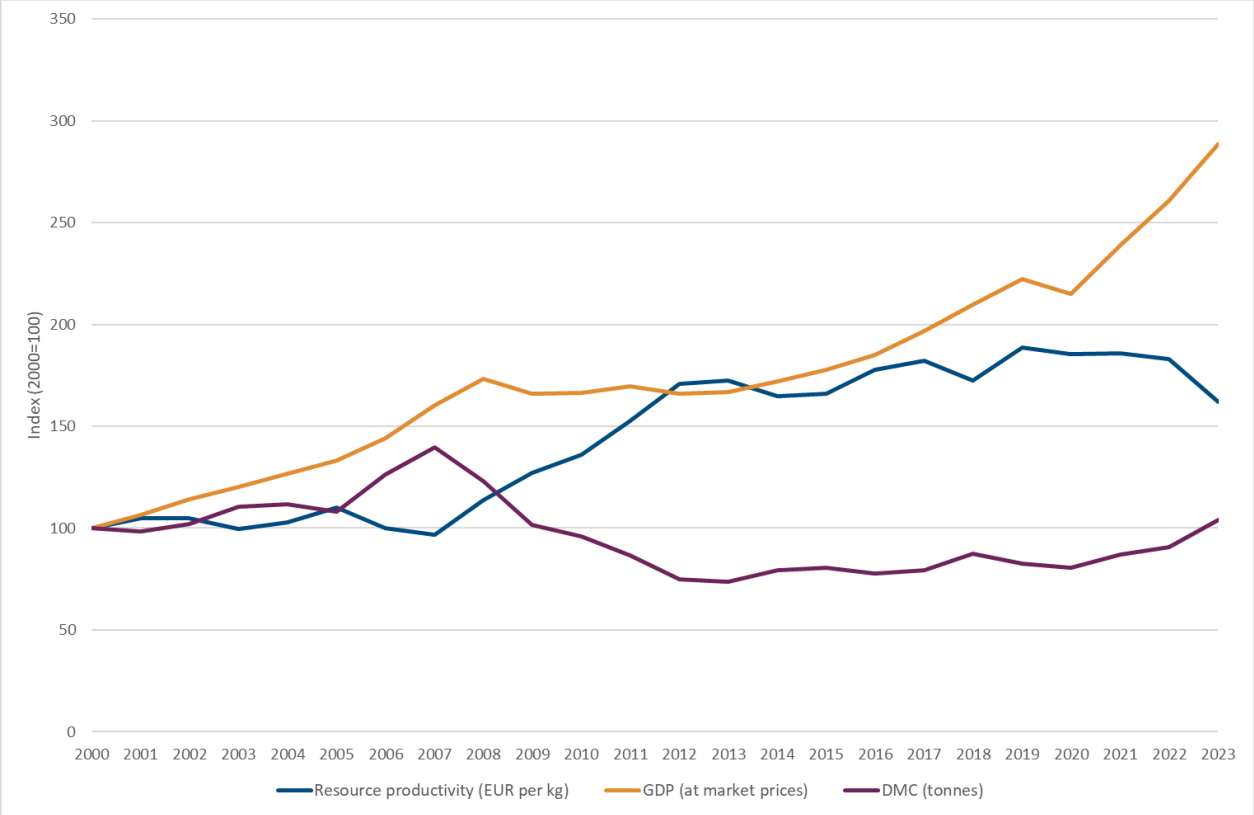
Source: Eurostat (2024) [env_ac_mfa] (accessed 21 August 2024)

Figure 4 Resource productivity (gross domestic product/domestic material consumption), EU27, 2010, 2019 and 2023, EUR per kilogramme



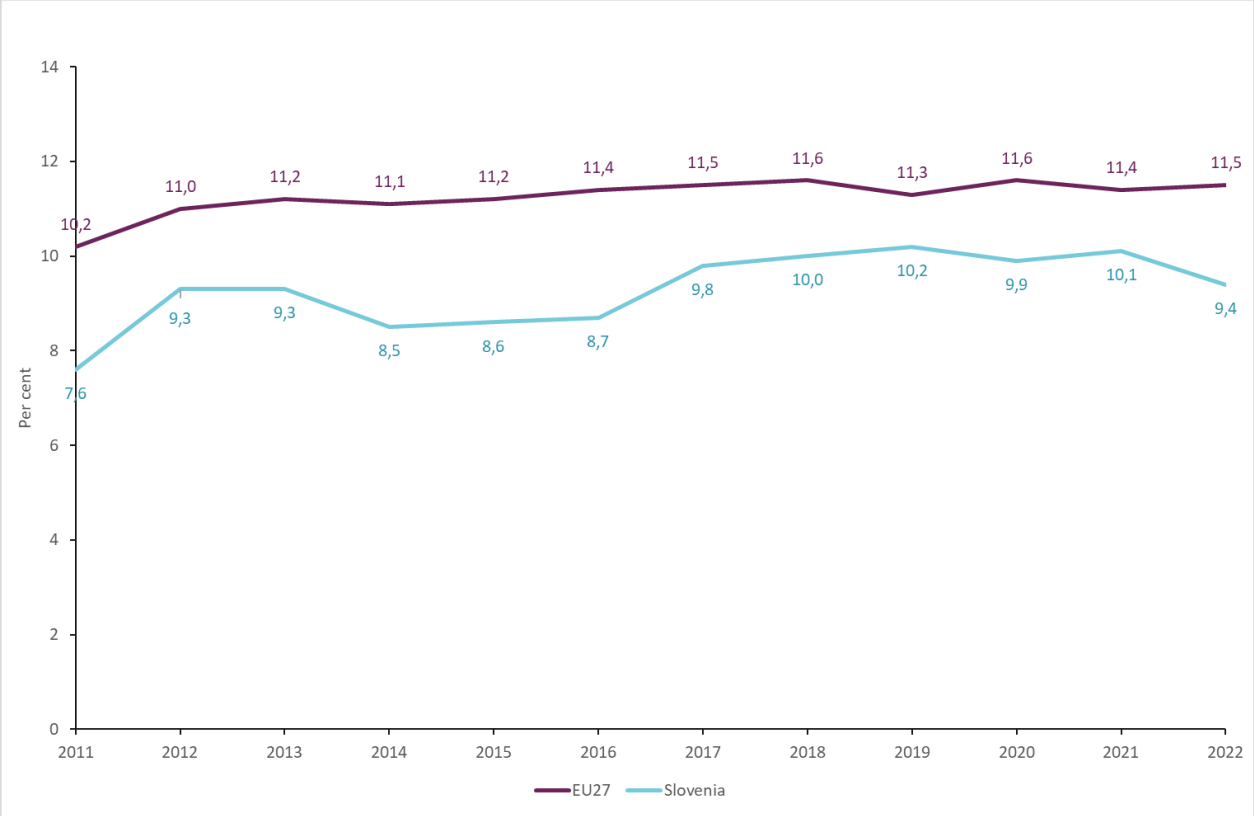
Source: Eurostat (2024) [env_ac_rp] (accessed 21 August 2024)

Figure 5 Gross domestic product, domestic material consumption and resource productivity trends, Slovenia, 2000–2023, index (2000=100)



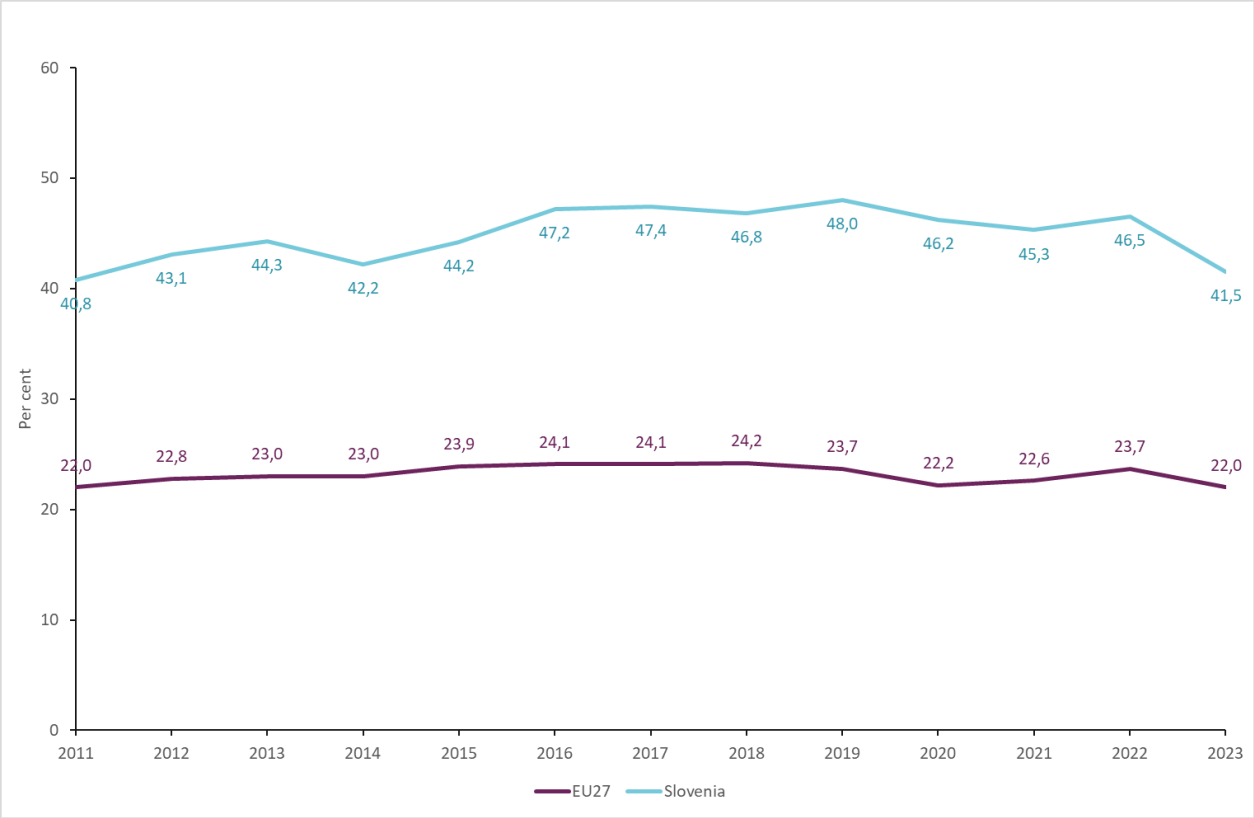
Source: Eurostat (2024) [env_ac_mfa], [env_ac_rp] & [nama_10_gdp] (accessed 21 August 2024)

Figure 6 Circular material use rate in Slovenia, 2011–2022, per cent



Source: Eurostat (2024) [env_ac_cur] (accessed 21 August 2024)

Figure 7 Material import dependency in Slovenia, 2011-2023, per cent



Source: Eurostat (2024) [cei_gsr030] (accessed 21 August 2024)

Existing policy framework

Dedicated national and/or regional strategy, roadmap or action plan for circular economy

The Slovenian government adopted a Roadmap towards the circular economy ([5]) in 2018. The Roadmap is understood as a process, rather than a one-off, finite document. It was designed with the aim of setting guidelines for Slovenia to allow for a controlled and expedient systemic transition into a circular economy. In the narrowest sense, it is directed at the Slovenian government, but in a broader sense, it is also aimed at all the interested stakeholders who have proven themselves invaluable co-creators in the process of creating this document. They hold numerous examples of good practices that often go unnoticed or unsupported. Recognised priority areas in the Roadmap are: the food system, forest-based value chains, manufacturing industry and mobility. The roadmap towards the circular economy was adopted in 2018 and has not been updated since.

A **regional strategy** for a transition to circular bioeconomy - Podravje 2023–2030 ([6]) was started in 2022.

Dedicated local strategy, roadmap or action plan for circular economy

Circular Cities and Zero Waste Cities

City of **Maribor** ([7])
Strategy for the transition of the city of Maribor to a circular economy ([8])

City of **Ljubljana** ([9])
Sustainable urban strategy of Ljubljana municipality 2014–2030 ([10])

Circular economy policy elements included in other policies

Slovenia has a special component on Circular economy in the **Slovenian recovery and resilience plan (2021-2026)** ([11]), which addresses challenges related to achieving climate neutrality by 2050, increasing material productivity, promoting energy efficiency and eco-innovation, improving the waste management system and strengthening the wood processing chain. The component also introduces green budgetary planning.

The objective of the component is supporting the transition of Slovenia's linear economy to a low-carbon circular economy, in line with **Slovenia's Development Strategy 2030** ([12]) and the new EU Circular Economy Action Plan: 'Towards a Cleaner and More Competitive Europe'.

In line with that, Slovenia is implementing a reform on Establishing a Framework for sustainable and green transformation. The objective of the reform is to accelerate the transition to a circular economy for resource efficiency. A strategic and legal framework for the transition to a circular economy shall be established to improve extended producer responsibility and promote the integration of recycled materials into new products. The reform is establishing green budgetary planning by introducing a methodology aimed at identifying and assessing elements of the public budget that affect environmental

[5] Roadmap towards the circular economy in Slovenia
[6] https://circulareconomy.europa.eu/platform/en/main-language/slovenian
[7] https://circularcitiesdeclaration.eu/cities/maribor
[8] https://rra-podravje.si/assets/docs/krozno-gospodarstvo/Sprejeta-strategija-kroznega-gospodarstva.pdf (in Slovene)
[9] https://zerowastecities.eu/bestpractice/best-practice-ljubljana/
[10] https://www.ljubljana.si/assets/Uploads/Trajnostna-urbana-strategija-od-2014-do-2030-kor.pdf (in Slovene)
[11] https://www.gov.si/en/registries/projects/the-recovery-and-resilience-plan/
[12] https://www.gov.si/assets/ministrstva/MKRR/Strategija-razvoja-Slovenije-2030/Slovenian-Development-Strategy-2030.pdf

policies. The reform does facilitate budget steering and support the coherence of budgetary and fiscal policies with climate objectives. The reform also strengthens the existing green public procurement system by integrating the principles of circular economy. In the framework of the reform, we established a one-stop shop to support businesses, in particular small and medium-sized enterprises (SMEs) in their transition to a circular economy.

An investment in order to increase the resource efficiency of companies and support their transition to a circular economy is also being implemented. Projects under this investment cover supporting start-ups in the field of low-carbon circular economy, training mentors to assist companies in identifying and developing transformative solutions and supporting the circular value chains through environment-friendly business environment for investors. More than 100 companies were supported (17 million EUR).

The second investment is about increased Wood Processing to accelerate the transition to a climate-neutral society. This investment is contributing towards increased domestic wood processing based on an environmentally friendly production process and resource efficiency. This investment is financing new capacity and expansion of existing capacity for wood processing. 63 companies (38 million EUR) were supported.

Moreover, the circular economy research and innovation projects in support of green transition and digitalisation is co-financed under another component of RFF, with altogether 130 projects of 281 beneficiaries with 36.4 million EUR.

Circular economy policy element	**Included in policy**
Waste management and prevention	Waste management programme and waste prevention programme of the Republic of Slovenia (April 2022) https://www.gov.si/assets/ministrstva/MOP/Operativni-programi/op_odpadki_2022.pdf (in Slovene)
Boosting waste recycling into valuable products by setting the environment for a circular economy in Slovenia	Waste management and Waste management Prevention Programme of the Republic of Slovenia (2022-2030) Life Restart (life-restart.si)
Sustainable farming practices	CAP Strategic Plan 2023-2027 https://skp.si/en/cap-2023-2027
Green public procurement([13]) *(further details below)*	https://www.uradni-list.si/glasilo-uradni-list-rs/vsebina/2021-01-2581 (in Slovene)
Decarbonising Slovenia through the transition to a circular economy *(further details below)*	National project Deep Demonstration with EU Climate KIC (2021-2025) https://www.climate-kic.org/circularslovenia-2-2/ https://www.gov.si/zbirke/projekti-in-programi/razogljicimo-slovenijo/ (in Slovene)

Circular economy criteria for product groups

Electricity, food and catering services, textiles, office paper and hygiene paper products, electronic office equipment, televisions, refrigerators, freezers and combinations thereof, washing machines, dishwashers, tumble dryers, vacuum cleaners and air conditioners, furniture, water heaters, space heaters and combinations thereof, and hot water storage tanks, sanitary fittings, flushing toilet and urinal fittings, wall panels, design or construction of buildings, design or execution of road construction, road transport vehicles and transport services, tyres, electric lamps and luminaires and interior lighting, road lighting and traffic signalling, cleaning, janitorial and laundry services, horticultural services, agricultural and other products, and gardening equipment and machinery, building furniture, noise-proof road fences.

[13] First Decree adopted 2011, in use since 2012, Revised Decree adopted 2017, in force since 2018

Decarbonising Slovenia through the transition to a circular economy ([14]) (National project Deep Demonstration with EU Climate KIC (2021-2025) ([15])([16]). The project is a research and development project aimed at the development and implementation of innovative approaches to increase the capacity and capability for systemic innovation in the public administration and more broadly in other stakeholder groups. The aim is to support Slovenia in achieving its highly cross-cutting climate goals by introducing circular economy principles.

The project identified **4 value chains** that are **key to decarbonisation**: the built environment, food, mobility, wood & forest and manufacturing. At this point, measures for two value chains, the built environment and food, are already in place.

The first phase of the project, which concluded at the end of June 2022, was dedicated to designing the approach and planning the further implementation of the project. In October 2022, the Government of the Republic of Slovenia adopted a plan for the implementation of the second phase of the Comprehensive Strategic Project for the Decarbonisation of Slovenia through the Circular Economy, based on the use of the Deep Demonstration system transition model, which is an operational model for system innovation and a key mechanism to support collaboration with stakeholders in the public and other sectors. In this way, we would like to create the conditions to facilitate the transformation towards a low-carbon circular society. The aim is to achieve a coherent transition to a resilient circular model in Slovenia that can reduce future economic, environmental and social costs while creating local added value.

The following actions have been identified as key actions in the project:

The **Built Environment Portfolio** developed the following measures:

1. Strengthening the support ecosystem for the construction and building materials industry
2. A digital platform for the use of (local) secondary raw materials
3. Upgrading the education system
4. Efficient green public procurement supports the natural resources market renewable materials and secondary raw materials; Strengthening the renovation of buildings with wood/pulp materials
5. Deconstruction of buildings promotes the recycling of secondary raw materials
6. Upgrading and digitisation of the construction logbook and a passport for building renovation
7. Tools spatial planning and mechanisms support sustainable and circular construction

The biggest problem at the moment is portfolio activation. Sustainable construction concerns various sectors that are active, but no decision has yet been taken on the key portfolio holder.

The **Food Value Chain**: The objective of transforming the food system is “Quality, locally and sustainably produced and affordable food on the shelves”. This is the broadest framework within which the entire portfolio must be placed. In it, stakeholders have identified 3 major sets of priorities for the portfolio: production, chain efficiency, consumption, within which there are 7 focus areas:

1. Sustainable livestock production;
2. Diversification into crop production with a focus on organic;
3. How to better organise the vertical chain, particularly in the area of crop production;
4. Transformation of the food chain in view of the transition towards a green, digital, climate-neutral one;
5. Reformulation of food;

[14] https://www.climate-kic.org/wp-content/uploads/2023/09/ClimateKIC_brochure_Decarbonising-Slovenia_FINAL-1.pdf

[15] https://www.climate-kic.org/circularslovenia-2-2/

[16] https://www.gov.si/zbirke/projekti-in-programi/razogljicimo-slovenijo/ (in Slovene)

6. Dietary changes by increasing the intake of plant proteins;
7. Increasing local supply and local demand by public institutions.

Compared to the built environment portfolio, the key positive difference is the active leadership role taken by the Ministry of Agriculture, Forestry and Food (MAFF).

The **Mobility Value Chain:** The aim of mobility chain design is to prepare a new national transport strategy.

Monitoring and targets

Assessment of circular economy performance

The European Commission has set up a monitoring framework to keep track of progress towards a circular economy. This framework provides a holistic view as it:

- measures direct and indirect benefits of 'becoming circular' and
- values the contribution of a circular economy in living well within the limits of the planet
- addresses energy and material supply risks.

It consists of **5 thematic sections** with a total of **11 statistical indicators**, some of which have additional sub-indicators. In some cases policy targets exist which should be achieved in the future, and the indicators monitor progress towards these targets. The current monitoring framework is a revision of the original framework which was set up in 2018.

This section elaborates on the assessment of Slovenia's progress in terms of observed trends over the last 5 years and what country characteristics or policy actions may explain differences between the country its performance and the average EU performance.

Circular economy trends are monitored, based on indicators managed by the **Slovenian Environment Agency** ([17]) and the **Statistical Office of the Republic of Slovenia** ([18]).

According to most indicators, which are the criteria for the transition to low-carbon circular economy, Slovenia lags behind the EU average. These are the indicators that measure the connection between economic development and consumption of natural resources and energy, creations waste and GHG discharges. The transition to a low-carbon circular economy is underway, but it is slow, despite commitments and incentive mechanisms. Implementation of measures for the transition to the circular economy takes place also at the company level. ([19])

Some key messages from productivity reports of the **Institute of Macroeconomic Analysis and Development (IMAD)** of the Republic of Slovenia ([20]) ([21]):

- Slovenia's share of energy consumption and greenhouse gas emissions from transport are above average mainly due to its transit location.

[17] https://kazalci.arso.gov.si/en/indicators-trend?term_node_tid_depth%5B24%5D=24
[18] https://www.stat.si/StatWeb/en/News/Index/10967
[19] https://www.gov.si/assets/ministrstva/MNVP/Dokumenti/porocilo_o_okolju_2022.pdf (in Slovene)
[20] IMAD Productivity Report (2022) https://www.umar.gov.si/fileadmin/user_upload/sporocila_za_javnost/2022/Sporocila_za_javnost/Konferenca_PoP22/aPoP_2022_w.pdf
[21] IMAD Productivity Report (2023): https://www.umar.gov.si/fileadmin/user_upload/publikacije/Porocilo_o_produktivnosti/2023/Productivity_Report_2023.pdf

- The shift to a circular economy is urgent from an environmental perspective, but also from the perspective of competitiveness and social benefits, requiring companies to do more than just react and ensure compliance.
- Slovenia's emissions and energy productivity gaps with the EU average have not been reduced over time (they are around 10%), and compared to the top three countries, Slovenia's productivity gaps are by more than 50% lower.
- In the area of smart transition, Slovenia has not yet managed to return to the ranks of strong innovators according to the European Innovation Index (EII), despite its progress since 2020.
- In the period 2021–2023, Slovenia has been progressing faster than the EU average and the innovation leaders in improving framework conditions and innovation transformation, but it continues to lag far behind both groups of countries in terms of investment.
- In terms of productivity, major investments in equipment and machinery are relatively high in Slovenia, while investments in intellectual property products are low.
- By investor sector, Slovenia has less investment by individuals and companies compared to the EU, and more investment by the state.

Circular economy monitoring frameworks and their indicators beyond the ones from Eurostat

A methodology for quantitative monitoring of the transition to the circular economy at the micro level (companies) was developed. It is in preparation also for the meso level (regions or industries) and macro level (countries or groups of countries) in the frame of the **Systems innovation for the transition to a circular, regenerative and low-carbon economy (CRP) project** ([22]): Introducing quantitative, multi-level monitoring of the transition to a circular economy (University of Maribor, Faculty of Chemistry and Chemical Technology).

A draft list of indicators was created under the **National project Deep Demonstration** ([23]) ([24]).

Slovenia is also using the sets of indicators mentioned above. Some **assessments of Eurostat indicators** with calculations by IMAD are presented in their productivity reports ([25]).

Indicators and publications are available for the public on the internet.

Circular economy targets

No specific circular economy targets have yet been set so far.

Innovative approaches and good practices

Examples of public policy initiatives (national, regional or local)

➔ *Good practice example: Financial support programmes targeting circular economy*

The Public Agency of the Republic of Slovenia for the Promotion of Investment, Entrepreneurship and Internationalisation (**SPIRIT**)([26]) in 2022-2025 provides professional and financial support to start-up, micro, small and medium-sized enterprises in an intensive process of strategic sustainable and circular business transformation, with a focus on pursuing the strategic objectives of reducing negative impacts on

[22] https://www.climate-kic.org/circularslovenia-2-2/
[23] https://www.climate-kic.org/wp-content/uploads/2023/07/DEL-5.2-MEL-Framework_for-publishing.pdf
[24] https://www.climate-kic.org/circularslovenia-2-2/
[25] https://www.umar.gov.si/en/publications/productivity-report
[26] SPIRIT: https://www.spiritslovenia.si/ (in Slovene)

the economy. The funding for the implementation of the call for proposals is provided by the European Union under the Recovery and Resilience Fund and by the Republic of Slovenia from the national budget.

➔ *Good practice example: Research & innovation*

Research programme objectives (CRP): Introducing quantitative, multi-level **monitoring of the transition to a circular economy** (2023-2024) (University of Maribor, Faculty of Chemistry and Chemical Technology).

The project focuses in particular on the implementation aspect of systems to monitor the transition to a circular economy. Project structure is divided into four working phases:

1. Review and analysis of the developed circularity monitoring systems.
2. Preparatory activities for the introduction of quantitative, multi-level monitoring of the transition to Circular Economy
3. Selection of the most appropriate ways of normalising indicators to create dimensionless indicators
4. Demonstration examples and adaptation or fine-tuning of calculation procedures sub-indices of circularity.

They are developing a methodology for quantitative monitoring of the transition to the circular economy at the micro level (companies), meso level (regions or industries) and macro level (countries or groups of countries).

➔ *Good practice example: Industrial symbiosis*

E-symbiosis ([27]) is a unique platform in Slovenia for the exchange of waste resources from different companies, free of charge. It is the first online tool in Slovenia that gives a quick overview of what someone offers or needs. At the same time, e-Simbioza also makes it easy to arrange collaborations.
The advantages of the platform are: freely available, easy to use, contains all the necessary information about the type and use of the waste resource and about the company providing it, allows immediate contact between companies and quick agreement. If you just want to view information on current supply and demand of waste resources, no registration is required. Simply navigate through the posts.
If you want to add your company to the list of suppliers/demanders and publish your information, you need to register first. The process is easy and quick.

Contact details are required for quick and direct contact between companies. The e-Simbioza team does not mediate between companies, all communication is between the companies themselves. Once you have selected a resource of interest to you, you simply call the company that offers it.

➔ *Good practice example: municipality, local initiatives*

One of the many successful local projects is the **NoviKrog project** ([28]), which was implemented in the municipality of Novo Mesto in 2022. The project addresses the issue of closing local material loops, analyses material flows, promotes circular public procurement. They will also set up a Circular Innovation Centre, which offers education for procurers and suppliers on green and circular solutions, innovative events focused on promoting the circular economy, a platform for showcasing and promoting circular economy pioneers, discussing the challenges, opportunities and future of the circular economy in public procurement, and networking with key players and innovators in this field.

[27] e-Simbioza: http://esimbioza.fis.unm.si/ (in Slovene)
[28] https://novikrog.si/en/matrika/

Examples of private policy initiatives (sectoral)

CIRCI – Introducing the circular economy into industrial processes ([29])([30])
The main objective of the project is to improve the eco-efficiency of the Slovenian and Norwegian (industrial) ecosystem and to increase the positive impact of the circular economy through innovation and awareness raising among target groups. The project addresses the reduction of material flows of virgin materials and energy in the production process, and our aim is to establish a database that will record waste or secondary materials generated in production processes that can be converted into important raw materials for another industry or production process in the circular economy business process. The Slovenian company TECOS is in charge of the preparation of the database in the field of recyclable plastics and is responsible for the preparation and implementation of the voucher scheme aimed at companies and research institutions.

Green Star ([31]) **(CER – Partnership for a sustainable economy)**
Certificate for the implementation of sustainability (ESG) aspects and climate action in the company.
Green Star is the first certificate for the successful introduction of sustainable - ESG principles and climate action in business operations. It rewards and highlights companies that bravely, decisively and concretely follow the path of green transformation.

Green Star is a strategic tool that collects all relevant data for a company in one place for a green transformation. By obtaining the certificate, your company will join the stars of the green Slovenian economy, which strive for the ambitious goals of sustainable business and climate action. The certificate brings long-term and short-term positive effects on the entire value-added chain.

➔ *Good practice example: New business models*

The **CINDERELA project** ([32]) is led by Slovenian National Building and Civil Engineering Institute and started in 2018. It aims to untap this potential by developing and demonstrating a new business model (CinderCEBM) to assist companies in setting up successful circular economy business cases based on waste-to-resource opportunities. The business model will be accompanied by a “one-stop-shop” (CinderOSS) service offering all that companies need to know for manufacturing and application of SRM-based construction materials in buildings and civil engineering works.

The Cinderela consortium is composed by 13 partners from 7 countries: Slovenia, Italy, Serbia, Spain, Poland, Netherlands, North Macedonia.

The consortium is structured in 6 local demonstration activities and several organizational structures to guarantee the unity of the aim and outcomes of the project. The partners along with the supporting parties cover the whole value chain of each local demonstration activity, which includes academia, public authorities, waste generators and end-users.

➔ *Good practice example for electronics & ICT*

Life Turn to e-circular project (2020-2024) ([33]) is dedicated to raising awareness of target groups and stakeholders about individual elements of the circular economy. Changing their habits when dealing with devices that are still working, namely with the help of awareness-raising activities, the construction of appropriate infrastructure and legislative proposals. Project is led by a company; two partners are the

[29] https://www.gzs.si/zbornica_elektroindustrije/vsebina/Projekti-in-sekcije/CIRCI-kro%C5%BEna-industrija (in Slovene)
[30] https://www.norwaygrants.si/projekti/projekti-programa-blazenje-podnebnih-sprememb-in-prilagajanje-nanje/circi/ (in Slovene)
[31] https://www.green-star.si/en/home
[32] CINDERELA
[33] https://www.zeos.si/en/turn-to-e-circular/

Chamber of Commerce and another company. The project is co-financed by the EU and the Slovenian Ministry of Environment, Climate and Energy.

Purpose and objectives of the project:

- Encouraging, informing and raising awareness of the local target groups and stakeholders about the concept of a circular economy and the advantages or the necessity of transitioning from a linear to a circular mode of operation.
- Changing the lifestyles of consumers and stakeholders in dealing with still working appliances with innovative tools and increasing the availability of information and locations to broadcast it.
- In cooperation with public utility companies, establish a network of uniform collection points, intended for taking over appliances that are still working, communicating the advantages of the circular economy, redirecting the share of e-waste into reuse or preparation for reuse.
- Preparation of professional, comprehensive and coordinated instructions, guidelines and algorithms among key stakeholders for guiding devices in the process of re-use, preparation for re-use and restoration of components for spare parts.
- To establish the first Slovenian circular economy online platform, designed as a meeting point for communication of all interested parties with information sources for repairers, consumers, reuse organizations, media, with lists of stakeholders, experiences of good practices, instructions for diagnosis and repair. The online platform will serve as a tool to monitor changes in consumer habits.
- Promote and implement a program of development and promotion of circular business models in cooperation with organizations that promote innovative business ideas.

CircThread ([34]) – handling electronic waste (in progress)
Closing the loop of product life cycles through greater recycling and reuse is a priority in line with the EU's ambitious transition to a circular economy. In this context, the EU-funded CircThread project will focus on data and information management to support the circular economy. More specifically, the project will support decision-making processes by promoting access to existing data. It will design a methodology for sharing information about the different stages of the products' life cycle, focusing on environmental, social, economic and circular aspects. The overall goal is to create data linkages between product chain, value chain, asset chain and life cycle chains. Circularly use cases will be tested in Italy, Slovenia and Spain.

➔ *Good practice example for packaging*

eBOTTLE ([35])
Smart packaging glass is developed with embedded active sensing while implementing the development of bio-based adhesives for e-component placement.

The participating company is becoming the carrier of process innovations in the area of carbon balance in their sector at the EU level. Thus, we created the most sustainable bottle in the world, which is made exclusively from 100% green hydrogen and 100% recycled glass and represents an innovation at the international level. According to the information we know, there is no glass packaging on the market that has been manufactured using such a process and achieved such a low environmental footprint.

With the carbon neutral bottle product, they wanted to demonstrate that the transition to carbon neutrality is already possible today and to create an innovative and sustainable solution that will position the entrepreneurial project partner as a trend setter in the increasingly competitive market of premium glass packaging and thus ensure significant differentiation on the market and the opportunity to create higher added value. Melting the glass for the first boutique series production of the world's most low-

[34] https://circthread.com/
[35] http://www.rc-enem.si/ebottle/

carbon bottles involved renewable energy sources. The production started with a combination of the use of solar cells, i.e. green hydrogen and waste recycled glass. Oxygen and hydrogen were used as fuel. The only by-product of production was steam, with no carbon dioxide emissions.

POLY Circular ([36])
The POLY Circular project aimed to develop innovative technologies for the chemical and biochemical degradation of packaging waste into high quality, value-added secondary raw materials for stand-alone use (gases, chemicals, oils/fuels, etc.) or for incorporation into new products such as biopolymers. Focus was on natural packaging waste of cellulose/lignocellulose origin and synthetic/plastic packaging (PET, PA, PP, PE, XPE, etc.). The main objective of the project is to establish new advanced circular processes (new circular business models) for the recycling of plastic/natural packaging waste, which can contribute significantly to increasing the material efficiency and at the same time the added value of the resulting products.

The project is constantly upgraded. The entrepreneurial project partner has the OpenLOOP technology consisting of several proprietary company's processing steps, including chemical and enzymatic hydrolysis to separate PET and CELLULOSE, neutral hydrolysis to depolymerize PET, rTA purification, chemical hydrolysis and purification to extract 5-HMF/furfural/LA. As part of the OpenLOOP project. They will refine the technology, integrate it into an industrial environment - the DEMO plant, automate processes to make them safe and easy to use, validate it, design process steps to ensure optimal productivity and prepare it for market entry.

The municipal material cycle of beverage cartons and hygiene paper ([37])
The municipal material cycle (MMC) of beverage cartons and hygiene paper connects stakeholders and residents of the local community to easily form their own circular model based on the existing take back system of used beverage carton management:

- used beverage cartons, collected separately by institutions and households in the local community, are purposefully recycled for the production of hygiene paper such as paper handkerchiefs, paper towels and wipes, toilet paper etc. from recycled cellulose.
- the new products are used by institutions in the same local communities where the used beverage cartons are collected as a source of raw material. MMC of beverage cartons and hygiene paper connects municipalities, municipal companies, companies for the collection and management of waste materials, and public institutions in the local community. All residents are included in this through the established system of waste packaging collection.

➔ *Good practice example for construction*

ReBuilt ([38]) (Slovenian National Building and Civil Engineering Institute)
Construction is a major contributor to resource consumption, waste generation and greenhouse gas emissions. For this reason, the transition to a circular economy in the construction sector is encouraged, which has a significant impact on the well-being of Central European society and increases the efficiency of resources. The current state of innovation ecosystems for circular and digital construction varies significantly from region to region in Central Europe. Some regions already have good practices in the use of recycled materials, established administrative procedures, such as the criteria for ending the status of waste, others are in the phase of the first steps in the direction of circular and digital construction. There are common gaps, such as a general dislike of products based on secondary raw materials; data on the quality of products based on secondary raw materials and their traceability (flows of waste to products); lack of administrative or legal channels for product reuse; lack of good practices of circular economy business models; lack of a transnational training program for professionals., founded by Interreg Central

[36] https://www.surovina.si/o-podjetju/projekti/projekt-poly-kroznost (in Slovene)
[37] https://municipal-material-cycle.org/en/home/
[38] ReBuilt

Europe, is introducing new solutions and encouraging the adoption of circular and digital practices in the education curriculum, which will help reduce the environmental impact of the construction sector.

The Slovenian national building and civil engineering institute (ZAG) is leading 14 project partners from Slovenia, Italy, Austria, Croatia, Hungary, Slovakia, Poland, Czech Republic, and Germany and 6 associated partners from Slovenia, Hungary, and Germany, who are aware that the adoption of circular and digital practices can help reduce the sector's impact on the environment.

The partners will contribute to the goals and results of the ReBuilt project:

- Increase the awareness and attractiveness of circular and digital construction by developing a new educational program
- Upgrade, development and testing of new, pilot technical and digital solutions and measures, including green labelling, end-of-waste status and green public procurement
- Creation of the first Central European strategy for circular and digital construction, which will be implemented through a network of regional circular and digital construction centres

➔ *Good practice example for biomass*

CEL.CYCLE ([39]) – Discarded potential of biomass (Pulp and Paper Institute)
Strategic direction of the programme is to exploit the potential of biomass for development of advanced materials and bio-based products, by creating new value chains for cascading utilisation of biomass. The programme is placed within priority area S4 (Slovenia's Smart Specialisation Strategy) – The natural and traditional resources for the future, Networks for the transition to the circular economy, and is co-financed by EU Structural Funds in Slovenia. It comprises all of the identified focus areas and technologies: technologies for development of new bio-based materials, technologies for utilisation of secondary raw materials, and technologies for reuse of waste and production of energy from alternative sources.

Product directions follow ambitious goals of the CEL.CYCLE Consortium to develop an array of competitive bio-based products, thus answering to demands for more efficient utilisation of raw materials and reduction of environmental burdens. With synergies arising from cross-sector partnership, which represent comprehensive value chain for material and energy utilisation of biomass, the programme contributes to long-term competitiveness of an important part of Slovenian industry: chemical, textile, paper, wood processing and automotive industry, construction, engineering and energy.

The programme is a cooperation platform for top research teams mastering materials, chemical engineering, manufacturing and processing technologies, biotechnologies and nanotechnologies. Collaborating within new value chains helps us move beyond fragmentation and strengthens our capabilities to achieve international Excellency in research and technological development.

BAmBI ([40])
The development of Bio-Butylated Amino Resins (BAmBi**)** project proposes the design of a process for the separation and extraction of n-butanol from the waste stream generated in the butylated amino resins production process. The results show that up to 94% of the n-butanol present in the waste stream can be recovered. Under the studied conditions, 99.76% pure n-butanol can be obtained. The product is equivalent to the products prepared from fossil raw material sources. The economic analysis of the process shows that the process is economically viable.

High Throughput Microfluidic Platform for the Selection of Microorganisms for Bio-refinery Application (AciesBio) ([41])

[39] https://celkrog.si/?lang=en (in Slovene)
[40] https://www.melamin.si/en/
[41] https://www.aciesbio.com/si/rri2-grant-received

The platform was developed within the scope of public call “Incentives for Research and Development projects 2”. The goal of this project is to develop a new service – a technological platform for rapid development of highly efficient industrial microorganisms that will allow very quick screening of large numbers of strains. Such cutting-edge service shall significantly shorten the development time of biotechnological processes. It will also enable sustainable use of organic waste materials and establishment of new bio-refineries capable of producing high-margin biomolecules.

The development of melamine bio-polymers for coatings ([42]) is led by one of the largest chemical companies in Slovenia. Together with the Jozef Stefan Institute, as the largest Slovenian public research institute, they developed melamine bio-polymers.

The development of melamine bio-polymer for the coating industry from renewable raw materials (wood biomass), which is equivalent to the product of fossil origin.

- Development and industrialisation of a new melamine biopolymer products
- Increasing the share of high-tech products in the company
- Creation of a new value chain with closed material flows
- Improvement of the material efficiency index

The main outcome of the project is the development of a new technology and a new bio Hexamethoxymethyl melamine (HMMM) product to industrial production level, as a result of the latest research results and technological achievements of Melamine's development department. The project, in collaboration with the Jožef Stefan Institute, has developed a method that can determine the bio-component content of the product, allowing the new product to be certified according to the standard “Bio-component content in plastics”.

The project is important because the newly developed bio-based product enables the company to break into global markets and thus to grow in a green and sustainable way. In a broader sense, the project brings about a gradual replacement of fossil fuels by renewable sources, which also forms the basis for the development of other industries.

Alps4GreenC ([43]) (National Institute of Chemistry, 2022-2024) (preparation of phase 2 in progress).
The Alps4GreenC project was focused on setting-the-scene for transnational utilisation of biomass residues through investigation of biomass conversion opportunities in project partner countries and proposal of transnational biochar-based value chains. As such, we are tackling the challenges of the Alpine area pertaining to adverse effects of energy dependency and high energy prices, biodiversity losses and high vulnerability to climate change, while offering solutions for the use of greatly available biomass in the region. By proposing the necessary supportive measures through policy recommendations and practical testing and pilot production of green carbon to evaluate the potential of its utilisation for steel and agriculture industry, we will contribute towards creating the conditions for energy sufficiency and climate-protection of the region showcasing the innovation and resource potentials already present, but currently disconnected. The advantages of this transnational collaboration will be primarily experienced by those directly involved in the value chain (residue producers, tech providers and end users, hence large enterprises and SMEs), however other stakeholders in the ecosystem, such as national/regional public authorities, sectoral agencies and higher education and research organisations, will also benefit from comprehensive framework creation. The framework we propose includes mapping of stakeholders and resources, implementation of crowdsourcing campaign to collect biomass residues and raise awareness, testing and piloting of biochar and context and gap analysis of biomass conversion opportunities for green carbon supply. Without a transnational approach to this issue, appropriate technologies for biomass conversion will not be identified and upgraded, therefore the shift to green, post-carbon approaches might

[42] https://srip-circular-economy.eu/project/the-development-of-melamine-bio-polymers-for-coatings/
[43] https://www.alpine-space.eu/project/alps4greenc/

not be fully realised. It is the first time, transnational collaboration for the establishment of biochar production value chain is foreseen.

The way forward

Identifying and addressing barriers and challenges

On general: the new policies and objectives of the circular economy are driving us, actors towards a new cross-sectoral systems approach.

Some **barriers and challenges** identified by IMAD, presented in the **Productivity report 2022** ([44]) are as follows:

- The gap between necessary investments and available resources: around EUR 130 billion per year: needs in environmental protection, biodiversity, resource management and the circular economy.
- Ensuring sustainability and circularity is not possible without an ecosystem approach throughout the value chain (e.g. through traceability). At the same time, working with the broader business ecosystem is also a way to encourage experimentation and innovation, which is critical for addressing climate change.
- The transition to a smart circular economy requires a comprehensive redesign of the processes and organisation of companies and other organisations within the ecosystem, both in terms of defining new responsibilities and adapting internal processes, for example in the context of sustainable controlling or improving existing key performance indicators (KPIs), and for example in terms of finding new, different, even disruptive solutions based on multidisciplinary, human-centred design.
- A faster transition to a low-carbon circular economy is also dictated by the rising costs associated with the rising prices of allowances, energy and raw materials. Slovenia needs to move beyond the prevailing focus on traditional manufacturing and business, which might prove to be its competitive advantage under the assumption of accelerated transformation in other segments as well.

From the sustainable consumption perspective, the main challenges according to the Publication **"Guide for sustainable consumption**" ([45]) are as follows:

- Raising awareness of products life cycle.
- Make a shift to more regenerative agriculture.
- Using more natural, sustainable materials in buildings.
- A shift from using cars to using more public transport.

The Ministry of Cohesion and Regional Development recognised some barriers for the industrial symbiosis in frame of the **project SYMBI** ([46]) as follows:

- Lack of a systemic approach in supporting industrial symbiosis,
- Imperfectly functioning market of secondary raw materials,
- Lack of appropriate financial incentives,
- Lack of connection between spatial planning and industrial symbiosis.

[44] IMAD productivity report 2022: https://www.umar.gov.si/fileadmin/user_upload/sporocila_za_javnost/2022/Sporocila_za_javnost/Konferenca_PoP22/aPoP_2022_w.pdf

[45] http://nfp-si.eionet.europa.eu/publikacije/Datoteke/Potrosnja_en/ARSO_Guide%20SC_ENG_15112023.pdf

[46] https://www.gov.si/zbirke/projekti-in-programi/symbi/ (in Slovene)

Future policy plans

No update on future policy plans except the information on a special component on Circular economy in the **Slovenian recovery and resilience plan (2021-2026)** ([47]), which addresses challenges related to achieving climate neutrality by 2050, increasing material productivity, promoting energy efficiency and eco-innovation, improving the waste management system and strengthening the wood processing chain. The component also introduces green budgetary planning (see section Existing policy framework for more details).

[47] https://www.gov.si/en/registries/projects/the-recovery-and-resilience-plan/

European Topic Centre on
Circular economy and resource use
https://www.eionet.europa.eu/etcs/etc-ce

The European Topic Centre on Circular economy and resource use (ETC-CE) is a consortium of European institutes under contract of the European Environment Agency.

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