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CURIOST

Circular design and development of Sustainable products in 4 key sectors in Central Europe

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ASSESSMENT OF MARKET STATUS AND READINESS FOR SUSTAINABLE PRODUCTS IN THE 4 SECTORS

Deliverable 1.2.1.

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1. INTRODUCTION

Project CURIOST is funded by INTERREG Central Europe Programme and aims at enabling SME and small mid-caps to exploit their potential in innovative sustainable product development and profit from matching business cases in the 4 key sectors which are highly relevant in partner regions:

- Mechanics and mechatronics,
- Packaging,
- Plastic,
- Construction and building.

CURIOST project integrates two-fold approach which aims to develop a comprehensive strategy targeting its uptake by minimum 140 SME and small midcaps, followed by transformation of this strategy into an action plan developed and adopted by policymakers to serve local businesses. It´s main goal to initiate the change in all sectors of the partner regions in Central Europe which will result in creating universal solution of matching business cases, which will accelerate the green transition in the Central European economy.

Within the CURIOST project, each project partner should participate in activities that provide understanding of current situation in product development in four targeted sectors, including gaps and challenges analysis and capitalization of best practices and benchmark in sustainable product design in Central Europe. These activities will give deliverables of Activity 1.2, namely:

- D.1.2.1 Assessment of market status and readiness for sustainable products in the 4 sectors

  The partnership assesses and gains insight about the maturity level and readiness of the market regarding the design and development of sustainable products, in particular in the sectors relevant in the partner regions. The result flows into the development of the strategy in A1.3.

- D.1.2.2 Evaluation of current business models

  Already implemented circular business models will be evaluated (key success factors) and categorized according to their type. Further, its applicability as blueprint or reference for SME + small midcaps in the 4 sectors will be analyzed and summarized in fact sheets, to be shared among the companies.

2. AIM OF THE ANALYSIS

Various circular business models have been developed over the last decade. They integrate digital and hybrid (e.g. additive manufacturing) technologies, which foster their implementation. Such models are already applied to a different extent in the 4 sectors mechanics & mechatronics, plastics, packaging and construction & building, but mainly in large manufacturing businesses in Europe and beyond.

For a better understanding and a common starting point, the partners will assess the current market status in the partner regions and the readiness for sustainable product design and development in the 4 sectors. For that purpose, the activity leader UEBA will create a matrix of key performance indicators that reflect the market status of the 4 sectors. All partners collect the KPIs for the sectors relevant in their region, and UEBA will consolidate the results.

The outcome forms one of the corner stones for the development of the strategy for sustainable product development in SME + small midcaps, in activity A1.3.

Further, already realized circular business models for sustainable products will be collected and analyzed. The key success factors will be identified and the potential of transferability to SME + small midcaps, as well as the transferability between the 4 sectors will be assessed. Finally, the results will be consolidated and grouped in the following four categories that have developed over the last few years:

- Cycling (keeping materials in the cycle with reuse, refurbishment, recycling),
- Extending (longer product life through circular design, maintenance and repair),
- Intensifying (sharing products intensifies its use phase),
- Dematerialising (service and software solutions instead of hardware).

3. ANALYSIS OF THE LEVEL OF MATURITY OF THE PROJECT PARTNER COUNTRIES

The assessment of the level of maturity of the circular economy, at the macro level, is based on verifiable and publicly available sources, while ensuring comparability in terms of content and time.

3.1. Austria

Performance and structure of the economy

Austria has the fifth highest GDP per capita in the EU - 123% of the EU average, with an average growth rate in line with the EU. Following the contraction by 0.8% in 2023, the Austrian economy is expected to recover gradually reaching 0.3% growth in 2024 and up to 1.6% in 2025.

Business and entrepreneurship

Austria's overall entrepreneurial activity is similar to the EU average, standing at 6.8%. The country outperforms the EU on top enterprises investing in R&D, with the value of 14.9 vs 8.4, drawing on strong business R&D expenditures overall, i.e. 1.06% of GDP in 2023.

Table 1.1 Selected indicators - Austria

Indicator	Value*
Summary Innovation Index	116.3
Digitalisation	89.6
Direct and indirect government support of business R&D	172.3
R&D expenditure in the business sector	150.0
Innovation expenditures per person employed	100.4
SMEs introducing product innovations	124.3
SMEs introducing business process innovations	129.7

* Performance relative to the EU in 2024
Source: https://circabc.europa.eu/ui/group/96ccdecd-11b4-4a35-a046-30e01459ea9e/library/a4d81e13-566b-49eb-bcdd-5c766eaec9b0/details

Austria's performance on circular economy indicators shows relative strength in business operations and relative weakness in societal behaviours. The strongest performing circular economy indicators are the number of EPR schemes and information readily available that can help access finance for circular economy related activities. The weakest performing circular economy indicators are the number of enterprises involved in the repair of computers and personal and household goods, as well as the share of employees in the repair of computers and personal and household goods.

Table 1.2 Selected circular economy indicators - Austria

Circular economy indicators	Country performance (normalised score)	Relative to EU in 2022 (EU=100)
Sustainable resource management	0.529	119.1
Societal behaviours	0.242	54.9
Business operations	0.509	135.4

Source: https://wayback.archive-it.org/org-1495/20220906175907/https://ec.europa.eu/environment/ecoap/austria_en

Austria traditionally has one of the highest waste management and recycling rates across Europe. In 2019, Austria recycled 58,2 % of its municipal waste, which represents the third-highest recycling rate in Europe. According to the Eurobarometer 2021, 67 % of Austrian SMEs undertake activities to minimise waste in supply and production, 65 % take actions in order to save energy, 59 % to save materials, and 47 % state that they undertake recycling activities, such as reusing material or waste within the company. 0,98 % of the Austrian value added in 2018 was generated in connection with circular economy activities.

The National Circular Economy Strategy of Austria1 was published in December 2021. Its four main strategic objectives are to:

1. Reduce the domestic material consumption.
2. Improve resource efficiency in the Austrian economy.
3. Raise the utilisation rate of reusable materials by +35 % by 2030.
4. Reduce material consumption of households by -10 % by 2030.

Construction and building

According to the EU's Circular Economy Action Plan, the construction sector has a significant impact on the use of resources. It accounts for about 50 % of all extracted material and is responsible for over 35 % of the EU's total waste generation.24 In 2020, 14 % of the Austrian material footprint (MF) and 8 % of the CO2 footprint were related to the construction sector.25 Against this background, the strategy contains the following objectives:

- New buildings will be planned, tendered, and erected in a circular manner. The focus is on longevity, modular construction, separability, and reusability of components and the use of the highest possible share of sustainable materials and secondary construction materials.

[1] https://www.bmk.gv.at/en/topics/climate-environment/waste-resource-management/ces.html

- The useful life span of existing buildings increases on the basis of better maintenance and restructuring. The focus of the renovation of buildings will be on high thermal quality and separability and reusability of material. Furthermore, the share of sustainable material and secondary raw material should increase.
- The material recycling of construction and demolition waste should increase, while separation during demolition should improve, pollutants should be removed and recycling-oriented renaturation, and recycling technologies and business models should be standard.

Plastics and packaging

Plastics and packaging are an elementary requirement across most industries. They have unique and manifold material characteristics and areas of application. At the same time, plastic waste finds its way to our environment and affects the landscape, soil, water, flora, fauna, and humans. In Austria's National Circular Economy Strategy, recycling packaging and promoting optimised and reusable packaging is stated as one main opportunity to establish a sustainable circular economy. The following objectives are specified by the strategy:

- Plastics should be used in a more targeted manner and should remain in the utilization cycle as long as possible, considering economic and ecological aspects.
- Packaging material should also be circulated as long as possible.
- The impacts of plastic use on the environment should be reduced.

Electronics and ICT

Electronics and ICT are an elementary part of the national industry and society. Against the background of the increasing trend to use electronic and electric devices, the accompanying increased demand for resources has to be considered. To establish a sustainable and efficient electronic industry and a balanced consumption of electronic devices, a cycle-oriented economy is required. The National Circular Economy Strategy includes the following main objectives regarding the electronic industry:

- The durability and operating time of electronic and electric devices should be extended.
- The need for new electronic and electric devices should be reduced due to new business models based on leasing or other services instead of purchasing.
- The recycling of electronic and electric devices should be strengthened.

3.2. Croatia

Performance and structure of the economy

Croatia's GDP per capita is 73% the EU average. Nevertheless, the Croatian economy is rapidly growing, by 5% on average annually, the second highest GDP annual growth rate in the EU. According to the European Semester Report (2024), this growth was mainly driven by an increase in private consumption, resulting from a rise in employment and in real wages. Croatia is expected to maintain relatively high GDP growth rates in 2024 and 2025.

Business and entrepreneurship

SMEs account for 99.8% of enterprises in Croatia. The relative importance of SMEs in the Croatian economy is reflected in a turnover share of SMEs relatively higher than the EU average. On the other hand, the turnover share of large enterprises is considerably lower than the EU average. Lastly, the share of foreign-controlled enterprises in value added is significantly higher than the EU average (18.2% versus 13.3%), highlighting the importance of foreign investments.

Table 1.3 Selected indicators - Croatia

Indicator	Value*
Summary Innovation Index	69.6
Digitalisation	67.1
Direct and indirect government support of business R&D	7.7
R&D expenditure in the business sector	51.3
Innovation expenditures per person employed	19.7
SMEs introducing product innovations	145.4
SMEs introducing business process innovations	119.8

* Performance relative to the EU in 2024
Source: https://ec.europa.eu/assets/rtd/eis/2024/ec_rtd_eis-country-profile-hr.pdf

Croatia's performance on circular economy indicators shows relative strengths in societal behaviours and relative weaknesses in sustainable resource management. The strongest performing circular economy indicators are turnover share of repair of computers and personal and household goods and the number of EPR schemes. The weakest performing circular economy indicators are the number of eco-labelled products and services and recycling of biowaste.

Table 1.4 Selected circular economy indicators - Croatia

Circular economy indicators	Country performance (normalised score)	Relative to EU in 2022 (EU=100)
Sustainable resource management	0.340	76.7
Societal behaviours	0.692	157.3
Business operations	0.443	117.7

Source: https://circabc.europa.eu/ui/group/96ccdecd-11b4-4a35-a046-30e01459ea9e/library/66959cb8-6b21-40a6-a169-545b7c119d18/details

Sustainable and circular economy is an important priority for Croatia, which extends to almost all key and strategic documents. Despite several constraints, the country still scored well in the 2020 Environmental Performance index, ranking 34 out our 180 countries, improving for over 13 points in the 10-year period. Notably, apart from the substantial policy efforts toward increasing the sustainability in Croatia, this positive environmental trend has been substantiated by the decline of several industries which have had an adverse environmental impact, such as iron industry, refineries, shipbuilding, etc. Furthermore, Croatia has a vast network of protected areas with 37% of its land designated under the Natura 2000 network. Among the EU Member States, Croatia ranks second, right after Slovenia, in terms of the percentage of total land covered by the Natura 2000 network. This level of protection has influenced the development and orientation of the economic activities with sustainability at their core. Natura 2000 sites also yield a range of ecosystem services that benefit the economy. Various sectors (agriculture, forests, fisheries, energy) benefit from the ecosystem services derived from Natura 2000 landscapes.

The key document for the Republic of Croatia is the National Development Strategy 2030 adopted in March 2020, which, based on the European Green Deal, defines the direction of the economy towards the circular model and emphasises circularity as a key development principle. There are several key areas covered by the National Development Strategy: climate policy, energy policy, industrial policy, construction, environmental protection, biodiversity, agriculture, mobility, and innovation. In each of these areas, through certain policies and measures, the goal is to move to a circular economy, i.e., to have effective and efficient waste and resource management.

Integrated National Energy and Climate Plan 2021-2030 for the Republic of Croatia is based on all the strategic documents of the Republic of Croatia and through the prism of five dimensions:

1. Decarbonisation: For the European Union Emissions Trading System (ETS sectors), the target is to reduce greenhouse gas emissions by at least 43% by 2030 compared to 2005, while for non-ETS sectors by at least 7% compared to the 2005 level.
2. Energy efficiency: The aim is to achieve the 50% savings in Article 7 of the Energy Efficiency Directive through a system of energy efficiency obligations.
3. Energy security: The most important goal within the energy security dimension is to ensure a permanent, secure, and quality supply of all energy sources.
4. Internal energy market: Given the satisfactory situation on the energy market in the Republic of Croatia, this dimension does not set special requirements other than maintaining the existing situation and increasing the value of net transfer capacity at borders by removing congestion/restrictions primarily in the internal network.
5. Research, innovation, and competitiveness: The state will increase investment in research, development, and innovation and investment in knowledge and technology transfer and development of knowledge and innovation-based technologies through various programs — from grants to conditional loans to state aid programs.

3.3. Germany

Performance and structure of the economy

Germany maintains a strong economy rooted in its prominent industrial and technological sectors. The country's high GDP per capita (117.3% of the EU average) is helped by its manufacturing industry, particularly in automotive, machinery, and pharmaceutical industries, which are key for its global exports in high and medium high-tech products.

The employment structure also reflects this, with significant participation in high-tech sectors from manufacturing (50.5%) and a notable presence in knowledge-intensive services (28.3%). Unsurprisingly, with companies such as Bosch, Bayer and, Siemens, large enterprises dominate the economic landscape with companies contributing substantially to turnover (61.2%) and value added, while SMEs face challenges in scaling up despite their importance in employment.

Business and entrepreneurship

Germany has a robust environment for business and entrepreneurship. KFW plays a significant role in supporting entrepreneurship and industry in Germany, which stands at 7.9 and higher than the EU average (6.8). As the country's public bank, KFW provides credits to industries and offers co-funding programs for citizens, such as those for purchasing heat pumps or insulating buildings. Additionally, Germany's Mittelstand,

consisting of small and medium-sized enterprises, includes many global innovation leaders. Key organisations such as the BDI (Federation of German Industries) also play a vital role, offering strong industry and employee associations with local offices and support structures. Additionally, Germany's strategic focus on innovative technologies across key industries like automotive engineering (e.g., Volkswagen's electric vehicles), machinery (e.g., Siemens' automation technologies), and pharmaceuticals (e.g., BioNTech's COVID-19 vaccine) fosters a favourable environment for top R&D spending enterprises (14.1% of enterprises) and foreign direct investment (2.8% of GDP), both strongly above the EU average.

Table 1.5 Selected indicators - Germany

Indicator	Value*
Summary Innovation Index	111.6
Digitalisation	86.4
Direct and indirect government support of business R&D	40.1
R&D expenditure in the business sector	143.7
Innovation expenditures per person employed	144.1
SMEs introducing product innovations	104.3
SMEs introducing business process innovations	130.8

* Performance relative to the EU in 2024
Source: https://ec.europa.eu/assets/rtd/eis/2024/ec_rtd_eis-country-profile-de.pdf

Germany's performance on CE indicators shows relative strengths in business operations and relative weaknesses in societal behaviours. The strongest performing CE indicators are municipal waste recycled and information readily available that can help access finance for circular economy related activities. The weakest performing CE indicators are the share of employees in repair of computers and personal and household goods and share of enterprises in repair of computers and personal and household goods.

Table 1.6 Selected circular economy indicators - Germany

Circular economy indicators	Country performance (normalised score)	Relative to EU in 2022 (EU=100)
Sustainable resource management	0.497	112.0
Societal behaviours	0.302	68.7
Business operations	0.450	119.6

Source: https://circabc.europa.eu/ui/group/96ccdecd-11b4-4a35-a046-30e01459ea9e/library/e34c8fdd-7d68-47fa-8144-9ea5761ecac2/details

A national strategy for circular economy so far is lacking in Germany. The coalition agreement (from December 2021) of the current government led by chancellor Olaf Scholz states that a national circular economy strategy will be prepared and bundle existing raw

material policy strategies. In Germany, waste management is used as a synonym for circular economy. Rather than having a holistic approach, considering the production of raw materials, the design of products, and the use and recycling of materials at the end of a product's life cycle, only prevention, disposal, and recycling of waste are considered. This is illustrated by the Reorganising the Law on Closed Cycle Management and Waste or the Circular Economy Act. It focuses on preventing hazards caused by waste rather than on preserving the material qualities of raw materials. Waste prevention and preparation for reuse are mentioned as priority options. However, unlike recycling, they are not backed up by quantified targets. Those who produce waste even when it could be avoided, and even though avoidance would be ecologically advisable, do not have to fear sanctions. Responsibilities (e.g., for a repair-friendly design) are also left unregulated by the Act. At 67% in 2019, Germany is the country that has the highest municipal waste recycling rate in the EU, exceeding the target of the Circular Economy Act in 2012 of 65% by 2035.

The Recovery and Resilience Plan is supporting flagship investments and reform projects, and it focuses on tackling the two great challenges of our time, climate change and the digital transition. Germany's plan allocates at least 42% of its measures to support climate objective and at least 52% to digital transition. Overall, the investments and reforms are to be made in six key policy areas:

- Climate change and energy transition.
- Digital transition of the economy and infrastructure.
- Digital transition of education.
- Social inclusion.
- A health system resilient to pandemics.
- Modern public administration and reduction of barriers to investment.

The measures focused on climate policy and energy transition is decarbonisation through renewable hydrogen, climate-friendly mobility, and climate-friendly construction.

The measure "CO2 building renovation: federal funding for efficient buildings" obliges economic operators carrying out building renovation to ensure that at least 70% (by weight) of the non-hazardous construction and demolition waste generated on the construction site is prepared for re-use, recycling, and other material recovery in accordance with the waste hierarchy and the EU Protocol on Construction and Demolition Waste Management, including backfilling operations using waste as a substitute for other materials. The measure includes technical specifications for the durability, repairability and recyclability of renewable energy equipment. In particular, economic operators will limit waste generation in construction and demolition processes in accordance with the EU Protocol on Construction and Demolition Waste Management. The design of buildings and construction techniques will support the circular economy, assess the dismantling or

adaptability of buildings, and demonstrate that the design increases resource efficiency, adaptability, flexibility and dismantling capacity, thus enabling reuse and recycling.

3.4. Hungary

Performance and structure of the economy

Hungary has a mixed economy that has high productive capabilities, however the GDP per capita remains lower than the EU average. The manufacturing sector employs a higher percentage of the workforce along with the high and medium high-tech sector. SMEs have a relatively high turnover share, although it is less than that of large enterprises, which dominate the economic landscape. Foreign-controlled enterprises contribute a substantial share of value added to the economy (31%), this is the second highest score within the EU, behind Ireland which has 57%, highlighting Hungary as one of the most attractive places in the EU for foreign enterprises.

Business and entrepreneurship

Hungary provides a solid ecosystem for business and entrepreneurship. The rate of enterprise births and total entrepreneurial activity is higher than the EU average. Foreign direct investment net inflows are the highest in the EU (39.4%), bolstered by heavy government support in offering favourable conditions for foreign companies such as through lower tax rates. Nonetheless, the reliance of FDI may have caused Hungary to have a very low number of companies (1.0%) in the top 2500 research and development (R&D) spending worldwide.

Table 1.7 Selected indicators - Hungary

Indicator	Value*
Summary Innovation Index	70.5
Digitalisation	86.9
Direct and indirect government support of business R&D	136.4
R&D expenditure in the business sector	66.7
Innovation expenditures per person employed	56.5
SMEs introducing product innovations	60.0
SMEs introducing business process innovations	33.4

* Performance relative to the EU in 2024
Source: https://ec.europa.eu/assets/rtd/eis/2024/ec_rtd_eis-country-profile-hu.pdf

Hungary's performance on circular economy indicators shows relative strengths in societal behaviours and relative weaknesses in business operations. The strongest performing circular economy indicators are the number of enterprises involved in the repair of computers and personal and household goods and information readily available that can help access finance for circular economy related activities. The weakest performing

circular economy indicators are the number of eco-labelled products and services and SMEs recycling waste, water, or materials for their own use or sale within the enterprises by innovating.

Table 1.8 Selected circular economy indicators - Hungary

Circular economy indicators	Country performance (normalised score)	Relative to EU in 2022 (EU=100)
Sustainable resource management	0.427	96.2
Societal behaviours	0.593	134.7
Business operations	0.295	78.4

Source: https://circabc.europa.eu/ui/group/96ccdecd-11b4-4a35-a046-30e01459ea9e/library/0d02cce6-535b-403d-b6bc-e8975841ab69/details

Hungary is still in the early stages of the development of a circular economy with a circularity rate of 8.7% — below the 12.8% EU average. A national strategy dedicated to the circular economy was published in 2023 with this objective: "*Hungary aspires to unleash the potential of the Hungarian economy, aligning it with the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs), and the ambitions of the European Green Deal. Hungary aims to live up to the EU Circular Economy Action Plan (CEAP) and the EU Strategy for Plastics in the Circular Economy and achieve its 2030/35 EU waste management targets.*" (OECD, 2023)

Nevertheless, in recent years, some efforts have been made to bring the concept more to the fore in policy strategies, as well as in the wider societal and corporate contexts, pointing out opportunities relating to the transition from a linear to a circular economy model.

The strategies focus circular economy developments mostly on increasing the share of renewable energy sources (in particular solar), improving energy efficiency and waste management as material recycling and reuse rates are still low in Hungary.

The National Waste Management Plan has a section on waste prevention that addresses the following points:

- Encourage the design, manufacture, and use of resource-efficient, durable, repairable, reusable, and upgradeable products.
- Ensure that products, services, and processes are designed to have the least possible impact on the environment throughout their life cycle and eco-design. For eco-design to become more widespread, companies need access to the latest information, appropriate regulation, political support, and consumer information
- Under the national waste prevention programme, the aim is to innovate services from an environmental point of view and shift consumption towards leasing of

services (resource-efficient services and the use of low environmental impact processes).

The Climate and Nature Protection Action Plan was published in 2021 and contains the following circular economy-related initiatives:

- Elimination and prevention of illegal waste dumping: introduction of stricter administrative sanctions from 1 March 2021 and support for waste disposal and prevention, aiming to keep waste in the legal treatment system.
- Introduction of a deposit-refund system: ensuring the replacement of glass, plastic bottles, and metal cans from 1 July 2023.
- Prohibition of single-use plastics: selling certain disposable plastic products and products made of oxo-degradable plastics is prohibited in Hungary from 1st of July 2021 (Act XCI of 2020 on the restriction of the commercialization of certain single-use plastics). In addition, the environmental product fee of plastic bags has been significantly increased.

Construction and demolition waste

The National Waste Management Plan defines the reuse and recycling rate of construction at demolition waste at minimum 70%. The strategy aims to secure the sorting of different types of construction waste (wood, minerals, glass, plastics, metals, plaster) and the establishment of new recycling centres. Setting up a tracking and monitoring system is also part of the strategy.

Plastics and packaging

The plan emphasizes the importance of implementing a deposit-refund system for plastic beverage packaging, as recycling targets cannot be achieved solely via selective collection of plastic waste based on experiences so far. It also aims to increase the use of secondary raw materials (emphasizing eco-design principles) and to expand sorting and recycling capacities. EPR system is planned to be introduced from 2023.

Electronics & ICT

At the moment, Hungary lags behind in achieving the targeted reuse and recycling rate of electronic waste as defined in the 2012/19 EU Directive. The strategy recognizes the need for a national plan to build a uniform collection system and to strengthen the EPR principle.

3.5. Italy

Performance and structure of the economy

The Italian economy was severely hit by the pandemic but has proven relatively resilient in recent years, maintaining an average annual growth rate of GDP well above the EU average. The main contribution to growth has been domestic expenditure and this is expected to remain the case in the coming year. Italian GDP per capita is still below the EU average, ranking twelfth highest in the EU (above Cyprus and below France).

Italy has long been an export-led country, with a strong manufacturing sector. Therefore, the share of manufacturing is above the EU average, but the high and medium high-tech manufacturing sector employment share is below the EU average. The Italian economy also holds a higher share of employment in services, but the share in knowledge-intensive services is below the EU rate.

Business and entrepreneurship

Italy is one of the European countries with the smallest average enterprise size. SMEs account for 99.8% of enterprises (above the EU average) and the relative importance of SMEs is reflected in the turnover share of SMEs, which is above the EU average. The contribution of large companies to the country's turnover is low as is the share of value added generated by foreign-controlled enterprises. While the Italian economy is highly open, the positive export performance in the manufacturing sector is generated by the country's industrial districts, largely composed of SMEs.

Table 1.9 Selected indicators - Italy

Indicator	Value*
Summary Innovation Index	89.6
Digitalisation	75.7
Direct and indirect government support of business R&D	57.1
R&D expenditure in the business sector	51.3
Innovation expenditures per person employed	73.9
SMEs introducing product innovations	152.1
SMEs introducing business process innovations	150.3

* Performance relative to the EU in 2024
Source: https://ec.europa.eu/assets/rtd/eis/2024/ec_rtd_eis-country-profile-it.pdf

Italy's performance on CE indicators shows relative strengths in sustainable resource management and relative weaknesses in business operations. The strongest performing CE indicators are resource productivity and municipal waste recycled. The weakest are citizens who have chosen alternatives to buying new products and self-financing ability for circular economy activities.

Table 1.10 Selected circular economy indicators - Italy

Circular economy indicators	Country performance (normalised score)	Relative to EU in 2022 (EU=100)
Sustainable resource management	0.491	110.5
Societal behaviours	0.342	77.7
Business operations	0.288	76.4

Source: https://circabc.europa.eu/ui/group/96ccdecd-11b4-4a35-a046-30e01459ea9e/library/6e1d32f7-f95f-46e8-9838-6eda12c32c5c/details

The 4th Report on circular economy in Italy, issued in 2022 by the CEN (Circular Economy Network), analyses the performance of Italy against other EU countries: Germany, France, Spain, and Poland. The report emphasises the positive trends observed in Italy in terms of circularity indicators, in a global context characterised by a decreased circularity rate (from 9,1% in 2018 to 8,6% in 2020) due to an increased level of consumption (+ 8% in the last five years) along with a modest increase in reuse of only 3%.

The 4th Report on Circular Economy in Italy provides useful insights into Italy's current status and performance in terms of circularity through a system of indicators based on the Carta of Bellagio, a European monitoring system of circular economy. According to the report, Italy has already a good level of productivity and presents a positive trend both in terms of material circular use rate (relationship between the circular use of materials and the overall consumption of materials) and sharing mobility. Besides, Italy has the largest number of EMAS certificates in EU, showing a relatively strong commitment of the companies towards sustainable models of production.

The National Circular Economy Strategy foresees that the development of a systematically circular economy and the eco-innovation landscape required for it will create significant economic and social benefits. The strategy is part of Italy's Recovery and Resilience plan (NRRP) adopted following the unprecedented crisis due to the pandemic and aimed at responding to the urgent need of fostering a strong recovery and making Italy's future ready. The plan allocates 191,5 billion € of financial allocation and foresees a package of investments and reforms articulated in the following 6 missions:

- Digitalisation, innovation, competitiveness, culture, and tourism.
- Green revolution and ecological transition.
- Infrastructure for sustainable mobility.
- Education and research.
- Inclusion and cohesion.
- Health.

Construction and buildings

Construction waste represents the principal category of special waste produced. The EU Directive 2008/98 sets the objective of 70% of recovery of construction waste. According to the proposal of the National Plan of Waste Management, based on ISPRA monitoring data, in 2019, Italy achieved the objective with a recovery rate of 78,1%. On this basis, the plan considers necessary to implement measures of selective demolition in line with the UNI/PdR 75:2020, develop technologies to reintroduce the construction waste into the production cycle, as well as promoting the creation of centers dedicated to the preparation for reuse of these material. Presently, Italy is expected to adopt a set of ministerial decrees following the "end of waste" criteria, including decrees on construction and demolition waste.

Plastics

Europe produces 16% of the global plastic production, amounting to around 58 Mt. Italy is the second consumer of plastics after Germany, with around 6,5 million tons used for packaging, construction, automotive industry, electronics, and other sectors. Italians consume around 2,3 Mt of plastics for packaging per year, of which around 1,5 Mt are sorted for differentiated waste collection. According to the National Strategy for the Circular Economy, Italy is at the forefront of bioplastic production and has already tested a system for the collection and recycling of plastic enabling the achievement of the targets set in the following years, also thanks to the interventions defined in the National Recovery and Resilience plan (i.e. Investment 1.2: flagship projects).

The EU Directive 2018/852/UE, implemented through the Legislative Decree n.116/2020, foresees that by the end of 2025 at least 50% in weight of plastic packaging must be recycled, reaching 55% by the end of 2030. Moreover, the EU Directive 2019/904/UE (single use plastic), implemented through the Legislative decree 196/2021, requires that the Member States adopt measures to ensure the separated waste collection single use plastic products equal at least to 77% in weight by 2025 and 90% by 2029. The actions identified by the proposal of the National Plan of Waste Management consist in developing plants using new technologies to recycle plastic waste fractions (plasmix).

Packaging

In September 2020, the legislative decrees implementing the European directives in the field of waste have been approved. With the legislative decree 108/2021, Italy introduced new dispositions that foresee the adoption of "deposit return systems and packaging reuse systems' aiming at increasing the share of packaging reused and reintroduced in the market. The legislative decree 196/2021 implements the directive on single use plastics that imposes the production of PET plastic bottles with at least 25% of recycled plastic by 2025 and 30% by 2030.

Electronics and ICT

In 2018, in EU27, almost 8,7 Mt of electronic waste (RAEE) were introduced for consumption, of which 3,2 Mt have been collected. In Italy, the improvement of the collection and recycling of RAEE is considered in the National Plan of Waste Management, both to reach the objectives set in the EU Directive 2012/19 (modified by the EU Directive 2018/849) and for the potential of production/recovery of raw materials (e.g., rare-earth elements) that have key role for technologies for circular economy. The last data available on the collection rate of RAEE in Italy shows some difficulties in terms of collection rate when compared to the European targets (36,8% against a target of 65% in 2020).

3.6. Poland

Performance and structure of the economy

Poland has the highest GDP per capita among all Emerging Innovators, at 79% of the EU average, with a robust growth rate. Employment in manufacturing and services is comparable to the EU average, although Poland's employment share in high and medium high-tech sectors is below the EU average. Poland faces economic challenges: according to the European Semester Report (2024), price stability in Poland is set to remain one of the key issues over the coming years, having a significant impact on the cost of living and influencing economic stability. Additionally, labour shortages persist, particularly in high-skilled sectors, which could hinder further economic growth and innovation capacity.

Business and entrepreneurship

Poland features a strong enterprise birth rate but shows weak entrepreneurial activity, much lower than the EU average. The country has the lowest number of enterprises among the top R&D investors in the EU, far below the EU average (although data for most Emerging Innovators is missing). Despite this, FDI net inflows in Poland are higher than the EU average, though relatively low when compared to other Emerging Innovators. This dichotomy underscores Poland's ongoing efforts to strengthen its entrepreneurial ecosystem and attract higher levels of R&D investment. The European Semester Report (2024) highlights the role of cohesion policy funds in enhancing Poland’s competitiveness and providing support to entrepreneurs.

Table 1.11 Selected indicators - Poland

Indicator	Value*
Summary Innovation Index	65.9
Digitalisation	80.1
Direct and indirect government support of business R&D	80.2
R&D expenditure in the business sector	63.9
Innovation expenditures per person employed	40.9
SMEs introducing product innovations	43.1
SMEs introducing business process innovations	47.5

* Performance relative to the EU in 2024
Source: https://ec.europa.eu/assets/rtd/eis/2024/ec_rtd_eis-country-profile-pl.pdf

Poland's performance on circular economy indicators shows relative strengths in societal behaviours and its relative weaknesses in business operations. The strongest performing circular economy indicators are municipal solid waste generation and material footprint: domestic material consumption. The weakest performing circular economy indicators are coverage of the circular economy topic in electronic mass media and the share of SMEs reporting no difficulties in implementing circular economy activities.

Table 1.12 Selected circular economy indicators - Poland

Circular economy indicators	Country performance (normalised score)	Relative to EU in 2022 (EU=100)
Sustainable resource management	0.397	89.3
Societal behaviours	0.471	107.1
Business operations	0.225	59.8

Source: https://circabc.europa.eu/ui/group/96ccdecd-11b4-4a35-a046-30e01459ea9e/library/6e1d32f7-f95f-46e8-9838-6eda12c32c5c/details

There is relatively little interest among Polish regulators in implementing schemes and programmes beyond those proposed at an EU level. The general, cross-sectoral strategies, and specific targets and goals are still lacking. There are a few examples of successful actions, the most notable one being the Roadmap for the transformation Towards Circular Economy. The roadmap prioritizes innovation and cooperation between the industry and the academia, the provision of high-quality secondary raw materials resulting from sustainable production and consumption, and the facilitation of those markets and the service sector.

The Polish Ministry of Development and Technology has prepared the 'Productivity Strategy for public consultations'. It defines the vision of Polish economic development by the year 2030, determining objectives in seven areas: natural resources, employment and human capital, investments (in fixed and financial capital), organisation and institutions, knowledge, data, and internationalisation.

Within the elements of the new business model, the following actions were proposed in 'the Road Map towards the Transition to Circular Economy' to enable the transition to circular economy:

- Regenerate - use of renewable energy and raw materials in production processes, etc.
- Share - sharing real estate (e.g., premises) and movables (e.g., cars), prolonging the life of products.
- Optimise – minimise waste, increase the efficiency of production processes, etc.
- Close the loop – by recycling, component reuse, etc.
- Virtualise – online shopping, non-material books and records.
- Exchange – the use of new technologies (3D printing), services, and substitutes for non-renewable raw materials.

Construction and demolition waste (CDW)

Construction and demolition waste is not covered by the CE Road Map. For the management of waste resulting from constructing, renovating, and dismantling buildings and road infrastructure, the following lines of action have been adopted in the National Waste Management Plan 2022:

1. Information and educational activities to inform investors and entities generating waste from construction, renovation, and dismantlement of buildings and road infrastructure about the proper handling of waste.
2. Introduction of a system of incentives to promote the selective collection of C&D waste.
3. Introduction of a system of incentives to promote the use of recycled C&D materials.
4. Continuation of carrying out inspections of entities generating waste from construction, renovation, and dismantlement of buildings and road infrastructure to ensure proper handling of waste.
5. Development of technical infrastructure for selective collection, treatment, and reuse of C&D waste.

As of 2020, it is anticipated that the amount of CDW will stabilize, meaning that its generation will range from about 6,8 million tons to 7,3 million tons. Though provisions on the separation of waste in general exist in Poland, they do not specify any provisions on the CDW in particular. Only since 2012 has there been an obligation to sort hazardous waste when collecting and managing it. A special focus is put on asbestos. While there is no obligation to separate CDW during private construction activities (except for hazardous waste), it is mandatory to sort CDW for municipal waste. Furthermore, there is a public procurement law stating that special requirements must be fulfilled during public construction work.

Polish targets regarding the preparation for re-use, recycling, and recovery are identical to those of the EU, which means that Poland aims to achieve a level of 70% by weight in re-use, recycling, and other forms of CDW recovery.

The initiatives to improve CDW management in Poland are rather rare. There have been attempts to collect plastic packaging waste generated during the construction work. However, the initiative did not bear fruit. The reason behind the lack of CDW management initiatives might be the unwillingness of construction companies to try recovered materials. The Polish Green Building Council aims to encourage sustainable development in the construction field by promoting BREEAM and LEED certification. In Poland, there is no obligation to separate CDW (except for hazardous waste) and thus the majority of construction companies do not want to pay additional costs for sorting and properly recovering waste.

Plastics and packaging

In the National Waste Management Plan 2022, for the management of packaging and packaging waste, the following actions have been adopted:

1. Application of activities for the benefit of packaging WP through the regular inclusion of environmental aspects in designing a product with an intent to improve the characteristics of the impact that this product has on the environment at the stage of production and throughout its life cycle, including the reduction in the weight of a packaging and the reduction in the size of packaging concerning the size of a product, use of reusable packaging should it be justified in ecological and economic terms.
2. Developing a system of selective collection of packaging waste and treatment of packaging waste, and in particular multi-material packaging waste and hazardous product packaging waste.
3. Continuation of information and educational campaigns addressed to sellers and users of hazardous substances which improve knowledge as regards the proper handling of packaging for such products.

Electronics & ICT (including batteries and vehicles)

The National Waste Management Plan 2022 mentions that waste products (such as waste oils, end-of-life tyres, waste batteries and waste accumulators, WEEE, packaging waste, and end-of-life vehicles) are covered by the EPR (environmental producer responsibility).

The EPR principle is a response to the challenges faced in particular by the municipal self-government as regards the management of the above-mentioned waste. The EPR assumptions lead to shifting the burden of management of waste products from the self-government administration and users to producers of oils, tyres, batteries and accumulators, electrical and electronic equipment, packaging products and packaging,

and vehicles. The purpose of implementing the EPR, by imposing on producers of the aforementioned products the obligations in financing and organising waste collection and treatment systems, is to encourage producers to redesign products and packaging, reduce the share of waste to be landfilled only, and increase the potential of its recycling.

3.7. Slovakia

Performance and structure of the economy

Slovakia's GDP per capita (72.3) is lower than the EU average. The country's average annual GDP growth is close to the EU average. The employment share in manufacturing is significantly higher in Slovakia than in the EU. Slovakia also has a higher employment share in high and medium high-tech sectors (47.1). However, the employment share in services and knowledge-intensive services is lower. The turnover share of SMEs in Slovakia is higher than the EU average, while the turnover share of large enterprises is lower. Foreign-controlled enterprises (24.2), especially in the automotive sector and electronics sector, account for a larger share of value added than the EU average. A low flat tax rate for both businesses and individuals and cheap and skilled labour (OECD, 2024) are Slovakia's main advantages for foreign investors.

Business and entrepreneurship

Slovakia has a higher rate of enterprise births and the total entrepreneurial activity in Slovakia (9.3) is also higher than the EU average. However, Slovakia's FDI net inflows are low and so is buyer sophistication. To support businesses and start-ups, Slovakia has several accelerators and incubators. Initiatives like for instance SAPIE (Slovak Alliance for Innovation Economy) focus on promoting new businesses.

Table 1.13 Selected indicators - Slovakia

Indicator	Value*
Summary Innovation Index	65.1
Digitalisation	66.8
Direct and indirect government support of business R&D	46.7
R&D expenditure in the business sector	36.1
Innovation expenditures per person employed	44.3
SMEs introducing product innovations	48.4
SMEs introducing business process innovations	43.3

* Performance relative to the EU in 2024
Source: https://ec.europa.eu/assets/rtd/eis/2024/ec_rtd_eis-country-profile-sk.pdf

Slovakia's performance on circular economy indicators shows relative strengths in sustainable resource management and relative weaknesses in business operations. The strongest performing circular economy indicators are the number of EPR schemes, and the

number of enterprises involved in the repair of computers and personal and household goods. The weakest performing circular economy indicators are coverage of the circular economy topic in electronic mass media and recycling rate of construction and demolition waste.

Table 1.14 Selected circular economy indicators - Slovakia

Circular economy indicators	Country performance (normalised score)	Relative to EU in 2022 (EU=100)
Sustainable resource management	0.413	92.9
Societal behaviours	0.367	82.0
Business operations	0.271	72.0

Source: https://circabc.europa.eu/ui/group/96ccdecd-11b4-4a35-a046-30e01459ea9e/library/7ec3d9d9-99ba-4a9b-8ffe-7368a2641ded/details

The Slovakian Government is working towards a national circular economy strategy and is reforming and updating legislation and strategies, preparing the ground for a circular economy transition in the country: the 'current policy landscape related to the circular economy in the Slovak Republic is fairly well advanced in the area of waste management, but there is an implementation gap that needs to be addressed'.

On 24th of November 2021, the Slovak government approved a new comprehensive strategic document — the Waste Management Program of the Slovak Republic for the years 2021 to 2025. Slovakia was facing infringement from the European Commission due to the long-term neglect of its waste management policy. Overall, there are about 14 main objectives with related indicators to monitor the progress. Some of the main objectives are:

- 60% sorting and recycle at least 55% of all municipal waste by 2025, while no more than 10% of municipal waste ending up in landfills by 2035.
- By 2025, the share of bio-waste in mixed waste should be reduced to 25%.
- By the end of 2025, the recycling rate of packaging waste should reach at least 65% (of total weight of packaging on the market).
- Electronic waste should achieve at least a recycling rate of 65%.
- By end of 2025, a recycling rate for waste tires should be at least 75%, and energy recovery rate of waste tires of a maximum of 24%.
- Create a functioning system for textiles in the Waste Act with effect from 1 January 2025.
- Reform legislation to increase the reuse and recycling of construction waste to 70% percent.

- Prepare the adoption of a new regulatory framework for batteries with a minimum recycling target of 90% for lead batteries, 75% for nickel-cadmium batteries, and 60% for other types of batteries.
- Prepare supporting documentation for a new regulatory framework for bioplastic waste management system (currently there is no system in place).

To help to support these objectives, the waste management rules will also be made clearer. Furthermore, the government wants to address the issue of textile waste, which currently is only collected on a voluntary basis, mainly by charities. Hence, the Ministry of the Environment wants to create a new system for textiles in the Waste Act with effect from 1st January 2025.

In May 2022, the Government of the Slovak Republic approved the reform of how construction waste is managed in the form of an amendment to the Waste Act. This is a response to the situation that Slovakia lags behind other European countries in terms of construction waste recycling rates. Only 54% of nonhazardous construction and demolition waste is being recovered, while the rest ends up in landfills. It will introduce the target of at least 70% of non-hazardous construction and demolition waste to be recycled. These measures will enable the development of the market for waste processors, but also for products produced from originally waste materials. The reform also aims at improving the data collection and to simplify the rules for the use of construction waste.

4. PERFORMANCE INDICATORS OF PARTNER COUNTRIES

Table 4.1 Development of selected circular economy indicators

Indicator	Austria		Croatia		Germany		Hungary		Italy		Poland		Slovakia	
	Value	EU*	Value	EU*	Value	EU*	Value	EU*	Value	EU*	Value	EU*	Value	EU*
Resource efficiency outcomes	0,464	127,0	0,440	120,5	0,611	167,1	0,275	75,2	1,00	273,5	0,307	84,0	0,527	144,2
Material productivity (GDP/Domestic Material Consumption, €/kg)	1,9	124,7	1,8	111,3	2,8	200,9	1,6	87,7	3,6	268,5	1,4	68,9	1,8	107,6
Water productivity (GDP/total fresh water abstraction, €/m³)	n.A.	n.A.	126,1	196,9	128,7	199,9	52,6	94,1	n.A.	n.A.	89,4	151,0	204,1	275,9
Energy productivity (GDP/gross inland energy consumption, €/toe)	9,8	151,0	5,7	71,4	10,0	154,6	4,7	52,7	10,3	160,4	4,7	52,3	5,0	58,6
Material Footprint: domestic material consumption (tonnes per capita)	18,8	192,2	11,2	63,5	13,4	101,2	14,4	118,2	7,5	0,0	17,6	171,1	11,6	70,7
Recycling of packaging waste (rate in %)	65,4%	103,1	48,9%	47,8	63,2%	96,1	46,7%	42,5	67,6%	110,5	55,5%	71,0	67,5%	110,2
Recycling of biowaste (kg per capita)	189,0	210,0	23,0	25,6	122,0	135,6	39,0	43,3	107,0	118,9	42,0	46,7	59,0	65,6
Recycling rate of construction and demolition waste (%)	90,0	100,0	78,0%	81,8	93,0%	104,5	99,0%	113,6	98,0%	112,1	84,0%	90,9	51,0%	40,9
Share of SMEs reporting no difficulties in implementing circular economy activities (% of SMEs)	0,81	148,8	0,812	150,0	0,83	160,7	0,674	67,9	0,74	107,1	0,604	26,2	0,704	85,7
Self-financing ability for circular economy activities (% of SMEs)	70,0%	100,0	67,0%	70,0	60,0%	0,0	75,0%	150,0	64,0%	40,0	72,0%	120,0	71,0%	110,0
Share of SMEs that facilitated recycling of products after use (% of innovative SMEs)	30,0%	114,3	34,6%	137,8	33,6%	132,7	16,4%	44,9	24,1%	84,2	16,4%	44,9	19,3%	59,7
SMEs recycling waste, water or materials for own use or sale within the enterprises by innovating (% of innovative SMEs)	39,8%	133,2	44,8%	159,6	47,8%	175,3	22,3%	41,1	14,5%	0,0	22,4%	41,6	31,7%	90,5
Number of eco-labelled products and services (per million population)	95,4	47,6	9,7	4,4	123,7	61,8	9,7	4,4	235,4	118,1	85,3	42,5	0,9	0,0

Source: https://ec.europa.eu/eurostat/data/database

Notice: EU* – Performance relative to EU is calculated as follows: (Normalised country score / EU score) x 100. Normalisation is done using the Min-Max approach. This leads to certain countries resulting in a zero score for an indicator, this implies that, that country is the lowest performing country vis-à-vis the other EU Member States.

Table 4.2 Material footprint (Tonnes per capita) – Raw material consumption

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Austria	25,078	24,389	24,446	25,949	24,557	23,832	24,295	23,374	23,730	23,638	23,947	23,583	22,265	24,230	22,566	20,371
Croatia	21,393	15,868	13,129	14,028	12,949	13,071	11,771	13,605	13,266	13,732	13,915	14,221	13,232	13,619	14,692	15,283
Germany	17,454	16,267	15,399	17,070	16,007	15,949	16,059	15,316	15,665	16,089	16,210	15,982	15,271	15,376	14,963	13,815
Hungary	12,407	10,947	9,261	9,030	8,181	9,662	12,811	12,672	12,068	13,926	15,906	16,698	14,297	14,499	14,358	15,855
Italy	18,091	16,164	15,068	15,186	12,480	11,033	10,630	10,604	10,527	10,392	10,772	10,547	9,602	11,012	11,319	11,122
Poland	15,866	15,321	15,673	19,529	16,399	15,402	15,517	15,577	15,962	17,293	17,794	17,057	16,775	17,057	17,374	17,023
Slovakia	19,168	14,727	14,327	13,977	11,624	11,773	12,504	13,084	13,548	13,750	14,825	13,602	12,706	12,754	12,078	11,795

Source: https://ec.europa.eu/eurostat/databrowser/view/cei_pc020/default/table?lang=en&category=cei.cei_pc

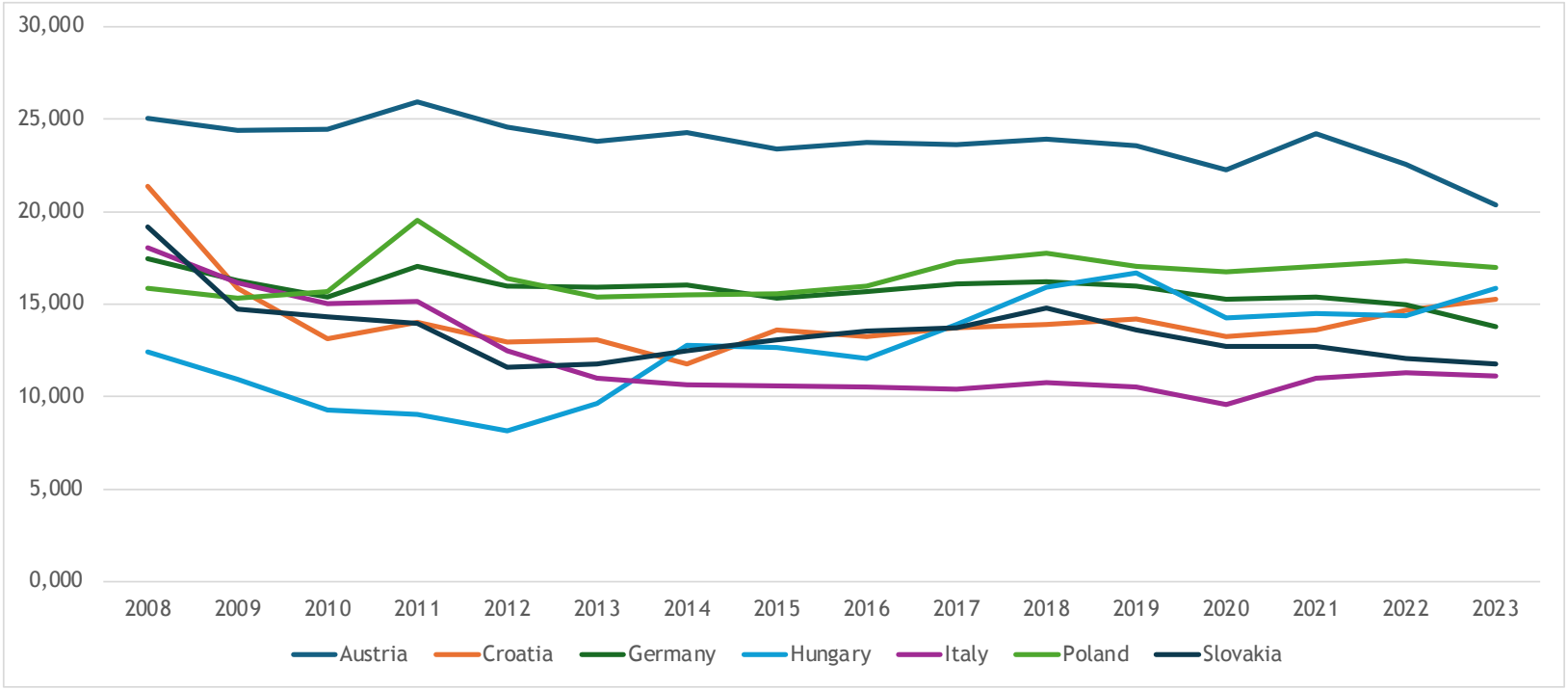


Figure 4.1 Material footprint (Tonnes per capita) – Raw material consumption

Table 4.3 Generation of packaging waste per capita (Kilograms per capita) – Packaging

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Austria	25,078	24,389	24,446	25,949	24,557	23,832	24,295	23,374	23,730	23,638	23,947	23,583	22,265	24,230	22,566	20,371
Croatia	21,393	15,868	13,129	14,028	12,949	13,071	11,771	13,605	13,266	13,732	13,915	14,221	13,232	13,619	14,692	15,283
Germany	17,454	16,267	15,399	17,070	16,007	15,949	16,059	15,316	15,665	16,089	16,210	15,982	15,271	15,376	14,963	13,815
Hungary	12,407	10,947	9,261	9,030	8,181	9,662	12,811	12,672	12,068	13,926	15,906	16,698	14,297	14,499	14,358	15,855
Italy	18,091	16,164	15,068	15,186	12,480	11,033	10,630	10,604	10,527	10,392	10,772	10,547	9,602	11,012	11,319	11,122
Poland	15,866	15,321	15,673	19,529	16,399	15,402	15,517	15,577	15,962	17,293	17,794	17,057	16,775	17,057	17,374	17,023
Slovakia	19,168	14,727	14,327	13,977	11,624	11,773	12,504	13,084	13,548	13,750	14,825	13,602	12,706	12,754	12,078	11,795

Source: https://ec.europa.eu/eurostat/databrowser/view/cei_pc040/default/table?lang=en&category=cei.cei_pc

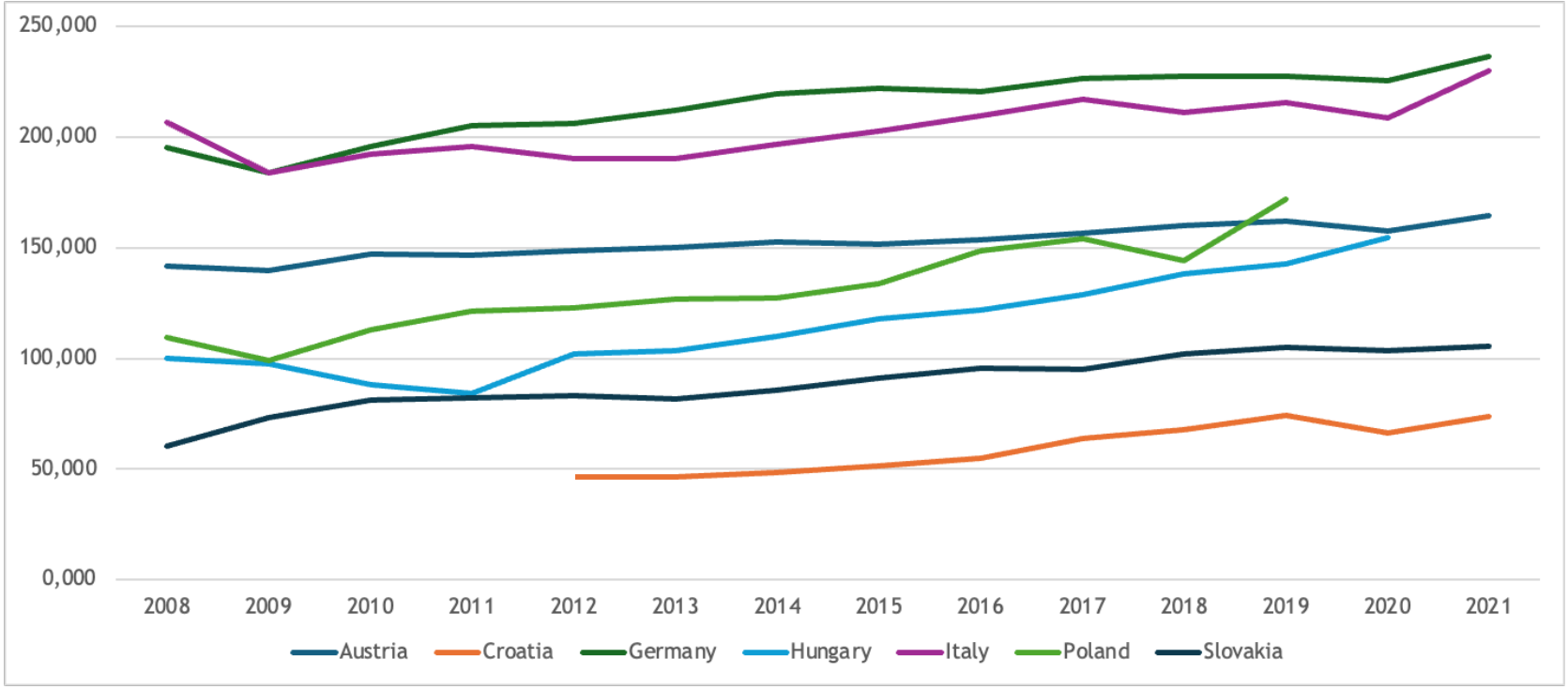


Figure 4.2 Generation of packaging waste per capita (Kilograms per capita) – Packaging

Table 4.4 Generation of plastic packaging waste per capita (Kilograms per capita) – Plastic packaging

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Austria	30,230	30,660	31,630	31,480	32,240	34,050	34,160	34,120	34,090	34,360	34,160	33,310	33,550	33,360
Croatia	n.A.	n.A.	n.A.	n.A.	11,310	11,460	11,590	12,350	13,120	14,670	15,730	16,760	16,270	17,910
Germany	33,280	32,000	32,900	34,580	35,270	35,630	36,370	37,360	37,620	38,530	39,030	39,110	39,710	41,090
Hungary	21,440	22,890	21,090	20,930	25,900	27,850	26,210	30,460	31,480	32,240	34,840	35,020	47,450	n.A.
Italy	37,480	35,400	34,940	34,940	34,460	33,910	34,250	35,050	36,530	37,520	37,930	38,750	37,160	38,400
Poland	17,570	17,470	19,270	20,610	21,860	23,530	23,600	24,630	26,530	27,420	25,940	34,190	n.A.	n.A.
Slovakia	15,140	16,970	19,620	19,750	19,330	18,060	18,030	19,620	21,990	22,830	24,220	24,690	23,490	23,560

Source: https://ec.europa.eu/eurostat/databrowser/view/cei_pc050/default/table?lang=en&category=cei.cei_pc

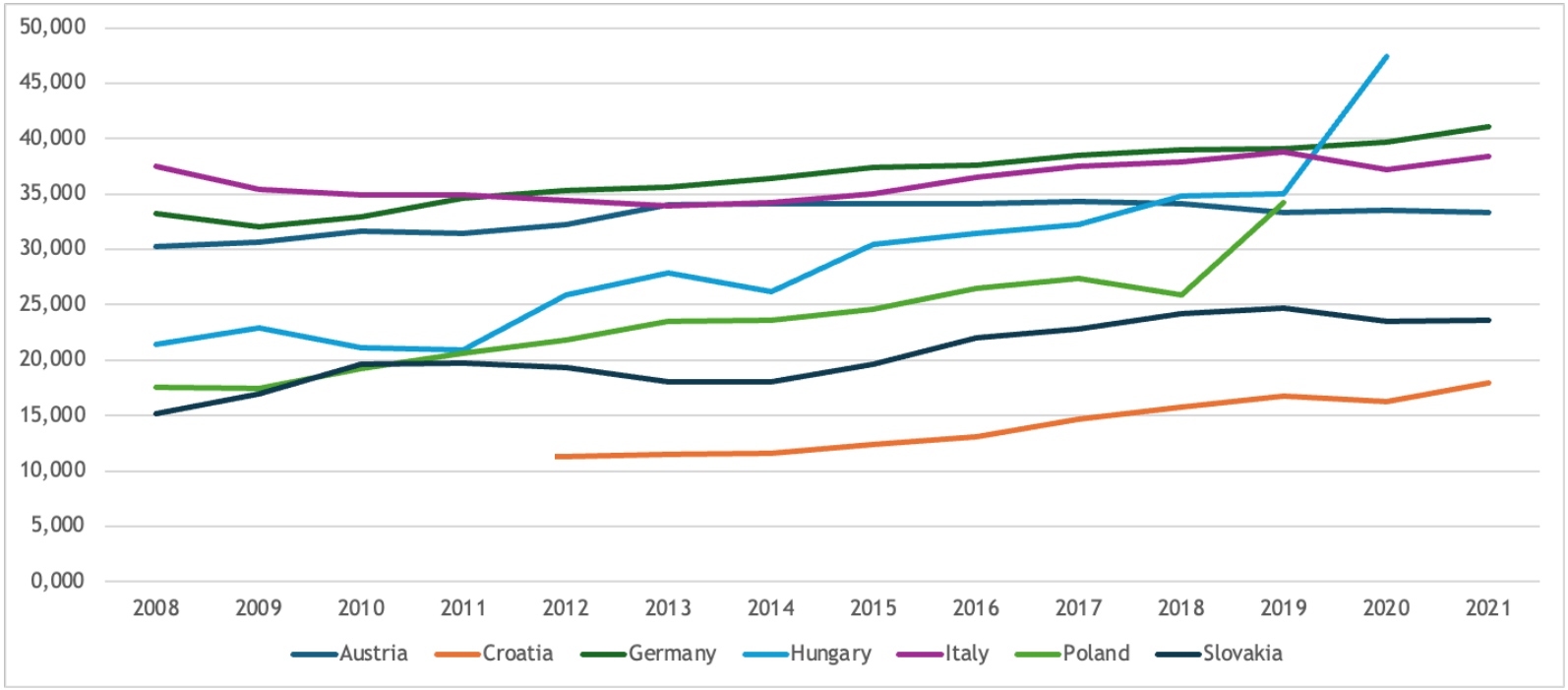


Figure 4.3 Generation of plastic packaging waste per capita (Kilograms per capita) – Plastic packaging

Table 4.5 Circular material use rate (Percentage)

Country	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Austria	*6,80*	*6,90*	*7,90*	*9,20*	*10,00*	*11,20*	*12,00*	*12,10*	*11,90*	*11,60*	*11,50*	*12,80*	*13,80*
Croatia	*1,60*	*2,40*	*3,50*	*3,90*	*4,80*	*4,60*	*4,60*	*5,10*	*5,00*	*5,30*	*5,50*	*5,70*	*5,80*
Germany	*11,20*	*10,70*	*11,00*	*11,10*	*11,20*	*11,70*	*11,80*	*11,70*	*12,10*	*12,50*	*12,90*	*12,70*	*13,00*
Hungary	*5,20*	*5,40*	*6,00*	*6,10*	*5,40*	*5,80*	*6,40*	*6,80*	*7,00*	*5,60*	*5,20*	*7,30*	*7,90*
Italy	*11,50*	*11,60*	*13,90*	*16,00*	*16,10*	*17,20*	*17,80*	*18,40*	*18,80*	*18,80*	*20,60*	*19,00*	*18,70*
Poland	*11,10*	*9,40*	*11,00*	*12,20*	*13,00*	*11,90*	*10,60*	*10,40*	*10,50*	*9,20*	*7,30*	*9,10*	*8,40*
Slovakia	*5,10*	*4,80*	*4,10*	*4,60*	*4,80*	*5,10*	*5,30*	*5,00*	*4,90*	*8,40*	*10,40*	*8,20*	*9,10*

Source: https://ec.europa.eu/eurostat/databrowser/view/cei_srm030/default/table?lang=en&category=cei.cei_srm

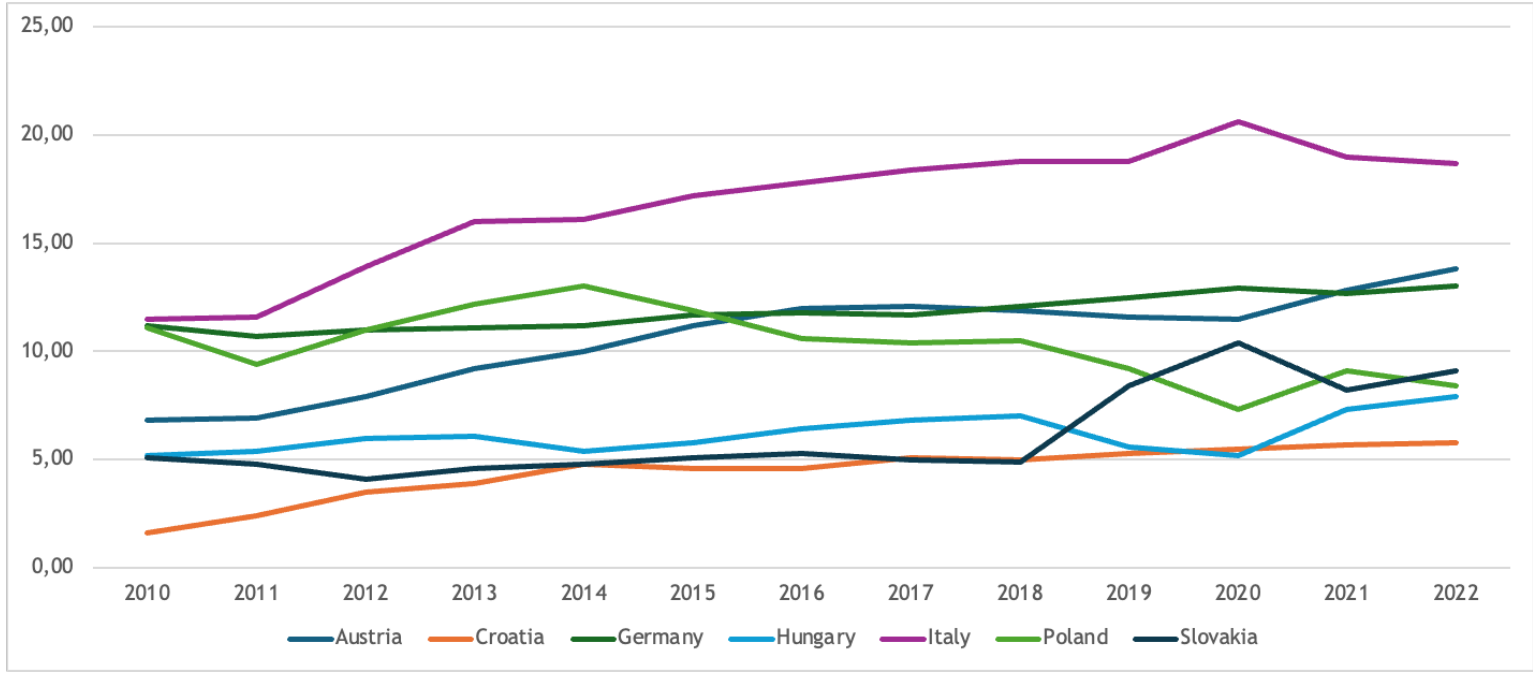


Figure 4.4 Circular material use rate (Percentage)

Table 4.6 Persons employed in circular economy sectors (Persons employed)

Country	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Austria	47 954	48 925	48 172	48 252	48 376	50 091	47 466	48 075	49 423	49 173
Croatia	42 218	42 218	45 261	44 872	44 088	46 104	51 368	58 574	50 818	52 113
Germany	617 452	611 082	657 563	651 777	677 723	700 179	744 774	739 622	764 770	785 297
Hungary	112 989	99 999	94 592	102 645	110 391	114 922	119 781	109 768	105 907	109 215
Italy	573 325	579 522	596 574	603 247	612 645	591 196	585 644	644 581	617 149	613 339
Poland	387 443	399 380	398 677	418 033	422 007	427 247	429 029	435 574	437 080	441 671
Slovakia	43 835	43 909	42 938	44 737	45 547	47 036	49 438	48 995	51 486	52 248

Source: https://ec.europa.eu/eurostat/databrowser/view/cei_cie011/default/table?lang=en&category=cei.cei_cie

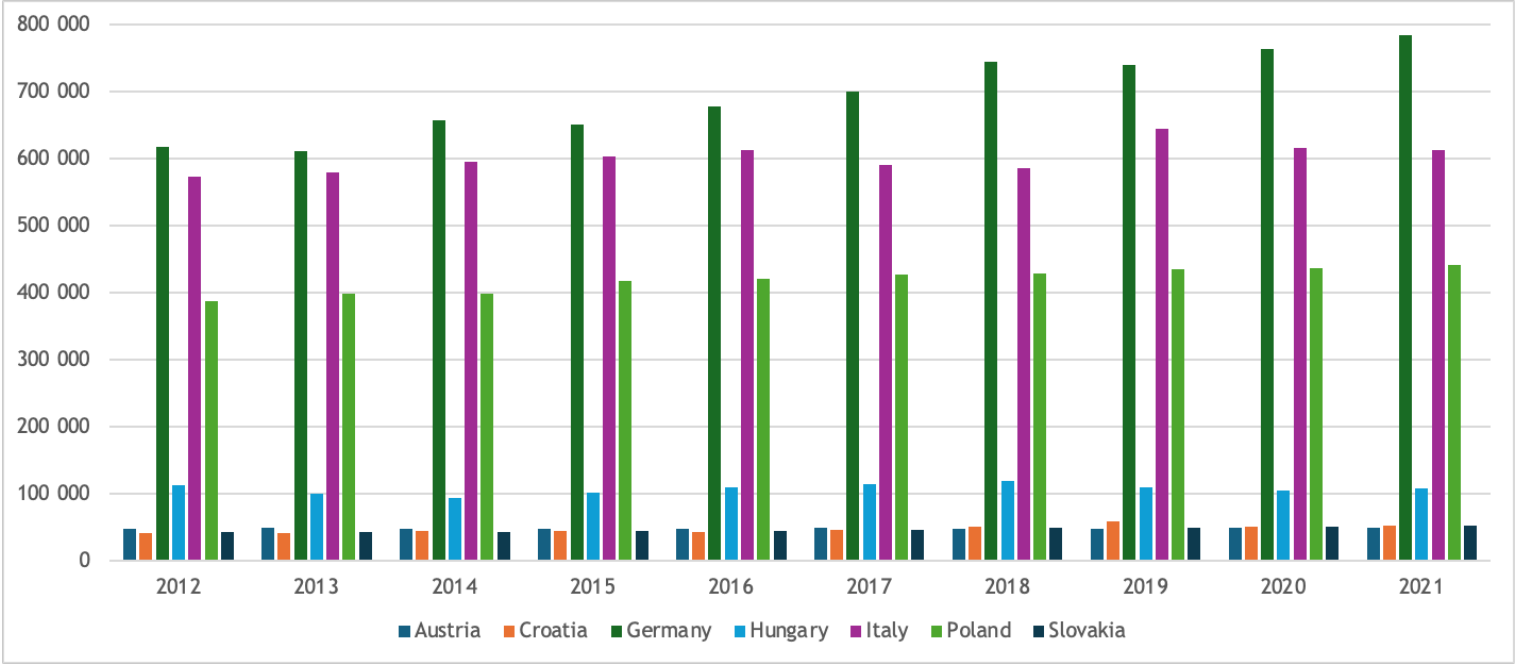


Figure 4.5 Persons employed in circular economy sectors (Persons employed)

5. SPECIAL AGGREGATES – ENTERPRISES BY NACE

Table 5.1 Structural Information about companies in sector – Construction and Building

Country	CONSTRUCTION and BUILDING											
	Total number of companies			Persons employed in these companies			Value added (million €)			Net turnover (million €)		
	2021	2022	2023	2021	2022	2023	2021	2022	2023	2021	2022	2023
Austria	5 957	6 274	6 246	84 688	85 502	83 336	6 508,24	7 127,12	n.A.	22 221,90	25 196,03	22 956,94
Croatia	8 372	8 748	8 984	49 631	52 177	55 378	920,10	1 166,87	n.A.	3 650,10	4 527,66	5 554,45
Germany	29 513	28 885	28 120	357 772	366 766	354 792	31 221,31	29 909,18	n.A.	91 191,72	96 776,10	93 597,52
Hungary	22 863	23 788	22 587	90 075	95 250	91 922	2 428,02	2 621,73	n.A.	11 656,65	13 043,34	13 296,60
Italy	109 552	112 301	111 932	327 023	371 348	383 586	17 401,86	22 030,12	n.A.	71 752,49	90 797,79	121 004,24
Poland	101 462	98 230	95 861	358 257	352 904	340 137	9 574,50	11 417,05	n.A.	47 354,72	52 279,42	54 784,65
Slovakia	18 651	20 532	21 748	37 033	39 395	40 007	664,55	772,89	n.A.	4 410,58	5 094,67	5 156,47

Source: https://ec.europa.eu/eurostat/databrowser/view/sbs_ovw_act/default/table?lang=en&category=bsd.sbs.sbs_ovw

NACE-codes of companies from Construction and Buildings

(https://ec.europa.eu/competition/mergers/cases/index/nace_all.html)

- F41 Construction of buildings
- F42 Civil engineering
- F43 Specialized construction activities

Table 5.2 Structural Information about companies in sector – Packaging

Country	PACKAGING											
	Total number of companies			Persons employed in these companies			Value added (million €)			Net turnover (million €)		
	2021	2022	2023	2021	2022	2023	2021	2022	2023	2021	2022	2023
Austria	51	50	n.A.	6 545	6 714	n.A.	667,20	668,12	n.A.	2 439,11	2 807,74	n.A.
Croatia	95	93	n.A.	2 111	2 258	n.A.	59,72	82,13	n.A.	225,15	306,38	n.A.
Germany	624	612	n.A.	66 293	67 368	n.A.	5 184,11	6 220,99	n.A.	17 530,20	21 861,46	n.A.
Hungary	235	227	n.A.	8 601	8 751	n.A.	238,72	267,99	n.A.	947,07	1 144,66	n.A.
Italy	1 064	1 086	n.A.	28 266	30 553	n.A.	2 256,34	3 012,66	n.A.	9 687,58	12 924,86	n.A.
Poland	1 480	1 451	n.A.	37 857	38 021	n.A.	1 825,74	2 031,71	n.A.	6 629,52	7 681,08	n.A.
Slovakia	88	87	n.A.	2 306	2 383	n.A.	69,07	80,42	n.A.	265,63	340,71	n.A.

Source: https://ec.europa.eu/eurostat/databrowser/view/sbs_ovw_act/default/table?lang=en&category=bsd.sbs.sbs_ovw

NACE-codes of companies from Packaging

(https://ec.europa.eu/competition/mergers/cases/index/nace_all.html)

- C17.21 Manufacture of corrugated paper and paperboard and containers of paper and paperboard (e.g., boxes, cartons)
- C17.22 Manufacture of household and sanitary goods and of toilet requisites (includes certain paper-based packaging)
- C23.13 Manufacture of hollow glass (which includes bottles and other glass containers)
- C25.92 Manufacture of light metal packaging (e.g., cans, tins)
- E38.32 Recovery of sorted materials (recycling of paper, plastics, and other materials)
- G46.76 Wholesale of other intermediate products (e.g., wholesale trade of packaging materials)
- N82.92 Packaging activities (e.g., packing goods for transportation or retail sale)

Table 5.3 Structural Information about companies in sector – Plastics

Country	PLASTICS											
	Total number of companies			Persons employed in these companies			Value added (million €)			Net turnover (million €)		
	2021	2022	2023	2021	2022	2023	2021	2022	2023	2021	2022	2023
Austria	22	21	n.A.	2 493	2 577	n.A.	1 700,97	1 082,34	n.A.	9 290,50	10 290,23	n.A.
Croatia	14	13	n.A.	190	164	n.A.	4,88	3,36	n.A.	43,91	49,84	n.A.
Germany	415	419	n.A.	42 284	43 870	n.A.	7 137,52	6 949,71	n.A.	29 264,19	33 292,32	n.A.
Hungary	40	38	n.A.	4 380	4 519	n.A.	988,52	580,74	n.A.	3 236,17	3 835,69	n.A.
Italy	321	314	n.A.	13 220	13 514	n.A.	2 269,36	2 137,24	n.A.	10 366,96	12 059,15	n.A.
Poland	336	345	n.A.	11 126	12 296	n.A.	966,55	1 181,81	n.A.	4 099,40	5 866,12	n.A.
Slovakia	58	60	n.A.	1 402	637	n.A.	60,90	28,75	n.A.	426,72	384,41	n.A.

Source: https://ec.europa.eu/eurostat/databrowser/view/sbs_ovw_act/default/table?lang=en&category=bsd.sbs.sbs_ovw

NACE-codes of companies from Plastics

(https://ec.europa.eu/competition/mergers/cases/index/nace_all.html)

- C20.16 Manufacture of plastics in primary forms (e.g., production of plastic resins, raw plastic material)
- C20.17 Manufacture of synthetic rubber in primary forms)
- C22 Manufacture of rubber and plastic products)
- C23.99 Manufacture of other non-metallic mineral products n.e.c. (includes certain plastic construction materials)
- C28.96 Manufacture of machinery for working rubber or plastics and for the manufacture of products from these materials (e.g., plastic molding machinery)
- E38.32 Recovery of sorted materials (includes the recycling of plastic materials)
- G46 Wholesale of other intermediate products (includes trade of plastic raw materials and products)
- G 47.52 Retail sale of hardware, paints, and glass in specialized stores (includes sale of plastic products for construction and household use)

Table 5.4 Structural Information about companies in sector – Mechanics and Mechatronics

Country	MECHANICS and MECHATRONICS											
	Total number of companies			Persons employed in these companies			Value added (million €)			Net turnover (million €)		
	2021	2022	2023	2021	2022	2023	2021	2022	2023	2021	2022	2023
Austria	128	134	n.A.	9 053	9 629	n.A.	1 287,20	1 595,64	n.A.	5 135,33	6 684,05	n.A.
Croatia	69	68	n.A.	910	923	n.A.	31,98	43,44	n.A.	130,97	204,88	n.A.
Germany	1 781	1 808	n.A.	76 010	83 666	n.A.	7 741,43	11 206,78	n.A.	25 830,70	33 251,62	n.A.
Hungary	215	216	n.A.	16 861	18 472	n.A.	502,38	514,23	n.A.	3 502,70	3 992,47	n.A.
Italy	912	903	n.A.	26 398	27 955	n.A.	2 217,91	2 798,72	n.A.	5 262,43	6 454,20	n.A.
Poland	519	497	n.A.	13 906	12 470	n.A.	395,77	383,21	n.A.	3 119,59	2 835,99	n.A.
Slovakia	446	479	n.A.	3 676	4 615	n.A.	131,32	167,26	n.A.	389,28	561,49	n.A.

Source: https://ec.europa.eu/eurostat/databrowser/view/sbs_ovw_act/default/table?lang=en&category=bsd.sbs.sbs_ovw

NACE-codes of companies from Mechanics and Mechatronics

(https://ec.europa.eu/competition/mergers/cases/index/nace_all.html)

- C26.11 Manufacture of electronic components (important for mechatronic systems)
- C26.12 Manufacture of loaded electronic boards)
- C27.1 Manufacture of electric motors, generators, transformers, and electricity distribution and control apparatus)
- C27.9 Manufacture of other electrical equipment)
- C28.1 Manufacture of general-purpose machinery)
- C28.2 Manufacture of other general-purpose machinery)
- C28.99 Manufacture of other special-purpose machinery n.e.c. (includes robotics and automated systems relevant to mechatronics)
- C33 Repair and installation of machinery and equipment)
- M71.12 Engineering activities and related technical consultancy (important for the design and development of mechanical and mechatronic systems)
- M72.19 Other research and experimental development on natural sciences and engineering (covers R&D activities in mechatronics and mechanical engineering fields)

CONCLUSION

The aim of this document was to analyse the state of readiness of enterprises for sustainable design and product development, in accordance with the principles of the circular economy. From a methodological point of view, the analysis was carried out based on a design matrix of key performance indicators.

The Matrix was designed to provide a global view of the economic context of the analysed countries – Austria, Croatia, Germany, Italy, Hungary, Poland and Slovakia – in the first dimension and then gradually penetrated into the circular economy. In its last dimension, it completes the picture of the size of the four key sectors that are the object of the project's research.

MATRIX OF KEY PERFORMANCE INDICATORS
Dimension I. General country indicators
• Summary Innovation Index • Digitalisation • Direct and indirect government support of business R&D • R&D expenditure in the business sector • Innovation expenditures per person employed • SMEs introducing product innovations • SMEs introducing business process innovations
Dimension II. Circular economy indicators (macro level)
• Sustainable resource management • Societal behaviours • Business operations
Dimension III. Circular economy indicators (specific target indicators) – global view
• Resource efficiency outcomes • Material productivity (GDP/Domestic Material Consumption, €/kg) • Water productivity (GDP/total freshwater abstraction, €/m^3) • Energy productivity (GDP/gross inland energy consumption, €/toe) • Material Footprint: domestic material consumption (tonnes per capita) • Recycling of packaging waste (rate in %) • Recycling of biowaste (kg per capita) • Recycling rate of construction and demolition waste (%) • Share of SMEs reporting no difficulties in implementing circular economy activities (% of SMEs) • Self-financing ability for circular economy activities (% of SMEs) • Share of SMEs that facilitated recycling of products after use (% of innovative SMEs)

• SMEs recycling waste, water or materials for own use or sale within the enterprises by innovating (% of innovative SMEs) • Number of eco-labelled products and services (per million population)
Dimension IV. Circular economy indicators (specific target indicators) – time dependence
• Material footprint (Tonnes per capita) – Raw material consumption • Generation of packaging waste per capita (Kilograms per capita) – Packaging • Generation of plastic packaging waste per capita (Kilograms per capita) – Plastic packaging • Circular material use rate (Percentage) • Persons employed in circular economy sectors (Persons employed)
Dimension V. Structural information about companies in the 4 key sectors
• Total number of companies • Persons employed in these companies • Value added (million €) • Net turnover (million €)

In the annex of this analysis there are proposals for evaluation matrices that reflect the essential facts regarding the performance, efficiency and environmental responsibility of enterprises in 4 key sectors (Mechanics and mechatronics, Packaging, Plastic, Construction and building), concentrating on:

- Matrix of indicators describing an economic sector.
- Matrix of key financial performance indicators for sectoral analysis.
- Matrix of key performance indicators for the market status.

The design of these matrices was based on the results of desk research and the requirements for ESG-reporting, which will affect all business entities across the board in the coming years, were considered. The current situation in the field of environmental reporting of companies is not satisfactory, obtaining some data is extremely difficult due to their unavailability or difficult verification.

Summary

The readiness of businesses for sustainable design and product development varies in countries such as Austria, Croatia, Germany, Hungary, Italy, Poland and Slovakia according to various factors, including political conditions, technological infrastructure, workforce education and availability of funds. Austria and Germany are among the leaders in sustainability thanks to their long-term environmental policy and high investment in research and development. In both countries, businesses are at the forefront of implementing green and innovative solutions, including in industries that include manufacturing and technology. These countries are known for their extensive

sustainability programs and are actively involved in international projects focused on green innovation.

Croatia and Hungary, on the other hand, show a slightly lower level of preparedness. Although they have a growing interest in sustainable development, limited investment and a less developed technological base are often an obstacle. However, these countries are experiencing improvements, mainly thanks to programmes co-financed by the European Union, which support small and medium-sized enterprises in adopting sustainable practices. Poland is also trying to catch up with its western neighbors, but faces challenges related to its high dependence on traditional forms of energy and slower adaptation to new technologies.

Italy is characterized by a diverse economy, where some manufacturing sectors are showing significant efforts to reduce their ecological footprint through innovative and eco-friendly solutions. On the other hand, the industrial regions of Italy face challenges associated with traditional production methods and a limited number of initiatives to modernize them. Slovakia faces challenges similar to those of Hungary and Croatia, with the gradual adoption of the principles of sustainable development. Opportunities here are often combined with EU support, which makes it possible to implement more environmentally sound strategies.

Due to these factors, Austria and Germany can be assessed as the most prepared for sustainable design and product development, followed by Italy, which is at the intermediate level of readiness. Croatia, Hungary, Poland and Slovakia have potential, but they need more significant investment and an improved legislative framework to support the green transition.

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ANNEX

Assessment of the current state using a matrix of key performance indicators

Sustainable product development is critical for modern companies, offering a dual strategic advantage. It aligns with the growing consumer demand for eco-friendly products, allowing firms to access expanding markets while strengthening their brand reputation. At the same time, adopting sustainable practices positions companies as active participants in environmental stewardship. This includes responsible resource usage, waste minimization, and emission reductions, all of which contribute to a smaller ecological footprint. By doing so, firms not only meet consumer expectations but also fulfil their role under the extended producer responsibility framework, ensuring they contribute to the broader goal of environmental preservation.

Analysing the financial implications of sustainable product development is essential for several reasons. While businesses are expected to contribute to environmental sustainability, their primary purpose remains profitability and revenue generation. This is similar to Michael Porter's insights regarding the rise of the Internet. Initially, some thought this technological leap made traditional business rules irrelevant, leading to a focus on growth over profitability. This contributed to the dot-com bubble collapse in 2000. However, Porter argued that the advent of the Internet, in fact, reinforced the importance of profitability within business models.

Incorporating Environmental, Social, and Governance (ESG) goals into corporate strategy makes profitability even more crucial. Profitability is the financial backbone that supports firms' investments in ESG initiatives. For example, while solar energy involves high initial costs compared to non-renewable sources, over time, it lowers energy bills and reduces environmental impact. Companies with strong profitability are better positioned to fund such investments, benefiting both economically and environmentally. Acknowledging the interdependence of these objectives is critical, as they significantly influence each other. Thus, just as the Internet's emergence reasserted the importance of profitability, the sustainability movement highlights the need to balance financial performance with corporate responsibility. Therefore, assessing the financial impact of sustainable product development is fundamental to long-term corporate success.

The analysis of the current state of the issue in 4 key sectors (Mechanics and mechatronics, Packaging, Plastic, Construction and building) will be performs through three matrices:

- Matrix of indicators describing an economic sector,
- Matrix of key financial performance indicators for sectoral analysis,
- Matrix of key performance indicators for the market status.

A.I Matrix of indicators describing an economic sector

This matrix has seven dimensions – Market performance, Employment, Production & Output, Investment & Capital, Trade, Financial indicators, Sustainability – includes 20 indicators and concentrates on holistic mapping of the whole sector.

Explanation of key categories (dimensions):

- Market Performance - these indicators help understand the overall size, growth, and competitive landscape within a sector.
- Employment - focuses on labour-related indicators, giving insights into the sector's impact on job creation and wage levels.
- Production & Output - measures the actual goods or services produced by the sector and the efficiency of its productive capacity.
- Investment & Capital - tracks the flow of capital into the sector, focusing on domestic and foreign investment, as well as innovation.
- Trade - assesses the sector's trade activities, including its role in exports and imports, and its trade balance.
- Financial Indicators - reflects the financial health and profitability of the sector, covering key metrics such as profit margins and revenue growth.
- Sustainability - monitors the environmental impact of the sector, focusing on carbon emissions and energy usage.

Indicators provide a comprehensive picture of a sector's economic health, covering both economic performance and broader social and environmental impacts.

Category	Indicator	Description	Unit of Measure
Market performance	Market size	Total value of goods and services produced in the sector.	EUR, HUF, PLN etc. (annual revenue)
	Market growth rate	The annual percentage increase in market size.	% growth per year
	Market Share by Company	Percentage of total market controlled by leading firms.	% of total market
	Market structure	Small, medium and large companies (according to sales or number of employees).	Number of companies according to their size
Employment	Employment Level	Total number of employees working in the sector.	Number of employees
	Average Wage	The average wage or salary of employees in the sector.	EUR, HUF, PLN per month/year
Production & Output	Sector Output	Total volume of goods or services produced by the sector.	Tons, units, or other production measures

Category	Indicator	Description	Unit of Measure
	Capacity Utilization	The percentage of the sector's productive capacity that is being utilized.	%
	Productivity	Output per worker or per hour worked in the sector.	Units per worker/hour
Investment & Capital	Capital Investment	Total capital invested in the sector, including new machinery, infrastructure, and technology.	EUR, HUF, PLN, etc.
	Foreign Direct Investment (FDI)	The amount of foreign capital invested in the sector.	EUR, HUF, PLN (annually)
	Research & Development (R&D) Expenditure	Total spending on innovation and research activities in the sector.	EUR, HUF, PLN, or % of revenue
Trade	Export Value	Total value of sector-specific goods or services exported.	EUR, HUF, PLN (annually)
	Import Value	Total value of goods or services imported into the sector.	EUR, HUF, PLN (annually)
	Balance of Trade	The difference between export and import values in the sector.	EUR, HUF, PLN
Financial indicators	Gross Profit Margin	The percentage of revenue remaining after the cost of goods sold is deducted.	%
	Return on Investment (ROI)	Measures the return generated on invested capital in the sector.	% ROI
	Sector Revenue Growth Rate	The annual percentage increase in revenue generated by the sector.	% revenue growth
Sustainability	Carbon Footprint of Sector	Total greenhouse gas emissions produced by the sector.	CO2-equivalent (tons/year)
	Energy Intensity	Energy consumption per unit of output or revenue in the sector.	kWh/unit or kWh/ EUR, HUF, PLN

A.II Matrix of key financial performance indicators for sectoral analysis

This matrix contains 20 of the most important key financial performance Indicators (KFPIs) for conducting a sectoral analysis in a region. These KFPIs are commonly used to assess the financial health and performance of businesses within various sectors.

Explanation of key dimensions:

- Profitability - these indicators measure the ability of a sector or company to generate profit from its operations. They provide insight into efficiency, cost control, and pricing strategy.

- Liquidity & Solvency - ratios indicate how well a company or sector can meet its short-term and long-term liabilities. They show financial stability and risk management.
- Efficiency – measures how effectively a company uses its resources to generate revenue, manage inventory, and collect payments. They reflect operational efficiency.
- Growth & Market Performance - growth KPIs focus on expansion and competitiveness in the market, evaluating sales, earnings growth, and overall market share.
- Investment Efficiency - indicators assess how effectively capital is being invested in the business, comparing returns to the cost of investment.
- Cash Flow - measure the liquidity of a business, focusing on how much cash is available for reinvestment, dividends, or debt repayment.

This matrix provides a broad view of the financial health and performance of businesses in a sector, offering valuable insights for stakeholders in decision-making, benchmarking, and strategic planning.

Category	Indicator	Description
Profitability	Net Profit Margin	Measures the percentage of revenue that remains as profit after all expenses are paid.
	Operating Profit Margin (EBIT Margin)	Shows the proportion of revenue left after deducting operating expenses.
	Return on Assets (ROA)	Evaluates how efficiently a sector uses its assets to generate profits.
	Return on Equity (ROE)	Measures the return generated on shareholders' equity.
	Return on Investment (ROI)	Measures the return on capital investment in the business.
	Gross Profit Margin	The percentage of revenue that exceeds the cost of goods sold (COGS).
	Earnings Before Interest, Taxes, Depreciation, and Amortization (EBITDA)	Indicates operating performance without the impact of capital structure, tax regime, and accounting decisions.
Liquidity & Solvency	Current Ratio	Measures a company's ability to pay short-term liabilities with short-term assets.
	Quick Ratio (Acid Test Ratio)	Assesses the ability to meet short-term obligations with its most liquid assets (excludes inventory).
	Cash Conversion Cycle (CCC)	Measures how quickly a company can convert resources into cash flows.
	Interest Coverage Ratio	Measures the ability to meet interest payments.
	Debt-to-Equity Ratio	Compares a company's total debt to its equity, indicating leverage level.

Category	Indicator	Description
Efficiency	Asset Turnover Ratio	Measures the efficiency of a company's use of its assets to generate sales revenue.
	Inventory Turnover Ratio	Indicates how efficiently inventory is managed by showing how often inventory is sold and replaced.
	Days Sales Outstanding (DSO)	Measures the average number of days it takes to collect payment after a sale.
	Days Payables Outstanding (DPO)	The average number of days a company takes to pay its suppliers.
	Working Capital Turnover	Shows how efficiently a company is using its working capital to support a given level of sales.
Cash Flow	Free Cash Flow (FCF)	Cash generated after accounting for capital expenditures.
	Operating Cash Flow (OCF)	Cash generated from operational activities.
	Dividend Yield	Measures the dividend income relative to share price.

A.III Matrix of key performance indicators for the market status

In this part, the evaluation of the market situation according to the individual sectors of the project partners will be elaborated - the market status in Mechanics and mechatronics, Packaging, Plastic, Construction and building.

Mechanics and mechatronics

Matrix of KPIs for Sustainable Product Development in Mechanics and Mechatronics

Category	Indicator	Description
Material efficiency	Use of Recycled or Recyclable Materials	Percentage of materials that are recycled or recyclable in mechanical components and assemblies.
	Lightweight Material Usage	Percentage of products that use lightweight, sustainable materials (e.g., aluminium, composites).
	Material Waste Reduction	Tracks reduction in material waste generated during product development and manufacturing processes.
Energy efficiency	Energy Efficiency of Mechatronic Systems	Percentage of energy saved by mechatronic systems compared to traditional systems.
	Power Consumption per Unit Produced	Measures energy used in the production process of mechanical and mechatronic systems.
	Renewable Energy Usage in Production	Percentage of energy consumption in production processes supplied by renewable energy sources.
Lifecycle sustainability	Product Durability and Longevity	Average lifespan of mechanical and mechatronic products compared to industry standards.

Category	Indicator	Description
	Reusability and Modularity of Components	Percentage of product components designed for reuse or modularity to extend product life.
	End-of-Life Product Recycling Rate	Percentage of mechanical and mechatronic products that are recyclable or properly disposed of at end-of-life.
Product performance	Energy Efficiency of Motors and Actuators	Measures improvements in the energy efficiency of motors, actuators, and other mechanical components.
	Reduction in Noise and Vibration	Percentage reduction in noise and vibration levels in mechanical systems for improved sustainability and user comfort.
	Precision and Accuracy of Systems	Tracks improvements in system accuracy and precision, reducing waste and inefficiencies.
Manufacturing sustainability	Waste-to-Product Ratio	Ratio of waste generated during manufacturing to the total number of units produced.
	Carbon Footprint of Manufacturing Processes	Measures CO2 emissions associated with the manufacturing of mechanical and mechatronic systems.
	Use of Additive Manufacturing (3D Printing)	Percentage of products or components manufactured using energy-efficient additive manufacturing techniques.
Supply chain sustainability	Supplier Sustainability Certifications	Percentage of suppliers that meet sustainability certifications (e.g., ISO 14001).
	Transportation Carbon Footprint	CO2 emissions generated by the transport of materials and products in the supply chain.
Product Development & Innovation	Investment in Sustainable R&D	Percentage of revenue invested in research and development of sustainable mechanical and mechatronic systems.
	New Sustainable Product Developments	Number of new mechanical or mechatronic products developed with sustainability features (e.g., energy-efficient motors, recycled materials).
Customer engagement	Customer Satisfaction with Sustainable Products	Customer feedback on sustainability features in mechanical and mechatronic products (measured via surveys, NPS).
	Product Return or Reuse Programs	Percentage of products enrolled in return, reuse, or refurbishment programs.
Regulatory compliance	Compliance with Environmental Standards	Percentage of products that meet or exceed environmental and sustainability regulations (e.g., EU Eco-Design, RoHS).
	Achievement of Eco-Labels or Certifications	Number of products that achieve eco-labels or sustainability certifications (e.g., Energy Star, Ecolabel).
Carbon footprint	Carbon Footprint per Product Developed	Tracks the carbon emissions associated with the design, development, and production of mechanical systems.
	Product Lifecycle Carbon Emissions	Measures the carbon emissions of mechanical systems over their entire lifecycle.

Explanation of categories:

- Material efficiency - focuses on using sustainable, recycled, and recyclable materials in mechanical and mechatronic components to reduce resource consumption and minimize waste.
- Energy efficiency - measures how energy-efficient both the production process and the final mechatronic systems are, with an emphasis on reducing overall power consumption and incorporating renewable energy sources.
- Lifecycle sustainability - tracks the durability and end-of-life options for mechanical products, encouraging modularity, reusability, and recyclability to extend product life and reduce environmental impact.
- Product performance - emphasizes improving the energy efficiency, precision, and overall performance of mechanical systems to reduce waste and optimize functionality.
- Manufacturing sustainability - monitors waste generation and CO2 emissions in manufacturing, encouraging the adoption of energy-efficient processes like additive manufacturing (3D printing) to improve sustainability.
- Supply chain sustainability - assesses the sustainability of the entire supply chain, from raw material sourcing to transportation, encouraging partnerships with certified suppliers and reducing transportation-related carbon emissions.
- Product Development & Innovation - encourages ongoing investment in research and development of sustainable solutions, focusing on creating energy-efficient, durable, and eco-friendly mechatronic products.
- Customer engagement - measures the effectiveness of efforts to engage customers in sustainability initiatives, including feedback on product sustainability features and participation in return or reuse programs.
- Regulatory compliance - tracks compliance with environmental standards and certifications, ensuring that products meet regulatory requirements and achieve recognized eco-labels.
- Carbon footprint - focuses on reducing carbon emissions throughout the product lifecycle, from development to end-of-life, promoting lower environmental impact across all stages.

Matrix of KPIs for the Market Status of the Mechanics and Mechatronics Sector

Category	Indicator	Description
Market Size & Growth	Global Market Size of Mechanics and Mechatronics	Total value of the mechanics and mechatronics market, measured in EUR or HUF or PLN.
	Regional Market Share	Percentage share of the market held by regions (Europe, Asia, North America).
	Mechatronics Market Growth Rate	Year-over-year growth rate in the mechatronics market.
Demand & Consumption	Industrial Demand for Mechatronics Solutions	Demand for mechatronics in key industries (e.g., automotive, healthcare, manufacturing, robotics).
	Growth in Automation Solutions	Increase in the adoption of automation technologies and mechatronics solutions across industries.
	Robotics and Automation Market Share	Share of the market for robotics within mechatronics and automation sectors.
Production efficiency	Energy Consumption per Unit of Production	Energy consumption per unit or machine produced (kWh per unit).
	Production Cost per Mechatronic Device	Average production cost for mechatronic devices, including materials, labour, and energy.
	Equipment Downtime and Maintenance Costs	Percentage of downtime and associated costs for mechatronics equipment and automation systems.
Innovation & Technology	R&D Investment in New Technologies	Percentage of revenue allocated to R&D for new technologies in mechanics and mechatronics.
	Number of Patents in Mechatronic Systems	Number of patents filed annually in mechatronic technologies and automation systems.
	Product Innovation Rate	Percentage of new product introductions in the mechatronics sector.
Sustainability & Environmental impact	CO2 Emissions from Production	Carbon footprint per unit produced in the mechatronics sector.
	Use of Renewable Energy in Manufacturing	Percentage of energy sourced from renewable sources for manufacturing mechatronic systems.
	Recycling and Reusability of Components	Percentage of mechatronic components that are recyclable or reusable.
Supply chain & Resource efficiency	Material Sourcing from Sustainable Sources	Percentage of raw materials sourced from sustainable suppliers for the production of mechatronic systems.
	Logistics and Supply Chain Carbon Footprint	Carbon footprint generated by the logistics and supply chain activities in the sector.
	Supplier Adherence to Sustainability Standards	Percentage of suppliers adhering to sustainability standards in production and distribution.
Financial performance	Revenue Growth in the Mechanics and Mechatronics Sector	Annual revenue growth of companies in the sector.
	Profit Margins in the Mechatronics Industry	Average profit margins for mechatronics manufacturers and automation companies.

Category	Indicator	Description
	Return on Investment (ROI) for New Technologies	ROI on investments made in new mechatronic or automation technologies.
Circular economy & Reuse	Reuse Rate of Mechatronic Components	Percentage of mechatronic components designed for reuse in other systems or products.
	Closed-Loop Manufacturing Systems	Percentage of systems that operate on a closed-loop model, where components are recycled or reused.
Regulatory compliance	Compliance with Industry-Specific Regulations	Percentage of companies compliant with global and regional regulations (e.g., RoHS, REACH, CE marking).
	Achievement of Sustainability Certifications	Percentage of companies or products certified with sustainability labels (e.g., ISO 14001, Cradle to Cradle).
Consumer & Market perception	Market Share of Eco-Friendly Mechatronics Products	Share of eco-friendly and energy-efficient mechatronic products in the market.
	Customer Satisfaction with Mechatronic Systems	Customer satisfaction scores or ratings for mechatronic devices and systems.
	Adoption of Predictive Maintenance Technologies	Percentage of companies adopting predictive maintenance technologies in their mechatronics systems.

Explanation of categories:

- Market Size & Growth - measures the overall growth and regional distribution of the mechanics and mechatronics sector, providing insights into market share and regional dynamics.
- Demand & Consumption - tracks the demand for mechatronics solutions across different industries, such as manufacturing, automotive, and robotics, with a focus on the growth in automation technologies.
- Production efficiency - emphasizes energy consumption, production costs, and equipment downtime, which are essential for evaluating the operational efficiency of the sector.
- Innovation & Technology - tracks R&D investments, new patents, and product innovation, reflecting the sector's capacity for technological advancement and staying competitive in the global market.
- Sustainability & Environmental impact - focuses on reducing the carbon footprint of production, increasing renewable energy use, and recycling or reusing components, aligning the sector with sustainability goals.
- Supply chain & Resource efficiency - monitors the sustainability of supply chain operations, including sourcing of raw materials and the carbon footprint of logistics, to improve resource efficiency.

- Financial performance - measures the economic health of the mechanics and mechatronics sector, tracking revenue growth, profit margins, and ROI for technological investments.
- Circular economy & Reuse - evaluates how the sector is contributing to a circular economy by designing products that can be reused or recycled, and implementing closed-loop manufacturing processes.
- Regulatory compliance - ensures that companies comply with industry regulations and obtain sustainability certifications, which are increasingly important in global markets.
- Consumer & Market perception - tracks customer satisfaction and market demand for eco-friendly and energy-efficient mechatronics products, as well as the adoption of advanced technologies like predictive maintenance.

Packaging

Matrix of KPIs for Sustainable Packaging Development

Category	KPI	Description
Material sourcing	Percentage of Recycled Content	Percentage of recycled materials used in packaging products.
	Use of Renewable or Biodegradable Materials	Measures the share of bio-based or biodegradable materials used in packaging.
	Sustainable Material Certifications	Percentage of raw materials certified as sustainable (e.g., FSC, PEFC for paper packaging).
Packaging design	Design for Recyclability	Assesses whether the packaging is easy to recycle based on material purity and separation.
	Reduction in Packaging Weight	Tracks efforts to minimize material usage in packaging without affecting functionality.
	Elimination of Single-Use Plastic	Measures reduction or elimination of single-use plastics in packaging solutions.
Production efficiency	Energy Consumption per Packaging Unit Produced	Measures energy usage during the manufacturing process per unit of packaging.
	Carbon Footprint per Unit	CO2 emissions generated in the production of each packaging unit.
	Water Usage in Packaging Production	Tracks water consumption in the production of packaging materials.
Waste management	Production Waste Recycled	Percentage of waste generated during production that is recycled.
	Packaging Waste Reduction	Reduction in waste generated through more efficient production and packaging designs.
End-of-Life Management	Recyclability of Packaging	Percentage of packaging that can be fully recycled at the end of its life cycle.
	Compostability Rate	Percentage of packaging that can be composted (for biodegradable materials).

Category	KPI	Description
	Return or Reuse Programs	Measures the effectiveness of take-back or reuse initiatives (e.g., reusable packaging).
Regulatory compliance	Compliance with EU and Local Packaging Regulations	Tracks adherence to packaging regulations, including restrictions on single-use plastics.
Innovation and R&D	Investment in Sustainable Packaging Solutions	Percentage of revenue invested in R&D for developing eco-friendly packaging alternatives.
	Number of New Sustainable Packaging Solutions	Number of new packaging designs introduced with sustainability features (e.g., recyclable, compostable).
Supply chain sustainability	Supplier Sustainability Certification	Percentage of suppliers that adhere to environmental and sustainability standards (e.g., ISO 14001).
	Carbon Footprint of Transportation	CO2 emissions related to the transport of packaging materials and products.
Customer engagement	Customer Awareness and Education	Percentage of customers informed about sustainable packaging and disposal methods (recycling, composting).
	Consumer Feedback on Packaging Sustainability	Customer satisfaction with the sustainability features of packaging (measured via surveys, NPS).
Lifecycle impact assessment	Total Carbon Footprint of Packaging Lifecycle	Tracks carbon emissions across the entire lifecycle of packaging (from raw material extraction to disposal).
	Packaging Lifecycle Assessment	Conducts regular life cycle assessments (LCA) to measure the environmental impact of packaging.

Explanation of categories:

- Material sourcing – focuses on using eco-friendly, renewable, and certified materials for packaging. Recycled content and the use of sustainable certifications are essential KPIs here.
- Packaging design – encourages designing packaging that minimizes material usage, maximizes recyclability, and supports the elimination of non-recyclable or single-use plastics.
- Production efficiency – monitors energy and water usage in the packaging production process, helping companies track their environmental footprint in terms of resource consumption.
- Waste management - targets waste reduction and recycling, both during production and after the packaging is used. Reducing production waste and increasing the recyclability of packaging are central to sustainable packaging.
- End-of-Life Management – focuses on the recyclability and compostability of packaging materials at the end of their life cycle. KPIs also monitor the success of return or reuse programs.

- Regulatory compliance - Ensures that packaging meets legal requirements and sustainability standards set by the EU and other local governing bodies.
- Innovation and R&D - encourages continuous development and investment in new, more sustainable packaging technologies.
- Supply chain sustainability - assesses the sustainability of the entire supply chain, from raw materials to the delivery of packaging products, focusing on carbon footprint and supplier compliance.
- Customer engagement - measures efforts to educate customers on how to properly dispose of or recycle packaging. It also tracks consumer satisfaction with the sustainability features of the packaging.
- Lifecycle impact assessment - involves evaluating the environmental impact of packaging over its entire lifecycle, from raw material extraction to disposal or recycling, with the goal of reducing its carbon footprint.

Matrix of KPIs for the Market Status of the Packaging Sector

Category	KPI	Description
Market Size & Growth	Global Packaging Market Size	Total value of the packaging industry, measured in EUR or HUF or PLN.
	Regional Market Share	Market share held by regions like Europe, Asia, North America in the global packaging market.
	Packaging Market Growth Rate	Year-over-year growth rate in the global packaging market, across different materials and segments.
Demand & Consumption	Packaging Consumption per Capita	Amount of packaging used per person per year (in kilograms).
	Industry-Specific Packaging Demand	Demand for packaging by sector (e.g., food & beverage, pharmaceuticals, e-commerce, electronics).
	Growth in Flexible Packaging Market Share	Percentage growth in flexible packaging usage across industries.
Production efficiency	Production Cost per Unit of Packaging	Average cost of producing one unit of packaging, accounting for raw materials, energy, and labour.
	Energy Efficiency of Production	Energy consumption per ton of packaging produced (kWh/ton).
	Material Waste in Packaging Production	Percentage of raw material wasted during the production process.
Sustainability & Environmental impact	Recyclability of Packaging Materials	Percentage of packaging materials that are recyclable.
	CO2 Emissions per Ton of Packaging Produced	Carbon footprint of producing packaging materials (tons of CO2 per ton of packaging).
	Biodegradable Packaging Share	Share of packaging products that are biodegradable or compostable.

Category	KPI	Description
	Plastic Packaging Waste Recycling Rate	Percentage of plastic packaging waste that is recycled.
Innovation & Product development	Number of Patents in Sustainable Packaging	Number of patents filed annually in sustainable packaging technologies.
	Investment in R&D for Eco-Friendly Packaging	Percentage of revenue invested in R&D for sustainable and eco-friendly packaging solutions.
	Circular Packaging Solutions Introduced	Number of packaging solutions introduced that focus on closed-loop or circular economy practices.
Regulatory compliance	Compliance with Packaging Waste Regulations	Percentage of packaging companies compliant with local and global packaging waste management regulations.
	Achievement of Eco-Certifications	Percentage of packaging products certified with eco-labels (e.g., FSC, Cradle to Cradle).
	Extended Producer Responsibility (EPR) Compliance	Percentage of companies adhering to EPR regulations, taking responsibility for packaging waste management.
Financial performance	Revenue Growth in the Packaging Sector	Annual growth rate of revenue for companies in the packaging industry.
	Packaging Industry Profit Margins	Average profit margins of packaging manufacturers.
	Return on Investment (ROI) for Sustainable Packaging	ROI achieved through investments in sustainable packaging solutions.
Supply chain & Resource efficiency	Packaging Material Sourcing from Sustainable Sources	Percentage of packaging materials sourced from renewable or sustainable sources.
	Packaging Supply Chain Carbon Footprint	Total carbon emissions generated by the packaging supply chain (tons of CO2).
	Use of Renewable Energy in Packaging Production	Percentage of energy used from renewable sources in the production of packaging materials.
Circular economy & Reuse	Percentage of Packaging with Recycled Content	Share of new packaging materials produced using recycled content.
	Return and Reuse Rate of Packaging Materials	Percentage of packaging materials that are returned and reused in a circular economy system.
Consumer & Market perception	Consumer Preference for Sustainable Packaging	Survey data showing consumer preference for eco-friendly and recyclable packaging solutions.
	Adoption of Refill and Reuse Programs	Percentage of companies offering packaging refill or reuse programs to reduce waste.

Explanation of categories:

- Market Size & Growth - reflects the overall size of the packaging market, tracking both global and regional growth trends across various packaging materials like paper, plastics, glass, and metal.
- Demand & Consumption - focuses on the trends in packaging demand across different sectors and on per capita packaging consumption, showing key industry drivers like food, beverage, and e-commerce sectors.

- Production efficiency - emphasizes the cost and energy efficiency of producing packaging, measuring key factors like production costs and material waste, which are critical for competitive market performance.
- Sustainability & Environmental impact - measures how sustainable the packaging materials and processes are, focusing on recyclability, CO2 emissions, and the shift to biodegradable or compostable packaging solutions.
- Innovation & Product development - tracks the development of new technologies and products in sustainable packaging, including investments in R&D and the introduction of circular packaging solutions.
- Regulatory compliance - ensures that the packaging industry complies with environmental and waste management regulations, achieving certifications and adhering to extended producer responsibility laws.
- Financial performance - reflects the economic health of the packaging sector, including growth in revenue, profit margins, and the return on investments in sustainable practices.
- Supply chain & Resource efficiency - measures the sustainability of the packaging supply chain, including the sourcing of materials from renewable sources and efforts to reduce the carbon footprint.
- Circular economy & Reuse - focuses on the adoption of circular economy practices, measuring the use of recycled materials in packaging and the effectiveness of return and reuse programs.
- Consumer & Market perception - Gauges consumer preferences for sustainable packaging, reflecting the growing market demand for eco-friendly and recyclable packaging options.

Plastic

Matrix of KPIs for Sustainable Product Development in Plastic

Category	KPI	Description
Materials sourcing	Percentage of Recycled Content	Measures the percentage of recycled or bio-based materials in the plastic product.
	Percentage of Renewable Materials	Tracks the percentage of biodegradable or bio-based plastics used.
Product design	Design for Recyclability	Assesses the recyclability of the product, including ease of disassembly and material purity.
	Weight Optimization	Reduction in material weight without compromising product quality, improving resource efficiency.

Category	KPI	Description
Production efficiency	Energy Consumption per Unit Produced	Measures the energy required to produce each unit, emphasizing energy efficiency.
	Water Consumption per Unit Produced	Tracks water usage in the production process.
Waste reduction	Waste Generated per Ton of Plastic Produced	Monitors the amount of production waste generated during manufacturing.
	Recyclable Waste Rate	Percentage of production waste that is recyclable or reused.
Carbon footprint	CO2 Emissions per Unit Produced	Tracks the carbon emissions associated with the production of plastic products.
	Carbon Offset Initiatives	Assesses the effectiveness of carbon offset programs implemented by the company.
End-of-Life Management	Product Take-back Programs	Percentage of products collected and recycled through company-led take-back programs.
	Post-Consumer Recyclability Rate	Percentage of products that are recycled at the end of their life cycle.
Regulatory compliance	Compliance with EU Plastics Directives	Tracks adherence to EU plastic waste regulations and bans on single-use plastics.
Customer engagement	Customer Awareness on Sustainable Practices	Percentage of customers educated about sustainable practices in product use and disposal.
	Consumer Feedback on Sustainability	Customer satisfaction ratings regarding sustainability aspects of products.
Innovation and R&D	Investment in Sustainable Material R&D	Percentage of revenue invested in researching sustainable plastic alternatives or biodegradable materials.
	Number of Sustainable Product Innovations	Number of new product lines or redesigns launched with sustainability improvements.
Supply chain sustainability	Sustainable Supplier Index	Percentage of suppliers adhering to sustainability standards (e.g., low emissions, ethical sourcing).
	Transport Carbon Footprint	CO2 emissions generated during transportation of raw materials and finished products.

Explanation of categories:

- Materials sourcing – focuses on the origin of materials used in the product. KPIs in this category measure how much recycled or renewable content is incorporated into products, aligning with circular economy principles.
- Product design – encourages product designs that are easy to recycle, use fewer materials, and lower overall environmental impacts. KPIs like "Design for Recyclability" promote better material choices and longer-lasting products.
- Production efficiency – monitors the environmental footprint of the manufacturing process, including energy and water usage. These KPIs drive efficiency improvements in the production stages.
- Waste reduction – targets the minimization of waste generated during manufacturing and the maximization of recycling or reuse of this waste.

- Carbon footprint - aims to reduce greenhouse gas emissions associated with production and transportation. This is critical for aligning plastic products with global climate goals.
- End-of-Life Management - encourages companies to take responsibility for the entire lifecycle of their products, particularly in how they are disposed of or recycled after use.
- Regulatory compliance – ensures that products meet the requirements of evolving environmental laws, especially important with ongoing restrictions on single-use plastics in the EU.
- Customer engagement – tracks how well companies communicate sustainability to consumers and encourage eco-friendly behaviors, such as recycling.
- Innovation and R&D - promotes continuous improvement through the development of more sustainable materials and production processes.
- Supply chain sustainability - assesses the environmental impact of suppliers, encouraging more sustainable practices throughout the supply chain.

Matrix of KPIs for the Market Status of the Plastic Sector

Category	KPI	Description
Market Size & Growth	Global Plastics Market Size	Total market size of the plastics industry, measured in EUR or HUF or PLN.
	Regional Market Share	Percentage share of the plastics market held by various regions (e.g., Europe, Asia, North America).
	Growth Rate in Plastic Production	Year-over-year growth in plastic production, by volume (tons).
Demand & Consumption	Plastic Consumption per Capita	Amount of plastic consumed per person, per year, measured in kilograms.
	Industrial Plastic Consumption	Total plastic demand in key industries (e.g., automotive, packaging, electronics, healthcare).
	Recycling Rate of Plastics	Percentage of plastic waste that is recycled, globally or regionally.
Production efficiency	Plastic Production Cost per Ton	Average cost to produce one ton of plastic, including raw materials, energy, and labour.
	Energy Efficiency of Production	Energy consumption per ton of plastic produced (kWh/ton).
	Use of Renewable Energy in Plastic Manufacturing	Percentage of energy from renewable sources used in plastic manufacturing processes.
Sustainability & Environmental impact	CO2 Emissions per Ton of Plastic Produced	Carbon footprint associated with the production of plastic materials (tons of CO2/ton plastic).
	Percentage of Bioplastics Production	Share of bioplastics in the total plastic production.

Category	KPI	Description
	Plastic Waste Diverted from Landfill	Percentage of plastic waste diverted from landfills through recycling, incineration, or reuse.
Product innovation	Number of Patents in Plastic Technologies	Number of patents filed annually in plastic-related technologies (e.g., recycling, bio-based plastics).
	Investment in R&D for Sustainable Plastics	Percentage of revenue invested in R&D for developing sustainable plastics or recycling technologies.
	New Products Developed with Recycled Materials	Number of products launched that incorporate recycled plastic materials.
Regulatory compliance	Compliance with Plastic Waste Regulations	Percentage of companies in the plastics sector compliant with regional plastic waste management regulations.
	Number of New Sustainability Certifications	Number of products or processes certified under sustainability standards (e.g., ISO 14001, Cradle to Cradle).
Supply chain efficiency	Plastic Material Waste in Production	Percentage of plastic raw material wasted during the production process.
	Sustainable Sourcing of Raw Materials	Percentage of plastic raw materials sourced sustainably (recycled, renewable, or biobased).
	Supplier Sustainability Adherence	Percentage of plastic suppliers that adhere to environmental and sustainability standards.
Financial performance	Profit Margins in the Plastics Industry	Average profit margins of plastic manufacturers.
	Plastic Industry Revenue Growth	Annual growth rate of revenue in the plastics industry.
Circular economy & Reuse	Percentage of Recycled Plastic in Products	Share of recycled plastic content used in manufacturing new products.
	Closed-Loop Recycling Rate	Percentage of plastic products that are recycled back into the same or similar products.
	Extended Producer Responsibility (EPR) Adherence	Percentage of companies participating in EPR schemes, taking responsibility for post-consumer plastic waste.
Consumer & Market perception	Consumer Preference for Sustainable Plastics	Survey data showing consumer preference for products with recycled or biodegradable plastics.
	Plastic Product Return and Reuse Programs	Percentage of products included in return, reuse, or refill programs.

Explanation of categories:

- Market Size & Growth – reflects the overall size and market share of the plastics industry, with a focus on both global and regional growth.
- Demand & Consumption - highlights the consumption trends across industries and per capita, emphasizing recycling rates and industry-specific demand like packaging and automotive.

- Production efficiency - focuses on the cost and energy efficiency of producing plastics, with targets to reduce energy use and increase renewable energy adoption in production processes.
- Sustainability & Environmental impact - measures the carbon footprint, bioplastics adoption, and diversion rates of plastic waste, which are critical indicators for understanding the sector's environmental sustainability.
- Product innovation - tracks the development of new products and technologies that contribute to sustainable plastic production, such as bioplastics and recycling innovations.
- Regulatory compliance - ensures the industry adheres to environmental regulations and achieves certifications that confirm sustainable practices.
- Supply chain efficiency - focuses on reducing material waste and increasing the sustainable sourcing of raw materials in the production of plastics, as well as ensuring supplier adherence to sustainability standards.
- Financial performance - measures the economic health of the plastics industry, including profitability and revenue growth, providing insights into the financial viability of the sector.
- Circular economy & Reuse - tracks the sector's shift towards a circular economy, emphasizing the use of recycled materials and closed-loop recycling practices.
- Consumer & Market perception - Gauges consumer preferences for sustainable plastic products and the effectiveness of return and reuse programs, which are increasingly important for market competitiveness.

Construction and building

Matrix of KPIs for Sustainable Product Development in Construction and Building

Category	KPI	Description
Materials sourcing	Percentage of Sustainable/Green Materials	Measures the percentage of materials used that are sustainably sourced or have green certifications (e.g., FSC, recycled content).
	Use of Recycled or Reclaimed Materials	Tracks the percentage of recycled or reused materials incorporated into construction projects.
	Carbon Intensity of Materials	Measures the carbon footprint associated with material production (e.g., concrete, steel).
Design efficiency	Building Life Cycle Assessment (LCA)	Regular assessments of environmental impacts across the entire life cycle of a building (design to demolition).

Category	KPI	Description
	Design for Energy Efficiency	Percentage of buildings designed to exceed local energy efficiency standards (e.g., LEED, BREEAM).
	Embodied Carbon in Building Materials	Total carbon emissions from materials used in construction (measured in kg CO2 per m^2).
Energy efficiency	Energy Use Intensity (EUI)	Measures energy consumption per square meter of building space annually (kWh/m^2/year).
	Renewable Energy Use in Buildings	Percentage of energy consumption supplied by renewable sources (solar, wind, geothermal).
	Building Automation for Energy Optimization	Percentage of buildings equipped with smart systems for energy management (e.g., HVAC control, lighting).
Water efficiency	Water Use Reduction per Project	Reduction in water consumption through efficient systems (e.g., rainwater harvesting, low-flow fixtures).
	Reuse of Greywater and Stormwater	Measures the percentage of water reused on-site for non-potable applications.
Waste management	Construction Waste Diverted from Landfill	Percentage of construction waste diverted from landfills through recycling or reuse.
	Percentage of Recycled Building Materials	Amount of construction waste that is recycled or repurposed for other projects.
Carbon footprint	CO2 Emissions per Construction Project	Tracks carbon emissions associated with construction activities, including material transport and machinery.
	Carbon Offset Programs	Amount of CO2 offset through reforestation, renewable energy credits, or carbon capture.
Health & Safety	Indoor Air Quality (IAQ)	Measures the levels of pollutants (e.g., VOCs, particulate matter) in indoor environments post-construction.
	Use of Non-Toxic and Low-VOC Materials	Percentage of non-toxic, low-VOC materials used in building interiors (paint, adhesives, flooring).
Innovation and R&D	Investment in Green Building Technologies	Percentage of revenue invested in research and development of sustainable construction technologies.
	Number of Sustainable Construction Innovations	Number of new eco-friendly products or construction methods developed and implemented.
Social and economic impact	Local Job Creation and Community Benefits	Measures the number of local jobs created and community engagement efforts during construction projects.
	Affordable Housing Units Developed	Number of affordable housing units built as part of sustainability-focused projects.
Supply chain sustainability	Supplier Adherence to Sustainability Standards	Percentage of suppliers that comply with sustainability certifications (e.g., ISO 14001, ethical sourcing).
	Transport Carbon Footprint	CO2 emissions generated by the transport of construction materials and workers.

Category	KPI	Description
Regulatory compliance	Compliance with Sustainable Building Standards	Percentage of projects that meet or exceed local or international green building standards (e.g., LEED, BREEAM).
	Green Certifications Achieved per Project	Number of buildings certified under green rating systems (e.g., LEED, Passive House).

Explanation of categories:

- Material sourcing - encourages the use of sustainable, certified, or recycled materials in construction to reduce environmental impact.
- Design efficiency - focuses on designing buildings for energy efficiency, low carbon impact, and life cycle performance, aligning with sustainability standards like LEED or BREEAM.
- Energy efficiency - tracks energy use intensity and promotes the use of renewable energy systems. Buildings should reduce overall energy consumption and increase reliance on renewable energy sources.
- Water efficiency - monitors water consumption and reuse, ensuring that buildings minimize their water footprint by using greywater systems and other water-saving technologies.
- Waste management - focuses on reducing construction waste and recycling building materials, diverting waste from landfills and reusing materials where possible.
- Carbon footprint - assesses the carbon emissions from the entire construction process, from material production to transport and on-site activities, with an emphasis on reducing CO2 emissions.
- Health & Safety - includes measures to ensure healthy indoor environments, such as air quality, and promotes the use of non-toxic building materials that improve occupant health.
- Innovation and R&D - encourages investment in new technologies and methods that improve sustainability, such as energy-efficient materials, smart building systems, and advanced construction techniques.
- Social and economic impact - emphasizes the social benefits of construction projects, such as job creation, community engagement, and providing affordable housing, all of which contribute to sustainable development.
- Supply chain sustainability - ensures that suppliers meet sustainability standards, reducing the environmental impact of the supply chain, including transport-related carbon emissions.

- Regulatory compliance - ensures that buildings meet sustainability certifications and standards, demonstrating compliance with international and local green building regulations.

Matrix of KPIs for the Market Status of the Construction and Building Sector

Category	KPI	Description
Market Size & Growth	Global Construction Market Size	Total value of the construction market worldwide, measured in EUR or HUF or PLN.
	Regional Construction Market Growth	Growth rate of construction activities by region (e.g., Europe, North America, Asia).
	Housing & Commercial Building Starts	Number of new housing and commercial construction projects started in a given year.
Productivity & Efficiency	Construction Project Completion Time	Average time taken to complete construction projects compared to industry benchmarks.
	Labor Productivity in Construction	Amount of construction work (e.g., square meters built) completed per labour hour.
	Equipment Utilization Rate	Percentage of time construction equipment is actively used on-site.
Sustainability & Environmental impact	CO2 Emissions from Construction Activities	Total carbon emissions generated by the construction industry.
	Energy Efficiency of Buildings	Percentage of newly constructed buildings meeting high energy efficiency standards (e.g., LEED, BREEAM).
	Use of Sustainable Building Materials	Percentage of building materials sourced from sustainable or renewable sources.
	Construction Waste Recycled	Percentage of construction and demolition waste that is recycled or reused.
Technology adoption	Adoption of Building Information Modelling (BIM)	Percentage of construction companies using BIM technology for project design and management.
	Use of Prefabricated and Modular Construction	Percentage of construction projects using prefabricated or modular construction methods.
	Investment in Smart Building Technologies	Percentage of new buildings integrating smart technologies (e.g., IoT, energy management systems).
Safety & Compliance	Construction Site Accident Rate	Number of accidents per 100,000 hours worked on construction sites.
	Compliance with Health and Safety Regulations	Percentage of construction sites compliant with local health and safety standards.
	Achievement of Green Building Certifications	Percentage of buildings achieving certifications like LEED, BREEAM, or other eco-labels.
Financial performance	Profit Margins in Construction Industry	Average profit margins for companies in the construction sector.
	Construction Sector Revenue Growth	Year-on-year revenue growth for construction companies.
	Return on Investment (ROI) for Green Construction	ROI achieved through investments in sustainable and green building practices.

Category	KPI	Description
Supply Chain & Resource efficiency	Construction Material Sourcing Lead Time	Average lead time for sourcing critical building materials.
	Construction Supply Chain Carbon Footprint	Carbon emissions generated by the construction supply chain.
	Availability of Local vs Imported Materials	Percentage of materials sourced locally versus imported materials.
Circular economy & Reuse	Use of Recycled Building Materials	Percentage of materials used in new buildings that are recycled from previous construction projects.
	Number of Circular Economy Projects	Number of construction projects that follow circular economy principles, focusing on reuse and recycling.
Customer & Market perception	Customer Satisfaction with Building Quality	Customer satisfaction scores or ratings for newly constructed buildings.
	Demand for Green Buildings	Percentage of consumers and businesses demanding eco-friendly and energy-efficient buildings.
	Market Share of Smart Buildings	Share of the market occupied by buildings that incorporate smart technologies.

Explanation of categories:

- Market Size & Growth - focuses on the overall size and growth rate of the construction market globally and regionally, including housing and commercial building projects.
- Productivity & Efficiency - tracks key indicators like project completion time, labour productivity, and equipment utilization to measure operational efficiency in construction projects.
- Sustainability & Environmental impact - monitors sustainability initiatives within the sector, such as CO2 emissions reduction, energy efficiency, and the use of sustainable materials, aligning with global sustainability goals.
- Technology Adoption - measures the adoption of innovative technologies like Building Information Modelling (BIM), prefabrication, and smart building systems that enhance construction processes and building performance.
- Safety & Compliance - evaluates the compliance of construction companies with health, safety, and environmental regulations, with a focus on reducing accidents and achieving green building certifications.
- Financial performance - analyses the financial health of construction companies, tracking profit margins, revenue growth, and ROI from green and sustainable construction practices.

- Supply chain & Resource efficiency - focuses on the efficiency and sustainability of the construction supply chain, including material sourcing lead times and the carbon footprint associated with supply chain activities.
- Circular economy & Reuse - monitors the adoption of circular economy principles in the construction sector, including the use of recycled materials and the implementation of reuse strategies in projects.
- Customer & Market perception - tracks market demand for high-quality, sustainable, and smart buildings, reflecting customer preferences and the growing importance of eco-friendly construction.

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