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Regional ecosystem Cradle2Cradle maturity analysis Austria

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Executive Summary

This deliverable documents the results of the analysis of the ecosystem for the region Austria with respect to circular economy in general and the cradle to cradle principles in particular.

The analysis has been performed in the 3 dimensions covered by the Cradle−ALP project:

- Policies and business support
- Technologies
- Business models

With the aim to take stock of the status quo, identify gaps and barriers for the circular transformation of the economy, as well as opportunities for fostering this transformation.

In each region, the analysis focused on the industrial sectors to be involved later in the project in industrial transformation pilot activities. In the case of the region Austria, those sectors are: wood, chemistry, textiles, packaging.

Contents

1 Introduction to the Cradle-Alp project

Cradle-ALP aims for mainstreaming cradle to cradle (C2C) approaches, circular design and circular substitutions (from the alpine region) for linear products in industrial processes, in different industrial sectors. The Alpine Space has many natural resources and the technologies to substitute fossil raw materials and toxic substances from production with circular and environmentally friendly alternatives. This should lead to the fact that materials and products can be led back into a healthy cycle after use. The focus of this project shall be on the substitution of chemical and fossil based/unsustainable materials with more circular, sustainable and bio-degradable ones.

First, the partners will build a broad awareness and understanding in the public, the relevant industries as well as among stakeholders from policy and innovation intermediaries, for the opportunities, barriers and mechanisms of the transformation of industrial products towards higher circularity by means of C2C approaches, circular design and circular substitutions. Business support providers shall be trained to accompany the transformation of businesses along more circular value chains.

In a second step, the partners will explore in details and test opportunities for implementing C2C approaches, circular design and circular substitutions along specific value chains in the chemistry/plastics and wood/forestry sectors supported by digital technologies. Building on a thorough multidimensional (technology, policy, economy, etc.) roadmapping exercise, transnational groupings of stakeholders – including businesses – will be installed, with the aim to transfer the C2C roadmaps into industrial practice along exemplary value chains.

Finally, the partners will work towards ensuring a transnational policy convergence towards transnational S4 strategies in the priority sectors of the project and initiate common cross border funding instruments for the industrial C2C transformation.

2 Objective and scope of the regional ecosystem Cradle2Cradle maturity analysis

The regional ecosystem maturity analysis performed in each project region is part of a larger set of activities, building together a transnational ecosystem Cradle2Cradle maturity analysis. The latter comprises:

- A regional ecosystem maturity analysis, performed in each project region,
- A transnational survey on the consumers' perspective on Cradle2Cradle in the Alpine Space,
- A transnational comparison/benchmarking in the dimensions policies/business support, technologies and business models.

The overarching aim of the transnational ecosystem maturity analysis is to is to understand the relevance of circular economy and more specifically the Cradle 2 Cradle principles in each of the project region within the triangle: policies/business support, technologies/knowledge, and business models/practices.

Practical implementation in the context of the Cradle-ALP project

In order to ensure a high relevance of the regional ecosystem maturity analysis for a successful implementation of the Cradle-ALP activities, the partners decided to focus the analysis on the

industrial sectors to be addressed in the roadmaps to Cradle2Cradle transformation. Those sectors are: polymers/plastics, wood/furniture, chemistry/materials, fibres/textiles, packaging.

The results of the analysis shall provide the basis for the development of sectoral Cradle2Cradle industrial transformation roadmaps in the five selected sectors (WP2), thus ensuring a smooth transition between WP1 - Capacity building for Cradle2Cradle transformation and WP2 - Roadmaps to Cradle2Cradle transformation.

Remark: this practical approach represents a deviation from the Application Form, where the analysis was described as more generic and meant to provide input for capacity building activities to performed in WP1.

Scope of the analysis in the Cradle-ALP project

The analysis integrates status quo, gaps and barriers, potentials for transformation, as well as good practices and failures to learn from within the triangle policies/business support, technologies/knowledge, and business models/practices.

It has been performed through a combination of desktop research, building on the knowledge already available among project partners and the previously performed identification of good practices, and interviews/workshops with regional experts and representatives of companies.

- **Status quo and good practices analysis**

The scope of the status quo and good practices/failures analysis in the dimensions policies/business support, technologies/knowledge, and business models/practices was aligned with the topics identified as a result of the identification of good practices and lessons learned (D.1.1.2) and the capitalisation workshops (D.1.1.3).

The following table shows the scope of the status quo analysis for the transnational ecosystem maturity analysis:

Policies and business support	Technologies	Business models and practices
▪ Regional and national strategies/policies fostering circular economy and more specifically C2C principles (fully closed loops). ▪ European and national/regional strategic documents (e.g. technology roadmaps). ▪ Funding schemes ▪ Further business support measures	▪ Significant technology and knowledge providers (Higher education and research organisations, technical centres, pilot infrastructures, innovation platforms, etc.) located in the project regions	▪ Role model companies ▪ Relevant industrial clusters and industrial networks

The partners performed a mapping for each project region according to the items listed here above.

- **Gaps and barriers – potentials for transformation**

At project level, the identification of gaps and barriers for a better uptake of the cradle to cradle principles in industrial practices, as well as the identification of potentials or opportunities for such a transformation is a core result of the transnational comparison/benchmarking in the dimensions policies/business support, technologies and business models.

The partners collected input for the transformation ecosystem analysis by collecting such gaps and barriers as well as potentials for transformation at the regional level. This was done through a series of direct interaction with regional experts and representatives of companies, either in bilateral discussions (interviews) or in the context of event, such as workshops, group discussions and fairs. The partners in each region organized those activities according to their local context. For example, industrial fairs could be used to interview several companies on the same day, cluster board meetings or awareness could be used to have a group discussion with the participants.

Scope of the regional analysis in the region Austria

The analysis in the region Austria focused on the following sectors: wood, chemistry, textiles and packaging. The results of the analysis are displayed in the following chapters of this deliverable.

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3 Policies and business support

3.1 Policies

The following relevant policies were identified:

Generic level	*Policies on national level:* ▪ Austrian Circular Economy Strategy (https://www.bmk.gv.at/en/topics/climate-environment/waste-resource-management/ces.html) The Austrian Circular Economy (CE) Strategy was published by the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) in December 2022 and the key objectives are: o Reduction of the material consumption ▪ Domestic Material Comsumption (DMC): max. 14 tonnes per capita and year (2030) ▪ Material Footprint (MF): max. tonnes per capita and year (20500) o Increase the product productivity by 50 % (2030) o Increase the circularity rate to 18 % (2030) o Reduce private consumption of households by 10 % (2030) ▪ Austrian Bioeconomy Strategy (https://www.bmk.gv.at/en/topics/climate-environment/climate-protection/bioeconomy/strategy.html) The Austrian Bioeconomy Strategy was published in 2019 and the key objective of the strategy is to substitute fossil materials with biobased materials keeping in mind the principles sufficiency, efficiency and consistency. ▪ Austrian Bioeconomy Action Plan (https://www.bioeco.at/) The Austrian Bioeconomy Action Plan was published in 2022 and includes 11 topics with in total 113 actions. Details regarding the actions can be found on the website, where the action plan is displayed in detail. *Regional Strategies (Upper Austria):* Upper Austria's regional economic and research strategy, known as #upperVISION2030, serves as a strategic action framework aimed at ensuring Upper Austria's long-term global competitiveness. It also functions as Upper Austria's Smart Specialization Strategy. In the #upperVISION2030, there are 4 priority fields of action defined: ▪ Action Field: Efficient and sustainable Industry and Manufacturing ▪ Action Field: Systems and Technologies for People ▪ Action Field: Connected and Efficient Mobility

	▪ Digitization / Digital Transformation stands as an enabler for all business sectors and finds its application in horizontal themes as well as in the vertical ones. Furthermore, there are further topics which are relevant to all action fields: ▪ Education, Skilled Labor, Specialists ▪ Key enabling Technologies and Core Competences ▪ Sustainable Solutions ▪ Digitization / Digital Transformation stands as an enabler for all business sectors and finds its application in horizontal themes as well as in the vertical ones. Sustainable Solutions is defined as follows: Upper Austria will be perceived as a livable and sustainably operating industrial region in 2030. The responsible use and reuse of resources is an essential element in this. The Upper Austrian economy and industry are an essential part of the solution to future challenges and can therefore continue to position themselves among the global leaders in the future. *Additional regional strategies are:* ▪ The Upper Austrian Climate and Energy Strategy: The Upper Austrian Climate and Energy Strategy builds upon existing climate-related strategies and plans, serving as a framework for overall control to achieve climate goals. ▪ Upper Austrian Waste Management Plan 2017: The goal is to recognize waste as a valuable resource so that waste can be reintegrated into production processes and ideally kept in a closed-loop system. ▪ Upper Austrian Pesticide Strategy 2023: It provides the framework for numerous measures to protect groundwater and drinking water, ensuring clean water for future generations while also considering economic viability and cost-effectiveness to secure the sustainability of water supply. One of the most significant contributions to groundwater protection in Upper Austria is raising awareness of how pesticide control must function to keep our precious groundwater clean and sustainable. Recycling Construction Materials Ordinance Guide: This guide offers an overview of the Recycling Construction Materials Ordinance. The ordinance regulates obligations related to construction and demolition activities, as well as the separation and treatment of resulting waste. Additionally, it outlines the production of recycling construction materials in various qualities and their potential applications. *Policies on European level:* ▪ Corporate Sustainability Due Diligence Directive – CSDDD (https://commission.europa.eu/business-economy-euro/doing-business-eu/corporate-sustainability-due-diligence_en) The broad aim of the CSDD directive is to promote sustainable and responsible corporate behaviour. The rules will inevitably require companies to identify and address the environmental and social impact of their activities and value chains, whilst also mandating that companies

	adopt and implement climate transition plans. The core elements of the CSDDD include identifying, preventing, mitigating and accounting for negative environmental and human impacts of the company's wider operations. The directive seeks to achieve such aims through providing guidance and incentives to directors to contribute to sustainability and climate change mitigation goals, and via mandates - such as requiring certain large companies to develop and implement a sustainability strategy. ▪ Corporate Sustainability Reporting Directive – CSRD (https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en) The CSR directive is expanding the Non-Financial Reporting Directive (NFRD) and broaden the scope. The reporting will be mandatory for capital market-oriented KMUs by 2028 latest and for big companies by 2025. The directive is standardising the sustainability reporting in Europe. ▪ Proposal for a Directive on Green Claims (https://environment.ec.europa.eu/publications/proposal-directive-green-claims_en) The European Commission has proposed the Green Claims Directive to address greenwashing concerns by tackling the risk of companies misleading EU consumers over environmental claims. The proposed requirements would apply to the vast majority of EU operating companies, but sectors that have existing or forthcoming rules on environmental claims (such as financial services) would be exempt. Under the proposed rules, companies will need to substantiate environmental claims using life cycle assessment, communicate them accurately and holistically, and have them externally verified. Common phrases such as 'net zero', 'carbon neutral' and 'eco-friendly' would be prohibited in advertisements, in social media posts or on packaging unless they were sufficiently substantiated and verified. ▪ EU Circular Economy Action Plan – CEAP (https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en) The EU's Circular Economy Action Plan was a comprehensive body of legislative and non-legislative actions adopted in 2015, which aimed to transition the European economy from a linear to a circular model. The Action Plan mapped out 54 actions, as well as four legislative proposals on waste. These legislative proposals were put forward by the European Commission along with the Action Plan and included targets for landfill, reuse, and recycling, to be met by 2030 and 2035, along with new obligations for separate collection of textile and biowaste. The Action Plan covered several policy areas, material flows, and sectors alongside cross-cutting measures to support this systemic change through innovation and investments. It also announced a sectoral strategy for plastics. ▪ Ecodesign for Sustainable Products Regulation – ESPR (https://environment.ec.europa.eu/publications/proposal-ecodesign-

	sustainable-products-regulation_en) The ESPR is intended to replace the Ecodesign Directive (2009/125/EG) and establish a legal framework for improving the sustainability of products by laying down ecodesign requirements that specific product groups must meet. Unlike the currently applicable Ecodesign Directive, the new regulation will apply not only to energy-related products, but to almost any physical product placed on the market or put into service, including components and intermediate products, thus considerably expanding the scope of application. Important topics in the directive related to circular economy are e.g. product passports or measures against the destruction of unsold consumer goods.
Wood sector	▪ European Wood Policy Platform – woodPoP (https://info.bml.gv.at/themen/wald/eu-international/woodpop-gipfeltreffen-in-innsbruck.html) The goal of this platform is to increase the dialogue between different ministries regarding policy of the forest-based value chain in Europe. The platform was initiated by Finland and Austria and the kick-off event was in December 2022 in Innsbruck.
Chemistry sector	*An excerpt from the **Upper Austrian Pesticide Strategy 2023*** In total, the priorities in the program include 8 points: 1. Reduction and water-conserving pest management advice. 2. Water measures: Avoidance of certain chemicals 3. Sustainable use through training and education 4. Measurement of pesticide-active substances 5. Priority actions in agricultural water monitoring 6. Implementing measures in accordance with the Water Rights Act 7. Implementing measures in accordance with the Soil Protection Act Implementing measures in accordance with the Plant Protection Products Act
Textiles sector	*An excerpt from the **Upper Austrian Waste Management 2017** (Textile):* Textiles, old textiles incl. shoes are valuable recyclable material, which is mainly given directly to social institutions by citizens in Upper Austria. A part is collected via public collection facilities. **Development of collection volumes and recycling** ▪ In 2015, around 5,900 tons or 4 kg per inhabitant of used textiles were generated in Upper Austria. About 2/3 of this was collected in the used material collection centers and the rest in container collections. ▪ The collection volume has remained in the same order of magnitude in recent years, with slight fluctuations. ▪ The share in residual waste was high in 2013 at 5.7 kg per inhabitant, resulting in a collection rate of 41%; i.e., more old textiles are found in residual waste than were collected separately. The Upper Austrian collection rate per capita is slightly higher than the average in Austria. ▪ The clean and wearable textiles of all kinds collected in the used material collection centers are transferred to the waste logistics center in Wels,

	from where they are delivered to sorting companies in the EU and then used for reuse and recycling. **Goals**: ▪ The separate collection of reusable and recyclable old textiles is expanded, thereby minimizing the proportion in residual waste. **Measures**: ▪ Setting awareness-raising measures to optimize the separate collection of used textiles. Elicit best practice examples on how to increase the collection rate of textiles. *Policies on European level:* ▪ EU strategy for sustainable and circular textiles (https://environment.ec.europa.eu/publications/textiles-strategy_en) The Strategy aims to create a greener, more competitive textile sector that is more resistant to global shocks. The Commission's 2030 vision for textiles is that o all textile products placed on the EU market are durable, repairable and recyclable, to a great extent made of recycled fibres, free of hazardous substances, produced in respect of social rights and the environment o ”fast fashion is out of fashion” and consumers benefit longer from high quality affordable textiles o profitable re-use and repair services are widely available o the textiles sector is competitive, resilient and innovative with producers taking responsibility for their products along the value chain with sufficient capacities for recycling and minimal incineration and landfilling.
Packaging sector	▪ Packaging and Packaging Waste Regulation – PPWD (https://environment.ec.europa.eu/publications/proposal-packaging-and-packaging-waste_en) The EU no longer allows certain single-use plastic items such as cutlery, plates, straws, stirrers, cotton buds, food and beverage containers made of expanded polystyrene, and products made from oxo-degradable plastics, to be placed on the Member States market. The Directive requires Member States to take action to curb the consumption of these products, for example through consumption reduction targets, design requirements and labelling requirements. The Directive also requires Member States to introduce extended producer responsibility schemes for certain single-use plastic products.

3.2 National/regional strategic documents

The following relevant European and national/regional strategic documents were identified:

Generic level	*European strategic document* **Circular economy action plan (EU)** Further information: https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en *National strategic documents* **Austrian circular economy strategy** The Austrian circular economy strategy was published in fall of 2022 and documents the steps necessary to reach the goal of climate neutrality in Austria by 2040. It displays its connection to existing EU regulations and presents the following five specific goals: ▪ the comprehensive reduction of resource consumption and use of resources (sparing resources) ▪ the avoidance of waste (Zero Waste) ▪ the avoidance of environmental pollution by hazardous materials (Zero Pollution) ▪ the reduction of greenhouse gas emissions (environmental protection) Furthermore, it lays out the possible screws to be turned to achieve the transformation from linear to circular, including funding, digitization, and the adjustment of legal and regulatory framework conditions. It also looks at relevant industries such as construction, **textile** and plastics. Further information: https://www.bmk.gv.at/themen/klima_umwelt/abfall/Kreislaufwirtschaft/strategie.html **Bioeconomy strategy for Austria** Going hand in hand with the circular economy strategy is the Bioeconomy strategy. Here, the goal is to reduce the use of fossil resources and replace these with renewable raw materials. The strategy touches upon the products, technologies and resources available in Austria but also explains the overall concept in an Austrian context. In order to successfully implement a shift on favor of this strategy, politics and policies are a focal point of this document. Further information: https://www.bmk.gv.at/themen/klima_umwelt/klimaschutz/biooekonomie/strategie.html **Technology Roadmap: Sustainable Plastics Solutions** Further information: https://www.biz-up.at/fileadmin/user_upload/Cluster/KC/2022/Statische_Seiten/biz_sustai

	nable-plastics-solutions_roadmap2022_220203_final.pdf *Regional strategic documents* **Future plan Burgenland** (https://www.burgenland.at/fileadmin/user_upload/Downloads/Landesregierung/Zukunftsplan_Burgenland_Textversion.pdf) This plan is promoting the expansion of the range of courses offered at the FH Burgenland in economic fields, with the training on the focus of circular economy and digitalisation. The establishment of Regional Waste Collection Points (RAS) by the BMV aims to promote separation discipline in the context of resource conservation, sustainability, and the circular economy. These professionally managed regional waste collection points will offer various services such as consumer-friendly opening hours, rental vehicle services, expert advice, and mostly free disposal of bulky waste and recyclables. This leads to improved separation of delivered waste and better recycling possibilities. Municipalities can join these inter-municipal, modern centers regionally and transfer the establishment and operation of their own waste collection points entirely to the BMV. **Burgenland 2050 Climate & Energy Strategy** (https://www.burgenland.at/fileadmin/user_upload/Bilder/Umwelt/20210125_2050_Klima_Energie_Buch_201215_low_einzeln.pdf) One goal by 2030 is the implementation of a circular economy in Burgenland Sustainable consumption as well as the reduction and avoidance of waste should make valuable contributions to a reduction of dependence on raw materials and a reduction of production and disposal costs. Thus, the reuse of consumer goods, the introduction of deposit systems and recycling, in which, among other things, waste products are reused as secondary raw materials, play a key role in achieving a circular economy and thus reducing greenhouse gas emissions. **Guide Annex Climate and Energy Model Region** (https://www.klimafonds.gv.at/call/klima-und-energie-modellregionen-2023/) The Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology (BMK) and the Climate and Energy Fund support Austrian municipalities and regions in achieving their climate goals. The offer ranges from concepts to implementation measures to support for concrete investments in the energy and mobility transition. In climate and energy model regions, the cooperation of municipalities is promoted in order to advance the optimal use of natural resources, the exploitation of energy saving potential and sustainable management in the regions. This has resulted in more than 6,000 successful projects so far, for example in the areas of renewable energy, energy efficiency, sustainable mobility and awareness raising. **Smart City Vienna Framework Strategy 2019-2050** (https://smartcity.wien.gv.at/wp-content/uploads/sites/3/2019/10/Smart-

	City-Wien-Rahmenstrategie-2019-2050.pdf) The path to an ecologically and socially sustainable smart business location means a profound structural change. The central guiding principle for this is the transformation from the current linear economy to a circular economy. Together with Lower Austria and Burgenland, Vienna would like to further develop a joint smart region with regard to sustainable economic and location development, which is increasingly oriented towards the principles of land and material efficiency, circular economy and decarbonisation and many other aspects. **Vienna 2030 - Economy & Innovation Strategy** (https://www.wien.gv.at/english/business-media/vienna-2030.html) This strategy fits into the city's existing strategies and initiatives. The guiding principle is the Smart City Vienna Framework Strategy 2019-2050, which makes a commitment to a high quality of life for all Viennese citizens with the greatest possible conservation of resources through comprehensive social and technical innovation. One of many goals of the Smart City Wien framework strategy for economy and work is that Vienna should be globally known as a location for circular and resource-efficient economy by 2030 and attract investments and talents in this field. **Climate and energy strategy Styria 2030** (https://www.technik.steiermark.at/cms/dokumente/12449173_128523298/f9e55343/KESS2030_Web_Seiten.pdf) This strategy emphasises the importance of the circular economy. The implementation of the EU circular economy package is emphasised, as recycling enables the reduction of greenhouse gas emissions. One focus is on the promotion of recycling technologies in order to establish Styria as a model region. Support for regional agriculture and short transport routes contributes to the circular economy. Innovation incentives are aimed at efficient energy use and waste heat utilisation in order to further advance the circular economy.
Wood sector	**Guideline for a circular economy planning and design** (https://ig-lebenszyklus.at/wp-content/uploads/2020/10/Leitfaden_Kreislaufwirtschaft_final.pdf) With the development of this guideline, the working group would like to provide concrete recommendations for clients, planners and building contractors in order to promote the implementation of a circular economy in the building sector. The guidelines should cover all phases of the building life cycle. “AG Kreislaufwirtschaft” started its work in 2020 with the main topic of "circular planning and construction", as a successful circular economy must already begin in the planning phase. Only by thinking in advance about later changes of use or deconstruction can buildings be used permanently or reused optimally. In the coming years, the working group will expand the guidelines to include additional topics (e.g. recyclable building materials, recyclable design of separable

	connections, digital component book for BIM). **Circular construction industry** (https://www.umweltbundesamt.at/fileadmin/site/publikationen/rep0757.pdf) It serves as a guide with principles and recommendations for practical application and legislative support. It describes key technical and organizational concepts to meet building requirements. The project aims to define circular economy principles for all building lifecycle stages, addressing existing challenges. Previous work involved creating a consortium and conducting interviews with stakeholders for White Paper development.
Chemistry sector	CSS (EU level) and several subsector specific BREFs (EU level) are the baseline of strategies applied in Austria/Upper Austria. Most Austrian agencies reference back to these EU level documents when discussing local and national strategies. Further information and links to all BREFs (Ranging from Common Waste Water and Waste Gas Treatment to the Production of Polymers) relevant for the (Austrian) chemistry industry can be found here: https://www.umweltbundesamt.at/industrie/chemische-industrie **National Actionplan POP** POP, short for Persistent Organic Pollutants, are the focal point of this National Action Plan. The document itself shows both the releases into air and water and can further be monitored in soil and food. This strategic paper builds on an action plan set up in 2017 and newly includes a guide for authorities and plant operators. This is intended to support the identification of POPs in plants and the prevention or reduction of POP emissions.
Textiles sector	Due to the existence of the **EU strategy for sustainable and circular textiles** Austria sees few national or regional additional strategies. Most entities who are active in this sector reference back to the EU strategy, there are no real additional strategies to be found in Austria. Further information can be found here: https://environment.ec.europa.eu/strategy/textiles-strategy_en **Incentives for a Sustainable Circular Economy in the Textile and Clothing Sector in Austria** - Analysis of Framework Conditions, Instruments and Perspectives for Action While this is not a strategic document per se, it builds upon the requirements of the afore mentioned EU strategy and puts it into an Austrian perspective. It analyses the current standing of Austria's textile industry and provides specific recommendations such as the creation of a roadmap for a circular Austrian textile industry but also the strengthening of networks, increased education and providing necessary legislative framework.

	Secondary raw materials for the Austrian textile industry (https://www.oegut.at/downloads/pdf/sekundaerrohstoffe-textilindustrie/schriftenreihe-2023-04-textilindustrie.pdf) The study highlights the economic challenges in emerging chemical recycling technologies due to lack of scalability and low prices for primary fibres. Integrated chemical recycling processes that recover pulp and polyester pellets from blended fabrics have shown economic potential. Versatile recycling processes that do not rely on high grade purity are beneficial. Linking different industries is crucial. These technologies should enable higher recycling rates, reduced raw material consumption and high-quality recycled products, and support EU circular economy initiatives.
Packaging sector	**Packaging regulation amendment 2021** (https://www.wko.at/service/noe/umwelt-energie/Verpackungsverordnungs-Novelle-2021.html) The amendment brings significant changes: In 2023, companies must join collection and recovery systems for commercial packaging. By mid-2024, one-way plastic beverage containers require fixed plastic closures. Producer reps in other EU states are needed from 2023. Household packaging will be separately collected by categories in 2023, with combined light packaging and metals in 2025. From 2030, only reusable or recyclable plastic packaging is allowed. Collection and recycling systems must provide and require annual reports on single-use plastic quantities.

3.3 Funding schemes and further business support measures

The following relevant funding schemes were identified:

Generic level	▪ FFG - The Austrian Research Promotion Agency (FFG) is the national funding agency for industrial research and development in Austria (national) – open to topics o For example: FTI-Pact Circular Economy) ▪ AWS (national) – open to topics ▪ Easy2innovate: support programme of the regional government of Upper Austria, implemented by Business Upper Austria to promote the competitiveness of SMEs in Upper Austria through research and innovation funding (https://www.biz-up.at/innovationsfoerderung/foerderprogramme/easy2innovate) ▪ Programme to stimulate the first-time cooperation of Upper Austrian companies with an R&D institution (SKU): s to establish cooperations for the implementation of cooperative R&D projects or organisational projects by Upper Austrian companies through financial support (https://www.land-oberoesterreich.gv.at/211775.htm)

	▪ Expanding Horizon Europe: the state government of Upper Austria supports the submission of applications of Upper Austrian companies and research institutions for the current EU research and innovation framework programme "Horizon Europe". (https://www.land-oberoesterreich.gv.at/119127.htm) ▪ Regional Calls - #upperVISION2030 (regional): Open to topics – only requirement is that the project has to be align with the strategic programme ▪ ÖKO PLUS: Small and medium-sized enterprises are supported o Sustainability Check o Consulting Service (CSR Reporting, Energy Management, Waste Management, Cleaner Production etc.) (https://foerderungen.wkooe.at/oeko-plus) ▪ **Promotion of waste prevention** (https://www.vks-gmbh.at/abfallvermeidungs-foerderung.html) Promotional measures include the avoidance of harmful input materials, the reduction of production and packaging waste, the optimisation of logistics, awareness raising, educational initiatives, product life extension through quality improvements and repair options, the reduction of waste during product use and the replacement of products with waste prevention services. ▪ **FTI Initiative Circular Economy** (https://www.ffg.at/3-ausschreibung-fti-kreislaufwirtschaft) Cooperative R&D projects will be funded in the following call focus areas: Innovations for circular economy, Intensification of the use of goods, Residual materials and recycling (experimental development only), Green Chemistry" education initiative (max. 4 years). In addition, two R&D services on the topics "Circular Economy Compass" and "Circular Design" will be funded. ▪ **KEM Bioeconomy and Circular Economy** (https://www.umweltfoerderung.at/betriebe/kem-biooekonomie-und-kreislaufwirtschaft) The KEM programme looks for a region that focuses on bioeconomy and circular economy and aims to set this region apart from others through ambitious measures in these areas and establish it as a role model for climate protection projects nationally and internationally. ▪ **Production of the future** (https://produktionderzukunft.at/de/mission/) The BMK's RTI programme "Production of the Future" aims to strengthen Austria's competitiveness through efficient use of resources, production flexibility and innovation promotion. Funding is provided for highly innovative R&D projects in the fields of: Efficiency and quality of production, Materials, surfaces and nanotechnology, Critical raw materials, Biobased Industry ▪ **Austrian Repair Bonus**

	(https://www.reparaturbonus.at/) This is a funding campaign within the framework of the Austrian Recovery and Resilience Plan. With the repair bonus, private individuals receive a subsidy of up to 200 euros for the repair of electrical and electronic appliances at participating partner companies. The aim of the funding is to increase the number of repairs of electrical and electronic equipment in Austria. The subsidy is financed from funds of the European Union - NextGenerationEU.
Wood sector	▪ **Österreichische Holzinitiative - THINK.WOOD.Innovation** (https://www.ffg.at/programm/thinkwood) The Wood Initiative has two main areas: material and energy use of wood. Its aim is to promote innovations in the forestry and wood sector in order to contribute to the resource and energy turnaround and to ensure the sustainability of forestry. ▪ **Waldfonds – Action 9: Increased use of wood as a raw material** (https://info.bml.gv.at/themen/wald/waldfonds/massnahme_9.html) Funding under action 9 supports activities such as knowledge transfer and awareness-raising about wooden construction, research for wood utilization in building, promoting sustainable forest wood use, and the construction of residential, public, and infrastructure buildings with a substantial share of renewable materials from sustainable forests.
Chemistry sector	▪ No specific funding schemes
Textiles sector	▪ **Incentives for a Sustainable Circular Economy in the Textile and Clothing Sector in Austria** (https://iwi.ac.at/wp-content/uploads/2021/11/BMK-Kreislaufwirtschaft-im-Textilsektor.pdf) The transformation to a textile economy in the sense of the circular economy is a major challenge and requires the involvement of all relevant actors - from the government as well as from society, science and business. In order to promote sustainable production and consumption in the textile and clothing sector in the sense of the circular economy, governments and other relevant actors use a variety of different measures and instruments. These can be, for example, legal instruments and regulations, agreements and conventions, funding programmes and other support instruments, sustainable public procurement or awareness-raising measures. In addition, the business sector has a number of good practices in recycling technologies, product design, circular business models and how digital technologies can be used for the circular economy.
Packaging sector	▪ **New installation and adaptation of reverse vending machines** (https://www.umweltfoerderung.at/betriebe/leergutruecknahmesysteme) Subsidies for new installations, replacements and adaptations of reverse vending machines. To be eligible, at least 200 beverage containers must be sold daily. In addition, reliable deposit containers must be recognised, one-

	way deposit containers must be cancelled and reliable data management must be possible. ▪ **Reusable Systems** (https://www.umweltfoerderung.at/betriebe/mehrwegsysteme) Funding is provided for investments in the construction, expansion and adaptation of washing plants, filling plants and plants for the packaging of reusable containers as well as the acquisition of standardised reusable containers and standardised reusable crates or comparable reusable transport packaging. ▪ **Sorting plants for plastic packaging** (https://www.umweltfoerderung.at/betriebe/sortieranlagen) Funding is offered for investments in the construction, expansion, or retrofitting of facilities for sorting and processing plastic packaging from separate or joint collection. Eligible costs include those related to the plant itself, planning, and assembly for the qualified facilities.

The following relevant business support measures were identified:

Generic level	▪ Circular Economy Forum Austria: The Circular Economy Forum Austria is Austria's largest independent multi-stakeholder platform for the promotion of the circular economy. The forum supports companies and their environment on the way to the circular economy and connects important actors for the creation of innovative value cycles. (https://www.circulareconomyforum.at/) ▪ Bioeconomy Austria (https://www.bioeconomy-austria.at/) ▪ TIM – Technology and Innovation Management is a regional technology advice and consultation initiative providing companies with research knowledge, comprehensive information, financing and coaching to foster the development of innovation projects in Upper Austrian companies. (https://www.tim.at/) ▪ The Circular Region OÖ initiative in Upper Austria (https://www.biz-up.at/circular-region/) ▪ Business Upper Austrian - Business Upper Austria is the Upper Austrian government's location agency (https://www.biz-up.at/) ▪ GRAND GARAGE – Innovation factory and open to all companies (https://grandgarage.eu/) ▪ Model region Bioeconomy and Circular Economy "Steirisches Vulkanland" (https://www.vulkanland.at/lebensraum/modellregion-biooekonomie-kreislaufwirtschaft-steirisches-vulkanland/) The goal of is to gradually convert the economy to a regional and sustainable resource base and to secure the resources of the future for a climate-friendly and sustainable regional economy and a high quality of life in the long term. The following goals exist in the priority areas and cross-sectional areas: Soil,

	Valuable resources, Food of the future, Sustainable living initiative. ▪ Platform for Green Transformation & Bioeconomy (https://www.ecoplus.at/interested-in/clusters-technopols/clusters-platforms-in-lower-austria/platform-for-green-transformation-bioeconomy/) The platform is pursuing the vision of making Lower Austria the European model region for bioeconomy, green transformation and circular economy. To achieve this, it will serve as an information hub to spread acquired know-how, network the many players who are already active in their fields today, complete missing pieces of the puzzle through targeted research and cooperation projects and serve as a central point of contact for business, science and policy making ▪ Austrian Institute of Technology – AIT (https://www.ait.ac.at/en/solutions/circular-economy) The AIT decides on a comprehensive, cross-sector approach to the circular economy, covering raw materials, products, buildings, and urban planning. They connect tech expertise with systemic competence to create sustainable circular pathways, emphasizing resource life cycles and rebound effects. ▪ Glacier (https://glacier.eco/) Glacier offers companies programmes to provide employees with the necessary awareness and knowledge of climate protection and application-oriented skills with modular learning paths from climate protection basics to in-depth specialised knowledge depending on the sector and activity in the company. ▪ Circular Futures (https://www.circularfutures.at/ueber-uns/english-language-summary/) Circular Futures was initiated by the environmental umbrella organization Umweltdachverband and is a collaboration of several umbrella organizations that advocate the transition to circular economy in politics and legislation. The collaboration partners are the Umweltdachverband (UWD), the European Environmental Bureau (EEB) as well as the Reuse and Repair Network Austria (RepaNet) and the Association Waste Consultants Austria (VABÖ). ▪ Circular Economy Forum Austria – CEFA (https://www.circulareconomyforum.at/) The Circular Economy Forum Austria is Austria's largest independent multi-stakeholder platform for the promotion of the circular economy. The forum supports companies and their environment on the way to the circular economy and connects important actors for the creation of innovative value cycles. ▪ Circularity in the Climate Lab (https://climatelab.at/circularity/) Climate Lab was initiated by the Climate and Energy Fund and the Ministry of Climate Protection (BMK) together with Wien Energie, EIT Climate-KIC and Impact Hub. In partnership with the Climate Lab, they

	promote climate protection through joint programmes, space for innovation and a cross-sector climate innovator community. The goal: climate neutrality. ▪ ÖGUT (https://www.oegut.at/de/) ÖGUT is a non-profit organisation that promotes sustainability in business and society. It networks over 100 organisations from business, administration and the environment, offers a wide range of services and develops innovative solutions.
Wood sector	▪ Bioeconomy Austria (https://www.bioeconomy-austria.at/) The network aims to connect different actors and companies along the value chains and promote cooperation to exploit synergies and cost advantages. It strengthens the regional economy, links regional and thematic clusters at federal and EU level and promotes the improved use of biomass while taking climate protection and competing land use interests into account. ▪ Circular economy in the Austrian wood sector (https://unipub.uni-graz.at/obvugrhs/download/pdf/6751817?originalFilename=true) The Austrian wood sector is experiencing increased demand for wood products, particularly in construction and furniture industries, creating economic growth. This expansion raises environmental concerns like deforestation, loss of biodiversity, and carbon emissions. The concept of the Circular Economy is seen as a potential solution. Wood cascading, the multistage reuse and recycling of wood products, plays a central role in improving resource efficiency and sustainability in the forest-based sector. The CE aims to minimize wood waste and prioritize material utilization over energy recovery.
Chemistry sector	▪ No specific business support
Textiles sector	▪ GRAND GARAGE – Textile Factory ▪ Smart Textile Platform (https://www.smart-textiles-platform.com/) The service portfolio of the Smart Textiles Platform Austria is very divers and has a big range of support in innovation and funding management to assistance in the search for, selection of and mediation with cooperation partners. In addition, providing information to platform members is a top priority. The range of services also includes representing members at national and international trade fairs and events.
Packaging sector	▪ There were no further business support measures for the textile sector identified.

4 Technologies and knowledge providers

The following relevant technology and knowledge providers were identified:

Generic level	▪ FTI projects and COMET competence centers (https://nachhaltigwirtschaften.at/resources/nw_pdf/broschuere-klwpt-2023-bmk.pdf?m=1695303354&) FTI projects are funded by the BMK. The projects deal with questions for the solution of current challenges in the fields of in the fields of circular economy and production technologies. The COMET competence centres work together with companies and research partners to develop solutions in future topics such as climate protection, digitalisation, mobility and health. This strengthens the innovation and business location, secures Austria a place among the top international research and creates highly qualified jobs. ▪ ARA Circular Economy Barometer (https://www.ara.at/news/ara-circular-economy-barometer-2023) Together with GfK, ARA creates this index, which measures the status of the circular economy in Austrian companies. ▪ Woodkplus Wood K plus (wood-kplus.at) Woodkplus is a leading research institution for wood and renewable raw materials in Europe. Their core competencies lie in materials research and process technology along the entire value chain - from raw materials to the finished product. More than 120 highly qualified researchers develop methods and basic principles and conduct applied research at the interface between industry and science in order to enable resource-saving management in the cycle-led bioeconomy. ▪ Johannes Kepler Universität Linz Institute for Integrated Quality Design. Founded in October 2015, the IQD is a new interdisciplinary research and teaching institute bridging management and engineering by focusing at the intersection of Quality, Innovation and the Circular Economy. Research and teaching is framed by the vision of a Circular Economy, a concept which proposes circular product design, processes and resource flows as strategies to overcome some of today's most pressing challenges, such as resource scarcity, dependence on fossil fuels, decreasing product quality (and respective lifetimes), waste and related environmental pollution. Considering this background, the institute's mission is to better understand the development and diffusion of product-service systems with superior technical, environmental and social quality regarding the full life-cycle (resources, production, use, post/re-use) – or even multiple life-cycles (i.e.

	circularity) – and how this can be enabled by integrated management systems and, more generally, organisational change and transformation. ▪ FH Oberösterreich - University of Applied Sciences Upper Austria Faculty of Engineering and Applied Sciences The University of Applied Sciences Upper Austria has developed a new bachelor's degree program called Sustainable Solutions. This degree program is interdisciplinary and includes, among others, the interfaces: Product and Process Design, Redesign, Sustainability Management, Interface "Technology, Economy & Social" and Project Based Learning. ▪ HTBLA – Höhere technische Bundeslehranstalt Wels Startseite » Höhere technische Bundeslehranstalt Wels (htl-wels.at) HTL graduates are employed in the paint and varnish industry, in plastics production, in textile dyeing works, surface coating companies, printed circuit board factories, in perfumery, cosmetics and detergent production, in building materials production, in pharmaceutical production, in public water treatment plants, in industrial plant construction, in public environmental protection offices (for air, soil and water monitoring), but also in analysis laboratories of hospitals, police or food monitoring offices. There are also opportunities for employment in the sale of chemicals, as well as the sale and assembly, but also technical service of the most modern analytical equipment. Often these are also connected with the possibility of stays abroad.
Wood sector	▪ See role model companies
Chemistry sector	▪ See role model companies
Textiles sector	▪ Kunstuniversität Linz Department of textile·art·design & Design and technology department The Kunstuniversität Linz aspires to help shape a sustainable society, integrated into the public life of Linz and Upper Austria and in resonance with a globalized world. Art, design, research and teaching engage constructively and critically with social, economic and ecological transformation processes, digitalization, globalization and post-growth issues. At the university, there are already numerous activities, initiatives and projects on the topic of sustainability. The Department of Design and technology focuses on the one hand on the perception of living environments and the question of materials, processes and/or objects that influence and determine our environment, and on the other hand on our own creative, informed actions and active co-creation of the environment. Material culture is explored in an interdisciplinary, action-oriented manner and through active engagement - inventing, constructing and artistically shaping - in its manifestations, functions and meanings.

	The bundling of diverse expertise in the department enables diverse fields of activity in teaching and research, and to establish the department as a cooperation partner vis-à-vis institutional and independent partners from educational and cultural institutions as well as the economy, and to be significantly involved in social, society-relevant developments.
Packaging	▪ See role model companies

5 Business models and practices

5.1 Role model companies

The following role model companies were identified:

Generic level	▪ Brantner (https://www.brantner.com/de/entsorgung/home.html) With more than 2,700 employees, the Brantner Group, founded by the Brantner family in 1936, is one of the most successful national and international waste management and logistics companies. The company is already being managed in the third generation at its founding location in Krems and they are shaping the future of waste and resource management in Austria.
Wood sector	▪ Stora Enso (https://www.storaenso.com/de-de/) Stora Enso develops and produces solutions based on wood and biomass for a range of industries and applications worldwide. The company is driven by a commitment to reduce, reuse and recycle resources, as well as their targets to offer products that are 100% recyclable by 2030 and 100% circular by 2050. The concept of 3Rs, or reduce, reuse, recycle, promotes sustainability in both production and consumption by emphasising the need to minimise waste generation, maximise resource efficiency, and close the loop by recycling materials. The company has the goal to foster the transformation towards a circular bioeconomy. Purpose statement: "Do good for people and the planet. Replace non-renewable materials with renewable products." ▪ Bene (https://bene.com/de/produkte/designlinien/bfriends) Bene is an Austrian furniture company with the headquarters in Waidhofen an der Ybbs. They apply a 3D printing process that requires no tooling for production, generates no waste itself, and produces on demand, minimizing inventory. Raw materials are sourced from local waste streams. Since no centralized production is required, the products can be manufactured through a distributed network of local production centres, shortening transportation distances for raw materials and finished products and significantly reducing supply chains and lead times. So far this technique is applied to the bFRIENDS collection only. These products are recycled and can be returned to Bene showrooms worldwide or sent to us for this purpose. We then feed the material into a new product cycle. ▪ Hempstatic (www.hempstatic.at)

	The startup Hempstatic is specialized in the production of hemp-lime acoustic panels. They incorporate today's technical, design and environmental demands into high quality materials. Passion for detail, passion for innovation and awareness of sustainability are the guiding principles. ▪ BauKarussell (https://www.baukarussell.at/) BauKarussell is the first provider of social urban mining - recycling-oriented deconstruction with social added value and a special focus on the reuse of building components of large-volume objects. BauKarussell has set itself the goal of promoting the circular economy in the construction industry and integrative employment in deconstruction by professionally accompanying building owners through deconstruction planning and implementation.
Chemistry sector	▪ Werner & Mertz Designed their packaging from 100% recycled plastics and for a 100% recycling loop. Changed their entire business model into only using recycled materials and teaching consumer on how to properly dispose their products after use. Additionally, to that, the design of the packaging increased in quality, so that it can be used multiple times. For that W&W offers refilling bags of the product, so reduce the amount of packaging waste. Produces detergents with no substances of concern, to not avoid pollution of water and soil when using their products. This has been enrolled on all their products. ▪ NAKU Producing sustainable packaging made out of bio-plastics. Their claim is that their products are 100% natural, 100% sustainable, 100% compostable and 100% recyclable. Their products are bags, bottles, wrapping utilities and many more. ▪ MKV Oberflächenbeschichtung Developed a new powder coating instead of wet coating that reduces emissions and toxic substances in products. Hence, the entire process of coating becomes less hazardous in the production but also in the use and recycling afterwards.
Textiles sector	▪ Lenzing (https://www.lenzing.com/de/nachhaltigkeit/produktion/technologien) Lenzing produces wood-based viscose fibers, modal fibers, lyocell fibers and filament yarn, which are used in the textile or non-woven industry. REFIBRA™ technology is based on the environmentally friendly Lyocell production process. In addition to wood pulp, up to one-third of the raw materials used are pulp from cuttings from the production of cotton clothing or, for the first time, used cotton textiles. By 2024, however, Lenzing wants to raise the bar for the industry even higher: Fibers with REFIBRA™ technology are to contain up to 50 percent recycled materials from cotton waste textiles, making textile waste recycling just as widespread as paper recycling. Eco Cycle technology is the nonwovens counterpart to our REFIBRA™ technology. Eco Cycle Technology is Lenzing's first step towards

	contributing to the circular economy in the nonwovens industry. ▪ Wolford (https://company.wolford.com/de/nachhaltigkeit/nachhaltigkeit-bei-wolford/) Wolford is a textile manufacturer of tights, bodysuits and underwear, as well as women's clothing and accessories with the headquarters in Bregenz. The company is the first hosiery manufacturer in the world to partner the bluesign® system with its strict requirements for sustainable production. In addition to observing the highest environmental standards in its own production, Wolford's current strategic focus is above all on implementing a sustainable strategy for the use of materials. By 2025, 50% of the products are to be recyclable, i.e. either biodegradable or technologically recyclable. Wolford is the world's first and so far only company in the textile industry to be certified gold by cradle to cradle for the development of environmentally neutral products in both categories ("biodegradable" and "technically recyclable"). ▪ Paptex Textilhandels GmbH (https://maryrose.at/) Paptex is a company for home textiles placed in Dornbirn. Their brand Mary Rose is Cradle to Cradle certified. From the fabric made of organic cotton, to the sewing thread, to the weaving and product label, to the color pigments - everything is completely biodegradable and can be returned to the biological cycle without leaving any residue. Beside the C2C label Mary Rose products have several other labels to show social responsibility and sustainability (e.g. GOTS or Fair Wear). ▪ Fahnengärtner (https://www.fahnen-gaertner.com/de-AT/index.html) Fahnen Gärtner is an Austrian manufacturer of flags, banners, beach flags, roll-ups and other textile advertising materials placed in Mittersill. Likewise, the company specializes in individual large and special prints. Fahnen Gärtner is a company with an eye on the future, without forgetting the present. They want to leave a living and healthy environment for future generations. Behind this lies an ecological, economic and social responsibility.
Packaging sector	▪ Gugler (https://www.gugler.at/) Gugler is an Austrian family business with the printing company DruckSinn, the agency MarkenSinn and the management consultancy SinnBildung. They are a pioneer in sustainable printing and cradle to cradle. In their view, FSC®, PEFC™, the Austrian Ecolabel or the EU Ecolabel are minimum requirements for ecological print products. Climate-positive printing is a supplement to this and subsequently the preliminary stage for Cradle to Cradle Certified® Silver and Gold, currently the highest quality standard for verified pollutant-free and healthy print products. Gugler is also a Common Good company and has already published its 2nd Common Good Report. ▪ Greiner (https://www.greiner.com/) Greiner Packaging is located in Kremsmünster and is producing plastic

	packaging for over 60 years. They are a leading company in the packaging sector. Regarding circular economy they follow the principles reduce, reuse and recycle. ▪ EREMA Group (https://www.erema-group.com/) EREMA Group consists of 3S, EREMA, KEYCYCLE, PLASMAC, PURE LOOP, UMAC, BLUEONE Solutions and plasticpreneur as well as the POWERFIL business unit. The group is following the vision that in 2030, Circular Economy for plastics is a reality. ▪ Werner & Mertz GmbH (https://frosch.at/de/das-kreislaufprinzip/) Werner & Mertz is a family-run manufacturer of cleaning and care agents with headquarters in Mainz and a factory in Hallein. The closed-loop principle plays a central role in the development of their formulations. The plant-based raw materials used should ultimately become fertilizer again and thus new plants. Frosch has succeeded in reaching a milestone: The fully recyclable bag made of monomaterial (polyethylene) with a removable band is the first flexible packaging worldwide to achieve "Cradle to Cradle Gold Certification." Around 85% of the packaging material is unprinted and can be recycled to a high standard. The remaining 15%, the printed band, is also fully recyclable. The stand-up pouches are used for Frosch laundry detergent, and for soaps and bottles with spray function they are used as refill pouches. ▪ Mondi (https://www.mymondi.net/ufp/de/cradle-to-cradle-certified) The entire product portfolio from Mondi Uncoated Fine Paper's mills in Austria and Slovakia have achieved the Bronze level of the Cradle to Cradle Certified® Products Program. This is a confirmation by external experts that they meet the high standards and demanding requirements of the certification. The Cradle to Cradle Certified® Product Standard evaluates the safety, recyclability and responsibility of materials and products in five sustainability categories: Material Health, Product Recyclability, Clean Air and Climate Protection, Water and Soil Management, and Social Responsibility. ▪ Mayr-Melnhof Packaging (https://www.mm-packaging.com/) Mayr-Melnhof Packaging is a manufacturer in the paper and packaging industry with the headquarters in Vienna. Re*flect is one of their products and represents a plastic-free, 100% recyclable alternative to Metpol. It is a solution where the metal layer remains in the box to be printed afterwards, keeping the look of traditional Metpol while removing the plastic.

5.2 Relevant industrial groupings and networks

The following industrial groupings and networks were identified:

Generic/Plastics	▪ Reuse Austria (https://www.linkedin.com/company/reuseaustria/about/) Re-Use Austria (formerly RepaNet) unites more than 40 member organizations under its umbrella as a voluntary interest group of Austria's socially oriented Re-Use businesses as well as existing repair networks and repair initiatives. Re-Use Austria acts as a "lobby for re-use" and is a topic leader in this field. Re-Use Austria is one of the key players in the current circular economy debate with a strong focus on intelligent, fair use of raw materials by extending the life of products, as well as creating fair jobs for the disadvantaged and involving civil society in the sector. ▪ Industry 4.0 Austria (https://produktionderzukunft.at/de/Plattformen/industrie-4-0-oesterreich.php) The association "Industry 4.0 Austria" has been promoting cooperation between society, politics, business and science to shape the future world of production and work since 2015. Their goal is to secure and increase prosperity in Austria by integrating digital technologies and innovations into companies and society in a socially acceptable way. They see it as a social challenge that can only be overcome through broad cooperation. ▪ Stakeholders of the sustainable plastics solutions A committed group of relevant actors in the plastics industry like machine manufacturers, plastic processers, producers and many more are aligned to push and enforces agendas of circular economy in the plastics industry especially in Upper Austria. ▪ Plastic Cluster Business Upper Austria The plastics cluster in Upper Austria conducts a lot of activities and initiatives to the topic of plastics recycling and brings together all the relevant stakeholders on one table to initiate projects and events to support the green transition in the plastics industry. https://www.kunststoff-cluster.at/en/ ▪ Circular Region Upper Austria The Circular Region in Upper Austria is part of the agency business upper Austria and lead and initiates activities in the field of circular economy over all sectors and industries. The focus is not only on the technological development but more on the development of the entire region of Upper Austria to become the international model region for circular economy. https://www.biz-up.at/circular-region/list
Wood sector	▪ Association of the Austrian Wood Industries (https://www.holzindustrie.at/unsere-themen/green-deal-kreislaufwirtschaft/)

	The Association of the Austrian Wood Industries represents the interests of almost 1,300 wood processing companies in the timber construction products, furniture, panel, sawmill and ski industries. It advocates for its members on a national and international scale, aiming to support growth, job security, and the wood industry in Austria. They influence policymakers, engage in legislative processes, and communicate the industry's concerns to the public and media. They collaborate with European associations and other trade groups to represent their interests effectively. ▪ Forest Association Austria (https://www.waldverband.at/) The Austrian Forest Association is a professional organisation of the Austrian Chamber of Agriculture and offers the eight provincial associations a platform for joint activities. Its main tasks are to coordinate and represent the interests of the provincial forest associations at the federal level. The joint activities are intended in particular to promote the production and joint marketing of wood for the benefit of the entire Austrian forestry sector. A particular concern is the sustainable supply of raw materials to all customers in order to secure Austria as a location for forestry and the wood processing industry. The activities are not profit-oriented. ▪ FHP (https://www.forstholzpapier.at/) The most important organisations from the forest, wood and paper value chain work together. FHP is a cross-value chain cooperation. It includes the forestry, wood, paper and pulp industries. Austrian issues are at the centre of the cooperation, whereby these are always to be seen in the context of international issues. In particular, political decision-makers are to be made aware of the importance of the value chain. This is especially true with regard to solving the climate problem, sustainability and future development, especially in research and education.
Chemistry sector	▪ Not known
Textiles sector	▪ Association of Textiles (https://www.textilindustrie.at/die-textilindustrie/) The professional group represents the interests and serves the textile industry companies in Austria. By investing in research & development and new technologies at the Austrian location, domestic textile companies take precautions to act in a future-oriented manner even in times of economic downturn. Often, entire solutions to problems are developed together with the customers. New production methods and combinations with other materials and economic sectors such as microelectronics or the plastics industry provide new impulses. Safety, transport, weight reduction through lighter textile materials, nanotechnology or new composite materials are dominant topics.
Packaging sector	▪ PROPAK (https://www.propak.at/) The PROPAK industry includes 85 companies that produce and finish

	products made of paper and cardboard. The PROPAK trade association, the PROPAK Austria business association and the PROPAK education forum are organised under the PROPAK umbrella brand. Austrian PROPAK companies are represented throughout Europe, the Middle East and the Mediterranean region and enrich the economy and everyday life with innovation, creativity and quality. PROPAK is internationally connected and active as a committed member of the European umbrella organisation CITPA and the individual industry associations. These represent the interests of the industrial manufacturers of paper and board in Europe in Brussels ▪ Austropapier (https://austropapier.at/) It represents – together with the trade association - the companies of the Austrian paper industry. Currently, the association looks after the interests of 23 factories, including 11 works that produce pulp or wood pulp. Packaging papers are in the foreground; they now account for more than half of the production volume, with an upward trend. ▪ Austrian Institute für Packaging (http://www.verpackungsinstitut.at/about.html) The Austrian Institute for Packaging (OeIV) was founded in 1956 as an independent and neutral body and is engaged in research, testing, training and consulting activities for the quality assurance and further development of packaging made of paper, cardboard, solid and corrugated board as well as packaging for the transport of dangerous goods. Quality tests are carried out for both packaging materials and packaging. ▪ 4evergreen (https://4evergreenforum.eu/) 4evergreen is a cross-industry alliance of over 100 members representing the entire lifecycle of fibre-based packaging – from forests to producers, designers, brand owners and recyclers. Together they share expertise to develop tools and guidelines for an even more sustainable sector. The goal is to reach a 90% recycling rate for fibre-based packaging by 2030.

6 Gaps and barriers – potentials for transformation

The following table summarises the gaps and barriers as well as potentials for an industrial transformation towards an economy following the cradle to cradle principles in the relevant sectors for the region Austria.

Sector	Gaps and barriers	Potentials for transformation
Generic level	▪ Data availability and transparency of products and including materials ▪ Planned obsolescence of products ▪ resource requirements of current business models ▪ monitoring of circular economy of different sectors ▪ identification of leverage points to shift towards circular economy in different sectors ▪ global and complex supply chains ▪ technology focus and wrong substidies ▪ GDP as indicator	▪ Education and training program for employee ▪ Social innovations and new business models (e.g. PSS) ▪ Working on future values – where society does not identify via consumption and ownership of products ▪ Shifting from waste management to resource management ▪ Common understanding of a holistic circular economy (10Rs where recycling is the last option) ▪ Technology impact assessment ▪ Reals costs (e.g. high CO2 price) ▪ Funding for transformation ▪ Lobby or pressure from the society for transformation
Wood sector	▪ Conservative sector ▪ Coatings, glue, fasteners ▪ Collaboration throughout the value chain (from forest to application) ▪ Building regulation ▪ Furniture often made in Asia ▪ Lobbying as sector	▪ Improve cascade use of wood ▪ Research and implementation of alternative fasteners that allows to apply the 10R strategies ▪ Harmless coatings that keep wood biodegradable ▪ Common understanding of the available woody biomass in Austria and Europe ▪ Module-based constructions with standard components
Chemistry sector	▪ The amount of ingredients in a chemical product is highly underestimated	▪ Chemicals of concern can be substituted with eco-friendly chemicals

	▪ Many chemicals are highly needed for the product to be effective, replacing them and still obtaining the same quality and function is often challenging ▪ Chemicals in general are often perceived as harmful, although not all are ▪ Replacing additives is challenging ▪ Along the supply chain many added chemical information is getting lost ▪ Cooperation along supply chains do not happen ▪ Entire value chain can often not be reflected in one single region ▪ Energy consumption for production sites is a challenge ▪ Closing loops and getting back the used materials is a challenge	▪ Chemicals are a supporting additive for many products and absolutely needed ▪ Support in the recycling process, with cleanness, quality and smell ▪ Chemicals prevent many products from being affected by bacteria, degradation, etc. ▪ The chemistry sector is linked strongly to the polymer sector and therefore already very familiar with the principle of circular economy ▪ Industrial chemistry is highly represented in the region of Upper Austria ▪ Analyse the overall energy consumption and arising potentials ▪ Monitor paths of the raw and produced materials
Textiles sector	▪ Not all materials can be received regionally ▪ Big companies are not in the region, not even in Austria ▪ B2C brands cannot be reached ▪ Collection and separation systems for textiles are not fully developed yet ▪ Still many substances of concern used for textiles ▪ Textiles need additives to be "useful" these additives can harm the recycling process ▪ Textile circularity is still perceived strongly as recycling, less as reuse, repair and repurpose ▪ Technology for textile re-use is still not fully developed ▪ Re-use is only common in B2C markets but not in B2B markets	▪ EU is preparing strong laws and regulations towards a more circular textile industry ▪ Austrias national circular economy strategy focuses on textiles ▪ International cooperation is enforced because entire value chain is not in the region ▪ New start-ups and businesses try to design textiles for circular economy ▪ Society is putting pressure for a change ▪ Textile challenges are similar to plastic challenges, hence much from the plastic transformation can be learned ▪ Strong b2c market for reused textile products ▪ Discovering new and sustainable materials in the own region (e.g. hamp) ▪ Reactivate knowledge in the regions about harvesting and

	▪ Challenging to present the entire value chain of textiles in the region ▪ Sustainable or circular textiles tend to have very high prices ▪ Bio-based alternative raw materials are known, but technology disappeared over time ▪ Gathering of textiles depending on ingredients missing ▪ High development costs and missing knowledge ▪ Collection of textiles ▪ Material mixture of textiles ▪ 10R hierarchy (more than reuse and recycling) ▪ Fast fashion ▪ Upscaling of recycling technologies ▪ Feedstock for recycling fibres ▪ Energy demand in production and recycling	processing alternative biobased materials ▪ Subsidies for technology developers and farmers to be developed ▪ Develop systems to monitor textile waste streams and gather them depending on raw materials ▪ Subsidies in research to be developed ▪ Reduce the share of virgin fibres (independent of virgin material) ▪ Recycling of cotton fibres ▪ Europe becoming a pioneer in textile recycling ▪ Production of durable textiles that can be used many times without breaking down ▪ Awareness raising for long use of textiles (new or used)
Packaging sector	▪ Difference between B2B and B2C ▪ Material mixtures of packaging ▪ Food compatibility after reuse and recycling ▪ Single use packaging	▪ Reusable packaging ▪ Material quality ▪ Packaging as service ▪ Focus on reuse instead of recycling ▪ Fostering a take back culture

7 Conclusions

If we look at the wood, chemistry and textiles sectors in the Austria / Upper Austria region with regard to transformation towards an economy following the cradle-to-cradle principles, subsequently it shows these results:

Starting with the **wood and furniture sector**, where the main material is wood, a biobased and biodegradable material. Wood is often combined with other materials, i.e. adhesives, which are the main challenge in implementation of circular economy in this sector. The wood and furniture sector plays a major role in Austria, but the implementation of circular economy is seen as challenge for the production companies and there are different measures to overcome this.

Within the **chemistry sector** the quantity and importance of ingredients and additives in products are often underestimated, making substitution of these substances difficult. Many chemicals are critical to product efficacy, making the development of substitutes a challenge. Nevertheless, chemicals in general often have a negative reputation, even though not all of them are harmful. Information about chemical additives is lost along the supply chain and cooperation between stakeholders is limited. It is often difficult to map the entire value chain in a single region. Energy consumption in production facilities is a problem, and closing loops and recovering used materials are complex tasks. These points illustrate the many challenges and aspects related to the chemical industry and its sustainability. These **gaps and barriers** highlight the many challenges and aspects related to the chemical industry and its sustainability.

On the other hand, there are many ideas and recognised **potentials for transformation**. In the chemical industry, chemicals of concern could also be replaced by environmentally friendly alternatives. Chemicals are an indispensable supporting additive in many products and play a crucial role in the recycling process, in terms of cleanliness, quality and odour. They also prevent many products from being affected by bacteria, decomposition and other factors. The chemical sector is closely linked to the polymer sector and is already well acquainted with the principle of the circular economy. The Upper Austria region is strongly represented in industrial chemistry. An analysis of the total energy consumption and the resulting potentials has been carried out, and the observation of the flows of raw materials and materials offers opportunities to tap further potentials. These points emphasise the important role of the chemical industry in terms of sustainability and circular economy, especially in the Upper Austria region.

In the **textile sector** some **gaps and barriers** were identified**.** Challenges in the textile sector include the limited availability of regional materials, as large companies are often located outside the region, and in many cases outside Austria. This makes access to B2C brands difficult to reach. In addition, collection and separation systems for textiles are not yet mature. Substances of concern are still used in textile production, and the necessary additives that make textiles "usable" can interfere with the recycling process.

The textile circular economy is often more associated with recycling and less with reuse, repair, and repurposing. Textile reuse technology is not yet mature, and reuse is mainly limited to B2C markets, while B2B markets do not practice it. Mapping the entire textile value chain in the region is proving difficult. Sustainable or circular textiles are often associated with high prices. Although bio-based alternative feedstocks are known, the appropriate technology is lacking. Ingredient-dependent textile manufacturing is insufficiently developed, and high development costs and lack of knowledge are other hurdles in this sector.

However, these are also contrasted by many **potentials** with regard to transformation. The EU is planning strict laws and regulations to promote a circular textile industry. Thus, in Austria, too, the national circular economy strategy will have a stronger focus on textiles. In view of the international business models of the textile value chain, increased international cooperation is being sought. There is a growing involvement of start-ups and companies that focus on the development of textiles produced in a circular economy and also based on such materials.

Society is pushing for change in the textile industry. The challenges in textiles are similar to those in plastics, so learning effects between both sectors are possible. On the other hand, however, it is also important to develop systems for monitoring textile waste streams and their raw material-specific collection. Thus, there is also a strong B2B market for reused textile products. The demand on the customer side is accordingly becoming stronger as well.

The discovery of new and sustainable materials, such as hemp or various other natural materials, in one's own region is being promoted. There is a need to reactivate knowledge in the regions about the extraction and processing of alternative bio-based materials. Coordination with regional research institutions (Linz University of Art - Department of Textiles) shows the great potential of previously unknown or unused materials.

Subsidies for technology developers and farmers must be created to promote the use of sustainable materials. Equally, these research and development subsidies should drive innovation in the textile industry. The goal in this sector would be to allow the highest possible degree of customisation to support the innovation affinity of creative people and companies. The **packaging sector** is also very diverse starting from paper or cardboards over plastic and composite packaging. When focusing on paper and cardboard packaging there are some big companies producing this kind of packaging and the recycling system is Austria is quite far developed starting from the collection system over the technical processes to use these secondary raw materials. The latest developments regarding deposit of packaging, i.e. glass, is an important measure towards reuse in the packaging sector.