SMART CIRCUIT

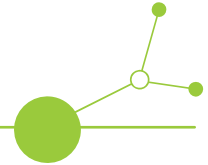# Policy-Interview Series on Impressions & Considerations of Circular Industry Futures

D2.2.2. – A report for A2.2

Version 1

03 2024

Document Summary	
Project Number	CE0100007
Project Title	SMART CIRCUIT
Work Package	WP2 LEVERAGE! Policy Learning & Strategic Engagement to Reduce Implement. Barriers & Promote Investment
Activity	A2.2 BUILD! Establish Policy Maker Outreach, STRATLAB Concept & Complete Strategy Benchmarking to Establish Transnational Opportunities
Deliverable	D2.2.2 Policy Interview Series on Impressions & Considerations of Circular Industry Futures
Deliverable Responsible (if applicable)	PP7/COMET
Deliverable Reviewer (if applicable)	PP10/TUKE
Deliverable Due Date	31.03.2024

Dissemination Level		
PU	Public	
PP	Restricted to other programme participants	
RE	Restricted to a group specified by the consortium	
CO	Confidential, only for members of the consortium	CO

Document History							
Version	Type	Status (explanation, internal re status internal or public)	Definition (explanation, internal)	Author(s), PP name	Revised by Partners	Date	Deadline description
0.1	Draft version 1	Internal	Draft Report	COMET	TUKE	22.03.2024	Strong first version of full deliverable
0.2	Draft version 2	Internal	Draft Report Ready for Review by All Project Partners	COMET	All PPs	27.03.2024	Integrated comments.
Final	Final Version	Internal	Final Version	COMET	All PPs	31.03.2024	Final version

A. Executive Summary

1. Project Overview

SMART CIRCUIT's objective is to champion DIH network & actor's role to fast-track the uptake of digital/tech driven Circular Economy to enable a resource-efficient & competitive transition in CE manufacturing.

Project Partners (PPs) foster 3 transnational solution systems (WP1: the Circular Innovation Academy (CIA), WP2: the Circular Industry Strategy Lab (STRATLAB), WP3: the Circular Industry Factory (FACTORY)) to bring multi-stakeholder (Enterprise/Policy/RTO/BSO, etc.) benefits & deliver a transnational approach at the intersect of digital/RIS3/circular economy strategies. PPs build capacities, reduce barriers, leverage finance & promote closing-the-loop through the identification, dissemination and implementation of key circular economy knowledge and principles within 3 key value chains (Electronics/ICT, Textile, Construction) and a combined cross-value chain (emphasizing regional specificities).

Associated to A2.2, the Circular Industry Futures Strategy Lab (STRATLAB) is linked to O2.1 (Pilot) & O2.2 (Solution) & vertically embedded in the project plan via A2.2, A2.3 & A2.4 (& evaluated in A2.5). The STRATLAB is a solution aimed at bridging a key strategic gap between policies/strategies addressing circular economy & digital industry (EU Industrial Strat & Digital Decade, the Green Deal + EU CEAP + connected work programs in HE, DEP). STRATLAB is a transparent forum of responsible stakeholders who address/implement these policies & promotes a method for reducing barriers & leveraging opportunities at the intersect of these policies (e.g. through optimised use of policy instruments & collective accountability in private & public partnership cooperation). The scaled Solution is a connected set of regional (w/ transnational impulses) multi-stakeholder forums to generate synergies in circular economy policy/regulation adoption to research & innovation smart specialisation strategies.

2. Scope of Document & Summary

The scope of the current report, deliverable 2.2.2 (D2.2.2) encompasses:

- Conducting and analyzing Interviews: Gathering insights from 36 policy makers across various regions and levels of governance to understand their views and experiences related to Circular Economy policies and practices.

- Transnational Panel Discussion: Synthesizing discussions from a panel involving a wide range of policy-makers to capture diverse perspectives on Circular Economy challenges and opportunities.

- Value Chain Analysis: Detailed examination of the Textile, Construction, and ICT/Electronics manufacturing sectors to identify specific needs, challenges, and opportunities for integrating Circular Economy principles.

- Strategic Considerations and Policy Recommendations: Developing strategic considerations for leveraging technology and digital solutions to promote Circular Economy practices in the industry. This includes proposing actionable policy options for the future.

D2.2.2 presents a comprehensive analysis of the Circular Economy landscape as it pertains to key manufacturing value chains, including Textile, Construction, and ICT/Electronics. Through a series of structured interviews carried out by the partner with 36 policy makers (3/PP) and a transnational panel

involving stakeholders from local to national levels, the report captures a multifaceted view of the current state, challenges, and opportunities within these industries for embracing Circular Economy principles.

Our findings highlight the critical role of digital and technological innovations in driving the transition towards more sustainable and circular manufacturing processes. The insights from policy makers underline the need for robust, forward-thinking policies that not only address current barriers but also capitalize on emerging opportunities to foster sustainability and economic growth.

The report identifies specific challenges within each value chain, such as resource efficiency, waste management, and the integration of circular practices in existing systems. It also showcases promising opportunities for innovation, including the use of digital tools for supply chain transparency, the development of sustainable materials, and the implementation of circular business models.

Based on these insights, the report outlines strategic considerations for industry stakeholders and policymakers to enhance the adoption of Circular Economy practices. It advocates for a collaborative approach, emphasizing the importance of aligning policies with technological advancements to create a conducive environment for sustainable transformation.

In conclusion, D2.2.2 offers a strategic framework for leveraging digital and technological solutions to accelerate the transition to a Circular Economy. It provides actionable policy recommendations to support this transformation, ensuring economic resilience, environmental sustainability, and societal well-being in the face of global challenges.

3. Audience

This document is directed at all project partnership members, because all members of the partnership should participate in WP2 ideation and implementation, more specifically A2.2 through this report. It should be considered an internal document, and the appropriate status should be reflected in the "Dissemination Level" table.

4. Change Control Procedure & Structure

PP7/COMET created this report, and it is under standard project change control, whereby PPs are requested to give feedback on the stated definition or tools in writing to the deliverable responsible (here COMET/PP7) in a timely manner (within 8 working days according to the Rules of Procedure). As per normal procedure, at any time partners believe a project methodology should change, the request should be brought to the work package or work stream leader and Lead Partner (in this case KPT/LP, Project Management Lead and TUKE/PP10, the STRATLAB WP2 Leader) to consolidate feedback from other partners, and integrate and disseminate the final agreed changes. A new version of the document should be created, and recorded in the document's "Document History" table.

Content

B. Introduction

This report builds upon D2.2.1 (guidance document) to provide a detailed analysis of policy makers interviews conducted by the project partners (PPs) and establish, together with 2.2.3, the groundwork for the development of D.2.3.1 – 1 planning guidance to deliver 12 regional labs (& 1 joint trans. Lab), focused dialogue on how to support digital & technology-driven circular economy in CE manufacturing via success stories & instrument exchange from enterprises within & policy makers outside the territory, that will pave the way to the establishment of the STRATLAB (A2.3).

1. Background and the Project overview

SMART CIRCUIT's objective is to champion DIH network & actor's role to fast-track the uptake of digital/tech driven CircEc to enable a resource-efficient & competitive transition in CE manufacturing.

The project is structured as follows:

➢ WP1 CAPACITIES! Creates enhanced, circular capacities across central Europe digital innovation hub (DIH) eco-systems, to better implement policies and promote an uptake of circularity in Industry through the establishment, validation & expansion of the CIA Solution.

➢ WP2 LEVERAGE! develops, tests & expands a permanent transnational policy/strategy solution in the Strategy Lab (STRATLAB), to reduce implementation barriers and help diverse TGs leverage access (processes and finance) to innovative circular solutions and services.

➢ WP3 UPGRADE! design, pilot and roll-out service-solutions (1 system, 4 DIH Solution Portfolios) to the CE Manufacturing Eco-System, to create shared value and permanently upgrade CE production value-chains with digital/tech driven circular economy services and support.

The STRATLAB aims to create multi-directional dialogue between DIHs, manufacturing enterprises and policy makers in the aim to reduce implementation barriers & leverage opportunities for public & private investment to advance circular uptake in industry. The STRATLAB promotes an exchange of information to broker mutual understanding & collective approaches to reduce implementation barriers & leverage investment in circular solutions.

The purpose of the STRATLAB is to:

1. A2.2 BUILD! sets a capacity baseline and engagement pool with 36 policy makers (3/PP) from CE local, regional and national CE manufacturing value-chains. This pool is interviewed on challenges, needs and perceptions regarding circular economy and policy options (D2.2.2).

2. A2.3 TEST! puts A2.2 into action by bridging together triple-helix stakeholders together via DIH-ecosystem into 12 regional strategy-learning labs (SSLs) and 1 transnational lab connecting and showing CE policy makers success stories from other territories.

3. A2.4 EXPAND! uses and further expands lessons and tangible outcomes of the pilot (2.3) to a permanent regional multidirectional platform, a dialogue open space where to bridge Circular to RIS3 strategies and promote optimal integration of EU industrial and digital strategies and CEAP, EU Circular Economy Action Plan, into regional ecosystem.
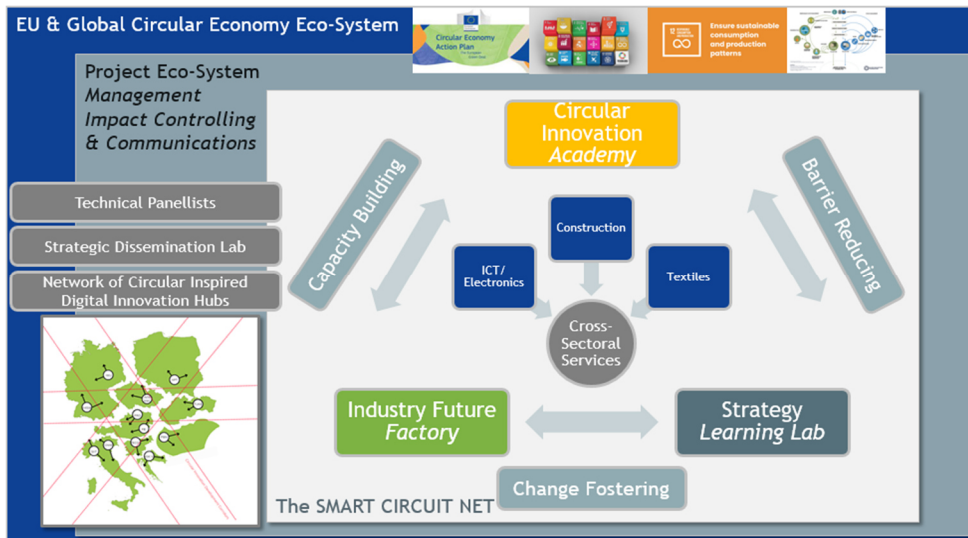
Figure 1 | SMART CIRCUIT Eco-System Overview (source: Project Generated, 2023)

WP2 is led by PP10/TUKE and aims to build, test, implement and expand a permanent transnational policy/strategy solution in the Strategy Lab (STRATLAB), to reduce implementation barriers & help diverse TGs leverage access (processes & finance) to innovative circular solutions & services. A2.2, sets a capacity baseline & engagement pool with 36 policy makers (3/PP) from the CE covering 3 different levels Local (e.g. municipality or a city), Regional (e.g. regional institution) and National (e.g. national ministries or funding institutions). This pool is interviewed (baseline audit) on challenges, needs & future policy options regarding circular economy (D2.2.2). WP2 impact translates directly in the communication Work Stream A2.2: 36 videos (policy makers interviews), and will be collected by PP9/PBN within one synopsis summary.

WP2 activities directly linked to two key project result:

1. Circular Industry Futures Strategy Lab (STRATLAB, Result 3) is linked to OT2.1 (Pilot) & OT2.2 (Solution) & vertically embedded in the project plan via AT2.2, AT2.3 & AT2.4 (& evaluated in AT2.5). The STRATLAB is a solution aimed at bridging a key strategic gap between policies/strategies addressing circular economy & digital industry (EU Industrial Strat & Digital Decade, the Green Deal + EU CEAP + connected work programs in HE, DEP). STRATLAB is a transparent forum of responsible stakeholders who address/implement these policies & promotes a method for reducing barriers & leveraging opportunities at the intersect of these policies (e.g. through optimised use of policy instruments & collective accountability in private & public partnership cooperation). The scaled Solution is a connected set of regional (w/ transnational impulses) multi-stakeholder forums to generate synergies in circular economy policy/regulation adoption to research & innovation smart specialisation strategies.

2. Central Europe Circular Industry Futures 2030 Strategy & Action Plan (Result 5), which is linked to OT2.3 & OT1.1, & vertically & horizontally integrated in the work plan in AT2.2, AT2.3, AT2.4 & AT1.1 (&evaluated in AT2.5, with the STRATLAB). This lasting, joint strategy provides the blueprint for policy/industry engagement & permanent brokerage via the transnational DIH-ecosystem. It provides both regional & transnational plans to foster collaboration & use project results to set thematic & instrument recommendations for future-oriented growth & creation of shared value (CSV) in CE's manufacturing eco-system. It fosters the strategy to deliver: ongoing capacity building efforts, barrier reduction & investment leverage & close-the-loop services for key production value chains critical to CE's achievement of key climate & resource-use targets.

It builds strategic connections to regional RIS3 + demonstrates sustainability through practical steps (rooted capitalised initiatives, incl. AT3.4 Flagships).

The Figure below provides insights on the STRATLAB design and implementation.
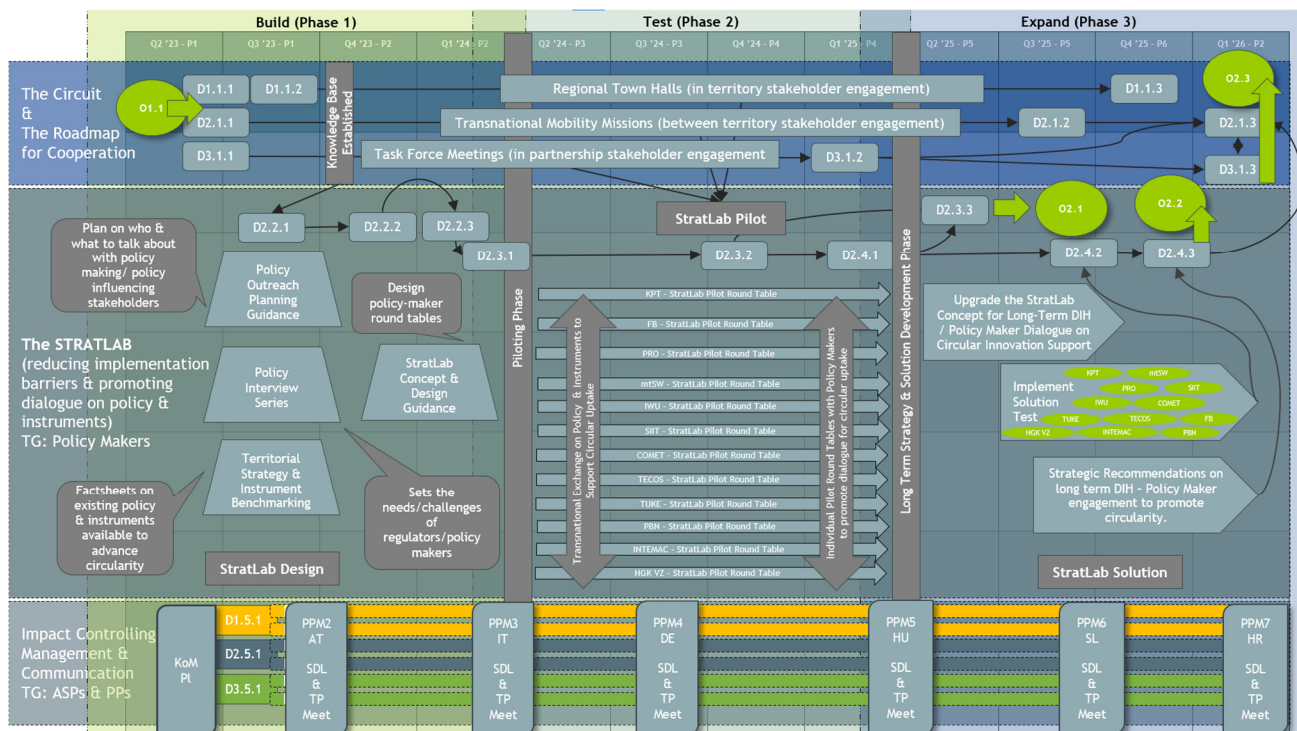
Figure 2 | Plan-on-a-Page for STRATLAB (source: Project Generated, 2023)

WP2 outputs are the following ones:

- The Strategy Learning Lab (STRATLAB) "Exchange & Leverage" Pilot, 1 Transnational System (12 Units) Implemented to Help Policy Makers understand Circular Industry Opportunities & hear TG needs.

- The Circular Industry Futures Strategy Lab (STRATLAB) Solution: Policy-Industry Brokerage for Long-Term Engagement on Bridging Territory & Strategy Gaps.

- CENTRAL EUROPE CIRCULAR INDUSTRY FUTURES 2030: Transnational Strategic Roadmap & Action Plans for Sustainable Roll-out of Service Solutions & DIH Brokerage.

2. Contribution from Activity Description and Cross-project Knowledge

Activity **2.2 BUILD! Establish Policy Maker Outreach, STRATLAB Concept & Complete Strategy Benchmarking to Establish Transnational Opportunities** aims to create multidirectional dialogue between DIHs + manufacturing enterprises + policy makers, to reduce implementation barriers & leverage opportunities for public & private investment to advance circular uptake in industry. In AT2.2, The STRATLAB focuses on starting policy-maker outreach (DT1.3.2) & territorial strategy & instrument benchmarking (DT1.3.3). 36 Interviews (3/PP) with local, regional, national policy-stakeholders build understanding about regulatory/legislative roll-out challenges & promotes exchange & spotlight on different territorial considerations for support instruments for circular industry futures.

3. Contribution from Deliverable Description

D2.2.1 Policy Maker Outreach & Strategy Benchmarking Planning Matrix & Guidance Paper

A planning guidance providing implementation steps to engage policy-makers in interview series (including. interview guide – 3/PP-36 total), transnational panel (KoM) and establish the processes for territory (national/regional) strategy benchmarking/instrument (policy/finance) analysis to promote uptake of circularity.

D2.2.2 Policy-Interview Series on Impressions & Considerations of Circular Industry Futures

1 report summarizing the results of the policy maker interviews (3/PP, 36 total), the transnational panel (KoM) involving local, regional and national Policy-makers, and analysing the needs & challenges of key manufacturing Value Chains (specific focus on Textile, Construction, ICT/Electronics). The outcome of this deliverable should be ideas of strategic considerations about Circular Economy opportunities in industry (digitally & tech. driven) and future policy options.

D2.2.3 Territorial Strategy & Instrument Benchmarking Fact Sheets on Circular Industry Futures

1 report, containing 9 national, and 12 regional strategy and instrument factsheets on the circular digital technology divide in territory (current status & future outlook) as well as an analysis of transnational strategic options for key Central Europe value-chains (such as Textile, Construction, ICT/Electronics) These Factsheets should then be used by the Task Forces (D3.1.2)

C. Regulatory Framework

Prior to delving into the analysis of the interviews conducted by the project partners (PPs), and exploring impressions, considerations, challenges and opportunities Policy Makers identified, we will outline the European regulatory framework to introduce the topic of how the digital-enabled circular economy is regulated by the EU legislator. In the impossibility of going into depth on all the regulations and directives, the more so adopted at the national or regional level, the following short analysis will provide readers with the reference legislative and regulatory framework within which both policymakers and manufacturing companies currently operate.

1. EU legislative framework in a nutshell

1.1. European Green Deal

In the eyes of the European Union, the circular economy is a crucial component of a climate-neutral future. Climate change and environmental degradation are an existential threat to Europe and the world. To overcome these challenges, the **European Green Deal**, a set of policy initiatives by the European Commission with the overarching aim of making Europe climate neutral by 2050.

The European Green Deal was introduced on December 11, 2019 by the European Commission against the backdrop of increasing environmental challenges, such as climate change, biodiversity loss, and pollution. It was designed as a roadmap to transform the EU into a modern, resource-efficient, and competitive economy. The deal is backed by significant financial backing, including a Just Transition Mechanism to mobilize at least €100 billion over the period 2021-2027 in the most affected regions. The main objectives of the deal are to reduce greenhouse gas emissions, decouple economic growth from resource use, stop the loss of biodiversity, and cut pollution. It aims to transform the EU into the world's first climate-neutral continent by 2050 while boosting the economy, improving health and quality of life, caring for nature, and leaving no one behind.

Significance for Manufacturing Companies: The Green Deal represents a significant shift towards sustainable practices for manufacturing companies. It will drive innovation in sustainable technologies, enforce stricter emissions standards, and push companies towards a circular economy model where the value of products and materials is maintained for as long as possible. Companies will need to adapt their business models, reduce their carbon footprint and contribute to the overall goal of climate neutrality.

Significance for Policy Makers: For policy makers, the Green Deal sets the agenda for legislation and regulations that will shape the future of the European economy. It requires a collaborative approach between the EU, national governments, industry and other stakeholders to create frameworks that enable the transition to a sustainable economy. Policy makers will play a critical role in guiding this transition, supporting innovation, and ensuring social fairness throughout the transformative process.

The European Green Deal is not only a set of policies but a growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient, and competitive economy where there are no net emissions of greenhouse gases by 2050 and where economic growth is decoupled from resource use. The Green Deal includes measures ranging from ambitiously cutting emissions, investing in cutting-edge research and innovation and preserving Europe's natural environment, to ensuring a just and inclusive transition for all. It includes specific strategies for biodiversity, from 'Farm to Fork', sustainable agriculture, clean energy and, of course, **circular economy** as we will see in the following chapter.

For further info: link (European Commission)

1.2. Circular Economy Action Plan (CEAP)

One of the main building blocks of the European Green Deal, is indeed the **Circular Economy Action Plan (CEAP)**. The EU's transition to a circular economy will reduce pressure on natural resources and will create sustainable growth and jobs and it is considered as a prerequisite to achieve the EU's 2050 climate neutrality target and to halt biodiversity loss.

As a major component of the European Green Deal, focusing on the sustainable use of resources and circularity principles across the economy, the CEAP was adopted on March 11, 2020 as a response to global challenges such as resource depletion, waste, and environmental degradation: a comprehensive program aiming to transition the EU's economy into a fully circular model, thus ensuring a sustainable future. The CEAP aims to reduce the EU's consumption footprint and double the EU's circular material use rate in the coming decade, while boosting economic growth. Its key objectives include making sustainable products the norm in the EU, empowering consumers and public buyers, focusing on sector-specific actions (including key product VCs such as **ICT and electronics**, batteries and vehicles, packaging, plastics, **Textiles, Construction and buildings**), ensuring less waste, and making circularity work for people, regions, and cities.

The CEAP introduces legislative and non-legislative measures across the entire life cycle of products. It includes stricter regulations on waste, sustainable production, and initiatives to encourage innovation in circular design. The plan also encompasses measures to improve the durability, reparability, and recyclability of products, as well as to curb planned obsolescence and tackle the presence of hazardous chemicals in products. While the CEAP itself does not have a dedicated budget, it is supported by the broader EU budget and initiatives such as the European Structural and Investment Funds and Horizon Europe.

Significance for Manufacturing Companies: For manufacturing companies, the CEAP brings a shift towards sustainability and efficiency. It means designing products for durability and recycling, adapting to new regulations, and potentially accessing new markets for circular products and services. Companies will need to embrace sustainable practices, not just for regulatory compliance, but to meet growing consumer demand for sustainable products.

Significance for Policy Makers: Policy makers are tasked with the implementation of the CEAP through the creation of supportive legislation, policies, and incentives that foster a circular economy. They have to engage with stakeholders across the value chain to ensure that the transition to circularity is both effective and inclusive. Policymakers will also need to monitor progress and adapt policies as needed to meet the CEAP's ambitious targets.

Ultimately, we can say that the CEAP serves as a roadmap for achieving the EU's sustainable product policy goals within the broader context of the European Green Deal, by setting ambitious measures to improve the entire lifecycle of products used in the EU to benefit both the environment and the economy, and calls for a systemic change to enable a transition to a circular economy.

For further info: link (European Commission)

1.3. European Industrial Agenda

The **European Industrial Agenda** is a broad initiative by the European Commission aimed at driving the competitiveness and sustainability of European industries, as part of the broader "Europe fit for the Digital Age" priority. The strategy has been designed to help the EU's industries lead the twin transitions towards green and digital technologies. The European industrial strategy (or 2020 Industrial Strategy) is indeed instrumental in achieving the EU's ambition of establishing a globally competitive, green, and

digital economy and it reinforces the EU's commitment to leading by example in tackling climate change and digitalizing.

The strategy was presented alongside the European Commission's new Industrial Strategy package, whose objectives include bolstering the competitiveness of European industry, reducing its environmental footprint, and enabling its transformation to a digital economy, emphasising strategic autonomy, aiming to ensure that Europe can rely on its own resources and capabilities to lead in the **green and digital transitions** and in the face of global uncertainties.

The strategy leverages a range of EU funding sources, including the Multiannual Financial Framework (MFF), Next Generation EU, Horizon Europe and the Digital Europe Programme. While it does not have a singular dedicated budget, it thus benefits from various investment plans and funds aimed at supporting its implementation and, ultimately, its objectives.

The Industrial Agenda introduces an array of actions, such as updating the regulatory framework to stimulate innovation, enhancing market surveillance, reducing bureaucratic burdens, and investing in skills. It also focuses on critical sectors and industrial ecosystems ensuring a level playing field, and setting clear conditions for businesses to thrive. Among the ecosystems included those of **Electronics, Textiles, Construction and buildings**.

Significance for Manufacturing Companies: For manufacturing companies, this strategy means adapting to a greener and more digital-oriented business environment, upskilling their workforce, and embracing innovative technologies. It presents opportunities in terms of access to new markets, modernization, and participating in a more resilient and sustainable industrial ecosystem. 2020 Industrial Strategy is a comprehensive plan to ensure that European industry can drive the dual transitions, maintain its global leadership, and support the EU's overarching goal of creating a future-ready economy, including a list of actions to support the green and digital transitions of EU industry, many of which have already been adopted or launched.

Significance for Policy Makers: Policy makers need to facilitate the strategy's implementation through effective policy measures, creating an enabling environment for businesses to innovate and compete. They are required to balance market dynamics with strategic imperatives, such as environmental sustainability and technological sovereignty, and to address the social impacts of industrial transformation.

It is worth mentioning that, to accelerate the twin transitions, the Commission suggests to pursue actions very aligned with SMART CIRCUIT scope, such as the so-called **"transition pathways", co-created** jointly with industry policy makers and relevant stakeholders to identify the actions needed to achieve the twin transitions, giving a better understanding of the scale, benefits and conditions required.

For further info: link (European Commission)

1.4. EU Digital Strategy (EU4DIGITAL)

Finally, the European Digital Strategy, often referred to as **"EU4DIGITAL"** is the European Commission's initiative aimed at fostering digital transformation across the European Union. The strategy was developed in response to the rapidly evolving digital landscape and the need for a coordinated EU approach to digitalization. It aims to ensure that Europe can benefit from digital technologies in a way that is consistent with European values, including respect for individual rights and promoting economic growth.

Presented by the European Commission on February 19, 2020, as part of its strategies to shape Europe's digital future, EU4DIGITAL strategy main objectives include ensuring that the digital single market benefits all EU citizens, making Europe a global leader in the digital economy and developing digital

solutions that can lead to sustainable economic, focusing on critical areas such as high-performance computing, AI, cybersecurity, and advanced digital skills.

While primarily focused on digitalization across the European Union, EU4DIGITAL intersects significantly with the principles of circularity, particularly in fostering sustainable digital transformation. The strategy emphasizes the role of digital technologies in enabling a more sustainable, efficient, and competitive economy.

1. Digital Technologies as Enablers of Circularity: Digital tools and platforms are fundamental in implementing circular economy models. Technologies such as the Internet of Things (IoT), artificial intelligence (AI), big data analytics, and blockchain can optimize resource use, enhance product lifecycle management, and improve waste tracking and recycling processes. The European Digital Strategy aims to accelerate the deployment of these technologies, thereby facilitating the transition to a circular economy.

2. Data for Circular Economy: A key aspect of the European Digital Strategy is its focus on data and data spaces, including the creation of a common European data space. Such initiatives can be instrumental in circular economy efforts, as they allow for better tracking of materials, products, and resources, facilitating the sharing of information among stakeholders in the value chain. This can enhance product design, maintenance, reuse, and recycling.

3. Sustainable and Secure Digital Infrastructure: The strategy also emphasizes the importance of a green and digital transformation, aiming to build a sustainable and secure digital infrastructure. This involves not only reducing the carbon footprint of the digital sector but also leveraging digital solutions to improve energy efficiency across all sectors of the economy, in line with circular economy goals.

4. Digital Skills for Circular Economy: Upskilling and reskilling the European workforce to harness digital technologies is a priority of the strategy. This focus on digital skills is equally critical for the circular economy, as employees need to understand and be able to apply digital solutions to drive circular practices within their organizations.

While the European Digital Strategy itself does not set specific circular economy regulations, **it creates a conducive environment for digital innovation that can support circular economy** policies and initiatives, such as the previously described Circular Economy Action Plan (CEAP). In essence, the European Digital Strategy, by advancing the digital transformation of the European economy, indirectly supports circularity by enabling the development and deployment of digital technologies that are critical to circular economy practices.

While specific figures for the entire strategy are not easily delineated, the Digital Europe Programme, which is part of the broader strategy, has a proposed budget of €9.2 billion for the 2021-2027 period. This budget is allocated across various sectors and initiatives to support the digital transformation.

Significance for Manufacturing Companies: For manufacturing companies, the European Digital Strategy offers opportunities to innovate and improve efficiency through digital technologies. It encourages the adoption of AI, IoT, and other digital tools to optimize production processes, reduce costs, and develop new products and services. The focus on cybersecurity and data management also means that companies need to prioritize the security of their digital operations.

Significance for Policy Makers: Policy makers play a crucial role in implementing the European Digital Strategy by developing and enforcing regulations that support digital innovation while protecting consumers and ensuring fair competition. They must also address the digital divide by ensuring that digitalization benefits all regions and sectors of the economy. The strategy calls for collaboration between EU institutions, member states, and industry stakeholders to achieve its goals.

For further info: link (European Commission)

2. EU approach to legislating on Circular Economy

EU Member States adopt the European Union's legislative framework - which includes regulations, directives, and decisions - through national measures. Regulations are directly applicable and binding in all Member States without the need for national implementation. Directives, on the other hand, require Member States to achieve a certain result within a given timeframe, leaving them discretion as to form and methods through national legislation. The general adoption process above described is critical for ensuring that EU-wide policies are uniformly applied across all Member States. However, the journey towards the harmonization of EU law across diverse national legal systems is complex and comes with its set of criticalities. While the system aims for harmonization and the smooth functioning of the internal market, it faces critical challenges related to legal diversity, implementation delays, over-implementation, enforcement disparities, and interpretation differences.

Legal and Administrative Diversity: The EU comprises Member States with their unique legal systems, traditions, and administrative structures. Transposing EU directives into national law while respecting these differences is a complex process that can lead to variations in implementation and enforcement.

Timeliness and Delays: The transposition of directives within the deadline is a recurrent issue. Delays in transposition can lead to legal uncertainty and unequal conditions for individuals and businesses across the Union.

Over-implementation or "Gold-Plating": Some Member States might introduce additional requirements or standards when transposing directives, a practice known as "gold-plating." While intended to ensure higher levels of protection or efficiency, it can lead to a fragmentation of the internal market and create unnecessary burdens for businesses operating across borders.

Enforcement and Compliance: Ensuring that national laws effectively reflect the objectives of EU legislation and that these laws are adequately enforced is crucial. Differences in enforcement and compliance can undermine the harmonization efforts, affecting the single market's functioning.

Interpretation Differences: The European Court of Justice plays a pivotal role in interpreting EU law to ensure its uniform application across Member States. However, national courts' interpretation of EU-derived laws can vary, leading to divergences in legal outcomes across the Union.

The European Union's approach to legislating on circular economy issues primarily involves the use of directives, rather than regulations. This is because the circular economy encompasses a broad range of activities and sectors, from waste management to product design and resource use, which often require flexible implementation strategies that can be adapted to the diverse legal, economic, and environmental contexts of each Member State.

For example, key pieces of EU legislation related to the circular economy include, among the others:

- **Waste Framework Directive (2008/98/EC):** Sets the basic concepts and definitions related to waste management, including the waste hierarchy, and introduces the principles of extended producer responsibility and recycling targets. Member States are required to transpose its provisions into national law and update their waste management practices accordingly. With this regard, it is worth mentioning the recent initiative (July 5, 2023) of the Commission to propose rules to make producers responsible for the full lifecycle of textile products and to support the sustainable management of textile waste across the EU. This EC proposal for a targeted revision of the Waste Framework Directive will accelerate the development of the separate collection, sorting, reuse and recycling sector for textiles in the EU, in line with the EU Strategy for Sustainable and Circular Textiles. In particular, the Commission is proposing to introduce mandatory and harmonised Extended Producer Responsibility (EPR) schemes for textiles in all EU Member States.

- **Packaging and Packaging Waste Directive (94/62/EC):** Aims to harmonize national measures concerning the management of packaging and packaging waste to ensure the functioning of the internal market and protect the environment. It sets recovery and recycling targets for packaging waste that Member States need to achieve.
- **Landfill Directive (1999/31/EC), End-of-Life Vehicles Directive (2000/53/EC), Battery Directive (2006/66/EC), and WEEE Directive (2012/19/EU)** on waste electrical and electronic equipment are other examples where directives set out the objectives and targets for Member States to incorporate into their national legislation.

These directives do not apply automatically but require Member States to enact specific national laws that achieve the directive's objectives within a given timeframe. This approach allows for the customization of laws to fit national circumstances while striving to meet EU-wide goals.

The advantage of using directives in the context of the circular economy is that it provides flexibility for Member States to choose the most appropriate measures and methods to achieve the set objectives, taking into account their specific legal systems, economic structures, and environmental conditions.

However, this means that there is an inherent requirement for Member States to actively transpose these directives into their national legislation and to ensure that these laws are enforced effectively to meet the directives' objectives. The process of transposition can sometimes lead to variations in implementation across the EU, which the European Commission monitors closely to ensure that the overall goals of the circular economy are being met across all Member States.

3. National and Regional level

If at the EU legislative level, the framework on circularity and digital-driven circularity is defined by a series of directives, to have a detailed picture of the specific legislation for the Central Europe Programme Area, which includes the States represented by the SMART CIRCUIT consortium (i.e, Hungary, Italy, Germany, Slovakia, Czech Republic, Hungary, Austria, Slovenia, Croatia), it is necessary to examine the specific laws and policies of each country and territory, considering the EU directives adapted at national levels.

With this regard, a mapping and analysis exercise of the strategies and economic and policy tools/instruments of the individual territories represented by the SMART CIRCUIT partnership was carried out by the PPs within the framework of A2.2. This exercise will lead to a report titled "Territorial Strategy & Instrument Benchmarking Fact Sheets on Circular Industry Futures" (D.2.2.3) containing 9 national, and 12 regional strategy & instrument fact sheets on the circular/digital/technology divide (current status & future outlook).

At regional level, it is worth mentioning the pivotal role of the so-called "Smart Specialisation Strategies" with circular economy and digital-driven circularity.

Research and Innovation Strategies for Smart Specialisation (**RIS3**) are policy frameworks developed by European regions to identify and select a limited number of research and innovation priorities based on their unique strengths and potential for excellence. RIS3 aims to boost regional innovation in order to achieve economic growth and competitiveness by enabling regions to focus on their most promising areas of specialization, while also addressing societal challenges. This approach encourages regions to utilize their innovation budgets more effectively by concentrating on their competitive advantages and potential for knowledge-based development.

The principles of the circular economy can be seamlessly integrated into RIS3 strategies, leveraging regional strengths to address global challenges such as resource depletion, waste management, and sustainable economic growth. The circular economy's focus on reducing waste, extending product

lifecycles, and regenerating natural systems presents an opportunity for regions to innovate and specialize in new technologies, processes, and business models that support these goals. By aligning RIS3 with circular economy objectives, regions can foster the development of industries and clusters that are resilient, resource-efficient, and environmentally sustainable. This includes promoting sectors such as recycling, renewable energy, sustainable construction or eco-design, as well as encouraging innovation in business models that facilitate product-as-a-service, sharing economy, and supply chain transparency.

Identify and Support Circular Economy Niches: Policy makers should conduct thorough analyses to identify regional strengths and opportunities related to circular economy practices. This includes evaluating existing industrial sectors, technological capabilities, and research institutions that can contribute to circular initiatives.

Facilitate Cross-sectoral Collaboration: Encouraging collaboration between different sectors and stakeholders (e.g., businesses, academia, government, and civil society) is crucial for fostering innovation in circular economy practices. This can lead to the development of integrated solutions that address complex challenges such as waste management, resource efficiency, and sustainable production.

Invest in Circular Economy Skills and Education: Developing a skilled workforce that understands circular economy principles is essential. Policy makers should support education and training programs that equip workers with the knowledge and skills needed to implement circular practices in industries ranging from manufacturing to digital services.

Promote Circular Economy through Public Procurement: Governments can lead by example by incorporating circular criteria into public procurement policies. This can drive demand for circular products and services, stimulating market development and encouraging businesses to innovate.

Provide Incentives for Circular Economy Innovation: Financial incentives, such as grants, tax breaks, and investment in circular economy startups, can stimulate research and development in sustainable practices. Policy makers should also consider supporting demonstration projects that showcase the feasibility and benefits of circular solutions.

Develop a Supportive Regulatory Framework: A regulatory environment that encourages resource efficiency, waste reduction, and recycling is crucial for the circular economy. Policy makers should review existing regulations to identify barriers to circular practices and explore new policies that facilitate the transition to a circular economy.

Integrating circular economy principles into RIS3, thus, offers a strategic opportunity for regions to enhance their innovation capacity, address environmental challenges, and achieve sustainable economic growth. By focusing on their unique strengths and fostering collaboration across sectors, regions can develop specialized industries that contribute to a more circular and resilient economy. Policy makers play a crucial role in enabling this transition through targeted support, investment, and regulation.

4. Scenarios: challenges and opportunities

The legislative framework analysis highlights that digitization offers significant opportunities for the transition to a more sustainable circular economy. However, it is essential to guide this process in the right direction to fully realize its potential.

The convergence between the **circular economy and Industry 4.0** offers particularly promising synergies. For example, I4.0 can integrate all key functions of production processes and share data, information, and knowledge throughout the supply chain. This interconnection not only automates crucial operational activities but also allows the production and access to real-time information, thus improving visibility and risk mitigation in the supply chain network. Clean production and corporate

social responsibility are significant implications for I4.0 developments worldwide. I4.0's ability to use historical data to improve product quality by adjusting performance limits in production systems offers significant advantages, as does the improvement of information sharing across the value chain, enabling real-time control and adjustment of operations according to variable demand, thus increasing operational efficiency and providing information on the potential of new products, services, and business models.

Furthermore, the new **Industry 5.0** paradigm represents an evolution beyond the fourth industrial revolution, which was characterized by the integration of digital technologies into manufacturing processes. While Industry 4.0 focuses on technology, automation, and efficiency, Industry 5.0 introduces a more holistic approach that emphasizes the integration of human creativity and craftsmanship with smart technologies. It aims to bring a strong emphasis on sustainability, personalized production, and the well-being of workers, alongside technological advancements. The concept of Industry 5.0 emerged from the recognition that while technological advancements are crucial for economic growth and productivity, the human aspect of manufacturing and the impact on society and the environment cannot be overlooked. It is a response to the challenges and limitations observed in Industry 4.0, especially regarding sustainability, resource depletion, and the disconnection between technology and human values.

4.1 Industry 5.0 entailment in Circular Economy

The European Commission has been a proponent of the Industry 5.0 paradigm and has recognized the importance of transitioning towards a more sustainable, human-centric and resilient industrial model. Its approach to Industry 5.0 is embedded within broader strategies and communications, including the New Industrial Strategy for Europe, the European Green Deal, and various initiatives related to digitalization and sustainability.

When it comes to the circular economy, Industry 5.0 plays a significant role by leveraging advanced technologies and digital solutions to enable more sustainable manufacturing processes and products. Below there is a (not exhaustive) list of how Industry 5.0 intertwines with circular economy principles:

Enhanced Recycling Processes: Advanced sorting, processing, and recycling technologies driven by AI and robotics can significantly improve the efficiency and effectiveness of recycling, reducing waste and enabling the reintegration of materials into the production cycle.

Product Lifecycle Extension: Through smart design and manufacturing techniques, products can be made more durable, repairable, and upgradable, extending their lifecycle and reducing waste.

Resource Efficiency: Industry 5.0 technologies can optimize the use of resources, including materials, energy, and water, throughout the production process. Digital twin technologies, for example, allow for the simulation and optimization of manufacturing systems to minimize resource use.

Personalized Production: By combining human creativity with digital manufacturing techniques such as 3D printing, Industry 5.0 enables the production of customized products on demand, reducing overproduction and waste.

Supply Chain Transparency: Blockchain and IoT technologies can provide greater transparency and traceability throughout the supply chain, ensuring responsible sourcing of materials and promoting sustainability standards.

Collaborative Consumption and Production: Industry 5.0 facilitates new business models such as product-as-a-service, which promotes the use of products without the necessity of ownership, encouraging a shift towards a sharing economy and reducing material consumption.

4.2 Digital Roadmap to Circular Economy

The European Policy Centre (EPC) is an independent, not-for-profit think tank dedicated to fostering European integration through analysis and debate. Established in Brussels, it aims to provide a platform for discussion on European Union (EU) policies and to offer insights and policy solutions to improve EU decision-making. The EPC covers a wide range of EU policy areas, including digital transformation, energy and climate change and circular economy.

On 2020, the European Policy Center's Task Force "**Digital Roadmap to Circular Economy**" has examined the interconnections between digitization and circular economy, exploring the opportunities created by data-enabled solutions and the challenges associated with harnessing their full potential for the transition to a circular economy.

One of the main obstacles to building a circular economy is the **lack of information transfer** across supply chains. Without any or inadequate access to data about the origin, make-up and design of products, it is impossible for producers, consumers and recyclers to adopt more circular, sustainable practices. Aligning the ongoing green transition and digital transformation carries the potential to overcome this barrier.

The EU's policies for enhancing information transfer across value chains is evolving quickly, as are new technologies. Today, online platforms, databases, apps, sensors, connected machines, QR codes, radio-frequency identification (RFID) and blockchain already make it easier to share data about a product's origin, design, repairability and future life cycle. Digital product passports (DPPs) show much promise. It is in Europe's interest to build on the related business cases and opportunities now and create a policy and financial framework that enables the use of these and new digital tools for the benefit of establishing a more circular economy.

To do so, the EPC's Task Force suggested EU policies to take the following actions:

- Establish a digital information system for a circular economy by 2030, enabling the exchange of information necessary to better design, reuse, repair and recycle products. It should lead the way towards building a global digital information system by 2040.
- Develop a common European data space(s) together with industry, member states, civil society and other relevant stakeholders. The common data space should build on all relevant existing datasets and needs to be customised for different value chains: electronics, the automotive sector, textiles, plastic packaging and chemicals.
- Establish rules on using digital product passports that build on the EU's current efforts to develop common European space(s) and further specify which data should be made available via DPPs, for which product categories and how.
- Use its economic and financial tools to enhance digital information transfer in circular value chains. The Multiannual Financial Framework and Recovery and Resilience Facility should be used to invest in developing the necessary digital tools (e.g. blockchain, IoT), infrastructure and skills. The EU should consider how its sustainable finance agenda can help direct private investments towards digital information transfer for CE.
- Lead global efforts to use digital tools in support of information transfer for the circular economy. This entails collaborating with international partners in developing necessary rules and standards while considering minimum CE-related transparency requirements for products entering the EU single market.

For further info: link (ECP)

4.3 Barriers and enablers to the transition

The transition to a circular economy presents a paradigm shift in how we view and manage resources, production, and consumption. It requires systemic changes across various sectors and levels of governance. By redefining growth and focusing on positive society-wide benefits, it aims to decouple economic activity from the consumption of finite resources, and design waste out of the system. However, despite its potential, the shift from a traditional linear economy to a circular one is not without its challenges.

These obstacles range from economic and financial constraints to cultural and technological barriers, each playing a significant role in shaping the pace and effectiveness of the transition. Understanding these barriers, as well as the enablers that can facilitate this shift, is crucial for policymakers, businesses, and stakeholders involved in the SMART CIRCUIT project.

Below some of the **primary hurdles** that need to be overcome to realize a fully circular economy are listed: they have to be considered areas where targeted **interventions and policy innovations** can make a substantial difference.

Barriers to Circular Economy Transition	
Economic and Financial Constraints	The initial cost of transitioning to circular practices can be high. Lack of financial incentives, such as subsidies for sustainable practices or penalties for wasteful ones, can hinder businesses and consumers from adopting circular models.
Regulatory and Policy Fragmentation	Inconsistent regulations and policies across regions and countries can create obstacles for businesses trying to implement circular economy practices, especially in a globalized market.
Technological Challenges	While technology plays a crucial role in enabling the circular economy, the lack of access to, or the high cost of, advanced technologies can be a barrier, particularly for small and medium-sized enterprises (SMEs).
Cultural and Behavioural Resistance	Changing the linear "take-make-dispose" mindset to one that values reuse, repair, and recycling requires significant cultural and behavioural shifts among consumers and producers.
Supply Chain and Logistics Complexities	Transitioning to a circular economy involves redesigning supply chains to enable the return, reuse, and recycling of products and materials, which can be logistically complex and costly.

Table 1 | Major barriers to CE Transition (source: Author Generated, 2024)

As we navigate through the complexities and challenges of transitioning to a circular economy, it is equally important to recognize and leverage the **enabling factors** that can drive this transformation forward.

These catalysts not only counterbalance the barriers but also pave the way for a smoother and more effective shift towards sustainability. The transition to a circular economy is not just about overcoming obstacles but also about harnessing the opportunities and strengths that encourage circular practices. From supportive policies to technological innovations and the growing public consciousness around sustainability, these enabling factors are foundational to achieving a circular economy. They represent the tools, motivations, and frameworks that can expedite the transition, making it not only possible but also profitable and desirable across various sectors. In the table below, we have synthesized the main enablers, as traditionally considered, highlighting how they contribute to the circular economy transition and why they are indispensable for the SMART CIRCUIT partners and their policymakers. The following exploration, thus aims to offer valuable insights into how these enabling factors can be optimized to facilitate the journey towards a more sustainable and circular future.

Enabling Factors for Circular Economy Transition	
Policy and Regulatory Support	Clear, coherent, and supportive policy frameworks are essential, including incentives for sustainable practices, regulations facilitating product standardization, and extended producer responsibility.
Technological Innovation	Advances in digital technology, such as IoT, AI, and blockchain, offer new opportunities for tracking, managing, and optimizing resource use, making circular economy practices more feasible and cost-effective.
Growing Sustainability Awareness	Increased public awareness and demand for sustainable products and practices drive businesses to adopt circular economy models, creating market opportunities for circular products and services.
Collaborative Networks and Platforms	Collaboration across industries, sectors, and borders can accelerate the sharing of best practices, innovative solutions, and technologies, fostering a more rapid transition to circular models.
Education and Skill Development:	Investing in education and training to equip the workforce with the necessary skills for circular economy jobs is crucial (e.g. eco-design, resource management, and digital skills).

Table 2 | Major enablers for CE Transition (source: Author Generated, 2024)

To sum up, the transition towards a digital-enabled circular economy is fraught with **challenges** but also filled with **opportunities**. To overcome barriers, a multifaceted approach involving policy support, technological innovation, financial incentives, education, and cultural change is required. In particular, The transition to a circular economic model in the manufacturing sector therefore requires an integrated approach that considers both legislative and operational challenges, and actively involves policymakers at all levels: local, regional, and national.

For the SMART CIRCUIT partners and policymakers, the following first recommendations could serve as a guide for future policy development:

1. **Implement Comprehensive Policy Frameworks**: Develop and harmonize policies that incentivize circular economy practices across all levels of government and sectors.
2. **Foster Innovation and Technology Adoption**: Support research and development in technologies that enable circular practices and reduce the financial barriers to their adoption.
3. **Promote Awareness and Cultural Change:** Launch campaigns to educate consumers and businesses about the benefits of the circular economy and how to participate in it.
4. **Strengthen Collaboration and Partnerships**: Encourage cross-sectoral and transnational collaboration to share knowledge, technologies, and practices that facilitate the circular economy transition.
5. **Invest in Education and Training**: Tailor education and training programs to meet the needs of a circular economy, focusing on sustainability, design for circularity, and digital skills.

By addressing these barriers and leveraging enablers, SMART CIRCUIT partners and their policymakers can accelerate the transition to a circular economy, ensuring sustainable growth and resilience for future generations.

D. Methodology and research limitations

1. Methodology applied

The methodology section provides an overview of the process that has been followed to collect and analyse data to generate D.2.2.2 "Policy-Interview Series on Impressions & Considerations of Circular Industry Futures". The methodology for generating D.2.2.2 encompasses a comprehensive approach to collecting and analysing qualitative data from a series of structured interviews with policy makers, supplemented by an in-depth analysis of discussions from a transnational panel held within the framework of the International Conference "Green transformation: from vision to action" (Krakow - April 27, 2023). The approach has been designed by D2.1.1. to capture a broad spectrum of insights and perspectives on the future of circular industry practices and the role of policy in facilitating this transition.

Survey design

The process began with the design of the survey that would have been addressed towards the policy makers. The survey was designed as the final output of D2.2.1 within the guidance document for Activity 2.1 under the lead of KPT/LP. The main aim of the survey was to identify the impressions of policy maker at local, regional and national level and to get from them strategic considerations about Circular Economy opportunities in industry, with particular reference to the three VCs addressed by SMART CIRCUIT.

Gathering the insights from the interview reports should enable the consortium to start envisioning the Circular Innovation Development Corridors and create synergies between territories, setting the ground-work for the strategy-(CENTRAL EUROPE CIRCULAR INDUSTRY FUTURES 2030) building initiatives and long-lasting cooperation to advance circularity through the use of DIHs. The Policy-Interview Series has indeed multiple objectives:

- Acknowledging different types of needs and challenges as they must address different level of intervention (local, regional, national).

- Engaging with Policy-makers to further on involve them in other activities (such as the Town Halls - see D1.1.1 for guidance and the Transnational Mobility Missions – see D2.1.1 for guidance).

- Creating links between different types of stakeholders and analysing the match or discordance of needs and challenges.

The survey consists of a set of mandatory questions (both open-ended and multiple choice questions) aimed at gaining insights across the following dimensions:

1. Administrative information
2. General knowledge towards digital-circularity
3. Challenges towards digital-driven circularity in the manufacturing industries
4. Strategy Development
5. Instruments and Measures
6. Stakeholder's Engagement
7. Their potential involvement within SMART CIRCUIT

The full survey can be found in the Appendix section.

The table below shows the planned timeline for conduction of interviews and responsibilities for the development of D2.2.2.

Task to achieve	Deadline	Responsibilities (RACI methodology)
Each partner identify and contact their 3 Policy-Maker and schedule the interviews	11.2023	R: COMET/PP7; A; All partners
Brief review of the interviews already run	12.2023	R: COMET/PP7; A; All partners
Each PP run the 3 interviews (+ fill-in the templates + upload on SharePoint)	02.2024	R: COMET/PP7; A; All partners
All templates are gathered and consolidated to deliver D2.2.2.	03.2024	R: COMET/PP7; A; All partners
D2.2.2 Draft version	03.2024	R: COMET/PP7; A: mstW (PP5)
D2.2.2 Final version	03.2024	R: COMET/PP7; A; All partners

Table 3 | Timeline for D2.2.2 (source: Project Generated, 2023)

Participant Selection and Interview Process

The data collection process was a collaborative effort among all partners. Each partner was tasked with conducting interviews with three policy makers operating in their own ecosystem covering 3 different levels:

- Local (e.g. municipality or a city)

- Regional (e.g. regional institution)

- National (e.g. national ministries or funding institutions)

The criteria to choose these Policy-makers have been set as follows:

- The Policy-maker should have been connected to the topic of digitalisation and circularity.

- The Policy-maker should have understanding and access to its territorial eco-system.

- The Policy-maker should have been able to express the challenges and needs faced within its territory to foster circular economy.

- The Policy-maker to be interviewed should have a great understanding on the existing policies and instruments fostering digitalisation and circular economy as well as a vision for the future.

Additionally, partners had the option to interview policy makers they were more confident with. The interviews were recorded with participants' consent, transcribed verbatim, and anonymized to maintain confidentiality. The process to collect data unfolded as follows:
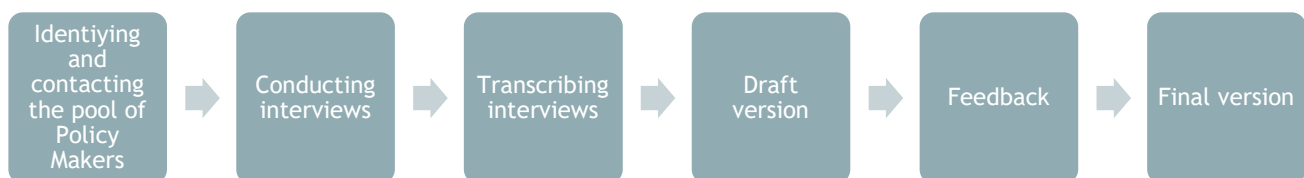

Figure 3 - The Report generation process (source: Author Generated, 2024)

Each partner was tasked with identifying a pool of Policy Makers from their ecosystems to contact for interviews and subsequently collaborate with towards implementing circular practices. To initiate cooperation with these profiles, partners reached out to them and scheduled interviews. These interviews have been both conducted online or in person, in either English or the native language, depending on agreements between PPs and the policy makers. Following the interviews, partners transcribed them and completed the survey in a Word document. If the interviews were conducted in the native language, partners translated all content into English. After submitting the draft versions, interviews were reviewed by PP7/COMET to address any misunderstandings. Feedback was provided, and PPs made necessary additions or corrections before submitting the final version.

It is important to highlight that the Project Partners (PPs) have successfully gathered 35 out of the 36 reports from their engagements with policy makers.

The inability to meet the initially established Key Performance Indicator (KPI) can be attributed to factors beyond our direct control, rather than a lack of effort or planning on our part. Consequently,this document serves as a consolidated overview of the insights derived from the 35 interviews with decision makers. Additionally, COMET / PP7 is open to updating this deliverable with information from the final interview once the details are finalized and fully analyzed.

The table below offers an overview of the number of Policy makers interviewed by each partner:

No.	Partner's name	Abbreviation	Interviewed PMs
PP1	Krakow Technology Park ltd.	KPT	4/3
PP2	Research Burgenland GmbH	FB	3/3
PP3	PROFACTOR GmbH	PRO	3/3
PP4	Fraunhofer IWU	IWU	2/3
PP5	microTEC South West e.V.	mtSW	3/3
PP6	SIIT Ligurian Technological	SIIT	2/3
PP7	COMET Scrl	COMET	3/3
PP8	Slovenian tool and die development centre	TECOS	3/3
PP9	Pannon Business Network Association	PBN	3/3
PP10	Technical University of Kosice	TUKE	3/3
PP11	Intemac Solutions ltd	INTEMAC	3/3
PP12	Croatian Chamber of Economy Varaždin County Chamber	HGK VZ	3/3

Table 4 - The number of interviewed Policy Makers by PP (Source: Author Generated, 2024)

Summary of findings and presentation of the results

Information from Policy Makers was collected in the survey described above. Each question was analysed independently, and general conclusions were drawn in the end. The analysis was done anonymously, excluding Policy Makers (individuals) names for data privacy and result validity. The questions were open-sourced, and the data received from the Policy Makers was unstructured.

The process began by consolidating and organizing the data into a single Excel spreadsheet. After cleaning the data, we performed an exploratory data analysis to gain a deeper understanding of the context and relationships between variables. Subsequently, we employed thematic analysis to derive the results. This involved developing thematic codes, which we organized into themes. Utilizing Excel spreadsheets, we quantified the findings by assigning numerical values and illustrated key insights through various charts. To gain insight into Policy Makers' understanding of circularity, we analysed whether or not their relevant territories were aware or in possession of a circular strategies. Data analysis created the baseline for interpretation of the findings and discussion in the Results and Discussion sections.

Analysis of Transnational Panel Minutes

In addition to the interviews, the methodology included the analysis of the entire International conference on the Youtube channel (available here) and from the transnational panel "Shaping together greener Europe in an open innovation ecosystem". This panel brought together leading policy makers, industry stakeholders, and academics to discuss the latest trends, challenges, and opportunities in circular economy practices across Europe. The minutes of this panel were systematically reviewed and embedded in the current report to extract key insights, recommendations, and strategic considerations that complemented the findings from the interviews.

Final data Analysis

The collected data from both the interviews and the transnational panel minutes were subjected to qualitative content analysis. This involved coding the data to identify recurring themes, patterns, and insights related to the implementation and impact of circular economy policies. The analysis was facilitated by qualitative data analysis software, which allowed for the efficient organization and examination of large volumes of text data.

Synthesis of Findings

The final stage of the methodology involved synthesizing the insights from the interviews and panel discussions to generate a comprehensive report with the aim to provide a nuanced understanding of the policy landscape surrounding circular economy practices, highlighting the key challenges, opportunities, and strategic directions for fostering sustainable industrial futures.

2. Research Limitations

In the course of compiling this synthesis report, which consolidates insights from 35 interviews with policy makers conducted by various project partners, we have encountered several limitations that must be acknowledged. These limitations have the potential to influence the interpretations and conclusions drawn from the data collected, and they warrant careful consideration in the analysis and application of the findings.

- **Limited Perspectives:** One notable limitation arises from the methodology of data collection, predominantly reliant on information provided by a single representative from each organization. While these policy makers offer valuable insights, their perspectives are inevitably shaped by their personal experiences, expertise, and viewpoints. This approach may not fully capture the diversity of opinions and knowledge present within their respective organizations, leading to a potential skew in the data towards individual interpretations.

- **Interview Bias:** The process of conducting interviews introduces another dimension of bias. The fact that policy makers were interviewed, often in their native languages, by project partners (PP) adds a layer of complexity to the interpretation of responses. The PP's understanding and paraphrasing of the policy makers' statements into insights for this report may inadvertently reflect the interviewers' biases and interpretations, rather than providing a direct, unaltered account of the policy makers' intentions.

- **Subjective Analysis**: Furthermore, the analytical phase of this research is not immune to the subjective biases of the researchers involved. The interpretation of qualitative data, such as interview transcripts, requires the researcher to make judgments about the relevance and significance of the information provided. These judgments are inherently influenced by the researchers' backgrounds, theoretical frameworks, and personal understandings of the topic at hand. This subjectivity can lead to variations in how data is analyzed and presented, potentially impacting the overall findings of the report.

- **Organizational Diversity and Fragmentation:** A significant challenge encountered in this research is the inherent fragmentation and variety among the organizations from which policy makers were interviewed. The diverse nature of these organizations in terms of size, focus, geographical location, and operational context introduces a level of complexity in comparing and synthesizing the data. This diversity, while enriching the study with a broad spectrum of viewpoints, also complicates the process of identifying common themes and drawing generalized conclusions across different policy-making environments.

These limitations underscore the need for a cautious interpretation of the findings presented in the current report. While the insights gleaned from the interviews with policy makers provide valuable

contributions to our understanding of the current landscape and future directions in policy making for circular economy, readers should remain mindful of the factors that might influence the data's representation and interpretation. Recognizing these limitations is crucial in ensuring that the conclusions drawn are considered within the appropriate context, and that future research endeavours are designed to address these challenges.

In some cases, we have encountered delays from partners in the provision of reports due to the necessity of obtaining the required authorizations to proceed with the publication. Although the templates have been analysed anonymously, PPs indeed needed a formal endorsement from the policy makers involved regarding their interviews given. This process has led to the delay of the current deliverable.

E. Results from the interviews to the Policy Makers

1. Introduction

Digital-driven circularity represents a holistic approach to achieve-environmental sustainability, economic growth, and social well-being. Policy makers play a crucial role in enabling this transition by creating supportive regulatory frameworks and fostering an innovation ecosystem that encourages circular and digital solutions.

The following section compiles the principal findings from the interview analysis, offering a thorough summary of the insights and impressions collected from the Policy Makers throughout Central Europe: the analysis of interviews with 35 policy makers involved by SMART CIRCUIT PPs from 9 different countries across the entire cooperation programme area, aims not only to provide an understanding of their impressions and perspectives about digital-driven circularity but also to lays the foundations for future policy options.

Firstly, it has to be said that recognizing territorial differences is crucial for a comprehensive understanding of each policy makers distinct challenges and opportunities. Diverse status quo, diverse regulations, varying stakeholders contribute to the diverse experiences and knowledge different Policy-Makers from different Countries (and from different territorial levels) have in circular transition.

The chart below offers an overview of the number of policy makers analysed from each Country:
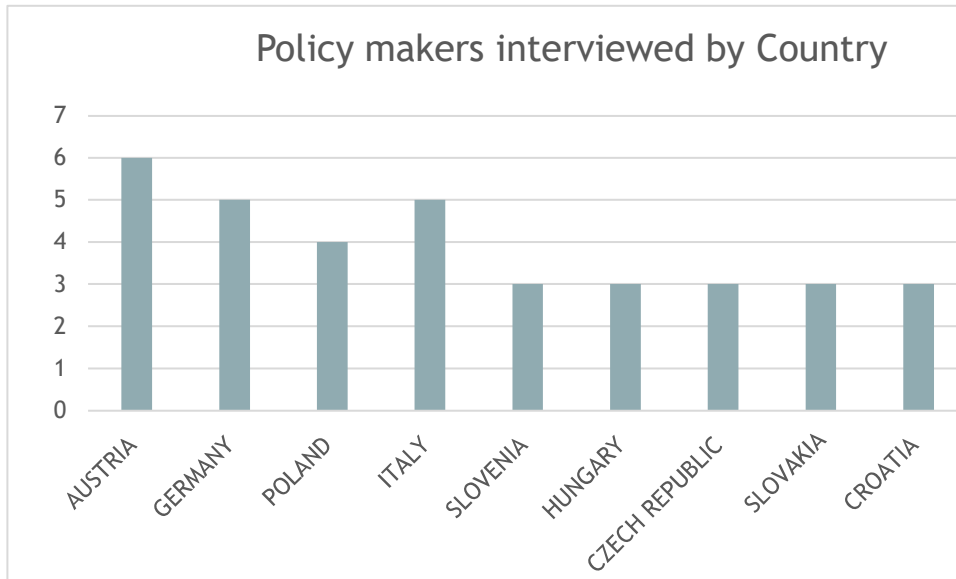
Figure 4 |Policy makers interviewed by PPs; breakdown by Country

Our analysis took into account the viewpoints of a wide variety of policy makers, representing various levels of intervention. In the figure below, a first subdivision by type of policy makers whose considerations have been analysed can be appreciated.
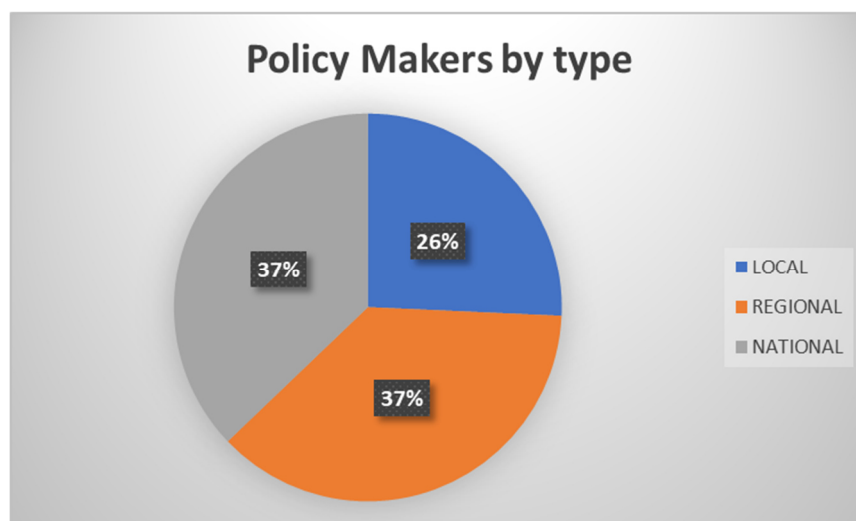

Figure 5 | Policy makers involved: breakdown by type of intervention (Q1.3)

The pie chart above (Figure 5) outlines the breakdown of the policy makers by their level of intervention, categorizing them into local, regional, and national levels. If we compare it with the countries of origin, a clear variation in the involvement of policy makers at different levels (local, regional, national) across countries can be appreciated, also reflecting the different governance structures or priorities within each country regarding the policy area under review. At Country level:

- Poland showed an involvement of 2 local, 1 regional, and 1 national policy makers.
- Austria indicated 1 local, 4 regional policy makers and 1 national policy makers.
- Germany reported 1 national, 3 regional and 1 local policy makers.

- Italy, listed 2 national, 2 regional, and 1 local policy maker.
- Hungary, Czech Republic and Croatia reported 1 national, 1 regional, and 1 local policy makers (each Country).
- Slovakia involved 2 National and 1 local policy makers.
- Slovenia, mentioned 3 national policy makers, with no local or regional ones reported (i.e. Slovenia is divided into statistical regions, which have no administrative function, so it means there are no Regional Administration in the Country).

2. General Knowledge Towards Digital-Circularity

The following section analyse the answers given by policy makers to "Section 2 - General Knowledge towards digital-circularity" (Q2.1 - Q2.5) of the Interviews carried out by the PPs.

Section 2 of the interview focuses on assessing the perspectives, engagement, and insights of policy makers concerning the circular economy and digital transformation within their respective regions. The section has been structured around the following five key questions designed to gather comprehensive insights on the current status, interest, and strategies related to the integration of circular economy principles and digitalization efforts. Here's a breakdown of what each question addresses:

2.1 - Role or Interest in Circular Economy or Digitalisation | The question set the stage for understanding the perspective from which the respondent was contributing to.

2.2 - Status Quo of Transition from Linear to Circular Economy | The question is critical for understanding the regional context and the specificities of the circular economy's implementation.

2.3 - Administration's Interest in Circular Economy | essential for assessing if politics is driving circular economy initiatives.

2.4 - Role of Digital Transformation in Supporting Circularity | area of inquiry that highlights the intersection between digital innovation and sustainable economic models.

2.5 - Relevance of Territorial DIH for Digitalisation Transformation | aiming to understand the policy makers perception on DIH's role in offering support, resources, expertise, and networking opportunities for embracing digitalization, specifically in the context of enhancing circular economy efforts.

2.1 - Role or Interest in Circular Economy or Digitalisation.

The question was aimed at identifying the respondent's direct involvement, role, or interest in the domains of circular economy and digitalization. It seeks to understand whether the interviewee is an active participant, a policy maker, a facilitator, or simply has a vested interest in the advancement of these areas. The involvement of policy makers across local, regional, and national levels showed a multi-faceted and in some cases, integrated approach towards circular economy and digitalization, such as in the case of Policy makers that have been involved in Poland where each respondent demonstrates a distinct but complementary role that collectively contributes to advancing circular economy initiatives within their respective domains.

The responses from policy makers across the 9 Countries represented at SMART CIRCUIT level (Poland, Austria, Germany, Italy, Slovenia, Hungary, Slovakia, Czech Republic, and Croatia) to question 2.1 regarding their role or interest in the area of circular economy or digitalisation reveal diverse perspectives and degrees of involvement in these areas, but generally speaking, across the responses, **digital transformation is frequently seen as a crucial enabler for the transition to a circular economy;** the integration of digital tools and technologies is seen as essential for optimizing processes, improving

resource efficiency, and facilitating sustainable practices. The answers provided on digital transition are reported and further exposed below under Q2.4.

2.2 - Status Quo of Transition from Linear to Circular Economy.

The question aimed to get an overview of the current state of the transition from a traditional, linear economic model to a more sustainable, circular economy within the respondents regions, aiming to gauge the progress made and the overall perception of this "paradigm shift" among policy makers.

The responses from policy makers across the Countries provide a diverse view of the stages, challenges, and priorities associated with this transition. There is indeed a noticeable variation in the stages of circular economy implementation across the Countries, with some in the initial phases of integrating circular principles (such as the case of Slovakia where *"early phase integration of circular economy principles into city and company collaboration" are in place")* and others actively already developing and applying strategies and policies for circularity. This is the case of Germany where the debate around circular economy has definitely gained its "momentum". First insight of this review: **there is a clear spectrum of stages in the transition from a linear to a circular economy across regions, from initial phases to more advanced implementations.**

The diversity in responses reflects the complex landscape of transitioning towards a circular economy, underscored by the unique **challenges and priorities** of each territory and/or region. Nevertheless, we can conclude that the emphasis on **challenges** such as financial constraints, lack of dedicated personnel, and the need for more comprehensive strategies are common in the feedbacks received, while **opportunities** lie in technological advancements, digital transformation and increasing awareness and collaboration among stakeholders. The **need for strategic policy frameworks** and **stakeholder collaboration** emerged also as common themes, indicating key areas for future focus and development in advancing circular economy goals across these regions: the importance of **integrating circular economy principles into policy frameworks**, and the role of **multi-stakeholder collaboration**, suggesting a need for coordinated efforts and shared strategies.

2.3 - Administration's Interest in Circular Economy

Under question 2.3, the focus shifted to the level of interest and commitment shown by the respondent's administration or organization towards the circular economy, evaluates how prioritized the circular economy is within their policy agenda, funding allocations, or strategic planning.

The commitment levels among administrations also vary, with some regions acknowledging circular economy as a top priority and others still considering it a niche topic. Analysing the provided answers by policymakers (in the pie chart above summarised) about their level of interest in the circular economy "topic" we can observe a range of commitments across different entities or regions and Countries.
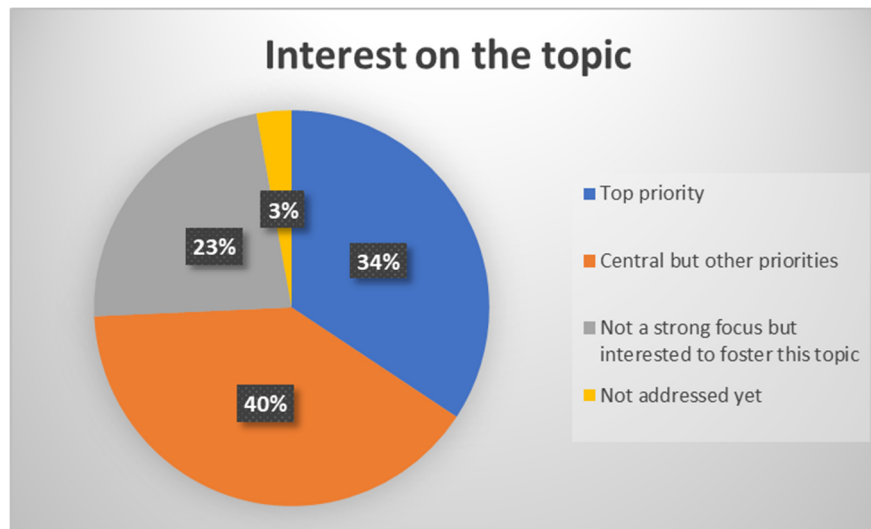
**Figure 6 |Policy makers interviewed: interest on the topic of
circular economy (Q2.3)**

"Top Priority" Interest: A total number of 12 policymakers have marked the circular economy as a "Top priority," suggesting that in their relevant territories there is a stronger framework and more initiatives in place to transition to a circular economy. This could also imply more robust funding, policy support, and public or private partnerships geared toward circular practices.

"Central but other priorities": the majority (14 out 35) reflects the realistic scenario where administrations are juggling multiple important issues; while the circular economy is significant, it must be advanced in tandem with other socio-economic and political goals.

"Not a strong focus but interested to foster this topic" (8 out of 35) suggests that there is a recognized potential for growth in the circular economy sector. Administrations here may be at the early stages of developing policies or lack resources but are open to supporting circular economy concepts as they progress.

The mixed responses suggest that the transition to a circular economy is a work in progress with varying degrees of integration into the mainstream economic and environmental agendas. The variety of commitment levels presents an opportunity for increased collaboration among regions and entities. Those with "Top priority" can share best practices, while those with "Not a strong focus" can benefit from shared knowledge and possibly joint projects. With this regard, it is worth mentioning, as a way of example, that 3 out of 4 the Polish policy makers involved have replied that circular economy is at the top of their agendas, ("Top Priority") while 3 out of 3 their Slovak "peers" do not have a specific focus on it even if they recognise its potential for growth (**"Not a strong focus but interested to foster this topic").**

Below a visualization that takes into account the different responses given at a territorial level (by Country) by the policy makers interviewed by the PPs.
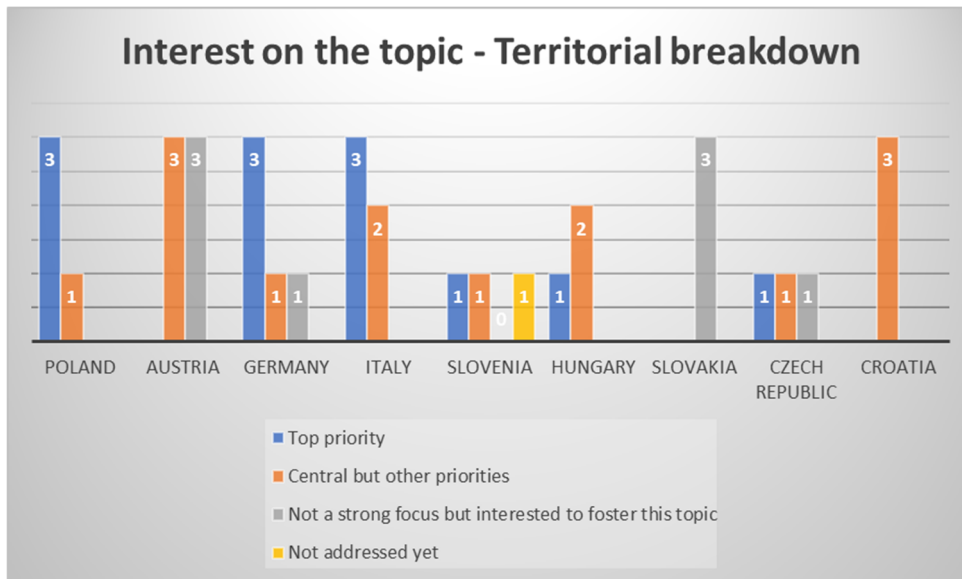
Figure 7 | Policy makers interviewed: interest on the topic of circular economy; territorial breakdown (Q2.3)

Poland, Germany and Italy have the highest level of interest, with 3 bars in the "Top priority" category, indicating that the topic is of utmost importance to these countries. Austria, Slovenia, Hungary and the Czech Republic show a moderate level of interest while Slovak policy makers unilaterally expressed theur interest to foster circular economy though not having it as a prior focus. Only 1 Policy maker from Slovenia has marked the topic as "Not addressed yet," suggesting that all the listed countries have at least some level of engagement with the topic of circular economy. The topic indeed is universally acknowledged to some extent by all surveyed policy makers, with no country completely neglecting it.

There is a divide in the level of priority given to the topic, with some countries considering it a "top priority" while others view it as important but less urgent.

For Countries with a strong interest, the topic could be central to policy discussions and development. For those with moderate interest, the topic may need further advocacy or evidence to become a higher priority. No country is starting from scratch with this topic; all have some foundation of interest, which could be built upon.

2.4 - Role of Digital Transformation in Supporting Circularity

The question explores the perceived role of digital transformation as a facilitator for the transition towards a circular economy. It seeks opinions on how digital technologies, data analytics, and digitalization processes can enhance the efficiency, transparency, and scalability of circular economy practices within the territory.

Across the board, digitalization is seen as a **necessary enabler of circular economy practices**, helping optimize processes, improve resource efficiency, and support sustainable decision-making. This is the case, by way of example, of Austrian policymakers (where the significance of digital transformation in supporting circularity is well-acknowledged, especially in terms of process orientation, resource efficiency, and the management of material flows), **German** (where "digital markers in products to make raw materials traceable, enhancing the efficiency of recycling processes and material reuse" are cited) or **Croatian** ones, where digital transformation is seen as a vital enabler for the circular economy

transition, leveraging tools like IoT for resource management, data analytics, AI, and automation to optimize production processes, improve supply chain transparency, and raise awareness about circular economy benefits. While digital transformation is acknowledged as important, there are challenges related to infrastructure, awareness, legislative barriers, and the need for further stakeholder engagement. There is also a recognition of the potential for digital tools to optimize production, reduce waste, and foster a sharing economy, which are all key aspects of circularity. There is also a noticeable variance in the **level of engagement with digital transformation** across regions, with some areas like **Italy** recognizing and implementing related measures, while others indicating a need for greater development and awareness. In summary, while the integration of digital transformation with circular economy initiatives is a common theme, the degree of integration, awareness, and strategic focus varies widely among the countries. The overarching sentiment is that digital technologies are critical for a successful transition to circularity, but they must be coupled with the right policies, infrastructure, and stakeholder collaboration to be truly effective.

2.5 - Relevance of Territorial DIH for Digitalisation Transformation

This query examines the importance and impact of the territorial Digital Innovation Hub (DIH) in preparing stakeholders for the digital transformation journey given by the interviewed policy makers.

The role of Digital Innovation Hubs (DIHs) and other forms of support infrastructure has been mentioned as critical across the board of the interviewed policy makers, in certain cases highlighting the need for capacity building and access to appropriate services to aid stakeholders in the digital transition, in others the presence of capacities, competences and infrastructures well known within the ecosystem.

The chart below (Figure 4) summarizes responses from policymakers regarding the accessibility and quality of services provided by their Digital Innovation Hubs (DIHs) in relation to stakeholders involved in the transition to a circular economy.
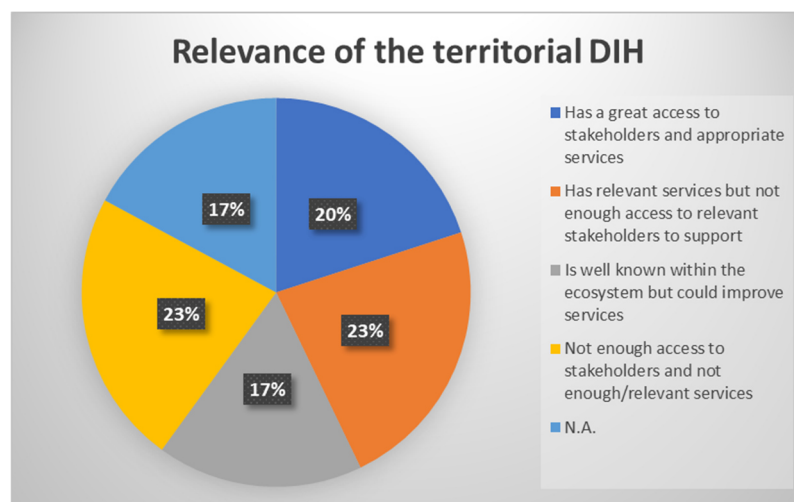

Relevance of the territorial DIH

- 20% — Has a great access to stakeholders and appropriate services
- 23% — Has relevant services but not enough access to relevant stakeholders to support
- 17% — Is well known within the ecosystem but could improve services
- 23% — Not enough access to stakeholders and not enough/relevant services
- 17% — N.A.

Figure 8 | Policy makers perception on their relevant DIH (Q2.5)

A consistent share (23%) of the interviewed policymakers indicate that there is "**Not enough access to stakeholders and not enough/relevant services.**", suggesting that under certain circumstances, the DIHs are under-resourced or not effectively connected to their stakeholder network. Nevertheless, it is worth mentioning also that the perception of the role and relevance of the reference DIH can vary due

to a range of factors and incidences, knowledge, experiences, etc... For example, in certain cases policy makers from the same territory have provided diametrically opposite responses suggesting that they had different individual interactions with the DIH or, simply, they represent varying degrees to which they have engaged with the services provided by the DIH.

The same percentage of the board **(23%)** is represented by those cases where DIHs have been perceived to **"Have relevant services but not enough access to relevant stakeholders to support"** implying that while the hubs have the capabilities and services needed for the transition to circularity, they struggle with outreach or engagement with the relevant stakeholders who would benefit from these services.

Some responses indicate that the DIHs are "**Well known within the ecosystem but could improve services**" **(17%),** pointing to a recognition of the DIHs within their own innovation landscape, but also to a need for enhancement in service quality or diversity to fully support the transition to a circular economy.

Only **20%** of the total policymakers reported that their DIHs "**Have a great access to stakeholders and appropriate services**," showcasing instances where the innovation hubs are functioning effectively with robust engagement and service offerings that support stakeholders in the circular economy transition.

It's important to note that for **17%** of respondents, the question was marked as "**N.A.**", which suggests that the question was not relevant to their context or they lacked sufficient information to respond, indicating areas where further investigation or engagement may be required to gain a complete understanding of DIHs' impact.

The data gathered from policymakers reveals a multifaceted view of Digital Innovation Hubs (DIHs) and their role in promoting the circular economy. Notably, 23% of those interviewed feel there is inadequate access to stakeholders and a deficiency in relevant services, highlighting potential resource constraints or gaps in the connectivity between DIHs and their stakeholder network. This view, however, is not uniform across the board; there is variability in the perceived role and efficacy of DIHs, influenced by individual knowledge, experiences, and the extent of engagement with DIH services. This is underscored by the fact that policymakers from the same region can offer vastly different assessments, ranging from inadequate to sufficient in terms of service provision. An equal proportion (23%) perceive DIHs to possess the necessary services but lack adequate access to key stakeholders. This suggests that while the infrastructure for support exists, there is a disconnect in effectively reaching or engaging with the stakeholders who could benefit from these services.

Additionally, 17% of respondents acknowledge the DIHs as established entities within the innovation ecosystem but propose that there is room for improvement in service quality or variety. This indicates a recognition of DIHs' presence but also points to potential for growth to better support circular economy efforts. In contrast, only a fifth of the policymakers report a positive scenario where DIHs demonstrate both strong stakeholder access and the provision of appropriate services, indicative of effective functioning and contribution to the circular economy transition.

Below a visualization that goes into deep, taking into account the different responses given at a territorial level (by Country) by the policy makers interviewed by the PPs.
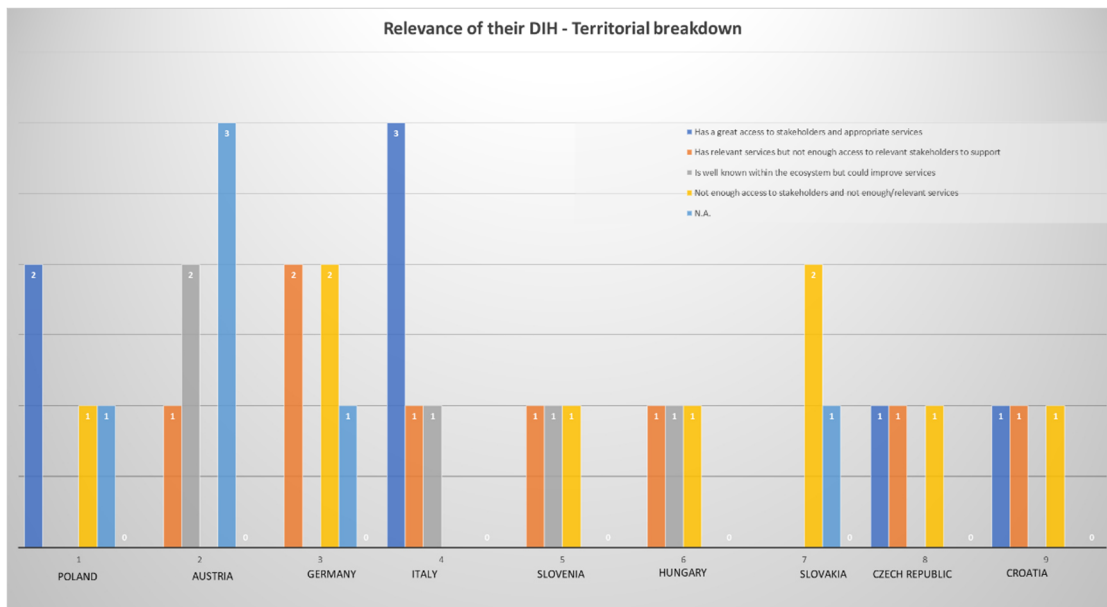
Figure 9 | Policy makers perception on their relevant DIH; territorial breakdown (Q2.5)

Based on the responses given at national level, which however could still be influenced by subjective opinions, Italy stands out as having the highest count (3) for "Has a great access to stakeholders and appropriate services." This indicates that the Digital Innovation Hubs (DIHs) there might be well-positioned with excellent access to both the services they require and the relevant stakeholders. In Countries like Germany, Slovenia, Hungary, Czech Republic and Croatia, the bar chart shows varying degrees of "Has relevant services but not enough access to relevant stakeholders to support." This suggests that while these DIHs offer relevant services, they may face challenges in stakeholder engagement, which is crucial for their success and integration in the local ecosystems.

But there is also a common situation across Countries where policy makers' perception is that the DIH are recognized within their ecosystem, yet there's room for service enhancement. To this scope, we have included those Countries having at least one bar in the "Is well known within the ecosystem but could improve services" relevant category (Austria, Italy, Slovenia and Hungary). The "Not enough access to stakeholders and not enough/relevant services" category is marked by a few countries (notably, Germany and Slovakia) indicating that certain DIHs might be less developed and could require significant improvements in both access to stakeholders and the quality or relevance of services they provide. Notably, Austria has 3 counts in "N.A." which might suggest a lack of available data for these categories or that the Digital Innovation Hubs in question did not participate or were not assessed for these aspects.

These conclusions underscore the need for a nuanced approach to evaluating and supporting DIHs, taking into account the diversity of experiences and perceptions among policymakers across the different Countries, and recognizing both the successes and the opportunities for enhancing the role of DIHs in the circular economy landscape. If the pie chart reveals a varied landscape in which some territories have well-functioning DIHs, while others are lacking (in either service provision, stakeholder engagement or both) it is also true that the **overall outlook is not the best**, given that 80% of the respondents have provided a not 100% positive judgment. Some considerations, aimed also and especially at the DIHs, could be:

- For DIHs to be effective in aiding this transition, they must not only offer relevant services but also ensure that these services are accessible to all stakeholders, and that there's an awareness of the support available to facilitate this important economic and environmental shift.

- For DIHs with services in place but lacking access to stakeholders, there is a clear need for improved outreach, engagement strategies, or possibly an adjustment in the services offered to better align with stakeholder needs. Where DIHs are known but services could improve, there is an opportunity for these hubs to evaluate and adapt their service offerings to more effectively support the circular economy.
- Regions with DIHs that have good access and services could serve as benchmarks or best practices for other regions. Sharing strategies and successes could help improve the overall network of DIHs.

3. Challenges Towards Digital-Driven Circularity in the Manufacturing Industries

The following section analyse the answers given by policy makers to "Section 3 – Challenges towards digital-driven circularity in the manufacturing industries" (**Q3.1**) of the Interview carried out by the PPs.

Section 3 of the interview aims to get the challenges that manufacturing industries face in transitioning towards a digital-driven circular economy. The general question (3.1) asks about the primary challenges and needs that manufacturing industries must address to become more circular. The section, then, delves into more specific manufacturing sectors with focused sub-sections:

3.1.1 - Construction Focus, where policy makers could report about unique challenges and needs related to circularity in the construction industry (e.g. material sourcing, building design, and the lifecycle management of construction materials).

3.1.2 - ICT/Electronics Focus: Here, the focus shifted to the information and communication technology and electronics sectors (e.g. difficulties of e-waste management, the recycling of electronic components, and the reduction of obsolescence).

3.1.3 - Textile Focus: where policy makers could include perceived circularity challenges within the textile industry (e.g. sustainable sourcing of materials, the reuse and recycling of fibers, and the implementation of circular business models).

3.1 - Primary challenges and needs met by manufacturing industries to be more circular

The responses given by policy makers involved in the SMART CIRCUIT project reveal a diverse range of challenges faced by manufacturing industries across Central Europe in their transition towards circularity. The following analysis covers responses from different Countries and different level of govern intervention (i.e. national, regional and local) focusing on the general challenges and needs they perceive as the most common for manufacturing industries in their path to be more circular.

Across the board, the primary challenges identified can be grouped into several categories:

Innovative Technology Implementation: Technological barriers are consistently mentioned (in 12 answers given out of 32) with a call for the development of sustainable materials, energy-efficient methods, and waste recovery technologies.

Utilization of Waste: There is a repeated emphasis (8 responses out of 32) on the utilization of waste as a substitute for raw materials, suggesting a significant shift towards repurposing industrial waste within production processes to enhance profitability and reduce environmental impact.

Data Accessibility and management: There is a recurrent mention (6 responses out of 32) of the need for better access to data, highlighting issues such as internal data silos, localized data usage, and the necessity of cross-value chain data management. The need for comprehensive data management systems

that support sustainable operations is crucial. **Several** responses highlighted the lack of access to critical data coped with the lack of access of advanced technologies as a significant barrier to implementing circular practices. This includes the need for data management systems, integration of small suppliers and technological enablement.

Energy and Resource Efficiency: Multiple policymakers stress the importance of access to low-emission energy and emphasize the reduction in the use of natural resources, plastics, and greenhouse gas emissions. There is a focus on flexible production and the efficient use of energy and materials.

Financial and Regulatory Hurdles: The need for financial incentives, funding and clear political frameworks is a common theme that emerged. Financial barriers, such as the need for investments in technology and adaptation of company structures, are identified as significant challenges.

Knowledge and Expertise: A clear need for increased knowledge and expertise in circular practices is identified, indicating a gap in current understanding and the necessity for training and education initiatives. In this sense, interesting what a Croatian policy maker pointed out "[…] *the primary challenges for manufacturing industries to become more circular include significant shortage of experts in advanced digital circularity technologies and wider implementation of digital transformation technological changes",*

Operational and Logistical Issues: The logistics of transforming supply chains, finding new suppliers, and implementing circular strategies within companies are highlighted as complex undertakings.

Market Demand: The demand for circular products needs to be cultivated, which involves educating consumers and creating markets for recycled and sustainable materials. Interesting the fact that only 3 Italian policy makers raised this point.

Figure 10 | Main challenges and needs perceived by Policy Makers Overview (source: Workcloud Generated, 2024)

Furthemore, other challenges perceived included strategic corporate transition, cultural and social barriers/challenges and the perceived need of more collaboration across the entire value chain. In a couple of cases, Italian policy makers mentioned that Corporate strategy and policy are seen as barriers if not aligned with the circular economy, signifying the need for businesses to integrate circularity into their core agenda. Across the answers provided there is a mention of the need for a cultural shift that values sustainability and recognizes the importance of circular practices. Social barriers such as consumer perception and throwaway culture are also identified and finally, creating networks and partnerships is deemed crucial for effectively developing and implementing circular solutions.

The feedback from policy makers across Central Europe indicates different challenges in transitioning manufacturing industries towards greater circularity. Common themes included the need for better access to technology and data, financial and regulatory support, increased knowledge and collaboration but also efforts to cultivate market demand for circular products. Addressing these challenges requires a coordinated effort from all stakeholders involved, including manufacturers, policymakers, consumers, and educational institutions, suggesting the perceived importance of a holistic approach to achieve circularity in manufacturing industries.

Sector-Specific Challenges

3.1.1 - Construction

Based on the analysis of the interviews reports regarding the specific sectorial challenges in construction, policymakers from various Central European regions have identified a number of challenges towards achieving digital-driven circularity in the construction industry, namely:

- **Access to Substrates and Human Resources**: Policymakers indicate a need for better access to construction substrates and skilled human resources. There's also a concern about the proper disposal of construction materials, with a significant amount of waste ending up in illegal landfills due to inadequate supervision by authorities.

- **Holistic Approach Requirement**: The transformation towards a circular economy in construction is seen as necessitating a holistic approach, involving all links in the supply chain and considering the entire life cycle of materials. The construction sector's considerable contribution to resource consumption and waste generation is highlighted, indicating the need for a shift towards using more ecological substitutes and recycled materials.

- **Digitalization and Standards:** The transition is tied to the adoption of digital standards such as Building Information Modelling (BIM) and predictive maintenance approaches that could increase the lifespan of buildings and their components. However, a standardized market reliant on digital approaches is considered challenging without widespread adoption.

- **Financial and Technological Barriers**: The costs associated with transitioning to circular practices in construction are mentioned as a core challenge. It's noted that construction is one of the industries requiring more substantial financial incentives for such a shift. Technological barriers also exist, with the need for innovations that can facilitate circular building solutions.

- **Regulatory and Compliance Issues:** Ensuring compliance with environmental regulations remains an obstacle, with existing policies sometimes not aligned with circular practices. The dilemma between focusing on price versus environmental aspects in public procurement is also noted as a problematic area.

- **Recycling and Upcycling of Materials**: A focus on recycling or upcycling of raw materials in construction is mentioned. This includes finding cost-effective ways to integrate recycled materials and standardize them for use, as well as addressing health concerns associated with potentially toxic materials found in recycled content.

- **Consumer Awareness and Demand**: The challenge of raising consumer awareness and demand for circularity in construction is implicit in the need for collaboration across the supply chain. There seems to be a gap in creating a market where customers are conscious of and prefer circular options.

The construction industry faces multifaceted challenges in embracing circularity, which range from managing resources and waste more effectively to embracing digital technologies and standards. Financial, technological, regulatory, and social barriers need to be addressed through a combined effort

involving increased investment, knowledge dissemination, stakeholder collaboration, and market demand cultivation. The shift towards circularity in construction is not only an environmental necessity but also presents opportunities for economic and social benefits, with the potential to create added value in the real estate sector and beyond.

These insights can help SMART CIRCUIT project to tailor the awareness-raising efforts and aid in designing support mechanisms that address these specific challenges in the construction industry. Emphasis on creating comprehensive strategies, fostering industry-wide cooperation, and advocating for supportive policies will be crucial to driving the transition towards digital-driven circularity in the construction sector.

3.1.2 - ICT/Electronics

The responses from policymakers on the specific sectorial challenges in the ICT/Electronics sector show a consensus on several key areas of concern:

- **Repairability and Lifespan of Devices:** There is an emphasis on increasing the repairability of electronic devices to extend their lifespan, thereby reducing waste. The message is clear: "Don't throw away old devices!" This is coupled with the need for energy efficiency in technical devices to reduce overall consumption and waste generation.

- **E-waste Management and Recycling Processes:** Inaccurate recycling processes are leading to significant loss of raw materials. Many electrical components that could be recycled are shipped to low-labor countries and then resold to Europe. This points to a need for improved recycling technologies and processes within the EU.

- **Lack of Sorting Infrastructure:** There is a noted lack of infrastructure for sorting electronic waste, which means that electronic devices are often shipped abroad rather than being dealt with domestically. This hinders the ability to maintain a circular approach within the local economy.

- **Rapid Increase in Consumption:** The rapid growth in electronic consumption leads to a significant increase in electronic waste, posing environmental and health hazards. The improper disposal of electronic products exacerbates this issue.

- **Supply Chain Transparency:** The lack of visibility and transparency in supply chains makes it difficult to assess the environmental impact and ensure ethical sourcing. Implementing technologies such as blockchain and IoT is suggested to enhance transparency and traceability throughout the supply chain.

- **Standardization and Design for Recycling:** Standardization in design for recycling is identified as a significant contributor to the successful transition towards a circular economy. This would involve designing products that are easier to recycle and that integrate recycled materials.

- **Collaboration Among Stakeholders:** There is a call for increased collaboration among industry stakeholders, policymakers, and consumers to overcome challenges related to the proper disposal and recycling of electronic waste and the encouragement of repairing and upgrading devices over replacement.

These responses indicate that the ICT/Electronics sector faces complex challenges that are deeply interwoven with the principles of the circular economy. Challenges in the ICT and electronics sector include the dependency on components from outside the EU, the rapid increase in e-waste, and the need for improved recycling technologies and product designs that facilitate easier recycling. Emphasizing repairability, upgradeability, and the use of recycled materials is considered crucial for circularity.

The key to addressing these challenges lies in an approach involving technological innovation, infrastructure development, regulatory support, and a shift in cultural practices towards sustainability. The SMART CIRCUIT project, as a facilitator for awareness and change, could leverage these insights to create targeted interventions that help overcome these sectorial challenges. Engaging with manufacturers, promoting consumer education, and advocating for supportive policies will be crucial steps towards establishing a more circular economy in the ICT/Electronics sector.

3.1.3 - Textile

In the quest to pivot towards a more sustainable future, the textile industry stands at a critical juncture. As we delve into the findings from the policymakers across the 9 Countries, we uncover the multifaceted challenges that this sector faces in the transition to a digital-driven circular economy. From grappling with the ramifications of overproduction and waste to tackling the intricacies of material use and consumer habits, the insights offered by our policymakers shed light on the urgent need for systemic change.

The responses from policymakers indeed highlighted several specific challenges for the textile industry under the framework of digital-driven circularity:

- **Overproduction and Waste:** The industry is contending with issues related to the overproduction of textiles, especially cheaper, lower-quality clothing that contributes to significant consumption and production increases. This overproduction leads to increased waste and environmental harm.

- **Short Product Lifespan:** The current business models in the textile industry lead to a short lifecycle for clothing.

- **Need for Circular Economy Transition:** Policymakers suggest extending the lifecycle of textiles through recycling and other circular practices; there is a consensus on the need for the industry to shift towards a circular economy. This would involve not only better resource utilization but also the adoption of sustainable product design, making items more durable, repairable, and recyclable.

- **Composite Materials:** In the textile sector, the use of composite materials presents a challenge. Policymakers are concerned with the ability to separate biological and technical materials for recycling purposes.

- **Consumer Practices:** The industry is affected by consumer demand for cheap products, which drives the fast fashion trend. There is a need for consumer education and a change in consumer behavior to value sustainability over cost.

- **Material Mixtures:** There are difficulties with the variety of textiles and polymers used in a single piece of clothing, which complicates recycling processes.

- **Energy Demands:** High energy demand for production and the subsequent carbon footprint are also significant concerns.

- **Lack of Infrastructure:** There is a noted lack of infrastructure for effective recycling and waste management within the textile industry.

- **Economic Factors**: Established big players dominate the market, making it challenging for new, more sustainable practices to gain a foothold. Also, the production costs, particularly for technical textiles, are high, which impacts the ability to switch to more sustainable practices.

- **Extended Producer Responsibility (EPR):** New legislation is anticipated that will place more responsibility on producers when textiles become waste. This is a step towards ensuring manufacturers account for the end-of-life impact of their products.

- **Circular Approaches Knowledge:** There is a noted lack of knowledge about the possibilities of circular approaches, and good examples are few and far between. Points of contact for professional support are also not well-known.

These challenges are interrelated, affecting the sustainability of the textile industry on multiple levels—from design and production to consumer behaviour and waste management. For the SMART CIRCUIT project, these insights underline the necessity of addressing these issues through a holistic approach, engaging with all stakeholders, including policymakers, manufacturers, and consumers, to foster a more circular textile industry. From the analysis of the provided answers, there is a call for more sustainable production practices, better management of textile waste, and the need for textiles to be durable, recyclable, and made in an environmentally friendly manner.

4. Strategy Development

The following chapter encapsulates a pivotal component of the SMART CIRCUIT project, focusing on the advancement of circular economy and digitalisation within the Central Europe cooperation programme area. This chapter synthesizes insights drawn from the interviewed policy makers, offering a panoramic view of the strategies, plans, and policies sculpting the region's transition to sustainable, circular economic models buttressed by digital innovation.

For reporting purposes, we have homed in on three critical segments within this chapter:

4.1 - Current policy landscape on circular economy and digitalisation, which gauges the state of policy development on circular economy and digitalisation, presenting a snapshot of where each territory stands in its strategic journey.

4.4 – Available instruments, which delineates tangible resources available at the territorial level to promote digital-driven circularity, linking directly to strategic documents that underpin these initiatives.

4.5 – Policy effectiveness review, which examines the extent to which detailed analyses of existing policies have been conducted, scrutinizing the breadth of policy instruments currently in operation, including rules, regulations, partnerships, programmes, and financial instruments designed to propel SMEs and other stakeholders towards circularity.

The decision to spotlight questions 4.1, 4.4, and 4.5 is strategic and intentional. It streamlines the focus of our analysis to the core elements that encapsulate the readiness and resourcefulness of territories in embracing circularity. Question 4.1 serves as the keystone, providing the foundational context of policy development stages, while questions 4.4 and 4.5 offer pragmatic insights into available instruments and the robustness of policy review mechanisms. Together, these elements furnish a comprehensive picture of the strides made and the tools at our disposal to realize the vision of a circular economy reinforced by digitalization. This approach ensures a focused narrative that accentuates the most impactful aspects of strategy development, aligning with the overarching goal of the SMART CIRCUIT project to elevate digital-driven circularity to the forefront of regional economic transformation.

Current policy landscape on circular economy and digitalisation (Q4.1)

From the analysis made, several insights can be gleaned about the "**Current Policy Landscape**" perspective.

Firstly, there is a notable variation across territories in the stages of policy development; Some regions are in the nascent stages of considering policies ("Under consideration"), while others have moved towards actively designing ("Under development") or implementing ("Under implementation") their strategies. It also appears that for some territories, the emphasis may differ between digitalisation and circular economy("Other") In certain cases, digitalisation is under implementation, suggesting that digital strategies may be more advanced than those for the circular economy, which might still be under development or only considered within other areas. A common thread across several regions is the gap between policy design and implementation. There are multiple instances where policies are "Designed but not yet implemented," indicating a need for action to transition from planning to execution.
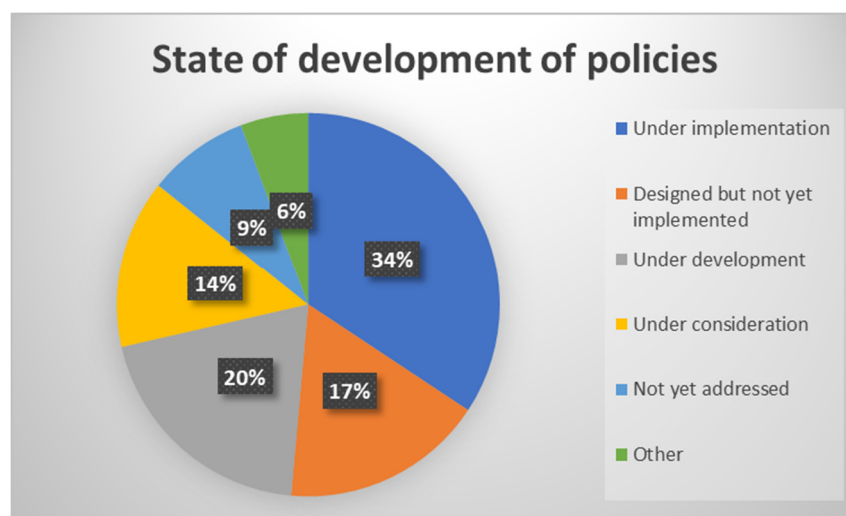

Figure 11 | Policy landscape on CE and digitalisation (Q4.1)

Based on the pie chart above, we can assume that:

- With many territories moving towards or already in the "**Under implementation**" phase (34%), there's an evident trend towards action. However, the presence of "**Designed but not yet implemented**" (17%) suggests challenges in moving from strategy to practice.

- The provided numbers next to "**Under implementation**", "**Designed but not yet implemented**" and **"Under development"** (20%) offer a quantitative dimension reinforcing the narrative that while strategic development is robust, a significant number of policies are awaiting implementation.

- The presence of "**Not yet addressed**" responses (9%) indicates that some territories have yet to begin the policy development process in earnest. This highlights an opportunity for initiating dialogue and providing support to kick-start the development of circular economy and digitalisation policies.

Analyzing the responses given by policy makers at Country level, the snapshot returns a multifaceted overview in this case as well, as illustrated by the following bar chart.
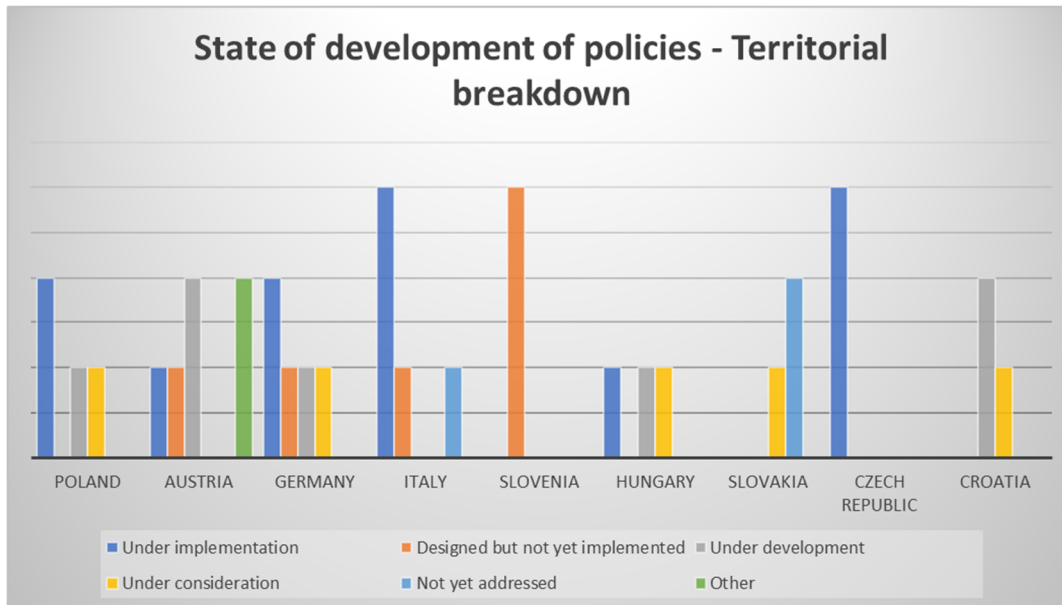
Figure 12 | Policy landscape on CE and digitalisation; territorial breakdown (Q4.1)

Based on the available data, Poland, Germany, Italy and Czech Republic have the most policies that are currently **"under implementation"**, suggesting a proactive approach to policy enactment. Slovenia stands out with the highest number of policies that are **"designed but not yet implemented"** (3 out of 3 responses given), indicating a planning phase with potential for significant policy activity in the near future. Several countries have policies **"under consideration"**, suggesting that in some cases (like Hungary, Slovakia and Croatia) there are policy discussions and debates, which might soon lead to formalized policies. Ultimately, the responses from Austrian policymakers indicate varied levels of policy formation and execution in Austria with respect to digitalization and the circular economy. Specifically, when responding to question 4.1, two Austrian policymakers demonstrated a robust commitment to advancing digitalization. However, they do not appear to incorporate the circular economy within their strategic policy framework. This might suggest a disjointed approach where sustainability and digitalization are treated as distinct and unrelated matters rather than as interconnected and mutually supportive components.

For the SMART CIRCUIT project, these insights are invaluable as they point to specific areas where support, guidance, and the sharing of best practices could accelerate the transition to circular economy and digitalisation. Understanding the current policy landscape in detail allows for targeted assistance and the development of tailored interventions to address the unique needs of each territory. It is essential for the project to leverage this information to drive the adoption and actualisation of policies that can foster sustainable economic growth and resilience.

Available instruments and resources (Q4.4)

Based on the interviews collected and analysed, there is a spectrum of development stages but also available resources and instruments across the territories to foster digital-driven circularity. This diversity reflects the unique economic, environmental and social landscapes of each region and terrritory, along with varying degrees of policy maturity.

As these initiatives continue to evolve, it is evident that a focused effort on the implementation, stakeholder involvement, and financial support mechanisms will be crucial to advancing the digital-driven circular economy in these territories.

Policy makers have listed as available resources a wide variety of tangible "assets" available at their own territorial level to foster digital-driven circularity, spanning from e.g. **comprehensive strategies** aimed at enhancing circularity to **databases** on products and packaging as well as on waste management. In other cases they have included more detailed examples such as in the case of a **geoportal** that serve as a tool for entrepreneurs interested in information about the possibilities of obtaining biomass with specific parameters or **Digital platforms** e.g. for vehicle recycling, showcasing an integration of digital tools to aid in the transition towards circular economies. The mention of **Digital Innovation Hubs** and / or technology transfer offices indicated in some cases that the territory is already on the right "path" to promote the transition to digital-driven circularity. Across the board, examples of stakeholder engagement in strategy development, with various regions engaging experts (like in the case of "Industry 4.0 Alliance scouts" providing support with intelligent digital methods), businesses, and public feedback through consultations have been mentioned. The availability of **consulting vouchers** and the existence of specialized offices point to a supportive framework that encourages businesses to adopt new technologies and circular practices, which is backed by financial and knowledge-based assistance from the state.

Generally speaking,the snapshot taken returns a situation where policy makers are approaching the circular transition by making various tools and tangible resources available. Territories are adopting diverse approaches to circularity, ranging from broad sustainability strategies to specific programs. Initiatives that emphasize sustainability and environmental protection, such as **EMAS certification** and **sustainability frameworks**, have been included as available tangible instruments. Among the answers given, policy makers have been included that financial incentives and supportive regulatory frameworks are in place to encourage the adoption of circular economy practices, indicating an evolving support structure for circular economy strategies.

In conclusion, the overall understanding of the progress and current condition of digital-driven circularity is that various levels of development and preparedness are present, as well as a multitude of available resources, across different territories. There is a broad spectrum in the maturity of policies and the types of resources available across regions. A wide array of practical tools and resources has been identified, which include comprehensive strategies, databases for product and waste management, and specialized digital platforms for various industry sectors. This range demonstrates tailored approaches to fostering circularity, reflective of each area's distinct economic, environmental, and social contexts. The variation in policy maturity suggests that while some territories have well-established strategies and instruments, others may still be developing or implementing these resources. There is a concerted effort across various territories to enable the shift towards a digital-driven circular economy. Policymakers are actively identifying and providing resources that support this transition. The diversity in approaches and the level of detail in the resources provided underline the customized nature of the strategies employed. Furthermore, there is an acknowledgment of the need for an ongoing, dynamic approach to policy development, stakeholder involvement, and support frameworks to ensure that the digital-driven circular economy is not only envisioned but effectively realized.

Policy effectiveness review (Q4.5)

The following section delves into the outcomes from policymaker responses to Q4.5, aimed at gauging the current state of policy instruments — such as rules, regulations, sector-based partnerships, and financial programs — and their alignment with circular economy and digitalization strategies. The focus

will be on understanding the effectiveness of these policies in fostering a digital-driven circular transition within various territories.

The responses given by about policy analysis status reveal a mix of situations; some territories are still preparing a detailed policy analysis while others, like policy makers from Hungary and Slovakia stating that in-depth studies evaluating digital circular economy measures have been carried out in their own territories. In several cases, while SWOT analyses or low-level evaluations have been mentioned, a comprehensive assessment of policies is not always available or is noted as "in preparation".
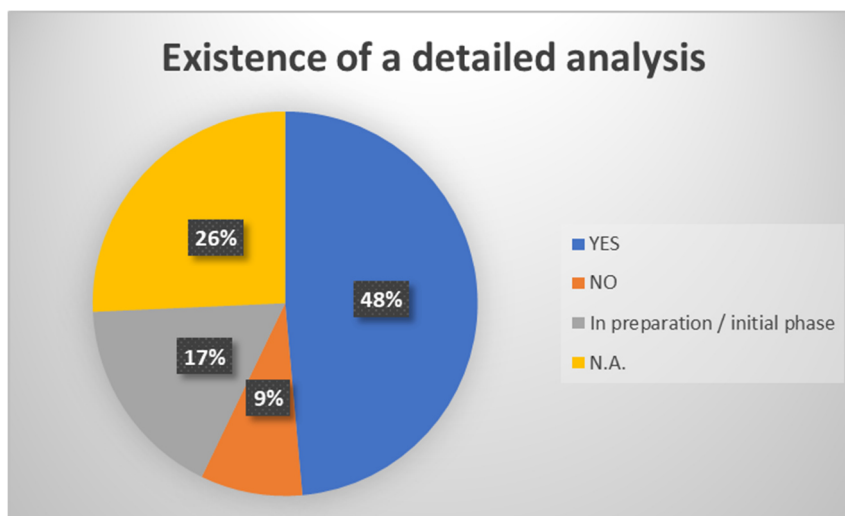

Figure 13 | Policy effectiveness review (Q4.5)

The review of policymaker responses suggests that while there is awareness of the need for detailed policy analysis, the degree of completion varies significantly across territories. Where detailed evaluations exist, they serve as a critical tool for refining strategies and ensuring. Based on the pie chart above, we can conclude that:

- The largest segment of the chart at **48%** indicates that nearly half of the territories have undertaken a detailed analysis of existing policies, suggesting a good understanding and evaluation of how current policies impact circular economy and digitalization goals.

- A quite notable segment (**17%**) of the territories are in the preparation initial phase or a comprehensive review is under development, demonstrating a commitment to policy effectiveness and suggests that these policy makers may have data-driven insights guiding their circular economy and digitalization strategies. This indicates a proactive movement towards better understanding and refining policy effectiveness, although the work is not yet complete.

- Nevertheless, **26%** (more than 1 fourth) of the respondents represent territories where the status is not applicable or unknown, which could mean various things, including that the question was not relevant to the territory or that the data was unavailable.
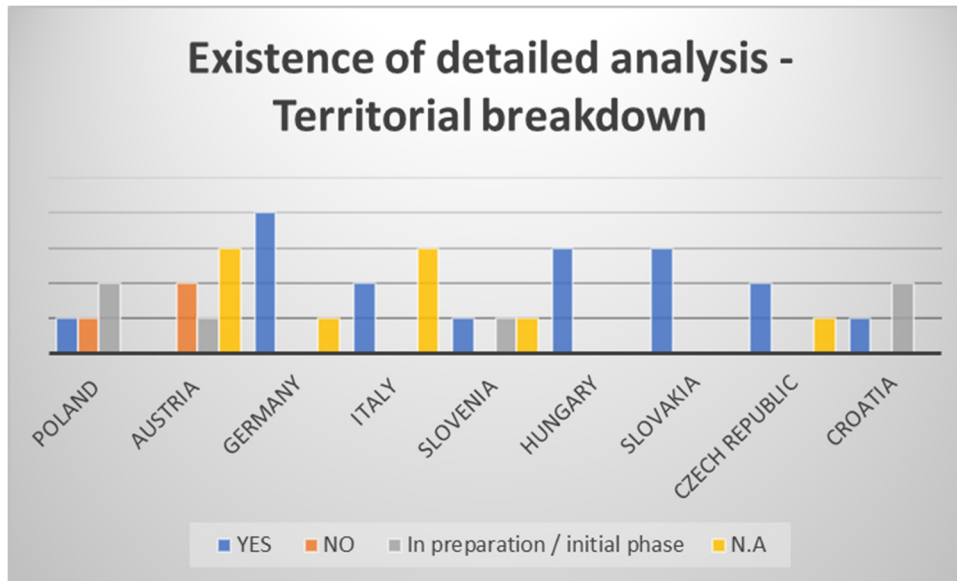
Figure 14 | Policy effectiveness review; territorial breakdown (Q4.5)

The bar chart above (Figure 14) reflects the existence of detailed analysis taken across the 9 countries.

The majority of the policymakers involved in the interviews from Germany, Hungary and Slovakia have stated that a detailed analysis has been conducted and exists, suggesting they have a clear and holistic picture of how current policies impact circular economy and digitalization goals. Half of the polish policy makers interviewed indicated that a detailed analysis is 'In preparation/initial phase', suggesting that they are in the process of conducting it.

One point to note is the responses given by the Austrian and Italian policymakers, who in the majority of cases either could not answer or did not have the information needed to answer (responses marked as "N.A."), indicating a gap in data that may need addressing to provide a complete picture of the analytical efforts across these territories.

The conclusions drawn from these observations suggest that while many territories are actively engaging with policy analysis and review to support the circular economy and digitalization, there is a clear indication that not all territories are at the same stage of implementation or evaluation. This disparity could point to the need for increased support, knowledge sharing, and capacity-building initiatives to ensure all territories can effectively contribute to and benefit from policies fostering circularity and digitalization.

There is a clear need for increased efforts in policy analysis across territories. Without a detailed understanding of existing policies, territories may struggle to effectively develop and implement strategies that support circular economy and digitalization goals. Territories that have completed their policy analyses could share insights and methodologies with those still in the initial phases or who have not yet begun. This could help accelerate the policy development process and promote a more uniform approach to achieving circular economy objectives.

5. Instruments and Measures

The following section explores the current state of measures and instruments available for small and medium-sized enterprises (SMEs) in the realm of digital transformation and circularity, as well as the support provided to Digital Innovation Hubs (DIHs) across the board brought out a multifaceted picture.

The current chapter examines policy makers' responses to specific inquiries about concrete action planning for policy implementation, support measures for SMEs in digitization and circular practices, and the current and potential support systems in place for DIHs to meet territorial expectations and foster digital-driven circularity. More in particular, The following questions were posed to policy makers:

5.1 - Is the implementation of existing policies supported by a concrete action plan, including responsibilities, timeline, and financial/human resources?

5.2 - What are the most relevant measures currently applied to support small and medium-sized enterprises (SMEs) in their digitization process?

5.3 - Current State - What do you, as a Policy-maker, do to support your DIH in providing relevant digital support to meet territorial expectations?

5.4 - What are the most relevant measures currently applied to support small and medium-sized enterprises (SMEs) in making their business more circular?

5.5 - Future State - What could you do to support your DIH to be a key player in fostering digital circularity?"

For the purpose of our analysis, Q5.2 and Q5.4 - on one side - and Q5.3 and Q5.5 from the onther one have been clustered to provide an overview of what the *current* and *future* state of the art is, respectively, with regards to manufacturing SMEs and DIHs when it comes to policy measures and support.

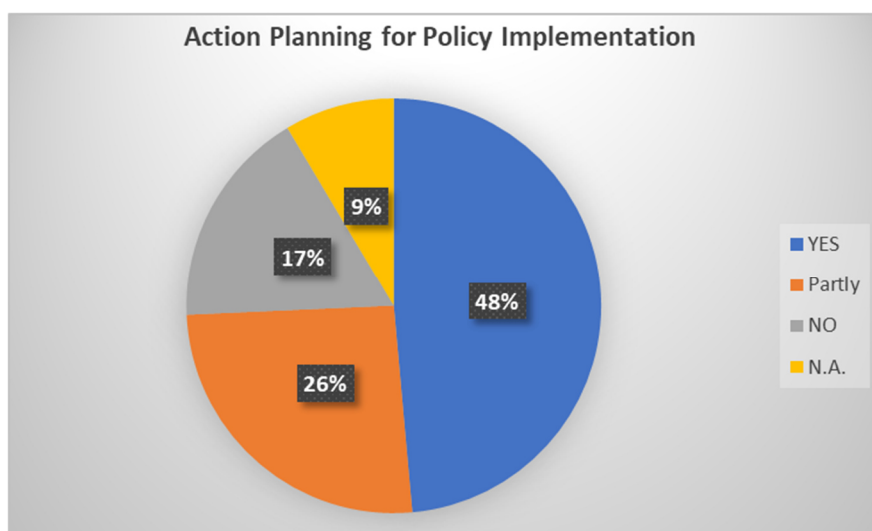**Action Planning for Policy Implementation (Q5.1)**

Figure 15 | Concrete action planning for policy implementation (Q5.1)

Based on the pie chart above, synthesizing the responses from policymakers across the Central Europe Programme Area to question 5.1, we can draw the following analysis and insights:

Almost half have complete action planning: 48% of policymakers indicate that there is a 'Yes' for concrete action planning, meaning that half of the territories have a comprehensive approach in place. This includes clearly defined responsibilities, established timelines, and allocated financial and human resources for policy implementation. This is a positive indication that there is a significant commitment to structured policy action in these regions.

26% of the responses indicate 'Partly', suggesting that while there is some level of action planning, it may not be fully comprehensive. These territories might have some components like responsibilities or timelines outlined but may lack sufficient financial or human resources, or vice versa. There may be room for improvement in ensuring that all aspects of concrete action planning are covered.

17% of responses marked 'No', signaling that in some territories there are no concrete action planning in place. This lack of planning could indicate potential areas for development where these regions could benefit from establishing more structured and detailed policy implementation plans.

3 out of 35 of the answers are marked as 'N.A.', which could mean that the question was not applicable to their territory or that there is a lack of information or awareness about such planning. This could also reflect areas where policy implementation is not as advanced or where new policies are not yet in consideration.

In the attempt to draw some useful conclusions at the "Country" level from the findings that emerged during the interviews with policymakers on the topic of action planning for policy implementation, the bar chart below reflects a multifaceted but interesting picture.
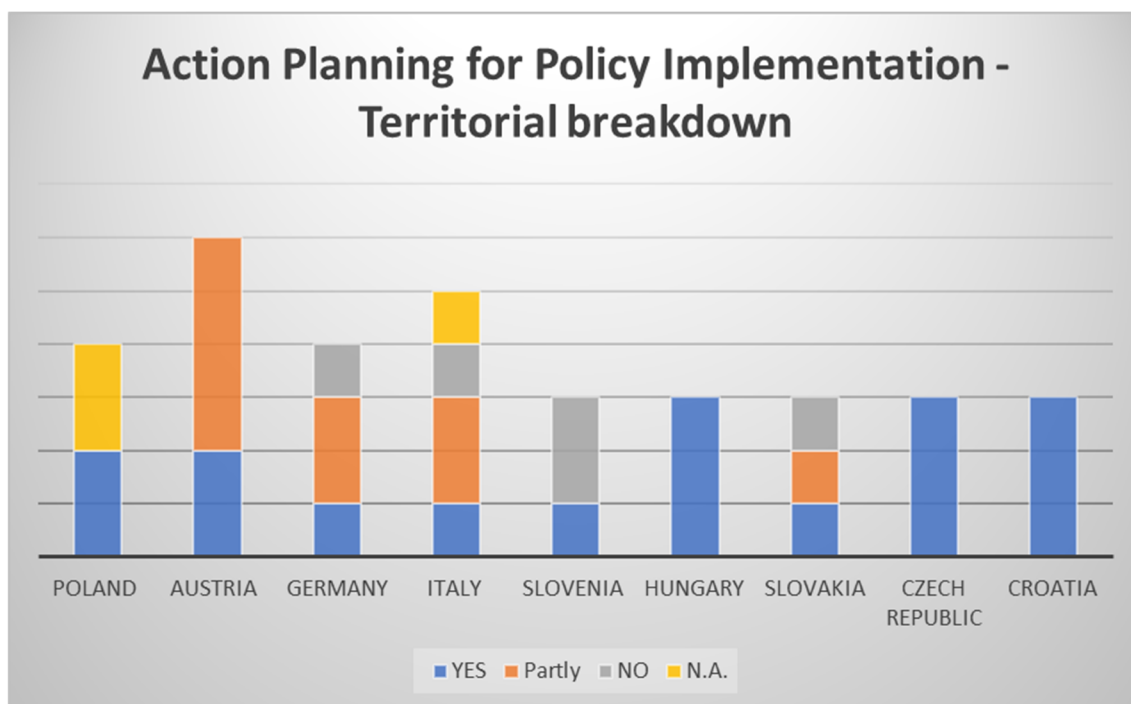

Figure 16 | Concrete action planning for policy implementation; territroial breakdown (Q5.1)

Overall, the chart reflects a varied approach to policy implementation planning across Central Europe, with some Countries being proactive and others showing gaps that may need to be addressed.

Hungary, Czech Republic and Croatia show full commitment to action planning with all the policy makers indicating that they have comprehensive action plans in place for policy implementation. Policy makers from Austria, Germany and Italy in some cases replied that while they have some level of action planning, it is not complete or may only cover certain areas / aspects. In half of the instances, Polish

policymakers pointed out that for certain policies, action planning data was either unavailable, deemed irrelevant, or was not evaluated during the interviews.

SME Policy support in Digitization & Circularity (Q5.2 and Q5.4)

In analysing the responses provided by policy makers regarding the measures currently applied to support SMEs in their digitization processes and in circularity, there appears to be a diverse range of actions and levels of knowledge across different regions. 5 policymakers have expressed a lack of knowledge or no competence in the subject, suggesting a potential gap in the strategic approach or a need for increased focus and resources in certain areas

While there is a mix of approaches and levels of implementation regarding digitization support for SMEs across different regions, common strategies include financial incentives, development programs focused on enhancing business environments and digital skills, collaborative platforms, and leveraging EU funds..

Initiatives in place for enhancing SMEs digitalisation include **financial support measures** (such as grants, open calls, tax incentives or vouchers for innovation) to promote their investments, to improve their business environments and generational change with modern technologies. Besides from financial aid provided at local, regional or national level, there is a mention of strategic programs that will be implemented using a combination of own funds, EU funds, and contributions from enterprises, indicating an integrated approach to financial planning for digitization support. Besides from financial support schemes, few territories listed (digital skills) training services among the measures in place for SMEs digitalisation, offering or facilitating access to training programs that equip SME employees with the necessary digital skills for the construction industry. The use of **collaborative platforms and data management tools** has been also highlighted, indicating an emphasis on shared resources and joint initiatives to aid in the digital transformation of SMEs. Finally, a particular emphasis on the role oft he DIHs services such as test before invest, technology readiness assessment, etc… has been given etc

The responses to question 5.4 provided by policymakers reflect, **similarly, various approaches** to aiding SMEs in transitioning towards more circular business practices and include measures to foster energy efficiency, encouraging the use of renewable energy sources, and upgrading infrastructure with energy-efficient technologies, the support for the creation of energy communities within territories (as a way to promote circular economy principles through shared sustainable energy practices), or again vouchers for Circular Economy Practices: For example, Slovenia is exploring vouchers and life cycle analysis (LCA) support through national funds as relevant measures . Innovation Programs, such as Programme ZIM in Germany provide substantial support for innovations, particularly for SMEs, which can contribute to circular economic practices. In addition, the development of workshops and educational initiatives for SMEs to understand and implement circular business models and practices have been highlighted, including raising awareness and helping SMEs see the value and future positioning of circular practices.

In summary, there is an emphasis on **education, financial support, infrastructure upgrades, regulatory guidance, innovation, and collaboration** to assist SMEs in becoming more circular. These efforts highlight an evolving framework for circular economy practices, underscoring the importance of a multifaceted approach that includes stakeholder engagement, practical initiatives, and policy support.

DIHs Policy Support for Digital Transformation & Circularity (Q5.3 and Q5.5)

Policymakers have acknowledged the significance of DIHs in meeting the digital needs of their territories. The measures include offering expertise and know-how, supporting through regional networking, and incorporating DIHs into strategic planning. However, some policymakers have indicated a lack of activities or the relevance of these actions in their regions or territories, showing a variance in engagement levels with DIHs.

Generally speaking, the role of DIHs is acknowledged as pivotal in driving both digital and circular transformations, with calls for enhanced collaboration and strategic resource allocation to empower these hubs to meet and exceed territorial expectations.

The overall impression is one of dynamic and evolving support structures, recognizing the varying needs and stages of development across different regions. As these strategies unfold, continuous evaluation and adaptation will be key to realizing the full potential of digital-driven circularity for SMEs and the broader economic landscape. For the future state, policymakers envision enhancing DIHs to be pivotal in fostering digital circularity. This includes interdisciplinary collaboration, pooling knowledge from various sectors, and building financial and shared value. There's a focus on integrating DIH activities with economic objectives and supporting innovation in digital technologies for the circular economy. Similar to the current state responses, some regions have not yet defined specific actions or regard this as not applicable, suggesting a disparity in future planning for DIH support across different areas.

For the future, there is an understanding of the need to support DIHs to lead in the digital circularity sphere. However, concrete plans and initiatives are still emerging, and in some cases, there is an apparent lack of direction or commitment. Furthermore, the disparity in responses suggests that while there is an overarching acknowledgment of the importance of DIHs, the execution of support strategies is inconsistent.

Regions that are actively engaging with DIHs may serve as models for others: looking ahead, there seems to be an aspirational alignment with the objectives of digital circularity, but it will require more concerted efforts and concrete action plans to realize this vision across all territories. The responses suggest a call to action for increased clarity and commitment to leveraging DIHs as catalysts for digital and circular economy advancements.

In conclusion, while the current state of DIH support shows variability, the vision for the future indicates an understanding of their importance. To capitalize on this, regions need to establish clearer strategies, action plans, and dedicated resources to empower DIHs to lead the transformation towards digital-driven circular economies. The evolution of DIH support from a state of variance to one of cohesive action will likely be pivotal in achieving the digital and circular goals of the Central Europe Programme Area.

6. Stakeholder's Engagement

The pathway to a sustainable future is underpinned by the transition to a circular economy—a transformative process that demands the collaborative effort of all sectors of society.

Our analysis of the interviews to the policy makers finally concentrated on the aspects related to stakeholder's engagement. The following chapter aims to dissect and understand the multifaceted roles and readiness of various territorial stakeholders in embracing this paradigm shift, by scrutinizing the major insights provided by policymakers in response to two critical questions:

6.1 Preparedness of Territorial Stakeholders for a Transition to a Circular Economy, assessing the current state of readiness among various territorial actors. It seeks to evaluate their understanding, capabilities, and willingness to adopt circular economy principles and to investigate the measures in place to enhance their preparedness for this transition.

6.2 Role of Multi-actor Approaches in Fostering Circular Economy: Here, the focus shifts to the synergistic potential of multi-actor approaches, exploring how collaboration between different stakeholders—including public authorities, private enterprises, academia, and civil society— is perceveid as a catalyst for the circular economy, driving innovation and ensuring that sustainable practices are integrated into the fabric of the territorial economy.

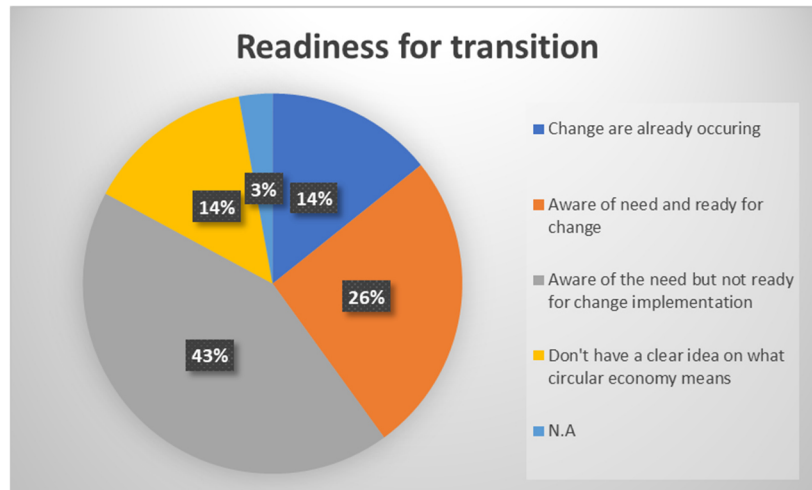**Preparedness of territorial stakeholders for transition (Q6.1)**

Figure 17 | Preparedness of territorial stakeholders for a transition to a circular economy (Q6.1)

Based on our analysis:

- **Aware but Not Ready for Change Implementation (43%):** A significant majority is aware of the necessity of a circular economy but has not yet taken steps towards implementation. This group may require additional support, resources, or information to move from awareness to action.

- **Aware and Ready for Change (26%):** nearly one third of stakeholders are those who recognize the need for a circular economy and feel prepared to initiate change. This suggests a significant level of engagement and readiness which bodes well for the implementation of circular practices.

- **Change Already Occurring (14%):** A small segment of policy makers are not just aware of the need for a transition to a circular economy but are actively engaged in making changes. This indicates a proactive segment that has already begun the process of transformation.

- **Lack of Clear Understanding (14%):** does not have a clear idea of what a circular economy entails, which could be a barrier to transition. Educational and informational efforts may be necessary to bring this group to a level of understanding that will enable participation in the circular economy.

- **Not Applicable Unknown (3%):** A small percentage is marked as N.A., which could indicate either that the concept of a circular economy transition is not relevant to their context or that data is missing.

The data reflects a **not so positive sign of engagement** among policy makers with **only 40%** either undergoing change or ready for it. For those aware but not ready, targeted interventions in capacity building, financial incentives, or clarity on policy could facilitate the next steps in their transition journey. The low percentage of N.A. responses suggests that resistance or irrelevance to the circular economy transition is minimal, indicating widespread acknowledgment of its importance. For effective transition, a focus on knowledge sharing, capacity building, and clear communication will be key strategies.
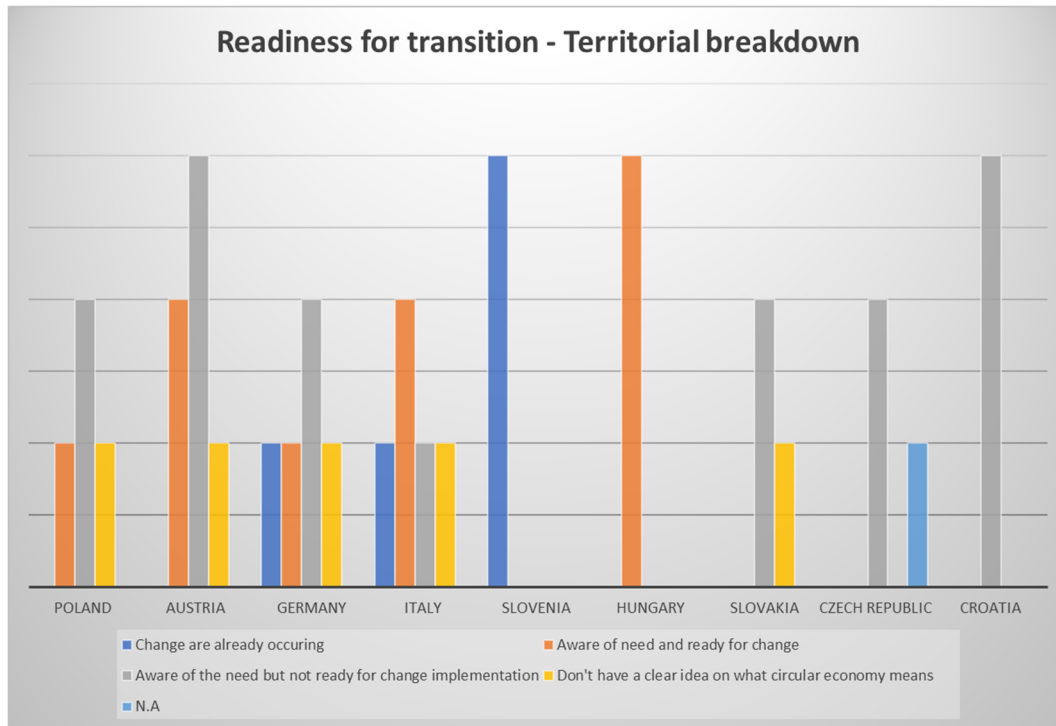
Figure 18 | Preparedness of territorial stakeholders for a transition to a circular economy; territorial breakdown (Q6.1)

There is a general awareness of the need for a transition to a circular economy across all countries, but the level of preparedness and readiness for actual implementation varies significantly. Based on policy makers' responses, Slovenia seems to be the most prepared, with a unanimous indication that change is already occuring while Hungary of awareness and readiness for change. Germany and Italy also seem to be "front runners" Countries with indications that a transition is already underway, although it is represented by a single policymaker in each case, suggesting some degree of active transition. Austria, Croatia and partly Slovakia show significant awareness but also a notable gap in readiness for implementation, suggesting potential areas for development.

Role of multi-actor approaches (Q6.2)

It is challenging to provide a definitive response when analysing the varied perspectives of policy makers on the role of multi-actor approaches in advancing the circular economy, especially given the open-ended nature of the inquiry. Nonetheless, our analysis has revealed a number of shared themes and clusters of insights:

- **Collaborative Networks and Education:** there is a common agreement on the necessity of collaboration across various sectors, including public administration, scientific institutions, businesses, and the community. For instance, the example from Małopolska shows an active platform promoting the principles of a circular economy. However, there is also a noted need for improved education to increase stakeholder activity, as seen in Poland's feedback.

- **Holistic and Coordinated Support:** Several territories - like Austria - acknowledge that joint coordination and multi-faceted support are essential for successful implementation. This includes harmonizing efforts across government, businesses, academia, and civil society.

- **Innovation and Resource Optimization:** in Countries such as Italy and Germany, there is a belief that multi-actor approaches facilitate innovation, effective policy-making, and optimization of resources which are critical for the advancement of the circular economy.

- **Structural and Regulatory Support:** Interesting inputs from Germany and Hungary highlights that political and infrastructural support, including regulations, financial incentives, and institutional roles, are vital for fostering circular practices.

- **Economic and Community Engagement:** The feedback from Hungary, Slovakia, and Croatia emphasizes the role of financial institutions, industry associations, and consumer engagement in promoting sustainable consumption patterns and economic development.

Across the board, while there is optimism about the benefits of a multi-actor approach, there are also challenges mentioned, such as the limited direct involvement of certain agencies and the need for greater engagement and education. For example, Slovenia notes that despite the will and ambition, concrete results are not as prominent. Different regions express varying levels of preparedness and existing initiatives. For instance, Italy's representatives feel moderately prepared, whereas the Czech Republic notes minimal current activity.

From these insights, we can conclude that while the concept of multi-actor approaches is widely recognized for its importance in fostering a circular economy, the degree of implementation and effectiveness varies across regions. There is a clear call for improved education, enhanced collaboration, and the development of supportive frameworks that can be adapted to local conditions and capabilities. This feedback also indicates a growing awareness and commitment to circular economy principles but highlights the need for a more cohesive and inclusive approach to achieve significant progress.

7. Conclusions from the Policy Makers' Interview series

Digital-driven circularity is gaining traction as a vital model for achieving sustainable development goals across Central Europe. Policymakers play a crucial role in fostering this transformation through regulatory frameworks and innovation ecosystems and almost all of them are aware of the importance played by digital transformation as a vital enabler for the circular economy transition.

Nevertheless, the general picture reflects a very complex and multifaceted situation, with diverse engagement level among Countries and relevant territories, driven by differing priorities, resources and mesures and encountered challenges. The commitment also varies significantly across regions and intervention "levels" (namely, local, regional and national), with differences stemming from varied governance structures and territorial priorities. Policymakers vary in their commitment levels, with some treating the circular economy as a top priority, while others acknowledge its importance but are yet to integrate it into their main policy agendas.

Similarly, territories are at different stages in the transition from a linear to a circular economy, with some just beginning to integrate principles and others actively developing strategies and implementing instruments and tangible resources, with a noticeable gap among the territories "analysed", between policy design and actual implementation. The role of DIHs is oftenly recognized as crucial for driving digital and circular transformations, however, there is a significant share of policymakers indicating insufficient access to stakeholders and services from DIHs, suggesting under-resourced hubs or ineffective connectivity.

A greater alignment in the responses given was found in identifying the challenges and needs perceived by manufacturing companies of the 3 VCs addressed by the SMART CIRCUIT project in the territories where the interviewed policy makers operate. Excluding a significant portion of respondents who could not provide details, possibly suggesting a lack of alignment or connection with the local production

activities, the entire audience included technological barriers, the need for innovation in sustainable materials, energy-efficient methods and waste recovery technologies as the most recurrent challenges and needs SMEs are facing. Similarly, challenges with data accessibility and management, and the integration of small suppliers emerged as evident, pointing to the need for comprehensive data management systems and technological enablement, but also financial barriers and regulatory hurdles have been listed, with a call for investments support measures in technology and more clear political frameworks. Finally, from the analysis emerged that knowledge and expertise gaps in circular practices still exist across the territories, highlighting the need for training and education initiatives.

Based on policymakers' feedbacks we can draw the following conclusions highlighting different levels of readiness among the 9 Countries object of investigation, laying the ofundations for collaboration and future policy options:

Interest and Commitment to Circular Economy (Q2.3): There is a spectrum of interest in CE, with Poland, Germany, and Italy indicating a top priority, suggesting a robust framework for CE transition. The majority of policymakers recognize CE as important, but it competes with other priorities, indicating a need for balanced advancement. A gap in understanding the CE in some territories calls for increased education and knowledge sharing, particularly from countries like Poland, Germany and Italy where CE is recognised as a top priority.

Digitalization's Role in CE (Q2.4): Digitalization is universally acknowledged as a facilitator for CE, but its integration varies, presenting an opportunity for cross-country collaboration and experience sharing. Advanced digital nations, such as Austria and Germany, could support others with less developed digital infrastructures through knowledge transfer and joint initiatives.

DIHs in Digital Transformation (Q2.5): DIHs are critical for the digital transition but face varying challenges regarding stakeholder access and service quality. Countries with DIHs that are perceived as effective from their own policy makers, like Italy, could provide case studies and support to other Countries where DIHs lack, such as in the case of Slovakia.

Policy Landscape on CE and Digitalization (Q4.1): Countries are at different stages of policy development; from the responses given by policymakers, countries like Germany, Hungary and Slovakia show active policy implementation. Poland and Croatia, indicating many policies designed but not yet implemented, could benefit from partnership with these active implementers to move forward.

Policy Effectiveness Review (Q4.5): A disparity in policy analysis across territories highlights a need for a more systematic approach, possibly through a collaborative platform where best practices and methodologies can be exchanged.

Action Planning for Policy Implementation (Q5.1): Comprehensive action plans in Hungary, the Czech Republic and Croatia showcase their readiness, offering insights for countries with partial plans like Austria, Germany, and Italy. For countries like Austria, indicating partly action planning data, collaboration with Hungary or the Czech Republic could provide a framework for development.

Preparedness of Territorial Stakeholders (Q6.1): Slovenian policy makers displayed readiness of their stakeholders for Circular Economy, while Hungary is aware and prepared for change, both potentially serving as models for other nations. The need for stakeholder education and engagement is evident, suggesting a role for multi-country workshops and collaborative learning experiences.

To conclude, from the analyses carried out following the interviews , the transition to a circular economy in Central Europe seems to be moving at different speeds, influenced by diverse regional contexts and readiness levels. The readiness for circularity shows indeed significant variation across the nine countries, with some, like Slovenia, Hungary, Germany, and Italy, demonstrating stronger frameworks or active engagement in transitioning towards CE. Other countries show awareness but require further

development in policy implementation and stakeholder engagement. This presents an opportunity for more advanced Countries to support less prepared ones through collaborative efforts, shared learning, and the exchange of best practices. The overarching theme suggests that an integrated approach, leveraging digital transformation and multi-actor cooperation, is crucial for a successful transition to a circular economy across Central Europe.

Policymakers are tasked with the crucial role of aligning strategies, resources, and stakeholders towards a common goal of sustainability; success will depend on a nuanced approach that addresses the specific challenges and leverages the unique opportunities within each territory. With this regard, we have reported and clustered below some useful insights:

- **Capacity Building and Education:** There is a need for capacity building or educational programs to increase stakeholder activity and readiness for the transition.

- **Infrastructure and Accessibility**: Enhancing the infrastructure and accessibility of Digital Innovation Hubs is crucial. Policymakers should focus on expanding these hubs' reach and improving the relevance and quality of their services.

- **Supportive Frameworks**: Policymakers should work on developing and implementing supportive frameworks that facilitate multi-stakeholder collaboration and integrate circular economy principles into policy frameworks.

- **Resource Allocation**: Allocating resources effectively to support the implementation of existing policies and developing concrete action plans that include responsibilities, timelines, and financial/human resources.

- **Engagement and Collaboration:** There is a clear call for greater engagement and collaboration among all stakeholders, including public administration, businesses, academia and the wider community.

F. Insights from the transnational panel (Krakow, 27.4.23)

1. Introduction

Alongside the SMART CIRCUIT Kick-off Meeting, the "**Green transformation - from vision to action**" International Conference has been held in Krakow on April 27, 2023 at the premises of the Krakow Technology Park. The conference gathered a large number of European experts to present the best practices in design for a circular economy and technologies for advanced circular production, and ended with presentations of the latest trends in hydrogen technology.

The conference has been organized within a framework that involved various stakeholders and initiatives dedicated to promoting the green transformation and circular economy. The conference's organization and thematic focus were influenced by the collaboration of different entities, including government bodies, educational institutions, industry representatives, and international projects like SMART CIRCUIT.

KPT (SMART CIRCUIT Lead Partner) organised and hosted the conference, emphasizing its commitment to fostering innovation and supporting the transition towards a circular economy; its involvement reflects its broader goals of driving technological advancement and sustainability in the region. The **Małopolska Region** has supported the initiative, underscoring the importance of local government involvement in advancing green transformation initiatives. Speakers and panellist involved included the **Deputy Marshal of Małopolska Region**, **Witold Kozłowski** who opened and welcomed as a special guest, highlighting the regional government's commitment and support for circularity. Further representatives of the Małopolska Office of the Marshal and the Regional Group for Development of Hydrogen Technologies were present at the conference, as part of the broader regional support and involvement in promoting green transformation.

Representatives of the **European Commission, Rosalinde van der Vlies** and **Peter Dröll** from the General Directorate for Research and Innovation of the European Commission, in introduction emphasized the importance of green transformation. Topics related to the circular economy occupy a high place on the agenda of the European Union, and the European Green Deal, a key strategy for the circular economy.

Besides from local and international high-level stakeholders, the conference featured representatives from SMART CIRCUIT consortium, namely Austria, Germany, Slovenia, Slovakia, Czechia, Hungary and Italy. SMART CIRCUIT project, has been introduced in the conference as a significant initiative for sustainable transformation in the Central Europe Programme Area, designed to foster the adoption of circular and sustainable practices within various sectors.

The central theme of the morning session was dedicated to product design as a very important factor in circular production. The representatives of the company **Ergo Design Sp. z.o.o.** spoke about their experiences on how to design products to be in accordance with the principles of the circular economy. Ultimately, company's intervention was about how to increase the awareness of the company to behave more responsibly and design products for reuse, disassembly or repair. Various successful examples and experiences from Austria and the Czech Republic were presented, which show that successful cooperation between the business and scientific community, including the use of innovative intelligent materials, can make the most of the potential of green production in solving existing environmental problems. In particular it is worth mentioning **Intemac Solutions** (partner of SMART CIRCUIT project) that shared insights into advanced manufacturing systems and the integration of green and digital technologies in industrial practices, illustrating the company's role in promoting industry 4.0 and circular

economy solutions, or the Austrian **STENUM** that offered examples of circular economy practices in production and business models, focusing on resource efficiency, waste reduction and sustainable business practices.

Regional cooperation for a Green Europe was also highlighted with a dedicated panel discussion debating whether European regions have an obligation to create circular economy strategies and roadmaps towards green transformation with a look at green initiatives in Małopolska, the Czech Republic, Hungary, and Austria.

The afternoon session entitled "**Hydrogen – fuel of the future**?" delved into the potential of hydrogen as a key component of the future's sustainable energy landscape. This session brought together experts to discuss various facets of hydrogen energy, ranging from its feasibility, opportunities, and associated risks to its practical applications and strategies for fostering collaboration between scientific communities and local governments. The session featured examples of hydrogen applications aimed at inspiring local governments to consider hydrogen technologies in their sustainability strategies, underscoring the evolving dialogue on hydrogen energy, highlighting its potential as a transformative fuel for the future while acknowledging the complexities involved in its adoption and implementation. The discussions provided a comprehensive overview of the current state of hydrogen technology, its implications for sustainability, and the collaborative efforts needed to realize its full potential in the green transformation journey.

Picture 1 and 2 – "Green transformation – from vision to action" International Conference | Krakow, April 27, 2023 (pictures provided with the courtesy of KPT)

2. Insights from Policy Makers and stakeholders

2.1 Insights from Policy makers

The International Conference provided a wealth of insights and strategic considerations regarding the circular economy and its integration with digital and technological advancements. Notably, representatives from the European Commission, **Rosalinde van der Vlies** and **Peter Dröll**, alongside the Małopolska representative, Deputy Marshal **Witold Kozłowski**, offered valuable perspectives.

Deputy Marshal **Witold Kozłowski** focused on regional efforts and the importance of collaboration among various stakeholders to drive the green transformation forward. The deputy marshal emphasized the significance of regional initiatives in Małopolska for developing a circular economy, including the establishment of hydrogen technologies as a clean energy source. He highlighted the value of engaging public administration, research institutes, academia, and businesses in collaborative efforts to exchange knowledge and driving innovation towards circularity. Furthemore he pointed out the necessity of raising

awareness about green transformation and circular economy practices among various groups, including the general public, businesses, and policymakers.

European representatives emphasized the urgent need to transition from a linear to a circular economic model to address the unsustainable consumption of resources. Their discussion highlighted the pivotal role of the **CEAP - The European Commission's Circular Economy Action Plan**, as part of the broader European Green Deal, which underscores the necessity of moving towards sustainable practices that reduce resource consumption and waste production. The Commission is focusing on regulatory measures and promoting innovations that span the entire lifecycle of products, from design to disposal. This includes efforts to make products more sustainable, encourage circular processes, and ensure waste is efficiently managed and recycled. But, as they added, the transition to a circular economy is not only an environmental imperative but also presents a strong business case. By adopting circular models, firms can significantly reduce material costs and dependence on finite resources, thus improving profitability and resilience. The importance of **supporting SMEs** through access to infrastructure, business, and regulatory consulting to bring innovative circular economy solutions to the market was highlighted. Their discussion also touched on the **critical role of materials**, advocating for the use of renewable and recyclable materials and the elimination of toxic substances to facilitate recycling and circularity. Additionally, the panellists underscored the critical need for a systemic shift towards a circular economy, driven by **both regulatory measures and innovative practices**. In this framework, policymakers are urged to:

- Foster Regulatory and Supportive Frameworks that incentivize sustainable practices and circular business models.

- Promote Collaboration and Knowledge Sharing among all stakeholders to accelerate the adoption of circular economy principles.

- Invest in Education and Awareness to build a culture of sustainability that permeates all levels of society and industry.

- Encourage Technological Innovation that supports circularity, including the development of sustainable materials and the integration of digital solutions.

- Consider Regional and Local Initiatives as essential components of the broader strategy to achieve a sustainable and circular future.

Their insights provide a roadmap for policymakers to navigate the transition towards a circular economy, emphasizing the importance of regulatory support, innovation, and multi-stakeholder collaboration.

2.2 Insights from the transnational panel

During the Transnational panel "**Shaping together greener Europe in an open innovation ecosystem**", regional support instruments, as well as local strategies, action plans and initiatives, that will ensure a green transition, were presented.

Moderated by **Monika Machowska** (Krakow Technology Park), green initiatives in Małopolska, the Czech Republic, Hungary, and Austria have been illustrated by the relevant stakeholders, who shared their perspectives and initiatives from their respective regions.

Distinguished speakers, including Jerzy Kopeć from the Marshal's Office of the Małopolska Region, Miroslav Londyn from the South Moravian Innovation Centre, Martin Dan from the Pannon Business Network in Hungary, Klaus Oberreiter from Business Upper Austria shared their insights on circular economy's potential to drive a greener Europe within an open innovation ecosystem.

Małopolska Region (Poland)

Jerzy Kopeć (Marshal's Office of the Małopolska Region, Poland), emphasized the importance of regional initiatives in fostering a circular economy and how his Regional administration is actively developing **diagnosis for its circular economy**, aiming to establish strategic operational directions.

The region's focus on hydrogen as an alternative, eco-friendly energy source underlines its commitment to innovative economic development and environmental sustainability. The **Silesian- Małopolska Hydrogen Valley** was established on 31 January 2022, to be seen not only an implementation of the Polish Hydrogen Strategy but also an important step towards innovation and decarbonisation of the Polish economy. The Hydrogen Valley aims to become a supra-regional place for launching specific projects within the hydrogen economy, including those based on hydrogen production in electrolysis process with the use of energy produced from the Renewable Energy Sources (RES) installations, its use in power engineering e.g. heat, transport and infrastructure as well as industry.

The commitment from the Regional Administration and the consideration of this close cooperation in the region is also demonstrated by the establishment of the Małopolska Innovative Center for Storage and Transport of Hydrogen, aimed at fostering the region's hydrogen related initiatives and the establishing of a Regional Working Group for the Development of Hydrogen Technologies.

South Moravia (Czech Republic)

Miroslav Londyn (South Moravian Innovation Centre, Czech Republic) highlighted the role of innovation centers in bridging the gap between research, industry, and circular economy practices; through collaboration and knowledge exchange, the South Moravian Innovation Centre supports the adoption of sustainable practices and technologies, thereby promoting a circular economy in the whole region.

Mr Londyn, working as a sustainability advisor at the South Moravian Innovation Center, plays a crucial role in bridging the gap between startups' current practices and the long-term benefits of sustainability. His main focus is to integrate sustainability into the services offered to startups, a topic increasingly prevalent among companies, yet still facing significant awareness and implementation gaps. Miroslav's role involves educating companies about sustainability and helping them identify and execute specific steps towards sustainable practices. He emphasized that sustainability and circular economy principles are not exclusive to manufacturing but are **also relevant for IT companies** and those without physical products. Through his example of an IT company providing logistics software, he has demonstrated how repositioning a product as not only a cost-saving solution but also as a means to reduce pollution and carbon footprint can significantly benefit the company. This shift in communication strategy not only boosted sales and prepared the company for future legislation but also addressed their challenge of attracting developers by highlighting their contribution to reducing traffic congestion and implementing green solutions.

Municipality of Szombathely (Hungary)

Martin Dan (Pannon Business Network, Hungary) discussed the significance of industry collaboration and digitalization in achieving circular economy goals. His organisation, the Pannon Business Network is partner of the SMART CIRCUIT project and works towards integrating digital technologies with circular practices to enhance resource efficiency and sustainability in manufacturing sectors. Mr Dan reported on the Municipality of Szombathely main initiatives and strategies

The local vision toward digital-driven circularity in Szombathely revolves around integrating digital technologies with sustainable practices to create a closed-loop system. Ultimately, the vision aims to align digital advancements with sustainability objectives, creating an interconnected system where technology drives circular practices, resource efficiency, and environmental consciousness within the

city of Szombathely. In particular, he mentioned the main strategic documents the Hungarian city has adopted such as the **"Szombathely2030" strategy** which aims to establish a crisis-resistant knowledge economy, focusing on creating quality, sustainable jobs, promoting industrial diversification with a focus on health industries and high-value production, and enhancing the city's resilience to economic challenges. The program also emphasizes developing an environmentally sustainable and intelligent city, utilizing innovative, green technologies, and smart city solutions to improve residents' quality of life and attract new businesses. Furthemore, the following strategies and action plans have been adopted by Szombathely and briefly illustrated:

- **"Sustainable Urban Development Strategy"** with a major focus on enhancing energy efficiency, promoting renewable energy, improving waste management, and advancing sustainable transportation. The strategy seeks to reduce CO_2 emissions, foster economic growth, and improve the quality of life for residents.

- **"Sustainable Energy and Climate Action Plan" aiming** at reducing CO_2 emissions in Szombathely by 2030, focusing on enhancing energy efficiency, promoting renewable energy, and improving public transportation. It targets sustainable urban development, involves community education, and fosters climate resilience. The strategy aligns with national and global environmental goals, emphasizing innovation and green infrastructure investment to create a sustainable, energy-efficient city.

- **"Hydrogen Strategy"**, which plans to integrate hydrogen technology into public transportation and city services, reducing carbon emissions and fostering urban sustainability.

Oberösterreich (Austria)

Klaus Oberreiter (Business Upper Austria, Austria) presented on the efforts of Business Upper Austria in advancing circular economy through technological innovation and collaboration among businesses, academia and government highlighting the importance of the policy to foster the paradigm shift.

The region promotes an open innovation ecosystem that encourages collaboration between businesses, academia and government entities. Mr Obereitter cited the #upperVISION2030 as the current strategy for business and research policy in Upper Austria, with a central focus on skills and technologies towards 4 main pillars : 1) Fit for Digital Age; 2) Fit for Sustainable Solutions; 3) Fit for Human-Centered Technology and 4) Fit for New Mobility.

With regard of Sustainable solutions, Mr Oberreiter mentioned the **Sustainable Plastics Solutions – Roadmap**. Starting from the vision of positioning Austria as a recognized model region for sustainable plastic solutions and circular economy, Business Upper Austria, together with the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation, and Technology, initiated a structured process to achieve this vision. The goal was to create a technology roadmap with a timeline up to 2030, with specific action options for Design4Circularity; Collection, sorting, and recycling and Materials, technologies, as well as research and development.

Upper Austria have interesting public funding available for projects that contribute to sustainability and the circular economy. Financial Schemes in Upper Austria is focused on driving innovation in sustainable plastics through various financial instruments, such as grants and incentives aimed at research and development in the circular economy.

The insights from the transnational panel "Shaping together greener Europe in an open innovation ecosystem" illustrated the diverse approaches and commitment across regions to foster a greener Europe. The discussed initiatives and strategies underscore the **critical role of regional support instruments,** the **integration of digital and technological advancements** and the importance of **multi-stakeholder collaboration** in achieving a sustainable and circular future.

Furthemore, relevant stakeholders have been involved in the afternoon in two panel sessions entitled "Inspirations for Local Governments" and "Building Cooperation between Science and Local Governments" in the field of hydrogen. During the first session, it has been underscored the need for local governments to adopt innovative hydrogen technologies as part of their sustainability strategies. Dr. **Andrzej Czulak** (MCH2) and **Robert Rusyniak (**Protium) presented practical use cases illustrating how hydrogen energy can be integrated into local infrastructure, from public transportation to energy supply systems. This part of the conference emphasized the tangible benefits of hydrogen energy, including its potential to significantly reduce carbon emissions and dependency on fossil fuels. The "Building Cooperation between Science and Local Governments" panel discussion highlighted the critical importance of establishing strong partnerships between scientific research institutions and local government bodies to foster the development and implementation of hydrogen energy projects. Contributions from Prof. **Magdalena Dudek** (AGH University of Science and Technology) and Dr. **Katarzyna Stec** underscored the synergy that can be achieved when academic research and policy-making align towards common sustainability goals. The dialogue pointed towards the necessity of creating platforms for knowledge exchange, technical support, and joint initiatives to drive the adoption of hydrogen technologies.

The two afternoon panels conveyed a strong message about the potential of hydrogen to significantly contribute to the green transformation, highlighting the urgency of adopting relevant technologies, the importance of cross-sectoral collaboration and the role of policymakers in facilitating this transition.

Major insights from the two afternoon sessions morning are following listed:

- **Hydrogen as a Key to Sustainable Energy Transition:** hydrogen has to be considered not just as an alternative fuel, but as a cornerstone of the future green energy landscape. Emphasis was placed on hydrogen's role in achieving decarbonization targets and enhancing energy security.

- **The Need for Cross-Sector Collaboration:** The success of integrating hydrogen technologies relies heavily on collaborative efforts across various sectors, including academia, industry, and government. Establishing multi-stakeholder partnerships is essential for sharing expertise, leveraging resources, and coordinating actions towards a common vision.

- **Investment in Research and Development:** There is a clear call for increased investment in R&D activities to innovate and improve hydrogen production, storage, and distribution technologies. Such investments are crucial for overcoming technical barriers and making hydrogen solutions more accessible and cost-effective.

- **Educational and Awareness Initiatives:** Educating the public and local government officials about the benefits and applications of hydrogen energy is vital for building support and fostering an environment conducive to the adoption of hydrogen technologies.

- **Development of Regulatory Frameworks:** The creation of supportive regulatory environments that encourage the use of hydrogen energy, provide financial incentives, and establish clear standards and guidelines is necessary for the growth of the hydrogen sector.

3. Key topics discussed

The " Green Transformation: from vision to action" International Conference served as a platform to showcase the diverse initiatives and approaches required to navigate the transition to a circular economy. By highlighting projects like SMART CIRCUIT, promoting the development of (Green) Digital Innovation Hubs, and exploring circular design strategies, the conference underscored the critical role of digital innovation, policy support, and collaborative networks in driving sustainable change. These discussions laid the groundwork for future policy options and strategic considerations for SMART CIRCUIT partners and policymakers, emphasizing the need for integrated solutions that leverage technology, design, and cross-sectoral collaboration to achieve circularity and sustainability.

The conference featured a robust lineup of discussions, case studies, and expert insights, particularly during the panel sessions, which illuminated the multifaceted approach required to drive the green transformation forward.

The following paragraphs highlight the key (main) topics addressed and discussed throughout the entire duration of the conference.

3.1 Digital Innovation & Circular Economy: Green Digital Innovation Hubs

Digital innovation hubs and the integration of digital technologies in promoting circularity were highlighted as important themes since they focus on leveraging technology to enhance resource efficiency, waste management, and sustainable production processes.

Within the framework of the conference, Green Digital Innovation Hubs (G-DHIs) were spotlighted as instrumental platforms in catalysing the transition to a digital-driven circular economy. The discussions, moderated by **Agnieszka Włodarczyk-Gębik** (KPT), illuminated their multifaceted role in fostering innovation, supporting businesses, especially SMEs, and facilitating the integration of green and digital technologies. The (G)DIHs will effectively bridge the gap between digital innovation and sustainable development, providing a platform for collaboration among businesses, research institutions but also policymakers.

G-DHIs have been indeed envisioned as ecosystems where technology and sustainability intersect to drive forward the principles of a circular economy. The conference underscored how these hubs act as catalysts for innovation, providing the infrastructure, networks, and resources necessary for developing and testing sustainable technological solutions that align with circular economy principles. A significant aspect of the G-DIHs discussed at the conference was indeed their role in supporting businesses in their green transition. By offering access to the latest digital tools, expertise, and funding opportunities, they can empower businesses to adopt more sustainable practices. This is particularly vital for SMEs, which may lack the resources to invest in digital transformation on their own. Another critical dimension of G-DIHs explored during the conference was their contribution to education and skill development: as the demand for green jobs increases, those hubs play a pivotal role in preparing the workforce with the necessary skills to thrive in a circular economy. From workshops on circular design principles to training in the use of AI for sustainability, G-DIHs will be essential in building a skilled workforce that can support the transition to more sustainable economic models.

3.2 The importance of circular design

A significant part of the discussion revolved around circular design strategies as a vital component of the transition to a circular economy. **Ergo Design Sp. z.o.o**, a Polish design consultancy, highlighted the importance of designing products with their end-of-life in mind, promoting durability, reparability and

recyclability. Circular design not only reduces waste and conserves resources but also opens up new business models centered around product-as-a-service, thereby extending product lifecycles and enhancing consumer engagement. The discussion illuminated how circular design goes beyond mere waste reduction, aiming to fundamentally re-envision the way products are conceived, produced, and utilized. The emphasis was on integrating sustainability at the very outset of product development, ensuring that products are designed for longevity, reparability, and recyclability. Circular Design Strategies prioritize **durability and reparability** as core principles. Th panellists highlighted how these principles could significantly extend the life cycle of products, thereby reducing the demand for raw materials and minimizing waste. This approach not only conserves resources but also offers consumers value through products that stand the test of time and are easier to repair. Experts at the conference shared insights on innovative design techniques and materials that could enhance the durability and reparability of products, ultimately fostering a more sustainable consumption model.

Another focal point of the speech, as previously mentioned, was the importance of **designing products with their end-of-life** in mind. This entails selecting materials and designing products in a way that facilitates easy disassembly and recycling. The panel emphasized how such design choices could significantly streamline the recycling process, ensuring that materials can be effectively recovered and reused, thus closing the loop in the product lifecycle. This strategy not only mitigates environmental impacts but also aligns with the economic imperatives of resource efficiency. Speakers have also explored how product design can **influence consumer habits** towards more sustainable practices. By creating products that are not only sustainable but also appealing and functional, designers can encourage consumers to choose products that contribute to a circular economy. The discussions pointed towards the need for awareness and education to shift consumer preferences and behaviours, highlighting the role of design in making sustainable choices the more attractive and convenient option. A significant part of the conversation around Circular Design Strategies revolved around their potential to spur **innovative business models**, such as product-as-a-service. This model decouples ownership from usage, allowing consumers to access the benefits of a product without owning it. This not only reduces material consumption but also opens up new revenue streams for businesses. The conference showcased examples of how circular design principles could be the foundation for these innovative business models, providing practical pathways for companies to integrate circular economy principles into their operations.

3.3 Renewable Energy and Resource Management

Initiatives related to **renewable energy sources**, and the efficient management of resources were emphasized. Panellists underscored the necessity of integrating renewable energy sources, such as solar photovoltaic (PV) systems, and the innovative management of resources to foster sustainable industrial practices and reduce carbon footprints, so as part of a broader strategy to reduce energy consumption and promote renewable energy sources.

Renewable energy, particularly the utilization of photovoltaic systems, emerged as a cornerstone for enterprises aiming to pivot towards greener operations. Discussions highlighted successful case studies where businesses implemented PV systems to significantly cut energy costs and contribute to environmental sustainability. The embrace of renewable energy is portrayed not just as an environmental commitment but as a **strategic economic advantage**, offering a return on investment within a few years thanks to supportive EU funding and incentives.

Effective resource management was another focal point, touching on the critical evaluation of material and energy flows within production processes. The narrative illustrated how companies are increasingly adopting circular principles by optimizing the use of raw materials, reducing waste, and repurposing by-products. This approach not only mitigates environmental impacts but also enhances operational efficiency and cost-effectiveness and, in this sense, companies should be encouraged to explore energy

efficiency measures to not only mitigate environmental impacts but also achieve cost savings in the long term.

Technological innovation stands out as a key enabler for both renewable energy integration and resource management. Advanced analytical tools and management systems allow for the meticulous monitoring and optimization of energy consumption, waste production, and resource utilization. Technology also facilitates the transition to renewable energy sources by enabling more efficient energy storage and consumption models.

3.4 Education and Awareness campaigns

The " Green Transformation: from vision to action" International conference highlighted the significance of education and awareness campaigns in **driving the transition** towards a circular and green economy, since they have a pivotal role in fostering a deeper understanding and commitment towards sustainability and circular economy practices among various stakeholders, including businesses, educational institutions, policy makers and the general public.

Discussions stressed the importance of **incorporating sustainability topics into educational curricula** across different levels, from primary education to higher learning institutions. This approach is seen as fundamental in cultivating a future workforce that is not only knowledgeable about sustainability practices but also skilled in implementing them. There was a notable focus on **raising awareness among businesses** about the benefits and necessity of adopting circular economy practices. In particular,discussions pointed out that while awareness is growing, there remains a substantial need to engage companies more deeply in understanding how sustainability can be a driving force for innovation and competitiveness, particularly for SMEs. The role of **public engagement campaigns** in shifting consumer behavior towards more sustainable choices have been highlighted: it was acknowledged that changing consumption patterns plays a crucial role in driving demand for circular products and services, thereby encouraging businesses to innovate and adapt. Finally, emphasis was placed on the importance of **sharing success stories and best practices** as a means of inspiring action and demonstrating the tangible benefits of transitioning to a circular economy. These stories serve as powerful tools for education and awareness, showcasing the feasibility and advantages of sustainable practices.

To sum up, the discussions at the conference made it clear that education and awareness are critical **enablers for the successful transition to a circular economy**. These insights from the conference underscore the collective responsibility of educational institutions, businesses but also policymakers in fostering a culture of sustainability that supports the transition to a circular economy.

3.5 Policy and Regulatory framework for Hydrogen

During the conference, discussions on Policy and Regulatory Frameworks were highlighted by various speakers, focusing on the challenges and necessities for a supportive legal environment to foster the development and implementation of sustainable technologies. In particular, the need for clearer regulations and strategic plans was a common theme, with a focus on creating a supportive environment for the deployment of hydrogen related technologies.

One of the main challenges emphasized during the afternoon session was the **lack of clear and transparent legal regulations** concerning hydrogen application and its implementation across industries. The absence of clear guidelines creates uncertainty for entrepreneurs and public administrations alike, making it difficult to proceed with confidence in investment and operational decisions.

There is a **need for comprehensive legislation** since there a fragmentation of legal provisions across various departments and ministries, which often results in conflicting regulations, is still present. The

suggestion was made to consolidate these provisions into a single legislative act, such as a "Hydrogen Act" or a "Hydrogen Strategy," to provide predictability for businesses and public administrations.

Another critical issue raised was the **lack of specific guidelines within construction law** to accommodate hydrogen installations. The absence of regulatory clarity on where and how hydrogen installations should be placed hampers the ability of the public administration to issue necessary permits, thereby creating a significant barrier to the deployment of hydrogen-based solutions.

Last but not least, the discussions highlighted that financing and legal uncertainties act as **significant brakes on the industry's developmen**t. With the industry currently not being economically viable without clear regulatory support and predictable financial and legal frameworks, there is a pressing need for action to prepare for a boom expected in the years 2030-2040, driven by rising emissions costs and diminishing CO_2 emissions permits. As industries navigate the complexities of implementing sustainable solutions, collaborative efforts in developing regulations that support innovation while ensuring safety, environmental protection, and economic viability has become more and more topical

3.6 Collaboration and knowledge sharing

Throughout the conference, the emphasis was placed on the **power of collaboration and knowledge sharing as enablers of the green transformation**. The successful implementation of circular economy practices requires a concerted **effort across Sectors, Regions and Disciplines**.

The conference further illuminated the importance of collaboration among various stakeholders, including **businesses, governmental bodies and policy makers and educational institutions**, to drive the green transformation forward. By sharing knowledge, resources, and best practices, these partnerships magnify the impact of circular economy and resource management initiatives, setting a precedent for a sustainable industrial future.   This perspective was woven throughout various discussions, highlighting that the transition towards circular economy practices and the integration of green transformations are not solitary endeavours but collective journeys that require the active participation and cooperation of diverse stakeholders. A **multi-stakeholder approach** fosters a holistic understanding of the challenges and opportunities inherent in the green transformation, ensuring that efforts are synergistic and inclusive. Representatives from businesses spoke to the value of forming alliances with research institutions to drive innovation, while policymakers underscored the importance of creating regulatory environments that encourage sustainable practices across all sectors.

The discussions highlighted not only the importance of local and national collaboration but also the potential of **transnational partnerships**. Panellists pointed out that environmental issues know no borders; thus, the solutions shouldn't either. The conference called for stronger transnational networks to share insights, technologies, and strategies that have been successful in one region and could be adapted and applied in another. This approach leverages the collective knowledge and resources of multiple regions to tackle shared environmental challenges more effectively.

A key topic of discussion was the development and utilization of **digital platforms** specifically designed for knowledge sharing among stakeholders involved in the green transformation. Such platforms might serve as repositories of case studies, best practices, technological advancements, and policy developments. They are crucial for disseminating valuable information that can accelerate the adoption of circular economy principles and sustainability practices across industries and regions.

As previously introduced, **Education** emerged as a foundational element of collaboration and knowledge sharing; educators and academic institutions were recognized for their role in shaping future leaders who are well-versed in sustainability and circular economy concepts. The integration of these themes into curricula across disciplines — from engineering to business and environmental sciences — prepares

a workforce that is equipped to address the challenges of the green transformation with innovative solutions.

4. Conclusions and takeways from the conference

The **"Green transformation - from vision to action"** International Conference discussions highlighted several key aspects and provided a rich platform for discussing the circular economy's integration with digital and technological advancements.

Policymakers, industry representatives, and academic experts shared their valuable insights on transitioning towards sustainable manufacturing practices, with a particular focus on textiles, ICT and electronics, and construction and buildings. Their related Value chains face the common challenge of reducing waste, enhancing sustainability and incorporating digital technologies to optimize resource use.

- For **Textiles**, the focus is on sustainable materials and recycling practices to address the industry's significant environmental footprint.

- In **ICT and electronics**, the rapid pace of technological change and the resulting e-waste present challenges for sustainable design and recycling.

- The **Construction and Buildings** sector must prioritize the use of sustainable materials, energy efficiency, and innovative construction methods to minimize environmental impact.

During the entire conference, **digitally & technologically driven solutions** have been considered of paramount importance to reach the paradigm shift. Digital technologies, such as IoT, AI, and blockchain, offer unprecedented opportunities for tracking resource use, enhancing supply chain transparency, and facilitating the adoption of circular economy models. Technology-driven platforms can foster collaboration across value chains, enabling the sharing of best practices, innovative solutions, and promoting circular design principles. In the quest for a sustainable future, the **transformation of traditional business models** is pivotal. An emerging paradigm that captures the essence of this shift towards sustainability is the concept of prioritizing service over product ownership. Models such as Product-as-a-Service (PaaS) stand at the forefront of this transformation, championing the principles of the circular economy by promoting reuse, repair, recycling, and upcycling. These innovative business models not only offer a pathway to minimize environmental impact but also present new opportunities for economic growth and consumer engagement. Recognizing the potential of such models, it becomes **imperative for policymakers** to play a supportive role. By crafting conducive incentives and regulatory frameworks, policymakers can significantly bolster the development and adoption of these sustainable business practices, fostering an environment where innovation and collaboration thrive, paving the way for a greener, more circular economy.

As we navigate the complexities of transitioning towards a more sustainable and circular economy, the **role of policy in shaping the future** cannot be overstated. The foundation for this transition lies in the continuous advancement of circular economy technologies and sustainable manufacturing practices. To this end, policies must be strategically oriented to nurture **innovation and development** within this sphere. Providing financial incentives, tax breaks, and funding opportunities for startups and small and medium-sized enterprises (SMEs) at the forefront of circular solutions is crucial for sparking significant transformations. Furthermore, the establishment and **enforcement of robust regulatory frameworks** and standards are essential components in this equation. Policymakers are tasked with the development of regulations that not only promote but necessitate the adoption of circular economy practices, including extended producer responsibility (EPR) schemes, recycling mandates, and the establishment

of standards for sustainable materials. Achieving **harmonization of these standards** at the European Union level is a critical step towards facilitating cross-border collaboration and ensuring a uniform approach to sustainability, thereby creating a level playing field for all stakeholders involved.

In the pivotal journey toward a circular economy, the power of education and awareness cannot be underestimated. As we seek to transform our relationship with the environment and the economy, cultivating a deep understanding and appreciation for circular economy practices among both consumers and businesses becomes imperative. Initiatives aimed at raising awareness not only illuminate the myriad benefits of adopting circular principles but also empower individuals and organizations to make informed decisions that contribute to sustainability. Moreover, embedding circular economy principles into educational programs across all levels promises to sow the seeds for a future generation of environmentally conscious citizens and professionals. By fostering an early and robust appreciation for sustainability, these educational endeavours lay the groundwork for long-lasting change, ensuring that the principles of the circular economy are not just adopted but are woven into the very fabric of our society.

Panellists at the conference underscored the urgency of transitioning to a circular economy, emphasizing the synergistic role of digital technologies and innovation in achieving sustainability goals. **For policymakers, the key takeaway is the need for integrated approaches that combine regulatory support, investment in R&D, and efforts to foster a culture of sustainability and innovation.**

To conclude and sum up, the main policy recommendations emerged during the conference and its transnational panel are aimed at:

- **Enhancing Cross-Sector Collaboration:** The successful integration of technologies and circular economy practices relies on collaborative efforts across academia, industry and government sectors. Establishing multi-stakeholder partnerships is crucial for sharing expertise and coordinating actions towards common sustainability goals.

- **Investing in Innovation and R&D:** Increased investment in research and development activities is essential to innovate and improve technologies related to hydrogen production, storage, distribution, and circular economy solutions. Such investments are vital for overcoming technical barriers and making sustainable solutions more accessible and cost-effective.

- **Fostering education and Public Awareness:** Raising awareness about the benefits and applications of hydrogen energy and circular economy principles among the public and local government officials is key to building support and fostering an environment conducive to sustainable technologies.

- **Developing Supportive Regulatory Frameworks:** Creating supportive regulatory environments that encourage the use of sustainable energy, provide financial incentives, and establish clear standards and guidelines is necessary for fostering innovation and ensuring a sustainable future.

The insights from the panel underscore the urgency of adopting sustainable technologies, the importance of collaborative efforts, and the role of policymakers in facilitating the green transition. Through targeted investment, education, and regulatory support, regions can effectively navigate towards a sustainable, circular, and greener Europe. By focusing on these strategic areas, policymakers can drive the adoption of circular economy practices across key manufacturing value chains, paving the way for a sustainable industrial future.

G. Conclusions

The key objective of this report was to consolidate insights gathered from the SMART CIRCUIT Policy-Makers' Interview Series and the transnational panel ("**Green transformation - from vision to action**" International Conference, Krakow April 27, 2023).

In particular, the **interviews** conducted with policy makers assessed their perspectives and level of engagement regarding the transition towards a digital-driven circular economy, delving into the current state of digital and circular practices, the readiness and challenges faced by manufacturing industries, and the effectiveness of existing and potential policy measures to support such a transition. The interviews outlined the landscape of digital and circular integration within different sectors, including construction, ICT/electronics, and textiles, highlighting the unique challenges and needs within each. Furthermore, they explore the development and implementation of strategic policies and plans related to circular economy and digitalization, evaluating the availability and effectiveness of tangible resources, policy instruments, and stakeholder engagement mechanisms to foster a sustainable, circular, and digitally advanced economic model. Coupled with **discussions from the transnational panel** during the "Green transformation - from vision to action" International Conference, the interviews have provided significant insights about the readiness in the transition a digital-driven circular economy across Central Europe.

Through the analysis of data provided covering in total 9 Countries across Central Europe cooperation area, evident patterns emerged, revealing common challenges faced across industries despite territorial-specific nuances. The major conclusions focusing on key insights and strategic considerations, policy recommendations to navigate the complexities of sustainable development effectively and future policy options are listed below.

Strategic Considerations:

- **Varied Commitment and Stages of Transition**: There is a diverse level of engagement and commitment among Countries and territories, with ones placing the circular economy as a top priority while others recognize its importance but haven't fully integrated it into policy agendas. Territories are also at different transition stages, from those just beginning to integrate circular economy principles to those actively developing strategies and implementing measures.

- **Digital Transformation as an Enabler:** Digitalization is acknowledged as a critical facilitator for the circular economy, though challenges such as technological barriers, data management issues, and insufficient infrastructure persist. Digital Innovation Hubs (DIHs) are recognized for their role in driving transformation, yet many face issues of accessibility and connectivity.

- **Manufacturing Challenges and Needs:** The manufacturing sector, particularly in textiles, ICT/electronics, and construction, confronts challenges including waste reduction, sustainable practices, and the incorporation of digital technologies. The need for innovation in materials, energy efficiency, and waste recovery technologies is paramount.

Policy Recommendations

- **Capacity Building and Education:** Enhance stakeholder activity and readiness for transition through capacity building and educational programs, emphasizing the sustainable and digital economy's benefits, also through knowledge sharing of best practices.

- **Infrastructure and Accessibility:** Improve the infrastructure and accessibility of DIHs to expand their reach and improve the relevance and quality of their services, supporting a smoother transition to circular practices.

- **Supportive Frameworks:** Develop and implement frameworks that facilitate multi-stakeholder collaboration and integrate circular economy principles, ensuring a unified approach across different sectors and territories.

- **Resource Allocation:** Allocate resources effectively to support policy implementation, including clear action plans that encompass responsibilities, timelines, and the necessary financial and human resources.

- **Engagement and Collaboration:** Foster greater engagement and collaboration among all stakeholders, including public administration, businesses, academia, and the community, to drive a comprehensive and inclusive transition.

- **Strategic Vision and Implementation:** Base future policy options on a strategic vision that includes detailed analysis, robust planning, and clear directives for implementation, addressing the specific challenges and leveraging the unique opportunities within each territory.

Future policy options:

- **Cross-Sector Collaboration:** Encourage collaborative multiactorial efforts across academia, industry, and government sectors to share expertise and coordinate actions towards sustainability goals.

- **Innovation and R&D Investment:** Increase investment in R&D to innovate and improve technologies, making sustainable solutions more accessible and cost-effective.

- **Education and Public Awareness:** Build support and foster an environment conducive to sustainable technologies by raising awareness about the benefits and applications of hydrogen energy and circular economy principles.

- **Supportive Regulatory Frameworks:** Create regulatory environments that encourage the use of sustainable energy, provide financial incentives, and establish clear standards and guidelines.

The transition to a circular economy, underpinned by digital transformation, presents a complex but feasible challenge for Central Europe. By addressing these key themes and implementing the recommended policies, policymakers can play a pivotal role in aligning strategies, resources, and stakeholders towards a sustainable future, fostering a resilient, circular, and digitally advanced economic model.

H. Appendix

Appendix 1 - Survey

Template to report on Policy-makers' interviews

Each PP should fill in 3 templates before the end of period 2 corresponding on each of the interview (Local, Regional, National) and should be completed by a short video provided to PBN for CDE purposes. Each of the templates can be completed by different persons within the same organisation. Please specify these different persons and their affiliation to the organisation interviewed (department or expertise of this person).

This template is organized under the following structure:

2. Administrative information

3. General knowledge towards digital-circularity

4. Challenges towards digital-driven circularity in the manufacturing industries

5. Strategy Development

6. Instruments and Measures

7. Stakeholder's Engagement

8. Their potential involvement within SMART CIRCUIT

This structure should facilitate the discussion from general knowledge and interpretations to SMART CIRCUIT specific focus on manufacturing and digital-driven circularity.

Important note: Each template must be associated to one short video answering three questions (See Section 2.6 from the Guidance report D.2.2.1)

Reporting Template	
1 - Administrative Information	
1.1 - Name of the PP	Choose your PP Name
1.2 - Date of interview (Provide a picture/screenshot if online meeting/ signed paper or photo if physical)	[Free Text Response]
1.3 - Policy-maker Type	Wählen Sie ein Element aus.

1.4 - Description of the Policy-maker(s) interviewed; *Please provides information on all person who provided information* *E.g. Name of Policy-maker(s) interviewed, Organisation, Territory they represent*	[Free Text Response]

2 – General knowledge towards digital-circularity

2.1 - What is **your role** or interest in the area of circular economy or digitalisation?	[Free Text Response]
2.2 - What is the **status quo** of the transition from a linear economy to a circular economy within your region?	[Free Text Response]
2.3 - How **interested** is your administration on the topic of circular economy?	Select in the list below Wählen Sie ein Element aus.
2.4 - How do you see the **role of digital transformation** supporting your territory's transition towards circularity?	[Free Text Response]
2.5 - How relevant is your **territorial DIH** for preparing stakeholders for digitalisation transformation?	Select in the list below Wählen Sie ein Element aus.

3 – Challenges towards digital-driven circularity in the manufacturing industries

3.1 - What are the **primary challenges** and needs met by **manufacturing industries** to be more circular? (general) *Please consider addressing different organisation's members to specifically address the focused value chains.*	[Free Text Response]
3.1.1 - Construction Focus	[Free Text Response]

3.1.2 - ICT/ Electronics Focus	[Free Text Response]
3.1.3 - Textile Focus	[Free Text Response]

4 – Strategy development	
4.1 - What about simplifying the question: **What is the state of development** of your policies /plans**/strategies** on circular economy and digitalisation?	Select in the list below Wählen Sie ein Element aus.
4.2 – **If exists,** 4.2.1 – What is the **name** of the plan/strategy 4.2.2 - **When** was it approved 4.2.3 - **What was the process** of plan/ strategy preparation – open, consulted, top-down, bottom - up 4.2.4 - **What stakeholders** were involved and at which stages? 4.2.5 - What new **financial or methodology** instruments were introduced to support implementation? 4.2.6 – What is the role that **internationalization** played to deliver your strategy? *To be inserted in the excel (1) Factsheet – General Overview) towards the delivery of D223* 4.3 **- If doesn't exist,** 4.3.1 - Which **department is responsible** for plans & strategies towards **the topic of circular economy and digitalisation?** **4.3.2 - What additional actions** has your territory taken to be more circular? E.g. 1) Survey undertaken 2) Policy responsible identified 3) Strategy and Resolutions drafted, 4) Special bodies formulated	[Free Text Response]

4.4 - What is **tangibly** available at your territorial level to foster digital-driven circularity in line with your strategic documents? *Please provide hyperlinks* E.g. Reports, Databases, Plans, Strategies	[Free Text Response]
4.5 - Is a detailed analysis of existing policies already undertaken and available, including a review of policy instruments which are already in place (e.g. rules, regulations, voluntary sector-based partnerships and existing programmes, financial instruments, vouchers, dedicated competitions for SMEs)?	[Free Text Response]

5 – Instruments and Measures

5.1 - Is implementation of existing policies supported by a concrete action planning, including responsibilities, timeline, and financial/human resourcing?	[Free Text Response]
5.2 - Which are the most **relevant measures** currently applied to support small and medium-sized enterprises (SMEs) in their **digitization process**?	[Free Text Response]
5.3 – Current State - What do you, **as a Policy-maker, do** to support your DIH to provide relevant digital support to meet territorial expectations?	[Free Text Response]
5.4 – Which are the most **relevant measures** currently applied to support small and medium-sized enterprises (SMEs) to make their business more **circular**?	[Free Text Response]
5.5 – Future State - What could **you do to support your DIH to be a key player to foster digital circularity**?	[Free Text Response]

6 – Stakeholder's Engagement

6.1 - How prepared do you feel **your territorial stakeholders** are for a transition to a circular economy and meeting circular economy regulations	Select in the list below Wählen Sie ein Element aus.
6.2 - How do **multi-actor-approaches** foster future circular economy for your territory?	[Free Text Response]
6.3 - What stakeholders are important to be part of a dialogue on the challenges to transitioning to a circular economy in the **manufacturing sector**?	[Free Text Response]
6.4 - Are there **further relevant contacts** we should make in your territory in the field of digitalisation or circular economy or other fields, which could benefit our holistic understanding of digitally-driven circularity challenges?	[Free Text Response]

7 - Further involvement in SMART CIRCUIT

7.1 - Would you – as a policy maker – be interested in **getting in touch** with other regional policy making players? If yes, do you have any preferences in terms of topics, areas, etc? *E.g. Participating in the Transnational Panel; join the Strategic Board of the Project*	[Free Text Response]
7.2 - Which **running initiatives** (for instance, projects) would you recommend to be included in our strategic planning for SMART CIRCUIT?	[Free Text Response] 1) 2) 3) …

7.3 - Hyperlink to pictures, signed papers tec. (Any proof to testify on the interview implementation)	[Free Text Response]
8 - Additional comments	
[Any additional comments]	

Appendix 2 - The List of Interviewed Policy Makers

The list of all the companies participating in the analysis can be found below:

No.	Policy Maker	Country	Type
1	Ministry of Agriculture and Rural Development - Department of Agricultural Markets and Rural Energy Transformation	Poland	National
2	Małopolska Region	Poland	Regional
3	Krakow Metropolis Association	Poland	Local
4	Municipality Office in Skawina	Poland	Local
5	Burgenland state administration Agriculture, nature and climate protection Department and Energy and Climate Protection Department	Austria	Regional
6	Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology (BMK)	Austria	National
7	GMAR	Austria	Regional
8	Business Upper Austria	Austria	Regional
9	Wirtschaftsagentur Burgenland (Burgenland Business Agency)	Austria	Regional
10	University of Applied Science in Burgenland	Austria	Local
11	German Bundestag of the electoral district Freiburg	Germany	National
12	Ministry of Economy, Labor and Tourism	Germany	Regional
13	FWTM and Circular Black Forest initiative	Germany	Local
14	Circular MTC e.V. Saxony	Germany	Regional
15	LVR Landesverband für Recycling e.V. Institut für Abfall und Kreislaufwirtschaft (Institute of Waste and Circular Economy)	Germany	Regional
16	Confindustria, DIH Liguria	Italy	National
17	Polo regionale ligure di ricerca e innovazione "Energia, Ambiente, Sviluppo Sostenibile" (Polo EASS)	Italy	Regional
18	Cluster Tecnologico Nazionale «Fabbrica Intelligente»	Italy	National
19	Regione Autonoma Friuli Venezia Giulia	Italy	Regional
20	Munipality of Maniago (Pordenone)	Italy	Local
21	Republic of Slovenia Ministry of Cohesion and Regional Development Smart Specialisation Coordination Unit	Slovenia	National
22	Chamber of Commerce and Industry Slovenia	Slovenia	National
23	Center for technology and Innovation; SRIP Factories of the Future - Josef Stefan Institute	Slovenia	National
24	Scientific Association for Mechanical Engineering	Hungary	National
25	Vas County Chamber of Commerce and Industry	Hungary	Regional
26	Municipality of Szombathely	Hungary	Local
27	Office for Spatial Planning and Construction of the Slovak Republic	Slovakia	National
28	Slovenská agentúra životného prostredia – Slovak Agency of Environment (SAŽP)	Slovakia	Regional

29	City of Kosice	Slovakia	Local
30	Ministry of Environment of the Czech Republic, Department of Circular Economy and Waste Management	Czech Republic	National
31	South Moravian Region, JIC (South Moravian Innovation Agency)	Czech Republic	Regional
32	Brno City Municipality and Metropolitan Area Department of Strategic Development and Cooperation	Czech Republic	Local
33	HAMAG BICRO (NGO founded by Republic of Croatia)	Croatia	National
34	Croatian Chamber of Economy - Varaždin County Chamber	Croatia	Regional
35	Zagreb University	Croatia	Local

Appendix 3 – Agenda of the Int.l Conference "Green Transformation: from vision to action" (Krakow, 27.04.23)