



# COLLABORATIVE ROBOTICS FOR CIRCULAR ECONOMY IN MANUFACTURING SECTORS

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Identification of National Strategies,  
Policies and Agendas related to CE



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## Table of Content

1	Introduction.....	3
2	National Strategies, Policies and Agendas related to Circular Economy and Collaborative Robotics .....	3
2.1	Spain .....	3
2.1.1	Summary of Strategies, Policies and Agendas related to Circular Economy .....	3
2.1.2	Summary of Strategies, Policies and Agendas related to Collaborative Robotic .....	4
2.1.3	Conclusion .....	5
2.2	Germany .....	5
2.2.1	Summary of Strategies, Policies and Agendas related to Circular Economy and Collaborative Robotics in Germany.....	5
2.2.2	Regional strategies and plans .....	6
2.2.3	Conclusion .....	13
2.3	Austria .....	13
2.3.1	Summary of Strategies, Policies and Agendas related to Circular Economy in Austria	13
2.3.2	Summary of Strategies, Policies and Agendas related to Collaborative Robotics in Austria	14
2.3.3	Conclusion .....	15
2.4	Poland.....	15
2.4.1	Summary of Strategies, Policies and Agendas related to Circular Economy and Collaborative Robotics in Poland .....	15
2.4.2	Conclusion .....	18
3.	Conclusion.....	18



# 1 Introduction

CROCEMS is an ERASMUS+ project, that aims to fill a gap in vocational education and training and create a new course focusing on the introduction and implementation of circular economy in manufacturing sectors by using collaborative robotics to perform waste management.

In joint cooperation between the partners Atmoterm (Poland), CETEM (Spain), Deusto (Spain), Karlsruhe University of Applied Sciences - HKA (Germany), and Vienna University of Technology - TU Wien (Austria), the aim is to create and deliver a comprehensive training course on how to apply collaborative robotics to circular economy processes (sensor planning system for vision, reusable piece-recognition or disassembly of valuable materials) in order to boost the most effective waste management in European Manufacturing Sectors, helping to reduce its impact while creating job positions, enabling new manufacturing processes, business models and industrial symbiosis

The current document defines the consortium partners countries frameworks, regarding strategies, policies and agendas related to Circular Economy and Collaborative Robotics. Each partner presents an excerpt from the currently valid or adopted strategies, and agendas or regulations. The report presents an excerpt of applicable regulations and political orientations and is not exhaustive.

## 2 National Strategies, Policies and Agendas related to Circular Economy and Collaborative Robotics

### 2.1 Spain

#### 2.1.1 Summary of Strategies, Policies and Agendas related to Circular Economy

##### 2.1.1.1 Regulation

- [Law 7/2022, of April 8, on waste and contaminated soils for a Circular Economy.](#)
- [Law 22/2011 of July 28 on waste and contaminated soils](#)
- [Law 11/1997, of April 24, on Packaging and Packaging Waste](#)
- [Royal Decree regulates the disposal of waste by landfilling](#)

##### 2.1.1.2 Guides, reports and plans

- [State Waste Management Framework Plan \(PEMAR\) 2016-2022](#)
- [State Waste Prevention Program](#)
- [Spanish Circular Economy Strategy](#)
- [New framework for municipal waste management.](#)
- [Recovery, Transformation and Resilience Plan.](#)
  - [C12.R2 Waste policy and promotion of the Circular Economy.](#)
  - [C12.I2 Program to promote industrial competitiveness and sustainability.](#)
  - [C12.I3 Support plan for the implementation of waste regulations and the promotion of the Circular Economy](#)
  - [C12.I5 Aid scheme to support key sectors of the Circular Economy.](#)



### 2.1.1.3 Standards

- **UNE-EN 17366:2021** Waste management - Access control to collection containers - Identification and authorization
- **UNE-EN 17367:2023** Waste Management - Data communication between communication management system and the back office system for stationary waste collection containers - Functional specification and the semantic data model
- **UNE-EN 14803:2021** Identification and/or determination of the quantity of waste
- **UNE-EN ISO 14001:2015** Environmental management systems — Requirements with guidance for use
- AENOR **"ZERO WASTE"** CERTIFICATE

## 2.1.2 Summary of Strategies, Policies and Agendas related to Collaborative Robotic

### 2.1.2.1 Regulation

- Royal Decree 1215/1997 of July 18, which establishes the minimum health and safety provisions for the use of work equipment by workers.
- Royal Decree 1644/2008, of October 10, which establishes the rules for the marketing and commissioning of machines
- Royal Decree 494/2012, of March 9, which modifies Royal Decree 1644/2008, of October 10, which establishes the rules for the marketing and commissioning of machines, to include the risks pesticide application

### 2.1.2.2 Guides, reports and plans

- Guide to application of the Machinery Directive 2006/42/EC
- National IC Strategy 4.0: The National Strategy IC 4.0. includes support programmes such as the 'Activa Financing' programme, which aims to support projects that promote digital transformation, specifically in the field of **collaborative robotics**.
- "Acelerapyme Plan"
- Recovery, Transformation and Resilience Plan. Component 12: Industrial Policy Spain 2030
  - C12.R2 C12.I2 Program to promote industrial competitiveness and sustainability.

### 2.1.2.3 Standards

#### Robotic safety

- **UNE-EN ISO 10218-1:2012** Robots and robotic devices. Safety requirements for industrial robots Part 1: Robots.
- **UNE-EN ISO 10218-2:2011** Robots and robotic devices - Safety requirements for industrial robots - Part 2: Robot systems and integration

#### Safety of machinery

- **UNE-EN ISO 13849-1:2016** Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2015)
- **UNE-EN 60204-1:2019** Safety of machinery - Electrical equipment of machines - Part 1: General requirements
- **UNE-EN ISO 14120:2016** Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards (ISO 14120:2015)
- **UNE-EN ISO 16092-1:2018** Machine tools safety - Presses - Part 1: General safety requirements (ISO 16092-1:2017)



- **UNE-EN ISO 12100:2012** Safety of machinery - General principles for design – Risk assessment and risk reduction (ISO 12100:2010)
- **UNE-EN ISO 11161:2009** Safety of machinery - Integrated manufacturing systems - Basic requirements (ISO 11161:2007)

### 2.1.3 Conclusion

In conclusion, Spain has demonstrated a proactive approach towards fostering both Circular Economy practices and the integration of collaborative robotics within its industrial landscape. The regulatory framework, encompassing laws, royal decrees, and standards, provides a solid foundation for guiding and governing activities in these domains. Spain's comprehensive approach, integrating regulations, strategic plans, and adherence to international standards, positions the country well to advance its objectives in both Circular Economy practices and collaborative robotics, contributing to sustainable development and industrial competitiveness in the long run.

For Circular Economy initiatives, Spain has enacted legislation such as Law 7/2022, emphasizing the importance of waste management and contaminated soils for achieving a circular Economy. Additionally, strategic documents like the Spanish Circular Economy Strategy and the Recovery, Transformation, and Resilience Plan underline the country's commitment to transitioning towards a more sustainable and resource-efficient model. Standards like UNE-EN 17366:2021 and UNE-EN ISO 14001:2015 further support the implementation of effective waste management practices and environmental management systems.

In the realm of collaborative robotics, Spain has established regulatory measures, including royal decrees and guidelines, to ensure the safety and proper utilization of robotic systems in industrial settings. The National IC Strategy 4.0 and programs like the 'Activa Financing' initiative reflect efforts to promote digital transformation, specifically in the realm of collaborative robotics. Standards such as UNE-EN ISO 10218-1:2012 and UNE-EN ISO 13849-1:2016 play a crucial role in guaranteeing the safety and reliability of robotic systems and machinery.

## 2.2 Germany

### 2.2.1 Summary of Strategies, Policies and Agendas related to Circular Economy and Collaborative Robotics in Germany

The National industry 4.0 in Germany aims to make Germany ready for the future digitalisation of the industry and production. Standardization into the industry 4.0 is making its way onto a factory and the manufacturing sector. The use of the digital technologies enables the transformation into the smart factory and optimize the performance and the production process.

Many organisations and research centres in Germany have been supporting the industry 4.0 concept and encourage the transformation. They tried to formulate a recommendation and develop a transformation-roadmaps for the integration into the Industry 4.0. Many frameworks and applications have been developed to support and optimize the manufacturing industry, they use various number of new technologies like data analytics and artificial intelligence, virtual and augmented reality, cheap advanced sensors, internet of things and next generation Internet, collaborative robots and programmable materials.



## 2.2.2 Regional strategies and plans

The continuation of RIS, which should define the state into the next funding period, was developed within the framework of a coordinated dialogue with business (including companies, associations, trade unions), science (including universities and research institutions) and society and it was evaluated by individual innovation policy measures and scientific research institutes.

In the following sections, a short overview of the future and the continuation of the RIS strategy in the different federal states.

### RIS strategy in Baden-Württemberg (2021-2027)<sup>1</sup>

Baden-Württemberg as many other federal states in Germany attaches importance to digitalisation on the basis of Industry 4.0. The overarching thematic areas of the state's innovation strategy focus on future technologies, key competencies, as well as resource and climate protection. The RIS BW (2021-2027) will align with the principles of Industry 4.0 and will be oriented towards the following main goals:

- Further increase in research and development intensity (R&D intensity) (increasing the public share of investments and greater participation of small and medium-sized enterprises (SMEs) in R&D investments).
- Enhance attractiveness of the research location (strategic expansion of infrastructures, focus on cross-cutting technologies, technology promotion, support for sustainable science and research).
- Strengthening research close to industry (e.g. artificial intelligence, IT security, robotics, energy and storage technologies, quantum technologies, nanotechnology).
- Increase innovation dynamics (shorten time to market readiness, greater involvement of SMEs in innovations, promotion of startups).

### RIS3 strategy in Bavaria (2021-2027)<sup>2</sup>

The strategic orientation of future RIS3 BY (also known as "Innovationsland.Bayern") aimed in particular at securing the position in the competition for innovation leadership in Germany and Europe (second place in a comparison of federal states). Bavaria defines five fields of specialisation (SF):

- Energy (clusters: energy technology, environmental technology)

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<sup>1</sup> RIS3 strategy in Baden-Württemberg: <https://wm.baden-wuerttemberg.de/de/service/presse-und-oeffentlichkeitsarbeit/pressemitteilung/pid/wirtschaftsministerium-foerdert-regionale-innovationssysteme-mit-rund-26-mio-euro?highlight=RIS-Strategie%20%28Research%20and%20Innovation%20Strategies%20for%20Smart%20Specialization%29>

<sup>2</sup> RIS3 strategy in Bayern: [https://www.stmwi.bayern.de/fileadmin/user\\_upload/stmwi/e-paper/index.php?catalog=28-02-2022\\_Innovationsland-Bayern](https://www.stmwi.bayern.de/fileadmin/user_upload/stmwi/e-paper/index.php?catalog=28-02-2022_Innovationsland-Bayern)



- Mobility (clusters: aerospace, automotive, railway technology)
- Digitalisation (clusters: power electronics, mechatronics & automation, sensor technology)
- Life science & health (clusters: biotechnology, nutrition, medical technology)
- Materials (clusters: chemistry, forestry and wood, industrial biotechnology, MAI carbon biotechnology, MAI Carbon, nanotechnology, new materials)

In contrast to the previous strategy, the update of the innovation strategy takes into account intersections with other country-specific strategies and initiatives such as central themes and measures of the topics and measures of the bioeconomy strategy and the high-tech strategy.

The High-Tech Agenda in the future will focus in particular on the key innovation impulses in the AI and "SuperTech" (including quantum technology, aerospace and clean tech).

### **RIS3 strategy in Berlin/Brandenburg (2021-2027)<sup>3</sup>**

The states of Berlin and Brandenburg adopted its Joint Innovation Strategy to the "innoBB 2025". In particular, innoBB 2025 focuses on cross-cluster initiatives and identifies the following topics, which will form binding priorities in the work of all clusters: Digitalisation, Reallabs & Testfields, Work 4.0 and Skilled Workers, Start-ups and Foundations.

For the use of EU funds in the funding period 2021 - 2027, the state government determines the following for state policy priorities and cross-cutting tasks applicable to all funds:

State policy priorities:

- Innovation and economic change
- Better educational opportunities and development of labour and skilled labour potentials.
- Resource protection, climate protection and energy transition
- Demand-driven support for development in the regions and strengthening of regional cohesion.

Cross-cutting tasks:

- Digitization
- Internationalization
- Simplification

### **RIS3 strategy in Bremen (2021-2027)<sup>4</sup>**

The Bremen RIS3 focuses on the potentials of cross-innovation and clustering. The future plan from Bremen is building on greater diversification of industries in order to expand the regional innovation ecosystem even faster and more efficiently.

In future, the state of Bremen will bundle its specific strengths and potential as an innovation location along five key innovation fields.

- Sustainable management and resource efficiency

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<sup>3</sup> RIS3 strategy in Berlin: <https://innobb.de/de/innobb-2025-eine-neue-strategie-fuer-neue-zeiten>

<sup>4</sup> RIS3 strategy in Bremen: <https://www.bremen-innovativ.de/innovationsstrategie-2030/>

- Networked and adaptive industry
- Mobility of the future
- Digital transformation
- Intelligent services

Preliminary ideas for prioritisation include eco-efficient flying (green aviation), transfer infrastructures, digital hub industry, artificial intelligence, climate-neutral production and production and transport, hydrogen technologies in industrial sectors, the food hub and hybrid value creation.

### **RIS3 strategy in Hamburg (2021-2027)<sup>5</sup>**

The future Strategy of Hamburg, new RIS3 HH, defines eight fields of specialisation (SF), which are essentially linked to the clusters of the federal state:

- Renewable energies
- Health care
- Life science
- Media /IT/ telecommunication
- Maritime communication
- Maritime industry/shipping
- Culture and creative industries
- Aviation
- Logistics/ transport

Like its predecessor strategy, the Fields of specialization (SFs) are not to be changed, but cross-cutting themes such as digitalisation are to play a greater role. In this context, particular emphasis is to be placed on the expansion of cross-cluster structures. In addition, international cooperation potentials are to be better utilised.

### **RIS3 strategy in Hessen (2021-2027)<sup>6</sup>**

The RIS3 strategy for Hessen was also updated for the period 2021-2027 under the leadership of the Hessian Ministry of for Economic, Energy, Transport and Housing. In the new strategy, the focus will be strongly oriented towards the new, overarching guidelines of the country:

- Sustainability
- Digitalisation
- Competitiveness

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<sup>5</sup> RIS3 strategy in Hansestadt Hamburg: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.isi.fraunhofer.de/content/dam/isi/dokumente/ccp/ris3-strategien/Hamburg\_innovationsstrategie.pdf

<sup>6</sup> RIS3 strategy in Hessen: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://wirtschaft.hessen.de/sites/wirtschaft.hessen.de/files/2022-02/2021-10-25\_hessische\_innovationsstrategie\_2021-2027.pdf



In addition, seven future fields of expertise have been identified in line with the approach of intelligent specialization:

- Digital technologies and digital economy
- Health and life sciences
- Mobility and logistics
- Energy systems and efficiency
- Advanced manufacturing and materials
- Cultural and creative industries
- Financial sector

On this basis, greater emphasis is to be placed on cross-cutting themes and the already holistic understanding of innovation as a basis and integrate a "continuous stakeholder process" through networking and communication of relevant stakeholders and lead.

### **RIS3 strategy in Mecklenburg-Vorpommern (2021-2027)<sup>7</sup>**

From the previous RIS3 strategy, which covered the following 6 subject areas, the following three fields of action and cross-cutting technologies emerged from a new status analysis carried out by Fraunhofer ISI:

Priority fields of action

- Renewable energies - Hydrogen technologies
- Medical technology and biotechnology
- Mechanical and plant engineering

Cross-sectional technologies:

- ICT (information and communication technologies)
- Bioeconomy

The carefully identified future-oriented fields of action and cross-sectional technologies will receive focused and active support from the federal state in the new current funding period. Cooperation between industry and science will continue to be a priority in Mecklenburg-Vorpommern. The expansion of competence centers will continue in the federal state. The focus here is on expanding the locations and existing laboratory and equipment facilities in line with the fields of action. Cooperation with the competence centers and the use of modern infrastructure should strengthen and further expand the competitiveness of regional companies.

### **RIS3 strategy in Niedersachsen (2021-2027)<sup>8</sup>**

In Niedersachsen, the Regional Innovation Strategy for Smart Specialisation (RIS3) for the period 2021-2027 was already published in 2020.

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<sup>7</sup> RIS3 strategy in Mecklenburg-Vorpommern: <https://www.regierung-mv.de/Landesregierung/wm/Technologie/Regionale-Innovationsstrategie-2021%E2%80%932027/>

<sup>8</sup>RIS3 strategy in Niedersachsen: [https://www.stk.niedersachsen.de/download/154440/Niedersaechsische\\_Regionale\\_Innovationsstrategie\\_fuer\\_intelligente\\_Spezialisierung\\_RIS3\\_.pdf](https://www.stk.niedersachsen.de/download/154440/Niedersaechsische_Regionale_Innovationsstrategie_fuer_intelligente_Spezialisierung_RIS3_.pdf)



For the funding period 2021-2027, seven areas of specialization (mobility, life science, energy technologies and systems, agriculture and food industry, new materials, production technology, maritime economy), will still building on the previous priorities. The topic of the digital economy is to become a cross-cutting theme for all the fields of strength.

In addition, the drafting picks up on the importance of cross-border cooperation between companies, especially SMEs. Thus internationalisation projects are to be supported in a targeted manner, for example by using of networks, business development agencies or cluster initiatives as initiators for international cooperation. In addition to the international perspective, the focus on the region-specific innovation potential of the various areas will be further strengthened in the funding period.

### **RIS3 strategy in Nordrhein-Westfalen (2021-2027)<sup>9</sup>**

The Ministry of Economics supports the continuation of the RIS3 NRW 2021-2027 and thus follows a cabinet decision from summer 2021.

The new strategy takes up the recommendations of the NRW 2020 Innovation Report and builds on the NRW Innovation Strategy 2014 to 2020. For the upcoming period, the strategy specifies the following seven fields of innovation.:

- Innovative materials and intelligent production
- Networked mobility and logistics
- Environmental economy and Circular Economy
- Energy and innovative construction
- Innovative medicine, health and life science
- Culture, media and creative industries and innovative services
- Key technologies of the future, ICT

The latter field has a special role: it acts as a cross-cutting theme and is intended to provide impetus for the other fields of innovation.

### **RIS3 strategy in Rheinland-Pfalz (2021-2027)<sup>10</sup>**

The RIS3 in Rheinland-Pfalz (RIS3.RP) is based on a broad consultation and participation process of innovation-relevant stakeholders.

Rhineland-Pfalz defines six areas of potential that will be maintained for the 2021-2027 funding phase. In addition, application markets are identified and linked to the economic and scientific competencies in the state competencies in the country.

The six potential areas are:

- Energy, environmental technology, resource efficiency
- Materials, materials and surface technology

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<sup>9</sup> RIS3 strategy in Nordrhein-Westfalen: <https://www.wirtschaft.nrw/innovationsstrategie> ; <https://nrwinnovativ.de/nrw-innovationsstrategie-2021-2027-auf-der-s3-plattform/>

<sup>10</sup> RIS3 strategy in Rheinland-Pfalz: <https://efre.rlp.de/foerderperiode-2021-2027/fortschreibung-regionale-innovationsstrategie-ris>



- Microsystems technology, sensor technology, automation
- Life sciences and healthcare industry
- Automotive and commercial vehicle industry
- Information and communication technology, software systems, artificial intelligence

### **RIS3 strategy in Saarland (2021-2027)<sup>11</sup>**

The resulting "StrategyPlus 2021-2023" adapted the Saarland RIS3 strategy to the new basic requirements of the EU Commission for the 2021-2027 funding period.

For the next period until 2027 is Saarland currently at the beginning of an explicit updating process. Some topics will be more focused due to Covid 19 (e.g. digitization with AI and cybersecurity, NanoBioMed with pharmaceutical research, hydrogen) and especially the opportunities, but also challenges associated with accelerated structural change. Strategic planning will be aligned with the legislative requirements of the EU Commission, e.g. the already existing internationalization, especially in the area of excellence-driven research, should have a higher relevance.

### **RIS3 strategy in Freistaates Sachsen (2021-2027)<sup>12</sup>**

The RIS3 SN (RIS3 Sachsen) aims to create more implementation in successful innovations for smart, environmentally sustainable and socially inclusive growth. In doing so, it defines the following main objectives: Expansion, bundling and best possible utilization of innovation potentials in the areas of education and research as well as in the labor market.

RIS3 is based on two pillars: smart specialization and smart diversification. The strategy deepens the approaches of smart specialization, addressing in particular the future fields of:

- Environment
- Raw materials
- Digital
- Energy
- Mobility
- Health

The aim of the strategy is to support innovation-based regional development (by modernizing and building unique regional profiles) so that the future prospects of all regions improve significantly.

### **RIS3 strategy in Sachsen-Anhalt (2021-2027)<sup>13</sup>**

The RIS3 ST (Sachsen-Anhalt) is an extension of the previous strategy RIS3 - 2014-2020.

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<sup>11</sup> RIS3 strategy in Saarland: <https://www.prognos.com/de/projekt/saarlaendische-strategieplus-2021-2023#:~:text=Die%20saarl%C3%A4ndische%20Innovationsstrategie%20%E2%80%9Estrategie%20f%C3%BCr,des%20Saarlandes%20bis%202023%20dar>

<sup>12</sup> RIS3 strategy in Sachsen: <https://www.prognos.com/de/projekt/innovationsstandort-sachsen>

<sup>13</sup> RIS3 strategy in Sachsen-Anhalt: chrome-extension://efaidnbmninnbpcjpcglclefindmkaj/https://mwl.sachsen-anhalt.de/fileadmin/Bibliothek/Politik\_und\_Verwaltung/MW/MWL/04\_Publikationen/02\_Wirtschaft/2023-01\_Regionale\_Innovationsstrategie\_LSA\_2021-2027.pdf



The cross-sectional areas from the previous strategy, "Information and communication technologies", "Key technologies" and "Creative and media industries" continue to be taken into account when setting priorities and have been expanded in the new strategy to include "Green hydrogen", "Lightweight construction" and "Algae biotechnology".

### **RIS3 strategy in Schleswig-Holstein (2021-2027)<sup>14</sup>**

The updated RIS3.SH for the 2021 - 2027 funding period further develops the existing innovation strategy of the federal state of Schleswig-Holstein. To this end, the content of the specialization fields will be further developed:

Specialization fields:

- Maritime economy
- Life sciences
- Energy transition and green mobility
- Food industry

Collaboration between the fields of specialization in particular opens up a wide range of cross-innovation potential. In the future, cross-sectoral cooperation will serve as a catalyst for growth and innovation processes in various industries.

A particular focus will be placed on activating small and medium-sized enterprises for innovation.

### **RIS3 strategy in Thüringen (2021-2027)**

The actual RIS3 TH defined quite broad fields of specialization (SF) that are strongly linked to the existing cluster structure in the Free State<sup>4</sup>:

- Industrial production & systems
- Sustainable & smart mobility and logistics
- Healthy living & health economy
- Sustainable energy & resource use
- ICT/creative economy/services - as a cross-cutting field.

In the next RIS3 TH strategy, particularly relevant cross-specialization topics for such as photonics, should be more clearly identified. The fields of specialization themselves are to remain in their current form, but the field of ICT/creative industries/services is no longer to be regarded exclusively as a cross-cutting field, but is to be formulated as an independent field of specialization. With regard to the monitoring system and governance structure, the approach used has proven successful and should therefore also form the basis for the next funding period.

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<sup>14</sup> Schleswig-Holstein: [chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.schleswig-holstein.de/DE/fachinhalte/T/technologietransfer/Downloads/ris3SH\\_Fortschreibung\\_Kurzfassung.pdf?\\_\\_blob=publicationFile&v=2](https://www.schleswig-holstein.de/DE/fachinhalte/T/technologietransfer/Downloads/ris3SH_Fortschreibung_Kurzfassung.pdf?__blob=publicationFile&v=2)



### 2.2.3 Conclusion

In conclusion, Germany's National Industry 4.0 initiative represents a concerted effort towards the digitalization of manufacturing and industry. This initiative underscores the critical importance of standardization in the transformation of factories into intelligent, optimized production environments, utilizing digital technologies to enhance performance and efficiency. Organizations and research institutions have played a pivotal role in advancing Industry 4.0, providing guidance through recommendations and transformation roadmaps.

A plethora of frameworks and applications, leveraging technologies such as data analytics and artificial intelligence, further bolster and streamline the manufacturing sector. At the regional level, German states have tailored their strategies to align with Industry 4.0 principles, focusing on aspects like research intensity, industry collaboration, and innovation dynamics. These strategies, as delineated in the Regional Innovation Strategies for Smart Specialization (RIS3), prioritize key sectors including digitalization, energy, health, and mobility while embracing overarching themes such as sustainability and international cooperation. By embracing digitalization and adhering to strategic priorities, Germany's industrial landscape is poised for global success, driving operational efficiency, innovation, and economic growth in the dynamic realm of digital manufacturing. Through targeted investments and collaborative endeavors, the nation aims to lead innovation within Europe and beyond, ensuring sustained prosperity in the ever-evolving industrial sphere.

## 2.3 Austria

### 2.3.1 Summary of Strategies, Policies and Agendas related to Circular Economy in Austria

#### 2.3.1.1 Regulation<sup>15</sup>

- [Abfallwirtschaftsgesetz 2002 \(AWG\)](#)
- [Deponieverordnung 2008 \(DVO\)](#)
- [Verpackungsverordnung 2014 \(VVO\)](#)
- [Elektroaltgeräteverordnung \(EAG-VO\)](#)
- [Recycling-Baustoffverordnung \(RBV\)](#)
- [Altfahrzeugeverordnung \(AFZ-VO\)](#)
- [Recyclingholzverordnung](#)
- [Abfallverbrennungsverordnung \(AVV\)](#)

#### 2.3.1.2 Guides, Reports, Plans<sup>16</sup>

- [The Austrian Circular Economy Strategy](#)
- [Circular Economy country profile – Austria](#)
- [Microplastics action plan 2022-2025](#) (in german)
- [Masterplan for Raw Materials 2030](#) (in german)
- [Sustainable public procurement \(naBe\)](#)
- [Bioeconomy - A Strategy for Austria](#)
- [Federal Waste Management Plan 2023](#) (in german)

<sup>15</sup> Wirtschaftskammer Wien, "Abfall und Kreislaufwirtschaft - Informationen für die Abfallwirtschaft zur Abfallvermeidung und -verwertung," 2024; Available from: <https://www.wko.at/abfall/kreislaufwirtschaft> (accessed on 12.03.2024).

<sup>16</sup> European Environment Agency - European Topic Centre on Circular Economy and resource use, "Circular Economy country profile – Austria," 2022; Available from: <https://www.eionet.europa.eu/etcs/etc-ce/products/austria-ce-country-profile-2022-for-publication.pdf> (accessed on 14.03.2024).



- [Waste prevention program 2023](#) (in german)
- [Masterplan Environmental Technologies](#) (in german)
- **Standards<sup>17</sup>**
- Standardisation of requirements on the prevention, preparing for re-use, recycling, other recovery and disposal of wastes as well as on the storage and transport of wastes
- Standardisation of requirements on pollutant and contaminant identification, risk analysis, action plans and management methods for waste recovery and disposal facilities
- Standardisation of methods for sampling planning, sampling and assessment of wastes
- Standardisation of methods for the investigation, evaluation, securing and remediation of contaminated sites
- Standardisation of methods for tracking waste material flows
- Standardisation of waste collection systems
- Standardisation of waste collection vehicles and equipment supporting the collection of wastes

## 2.3.2 Summary of Strategies, Policies and Agendas related to Collaborative Robotics in Austria

### 2.3.2.1 Regulation<sup>18</sup>

- [Maschinen-Sicherheitsverordnung 2010 \(MSV\)](#)
- [Niederspannungsgeräteverordnung 2015 \(NspGV\)](#)
- [Funkanlagen-Marktüberwachungs-Gesetz 2016 \(FMaG\)](#)

### 2.3.2.2 Guides, Reports, Plans

- [Artificial Intelligence Mission Austria 2030 \(AIM AT 2030\)](#) (in german)
- [Shaping Austria's future with robotics and artificial intelligence](#) (in german)
- [Collaborative industrial robots](#) (in german)

### 2.3.2.3 Standards<sup>19</sup>

- [ÖNORM EN ISO 12100:2013 - Safety of machinery - General principles for design - Risk assessment and risk reduction](#)
- [ÖNORM EN ISO 13849-1:2016 & -2:2013 – Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design; Part 2: Validation](#)
- [ÖNORM EN ISO 10218-1 & -2:2021 - Robotics - Safety requirements - Part 1: Industrial robots; Part 2: Robot systems, robot applications and robot cells integration](#)
- [ÖNORM EN ISO 3691-4:2020 - Industrial trucks - Safety requirements and verification](#)

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<sup>17</sup> Austrian Standards, "KOMITEE 157 - Abfallwirtschaft," 2024; Available from: <https://www.austrian-standards.at/de/standardisierung/komitees-arbeitsgruppen/nationale-komitees/committees/782/details> (accessed on 12.03.2024).

<sup>18</sup> TÜV Austria Group, "Sichere mobile Robotik in modernen Produktionsumgebungen," 2022; Available from: <https://www.tuv.at/wp-content/uploads/2022/03/tuv-austria-white-paper-Sichere-mobile-Robotik.pdf> (accessed on 15.03.2024).

<sup>19</sup> TÜV Austria Group, "Sichere mobile Robotik in modernen Produktionsumgebungen," 2022; Available from: <https://www.tuv.at/wp-content/uploads/2022/03/tuv-austria-white-paper-Sichere-mobile-Robotik.pdf> (accessed on 15.03.2024).



- [ÖVE/ÖNORM EN ISO/IEC 27000:2020 - Information technology - Security techniques - Information security management systems](#)
- [ÖVE/ÖNORM EN 61508:2011 - Functional safety of electrical/electronic/programmable electronic safety-related systems](#)
- [ÖVE EN 62061:2016 - functional safety of electrical control systems](#)

### 2.3.3 Conclusion

In Austria there are a lot of initiatives regarding the Circular Economy, such as the masterplan for raw materials 2030, the waste prevention program 2023 or the bioeconomy strategy for Austria. The most important document in this sense is the Circular Economy Action plan, which includes Austria's strategy for the Circular Economy. Most of the relevant regulations are in the area of waste management; there is currently no specific regulation on the Circular Economy or climate protection. Resource management is supported with different standards to waste sampling, -assessment, -collection, -tracking, -recycling, -prevention and -reuse.

Concerning collaborative robotics, Austria's initiatives are only just emerging. The most relevant documents in this sense are the Artificial Intelligence Mission Austria 2030 and an older whitepaper on the future of robotics and Artificial Intelligence. The first document focuses on the broad application areas of Artificial Intelligence, its challenges, and opportunities. The second one formulates the state of development, the opportunities, and challenges, as well as fields of action and recommendations. Regulations and Standards are mainly focusing on the safety and security of robotics.

The report on collaborative industrial robots of the Austrian parliament makes clear, that beside national and international research, development and governance, Austria needs to further develop a framework for the development, production, and safe use of collaborative robotics.

## 2.4 Poland

### 2.4.1 Summary of Strategies, Policies and Agendas related to Circular Economy and Collaborative Robotics in Poland

The main law regulating waste management in the country is The Act on Waste. It lays down measures to protect the environment and human life and health by preventing and reducing the generation of waste and the adverse impacts of waste generation and waste management and by reducing overall impacts of resource use and improving the efficiency of such use, for the purpose of the transition to a circular economy. The Act on Waste defines terms used in a number of waste-related acts. It also defines the term of extended producer responsibility scheme - a set of measures taken to ensure that entities placing products on the market, including packaged products, bear financial responsibility or financial and organisational responsibility for the management of the waste stage of a product's life cycle.





In terms of planning the main document is the National Waste Management Plan 2028 (NWMP 2028<sup>20</sup>). It refers to waste generated in Poland, including municipal waste, waste generated from products, hazardous waste and other waste. NWMP 2028 was developed based on the waste hierarchy and the objectives set out in the directives of the European Parliament in the field of continuous improvement of waste management rules, taking into account the product life cycle, so as to create a truly circular economy.

The NWMP 2028 is embedded in the National Environmental Policy 2030 (NEP2030<sup>21</sup>) – a development strategy in the area of environment and water management, whose main objective is: 'Developing the environmental potential for citizens and undertakings', and one of the specific objectives is 'Environment and economy. Sustainable management of environmental resources.' The directions of intervention (priorities) of the NEP2030 include: 'Waste management towards a circular economy'. According to NEP2030, it is necessary to departure from the linear model of the economy in favour of the implementation of a circular economy (CE). Business models and business operating frameworks must change, and consumers and the legal and institutional environment should be prepared for these changes. One important premise of the circular economy is the implementation of full waste recovery at the local level. In the case of urbanised and suburban areas, the circular economy offers opportunities for better use and recovery of available material and energy resources and the limitation of the quantities of waste landfilled.

NWMP 2028 is also in line with the National Raw Materials Policy (NRMP2050), the main objective of which is to ensure the country's raw material security, and one of the specific objectives is 'Acquisition of raw materials from anthropogenic deposits and supporting the development of a circular economy', as well as 'Dissemination of knowledge'.

On September 10, 2019, the Council of Ministers adopted a resolution on the adoption of the "Roadmap for transformation towards a circular economy"<sup>22</sup>. The road map is a document containing a set of tools, not only legislative ones, aimed at creating conditions for the implementation of a new economic model in Poland. It is one of the projects of the Strategy for Responsible Development.

According to the road map, national priorities in the field of circular economy are:

1. innovation, strengthening cooperation between industry and the science sector, and as a result, implementing innovative solutions in the economy;
2. creating an European market for secondary raw materials;
3. ensuring high-quality secondary raw materials;
4. development of the service sector.

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<sup>20</sup> National Waste Management Plan 2028; Warsaw 2023; <https://dziennikustaw.gov.pl/M2023000070201.pdf>

<sup>21</sup> National Environmental Policy 2030; Warsaw 2019; [Monitor Polski 2019 r. poz. 794](#)

<sup>22</sup> Roadmap for transformation towards a circular economy; Warsaw 2019; <https://gozwpraktyce.pl/regulacja/mapa-drogowa/>





The actions proposed in the Circular Economy Roadmap are intended to contribute to the implementation of these priorities. The map is based on the circular economy model commonly used in the EU, which assumes the existence of two cycles: biological (including renewable raw materials) and technical (including non-renewable raw materials).

The road map contains 5 chapters:

- Sustainable industrial production
- Sustainable consumption
- Bioeconomy
- New business models
- Implementation and monitoring of circular economy

Investments related to circular economy in the programming period for 2021-2027 may be co-financed from EU funds. Support may be provided for activities including: waste recycling, minimizing the consumption of raw materials and the amount of production waste generated. The scope of activities eligible for funding may vary depending on the program in question.

The circular economy concept is included in the National Recovery and Resilience Plan, the European Funds for a Modern Economy Program (FENG) and in the regional programs.

The Polish Agency for Enterprise Development (PARP) plays an important role in supporting the transformation of Polish companies towards a circular economy model. The agency organizes a number of aid programs that are intended to stimulate innovation and investments related to circular economy.

One of the key areas of PARP's activity is support for research and development projects that lead to the implementation of new technologies that are consistent with the assumptions of the circular economy. Companies can apply for funds from European Funds to work on innovative products, services or production processes that reduce the waste of resources and facilitate recycling.

Circular Economy topic is on the list of National Smart Specializations, which indicates preferential areas of support for research, development and innovation (R+D+I) for the transformation of the Polish economy (S7). Description of the S7 specialization includes technical and technological solutions, tools, models, methods, processes, support systems, materials consistent with the assumptions of the circular economy model. Changes resulting from the implementation of circular economy are associated not only with technological and product innovations, but also with new system and legislative solutions, organizational, financial and educational, taking into account the value chain and all stakeholders.

Robotics is also included on the list of National Smart Specializations (as S11). S11 specialization covers issues related to automation and robotization of technological processes constituting an essential part of the production process, taking into account current and future national, European and global trends related to manufacturing processes in various industrial sectors.



Robotics and circular economy aspects are mentioned in the following sub-sections of S11:

- technologies for intelligent control of devices, machines and robots in systems production, including management of energy consumption and hardware/material resources;
- mobile technologies in devices, machines, robots and in manufacturing and related processes logistics processes;
- sensor techniques, drives, power supply in processes, machines, devices and robots;
- technologies for improving the quality of production and assembly that extend the product life cycle and enabling product repair (including those carried out in space conditions);
- intelligent RPA programming systems (robotic process automation).

Automation and robotization of technological processes can be found on the list of goals set out in the Productivity Strategy 2030<sup>23</sup>, which is one of the main strategic documents defining the country's economic development.

Innovative activities in the field of collaborative robotics are present in industry and academia. An example is the COBOTAGV project implemented by the Silesian University of Technology in Gliwice in 2020-23<sup>24</sup>.

### 2.4.2 Conclusion

The circular economy concept is included in the most important strategic and planning documents in Poland regarding environmental protection. A road map for the implementation of circular economy principles in the coming years has been prepared.

Both the circular economy and robotics topics are on the list of smart specializations that determine the innovation implementation program.

Robotization of technological processes are included in the country's strategy of economic development and innovation.

## 3. Conclusion

The concept of circular economy is a key focus in Poland, with strategic documents outlining plans for its implementation in the coming years. Robotics and circular economy are identified as smart specializations for innovation in the country's economic development strategy. In Austria, initiatives for circular economy and robotics are also prominent, with various programs and strategies in place to support resource management and technological advancements. Germany's Industry 4.0 initiative highlights the importance of digitalization in manufacturing, emphasizing standardization and

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<sup>23</sup> Productivity Strategy 2030; Ministry of Development and Technology; Warsaw 2022

<sup>24</sup> COBOTAGV project web page; <https://www.cobotagv.aei.polsl.pl/index.php/pl/>



technology adoption for enhanced efficiency. Spain has shown proactive efforts in promoting circular economy practices and collaborative robotics, with a strong regulatory framework and strategic plans guiding these initiatives towards sustainable development and industrial competitiveness. Each country's approach reflects a commitment to innovation, sustainability, and digital transformation within their respective industrial landscapes.