GEMSTONE

JOINT TRANSREGIONAL "GREEN MANUFACTURING" SERVICE OFFER

GrEen Manufacturing SupporTing recOvery and resilieNcE of industrial SME

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ABSTRACT

This document presents the evolving transregional service offer developed within the framework of the GEMSTONE project - **“GrEen Manufacturing SupporTing recOvery and resilieNcE of industrial SMEs.”** funded by the European Union.

GEMSTONE mobilizes European manufacturing SMEs to accelerate their green and digital transitions through a unified support strategy built around three pillars: **Train, Innovate,** and **Explore.** The service offer consolidates a wide range of initiatives across seven European clusters, supporting SMEs with targeted capacity-building activities, innovation strategies, vocational training, internationalization tools, and financial mechanisms. By addressing five key industrial sectors - **Aeronautics/Defence, Energy, Mobility, Agriculture/Agri-food,** and **Materials** - the document outlines a replicable, scalable methodology that empowers clusters to deliver sustainable value and resilience to SMEs.

This living deliverable was updated throughout the project duration to reflect the latest developments, services, and examples of best practices, ultimately contributing to a more sustainable and competitive European industrial ecosystem.

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Green Manufacturing Supporting Recovery and Resilience of Industrial SMEs

OVERVIEW OF THE GEMSTONE PROJECT

GEMSTONE FACTS

Project Acronym	GEMSTONE
Project Title	GrEen Manufacturing SupporTing recOvery and resilieNcE of industrial SMEs
Project Reference	101074549
Project Topic	SMP-COSME-2021-CLUSTER-01
Project Duration	36 months (September 2022 – August 2025)
Overall Budget	€1.050.000 will directly benefit SMEs in the form of financial support to third parties
WEB	https://projectgemstone.eu/

GEMSTONE AMBITION

GEMSTONE aims to mobilise manufacturing companies, in particular innovative SMEs, on the challenges of "Green Manufacturing" by developing a dedicated joint service offer and operational and financial support tools around the 3 pillars **"Train, Innovate, Explore"** to encourage and empower manufacturing companies in their environmental and digital transition process.

The project aims to define, deepen and apply a common methodology on issues related to Green Manufacturing in 5 identified industrial sectors: **Aeronautics/Defence, Energy, Mobility, Agriculture/Agri-food, Materials.** This ambition is driven by the thoughtful association of European clusters with complementary ecosystems both in terms of expertise and priority targets, bringing together organizations and people facilitating innovation.

GEMSTONE strategy is:

1. To identify key needs and challenges for manufacturing companies around Green Manufacturing,
2. To support manufacturing companies in assessing their needs for new skills related to Green Manufacturing and guide them towards the relevant vocational training offers and providers,
3. To provide services and tools to manufacturing companies to create opportunities for international development in terms of business and innovation around Green Manufacturing,
4. To provide financial support to innovative SMEs to facilitate emergence of new concrete solutions and sustainable value chains within the areas identified by the project.

To this end, the consortium has planned to devote a budget of 1 050 000,00 € for financial support to third parties across a total of three mechanisms: TRAIN, INNOVATE, EXPLORE

GEMSTONE PARTNERS

CIMES Auvergne-Rhône-Alpes / France (Coordinator)

Pôle EMC2 / France

Pôle MECATECH / Belgium

EVOLUMA / Poland

POOL-NET / Portugal

Clust-ER MECH / Italy

Green and Smart Technology Cluster / Latvia

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DEVELOPMENT OF JOINT TRANSREGIONAL "GREEN MANUFACTURING" SERVICE OFFER

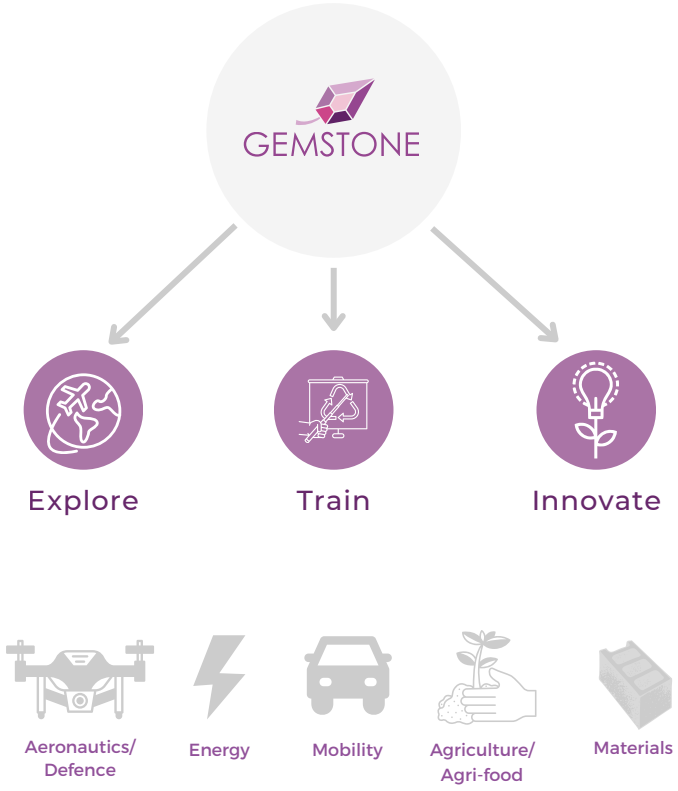
One of the central goals of the GEMSTONE project was to improve, structure, and update the range of services that clusters can offer to SMEs in the field of Green Manufacturing - while reinforcing the strategic role of clusters as intermediaries supporting the Twin Transition through innovation. This objective has been realized through the development of **a Joint Transregional "Green Manufacturing" Service Offer**, which now stands as a comprehensive catalogue of services focused on three strategic pillars: **Explore, Train, and Innovate.**

What began as an ambition to better align clusters' capabilities with SMEs' sustainability needs has materialized into a concrete, user-driven framework. The final version of the service offer consolidates the collective experience, service portfolios, and capacity-building efforts of seven cluster organizations across Europe. It reflects a collaborative process of self-assessment, learning, and co-design, carried out over the duration of the project through ten cross-cluster learning cycles and capacity-building workshops.

This service offer is more than a static catalogue - it is a dynamic tool that guides Clusters and SMEs through the green and digital transition. It integrates lessons from internationalization support (EXPLORE), workforce upskilling and reskilling (TRAIN), and adoption of green technological solutions (INNOVATE), all supported by practical examples, financing mechanisms, and collaborative actions.

Throughout the project, the GEMSTONE consortium ensured the offer remained closely aligned with real market needs, regulatory trends (e.g., EU Taxonomy, CSRD), and emerging technologies. The Resilience Plan concept was introduced as a structured approach for SMEs to implement sustainable solutions, underpinned by direct financial support (via cascade funding) and ongoing strategic guidance.

Ultimately, this transregional European service offer - developed under the Joint Cluster Initiatives (EUROCLUSTERS) framework for Europe's recovery - provides a replicable model that can continue to inspire future cluster strategies and EU-funded initiatives. It highlights how clusters can actively shape the future of sustainable manufacturing by building bridges between knowledge, funding, innovation, and SMEs' practical transformation needs.



HOW TO NAVIGATE THE SERVICE OFFER:

1 METHODOLOGY

- GEMSTONE Project roadmap
- Green manufacturing definition
- Steps how to address challenges of Green Transition and green manufacturing
- SME`s benefits from implementing green manufacturing

Gain a comprehensive understanding of common methodologies aimed at enhancing companies' awareness of the potential and economic feasibility of green manufacturing. The roadmap is a resilient, user-friendly, and transparent system that enables businesses to boost productivity by transforming manufacturing processes through the integration of green, smart, and sustainable solutions. Explore the GEMSTONE project roadmap and its focus on five key industrial sectors: Aeronautics/Defense, Energy, Mobility, Agriculture/Agri-food, and Materials.

2 SERVICE OFFER

Provided service examples based on 3 GEMSTONE Project choosen strategies:

- Explore
- Train
- Innovation

The service offer examines the existing services of project partners, including the GEMSTONE project, while also introducing new strategies and services that can inspire future projects and initiatives for European clusters in supporting SMEs in their green transition. It provides support tools based on the three pillars - Train, Innovate, Explore - to encourage and empower manufacturing companies in their environmental and digital transformation.

3 CAPACITY

Capacity-building activities for cluster`s members

- ECCP trend univers
- R&D projects with ethical and environmental criteria
- Development of business resilience diagnostics
- Twin transition: practices exchanges between clusters

The service offer catalog is developed through a process of self-assessment and continuous improvement by project partners, supported by capacity-building activities. This results in a well-defined set of services that clusters can offer to SMEs preparing for the green transition of their operations. This section examines current trends and tendencies in Europe, as well as existing best practices exchanged between clusters. Additionally, the Resilience Plan, a key tool for implementing identified solutions, will be presented along with a summary of its outcomes as part of the GEMSTONE project results.

4 WORKSHOPS

Cycle of awareness and mobilisation workshops for SME`s:

- European level workshops
- Regional workshops

To support manufacturing companies in assessing their need for new skills related to green manufacturing and connecting them with relevant vocational training opportunities, a cycle of awareness and mobilization workshops for SMEs is organized. To further enhance awareness within industrial ecosystems, project partners host a series of activities - including workshops, webinars, and conferences - focused on the key concepts and approaches of green manufacturing. The service offer consolidates key insights and outcomes from these activities while also providing access to recorded European-level webinars.

5 ALLIANCE

Development of green manufacturing alliance

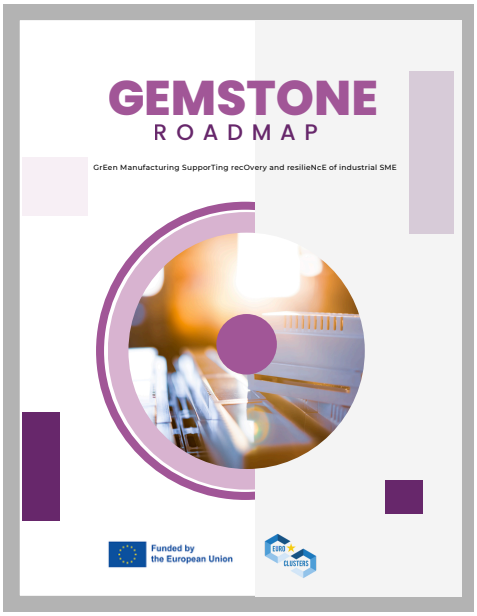
The project aims to establish a lasting structure that unites clusters across Europe in advancing green manufacturing. The project consortium serves as the driving force behind this initiative. Throughout the project, partners actively collaborate to build this alliance, which will function as both an influential platform and a forum for dialogue on the challenges of the Twin Transition in manufacturing.

We invite you to use the active links, underlined in blue, to familiarize yourself with both the additional information provided and valuable materials, such as: Project GEMSTONE website.

METHODOLOGY

GEMSTONE PROJECT ROADMAP

GEMSTONE roadmap is a guide through the evolution of the project and the development of its deliverables, precisely defines the methods and tools necessary to help manufacturing companies identify their needs and the challenges in terms of green transition. The roadmap carries a trans-sectoral and trans-European vision to be able to reach a wide audience.



On the basis of the methodology developed in GEMSTONE roadmap, the partners have created three service portfolios around the three main following topics: Train, Innovate, Explore. The calls are open to manufacturing, technology and solution providers SMEs, and in particular industrial equipment and tool providers, willing to gain knowledge on solutions offered by Green Manufacturing. The project targets all manufacturing SMEs, especially those active in the following 5 industrial sectors: Aeronautics/ Defence, Energy, Mobility, Agriculture/ Agrifood, Materials.

GREEN MANUFACTURING DEFINITION

Green manufacturing is a combination of the renewal of production processes and the establishment of environmental-friendly operations within the manufacturing field, where innovation and green approach takes a major role in the reduction of greenhouse gases. The manufacturing industry is in a key position to enable the transformation to truly circular business models and the production of new environmentally friendly products in existing or emerging value chains.

STEPS HOW TO ADDRESS CHALLENGES OF GREEN TRANSITION AND GREEN MANUFACTURING

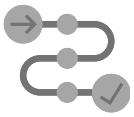
By following these steps, cluster organizations can effectively address the challenges of Green Transition and green manufacturing, supporting SMEs on their the way for a more sustainable and environmentally-friendly future.

Assess the current state

Begin by assessing the current practices, processes, and technologies in place. With different activities help SMEs to identify areas where improvements can be made to reduce environmental impact, increase energy efficiency, and minimize waste generation. This assessment can include conducting audits, measuring resource consumption, and analyzing the carbon footprint.

Set goals and targets

Establish clear and measurable goals and targets for the Green Transition. These goals can be related to reducing greenhouse gas emissions, achieving energy efficiency, optimizing material use, or adopting renewable energy sources. Setting targets provides a direction and helps to track progress.



Develop a roadmap

Create a roadmap outlining the steps and actions needed to achieve the goals and targets. This roadmap should include specific timelines, responsibilities, and resources required. It should address key areas such as energy management, waste reduction, product design, and supply chain sustainability.

Engage stakeholders

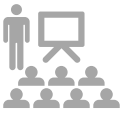
Involve all relevant stakeholders in the Green Transition process. This includes management, employees, suppliers, customers, and even local communities. Engage them in discussions, workshops, and initiatives to gather diverse perspectives, gain support, and foster a culture of sustainability.

Invest in green technologies and infrastructure

Help to identify and find funds and projects that focus their investment in green technologies and infrastructure that can support the transition towards sustainable manufacturing. This can include adopting energy-efficient machinery, implementing renewable energy systems, installing water-saving technologies, and implementing waste management systems.

Promote innovation and research

Encourage SMEs to innovate and research to develop new sustainable technologies, processes, and products. Foster partnerships with academic institutions, research organizations, and other companies to collaborate on green innovation projects and stay at the forefront of sustainable manufacturing practices.



Provide training and education

Support SMEs to ensure that their employees have the necessary knowledge and skills to implement green practices. Offer training programs on energy conservation, waste management, sustainable design, and other relevant topics. Raise awareness among SMEs about the importance of sustainability and their role in achieving the Green Transition goals.

Monitor and measure progress

Continuously monitor and measure the progress towards the Green Transition goals. Suggest trainings that can help to collect data on resource consumption, emissions, waste generation, and other relevant indicators. By using this data SMEs will track their performance, identifying areas for improvement, and communicate achievements to stakeholders.

Communicate and engage with stakeholders

Regularly communicate the progress, achievements, and challenges of the Green Transition to stakeholders. Use various communication channels to engage with customers, suppliers, investors, and local communities. Transparency and open dialogue build trust and enhance the reputation of SMEs.

Continuous improvement

Embrace a culture of continuous improvement and innovation. Regularly review and update your the Green Transition roadmap to align with evolving industry standards, regulations, and best practices. Encourage feedback from SMEs and foster a culture of experimentation and learning.

SME`S BENEFITS FROM IMPLEMENTING GREEN MANUFACTURING

Good for the planet

Reduce or eliminate undesirable materials such as pollutants and poisonous by-products generated during the manufacturing process as part of waste reduction. To effectively decrease waste, the sustainable industrial industry can recycle its products.

Positive impact on your staff

When the administration acknowledges and even honors these eco-friendly accomplishments, it motivates employees to work harder. It reminds them that they are positively impacting the market and the ecosystem.

Saving money

Sustainable production monitors every stage of the manufacturing method and applies the only best strategy to reduce cost and unnecessary errors.

Increasing competitiveness continuously

Continuously improving performance has improved production processes and operations—quality control in the manufacturing process and fewer steps in the manufacturing process. Automation and 3D printing are examples of manufacturing advances—lower labour and production expenses and increased efficiency.

Improving profits

Increased profit margins are achieved by lowering overhead due to being more sustainable. Another way that sustainability can help enhance profit margins is by reducing waste production and reducing the amount of expenditure spent on waste management. Finally, due to the new clients drawn and the prospective rise in cost that these customers are ready to pay, the profitability can also be improved.

More appealing for your clients

Environmentally-conscious customers are more likely to support sustainable businesses. Businesses may help save the Earth's natural and non-renewable resources and, as a result, improve the environmental conditions by implementing sustainable marketing practices. Sustainable manufacturing has the ability to not only make your product more appealing, but will also hurt your revenues if you ignore it.

SERVICE EXAMPLES: INTRODUCTION

The following section presents a curated collection of practical service examples that bring the GEMSTONE joint transregional "Green Manufacturing" service offer to life. Spanning the pillars of **Explore, Train,** and **Innovate**, these examples illustrate how European clusters and their partners have actively supported SMEs in overcoming the challenges of environmental and digital transformation.

This catalogue is not merely a reflection of current capabilities - it is **a tool for inspiration, replication, and scaling.** Each example highlights actionable approaches, support mechanisms, and pilot activities implemented across partner regions, showcasing how clusters can act as catalysts for change. From internationalization support and funding access, to training programs and technological innovation, the services featured here demonstrate diverse ways to build SME resilience, boost competitiveness, and align with EU sustainability goals.

These examples are critical because they translate strategic ambition into tangible results. They reveal how clusters can support the **Twin Transition** not only by identifying needs but by delivering targeted, high-impact services tailored to local ecosystems and sectoral priorities.

By documenting and sharing these real-world cases, the GEMSTONE project adds long-term value: it equips clusters, policymakers, and innovation actors with ready-to-use models, tools, and ideas to **amplify green manufacturing efforts** across Europe. This section thus serves as both a snapshot of achieved impact and a blueprint for future collaborative action.

EXPLORE – INTERNATIONALIZATION

Small and medium-sized enterprises (SMEs) form the backbone of the EU economy. They account for around 99 % of all businesses and represent 65 % of all jobs in the non-financial business sector. International trade is a critical driver for the EU economy, with more than 90 million jobs depending on exports. Despite their importance for the economy, SMEs do not contribute to international trade to the same extent as larger companies; SMEs account for only 30 % of total exports (by value) to non-EU countries.[1]

The EU has put in place various instruments to support SME internationalisation, which differ considerably in terms of approach and objectives. They range from support networks for general information and advice to financial assistance and IT tools, as well as portals and helpdesks providing information on the regulatory requirements for international trade.
Some instruments exclusively target SMEs (and even SME internationalisation), whereas for others, SMEs feature in just one of several support areas. The EU contribution for instruments specifically targeting SME internationalisation amounted to about €850 million in the period 2014-2020.[1]:

- Enterprise Europe Network (EEN
- Start-up Europe Initiative
- European Clusters network
- EU Japan centre for industrial cooperation
- EU SME centre for China
- ELAN network
- ENRICH NETWORK
- EU Gateway
- Eurostars
- IPR-Helpdesks

GEMSTONE PROJECT INTERNATIONALIZATION STRATEGY

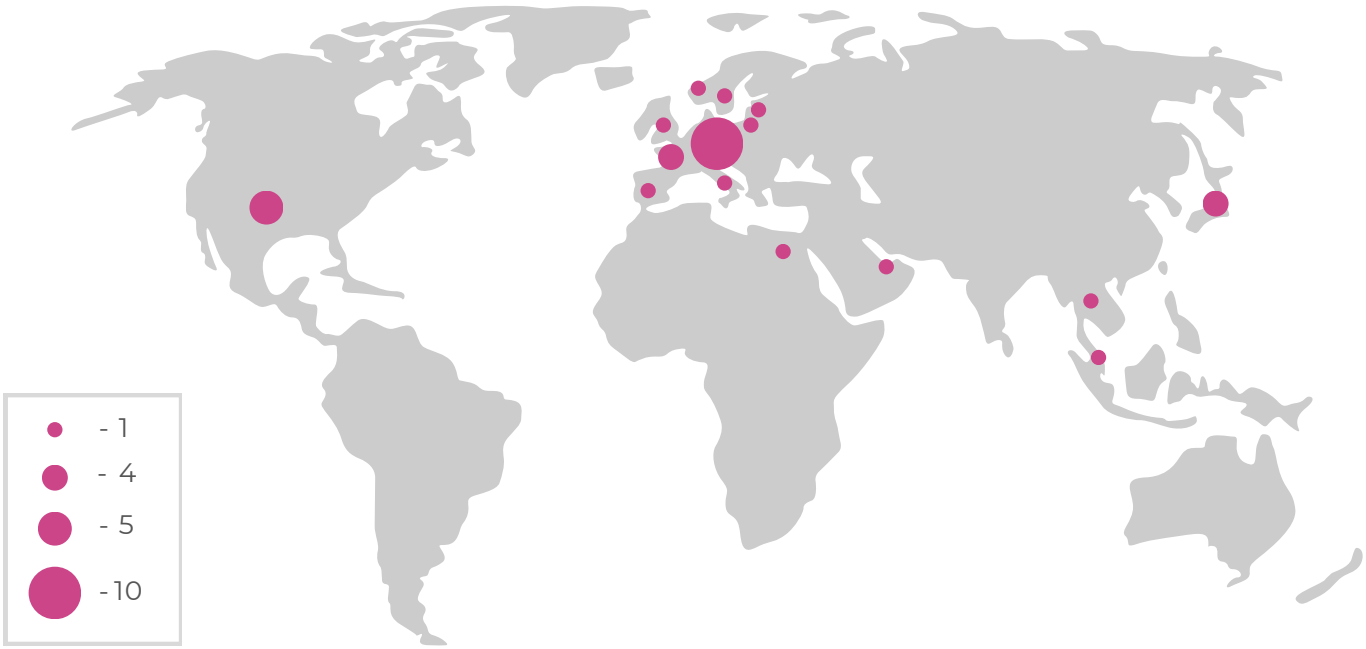
GEMSTONE projects financial mechanism for exploration (EXPLORE) aims to facilitate SMEs internationalisation strategy by supporting their participation in business fairs and other international events deemed interesting for their activities, in targeted countries and in relation to Green Manufacturing. The events targeted can be organised in any country in the world, including the EU member states, with specific attention brought in the targeted strategic areas defined in the call and the project.

3 targeted areas

Objectives to participate in the call

- Participation in trade fairs/ international event for companies providing services, technologies, solutions linked to green transition and green manufacturing:
  - Market exploration;
  - Branding, sales and marketing of company;
  - Demonstrate their solutions/ technologies (e.g., booth visitations and exhibitions);
  - Sharing knowledge, experience and information in Green Manufacturing specific areas.
- Participation in trade fairs/ international event, study visits or learning mission having a specific focus on Green manufacturing:
  - To gain knowledges, explore Green Manufacturing existing solutions;
  - To attend B2B events;
  - To do networking activities, identification of new partners and creation of new business opportunities;
  - To support project development, innovation and research and development.

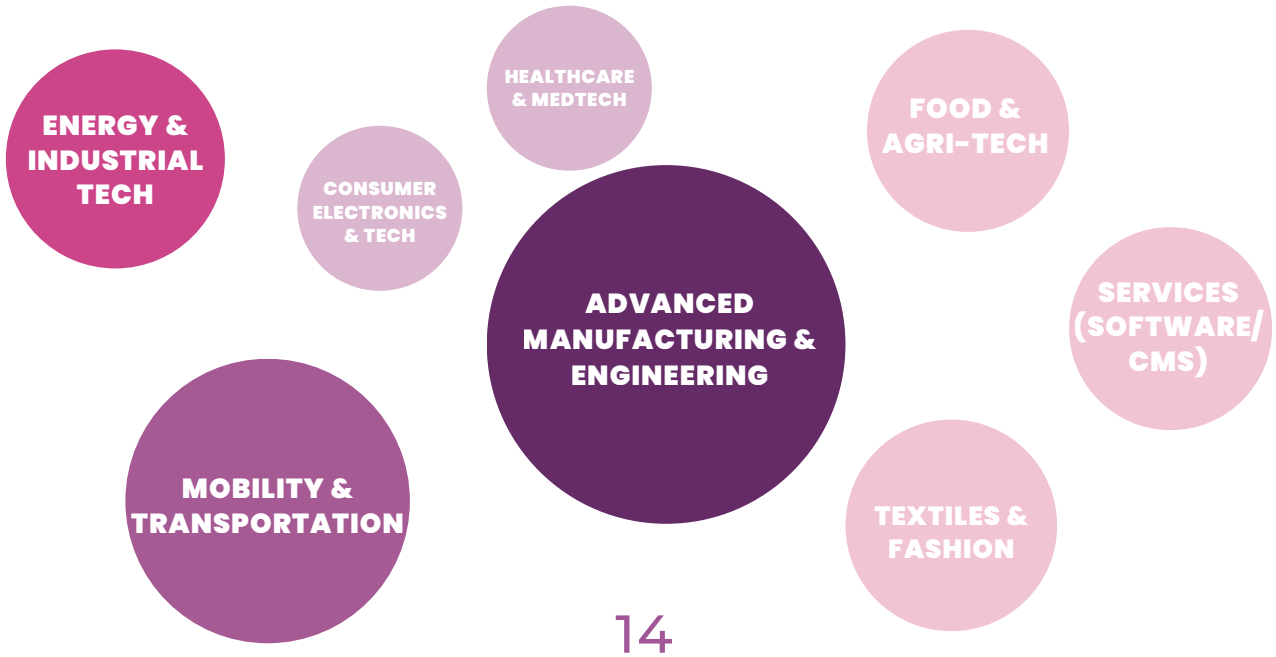
GEMSTONE projects results - "EXPLORE" destinations chosen by participants



Analysis of main event themes chosen by participants

Sustainable and Green Manufacturing	Digital Transformation and Industry 4.0/5.0	Sustainable Mobility and Transportation	Advanced Materials and Energy Transition
1. Energy Efficiency 2. Circularity & Recycling 3. Resource Optimization 4. Eco-Design	1. AI and Data-Driven Optimization 2. Smart Factories & IoT 3. Interoperability and Data Exchange 4. Robotics and Automation	1. Electrification 2. Urban Mobility and Micromobility 3. Green Logistics	1. Energy Storage 2. Alternative Energy Sources 3. New Material Processes

Analysis of sectors represented by participating companies



SERVICE EXAMPLES

Market intelligence

European clusters can provide SMEs with information and analysis on potential green markets and trends, helping them identify opportunities for expansion and new product development.

Pôle Mecatech in close collaboration with Infopole Cluster TIC organized a journey in the framework of Global Industry Lyon composed of 3 steps: a creative workshop to select priorities and prepare the visit, a collective smart watch during the fair and finally, a follow-up workshop. The objective of the "Parcours Connexion Innovation" is to develop and drive innovative collaborations between solutions providers and manufacturers in the European Industry 5.0.

F2F Health Matters implements a project to support the internationalisation actions of SMEs which allows Commercial Lead Support to cover the consultancy services of commercial prospecting on global or specific markets. By providing such a service SMEs could get personalized support from external service providers with excellent market knowledge.

Networking and matchmaking

Clusters can facilitate networking events and matchmaking activities, bringing together SMEs, research institutions, and potential partners or customers. This enables SMEs to establish valuable contacts and collaborations for green manufacturing.

The cluster EMC2 organises Learning Expedition (LEX) allowing participants to discover and get inspired by best practices from innovation ecosystems in other countries. EMC2 plans to work on the development of learning expeditions dedicated to green manufacturing, for example on the themes of twin transition, industrial ecology or the circular economy; an effective way for cluster members to benefit from feedback from foreign companies and to be able to exchange good practices.

Clust-ER MECH organized an international matchmaking online event with Indian peers for the Aerospace and Material sectors. The specific goal of the initiative was to facilitate the direct connection between clust-ER MECH members and companies from the automotive and aerospace clusters in India.

Business support services – internationalisation activities

Clusters can offer tailored business support services to SMEs, including guidance on legal and regulatory aspects, technology transfer, intellectual property rights, and supply chain management, all aimed at enhancing their competitiveness in the green manufacturing sector.

Clust-ER MECH organized a regional delegation, composed by cluster's members and regional stakeholders, to attend and actively participate to several international fairs, with a specific technological/sectorial focus. In 2022, the cluster attended in Dubai the EXPO, organising several meetings and activities with local companies and innovation centers and building a close connection with the UAE innovation ecosystem. In 2023, the cluster organises a delegation for the automotive sector in order to attend the Global Automotive Components and Suppliers Fair in Stuttgart.

POOL-NET organises business missions such as Medical Devices Mission; Manchester Automotive Mission and Valencia Plastics Mission.

A part from Innovation Mobilization Program in Additive Manufacturing POOL-NET is mapping of additive service providers and sector specific applications.

Market entry strategies

Clusters can provide assistance in international market entry strategies, offering advice on export procedures, market-specific regulations, and cultural aspects.

Access to funding

Clusters can assist SMEs in accessing funding opportunities for their green projects through various channels, such as EU grants and programs, national funding schemes, and private investors.

Evoluma Cluster "Guide to Grants" is an online tool (ePKD database), which makes it possible to obtain information on funding sources available from aid funds for Cluster Members and other entities associated with the Cluster in order to develop business activities and implement new projects. The funding database takes into account the areas of: green transformation, digitization of processes, consulting services/Pro-innovation services, internationalization, research and development, infrastructure/Investments training. The cluster provides services to its members with regard to the preparation of application forms, implementation and settlement of projects. As result cluster coordinator implements and services aid-funded commercial infrastructure and development projects for the entire cluster network. In the last 4 years, thanks to this service, 75 cluster members have received funding for the development of the internationalisation of companies to the amount of EUR 9M.

Pôle Mecatech, also member of the EDIH Walhub, offers access-to-fundineg services including a collective support (ex: info sessions about cascade funding opportunities) and an individual support (guidance to adapted funding to the SMEs' needs, connection with potential partners and reviewing of the proposal in case of cascade funding).

The European Cluster Collaboration Platform (ECCP) Trend Universe is a tool which allows cluster organisations to get a deeper understanding into future trends and their impact on their cluster organisation. More information in page 32.

Training and skills development

Clusters can organize international training programs and workshops in cooperation with non-European SMEs supporting organizations to enhance the skills and knowledge of SMEs in areas such as sustainable manufacturing practices, circular economy principles, and green product design.

Research and innovation collaboration

Clusters can foster collaboration between SMEs and research institutions, facilitating access to research and innovation projects related to green manufacturing. This collaboration can lead to the development of innovative green technologies, processes, and products.

Cooperation with other state institutions

Clusters can cooperate with state institutions by exchanging information on potential projects, trade missions and support mechanisms for SME internationalization strategy.

Evoluma cluster signed a cooperation agreement with the Polish Investment and Trade Agency (government agency) on cooperation with regard to activities promoting internationalisation of companies, members of the cluster. This link gives the possibility of additional channels of promotion and impact of the offer of the cluster and its members and gives the possibility of additional and alternative financing of the costs of these activities, such as participation in international fairs.

As result, Evoluma realised collective participation of cluster members on the national stand at Global Industrie Lyon 2023 and Global Industrie Paris 2024.

Investment and Development agency of Latvia implements project Trade mission "Clean and green technologies in Canada", with the aim of companies interested in the directions of the clean and green technology sector to participate in the trade mission, in particular, hydrogen and wind parks and technology development in Canada's western region. Within the scope of the mission, joint and/or individual B2B meetings with potential partners.

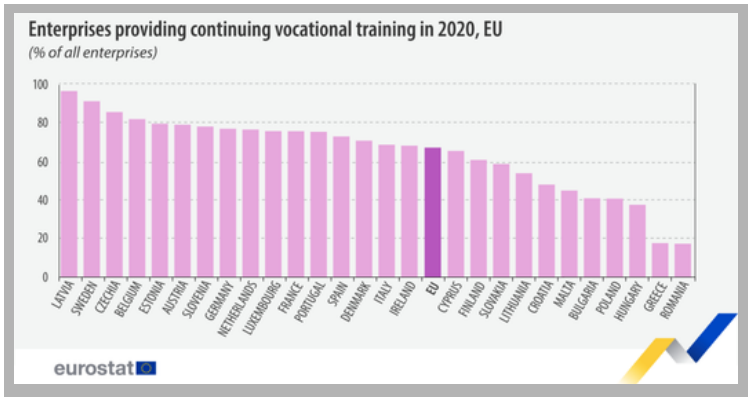
TRAIN – STEPS FOR SKILL IMPROVEMENT

Skills are critical to achieve the green transition; currently skills mismatches are identified as major obstacles to green transition of the manufacturing industry. Also, the lack of knowledge of the environment– skills nexus is hindering the achievement of an effective transition. Therefore, it is necessary to help staffs acquire or improve skills that will be essential for the development of their jobs – and this at all level of the company (workforce, management…).

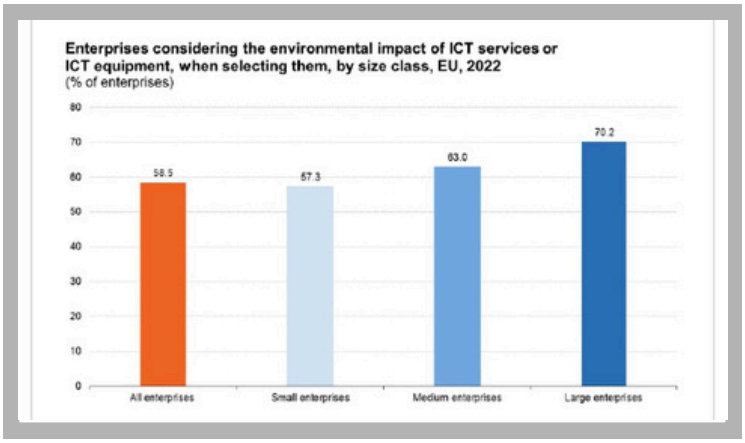
There are several European studies and reports that analyse the link between the level of training of industrial personnel and the needs of industries to make progress in the green transition.

Eurostat provides statistics on education and vocational training, as well as employment in industrial sectors.

- Participation rates in vocational training: Data shows that countries with higher participation rates in vocational training tend to have better adoption of green technologies.



- Skills in technology and environment: Eurostat measures skills in information and communication technologies (ICT) and environment, showing a correlation between these skills and efficiency in implementing green technologies.



CEDEFOP produces detailed studies on the skills needed for the green transition:

- "Skills for Green Jobs" report: This report examines the skills required for green jobs in various European countries and highlights the importance of continuous training and adapting educational programs to meet industry needs.
- Skills Panorama: This report provides an analysis of green skill needs by sector and shows how training programs can address these gaps.

These sources show a positive correlation between the level of training of industrial personnel and the ability of industries to progress in the green transition. Industries with a better-trained workforce are generally more effective in adopting sustainable technologies, reducing carbon footprints, and innovating in green technologies. To continue advancing, it is crucial to strengthen vocational and continuous training programs, focusing on the specific skills needed to support the ecological transition.

GEMSTONE PROJECT TRAINING STRATEGY

GEMSTONE supports SMEs to purchase services related to **“green skills”** such as technical knowledge and skills that enable professionals to effectively use green technologies and processes and transversal skills, as well as knowledge, values and attitudes needed to live in, develop and support a sustainable and resource-efficient manufacturing industry.

- Value, behaviour, normative skills (values related to responsibility, future, environment, justice, solidarity and tolerance, e.g. environmental awareness. Skills that will allow trainees to better understand the framework of Green Manufacturing and to have a more thorough knowledge of the challenges and impacts);
- Technical occupational competences (vocational and technical skills related to technology, emerging products and services. Occupation-specific skills that are related to the particular challenges of a certain job);
- Training services can address either upskilling or reskilling. The eligible activities can take the form of individual or group activities. They can be attended online or physically.

Analysis of main themes chosen by participating comapnies in "TRAIN" call

Regulatory Compliance & Certification	Measurement and Quantification	Process-Specific Technical Optimization
1.Ecodesign for Sustainable Products Regulation (ESPR) 2. Product Certification & Standards 3. Management System Certification	1. Carbon Footprinting 2. Energy Consumption Monitoring 3. Sustainability Reporting	1. Eco-Design 2. Energy Efficiency 3. Circular Economy Implementation

Analysis of competencies comapnies wanted to improve

Compliance & Risk Management Competencies

- **Understanding and Implementing Regulations:** Ability to navigate complex new laws like ESPR, Green Claims Directive, and certification requirements (CE marking).
- **Audit and Assessment Skills:** learining BREEAM assessment to officially evaluate building sustainability
- **Certification Preparation:** Gaining the specific knowledge required to achieve and maintain certifications like ISO 14001.

Technical & Analytical Competencies

- **Life Cycle Assessment (LCA) & Carbon Accounting:** The ability to measure a product's environmental impact from cradle to grave.
- **Data Monitoring and Analysis:** improving ability to collect and analyze energy data to find savings.
- **Technical Design for Sustainability (Eco-Design):** The practical skill of designing products for disassembly, recycling, and lower energy use.
- **Programming for Efficiency:** Training in C++ to write more efficient code for its scooters, directly improving battery life.

Strategic & Operational Competencies

- **Circular Economy Implementation:** Moving from theory to practice, e.g., Training IT staff to automate sorting for circularity.
- **Sustainable Supply Chain Management:** training to optimize resource use and environmental impact upstream and downstream.
- **Green Product Marketing & Communication:** training on the Green Claim directive to accurately and legally communicate product sustainability to customers.
- **Operational Efficiency Models:** training to implement new management models focused on reducing waste and energy consumption.

TRAINING SERVICE EXAMPLES

Environmental awareness and sustainability training

SMEs need to understand the principles of environmental sustainability and the benefits of transitioning to green manufacturing practices. This training can cover topics such as **resource efficiency, waste reduction, energy management, and greenhouse gas emissions reduction.**

EMC2 do not provide specific trainings, however cluster works on improving innovation and transformation capabilities of its members by distributing of information about funding programmes and possibilities, and by providing animations focused on acculturation/ sensibilisation/ technological expertise - for example RIDE event.

POOL-NET promotes continuing professional development in articulation with other entities focus in innovation and sustainability. Training programmes/ raise industry competences (Human - Centred Manufacturing/ Innovation/ Leadership; Marketing Digital).

Pool-Net promotes funding programmes and other opportunies (e.g. workshops) related circular economy, sustainability, 4.0 technologies competences (e.g. MOULDS WEEK; S4PLAST). POOL-NET, is a co-organizer, every two years, of the MOULDSEVENT, which represents the key platform for international network, knowledge and research activities that includes several international conferences dedicated to promoting, the discussion, especially about the new competencies required by the Moulds and Plastics industries.

Evoluma has a cooperation agreement with a supplier of solutions in the area of energy consumption optimisation, energy distribution, use of alternative sources of energy supply. Providing green energy certificates for cluster member companies. Within the framework of advisory and training activity for cluster members it is a cyclical service of the cluster building awareness and importance of applying optimization of energy consumption in the manufacturing sector. Which results in contracting by cluster members for the supply of energy and green certificates and diversification of energy sources.

Green product design and development

SMEs can benefit from training on **green product design**, considering aspects such as **product lifecycle analysis, eco-design principles,** and **sustainable materials selection.** This training can help SMEs develop innovative and environmentally friendly products that meet market demands.

The CIRCO method Developed by TU Delft enables companies to rethink their products and services using a holistic approach to value chain analysis, in order to identify the product/business model combinations that will capture and create value for the company. This programme is promoted (and adapted) by Pole Mecatech (Belguim) and Pool-Net (Portugal) to involve their industrial ecosystem in the circular economy. Also example for the following point (circular design methods).

Circular design thinking and methods

By understanding Circular Design Strategies SMEs can apply the **circular economy principles (e.g. reuse, refurbish, and recycle)** in the design process to achieve positive human and environmental impact. The circular design process involves four stages: understand, define, make, and release. It includes safe and circular material choices; dematerialisation; from products to services; product life extension; designing for inner loops and modularity. This includes training on better understanding on users' needs by watching them in action, defining the problem by putting the users' needs into words, brainstorm ideas for creative solutions to the problem and prototyping as well as testing.

Circular economy and waste management

SMEs can receive training on circular economy concepts to understand how to **minimize waste generation**, **increase resource efficiency**, and **implement effective recycling** and **waste management practices**. This includes training on **waste reduction strategies, recycling technologies,** and **extended producer responsibility.**

Evoluma is participating in project CEMIVET – Circular Economy in Metal Industries, which is supporting SMEs in metal clusters and VET (teachers and learners) to better understand ongoing transformations (e.g. Climate crisis), to recognize their impacts and to undertake adaptation measures. The whole is implemented within the framework of the EU policy in the sphere of promoting the transformation of the economic system into a circular economy. Moreover CEMIVET demonstrates CE possibilities, particularly with regard to metalworking, manufacturing and other processes. Development of analyses, sector reports, training and educational materials for vocational teachers, students and entrepreneurs.

Sustainable supply chain management

Training on sustainable supply chain practices can assist SMEs in **establishing partnerships with suppliers** who share their commitment to environmental sustainability. It can cover topics such as **responsible sourcing, sustainable logistics**, and **supplier audits for environmental compliance**.

Energy efficiency and renewable energy

SMEs can benefit from training on **energy efficiency measures**, including **energy audits, energy management systems**, and the implementation of **energy-saving technologies.** Training on renewable energy sources can also help SMEs explore opportunities for integrating solar, wind, or other forms of renewable energy in their manufacturing processes.

Standards and certifications

SMEs may need training on relevant **green standards** and **certifications** that can enhance their credibility and market recognition. This may include training on eco-labeling, carbon footprint calculation, or compliance with specific environmental management systems.

Digital transformation

Twin transition integrates sustainability into digital transformation strategies, and enables organizations to operate more efficiently and sustainably at the same time. Digital transformation and sustainability are surprisingly closely connected, SMEs can participate in trainings improving theirs digital transformation.

Green Tech Cluster is implementing the European Union project "Digital accelerator of Latvia (DAoL)" and within the framework of this project, cluster provides training and upskilling for SMEs. All project partners implement training and skills development classes. DAoL organizes both intensive digital skills courses for highly qualified company employees (MI, HPC, cyber security, etc.) and digital transformation courses for company management. DAoL also provides introductory courses and internships in digital innovation field to promote digitization and strengthen the ecosystem. As result 34 programmes are offered to SMEs.

POOL-NET is the coordinator of PTCentroDiH (a consortium of 21 entities), a regional and transversal hub in Portugal that is highly focused on promoting the digitalisation of the entities of the Centro's Region in order to foster its innovation and competitiveness (specially SMEs and Start-ups). One of the specif goal is contribute to the identification of the needs for qualification and requalification of human resources. PTCentroDIH will support SMEs from different sectors to gain competencies in advanced digital skills (e.g. Cybersecurity, HPC and AI).

EMC2 is part of the EDIH DIVA in *Pays de la Loire* region. With the framework of this initiative digital maturity assessments are carried out in order to identify solutions to support companies in their digital transition. Trainings are provided as services of the EDIH.

Green marketing and communication

SMEs can receive training on effectively promoting their green products and sustainability efforts to consumers. Training in green marketing strategies, **eco-labeling guidelines**, and communication techniques can help SMEs differentiate their brand and attract environmentally conscious customers.

Strategic advisory services

POOL-NET gives advice to companies within training projects that aimed at qualifying company workers within the scope of professional training. Companies training projects aligned with the Engineering & Tooling cluster's development strategy and in priority areas for the development of the industry, related to innovation and sustainability (e.g. Eco-design and product engineering; Circular economy, sustainability and environment; Digital economy, digitalization and Industry 4.0; Energy efficiency and transition).

POOL-NET, in collaboration with other Portuguese Clusters and the Regional Centre for the Coordination and Development Commision (CCDRC), disseminated the priorities of the Smart Specialisation Strategy close to their members and other relevant stakeholders, through seminars and workshops. Several RIS3´dissemination activities in Center Region.

INNOVATE – TECHNOLOGICAL INNOVATION

Innovations and technological advancements play a crucial role in enabling SMEs to implement green manufacturing practices. Innovations and technological advancements provide SMEs with tools and solutions to enhance their operational efficiency. Green manufacturing involves reducing energy consumption, waste generation, and resource use. Technological innovations can automate processes, optimize energy usage, and streamline production, leading to significant improvements in resource efficiency for SMEs. For example, adopting energy-efficient machinery, using smart sensors for energy management, or implementing automated systems for waste reduction can lead to significant cost savings. Many countries and regions have implemented regulations and standards that promote sustainable manufacturing practices. Innovations and technological advancements can assist SMEs in meeting these regulations and achieving compliance. Embracing green manufacturing practices can enhance the reputation and brand value of SMEs. Innovations and technological advancements allow SMEs to showcase their commitment to sustainability, differentiate themselves from competitors, and attract environmentally conscious stakeholders. This can lead to increased brand loyalty, customer trust, and a positive company image.

GEMSTONE PROJECT INNOVATION STRATEGY

GreenInnov aims to support SMEs in the exploration and development of an advanced green solution for industries. The main goal of this instrument is to support the development of a **new green technology**, **service**, **product or production process** with focus on prototyping in an industrial environment.

GreenInnov financial support aims to fund the following type of activities (TRL 5-6):
Applications must fall under one of the 3 thematic areas - Circular Design, Optimal Use, Value Recovery.

- Prototype development; Technical prototyping; Technical testing, and market testing; Prototype/system integration design and development, ...

GreenAdopt aims to facilitate the adoption of green smart solutions by industrial European SMEs. The ambition of the call is to foster the implementation of **a new green technology, service, product or business production process in a real operational environment and collaborative projects between a solution provider and a manufacturing company**. Proposals will aim at implementing functional solutions and demonstrate the green transition of the SMEs.

GreenAdopt financial support aims to fund the following type of activities (TRL 7-8).:
Applications must fall under one of the 3 thematic areas - Circular Design, Optimal Use, Value Recovery.

- Validation or/and demonstration of a solution, product, process, service, or technology in a manufacturing environment in collaboration with another SME
- Implementation of a tested solution, product, process, service, or technology in real environment in collaboration with another SME

GEMSTONE Project INNOVATION call results – innovation project examples

The SAPHIRE project aimed to advance green manufacturing in additive manufacturing and welding by developing an AI-driven workflow to predict metal hardness. This system sought to optimize process parameters, reduce waste, and improve efficiency by replacing traditional, resource-intensive material testing.

The project successfully developed a machine learning algorithm that predicts weld hardness with high accuracy, achieving a coefficient of determination of 0.964. This innovative approach eliminates the need for extensive laboratory material testing, thereby significantly reducing effort, cost, the use of corrosive media, and carbon emissions. Furthermore, the project drastically cut the time required to acquire a set of 20 bead data points from 28 hours (manual process) to just 4 hours (automated process). The automated screening process consumes roughly 20 kWh per session, a substantial reduction compared to the 140 kWh needed for manual procedures.

The AIvent, a project created as a result of collaboration aimed to drastically reduce energy consumption from industrial ventilation, which initially accounted for nearly half of companies total energy use. The project significantly exceeded expectations, achieving a 70% reduction in energy consumption (far surpassing the 20% target) and annual energy cost savings of €12,600 (tripling the projected €3,600). This was accomplished through an AI-powered system that dynamically adjusted fan operation and heating based on real-time data from sensors and human presence detection.

Beyond economic benefits, AIvent dramatically improved air quality and worker safety, contributing to a healthier work environment. It also had a substantial environmental impact by reducing emissions from optimized fan use and heating. AIvent is continuously evolving from a ventilation controller into a comprehensive environmental monitoring and control platform, with plans to integrate more sensors and connect with robotic systems. This ongoing development aims to offer a scalable solution for efficiency, sustainability, and operational insight in manufacturing.

The DiCyTrailerS project was a collaboration to develop a digital simulator for electric cargo cycle trailers. The initial goal was to create a physics-based digital twin to virtually test eTrailer performance, safety, and control strategies, aiming to reduce prototyping resources, material use, and CO2 emissions.

Successfully implemented, the project delivered a robust digital simulator integrating a physics-based digital twin of the eTrailer and its real-time firmware controller. This allowed for virtual testing of dynamic behavior and safety-critical scenarios, reducing the need for physical prototypes and cutting costs. The simulator achieved high accuracy, with virtual results matching experimental data, leading to enhanced design precision, shorter development cycles, and improved safety and energy efficiency. The partnership demonstrated how digital tools can transform manufacturing processes to be more sustainable and cost-effective, with a direct impact of 600 eTrailers saving 800 tonnes of CO2 annually and cutting city noise by 49%.

The Intel50001-SCM project aimed to integrate an advanced energy management software into the textile supply chain. The key challenge was to bring subcontractors, often disconnected from corporate sustainability goals, into a centralized, ISO50001-compliant system for energy oversight and CO2 reduction.

The project successfully implemented predictive energy modeling and real-time monitoring across Rok Textile and eight subcontractors, achieving 14-17% energy savings and reduced carbon emissions in the first three months. It led to a 16.08% reduction in energy costs, improved planning via ERP integration, and secured ISO50001 certification. The initiative also trained 81 staff, fostering capacity building and cultural change in micro-enterprises. The environmental impact included significant CO2 reductions and readiness for CBAM and digital product passports. Economically, it boosted cost efficiency and market competitiveness. Socially, it fostered inclusive upskilling and encouraged subcontractor digitalization.

The Pluvi project aimed to address the issues of easy breakage and environmental impact of traditional umbrellas by developing a patented, durable, easily repairable, eco-sustainable, and 100% recyclable umbrella.

The project successfully developed and produced a sample batch of 2,500 units of the innovative umbrella, achieving impressive durability metrics: the umbrellas withstood 10,000 opening and closing cycles and 5,000 canopy inverting cycles. Furthermore, the production process demonstrated high efficiency with a remarkably low defect rate of approximately 1%. Environmentally, the initial production run prevented the disposal of 0.88 tons of material, recovered 0.66 tons of plastic, avoided nearly 5,000 tons of CO2 equivalent emissions, and saved over 21,000 kWh of energy.

The WhiteWall project aimed to develop a novel bio-based composite material for increased safety in electric bus transport, specifically to protect passengers in the event of a battery fire. The core goal was to create an environmentally friendly, non-flammable composite that could withstand high temperatures for a crucial period.

The project successfully developed a WhiteWall composite that significantly exceeded its initial temperature resistance and burning isolation time targets. It achieved a flammability temperature resistance of 1100 degrees Celsius for 15 minutes at a composite weight of 6 kg/m2, far surpassing the initial assumption of 900 degrees Celsius for 5 minutes at 3-6 kg/m2. This innovative bio-based composite, made with natural materials like cork agglomerate and a newly developed carbonate binder, offers a much lower carbon footprint than traditional materials and is expected to become a flagship product for the company, with potential to increase turnover by at least 50%.

The MECOTRONICS project aimed to improve the energy efficiency and environmental sustainability of mechatronic production plants through optimized control strategies and enhanced human-machine interaction. The goal was to reduce energy waste by intelligently controlling the operation of mechatronic elements and minimizing downtime caused by faults.

The project achieved a total energy saving of 33% on the demonstrator plant. This was a combination of two main results: a 20% energy saving due to new control solutions that stop mechatronic elements when not actively involved in the process , and a 16% energy saving resulting from the integration of IoT devices (Willie system) that improve human-machine interaction and reduce intervention times during plant faults. These improvements significantly decreased daily energy consumption and paved the way for cost reductions and a more sustainable manufacturing approach.

INNOVATION SERVICE EXAMPLES

Technology scouting and matchmaking

Clusters can support SMEs in identifying relevant green technologies and solutions by scouting for innovative technologies both within and outside the cluster. They can facilitate matchmaking between SMEs and technology providers, helping SMEs find and adopt cutting-edge green technologies suitable for their specific needs.

Green Tech Cluster (Latvia) is implementing the European Union project "Digital accelerator of Latvia (DAoL)". The objectives of Digital Accelerator of Latvia (DAoL) are to promote digital transformation and innovation, to improve the competitiveness of Latvian companies and the quality of public services through new digital solutions, to boost investments in research and development of ICT technology.
Specialisation of DAoL:

- AI with specialisation in R&D of new digital products and digital services.
- 5G incl. application in IoT, Internet of Energy, Connectivity technologies, Autonomous and controlled vehicles, robots.
- GovTech incl. Government as a platform, Cybersecurity, Quantum technologies and EdTech. Support at least 1236 companies and organizations in Latvia.

Evoluma has designed and implemented a platform for cooperation orders eRFQ (Evoluma Request For Quotation), which enables the search for business partners (matchmaking) for the implementation of executive orders in the subcontracting sector for specific orders and innovative technologies with the possibility of their direct calculation and submission of an offer on the platform. The aim is to expand the tool and make it available on foreign markets. So far it has result functioning platform for the handling of cooperative orders from the mechanical engineering industry. English version of the platform is under creation.

The EMC2 cluster organise and/or take part in activities like innovation workshops and technology scouting, to support access to latest technologies and information to its members.

Networking and collaboration opportunities

Clusters can facilitate networking and collaboration among SMEs, enabling them to share knowledge, exchange best practices, and collaborate on green innovation projects. This can help SMEs learn from each other's experiences and pool resources to accelerate their green transition.

Evoluma cluster CATCH-UP Pilot project for the development of R&D cooperation between business and regional universities. The aim of the project was to strengthen the cooperation network of regional technical universities, to learn about the R&D potential of universities, and to identify and subsidise innovative projects aimed at commercialising the solution. One of the results of the project was also the creation by the cluster of a database of university laboratory equipment in the form of the Science4business.pl platform of services for business, illustrating the research and development potential of the region and containing, among other things: a list of research equipment and apparatus, specialist staff, and a list of potential services and research topics conducted by research units from the region that could potentially be of interest to entrepreneurs.

During the entire 2022, the clust-ER MECH (Italy) managed to organize a cycle of workshops and discussion groups with the specific aim of identifying innovative themes within the regional innovation ecosystem. Involving the 7 thematic working groups within the cluster, the activity identified 19 collaborative proposals, as a first step towards European and regional applications for innovation funds. As result directly and indirectly, from the activity carried out, the clust-ER MECH members have participated in more than 20 proposal which received +10mln€ from the regional innovation call in 2023.

POOL-NET promotes networking and collaboration opportunities among cluster members to share intelligence services and experiences through seminars, workshops, cross-cluster initiatives (e.g. Technological Roadmaps, Circular Economy Questionnaire, working Groups, cooperation projects etc.)

Demonstration and pilot projects

Clusters can facilitate the organization of demonstration and pilot projects where SMEs can showcase their green innovations and solutions. These projects can help SMEs validate their technologies, generate market interest, and gain visibility.

Evoluma conducts cyclical study visits to technology reference centres in Poland and member companies. The visits provide an opportunity to check technological solutions in the form of a demonstration or real case industry, access to specialized knowledge, which facilitates the decision to invest and implement the solution in an enterprise. Visits are also a process of building a network of cooperation with other technology centres, for example, such visits of the show - room in eDIH Krakow Poland and visit of clusters partner - Krakow Science and Technology Park. On average, Evoluma organises 5 study visit-type meetings per year, each attended by approximately 10-15 cluster members.

Evoluma - Welding Hackathon. Demonstration of the welding process in AR technology, solving assigned tasks for teams of several students of the polytechnic and industry representatives. Event carried out in partnership with the Białystok University of Technology. The aim of activity is by learning about the latest welding technologies using augmented reality, experiencing practical solutions with an element of competition. Pilot project with a plan for development and cyclical repetition with the involvement of companies from the sector carried out during the general meeting of cluster members. As in result in Welding Hackaton participated 5 teams of 25 people, students from Bialystok University of Technology and employees from industry sector.

Innovation management support

Clusters can offer innovation management support to SMEs, assisting them in the process of ideation, research and development, and implementation of green innovation projects. This can encompass project management, technological feasibility analysis, and assistance in navigating regulatory frameworks related to green transitions.

POOL-NET is the coordinator of PTCentroDiH (a consortium of 21 entities), a regional and transversal hub in Portugal that is highly focused on promoting the digitalisation of the entities of the Centro's Region in order to foster its innovation and competitiveness (specially SMEs and Start-ups). One of the main goals is establish an innovative portfolio of services that will help entities becoming more competitive and innovative through the adoption of digital technologies.

Pole Mecatech (Belgium) under the support from the local government are managing open calls to foster collaborative projects:

- Pole projects: collaborative innovation projects in applied Research and Innovation technologies, between 4 partners at least (2 coming from the RTOs or academic insitutions, and 2 companies - and at least one SME). The are supported to work together in a disruptive solution applied to the mechanical engineering sector.
- PoC - Proof of Concept - financing small demonstators among manufacturing companies and collaboration between solution providers and the manufacturers. Pole Mecatech launched a PoC "Proof of Circularity" in the metal value chain (metal processing, batteries, transport) to develop an ecodesign solution, a circular business model or a greener innovation strategy among SME.

Strategic advisory services

Clusters can provide SMEs with strategic advisory services to help them develop green transition roadmaps aligned with their business goals. These services may include market analysis, competitiveness assessment, and guidance on identifying green market opportunities and potential partnerships.

The cluster members have benefited from the cluster with regards the access to funds from European calls. In particular several SMEs had the opportunity to submit proposals within the European cascade funding projects (such as GEMSTONE), both for projects in which the cluster was a partner and those in which the clusters didn't participate to the consortium. As result several members received funding for developing new projects.

The EMC2 cluster (France) supports collaborative project development and provides dedicated information about potential funding opportunities. As result several members received funding for developing new projects.

The EMC2 cluster (France) is expanding its support by creating a new type of service offer that consists of establishing a life cycle analysis, after having collected testimonies from companies on their situation. This analysis enable initial roadmap to be defined on priority actions and to direct companies to the technical experts associated with our cluster. The cluster supports also the companies in their search for funding to make the investments needed their ecological transition.

The POOL-NET through CENTIMFE partners supports companies collaborative project development and provide technical advice in funding and setting up innovation and research projects. As a result More than 50 M€ and 100 entities envolved in last period (2017-2022).

ACHIEVED RESULTS OF THE GEMSTONE PROJECT

CAPACITY-BUILDING ACTIVITIES

The development of the GEMSTONE joint transregional "Green Manufacturing" service offer was grounded in a robust process of **capacity building**, designed to strengthen the strategic and operational capabilities of clusters across Europe. Recognizing that clusters are pivotal intermediaries in the green and digital transformation of industry, this part of the project focused on empowering cluster organizations themselves to better **support SMEs in their Twin Transition.**

To meet this objective, the GEMSTONE consortium implemented **10 structured cycles of cross-cluster learning activities,** co-creation sessions, and thematic workshops. These were informed by early-stage needs assessments and surveys conducted among cluster partners, which revealed key challenges such as fragmented knowledge, uneven access to sustainable finance, lack of strategic foresight, and varying levels of digital and green competencies.

The capacity-building phase of the project aimed to **close these gaps** by enabling partners to exchange best practices, pilot new approaches, and collectively design tools and services that would be both relevant and transferable. Topics covered included:

- **Business resilience diagnostics** and green transition roadmaps
- **Ethical and environmental R&D project design** aligned with EU taxonomy and CSRD
- **Internationalization strategies** for green SMEs
- **Funding access and cascade funding mechanisms**
- **Trend monitoring using ECCP Trend Universe**
- **Creation of a Green Manufacturing Alliance** to foster long-term cooperation

Each activity directly contributed to improving the clusters' ability to act as facilitators of green innovation, by equipping them with the methodologies, networks, and resources necessary to engage SMEs effectively. These efforts culminated in a service offer that is not only technically comprehensive but also **strategically aligned with the evolving industrial and policy landscape in Europe.**

This section provides a detailed look into these capacity-building activities: what was done, why it was needed, and how it strengthened the foundation of the service offer. It showcases the **systemic value of investing in the enablers -** the clusters themselves - so they can, in turn, deliver high-impact support to the companies driving Europe's sustainable industrial future.

BUSINESS RESILIENCE DIAGNOSIS

One of the types of support offered to SMEs by the cluster during the implementation of the GEMSTONE Project was the possibility to carry out business resilience diagnostics.

It is an important tool that allows clusters to conduct business resilience diagnostics with SMEs to carry out urgent inventory needs related to green manufacturing and to collect information on the production practices and processes, competence needs, business challenges etc.

The purpose of the diagnostics is to compile individual reports in which the priorities for action can be be identified and it will allow to obtain results that would determine which support mechanism would be most suitable for a given company. It will also allow it to perform a diagnostic analysis of business viability in order to provide solutions and prevent the challenges that the supported companies will have to implement when they receive financial support. The received reports are analysed and evaluated by the Solution Desk, the implementation of the solutions where followed by the project partners and the impact was be measured by performance indicators.

Business resilience diagnostics refers to the process of assessing and analysing the resilience of a business or organisation. It involves evaluating various aspects of the business's operations, processes, and systems to identify strengths, weaknesses, and potential vulnerabilities that could impact its ability to withstand and recover from disruptions or crises. It helps to identify areas that need improvement and enables the development of targeted strategies and plans to enhance the organisation's overall resilience. The exapmple of business resilience diagnostics is available in annex 2.

ECCP TREND UNIVERSE

The European Cluster Collaboration Platform (ECCP) Trend Universe is a tool which allows cluster organisations to get a deeper understanding into future trends and their impact on their cluster organisation. The platform is an initiative of the European Commission funded by the EU programme for the Competitiveness of Enterprises and SMEs (COSME). In order to provide support to cluster members, project partners have become ECCP trend univers Pro users, which will give them the opportunity to support their members by improving their own strategic foresight through the assessment of future trends.

ECCP trend univers identify early developments within 14 different industrial ecosystems and allows its members to view relevant trend assessments from other clusters and global data in these radars.

The aim of the ECCP is to be the European online hub for cluster stakeholders (cluster organisations, policymakers and other related stakeholders from the cluster ecosystem) and the reference one-stop-shop for stakeholders in third countries aiming to set up partnerships with European counterparts.

ECCP merged with the European Observatory for Clusters and Industrial Change (OECIC) and the European Resource Efficiency Knowledge Centre (EREK). Since 2015, the ECCP has acted as a platform for industrial clusters to come together and strengthen the European economy through collaboration. ECCP seeks to strengthen the competitiveness and sustainability of Europe's economy and industry, particularly SMEs, improving their performance in terms of productivity, innovation, internationalisation and resource efficiency.

The ECCP acts as a service facility aiming to provide cluster organisations, cluster partnerships, initiatives and networks, cluster associations and resource efficiency support actors (EREK) with a variety of modern tools. Furthermore, these tools also enable training providers and public/policy institutions to:

- Make efficient use of networking instruments (search and find potential partners and collaboration opportunities);
- Develop collaboration trans-nationally (within Europe) and internationally (beyond Europe);
- Support the emergence of new value chains through cross-sectoral and cross-industrial cooperation;
- Access the latest quality information on cluster development through news announcements and events;
- Improve their performance and increase their – as well as their members' – competitiveness;
- Build up knowledge and capacities on industrial ecosystems and cluster development.

EUROPEAN CLUSTER COLLABORATION PLATFORM

R&D PROJECTS WITH ETHICAL AND ENVIRONMENTAL CRITERIA

How can clusters address this topic and improve support to their members?

Introduction EU taxonomy and CSRD (Corporate Sustainability Reporting Directive) - An opportunity for a sustainable industry

The economic and demographic growth of human societies has significantly increased the demand for energy and raw materials, leading to major environmental challenges. These include climate change, biodiversity loss, pollution of air, water, and soil, and the depletion of essential natural resources.

In response, the European Union has introduced the European Climate Law, which came into effect on 29 July 2021. This law sets a clear direction for achieving climate neutrality by 2050 and establishes a binding target to reduce net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. It also provides a structured framework to monitor progress, offer predictability for investors and businesses, and ensure an irreversible transition to a sustainable and climate-neutral economy. For SMEs, this means both challenges and opportunities, as adapting to these new regulations can drive innovation, enhance competitiveness, and open access to sustainable investment and markets.

Achieving these climate goals requires substantial investment—€350 billion per year, plus an additional €130 billion annually to meet other environmental objectives. Public funding alone will not be sufficient to cover these costs, making it essential to redirect private financial flows toward sustainable activities aligned with the EU's climate policy. Recognizing this need, the European Commission launched its Action Plan for Financing Sustainable Growth on 8 March 2018, with its first key initiative being the creation of a European Taxonomy. This classification system helps businesses and investors identify environmentally sustainable activities, ensuring that capital is directed toward projects that contribute to climate and environmental objectives.
For SMEs, this evolving financial landscape presents both challenges and opportunities. Compliance with sustainable regulations and access to green financing can enhance competitiveness, unlock new markets, and drive long-term business resilience. By aligning with the EU's sustainability goals, SMEs can future-proof their operations, attract investment, and contribute to a more sustainable economy.

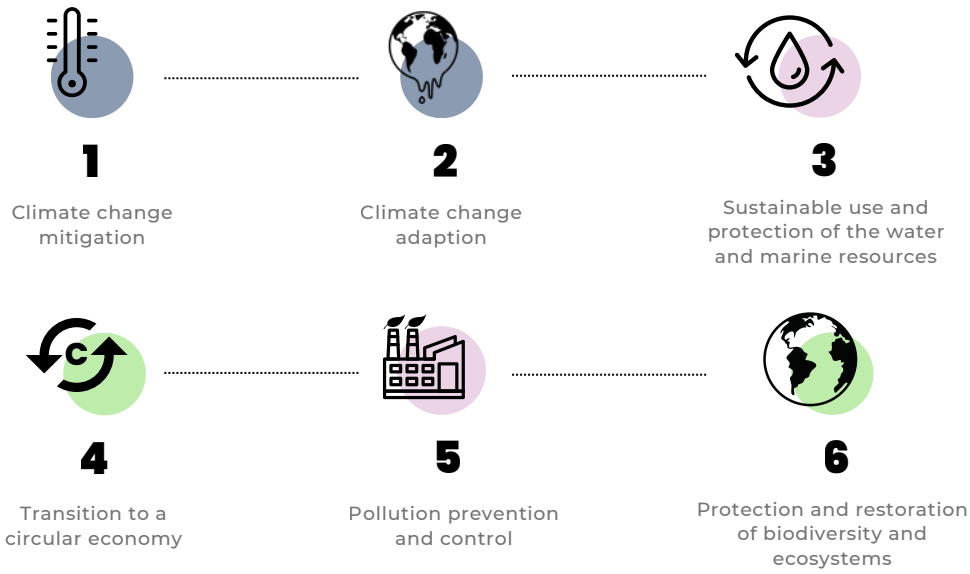
The Taxonomy Regulation (EU) 2020/852, published in the Official Journal of the European Union in June 2020, establishes a classification system that defines what is considered environmentally and socially sustainable. This framework helps investors, businesses, and policymakers identify economic activities that genuinely contribute to sustainability.

The EU taxonomy provides a **reference framework for investors and companies** to:

- support companies in their efforts to plan and finance their transition;
- protect against greenwashing practices;
- help accelerate financing of those projects that are already sustainable and those needed in the transition.

For SMEs, understanding and aligning with the EU Taxonomy can open doors to new funding opportunities, enhance market credibility, and ensure compliance with evolving sustainability regulations. Companies that integrate sustainable practices into their operations will be better positioned to attract investment, remain competitive, and contribute to the transition toward a greener economy.

6 Climate and environmental objectives



Article 9 of the taxonomy regulation

The 6 objectives explained

Climate change mitigation: activities aimed at keeping the increase in global average temperature well below 2 C. This also includes continuing efforts to limit the increase to 1.5 C above pre industrial levels.

Climate change adaptation: activities that substantially reduce the climate related risk on that activity or on people, nature or assets.

Protection of water and marine resources: activities that allow sustainable water use and activities that maintain biodiversity and provide dynamic, clean, healthy and productive oceans and seas.

Transition to a circular economy: activities aimed to maintain the value and efficient use of resources through waste prevention, re use and recycling and minimize waste and the release of hazardous substances at all stages of the product life cycle.

Pollution prevention and control: activities aimed to prevent or reduce pollutants in the air, water or land (not including greenhouse gases) or improve air, water or soil quality while avoiding adverse impacts on human health and the environment.

Protection and restoration of biodiversity and ecosystems: Economic activities aimed to protect, conserve or restore biodiversity among terrestrial, marine and aquatic organisms and their ecosystems.

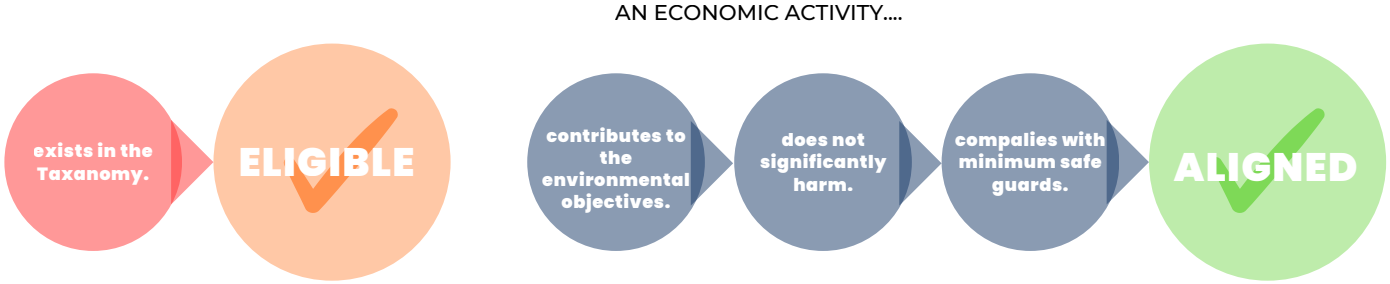
Taxanomy regulation: Delegated acts

The Taxonomy Regulation tasks the Commission with establishing **the actual list of environmentally sustainable activities** by defining technical screening criteria for each environmental objective through delegated acts:

- Climate Delegated Act published in the Official Journal on 9 December 2021 and applicable since January 2022.
- Complementary Climate Delegated Act published in the Official Journal on 15 July 2022 and applicable since January 2023.
- Environmental Delegated Act published in the Official Journal on 21 November 2023 and to apply as of January 2024.
- Amendments to the Climate Delegated Act published in the Official Journal on 21 November 2023 and to apply as of January 2024.

Criteria to define sustainable economic activities

- Making a **substantial contribution** to at least one environmental objective;
- **Doing no significant harm** to any of the other five environmental objectives;
- Complying with **minimum safeguards**;
- Complying with the **technical screening criteria** set out in the taxonomy **delegated acts**.



EU Taxanomy: from Eligible to Aligned

Different shades of "green" when it comes to sustainability:

Sustainable Activities: These are activities that significantly support one of the six environmental goals without negatively impacting the other five. They must also adhere to fundamental social standards.

Transitional Activities: These activities currently lack viable low-carbon alternatives but still contribute to climate change mitigation. They must:

- Have greenhouse gas emissions that align with the best industry standards.
- Not hinder the development of low-carbon alternatives.
- Avoid locking in carbon-intensive assets for the long term.

Enabling Activities: These activities help other activities meet environmental goals. They play a supporting role in achieving sustainability objectives, including research and innovation (R&I) projects.

Companies that fall under the scope of the Corporate Sustainability Reporting Directive (CSRD):

Companies that fall under the scope CSRD are required to include detailed sustainability disclosures in their annual reports. Specifically, they must report the extent to which their activities align with the EU Taxonomy, assessing both their eligibility and compliance with the criteria outlined in the Taxonomy delegated acts. Since the 2022 reporting year, companies previously subject to the Non-Financial Reporting Directive (NFRD) must also disclose their Taxonomy alignment in terms of total capital expenditures (CapEx), operating expenditures (OpEx), and turnover, ensuring transparency in their environmental impact and sustainable investment practices.

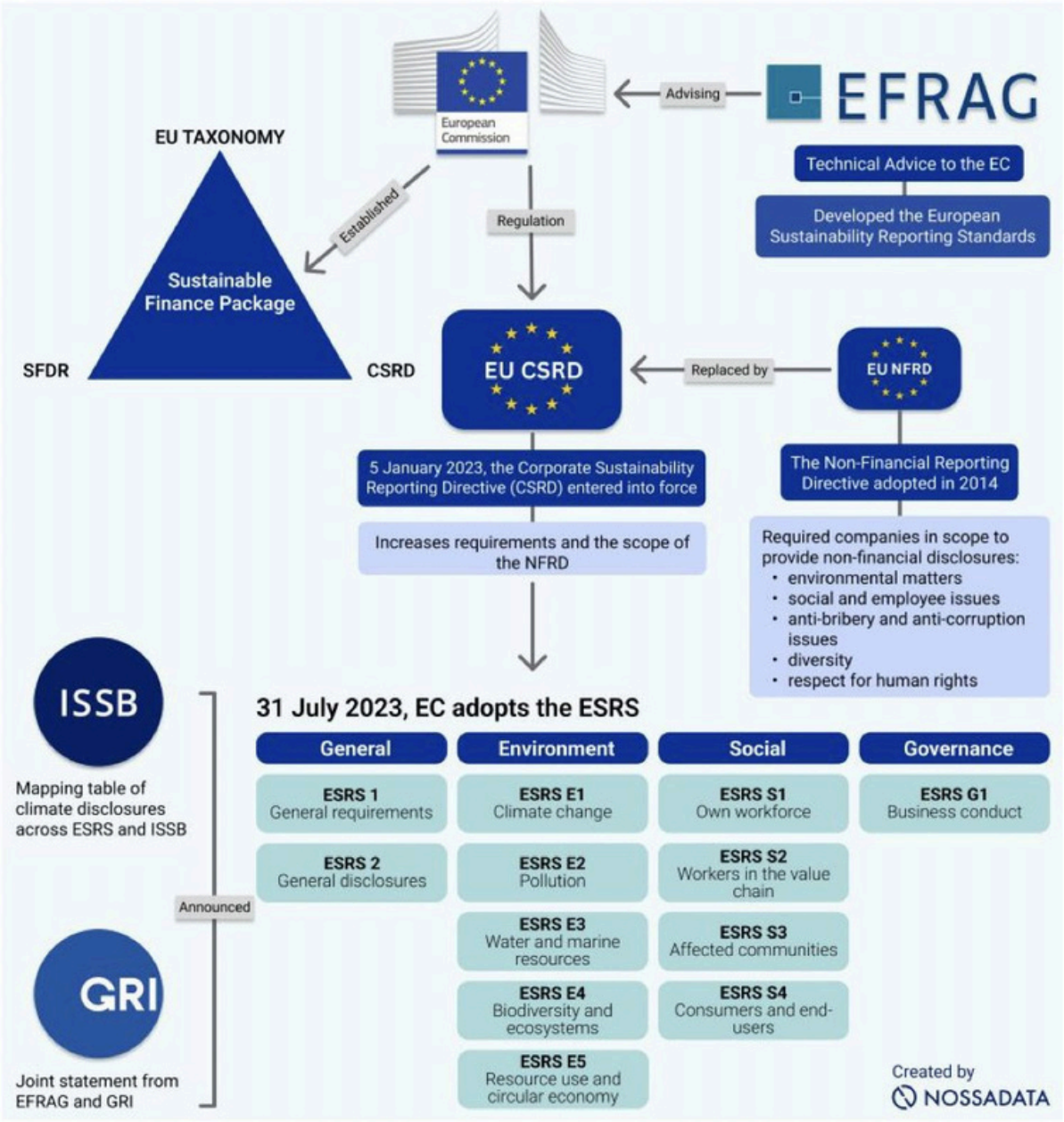
Other companies that do not fall under the scope of CSRD:

On the other hand, companies that are not obligated to report under the CSRD may still choose to disclose this information voluntarily. Doing so can provide strategic advantages, such as gaining access to sustainable financing, improving stakeholder trust, and enhancing their reputation in the market. Voluntary reporting of Taxonomy alignment can also help businesses attract environmentally conscious investors and customers, demonstrating their commitment to sustainability even if they are not legally required to report.

CSRD : Corporate Sustainability Reporting Directive

- Replaces the NFRD (Non Financial Reporting Directive).
- Published in the Official Journal of the European Union in December 2022.
- Comes into force in 2024.

EU Sustainable finance framework



Breakdown of the ESRS universe by 2023 Nossa Data

CSRD: A new pradigm

The CSRD implies **to consider sustainability information at the same and equivalent level as financial information.** The companies concerned must publish information on what they consider to be:

- **Risks and Opportunities** arising from social and environmental issues,
- As well as on the **Impact of their activities** on people and the environment (ROI priciple).

The aim is to make the assessment of companies' sustainable development performance accessible to all stakeholders. The aim of this new directive is to:

- Strengthen and standardise Environmental Societal Governance (ESG) information requirements.
- Extend the scope of companies concerned.

A sustainability issue may be important from the point of view of impact, or from the financial point of view, or from both:

An impact perspective - is concerned with the actual or **potential material impacts,** positive or negative, of the company on **people or the environment** in the short, medium and long term. Impacts include those associated with the **company's own activities** and the upstream and downstream **value chain,** including through its products and services, as well as its business relationships." (ESRS 1 paragraph 43)

A financial impact - This is the case when a **sustainability issue generates or may generate risks or opportunities** that have a significant influence , or can reasonably be expected to have a **significant influence,** on the **company's development,** financial position, financial performance, cash flows, access to finance or cost of capital in the short, medium or long term". (ESRS 1 paragraph 49)

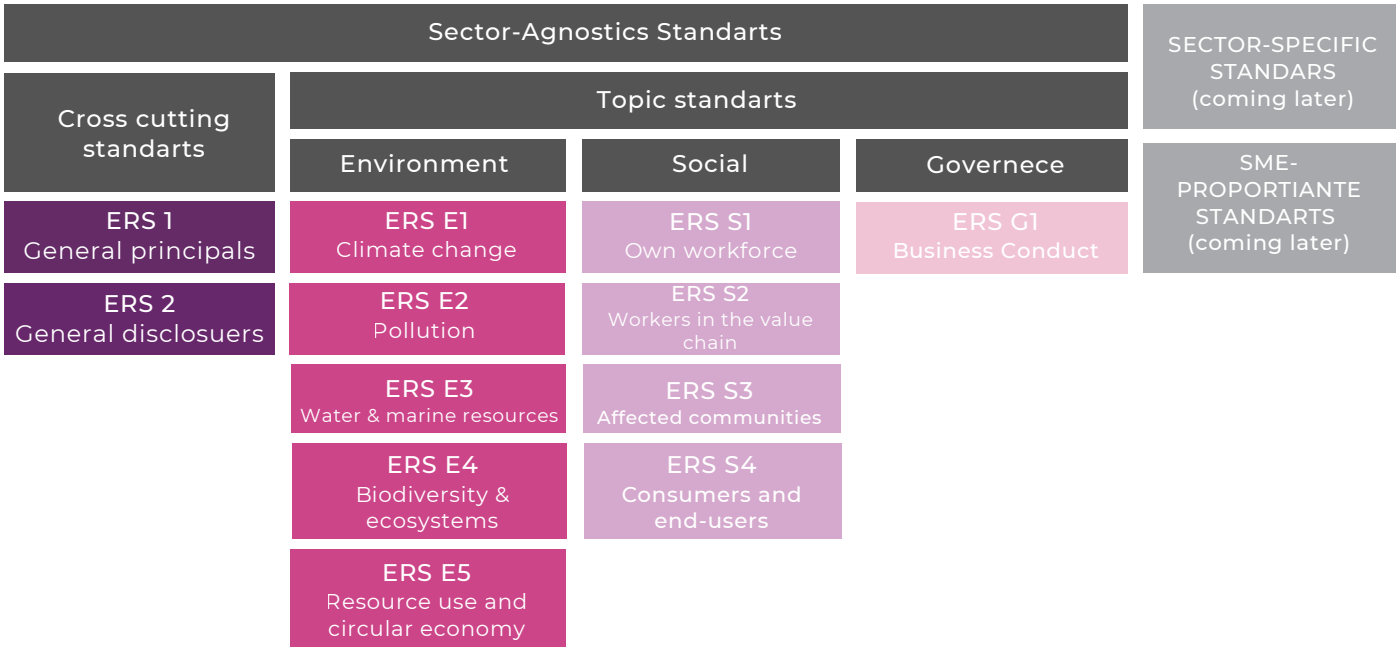
European Sustainable Reporting Standards

The ESRS is the operational component of the CSRD, which aims to:

- Define the information that a company needs to publish in the sustainability report.
- Specify the methodologies to be applied (double materiality, value chain, etc.).

The ESRS cover a wide range of topics, including climate change, pollution, water and marine resources, biodiversity, human rights, and business conduct. They apply to companies that fall under the scope of the CSRD and aim to provide investors, stakeholders, and the public with reliable and consistent sustainability information. The ESRS were officially adopted by the European Commission on July 31, 2023 and are designed to align with global sustainability frameworks such as the Global Reporting Initiative (GRI), the Task Force on Climate-related Financial Disclosures (TCFD), and the International Sustainability Standards Board (ISSB).

ESRS overview



Structure of European Sustainable Reporting Standards

TAXONOMY & CSRD: impact on R&I programmes

R&I an essential tool for sustainability:

- R&I produces **the technologies and solutions of tomorrow a pivotal tool to reach or go beyond the standards set in the EU Taxonomy.**
- **EU programmes are more and more targeting R&I projects addressing sustainability** to foster market uptake of innovative technologies and solutions.

Labelling R&D project with ethical and environmental criteria

Approach of cluster organisation - CIMES

The Green Manufacturing by CIMES initiative, launched on September 15, 2021, during an Extraordinary General Assembly, aims to promote sustainable manufacturing practices. This approach focuses on integrating environmentally friendly processes and technologies into production systems to reduce waste, conserve energy, and minimize environmental impact.

By adopting green manufacturing principles, companies can enhance operational efficiency, comply with environmental regulations, and contribute to global sustainability efforts.

Proximity
Local, direct circuits;
Territorial Industrial Ecology;
Location: raw material/production/use market compromise.

Performance
Promoting the culture of Multicriteria: cost and impacts;
Management of cost/sovereignty/agility trade-offs;
Optimization methods under constraints;
Multi-criteria LCA over the entire life cycle.

Continuty
Long term vision;
Anticipate/prevent “rebound effects;
Compromise of interest;
Controlled obsolescence;
Resilience; Sovereignty; Training.

Sharing
Value sharing;
Sharing feedbacks;
Sharing knowledge;
Sharing successes and good practices.

Process
Material frugality;
Energy efficiency Low-consumption machines and processes;
Direct manufacturing;
Process LCA;
Reduction and Recovery of process waste;
Master part preparation operations (washing, degreasing, etc.

Product
4Rs: Rethin , Reduce, Reuse, Recycle;
Eco design; Product LCA.

The 6 Ps “Levers for green manufacturing"

Details of the 9 evaluation criteria for project labeling

Resources-Material:
To what extent does the project take into account tensions (scarcity, volatility, availability, etc.) on resources? Matter, energy, water in particular.

Product lifecycle:
How does the design approach question the impact of the product at each of its stages and until the end of its life? End-of-life management, obsolescence suffered or assumed, recyclability, retrofit and remanufacturing, LCA and impact analysis.

Process frugality:
How does the project reduce the impact of the manufacturing process at each of its stages? Process waste, energy consumption, waste heat, etc.

New business models:
To what extent does the project question economic models and challenge organizational innovation on the value chain?

Risk management:
To what extent does the project seek to minimize negative impacts on the climate and biodiversity? At a minimum, precautionary principle, or simple application of regulations or anticipation of regulations.

Territorial cooperation:
Beyond the collaborative dimension of the project (covered elsewhere), to what extent are the following principles addressed/integrated: territorial synergies, industrial symbiosis, short circuits?

Ethical dimension of the project with regard to the human-citizen:
Usefulness of the solution, respect for privacy, transparency, accessibility and universality, better living.

Ethical dimension of the project with regard to the human-employee:
Quality of life, shared responsibility, TMS (work-related musculoskeletal disorders), diversity, involvement-belonging, training-mobility-career.

Go beyond:
How does the project fit into a global (systemic) virtuous dynamic? Short/medium/long term impacts? Does it respond to a balanced and assumable vision? Resilience and anticipation, anticipation through a multi-scenario approach or bifurcation strategy in the face of an uncertain context, compromise of individual/collective interests.

Evaluation & Labeling Process

Projects are scored based on four main criteria:

- **Maturity** (15 points) – 19% weight
- **Innovation** (18 points) – 22% weight
- **Impact on Cluster & Economic Benefits** (21 points) – 26% weight
- **Ethical & Environmental Criteria** (27 points) – 33% weight

Projects scoring over 75% in Ethical & Environmental Criteria receive the Green Manufacturing CIMES trophy.

TWIN TRANSITION: PRACTICES EXCHANGES BETWEEN CLUSTERS

Experience exchange of other existing tools used by clusters

EMC2

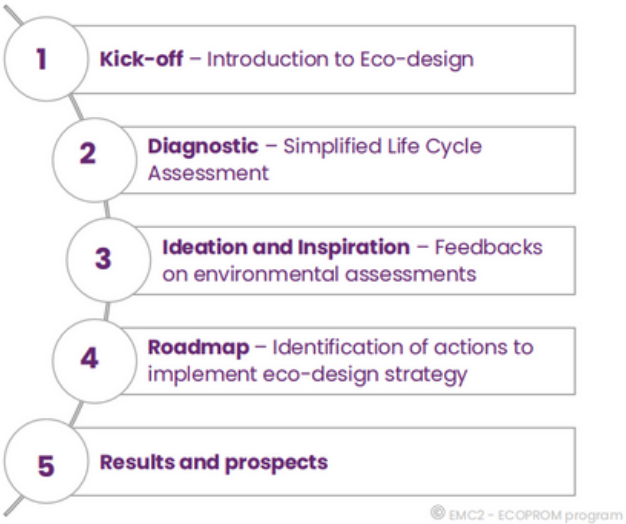
ECOPROM - Mentoring program on eco-design

- Aims to disseminate the eco-design methodology among SMEs to help them reduce the environmental impact of their products or services.
- ECOPROM supported 8 SMEs to conduct a Life Cycle Analysis (LCA) of a product or a service with the support of eco-design experts.
- The accompanied SMEs also benefited from the advice of a mentor, and of the broader manufacturing community through the organization of collective events to share good practices, bottlenecks and solutions.

A mentoring program with 2 stakes...

Mentoring program between peers (animated by EMC2 and supported by Eco-design Experts)	Sensibilisation & community building of the regional ecosystem on eco-design topic
• 1 SME, 1 mentoring company and 1 expert • Conduct a simplified Life Cycle Assessment of a product and a roadmap	• Program of animations by EMC2 allowing sensibilisation on Eco-design and circular economy • Collective events to support emergence of solutions and collaborations

- First edition launched in 2023
- First part of the program achieved on 6 months (June-Dec 2023) with 5 steps:
  - mix of individual and collective support
  - 3 collective sessions during which beneficiaries, mentors and experts shared results and exchanged with peers building-up a community.
- 2024: animations and workshop program.



ENERGY EFFICIENCY CALCULATOR

Green-Tech Cluster or Green and Smart Technology Cluster is organization developed for cross-sectoral cooperation bringing together companies, educational and research institutions, as well as other organizations that partly or fully operate in the industries of green and smart technologies. The cluster includes industries important to the sustainable development of Latvia, which also are priority sectors of smart specialization strategy: mechanical engineering and engineering, information, and communication technology and space technology, energy-efficient buildings, efficient production and environmentally-friendly raw materials.

FUTURE MOBILITY	SMART MANUFACTURING AND GREEN RESOURCES	ENERGY EFFIECIENT BUILDINGS
1. INTELLIGTEN TRANSPORT SYSTEMS 2. FUTURE MOBILITY CONSORTIUM 3. MICROMOBILITY 4. E-MOBILITY 5. SHARED MOBILITY	1. LEAN MANUFACTURING 2. AUTOMATION 3. IOT 4. CIRCULAR ECONOMY 5. DIGITALIZATION	1. TECHNOLOGY PROMOTION 2. EDUCATION FOR GENERAL PUBLIC 3. EDUCATION FOR COMPANIES • Energy efficiency week • GreenBox smart buildin g solution • Energy efficiency calculator

Green Tech Cluster has developed a tool for internal use that helps to calculate the energy consumption of companies. With the help of the tool, it is possible to determine the most suitable alternative renewable energy resource options for the company and potential cooperation with other companies.

The energy sector is one of the most important industries globally, as it enables the existence and development of other sectors. Energy production relies on different resources:

- Non-renewable fossil fuels (coal, peat, natural gas, oil) contribute to climate change by emitting greenhouse gases.
- Renewable energy sources (wind, solar, bioenergy, hydro, geothermal, wave, tidal) are considered climate-neutral.

Latvia aims to achieve a 50% share of renewables in total energy consumption by 2030. To meet this goal and counter rising energy prices, more businesses and households are switching to renewable energy sources like wind and solar power.

To help you calculate the optimal installed solar panel generation capacity, a solar panel calculation tool has been developed. The tool allows you to calculate the optimal installed solar panel capacity according to 5 different scenarios:

1. Scenario: to cover 100% of your own electricity consumption.
2. Scenario: to cover x% of your own electricity consumption (a percentage value manually entered by the user).
3. Scenario: to ensure the optimal level of effective solar panel capacity and investments.
4. Scenario: to ensure 100% connection capacity utilization and necessary investments.
5. Scenario: required readings, covering 100% of the available solar panel area and necessary investments.

The calculation of solar panels is based on the hourly consumption data of the facility, which can be obtained on the AS Sadales Tīkls client portal https://mans.e-st.lv/
To perform an indicative calculation of solar panels, it is necessary to select hourly consumption data in MS Excel format for the calendar year on the ST client portal, selecting data for each month.

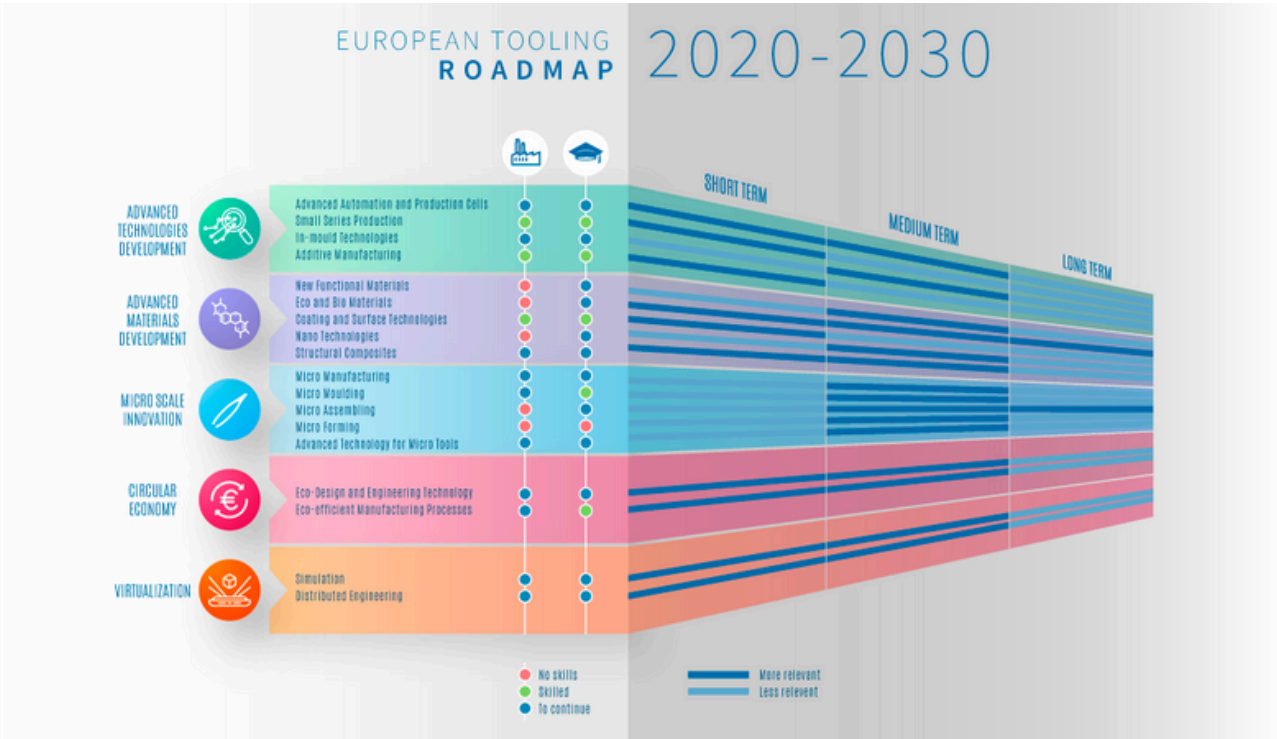
The "Tooling Roadmap 2030" developed by Pool-Net: Portuguese Tooling & Plastics Network outlines a strategic vision for the future of Portugal's tooling and plastics industries, focusing on innovation, internationalization, and diversification. This roadmap serves as a valuable example for other cluster organizations in several ways:

Strategic Vision and Objectives: The roadmap sets clear goals, such as positioning the sector among the top five globally in productivity, innovation, and human resource qualification, and reducing dependence on the automotive industry by expanding into sectors like energy, environment, electronics, medical devices, pharmaceuticals, and aeronautics.

Collaborative Approach: By promoting cooperation among companies, universities, R&D centers, and public entities, the roadmap fosters synergies that would be challenging to achieve individually. This collaborative model enhances knowledge sharing and innovation within the cluster.

Internationalization Efforts: The roadmap emphasizes the promotion of the collective brand "Engineering & Tooling from Portugal," aiming to consolidate the industry's reputation in traditional and new markets, differentiate national offerings from international competitors, and increase exports.

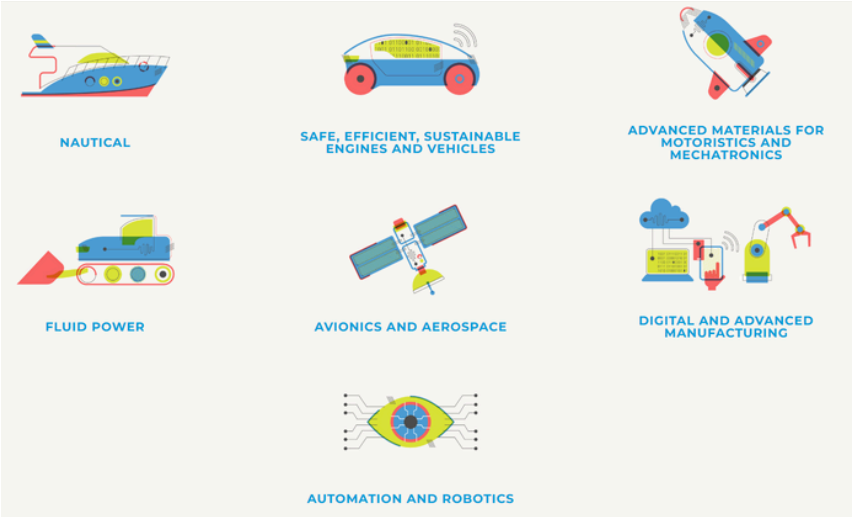
Integrated Service Offering: By advocating for a fully integrated service model that includes design, engineering, prototyping, material selection, mold production, and testing, the roadmap enhances the cluster's competitiveness as a "one-stop-shop" for clients.



Roadmap infographic timeline

The Mechatronics and Motoristics Clust-ER focuses its action on 8 strategic lines of research and innovation enabled through 8 working groups, or Value Chains, representing the Emilia-Romagna mechatronics and motoristics systems:

- Digital and Advanced Manufacturing
- Automation and Robotics
- Safe, efficient, sustainable engines and vehicles
- Advanced Materials for Motoristics and Mechatronics
- Avionics and Aerospace
- Nautical
- Fluidpower
- Mobile Electrification Systems



VALUE CHAIN

Diverse Membership: Comprising 110 entities, including companies, research centers, and training institutions, Clust-ER MECH fosters a collaborative environment that leverages a wide range of expertise to enhance sector competitiveness.

Strategic Focus Areas: The cluster operates through eight specialized working groups, or Value Chains, each targeting specific areas. This structure enables focused research and innovation efforts within each domain.

Integration into Regional Innovation Ecosystem: As a key player in Emilia-Romagna's innovation ecosystem, coordinated by ART-ER, Clust-ER MECH collaborates with Technopoles and the High Technology Network laboratories. This integration facilitates the multiplication of innovation opportunities through a collaborative approach.

By adopting a collaborative model with diverse stakeholders, establishing specialized working groups, and integrating into the broader regional innovation framework, Clust-ER MECH provides a replicable example for other cluster organizations aiming to enhance their sector's competitiveness and innovation capacity.

Pôle MecaTech

Initiatives for industrial transformation and sustainability

Pôle MecaTech, a Belgian innovation cluster, has implemented several initiatives that exemplify best practices for cluster organizations aiming to drive industrial transformation and sustainability:

CAP IMPACT	CIRCO track	PoC Industry of the Future
Digital (& green) transition Individual support 1) Diag 360° + 2) 10 days of expertise	Circular Economy – Metal, Batteries, Transport Collective workshops Identify 1 opportunity + build an action plan to go circular	Digital and green transition Financing Support the development of an innovative solution close to the market

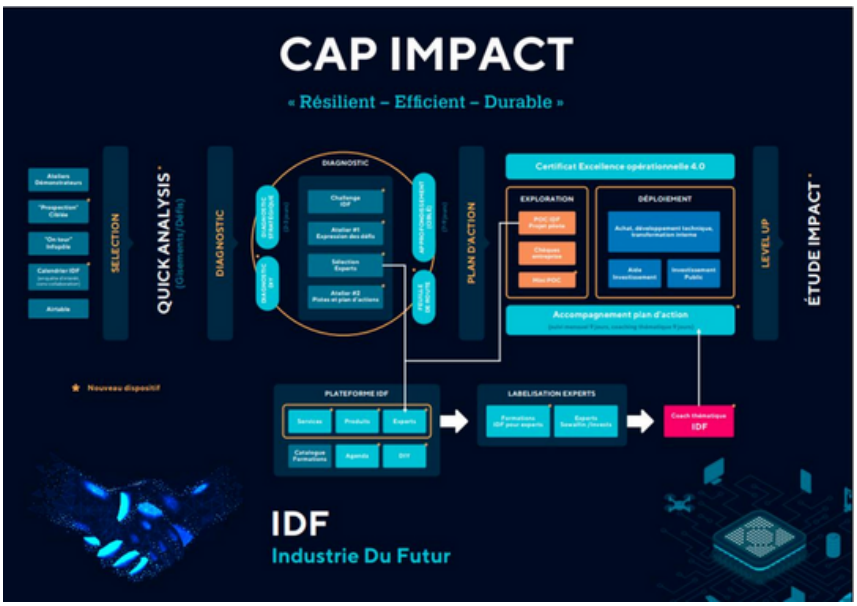
CAP IMPACT Program: This comprehensive initiative assists Walloon manufacturing companies in deploying operational excellence strategies and transitioning towards Industry 4.0. It offers a proven methodology and step-by-step support, from diagnostics to automation and activity optimization. Key benefits include a 360° diagnostic, action plan development, expert consultations, and integration into a network of industrial and technological experts. The program is subsidized, significantly reducing participation costs for companies.

CIRCO Track: This program provides collaborative workshops that enable companies to develop business opportunities underpinned by circular design strategies. The CIRCO methodology supports participants in revolutionizing their products through circular eco-design, focusing on extending product life cycles and developing innovative business models.

Proof of Circularity (PoC) Industry of the Future: Aligned with the Circular Wallonia strategy, this initiative funds real-world testing of eco-design innovations within the metal, batteries, and transport value chains. It supports solutions that significantly improve aspects of the product life cycle related to materials, processes, or product design, promoting circular business models and innovation strategies within companies.

SME's benefits:

- 10 days of personalized support from operational excellence specialists;
- Diagnosis and analysis by an external perspective;
- Customized action plan aligned with your ambitions and resources;
- Privileged access to MecaTech network.



The Evoluma Industrial Cluster has developed a range of training services as part of its newly established DemoLab Vocational Competence Center.

This is an innovative training solution that blends real and virtual elements to create a life like welding experience. Powered by HyperReal-Sim technology, the Soldamatic system delivers the most realistic welding training available outside of actual welding practice.

The system does not fully replace traditional training on real welding machines but complements it. The optimal approach combines simulator training (e.g., mastering techniques and welding positions) with hands-on practice on actual equipment. The system aligns with European (EWF) and American (AWS) standards, offering a variety of welding positions and joint types.

It enables practice across multiple welding processes, including GMAW/MIG-MAG, SMAW/MMA, FCAW-G, FCAW-S, and GTAW/TIG, while also simulating different welding positions and joint configurations, ensuring comprehensive welder training.

The benefits of implementing AR technology in the DemoLab training facility are multifaceted and far-reaching. Here are some key advantages:

DEMOLAB 4.0 COMPETENCE CENTER 4.0

A. For training participants:

1. Industrial sector employees:

Skill development in a safe environment: Employees can refine their skills (e.g., welding in challenging positions or with various materials) without the risk of injury or costly mistakes for their employers. AR simulates real-world industrial scenarios safely.

Reduced stress: AR allows employees to practice in a comfortable setting, which is especially valuable for less experienced workers, alleviating the pressure of operating real welding equipment.

Rapid skill enhancement: The system provides real-time analysis of welding parameters (e.g., torch angle, travel speed), accelerating learning and improving precision compared to traditional methods, where feedback is often delayed.

2. Students (e.g., vocational schools, technical universities):

Practical learning without barriers: Students gain access to realistic training without requiring extensive materials or infrastructure. They can practice various welding techniques (MIG/MAG, TIG, MMA) on the simulator before transitioning to real machines.

Confidence building: AR enables repeated practice and error analysis, strengthening their readiness for the job market.

Modern learning approach: As a generation familiar with digital technologies, students appreciate the engaging, interactive nature of the training, boosting their motivation.

3. Future industry workers:

Enhanced professional preparation: Thanks to this technology, prospective welders enter the workforce with advanced practical and theoretical skills, increasing their competitiveness.

Environmental awareness: AR-based training fosters a responsible approach to resource use and production processes among future workers.

Versatile skillset: The system adheres to international standards (EWF, AWS), opening opportunities for work across countries and industries.

Support for recruitment and aptitude assessment: The system aids in evaluating candidates' suitability for the welding profession.

B. Benefits of AR technology in the training process:

1. Human-centered focus:

AR: The Soldamatic system places the individual at the heart of the training process. Users operate real welding torches and see their actual surroundings enriched with virtual elements, supporting natural muscle memory and coordination development. Real-time feedback (e.g., weld bead visualization) helps users understand mistakes and refine techniques intuitively, unlike the often-delayed feedback from traditional instructor observations.

Traditional methods: Learning on real welders requires constant instructor supervision, with feedback that can be subjective and delayed. Additionally, risks like burns or eye exposure place the learner in a less comfortable position.

2. Resource efficiency and cost savings:

AR: Soldamatic eliminates the need for consumables such as electrodes, welding wire, shielding gases, or metal samples. Physical training components (e.g., QR-coded samples) are reusable, significantly cutting costs and waste.

Traditional methods: Conventional welding consumes materials continuously, generating high costs and waste (e.g., spent electrodes, metal scraps). It also requires specialized workstations with exhaust systems and protective gear, increasing resource demands.

3. Zero emissions:

AR: The simulator produces no fumes, smoke, or sparks, and its energy consumption is minimal (comparable to a PC). This aligns fully with sustainable development policies and the "Green Deal."

Traditional methods: Conventional welding emits welding gases (e.g., CO_2, ozone) and particulates, negatively impacting the environment and user health. It also requires ventilation systems that consume additional energy.

4. Training appeal:

AR: Combining digital technology (3D graphics, interactive software) with real tools makes training modern and engaging. Features like weld visualization or gamification (e.g., comparing scores) attract younger participants.

Traditional methods: Traditional methods: Learning on welders can feel monotonous and stressful for beginners, with no interactive elements to sustain motivation.

5. Integration of digital and physical technologies:

AR: Soldamatic merges physical tools (torches, samples) with digital simulation, creating a hybrid training environment. Users work with authentic equipment, but their results (e.g., weld bead shape) are digitally generated, blending the best of both worlds.

Traditional methods: Lacking digital integration, the process remains fully analog, limiting data analysis or personalized training options.

6. Performance tracking, skill progression, and data processing:

The solution supports modern vocational training methods, offering value to both industrial companies and young talents while promoting the technologies of the future.

Watch here

CYCLE OF AWARENESS AND MOBILISATION WORKSHOPS

Between April 2023 and May 2025, the GEMSTONE project organized a **joint European cycle of awareness-raising and mobilization workshops** aimed at fostering a broad understanding and practical application of **Green Manufacturing principles** among SMEs, industrial partners, and regional stakeholders. A total of 19 workshops - **8 international (online)** and **11 regional (physical)** - were held, exceeding the project's original targets and engaging **403 participants across Europe.**

Total Events: **19**

Total Participants: **403**

Key Principles: **Circular Economy, Eco-design, ESG, Skills**

Outputs: **Shared methods, tools, and good practices**

The workshops were designed to:

- Equip SMEs with knowledge and tools to implement green practices.
- Promote innovation through eco-design, circular economy, and ESG frameworks etc.
- Support regional and cross-border cooperation on sustainable industrial strategies.

By addressing both European-level policy and localized industry realities, the initiative successfully bridged strategic goals with grassroots action, supporting the green transition of industrial ecosystems.

Workshop categories by Green Manufacturing Principles

Circular Economy & Waste Reduction

- Business models that extend product life (e.g., servitization, Product-as-a-Service)
- Remanufacturing and recycling innovations (e.g., DeremCo, GENPLAST, UPB Group).
- Closed-loop systems and resource recovery as drivers for industrial sustainability.

Sustainable Product & Process Design

- Eco-design tools (Brezet Wheel, CIRCO methodology).
- Life Cycle Assessment (LCA) and Life Cycle Engineering (LCE) to guide product development and material selection.
- Integrated strategies to reduce environmental impact at the design stage.

Resource & Energy Efficiency

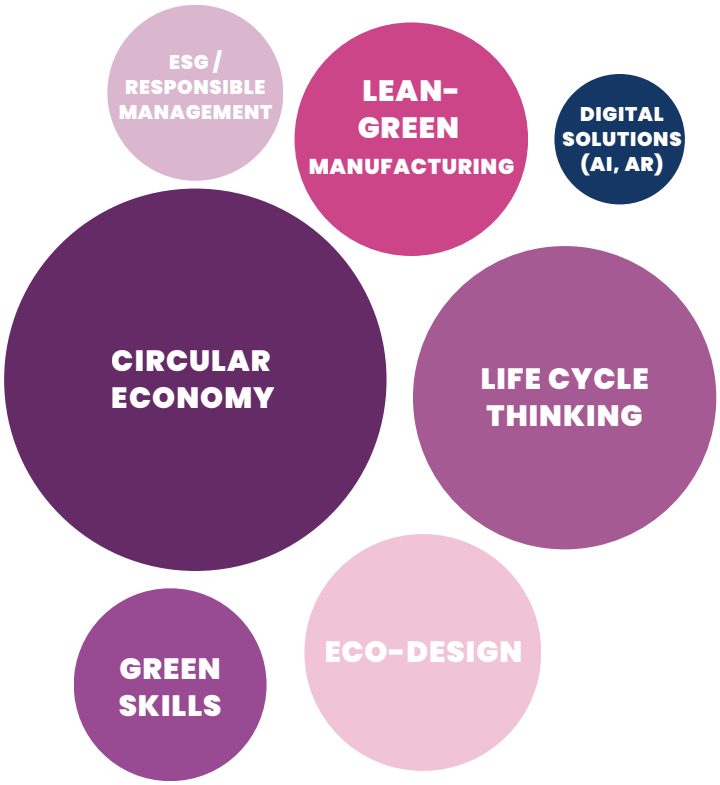
- Lean-Green Manufacturing to optimize value chains.
- Use of advanced technologies (e.g., laser welding, digital twins) for cleaner production.
- Practical case studies demonstrating efficiency in real manufacturing environments.

ESG & Responsible Management

- ESG strategies aligning with climate goals and governance standards
- Tools for stakeholder dialogue, ESG risk mapping, and KPI design.
- A holistic view of sustainability through corporate responsibility frameworks.

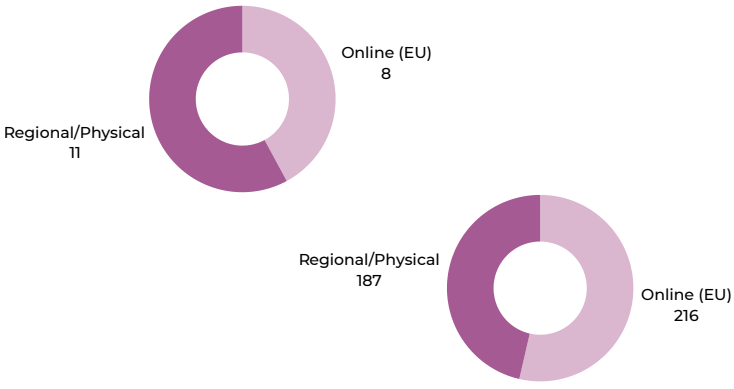
Training, Skills & Green Jobs

- Emerging green skills in design, resource management, and data analysis.
- Upskilling and vocational training offers aligned with new industry requirements
- Partnerships between business and education to foster green talent pipelines.



Green manufacturing Principles Frequency Map

The workshops applied a variety of formats: webinars, technical seminars, live demonstrations, and collaborative group sessions - making the learning process engaging and actionable.



Online vs Physical participation ratio

- *International Workshops: Delivered online, covering broad strategic themes, open to European stakeholders, and archived on YouTube for wider access.*
- *Regional Workshops: Held on-site, grounded in local contexts with hands-on case studies, industry visits, and regional policy integration.*

The main topics discussed in the GEMSTONE workshops each play a vital role in driving the green transition in manufacturing. Circular economy and waste reduction form the foundation for a more resource-efficient industrial model - redefining how materials are used, extended, and reintroduced into production systems. This principle not only reduces environmental impact but also fosters innovation in business models, such as servitization and product-as-a-service, which shift the focus from ownership to performance.

Sustainable product and process design, including the use of life cycle assessment (LCA) and eco-design strategies, enables companies to minimize environmental impact from the earliest design phase, ensuring that products are developed with reuse, recyclability, and material efficiency in mind. This aligns closely with European-level initiatives such as the European Green Deal and Circular Economy Action Plan, which emphasize lifecycle thinking and product sustainability as policy priorities.

Similarly, resource and energy efficiency, supported by lean-green manufacturing principles and cleaner technologies, helps industries meet increasingly stringent energy targets while remaining competitive. ESG and responsible management practices bring a governance and social lens to green manufacturing, aligning business operations with broader sustainability and transparency goals—crucial for securing funding, meeting regulatory demands, and building consumer trust. Finally, skills development and green jobs are pivotal in addressing the workforce challenges of the green transition.

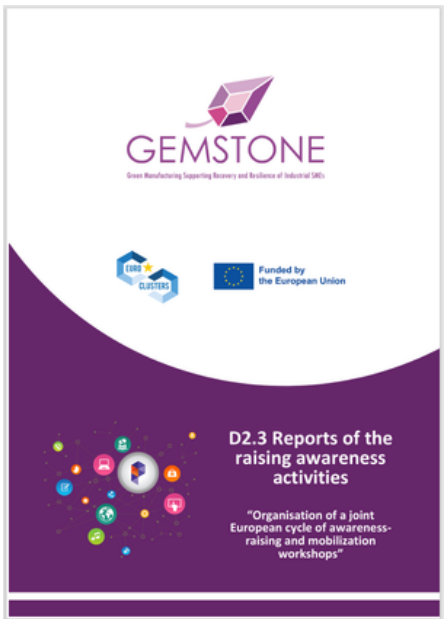
Building capacity in emerging areas like impact analysis, circular design, and digital sustainability tools ensures that both current and future professionals are equipped to drive transformation on the ground. In this way clusters can create a powerful framework that not only supports EU policy objectives but also strengthens local ecosystems by embedding sustainable practices into regional supply chains, industrial networks, and innovation systems. The interconnectedness of these topics highlights the need for coordinated, multi-level efforts to make the green transition both practical and inclusive.

The GEMSTONE workshops contributed meaningfully to raising awareness and building capacity around green manufacturing, offering practical tools, insights, and examples that supported SMEs and stakeholders in exploring more sustainable practices. While the full impact of these efforts cannot yet be fully measured, the sessions provided opportunities for participants to engage with circular economy principles, eco-design strategies, ESG frameworks, and new business models. They also served as a valuable platform for dialogue and knowledge exchange between industry, academia, and policymakers, helping to foster relationships and ideas that may lead to longer-term change.

Overall, the GEMSTONE initiative has made an impact by bridging policy goals with on-the-ground industrial transformation. By addressing both European-wide objectives and local implementation challenges, the workshops strengthened regional innovation ecosystems while contributing to the broader vision of a climate-resilient, competitive, and circular manufacturing economy. This coordinated approach - blending awareness-raising, skills development, and cross-sector collaboration - demonstrates a scalable model for driving sustainable change within Europe's industrial landscape.

We invite you to explore the report on the European cycle of awareness-raising and mobilization workshops available on projecs website - this document offers valuable insights into how green manufacturing practices are being introduced, discussed, and applied across Europe.

Inside, you'll find detailed overviews of both international webinars and regional workshops. Each session was crafted around real challenges and opportunities identified by our partners - covering themes mentioned on page 52. We also share practical examples, emerging tools, and reflections on how different stakeholders are mobilising to support a greener future in manufacturing.



Video recordings on International Workshops you can find in our Youtube chanel

@GEMSTONEProject

Lean-Green Manufacturing to optimize value chains

Green Manufacturing: New Borders for Industry

Green Manufacturing: Cases in Engineering Design for Sustainability

Circular Economy: Funding and Training Event (Hybrid: Online + In-Person)

New Business Models to Foster Circular Economy

Green Manufacturing: European Programmes

Sustainability and Integration of Recycled Materials into New Products

Green Jobs & Emergent Talent

WELCOME TO THE EUROPEAN CLUSTER ALLIANCE FOR GREEN MANUFACTURING

Why This Alliance Matters

In response to the urgent need for green and digital transformation in European industry, the European Cluster Alliance for Green Manufacturing was founded to unite industrial clusters in a collaborative, future-oriented network. Born from the GEMSTONE project, the Alliance is a shared initiative to accelerate innovation, sustainability, and competitiveness across Europe.

By working together, we can meet the complex challenges of climate change, energy efficiency, and technological advancement more effectively than acting alone.

What Is the Alliance?

The Alliance is a voluntary, open platform connecting European industrial clusters to:

- Foster cross-border collaboration
- Support the green and digital transition
- Strengthen SMEs' capacity to innovate
- Represent clusters' interests at the EU level
- Share knowledge, tools, and opportunities

Key Objectives

Knowledge Exchange

Share best practices and green technologies

Joint Projects

Develop collaborative, impactful initiatives

Support to SMEs

Provide services and tools for sustainable growth

Policy Engagement

Contribute to EU policy shaping

How It Works

Who Can Join?

Any European industrial cluster committed to green manufacturing, with an ECCP profile.

Governance

- *Assembly of Members:* Annual general body
- *Coordinator:* Oversees operations
- *Industrial Council:* Advises with industry and research insight

Activities

- Joint EU project participation
- Online best practice catalogue
- Events, B2B, and communication platforms

Join Us

This Alliance is your platform to shape the future of sustainable European manufacturing. Get involved, collaborate, and contribute to a greener, smarter Europe. For more details please take a look at Charter of the European Cluster Alliance for Green Manufacturing, reach out to the coordinator Loïc MARIN (l.marin@cimes-hub.com)

CONCLUSION

The Catalogue of Transregional “Green Manufacturing” Services is one of the final results of the GEMSTONE project, delivered under the Joint Cluster Initiatives (EUROCLUSTERS) framework to support Europe’s industrial recovery and transformation.

Developed through a collaborative process of capacity-building, peer learning, and continuous improvement, the catalogue reflects the collective expertise and efforts of project partners. It provides a well-structured set of services that clusters can deliver to SMEs to support their green and digital transition in the manufacturing sector.

Throughout the project, the service offer was updated three times, each version integrating new insights, examples, and outcomes from the evolving work of partners. This ensured that the final catalogue is aligned with real industry needs, policy frameworks, and best practices from across Europe.

By building a joint transregional service offer, GEMSTONE strengthened the ability of cluster organizations to act as key facilitators in the transition toward sustainable and resilient manufacturing. The offer also served as a tool to foster collaboration, knowledge exchange, and innovation among SMEs and clusters operating in five priority sectors: Aeronautics/Defence, Energy, Mobility, Agriculture/Agri-food, and Materials.

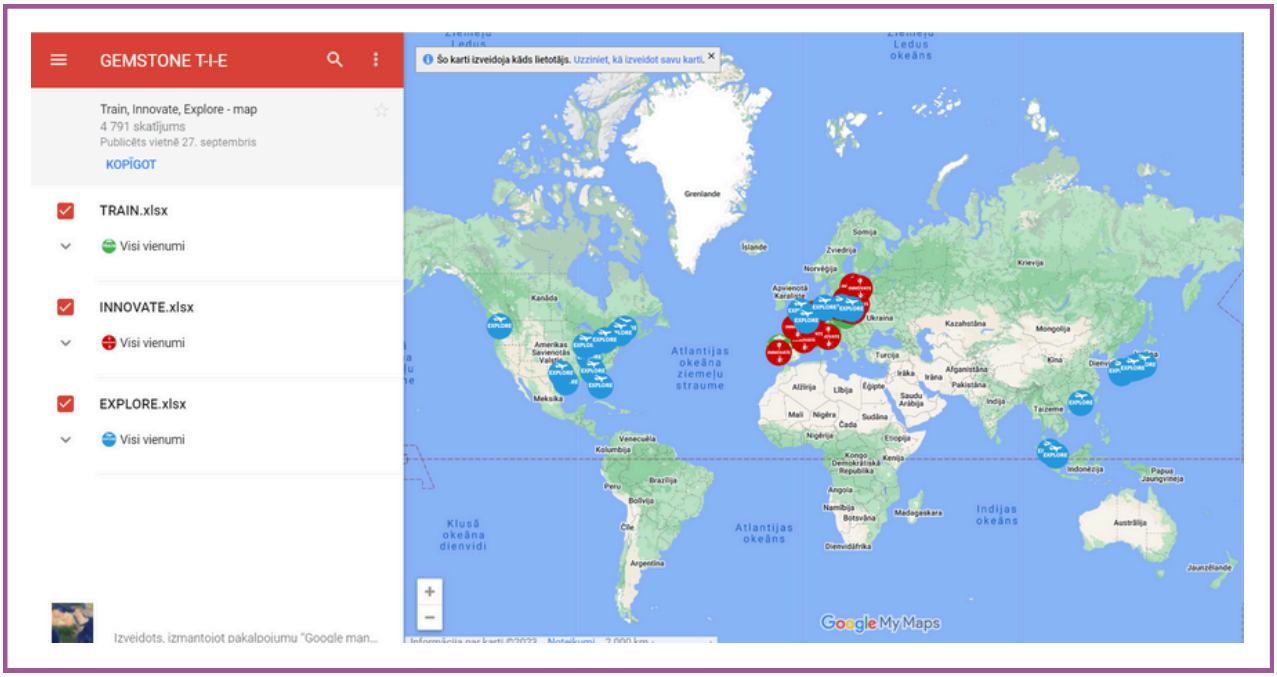
The final catalogue is now available and has been disseminated widely among European clusters and stakeholders. We invite continued engagement with this resource and welcome feedback from all users to build upon the achievements of GEMSTONE and further accelerate the Twin Transition across Europe’s manufacturing ecosystems.

ANNEX

ANNEX 1

ESTABLISHMENT AND DEVELOPMENT OF T-I-E PORTFOLIO SERVICE DATABASE

On the GEMSTONE project website Portfolio Map T-I-E (Train-Innovate-Explore) is implemented as an interactive tool which contains information about service providers related to improving skills, technological innovation and internationalization of their activities in above mentioned calls. This tool was supplemented in the entire time of the project to support European SMEs in their successful transformation of "Green Manufacturing" through identification and easier access to T-I-E services and potential contractors subject to open calls (grants to be received) within the framework of the FSTP mechanism.



SERVICE OFFER

ANNEX 2

BUSINESS RESILIENCE DIAGNOSIS EXAPMPLE

Company	Name of the company
Sectors of activities	
> Core business	Example: Agriculture / agrifood
> Other Sectors (if needed)	
Status	SME
Profile	Example: Manufacturing company
Cluster	Example: GREEN TECH LATVIA
Country	Latvia
Region	Vidzeme
In case the company is not a registered member of our ecosystem (optional)	
Contact person	
Email address	
Location	
Website	

1. YOUR STRATEGIC PATHS towards green manufacturing (a scale from 5 - high priority to 1 - low priority)				
What paths are your main priorities today and will be your main priorities for the future (fill in N+1 to N+3 for a strategy at mid-term and see the results in the "graphs" tab, if relevant for the company)				
1. (re)defining the development of products and services (longer life of product, sustainability, ecodesign, etc.)	Today (N)	N+1	N+2	N+3
	3	4	5	5
2. Raw material substitution	3	4	5	5
3. More resource - efficient production processes (energy, water, raw materials)	4	5	5	5
4. Cleaner production process	3	4	5	5
5. Waste management and promotion of product reuse and recyclability	2	3	4	5
6. The development of new business models	3	4	5	5
7. Building maintenance (re-conditioning, repair service, maintenance and other)	1	2	4	5
8. Improved productivity	3	4	5	5
9. Other*				
*If other of for any additional comment: Addressing the shortage of electrical engineers by supporting junior engineers in entering the industry				
Explain				

ANNEX 1

2. YOUR MOTIVATION - Why would you enter a greener manufacturing process? (target your main motivation factors - max. 3 answers)	
from the most to the less important: 3 (= first motivation), 2 (= 2nd motivation) and 1 (= the last motivation factor)	
🎯CLIENTS & MARKET: get closer to or more appealing for (new) customers, seize new business opportunites	1
👷HUMAN RESOURCES: motivate our workforce, achieve positive impact and image for our staff (and future workers)	
💰FINANCE: reduce or limit costs (by monitoring the production to lower wastes and errors)	
🏆COMPETITION: our competitiveness, performances and attractivity	
📈PROFITS: improve and optimize your organisation/production	
⚖️ LEGAL: anticipate future regulations	
🌳ENVIRONMENT: don't miss the geen trend, reduce our resources consumption or the pollution and our global impact on the environment	2
🚚SUPPLY CHAIN : anticipate supply chain disruption, price/costs variations, (raw) materials dependancy, etc.)	3
Other*	
*If other of for any additional comment:	
Explain	

3. YOUR CHALLENGES - If you already identified them, what are the 3 main obstacles you are facing by implementing your strategic paths	
from the most to the less important: 3 (first obstacle), 2 (2nd obstacle) and 1 (the last obstacle)	
🗓️ TIME: The procedure to get the implementation is too time-consuming to design any implementation	3
👩‍🎓HUMAN RESOURCES: No one or too few workers have the competences for coordinating/developping these kind of implementation	
⚙️TECHNOLOGIES: We currently don't have the technology for implementation (or haven't found it yet)	
🕸️LIMITED LOCAL NETWORK: We don't have solution providers geographically close to us able to upgrade our technology	1
🧑‍🤝‍🧑PARTNERSHIP: We have not found the right and specialized solution provider within our network or a good use case	
💪🏽SUPPORT: We need analysis, advice and support to begin such a new approach more globally	
💰FINANCE: we need some financial supports to go to this transition or technologies are too costly to obtain	2
Other*	
*If other of for any additional comment:	
Explain: (Example) - Legal regulations to allow the product use on the streets.	

ANNEX 1

4. YOUR SHORT-TERM PROJECT/OBJECTIVE - If you had to choose for one project, which one would you implement?
Exapmple: We want to produce our products sustainably - by producing them in a sustainable process, in environmentally friendly packaging and from as many local raw materials as possible, creating added value for local products. The most valuable feature of the products is their long shelf life and nutritional value. We are interested in both calls Train and Explore.

to go further (if needed - optional part)

👩‍🏫HUMAN RESOURCES: No one or too few workers have the competences for coordinating/developping these kind of implementation
Explain - Have you identified the skills you would need in your team, a member of your staff to train, etc.
⚙️TECHNOLOGIES: We currently don't have the technology for implementation (or haven't found it yet)
Explain - Have you identified the kind of technologies or enablers you could apply for your project? (advanced smart material, data analysitics, AI, machine learning, digital twins, immersive technologies like AR/VR, etc.)
🕸️LIMITED LOCAL NETWORK: We don't have solution providers geographically close to us able to upgrade our technology
Explain - What would be the solution providers' profile(s) you are looking for? (skills, activities, location, etc.)
👫PARTNERSHIP: We have not found the right and specialized solution provider within our network
Explain - What is the partner's profile(s) you are looking for? (skills, expertise, sector of activity, location, etc.)
💪SUPPORT: We need analysis, advice and support to begin such a new approach more globally
Explain your pains and project.
💰FINANCE: we need some financial supports to go to this transition or technologies are too costly to obtain
Explain your project / idea, the amount and type of costs (staff, equipment, infrastructure, R&D study, other) you would need to support its implementation.

ANNEX 1


Your strategic paths towards green manufacturing
Today (N)
N+1
N+2
N+3
1. (re)defining the development of products and services (longer life of product, sustainability, ecodesign, etc.)
2. Raw material substitution
3. More resource - efficient production processes (energy, water, raw materials)
4. Cleaner production process
5. Waste management and promotion of product reuse and recyclability
6. The development of new business models
7. Building maintenance (re-conditioning, repair service, maintenance and other)
8. Improved productivity
9. Other*
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0

NOTES

NOTES

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PROJECT INFO

Grant Agreement	Project 101074549 — GEMSTONE
Programme	Single Market Programme (SMP COSME)
Call	SMP-COSME-2021-CLUSTER
Topic	SMP-COSME-2021-CLUSTER-01
Type of action	SMP Grants for Financial Support
Project Title	Green Manufacturing supporting recovery and resilience of industrial SMEs
Project starting date	1st September 2022
Project end date	31st August 2025
Project duration	36 months

PROJECT CONSORTIUM

GEMSTONE

Funded by the European Union

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