Influence of GlassCircle's Events on Raising Excellence and Awareness of Sustainability in Glass Fiber Industry

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Introduction

Glass fiber materials play a vital role in numerous industries, from construction to transportation and beyond. However, the increasing production and usage of glass fiber composites pose significant challenges, particularly in managing waste and achieving sustainability. Circular economy principles offer a promising solution by minimizing waste and maximizing resource efficiency. This report draws insights from the GlassCircle project, a multi-stakeholder initiative aimed at advancing sustainability in the glass fiber industry. Through events such as hackathons, workshops, and conferences, the project has successfully engaged industry leaders, academics, policymakers, and society in promoting circularity and innovation.

Event 1) Hackathon for Repurposing Industrial Glass Fiber Waste:

Held simultaneously across three universities (Riga Technical University, Aarhus University, and Luleå University of Technology), this event engaged interdisciplinary students teams in developing creative applications for glass fiber residues. Industry partnerships and mentorship provided practical guidance, showcasing the potential for scalable solutions. Engaging students raises awareness among the next generation of engineers, designers, and entrepreneurs, who will carry forward the principles of sustainability and circular economy in their careers.

The best practices were awarded prices. The team from Sweden introduced the idea of creating useful storage items to be used at marine leisure events while the team from Denmark proposed to use the residue in making items used within the IoT equipment housing and the team from Latvia created a demonstrator for the concrete formwork textile. Providing the awards have an impact through visibility. Award-winning ideas gain visibility, raising awareness about the possibilities of circular economy practices in the glass fiber industry. It also serves as inspiration. The recognition of innovative solutions inspires other students, researchers, and industry professionals to explore similar ideas.

Such an event can drive awareness and have several contributions to society by creating a culture of sustainability by encouraging participants to think creatively about waste reduction and resource efficiency. The event also promotes the idea that sustainability is not just a responsibility but also an opportunity for innovation and growth. These two values create not only immediate changes but also long-term impacts. This is achieved by instilling a culture of sustainability in young minds, the hackathon contributes to long-term changes in how industries approach waste management and resource use. Moreover, it helps in community building as such event builds a community of like-minded individuals and organizations committed to advancing circular economy practices. The possible industry adoption of scalable solutions encourage industries to adopt circular economy practices, knowing that they can be implemented on a larger scale. This makes an impact on economic viability by demonstrating the economic potential of repurposing glass fiber waste. The hackathon motivates companies to invest in sustainable practices.

Event 2) Workshop: Environmental and economical feasibility to recover glass fibers

The workshop brought together various stakeholders, including industry experts, researchers, and policymakers, to discuss and present innovative solutions for promoting sustainability and circular economy practices in the glass fiber industry. The different topics within the presentations contributed greatly to the raising of excellence and awareness in the glass fiber industry.

1. (IPF – Academia) An introduction to Glass Fibers, its sizing and Recycling opportunities and Circular Economy contributed to highlighting the challenges and opportunities in recycling glass fibers, emphasizing the need for "gentle" recycling processes to minimize strength loss. Discussing the role of sizing (chemical coatings on fibers) in fiber-matrix adhesion and how it affects recycling was also introduced and resizing as a method to regenerate fiber strength after recycling, was proposed for enabling reuse in new applications. These suggestions reflect some impacts on increased awareness of the technical challenges in recycling glass fibers and the importance of chemical treatments in maintaining fiber quality. They also provided insights into how recycled glass fibers can be reintegrated into new products, promoting circular economy practices.
2. (ZAAO – municipal company) Presentation regarding Waste Management and Recycling in the Glass Fiber Industry by introducing the Daibe landfill project with the challenges introduced by the organic substances in the sizing and other finishings of the fibers on their recyclability and highlighting the ongoing research projects to purpose glass fiber waste into construction materials like concrete and ceramics. This has an impact by showcasing the practical examples of how glass fiber waste can be repurposed, reducing landfill use and promote sustainability.
3. (HITACHI ENERGY – industry) Presentation of the efforts of the energy sector to reduce the environmental impact of glass fiber composites in products like composite utility poles by performing the LCA to identify hotspots for reducing the carbon emissions and waste and proposing strategies for improving the sustainability through material optimization and reduction of the production scrap. This has an impact of demonstrating how large companies can integrate sustainability into their operations and setting an example for the whole industry by emphasizing the role of LCA to achieve the goals.
4. (PODCOMP – Industry) Presentation of companies' efforts to reduce the glass fiber composite waste by utilizing the cut-offs from the production in new products like furniture and art pieces and saving resources by reducing demands on raw materials. The potential of using the waste in 3D printing technologies was also highlighted which also reflect on the impact of reusing the waste creatively to reduce the ladfilling potential and raise awareness for the need to finding sustainable alternatives.
5. (Valmiera Glass – Industry) presentation on the efforts of Valmiera Glass to recycle glass fiber waste internally and through outsourced projects with highlighting again challenges of the presence of organic substances and the unstable characteristics of the fibers for outsourcing

projects. The company is developing an equipment to melt the fibers while the rest is made into non-wovens for variety of uses.

6. (Miljøskærm – Industry) Presented innovative solution for recycling end-of-life wind turbine blades into noise barriers and discussed the challenges of recycling fiberglass and the development of purpose-built machinery for processing it due to tool ware by the glass fibers. The compromise of the clean energy produce by the wind turbine by the unsustainable end of life handling of the large structures was highlighted with proposal to create valuable products. (Impact?)
7. (ZAG – Research Institute) Presented the Wool2Loop concept: Recycling Mineral Wool into Alkali-Activated Materials. The presentation contained detailed step-by-step information on performing LCA analysis for assessing the sustainability of the proposed solution of using the waste of mineral wool to create a new product used for facade panels and pavement slabs. Such presentation also contributes to raising awareness on by showcasing innovative recycling solutions for mineral wool, reducing waste and promoting sustainable construction materials of high value.

In general the workshop contributed to raising excellence by providing a platform for sharing innovative solutions and best practices in glass fiber recycling, promoting excellence in sustainable manufacturing and waste management. It also contributed to the awareness in sustainability by showcasing real-world examples and case studies of the environmental and economic benefits of recycling glass fibers and adopting circular economy practices. The workshop fostered collaboration between industry, academia, and policymakers, encouraging the development of new technologies and solutions for sustainable glass fiber production and recycling.

Event 3) Co-Creation Workshop

The different topics covered during the workshop—ranging from collaborative business models and digital solutions to stakeholder engagement and innovative recycling technologies—all contribute to raising excellence in the glass fiber circularity industry.

1. Collaborative Business Models (Co-Creation) Contribution to raising excellence

Co-creation fosters collaboration among stakeholders (manufacturers, recyclers, researchers, policymakers) to develop shared value solutions. It encourages the development of circular economy business models that reduce waste, optimize resource use, and create new revenue streams. This has an impact on innovation by pooling resources and expertise, stakeholders can create innovative products and processes (e.g., using recycled glass fibers in furniture or construction materials). It also impact scalability by providing collaborative models that can be scaled across industries and regions, promoting widespread adoption of circular practices. Moreover, Its impact on sustainability is defined by co-creation that ensures that business models are designed with environmental and social benefits in mind, aligning with global sustainability goals.

2. Digital Solutions (Robotic Sorting, AI, Digital Twins)

Digital solutions contributions to excellence raising since digital tools like robotic sorting systems, AI-based machine vision, and digital twins enable efficient and accurate sorting of glass fiber residues. These technologies address key bottlenecks in the recycling process, such as the difficulty of sorting mixed or contaminated fibers. Their impact is distinguished by efficiency as automation reduces manual labor and increases the speed and accuracy of sorting, making recycling more cost-effective. Moreover, it contributes to quality control since AI and machine vision ensure that recycled fibers meet quality standards, making them suitable for high-value applications. While feasibility testing of Digital twins allow stakeholders to test and optimize recycling processes in a virtual environment before implementation, reducing risks and costs.

3. Stakeholder Engagement and Knowledge Sharing

The contribution to raising excellence is evident through the platforms like the Knowledge Hub in the EoLO-HUBs project that facilitate the sharing of best practices, research findings, and innovative solutions among stakeholders. Other activities like workshops, hackathons, and conferences bring together industry experts, researchers, and policymakers to exchange ideas and co-create solutions. Through this engagements several impacts could be achieved. For example, on awareness, where stakeholder engagement raises awareness about the challenges and opportunities in glass fiber circularity, encouraging more companies to adopt sustainable practices. On the other hand, networking and knowledge-sharing platforms help build networks of stakeholders, fostering long-term partnerships and collaborations which builds capacity. Workshops and training programs (e.g., LCA/LCC schools) equip industry professionals with the skills and knowledge needed to implement circular economy practices.

4. Innovative Recycling Technologies

Its contribution towards raising excellence through this workshop is manifested by explaining technologies like low-carbon pyrolysis, green chemistry solvolysis, and fiber reclamation processes enable the recovery of high-quality glass and carbon fibers from end-of-life products. Projects like EoLO-HUBs focus on developing scalable and sustainable recycling solutions for wind turbine blades and other composite materials. These projects and technologies impact the circularity by promoting resource recovery such as advanced recycling technologies maximize the recovery of valuable materials, reducing the need for virgin resources. Moreover, provides environmental benefits since these technologies minimize waste and emissions, contributing to a lower carbon footprint for the industry. They enhance economic viability by recovering high-value materials, recycling technologies and create new revenue streams and reduce disposal costs.

5. Policy and Planning Documents

Such documents proposed by the municipalities and authority members contribute to the excellence raising by showcasing the EU-level initiatives like the European Green Deal and Circular Economy Action Plan provide a regulatory framework and funding for circular economy projects. National and regional strategies (e.g., Latvia's Climate Neutrality Strategy) align local industries with global sustainability goals. These have a great impact represented by regulatory support where policies and regulations encourage industries to adopt circular practices by setting targets and providing incentives. They provide awareness of funding opportunities as EU and national funding programs (e.g., INTERREG) support research, innovation, and implementation of circular economy solutions. The impact of strategic alignment through well-planning of documents ensure that industries, municipalities, and regions work toward common sustainability goals.

6. Contributions of case studies and pilot projects

The case studies contributions towards raising of excellence and circularity in the glass fiber industries is evident through projects like GlassCircle, EoLO-HUBs, and Advantis' Flexible Blade Cutter System that demonstrate the feasibility and benefits of circular economy practices in real-world applications. Case studies provide valuable insights into the challenges and successes of implementing circular solutions. These can provide impact through proof of concept where pilot projects show that circular economy practices are technically and economically viable, encouraging wider adoption. The lessons learned through these case studies highlight best practices and areas for improvement, helping other companies and regions replicate successful models. They also provide inspiration as successful projects inspire innovation and collaboration across industries.

7. Education and Training (LCA/LCC Schools)

Programs like EPICENTRE's LCA/LCC schools provide education and training on life cycle assessment (LCA) and life cycle costing (LCC), which are critical for evaluating the environmental and economic impacts of circular economy practices. They make impact on skill development through training programs that equip professionals with the skills needed to design, implement, and evaluate circular economy solutions. Moreover, they make impact by informed decision-making as LCA and LCC tools help companies make data-driven decisions that optimize sustainability and profitability. They also impact the industry standards since such education programs promote the adoption of standardized methodologies, ensuring consistency and credibility in circular economy practices.

In summary, the combination of collaborative business models, digital solutions, stakeholder engagement, innovative technologies, policy support, case studies, and education creates a holistic approach to raising excellence in the glass fiber circularity industry. These elements work together to drive innovation, sustainability, and economic growth while addressing the challenges of waste management and resource efficiency.

Event 4) Final Conference for GlassCircle project

During 3 sessions long day, several presentations were held by academic experts, industry representatives and policy makers. The presentations from the event cover a wide range of topics related to the sustainability and circular economy of glass fiber (GFRP) and composite materials.

1. Managing End-of-Service Composite Structures (Alann André, RISE)

This presentation focused on the challenges of managing end-of-service (EoS) composite structures, particularly glass fiber-reinforced polymers (GFRP). It highlighted the difficulties in recycling GFRP due to the thermoset resins used, which are hard to separate from the fibers. The presentation also covered repurposing EoS GFRP structures, such as wind turbine blades, into new products like pedestrian bridges, roofing panels, and sound barriers. The focus on the wind turbines is coming from the fact that many of these structures are coming to their end of life in the coming years creating a huge amount of waste to deal with. The presentation highlighted the need to repurpose those structures with minimum energy input (with least modification) to boost their value. Hence the choice of simple products such as the pedestrian bridges.

2. Strategic Framework for Reusable Dishes in Public Events (Liina Kanarbik, Tallinn)

This presentation outlined Tallinn's strategic framework for reducing single-use plastics at public events by promoting reusable dishes. It presented the successful implementation of reusable dish systems at large events, such as the Youth Song and Dance Festival, which significantly reduced waste. While not directly related to glass fiber, this presentation highlights the importance of systemic approaches to waste reduction and circular economy principles. It can inspire similar strategies in the glass fiber industry, such as designing products for reuse and recycling.

3. Recycling of Fiber Composites (Anders Sjögren, Lund University)

In his presentation, Sjögren explores various recycling processes for fiber composites, including mechanical, chemical, and thermal recycling. He discusses the challenges of recycling, such as fiber and matrix degradation and the need for robust certification processes. the presentation shed lights on the importance of the choice of the process depending on the volume of the waste, the type of material to be recycled and the downstream demands. By providing a pedagogic overview of recycling technologies, this presentation raises awareness about the technical challenges and opportunities in recycling glass fiber composites. It emphasizes the need for innovation and collaboration to improve recycling rates and reduce the environmental impact of GFRP.

4. Giving Boat Manufacturing Waste a New Life (Augustin Hueso & Maria Bohic, LTU)

This presentation describes the journey of hackathon two winners proposing the repurposing of glass fiber waste from boat manufacturing into storage solutions for sailors and beach visitors. The idea demonstrates how waste materials can be transformed into functional products using circular economy principles showcasing the potential for creative solutions to repurpose glass fiber waste, raising awareness about the value of circular economy practices in the industry. It also highlights the importance of local ecosystems and collaboration in driving sustainable innovation.

5. Survey on Glass Fiber Residue (Valmiera)

Valmiera municipality shared the results of a survey on public awareness of glass fiber production and waste management in Valmiera, Latvia. It reveals that while many people are aware of glass fiber production, there is limited knowledge about recycling and repurposing options. The survey highlights the need for increased public awareness and education about the sustainability challenges and opportunities in the glass fiber industry. It underscores the importance of community engagement in promoting circular economy practices. The positive or neutral attitudes toward glass fiber production facilities suggest that there is no significant public opposition to these facilities, but there is also a lack of strong engagement or understanding of their environmental and economic impacts. The proposals for reuse of glass fiber waste highlight the potential for innovation in this area, but the lack of awareness about existing companies and processes suggests that more education and outreach are needed to fully realize the potential of a circular economy in the glass fiber industry.

6. Waste Management Challenges with Wet Filament Winding (Hitachi Energy)

This presentation discusses the waste generated during the wet filament winding process used in manufacturing glass fiber/epoxy products. It outlines the challenges of recycling this waste and proposes potential solutions more viable than incinerations and land fill that are currently used. Higher level recycling is technically possible but logistic chains and economy of scale is still missing. Emphasis on potential for collaboration between manufacturers and recyclers to improve sustainability was also highlighted.

7. Tire & Textile Sorting in Latvia (AJ Power Recycling)

This presentation focuses on AJ Power Recycling's efforts to manage tire and textile waste in Latvia. It discusses the development of recycling systems and the importance of regulatory frameworks, such as the Natural Resources Tax (NRT), in promoting recycling. While primarily focused on tires and textiles, this presentation provides valuable insights into the development of recycling systems and the role of policy in driving sustainability. These lessons can be applied to the glass fiber industry to improve waste management and recycling practices.

8. Composite Recycling in Finland (KiMuRa Route)

This presentation outlines the KiMuRa Route, a system for recycling composite waste in Finland by co-processing it in the cement industry. It discusses the challenges and opportunities of this approach, including the need for mobile cutting systems for large composite parts like wind turbine blades and the amount of composite waste generated in this industry. The KiMuRa Route demonstrates a practical solution for recycling composite waste, raising awareness about the potential for collaboration between industries to achieve sustainability goals. The presentation shared the practical advice for companies starting to recycle the waste based on the experience of the successful implementation in the KiMuRa Route.

9. Post-Election Europe: A Clean Industrial Deal (FEAD)

In this presentation, the new plan for Europe's sustainable prosperity and competitiveness was introduced including A new Circular Economy Act, helping to create market demand for secondary materials and a single market for waste. Moreover, the new industrial strategies for Europe were explained including reduction of energy prices and accelerating innovation and highlighting how Circular Economy is the focus of this strategy until 2029. FEAD advocates for a European Industrial Deal that prioritizes sustainability, competitiveness, and circularity. The presentation calls for policies that support the recycling of materials and emphasizes the role of waste management in achieving climate goals in general and in Europe in particular. By pushing for a regulatory framework that supports circular economy practices, FEAD's presentation aligns with the goals of the glass fiber industry to reduce waste and promote the use of recycled materials. It highlights the need for collaboration between industry and policymakers to create a sustainable market for secondary materials.

These presentations collectively contribute to raising excellence and awareness in the sustainability of the glass fiber industry. Overall, these presentations provide a comprehensive overview of the current state of sustainability in the glass fiber industry and offer actionable insights for improving recycling, repurposing, and waste management practices. They contribute to raising excellence by promoting innovation, collaboration, and systemic approaches to sustainability.

Lifecycle Awareness

Alongside the different activities in the project, Life Cycle Assessment (LCA) was a core strategy highlighted as a substantial tool aiding the progress towards the project's goals for sustainability. The different workshops included educational as well as inspirational talks about the importance of such tools in advancing the sustainability. The GlassCircle Final Conference provided a platform for sharing advanced lifecycle assessment (LCA) methodologies and example of case studies where the LCA helped in taking decisions that are otherwise difficult to justify. In many instances the audience were informed about the platform where they could learn from experts about the LCA and get to be professionals in performing LCA by joining the school organized by some of the partners in a parallel project.

Interview with Mārtiņš Rubenis:

Olympic medalist Rubenis demonstrated how glass fiber residues are repurposed into high-performance luge sleds, exemplifying how specialized applications can drive sustainability. This success story serves as a blueprint for other industries to adopt circular economy practices. His vision of local enterprises utilizing industrial waste highlights a practical path to fostering circularity. The interview inspires other industries to explore creative ways to reuse glass fiber waste, proving that circular economy practices are not only feasible but also beneficial. By turning waste into high-value products, the project validates the potential of circular economy solutions, encouraging wider adoption across industries demonstrating practical examples of circular economy. Rubenis envisions a future where smaller companies emerge around large manufacturers to utilize waste materials locally, creating a network of sustainable, circular businesses. This model can stimulate the growth of small and medium enterprises (SMEs) focused on recycling and repurposing materials, creating jobs and fostering innovation while highlighting the power of cross-industry collaboration.

Conclusion

The GlassCircle project has successfully demonstrated how industry and society can collaborate to achieve excellence in glass fiber circularity. By fostering innovation, knowledge sharing, and cross-sector collaboration, the project has set a benchmark for sustainable practices. The transition to a circular economy requires sustained effort, but the outcomes of initiatives like GlassCircle offer a roadmap for scaling these practices globally. Stakeholders are encouraged to build on these successes, ensuring a greener and more sustainable future for the glass fiber industry. All events were organized in a hybrid form to allow wider participation from audience overcoming the limitations of travel costs and time shortages as well as promoting sustainability by reducing the possible emissions of extra travels. Each event type played a crucial role in engaging different audiences, sharing knowledge, and promoting sustainable practices in the following manner

1. **Diverse Engagement:**
   The project successfully engaged a broad spectrum of participants—students, industry experts, policymakers, and the public—through tailored events that addressed different aspects of the glass fiber circularity challenge.
2. **Knowledge Sharing:**
   Workshops, surveys, and interactive demonstrations provided platforms for knowledge dissemination, allowing participants to learn from real-world success stories and contribute their own insights.
3. **Practical Demonstrations:**
   Events like the sled manufacturing interview illustrated the practical applications of circular economy principles, making the concept tangible and relatable.
4. **Collaborative Innovation:**
   The co-creation workshop facilitated collaboration among diverse stakeholders, resulting in innovative business models that could be implemented in the industry.
5. **Data-Driven Insights:**
   The public survey and resulting database tool not only mapped the availability of glass fiber residue but also informed strategies for managing waste sustainably, based on community input and industry data.

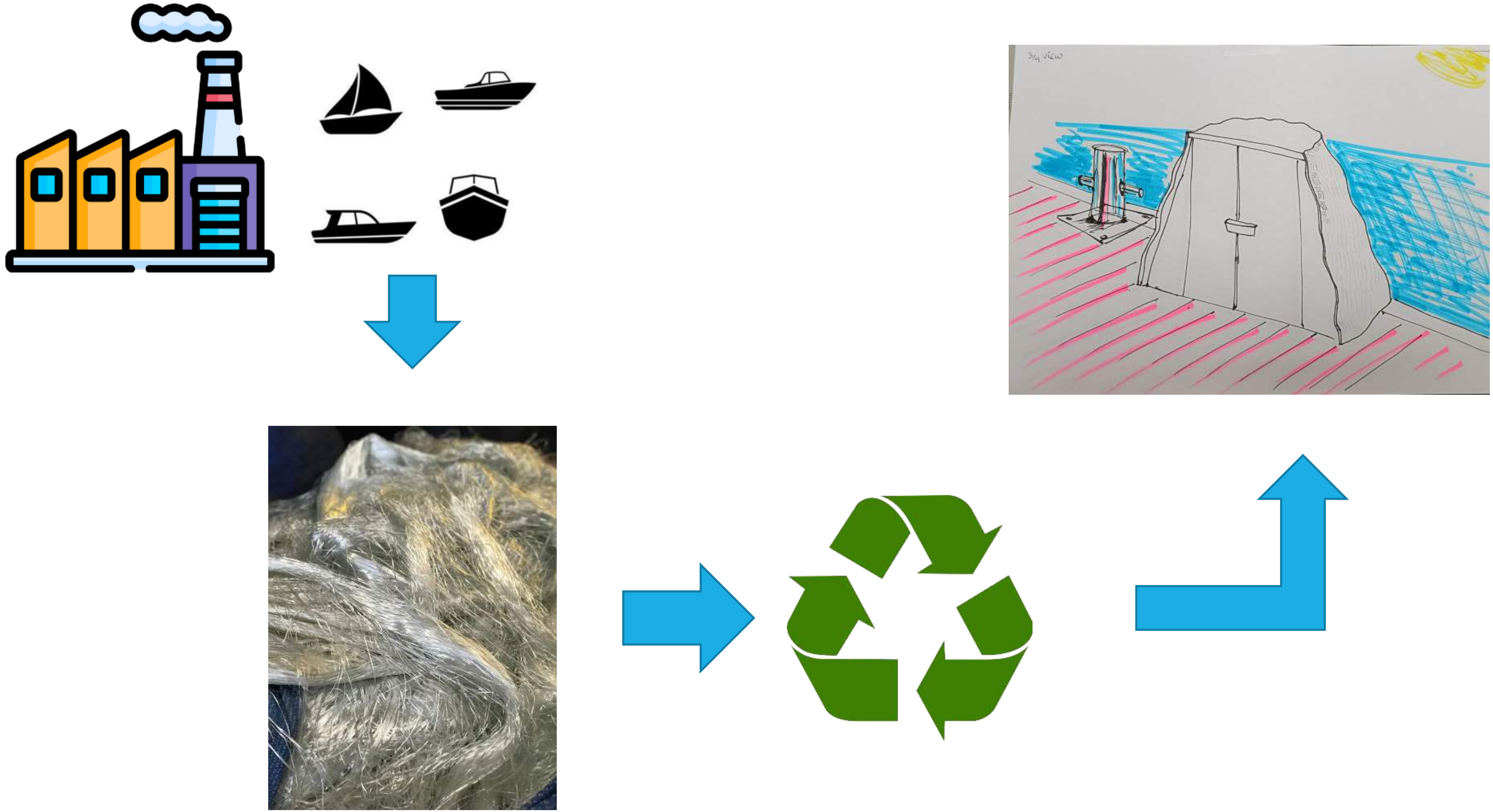
Appendix:

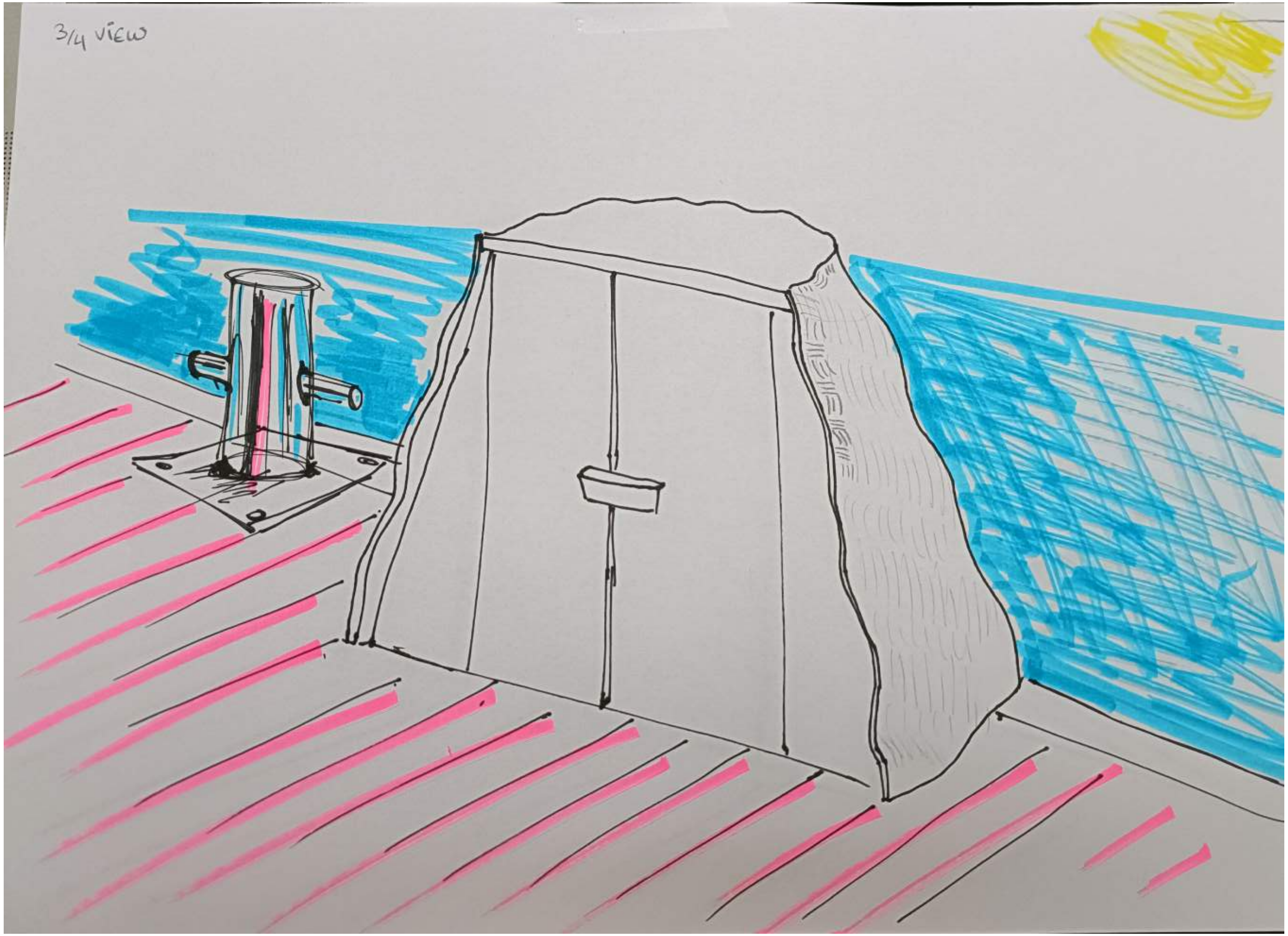
All available presentations from the events that have been approved for publishing

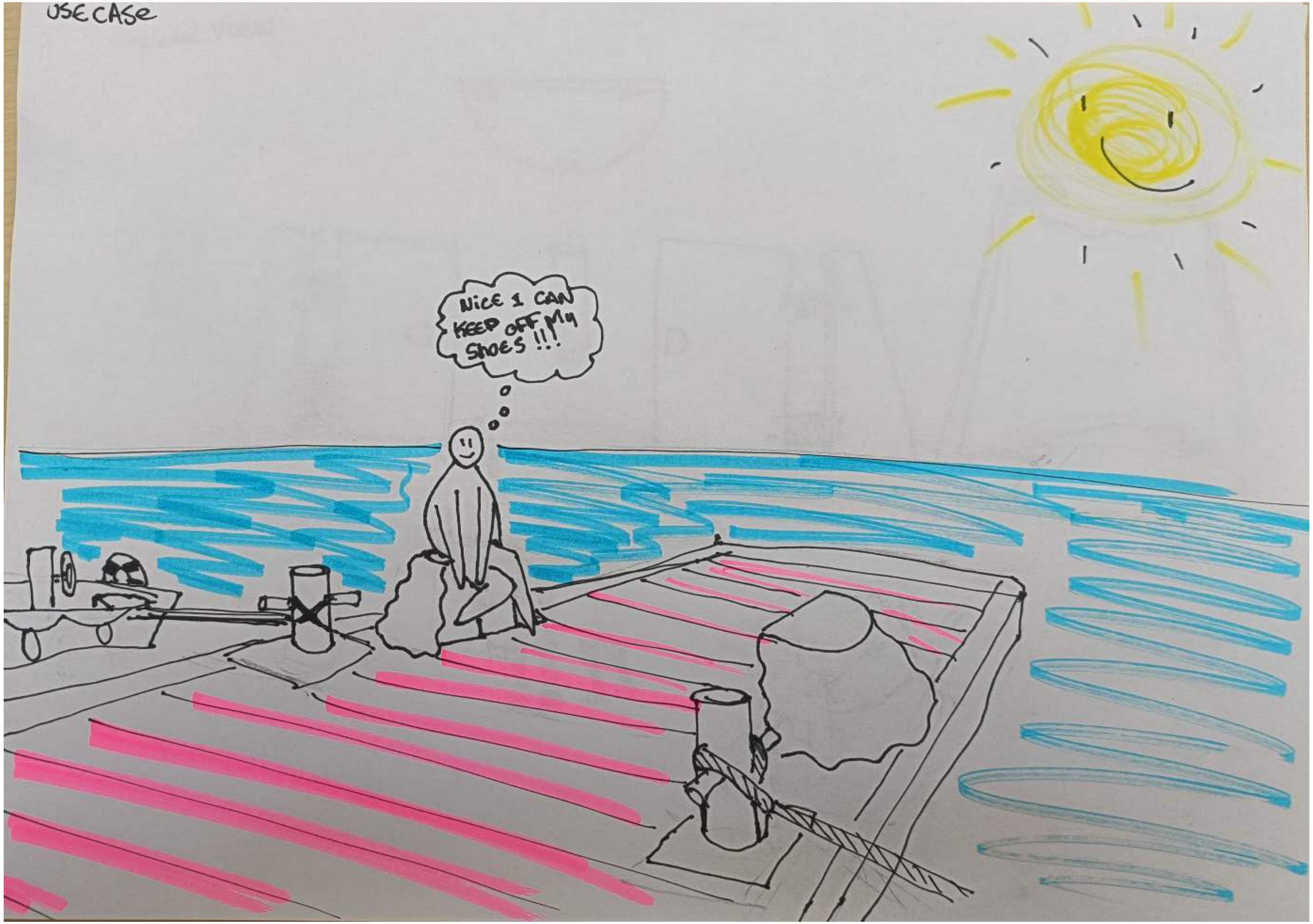
Locker out of glass fibres

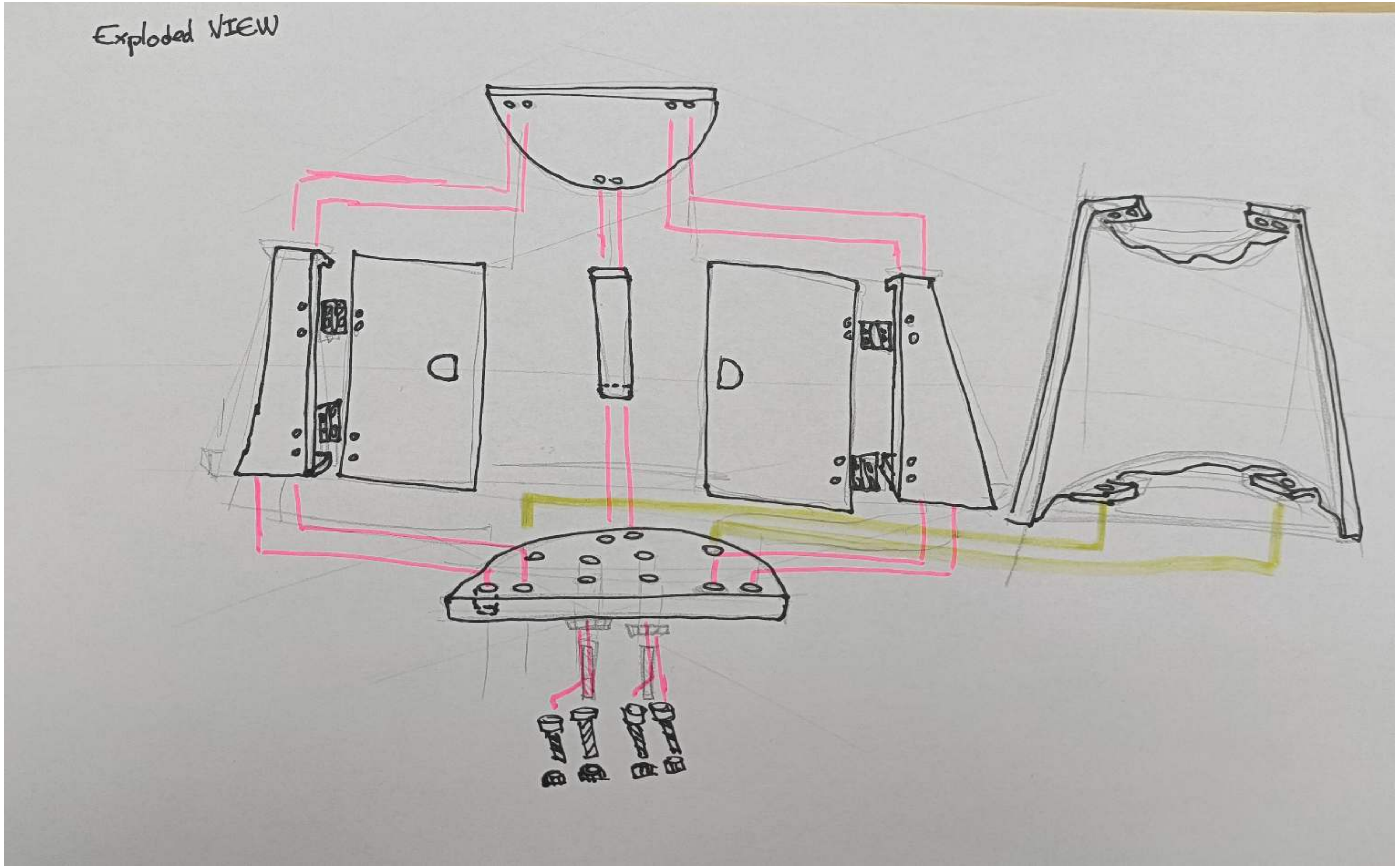
Team 2 : Interior design or furniture elements with specific requirements

LULEÅ UNIVERSITY OF TECHNOLOGY




3/4 VIEW


USE CASE
NICE I CAN KEEP OFF MY SHOES !!!


Exploded VIEW

Interreg
Baltic Sea Region

Co-funded by
the European Union

CIRCULAR ECONOMY
GlassCircle

Environmental and economical feasibility to recover glass fibers

Workshop Agenda

Aarhus University | 14-15 September 2023
Zainab Al-Maqdasi - LTU

interreg-baltic.eu/project/glasscircle

Meet The Organizers

LTU

Prof.

Roberts Joffe

Dr.

Zainab Al-Maqdasi

LULEÅ UNIVERSITY OF TECHNOLOGY

AU

Assoc. Prof.

Michail Beliatis

AARHUS UNIVERSITET

RTU

Assoc. Prof.

Liva Pupure

1862

RIGA TECHNICAL UNIVERSITY

Day 1 – 14/09/2023

GlassCircle Project – Michail Beliatis 15:30

Head of Digi Lab at AU BTECH.

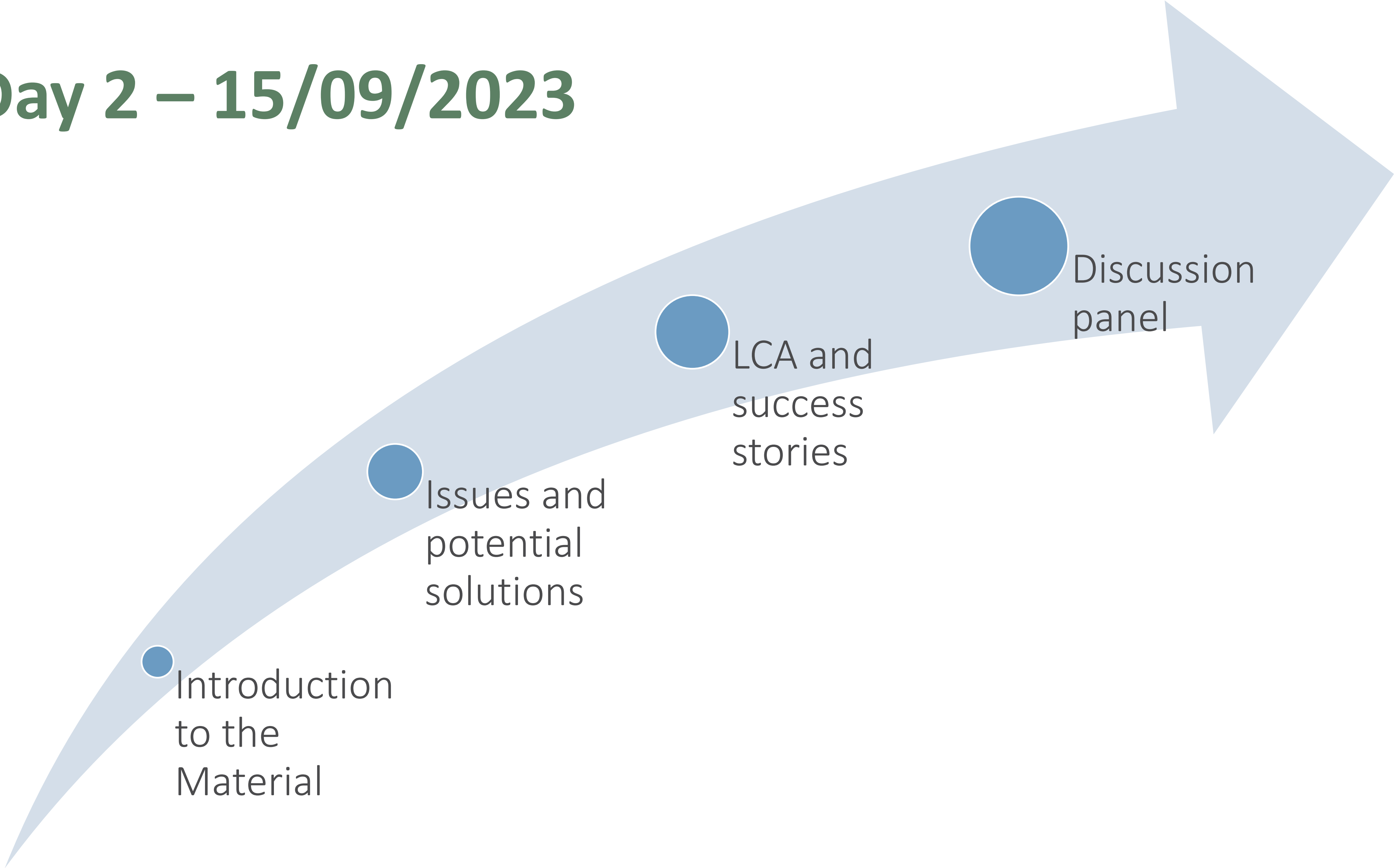
Co-founder of InfinityPV ApS

PhD in Nanotechnology – University of Surrey

Mapping glass fiber ecosystem for value creation through circular use – AU Student 16:00

Concluding Remarks – Roberts Joffe 16:30

Day 2 – 15/09/2023



Speakers

Christina Scheffler

09:00

- Leibniz Institute of Polymer Research, Head of Cluster Multiphase Systems and Research Group Fiber-Engineering
- Guest Professor at LTU within WISE Program (Wallenberg Initiative Materials for Sustainability)

- PhD in Textile Engineering – Dresden University of Technology

Title of the talk: Glass fibers – Strong but Sensitive

Speakers

Martins Niklass

09:30

- SIA "ZAAO“, Head of Development Department
- Chairman of s.c. for Roller Skiing, FIS Technical delegate

- MSc in Environmental Science - University of Latvia

Title of the talk: Role of Recycling Industry

Speakers

Hitachi Energy

Anders Holmberg

09:50

- Engineering Manager at Hitachi Energy, Composites
- Expert in IEC working group TC112/WG5. Evaluation and qualification of electrical insulating materials and systems

- PhD in Polymer engineering - Luleå University of Technology

Title of the session: Industries - Issues and Solutions

Speakers

Birgitha Nyström

10:10

- Sustainability Coordinator at Podcomp
- Senior Scientist and Project leader at Swerea SICOMP until 2019
- Lic. Engineer in Polymeric Composite Materials - Luleå University of Technology

Title of the session: Industries - Issues and Solutions

Speakers

Martins Millers

10:30

- Research and development engineer at Valmiera Glass

Title of the session: Industries - Issues and Solutions

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CIRCULAR ECONOMY
GlassCircle

Break - back at 11:10 CEST

Workshop: Environmental and economical feasibility to recover glass fibers

Speakers

Carmen Cristescu

SLU
Swedish University of Agricultural Sciences

11:10

- Researcher and Wood Scientist at the Swedish University of Agricultural Sciences
- Environmental Specialist and licensed with Environmental Assessment Tool for Buildings
- PhD in Forest and Wood Technology - Luleå University of Technology

Title of the talk: Introduction to LCA

Speakers

Barbara Horvat

11:40

- Researcher at Slovene National Building and Civil Engineering Institute

- PhD in Nanotechnology and Nanophysics - Institut Jožef Stefan

Title of the talk: Waste mineral wool upcycled into alkali-activated facade panels and cobblestones with LCA,

Speakers

Miljøskærm®

Jakob W Nielsen

12:10

- Founder and CEO of Miljøskærm

- Marine Engineer

Title of the talk: Giving recycled fiberglass a new life in circular products

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GlassCircle

Break - back at 12:50 CEST

Workshop: Environmental and economical feasibility to recover glass fibers

Discussion Panel

12:50

Christina Scheffler

Carmen Cristescu

Birgitha Nyström

Anders Holmberg

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Concluding Remarks 13:50

Workshop: Environmental and economical feasibility to recover glass fibers

GlassCircle 2nd Hackathon at MakerFest

Interreg Baltic Sea Region

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CIRCULAR ECONOMY GlassCircle

On residcue glass fibre material circular use

Om genbrug og genanvendelse af glas fibre materiale til cirkulært brug

AWARD CEREMONY – *WINNERS ANNOUNCEMENT!*

PRÆMIE-OVERRÆKKELSEN – *VINDERNE BLIVER UDRÅBT!*

RIGA TECHNICAL UNIVERSITY

LULEÅ UNIVERSITY OF TECHNOLOGY

VALMIERA

POD COMP

AARHUS BSS DEPARTMENT OF BUSINESS DEVELOPMENT AND TECHNOLOGY AARHUS UNIVERSITY

Hitachi Energy

CLIMATE-NEUTRAL SOCIETIES

Interreg
Baltic Sea Region

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CIRCULAR ECONOMY
GlassCircle

Exploring full cycle circular economy for glass fibre industry

Herning, DK | 15/09/2023
Michail Beliatis

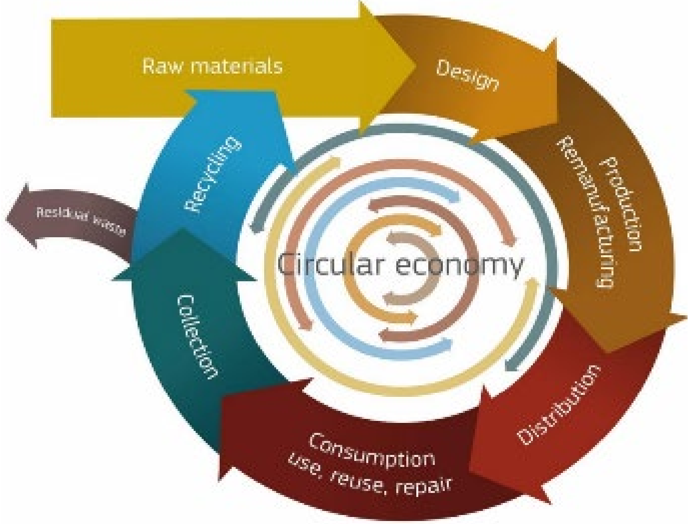
interreg-baltic.eu/project/glasscircle

Background

How it all came together:

During glass fibre manufacturing, as well as in many composite manufacturing processes a significant amount of residue material is generated.

Currently, a large amount of this residue glass fibres product is buried in a landfill



Background

How it all came together:

Part of this residue consists of relatively good-quality glass fibres or fabrics

This problem of glass fibre residue is common for many companies dealing with glass fibre or composite manufacturing – thus it would be more efficient to work together to solve this issue

GlassCircle

Objectives

The goal of the project: To create a **strong cluster** consisting of key players within the **glass fibres life cycle** (manufacturers, users, re-users, recyclers, etc.) within the Baltic Sea region

The project aims to **bring together** *industry*, *experts*, and *scientists*, as well as *public authorities* within the field – to **exchange knowledge** and **discuss the possible solutions** and **necessary next steps** for faster change from a linear to a circular economy within the glass fibre and composite industry.

Reaching UN sustainability goals

Project funding

Interreg Baltic Sea region

This project funded by European Union for 2 years and this project call funds four priorities:

1. Innovative societies;
2. Water-smart societies;
3. **Climate-neutral societies**;
4. Cooperation governance

Project consortium

Partners from Latvia, Sweden, Denmark

Project lead partner:

Riga Technical University (Latvia)

Contact person: Liva Pupure, Liva.Pupure@rtu.lv

Project partners:

Lulea University of Technology (Sweden)

Contact person: Roberts Joffe, Roberts.Joffe@ltu.se

Aarhus University (Denmark)

Contact person: Michail Beliatis, mibel@btech.au.dk

Podcomp AB (Sweden)

Hitachi Energy Sweden AB, Composites (HPAG) (Sweden)

Valmiera Municipality Government (Latvia)

Project activities

Timeline

Project starts — October

2023

Hackathon «GlassCircle»

Workshop on the circularity of glass fibers

Survey of communities about the circularity of glass fibre

2024

Workshop «Business model for circular economy»

Conference session «GlassCircle – structural use of glass fibre composite materials»

Project ends — September

Previous activities

Hackathon «GlassCircle»

Hackathon «GlassCircle»

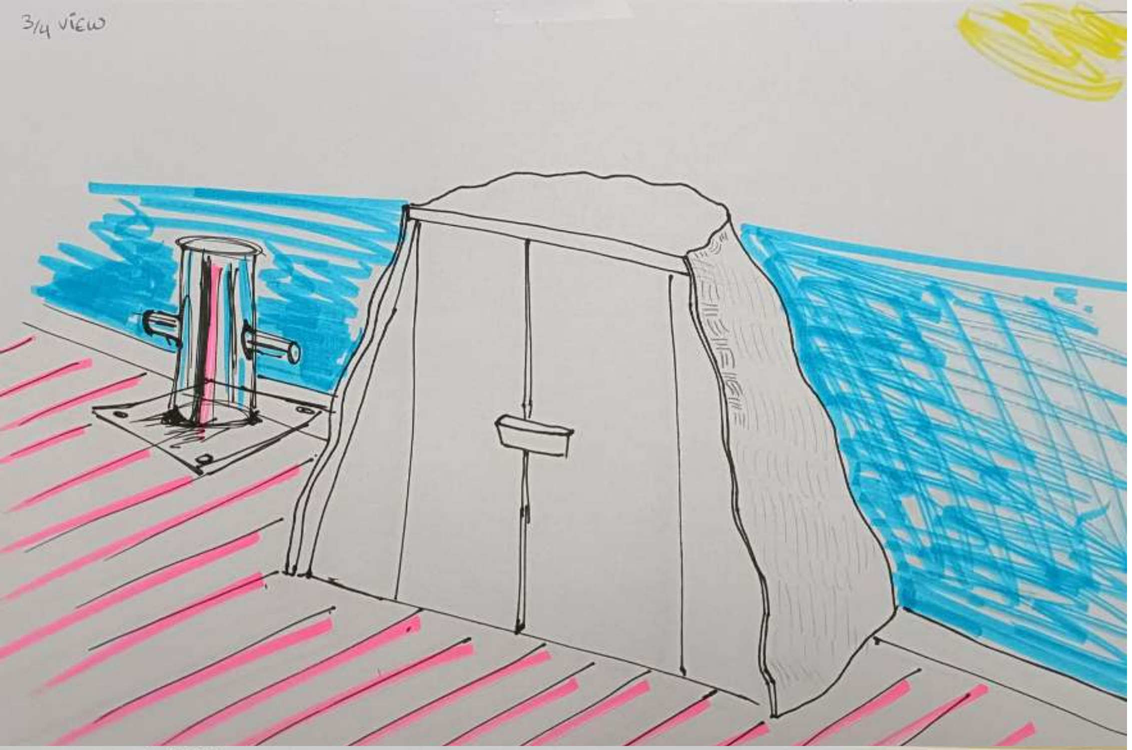
1. Participants from Latvia, Denmark and Sweden
2. Five new ideas generated
3. Student groups did excellent in the short time span they got.

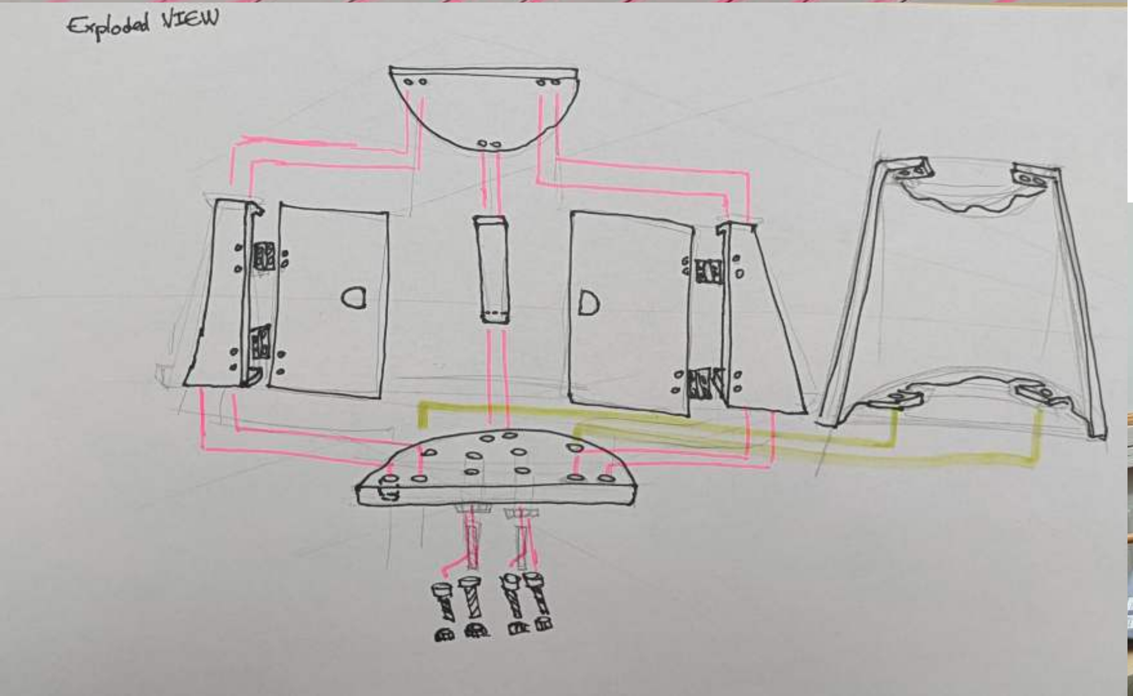






WINNERS
AWARD
500€
VALMIERA GLASS
GROWTH
AWARD
250€
VALMIERA GLASS





Winners:

Team 2: Interior design or furniture elements with specific requirements:

Locker out of glass fibers – from marine industries residue.

2nd Place

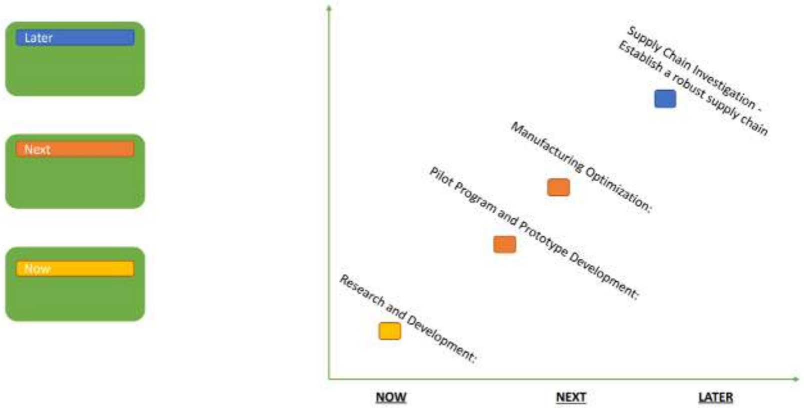
EcoFlight Component

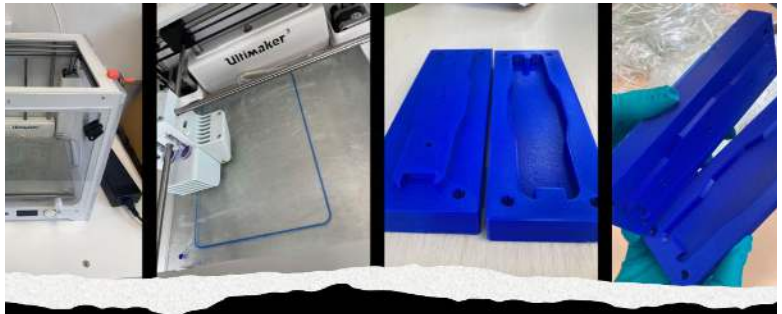
- Designed and manufactured using recycled glass fiber materials
- Compression molding with 3D-printed molds – 1st draft!
- Sustainable alternative to traditional RC drone components made from virgin materials
- This component is placed within the structural frame
- Offers comparable performance to conventional components while reducing the reliance on new raw materials

Business Case (CE): Recycled Glass Fiber Drone Components

- **Market Demand**: Customers who prioritize eco-conscious practices that values sustainable and environmentally friendly solutions
- **Cost Savings**: Recycling glass fiber drone components can lead to significant cost savings for both manufacturers and end-users - reduce the need for raw materials and lower production costs
- **Sustainability and Corporate Social Responsibility** (CSR): aligns businesses with sustainability goals and demonstrates a commitment to CSR
- **Regulatory Compliance**: Recycling initiatives are gaining momentum globally, and governments are increasingly implementing regulations and incentives to promote recycling practices
- **Long-Term Cost and Supply Chain Stability**: Reducing reliance on virgin materials, less vulnerable to price fluctuations and disruptions

Roadmap for Introducing Recycled Glass Fiber Drone Components:

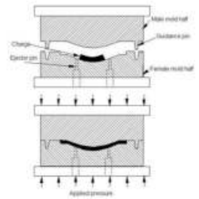


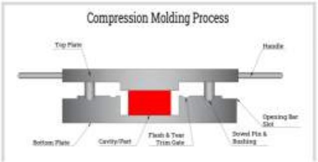


Instant compression molding method for recycling of glass fiber materials

Compression molding

- Speed and design flexibility
- Customization
- Enhanced Material Properties: Glass fiber-reinforced materials offer excellent strength, stiffness, and lightweight properties





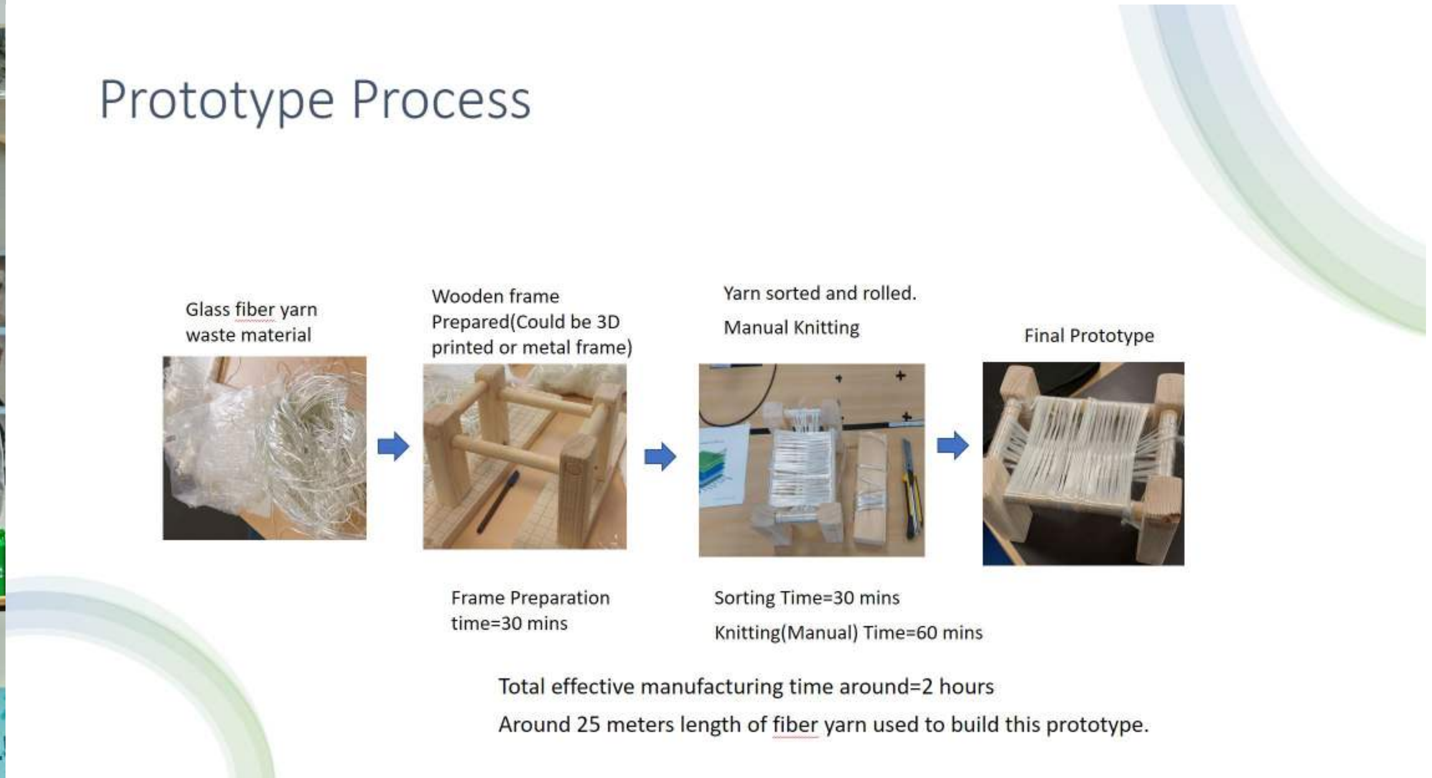
- (Dhananjayan, V. K. (2013). Design And Analysis Of A Compression Molded Carbon Composite Wheel Center. https://rc.library.uta.edu/uta-ir/handle/10106/11909

3rd place:

Team 3: Glass fiber textiles as a framework for concrete

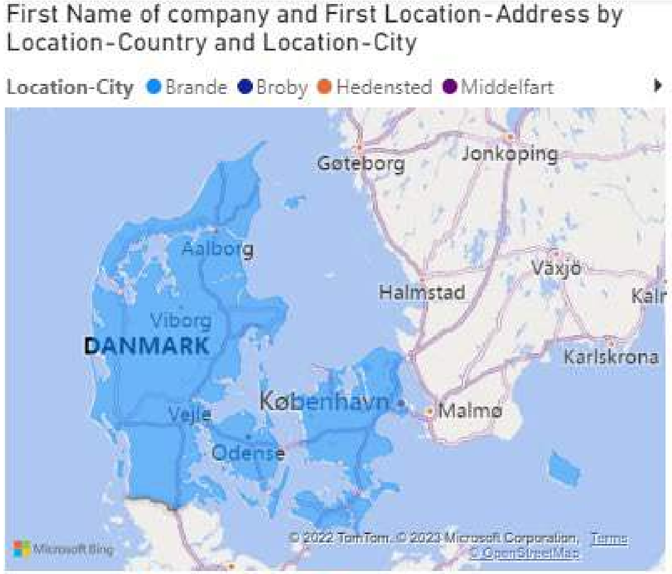
Team 1: Transforming wind turbine blades into practical objects

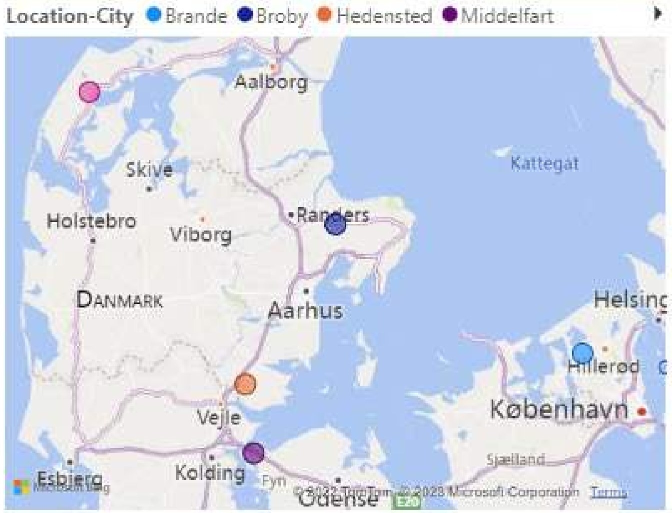
Team 5: Reuse of glass fiber – home furniture



Current activity - DataBase for strong cluster establishment

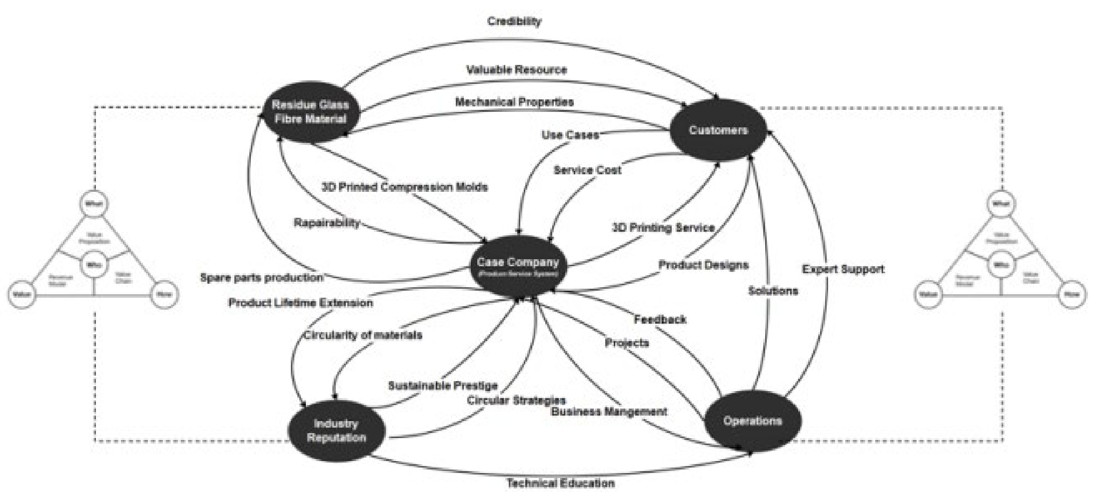
- **Identifying the study criteria and map key players for cluster** within the **glass fibers life cycle** (manufacturers, users, re-users, recyclers, etc.) within the Baltic Sea region and **create a value mapping digital atlas tool**
- We identified and mapped **2 good CE business ecosystems cases** till now





Location-Country	Location-City	Name of company	Production	Re-use/repair	Recycle	Supply Chain	Consumption
Denmark	Brande	Siemens Gamesa					X
Denmark	Broby	Dansk Polyglas A/S	X				
Denmark	Hedensted	Poca	X				
Denmark	Middelfart	Fiberline composites					
Denmark	Ringkøbing	Gurit Wind Systems A/S					
Denmark	Roslev	ReFiber			X		

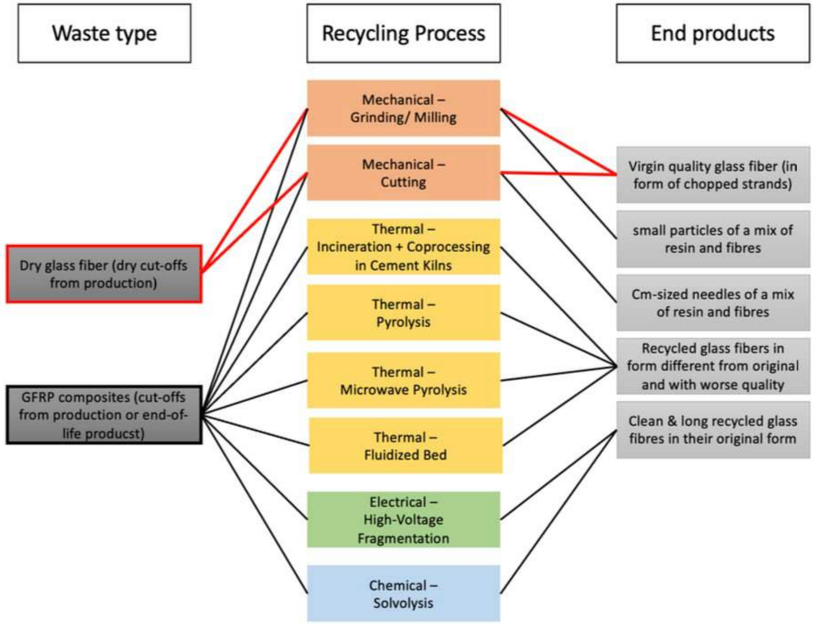
Successful circular economy case

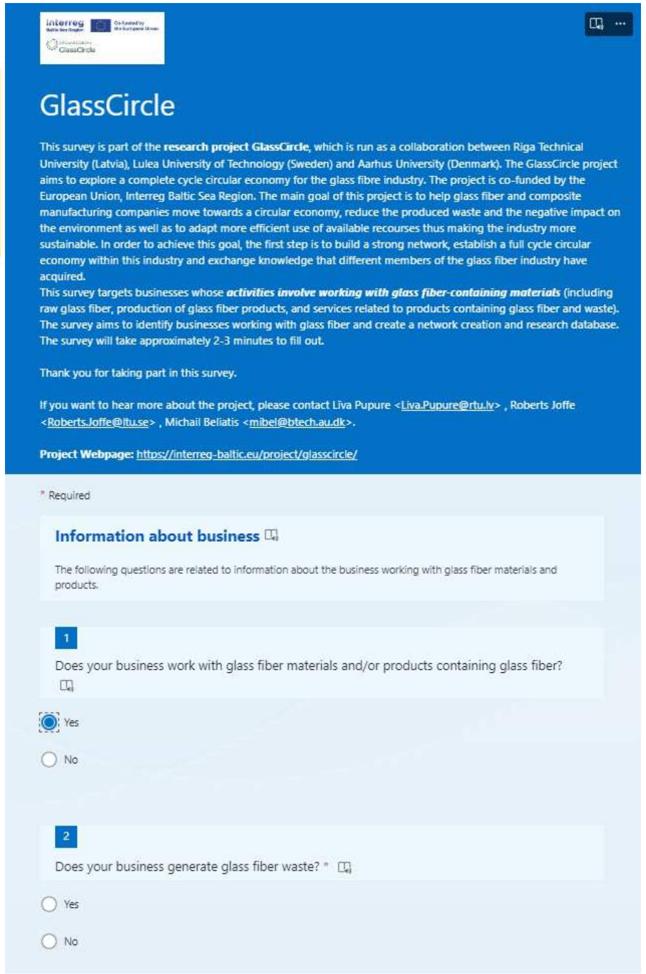


Current activity - DataBase for strong cluster establishment

Survey to Identifying successful green business cases of circular economy among different ecosystems and processes used as well as bottlenecks in Horizontal and Vertical applications.

- Industry
- Geo locations
- SDGs
- Circular economy





GlassCircle

This survey is part of the **research project GlassCircle**, which is run as a collaboration between Riga Technical University (Latvia), Lulea University of Technology (Sweden) and Aarhus University (Denmark). The GlassCircle project aims to explore a complete cycle circular economy for the glass fibre industry. The project is co-funded by the European Union, Interreg Baltic Sea Region. The main goal of this project is to help glass fiber and composite manufacturing companies move towards a circular economy, reduce the produced waste and the negative impact on the environment as well as to adapt more efficient use of available recourses thus making the industry more sustainable. In order to achieve this goal, the first step is to build a strong network, establish a full cycle circular economy within this industry and exchange knowledge that different members of the glass fiber industry have acquired.
This survey targets businesses whose ***activities involve working with glass fiber-containing materials*** (including raw glass fiber, production of glass fiber products, and services related to products containing glass fiber and waste). The survey aims to identify businesses working with glass fiber and create a network creation and research database. The survey will take approximately 2-3 minutes to fill out.

Thank you for taking part in this survey.

If you want to hear more about the project, please contact Liva Pupure <Liva.Pupure@rtu.lv> , Roberts Joffe <Roberts.Joffe@ltu.se> , Michail Beliatis <mibel@btech.au.dk>.

Project Webpage: https://interreg-baltic.eu/project/glasscircle/

* Required

Information about business

The following questions are related to information about the business working with glass fiber materials and products.

1
Does your business work with glass fiber materials and/or products containing glass fiber?

- (●) Yes
- ( ) No

2
Does your business generate glass fiber waste? *

- ( ) Yes
- ( ) No

Current activity

14-15 September, 2023

Dissemination - Workshop on Circularity of glass fibres

1. Experts from industry, academia and policy makers will come together to talk about these issues;
2. During the workshop participating companies will have the possibility to describe their needs in terms of recycling glass fibres and have the opportunity for networking with leading experts in LCA as well as composite professionals

***Register here** (participation in the workshop is free of charge).*

Interreg Baltic Sea Region | Co-funded by the European Union

CIRCULAR ECONOMY GlassCircle

WORKSHOP: 14-15 September 2023

Environmental and economical feasibility to recover glass fibers

The final program

Day 1 (14/9)		Day 2 (15/9)	
Welcome!	15.00	**Opening of Day-2**	08.55
Workshop's agenda, *Zainab Al-Maqdasi (LTU)*	15.15	**Glass fibers - strong but sensitive,** *Christina Scheffler (IPF)*	09.00
GlassCircle project, *Liva Pupure (RTU)*	15.30	**Role of recycling industry,** Martins Niklass *(ZAAO)*	09.30
Mapping glass fiber ecosystem for value creation thought circular use, *Student presentation (AU)*	16.00	**Industries: issues and solutions** - *Anders Holmberg (Hitachi)* - *Birgitha Nystrom (PodComp)* - *Martins Millers (Valmiera Glass)*	 09.50 10.10 10.30
Concluding remarks	16.30	***Break***	10.50
		Introduction to LCA, *Carmen Cristescu (SLU)*	11.10
Link for on-line participants: ZOOM https://aarhusuniversity.zoom.us/j/64855629034		**Waste mineral wool upcycled into alkali-activated facade panels and cobblestones with LCA,** *Barbara Horvat (ZAG)*	11.40
		Giving recycled fiberglass a new life in circular products, *Jakob W Nielsen (MILJØSKÆRM)*	12.10
		Break	12.30
		Discussion panel, *moderated by Z. Al-Maqdasi and R. Joffe (LTU)*	12.50
		Concluding remarks	13.50

Scan the QR code to access the event webpage

CLIMATE-NEUTRAL SOCIETIES

More about current activity

14-15 September, 2023

Attendee confirmation for GlassCircle Workshop H

49
Responses

05:28
Average time to complete

View results

1. Which date can you attend?

More Details

- 14th September 2023 38
- 15th September 2023 44

6. How would you prefer to attend the event? (For catering purposes)

More Details

- Join remotely online 40
- Join in person 9

7. Purpose of joining this event.

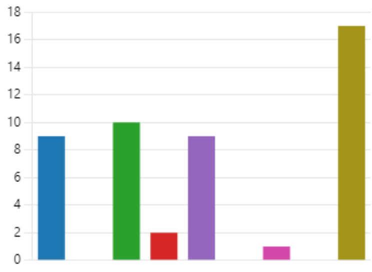
More Details

- Get better understanding of late... 35
- Share status progress to keep te... 13
- Brainstorm new direction for pr... 19
- Other 11

8. In which country are you based ? (only for statistical purpose reporting in the project)

More Details

- Denmark 9
- Norway 0
- Sweden 10
- Finland 2
- Latvia 9
- Estonia 0
- Poland 1
- Lithuania 0
- Other 17



9. Would you be interested to participate in an interview later on?

More Details

- Yes 18
- No 31

***Register** here (participation in the workshop is free of charge).*

Interreg Baltic Sea Region
Co-funded by the European Union
Circular Economy GlassCircle

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More about current activity

14-15 September, 2023


Register here (participation in the workshop is free of charge).

Interreg Baltic Sea Region | Co-funded by the European Union | GlassCircle

WORKSHOP: 14-15 September 2023

Environmental and economical feasibility to recover glass fibers

The final program

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…rsity.z …034		*Break*	12.30
		Discussion panel, *moderated by Z. Al-Maqdasi and R. Joffe (LTU)*	12.50
		Concluding remarks	13.50

…o access the event webpage

Planned activities

Middle of 2023

<u>Survey of communities about the circularity of glass fibre</u>

1. Important information about society's view of glass fibre and its circularity will be obtained;
2. This will also be a way to ask the larger society about their needs since they represent the product end-users
3. Awareness raising of the glass fibre residue waste issue in the larger society

Planned activities

Beginning of 2024

Workshop «Business model for circular economy»

1. **Survey and Mapping** of the fibre glass manufacturers and users during various activities at the project Industry. Relevant actors in the fibre glass industry are mapped across the different Baltic sea regions in order to locate the critical subprocesses in the industry that could be supported by digitalization and a circular economy;
2. **Identification of case companies.** Suitable companies that could benefit from the developed digitalization and circular economy solution are identified in corresponding municipalities/countries. 3-5 actors are selected to create a focus group within a specific part of the value chain to co-create a prototype and test the effect before the solution is applied to a larger part of the industry.
3. **Development of white paper** with findings from the glass fibre industry on transitioning to a circular economy

Planned activities

Middle of 2024

Conference session «GlassCircle – structural use of glass fibre composite materials»

1. Gathering experts from academia and industry to present the latest innovation in the field of reuse, recycling, or recovery of glass fibres;
2. It is planned to have a special issue within a scientific journal with all the session presentations;
3. Separate session where policymakers meet and discuss their approaches, success stories and problems

Database «GlassCircle cluster»

Main outcome of the project

- During the project interested companies will have the opportunity to join our GlassCircle cluster in a form of a database;
- Our target audience is mainly small and medium enterprises, however, we welcome also large enterprises, that produce a large amount of this residue material;
- With the help of this database, we hope to foster practices of the circular economy;
- There is hope, that we might connect glass fibre residue donors with possible receptor companies;
- This database is an opportunity to create new networks and use the obtained information and connections to create further cooperation initiatives

Interested in joining our database?

Liva (RTU, Latvia): Liva.Pupure@rtu.lv
Roberts (LTU, Sweden): Roberts.Joffe@ltu.se
Michail (Aarhus, Denmark): mibel@btech.au.dk

More information can be found on the project web-page:
interreg-baltic.eu/project/glasscircle

Acknowledgments

This project has been funded by European Union

Interreg Baltic Sea Region

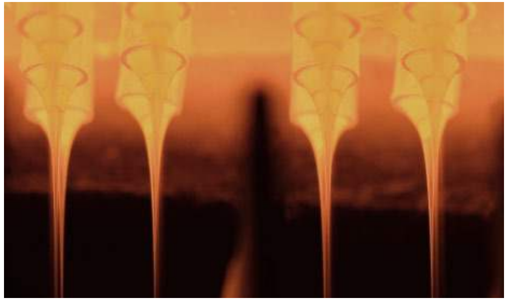
Co-funded by the European Union

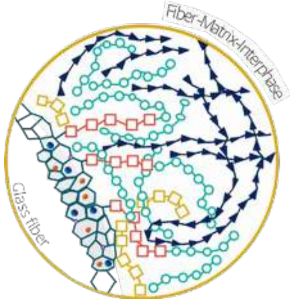
Leibniz-Institut für Polymerforschung Dresden

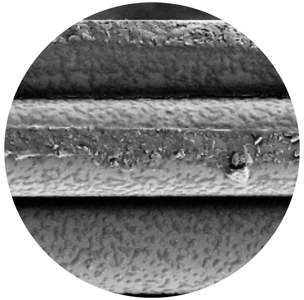
GLASS FIBERS – STRONG, BUT SENSITIVE

GlassCircle - Workshop
14. – 15. September 2023, online

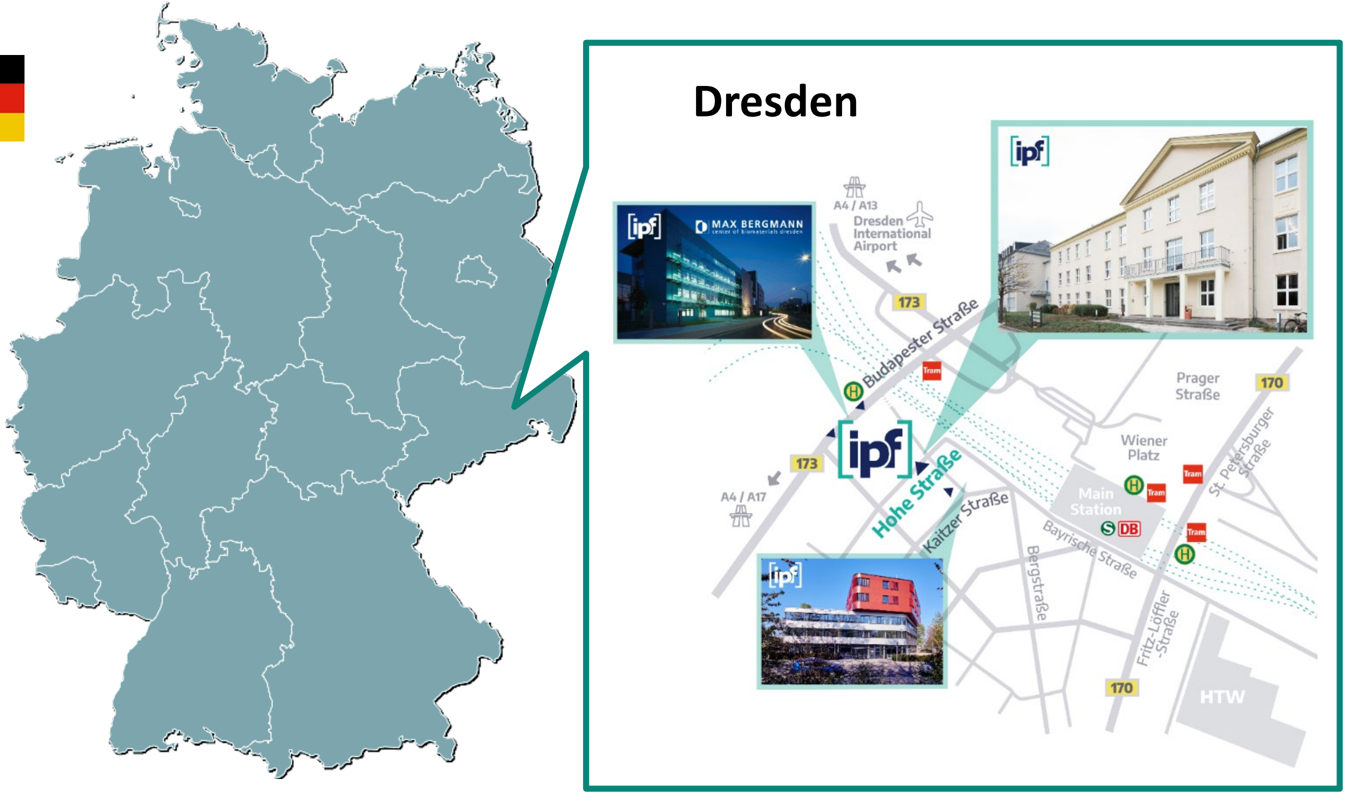
Christina Scheffler







Location - Leibniz-Institut für Polymerforschung Dresden e. V.



Outline

Glass fiber spinning + textile products

Sizings + sizing function

Glass composition + mechanical properties

Recycling + glass fiber properties

Summary

Glass fiber reinforced composites - Application

> 90% glass fibers; Automotive, Transport, Ship Building, Containers, Rotor blades, Civil Engineering etc.

Manufacturing of a rotor blade with glass fiber reinforced thermoset https://industrieanzeiger.industrie.de

Tailgate elements made of long-fiber reinforced polypropylene www.plastverarbeiter.de

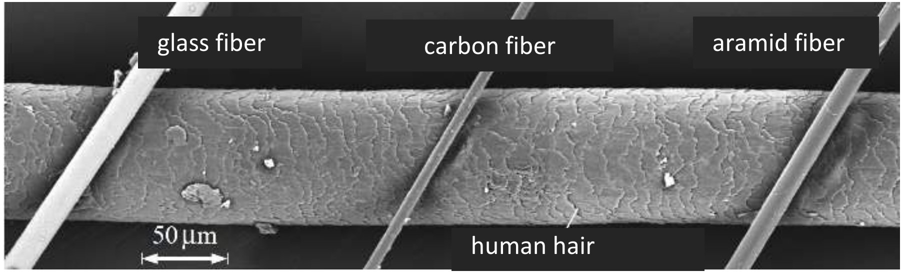
Oil tank made for GRP www.haasetankhamburg.de

Boat building with fiber glass https://www.boats.com/how-to/boat-building-construction-resin-fiberglass-cores/

Rebars, tubes, meshes for building constructions + GRFP in Transport https://gfrprebartechnology.com/en/types-construction-structures-gfrp/

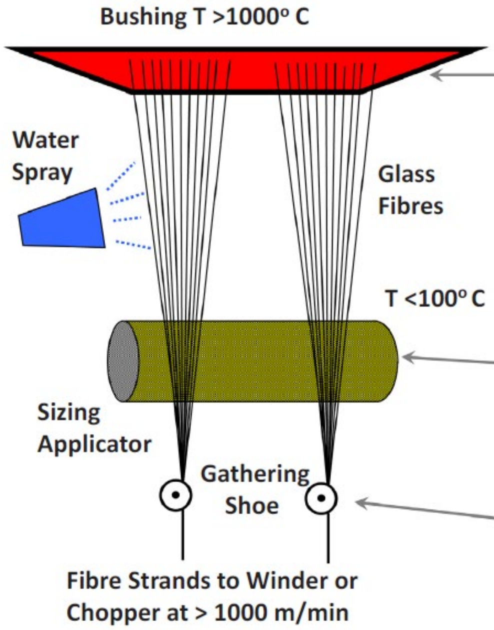
Properties of reinforcing fibers

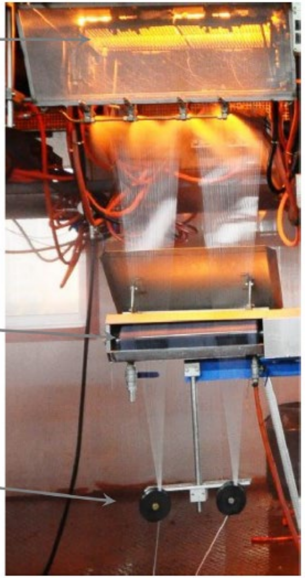
fiber		tensile			compression	density	T_{max}
		Modulus [GPa]	Strength [GPa]	Strain [%]	strength [%]	g/cm³	°C
steel		200	2,8	4,8	–	7,8	1000
glass	S-Typ	90	4,5	5,7	1,1	2,46	250–300
	E-Typ	80	3,5	4,0	–	2,54	300–350
bor		440	3,5	1,0	5,9	2,6	1800
SiC		400	4,8	0,9	3,1	2,8	1300
Carbon	Pan-HT	240	3,75	1,6	2,9	1,78	500
	– HM	400	2,45	0,7	1,6	1,85	600
	– UHM	540	1,85	0,4	1,1	2,0	600
	Pech-HM	800	3,5	0,4	0,7	2,15	600
	– isotrop	50	1,0	2,3	0,7	1,55	400
Aramid	Kevlar 49	135	3,5	2,8	0,48	1,45	250–300
	Kevlar 149	185	3,4	2,0	0,46	1,47	250–300
UHMW-PE		172	3,3	4,0	0,17	0,97	100
Textil PET		16	1,2	15	0,09	1,39	150
Natural	hemp	70	0,60	1,6	–	1,45	200
	flax	30	0,75	2,0	–	1,48	200
	Jute	55	0,55	2,0	–	1,3–1,5	200
	Sisal	20	0,60	2,0	–	1,45	200



H. Schürmann, Konstruieren mit Faser-Kunststoff-Verbunden : mit ... 39 Tabellen, 2., bearb. und erw. Aufl. ed. Berlin: Springer, 2007

Glass fiber manufacturing by nozzle drawing





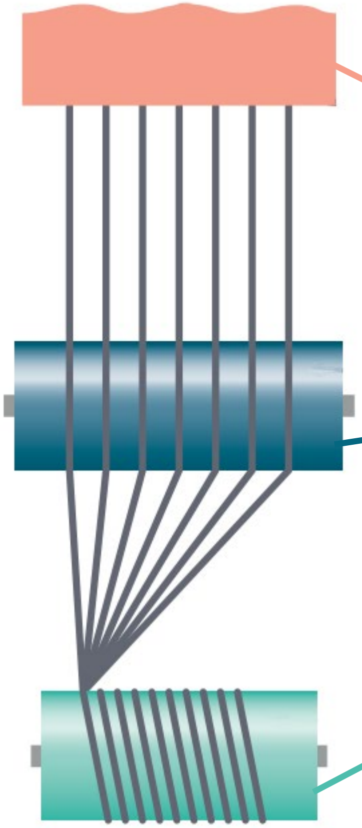
- Melt leaves the furnace at a temperature of > 1000°C
- Glass melt is extruded through heated feedthrough plates with 200 to 8,000 nozzles

- winders draw melt into thin filaments
- cooled by water spray
- coated with sizing

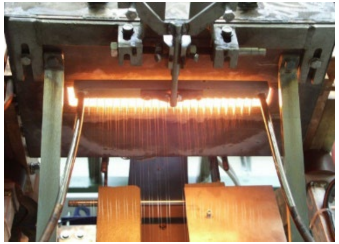
Thomason, J. L. (2019). Glass Fibre Sizing: A Review. *Composites Part A: Applied Science and Manufacturing*, 105619. https://doi.org/10.1016/j.compositesa.2019.105619

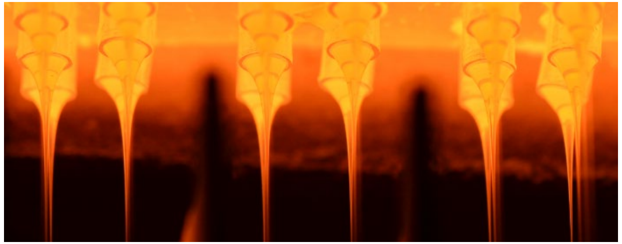
https://www.compositesworld.com/articles/the-making-of-glass-fiber

Glass fiber spinning by pilot line at IPF

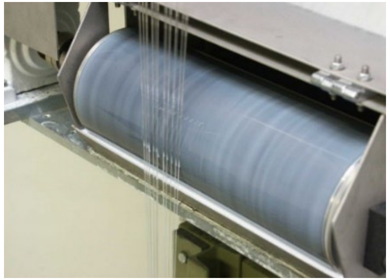


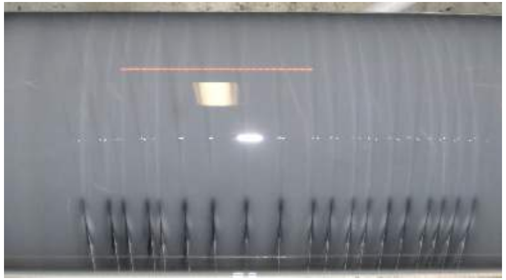
Bushing



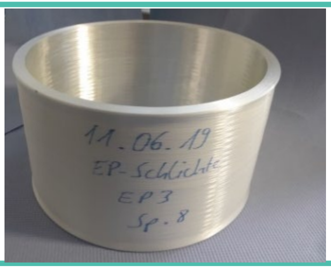


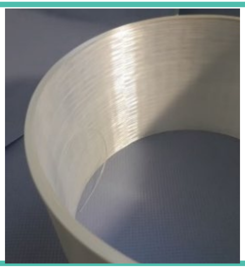
Sizing application





Winding





Outline

Glass fiber spinning + textile products

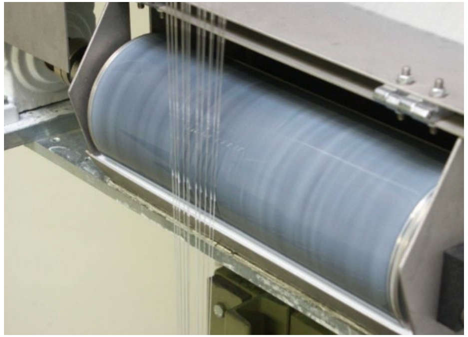
Sizings + sizing function

Glass composition + mechanical properties

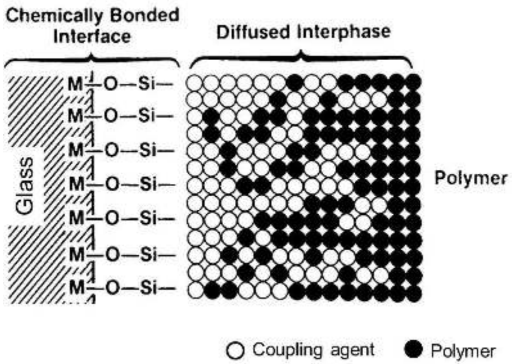
Recycling + glass fiber properties

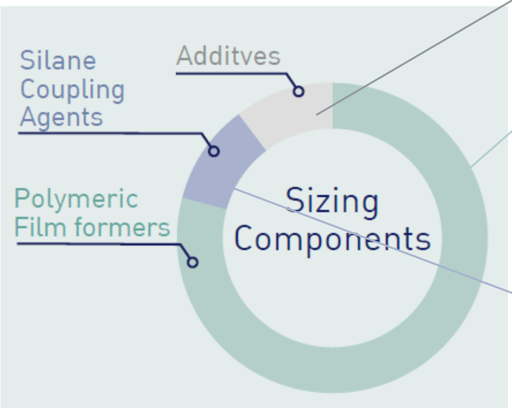
Summary

Sizing - composition



Plueddemann model:





- friction
- wetting
- strand properties
- stability

- interphase morphology
- textile workability
- strand integrity
- yarn tensile strength

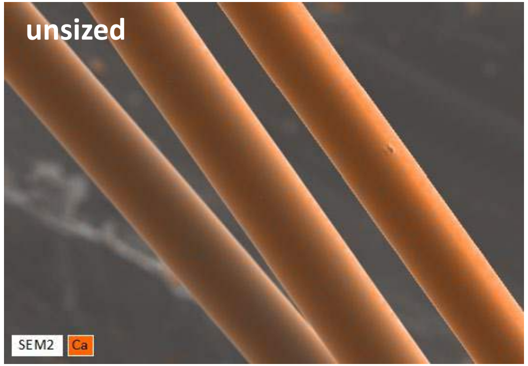
- fiber-matrix adhesion
- hydrophobicity

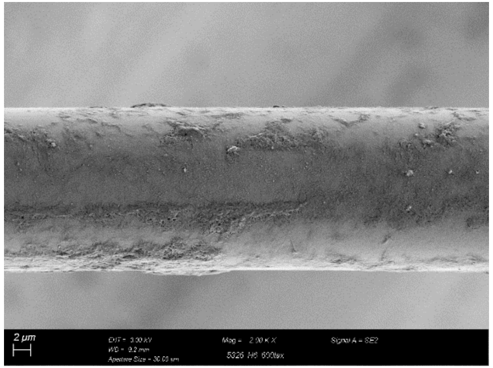
Edwin P. Plueddemann (1988) Silane primers for epoxy adhesives, Journal of Adhesion Science and Technology, 2:1, 179-188, DOI: 10.1163/156856188X00183

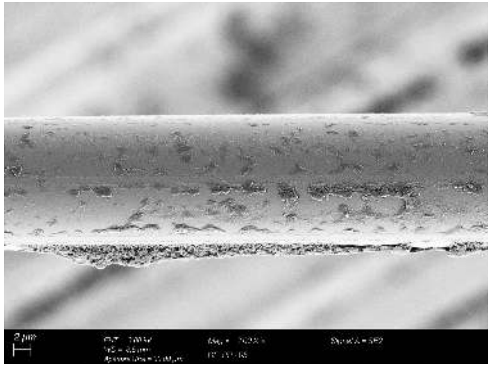
9

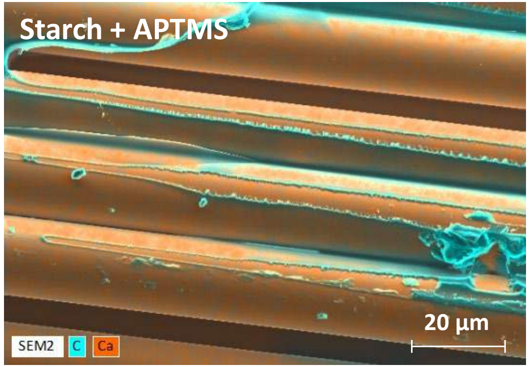
Sized glass fibers - examples

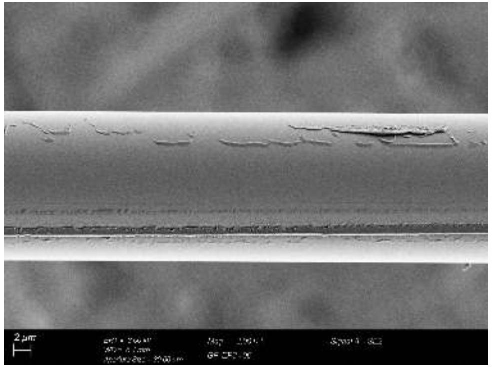
SEM/EDX
Sizing distribution on the fiber surface

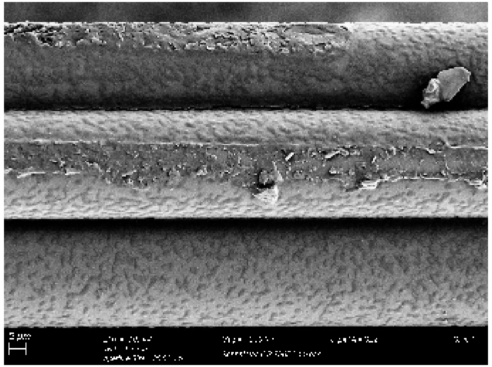








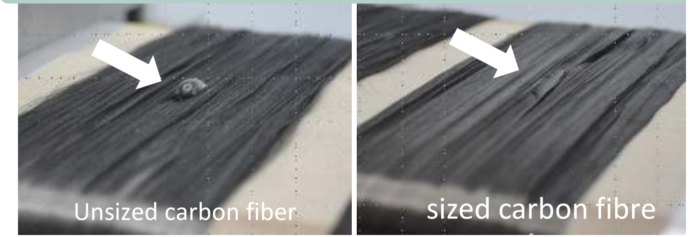




Sizing - function

Homogeneous wetting of the sizing roll

Wetting with matrix polymer

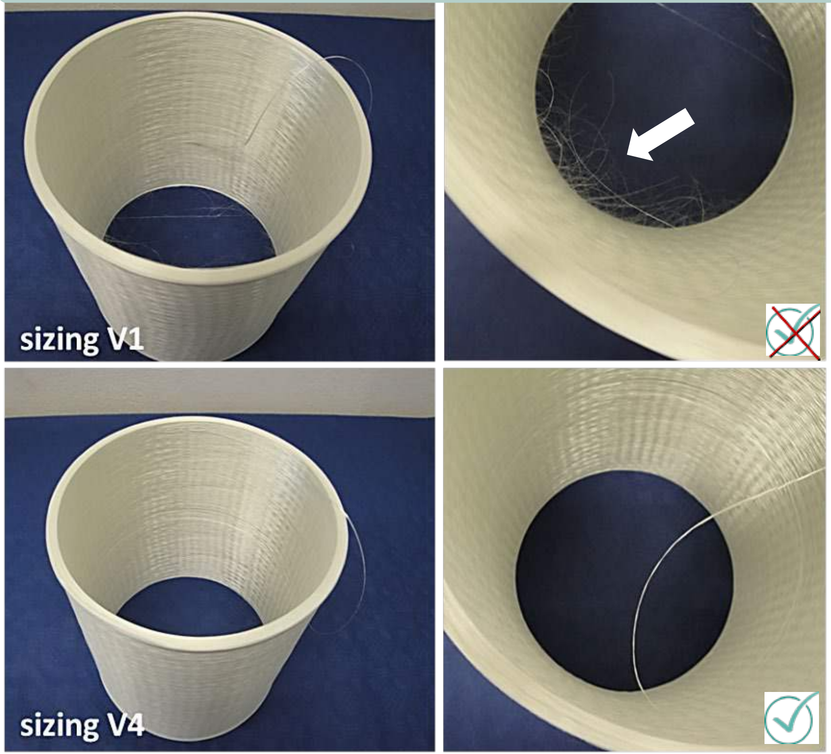


Chopping, dosage and textile processing of short and long fibers

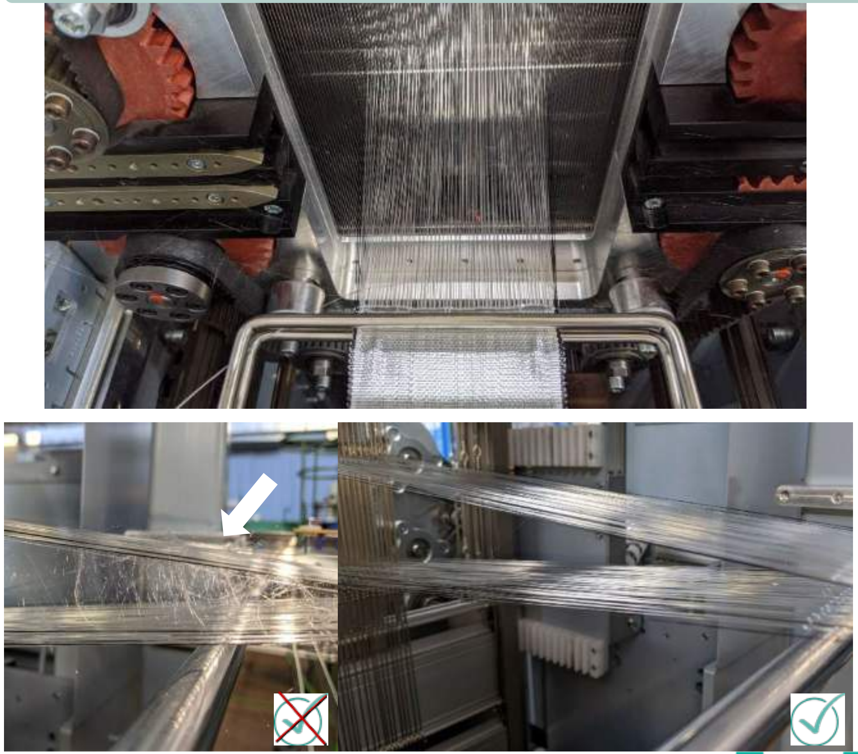
sizings to avoid fiber separation+fuzz formation

Sizing - function

Ensuring spooling and yarn quality



Textile processing



Glass fiber products

Multi-end roving

http://www.ocvreinforcements.com/pdf/products/MultiEndRov_P244C_AP_08_2008_REV0.pdf

Single-end roving

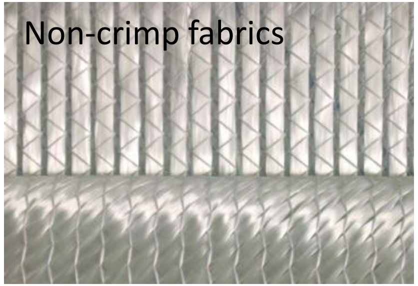
https://www.indiamart.com/proddetail/direct-roving-e-glass-2400-tex-4800-tex-single-end-roving-16609811355.html

https://www.konstruktionspraxis.vogel.de/innovative-stricktechnologie-fuer-kohle-und-glasfaser-a-334016/

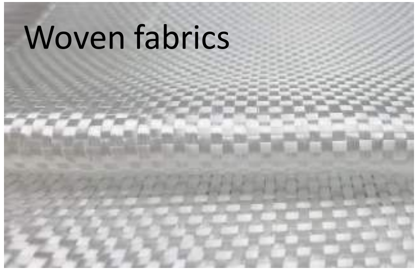
https://www.buefa.de/images/potrait-small/oschatz_textilglasmatte.jpg

https://shop.hp-textiles.com/shop/images/product_images/popup_images/hp-gs6_shop.jpg

https://www.neg.co.jp/en/product/fiber/e-milled_fiber



https://shop.hp-textiles.com/shop/de/750g-m-Triaxial-Glasfasergelege-HP-T750E.html



https://www.phd-24.de/formenbau/gewebe/gewebe-fuer-epoxidharz/

Outline

Glass fiber spinning + textile products

Sizings + sizing function

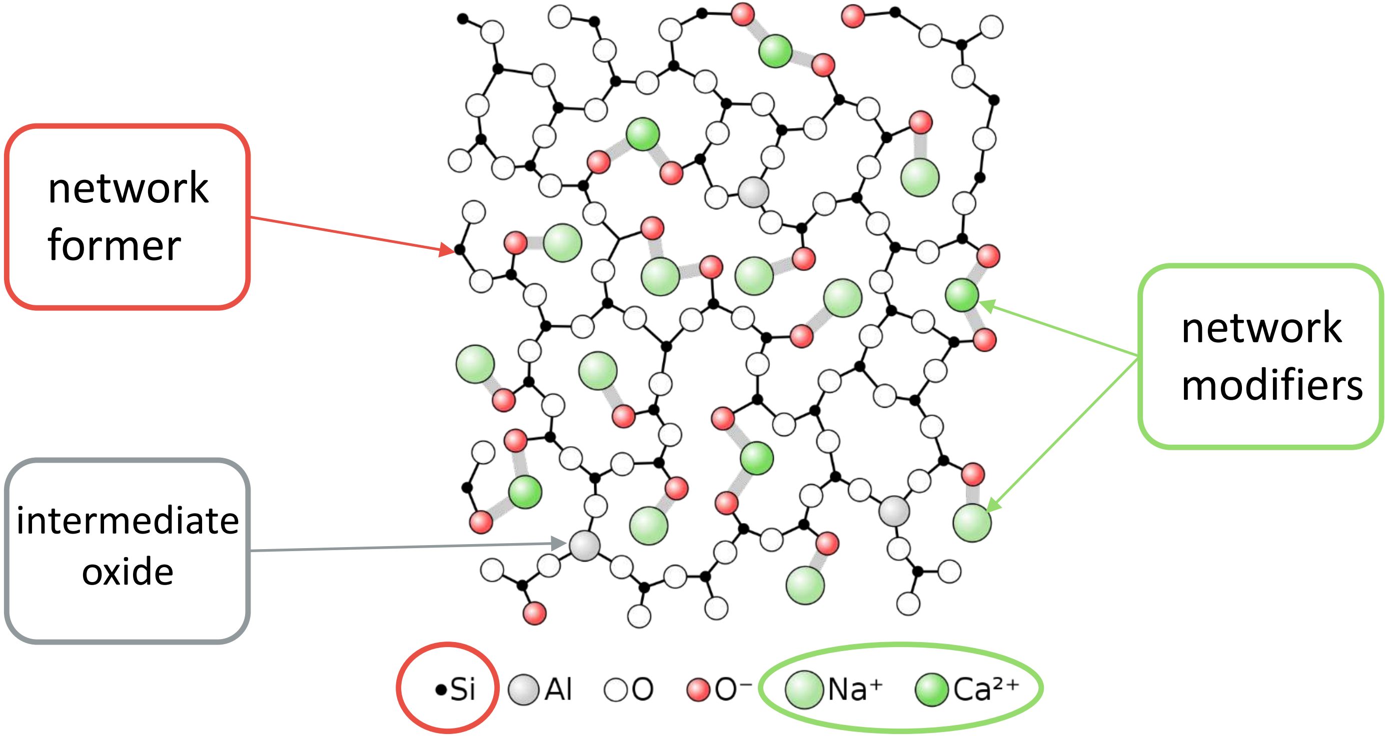
Glass composition + mechanical properties

Recycling + glass fiber properties

Summary

Glass structure and compositions

Glass is an amorphous solid. Although the atomic-scale structure of glass shares characteristics of the structure of a supercooled liquid, glass exhibits all the mechanical properties of a solid.



Von Mrmw - Eigenes Werk, basierend auf: Kalk-Natron-Glas 2D.png:, CC0, https://commons.wikimedia.org/w/index.php?curid=98920200

Glass compositions for fibers

Glass composition determines strength, modulus, chemical resistance!

Constiutents [weight-%]	Typ E	Typ AR	Typ R	Typ S	Silica	Typ M
SiO_2	50,0 … 56,0	60,9 … 62,0	60	62,0 … 65,0	99,9	53,5
Al_2O_3	12,0 … 16,0	–	24,0 … 25,0	20,0 … 26,0	–	–
CaO	16,0 … 25,0	4,8	6,0 … 9,0	–	–	13,0
MgO	$\leq$ 6,0	0,1	6,0 … 9,0	10,0 … 15,0	–	9,0
B_2O_3	6,0 … 13,0	–	–	$\leq$ 1,2	–	–
F	$\leq$ 0,7	–	–	–	–	–
Na_2O	0,3 … 2,0	14,3	0,4	$\leq$ 1,1	–	–
ZrO_2	–	10,2	–	–	–	2,0
K_2O	0,2 … 0,5	2,7	0,1	–	–	–
Fe_2O_3	0,3	–	0,3	–	–	0,5
TiO_2	–	6,5	0,2	–	–	8,0
ZnO	–	–	–	–	–	–
CaF_2	–	–	–	–	–	–
LiO_2	–	–	–	–	–	3,0
SO_3	–	0,2	–	–	–	–
BeO	–	–	–	–	–	8,0
CeO	–	–	–	–	–	3,0

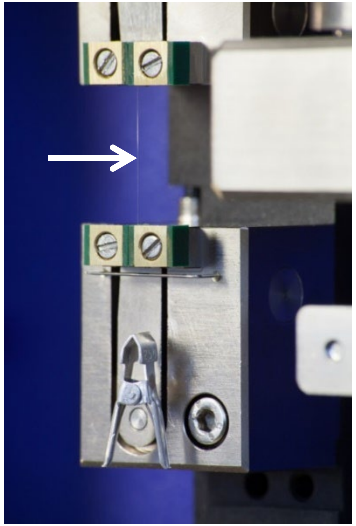
PHYSICAL PROPERTIES	E GLASS	ECRGlas®	AR GLASS	R GLASS	S-2 GLASS®
Density, gm/cc	2.58	2.72	2.70	2.54	2.46
Refractive Index	1.558	1.579	1.562	1.546	1.521
Softening Point, °C (°F)	846 (1555)	882 (1619)	773 (1424)	952 (1745)	1056 (1932)
Annealing Point, °C (°F)	657 (1215)				816 (1500)
Strain Point, °C (°F)	615 (1140)			736 (1357)	766 (1410)
Tensile Strength, MPa					
-196°C	5310	5310			8275
23°C	3445	3445	3241	4135	4890
371°C	2620	2165		2930	4445
538°C	1725	1725		2140	2415
Young's Modulus, GPa					
23°C	72.3	80.3	73.1	85.5	86.9
538°C	81.3	81.3			88.9
Elongation %	4.8	4.8	4.4	4.8	5.7

E-Glass:	Aluminum borosilicate glass, <2% alkali oxides, general plastic reinforcement and electrical applications, most commonly used GF type
AR-Glass:	Alkali glass with added zirconium dioxide, alkali resistance for concrete reinforcement
R-Glass:	Aluminosilicate glass with calcium and magnesium oxide; high mechan. requirements even at high temperatures
S-Glass:	Aluminosilicate glass with magnesium oxide, high mechan. requirements even at high temperatures
ECR-Glass	(E-Glass Corrosion Resistant) high chemical/thermal resistance for laminates in contact with acids/bases
Silica:	very high mass fraction of SiO2 (>99.9%), very high temperature resistance
M-Glass:	berrylium-containing glass, high E-modulus, application at highest mechan. requirements

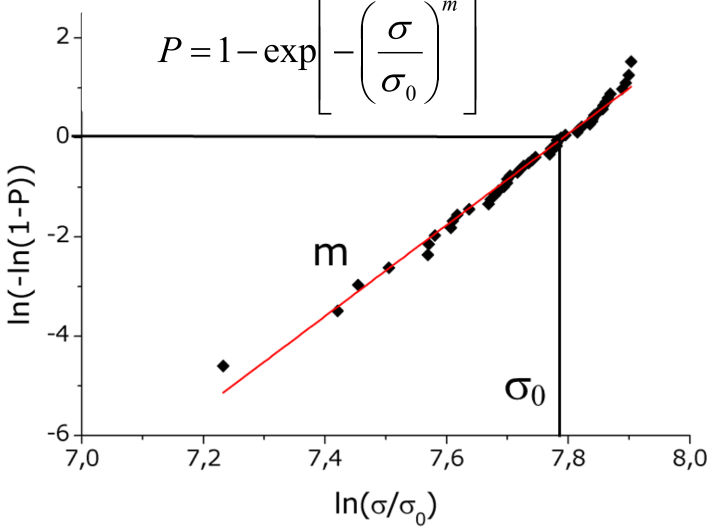
Cherif, C. (2011). Textile Werkstoffe für den Leichtbau. Techniken, Verfahren, Materialien, Eigenschaften. SpringerLink: Bücher. 9783642179921. Heidelberg ua: Springer.
https://www.agy.com/wp-content/uploads/2014/03/High_Strength_Glass_Fibers-Technical.pdf

Mechanical properties

Single fiber tensile test



Favimat+ (Textechno)
gauge length: 50 mm
testing speed: 25 mm/min



$$P = 1 - \exp\left[-\left(\frac{\sigma}{\sigma_0}\right)^m\right]$$

P: cumulative probability of failure
m: Weibull modulus (shape parameter)
σ: measured stress
σ_0: characteristical stress (at which 63.2% break)

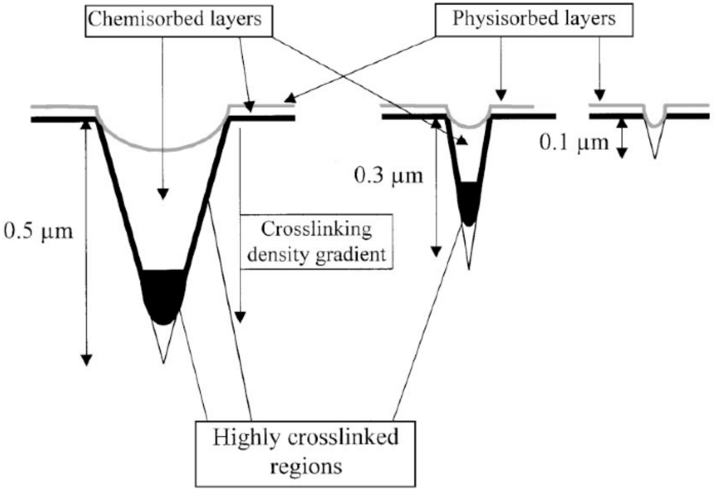
Weibull modulus m:

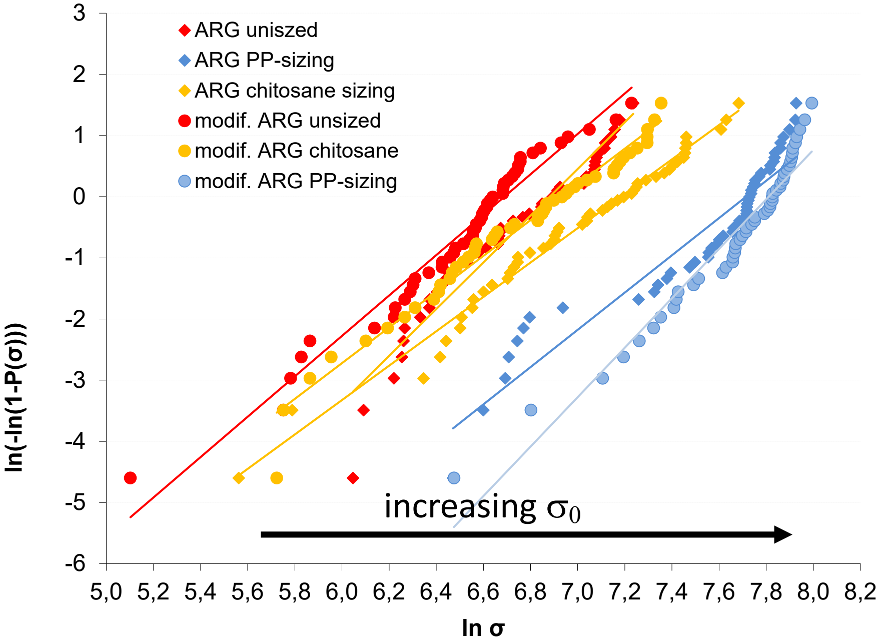
A measure of the scatter around the mean value of the strength: the higher the modulus m, the more homogeneous is the strength of the fibre.

Scheffler, C., Förster, T., Mäder, E., Heinrich, G., Hempel, S., Mechtcherine, V. (2009). 355(52-54), 2588-2595.

Glass fibers – mechanical properties

Healing of glass structure surface defects by sizings





Zinck, P., Pay, M. F., Rezakhanlou, R., & Gerard, J. F. (1999). Mechanical characterisation of glass fibres as an indirect analysis of the effect of surface treatment. Journal of materials science, 34(9), 2121-2133.

Outline

Glass fiber spinning + textile products

Sizings + sizing function

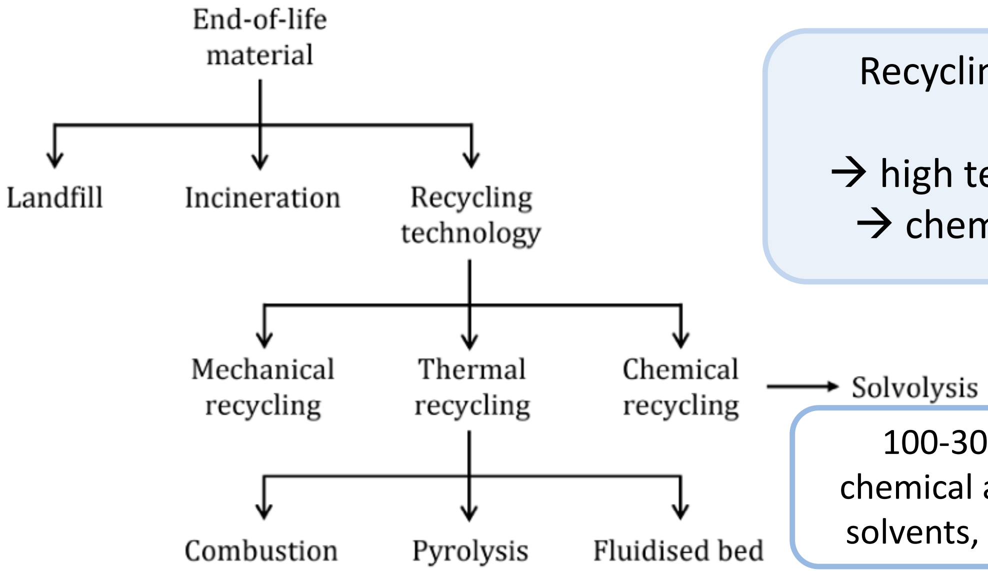
Glass composition + mechanical properties

Recycling + glass fiber properties

Summary

Composite recycling processes

Recycling processes for thermoset composite materials



Recycling involves

→ high temperatures
→ chemical attack

100-300°C
chemical agents
solvents, water

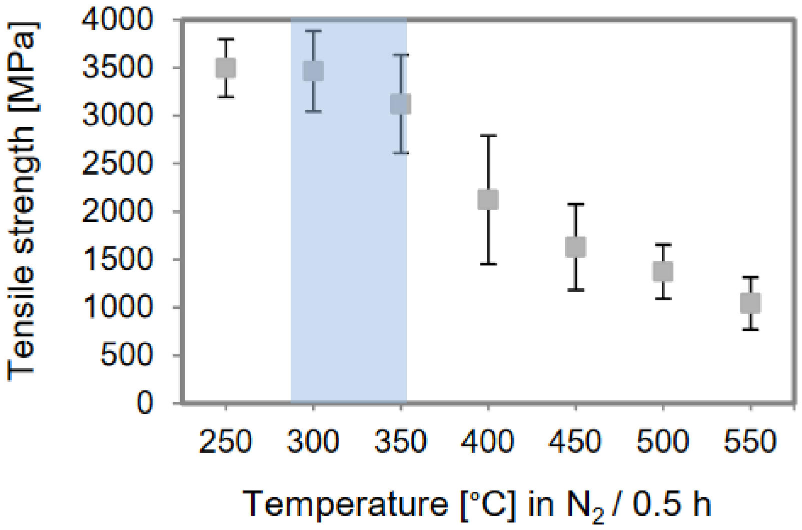
450-800°C
no chemical agents
char formation

450 to 550 °C

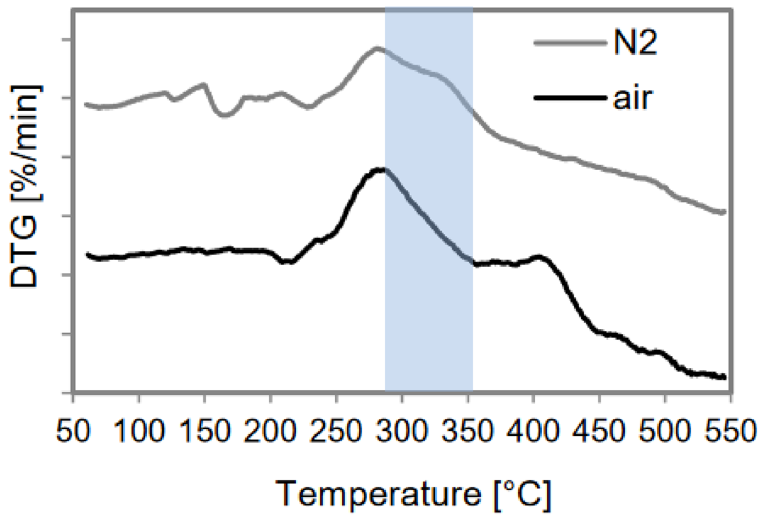
Gonçalves, R. M., Martinho, A., & Oliveira, J. P. (2022). Recycling of reinforced glass fibers waste: Current status. Materials, 15(4), 1596.

Fiber strength - temperature

Single fibre tensile strength of sized basalt fibres



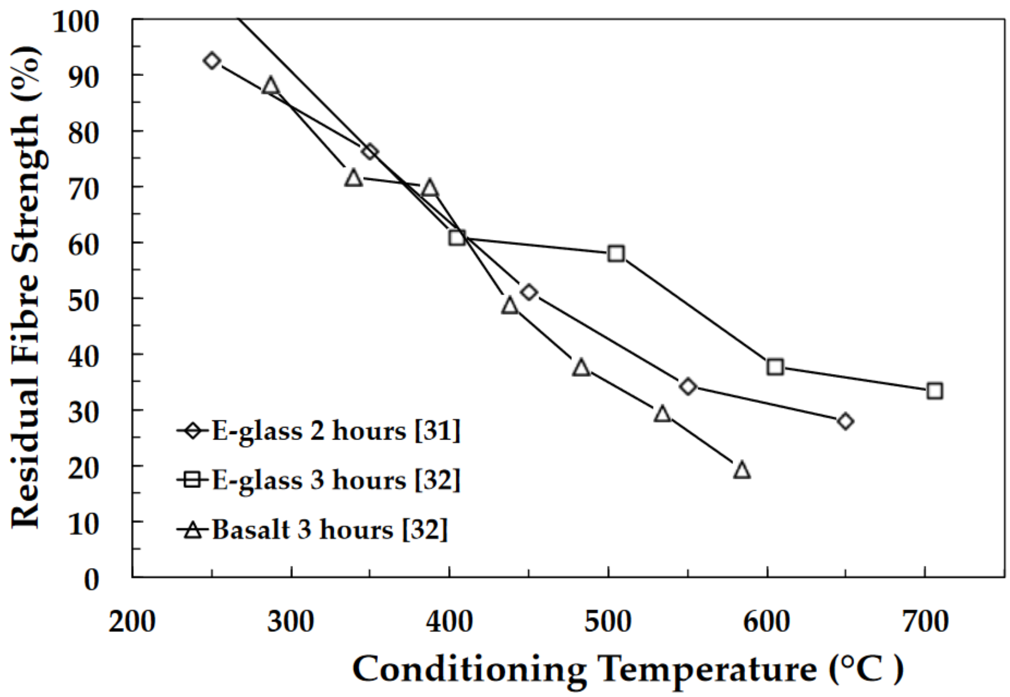
TGA/DTG curves of sized basalt fibres



Strength loss is not only resulting from removal of sizing!

Förster, T., Sommer, G. S., Mäder, E., & Scheffler, C. (2016, July). Surface, interphase and tensile properties of unsized, sized and heat treated basalt fibres. In IOP Conference Series: Materials Science and Engineering (Vol. 139, No. 1, p. 012019). IOP Publishing.

Fiber strength - temperature



Strength loss due to:

- Thermal Compaction
- Anisotropy Relaxation
- Crystallisation
- Ion Exchange

Thomason, J., Jenkins, P., & Yang, L. (2016). Glass fibre strength—a review with relation to composite recycling. *Fibers*, *4*(2), 18.

Fiber strength - temperature

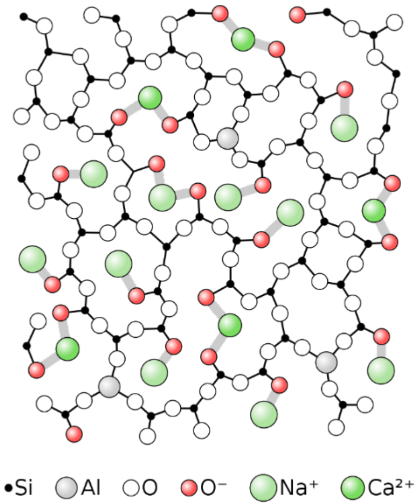
Fibre Type	Fibre Diameter (microns)	Coating, Sizing	Maximum Conditioning Temperature (°C)	Time (min)	Maximum Strength Loss (%)
E-glass	6–17	unsized	273	240	40
E-glass	17	unsized	400	25	45
E-glass	17	aminosilane	400	25	55
E glass	17	unsized	600	25	45
E-glass	17	aminosilane	600	25	73
E-glass	17	unsized	600	25	65
E-glass	17	aminosilane	600	25	75
E-glass	17	SE1500	600	25	65
Basalt	9–16	unsized	600	?	80
Basalt	–	unsized	650	60	97
Basalt	9	–	500	60	90
Basalt	10	–	500	5	77
Basalt	10	–	500	20	89
Basalt	15	epoxy	600	?	80
NA-ABG *	12	unsized	650	?	75
NA-ABG *	22	unsized	650	60	70
Soda-lime	3000	unsized	530	60	70
NA-ABG *	–	–	550	?	55
Alkaline	20	unsized	500	60	70

* Non-alkaline aluminoborosilicate glass.

Thomason, J., Jenkins, P., & Yang, L. (2016). Glass fibre strength—a review with relation to composite recycling. *Fibers*, *4*(2), 18.

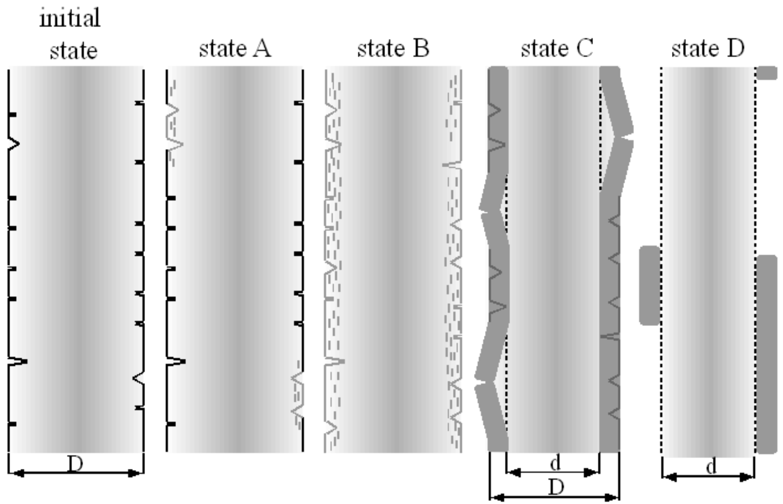
Glass fiber – chemical resistance

- alkaline media → corrosion is mainly controlled by the dissolving of the SiO2-network
- acid media → diffusion of ions



$$\equiv Si - O - Si \equiv + OH^- \longrightarrow \equiv Si - OH + \equiv Si - O^-$$

$$\equiv Si \quad O + H_2O \longrightarrow \equiv Si \quad OH + OH$$



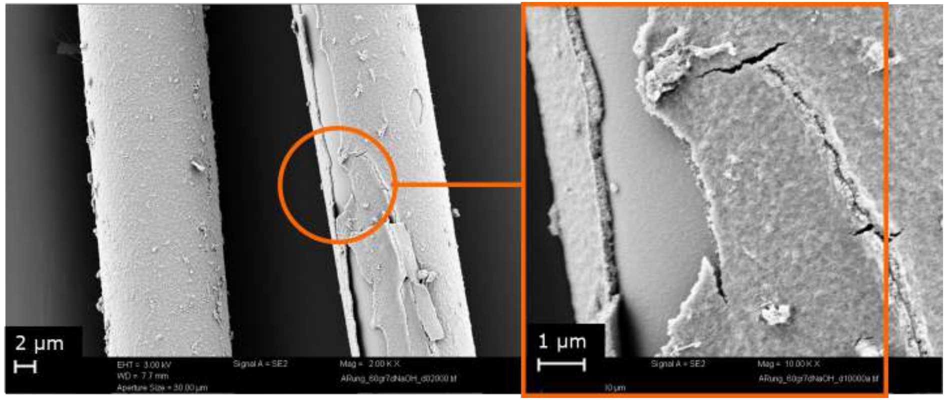
Hot sodium hydroxide (NaOH) treatment for strength regeneration*

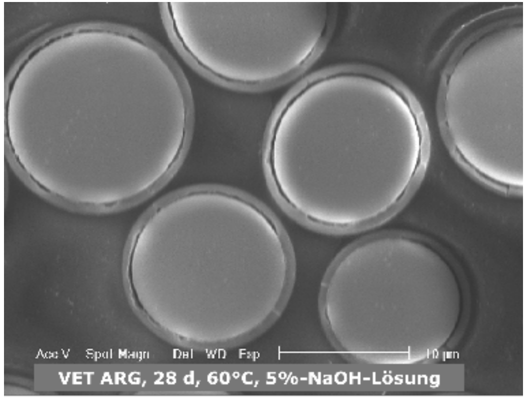
Strong alkaline corrosion can lead to removal of surface layers and sizing

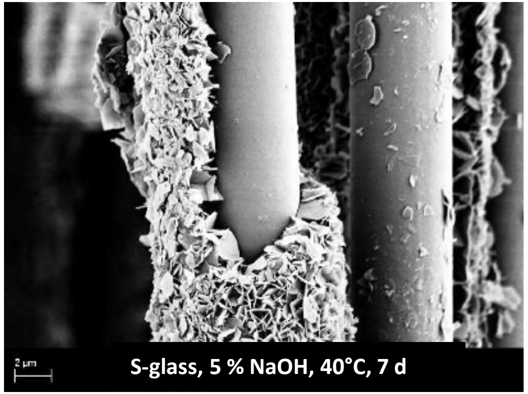
Scheffler, C., Förster, T., Mäder, E., Heinrich, G., Hempel, S., & Mechtcherine, V. (2009). Aging of alkali-resistant glass and basalt fibers in alkaline solutions: Evaluation of the failure stress by Weibull distribution function. Journal of Non-Crystalline Solids, 355(52-54), 2588-2595.

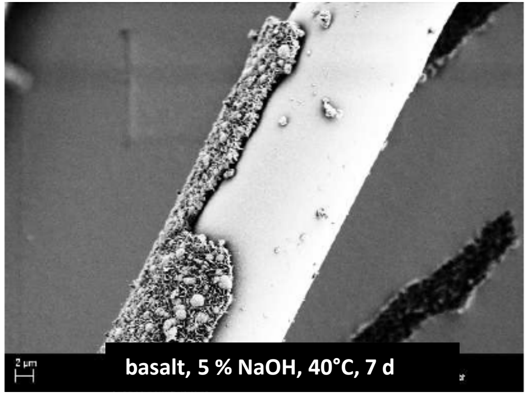
*Thomason, J. L., Nagel, U., Yang, L., & Sáez, E. (2016). Regenerating the strength of thermally recycled glass fibres using hot sodium hydroxide. Composites Part A: Applied Science and Manufacturing, 87, 220-227.

Glass fiber – chemical resistance



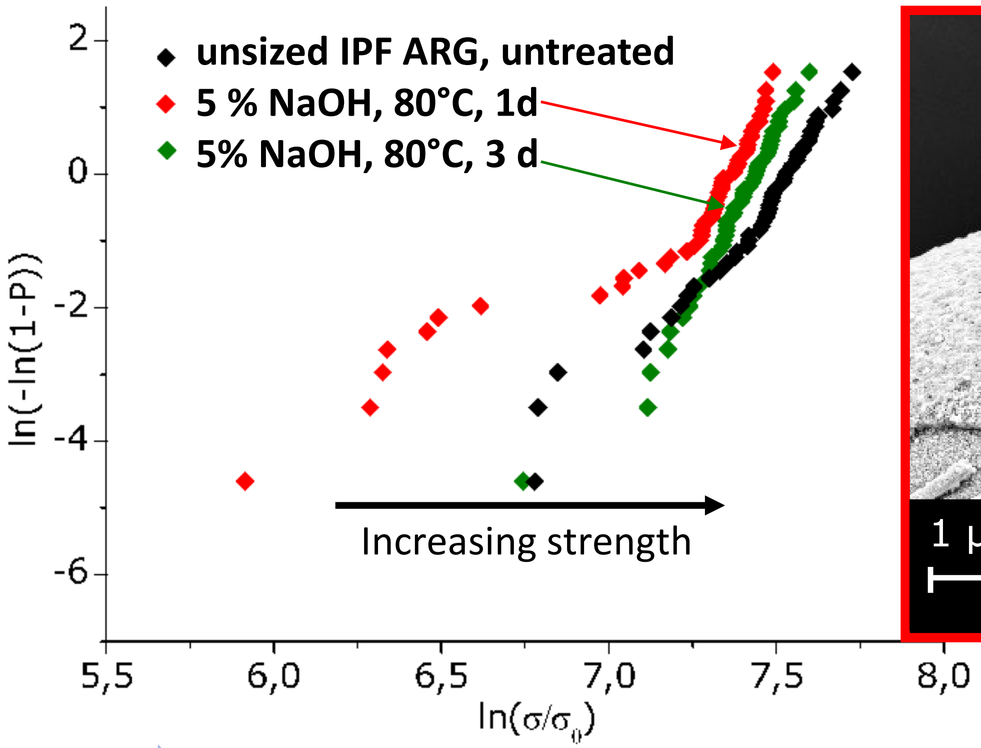


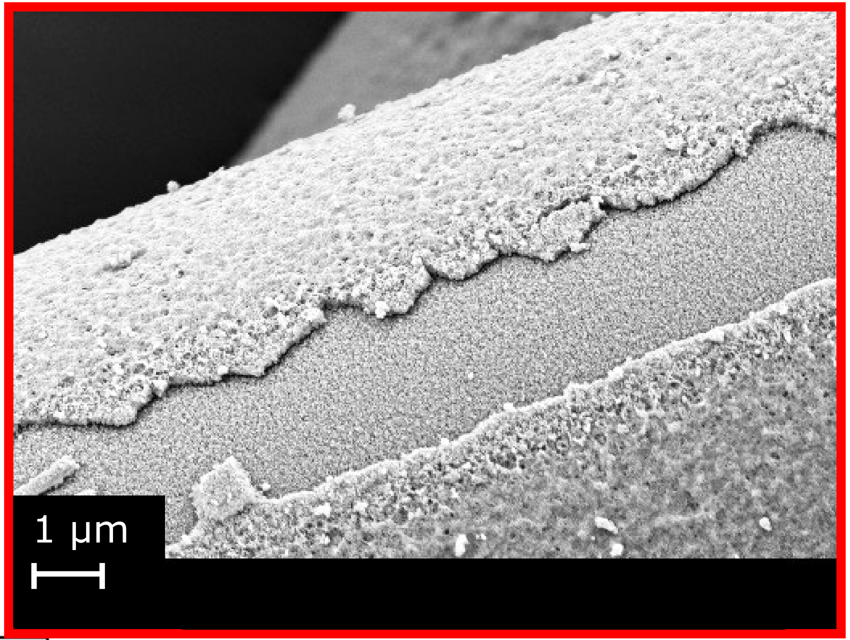




Scheffler, C., Förster, T., Mäder, E., Heinrich, G., Hempel, S., & Mechtcherine, V. (2009). Aging of alkali-resistant glass and basalt fibers in alkaline solutions: Evaluation of the failure stress by Weibull distribution function. Journal of Non-Crystalline Solids, 355(52-54), 2588-2595.

Glass fiber – chemical resistance





Tailored chemical corrosion + resizing provide potential for strength regeneration

Scheffler, C., Förster, T., Mäder, E., Heinrich, G., Hempel, S., & Mechtcherine, V. (2009). Aging of alkali-resistant glass and basalt fibers in alkaline solutions: Evaluation of the failure stress by Weibull distribution function. Journal of Non-Crystalline Solids, 355(52-54), 2588-2595.

Outline

Glass fiber spinning + textile products

Sizings + sizing function

Glass composition + mechanical properties

Recycling + glass fiber properties

Summary

Summary

→ Glass fibers are applied in huge amounts in composites (> 90%)

→ „Gentle“ recycling processes are required regarding temperature and chemical agents or solvents in order to reduce strength loss

→ Resizing offers potential for strength regeneration, but also protection during second textile processing

Thank you!

Contact

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E-Mail: scheffler@ipfdd.de
Web: www.ipfdd.de/fiber-spinning

ZAAO

Cilvēkam un videi

VIDZEME REGION WASTE MANAGEMENT COMPANY

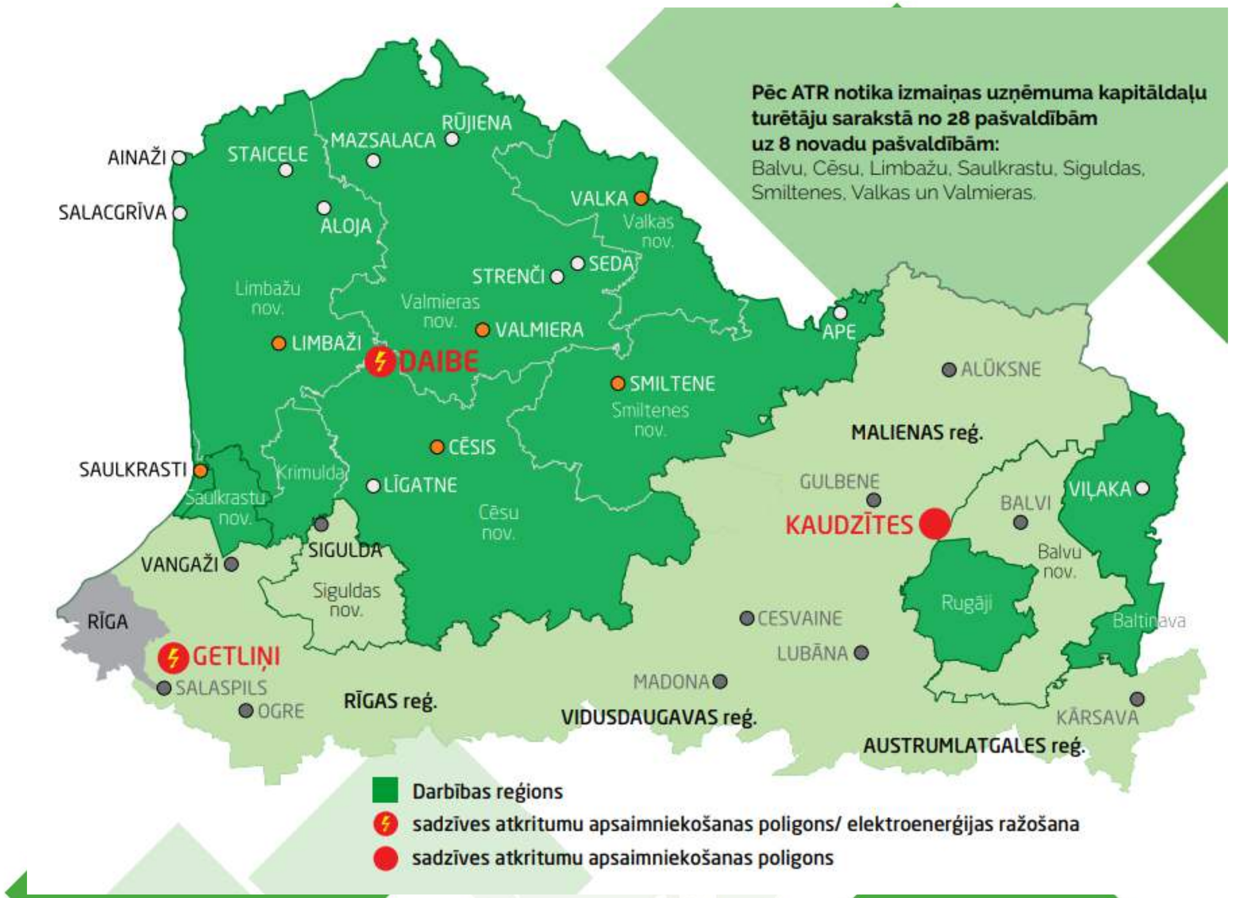
Company history

- Solid Waste Management strategy in Latvia, 1998
- Program “500-”
- Pilotproject in North Vidzeme Region
  - New, regional waste management system
  - New SW landfill complying with EU requirements
  - partial recultivation of the existing dumpsites
- Cooperation with the Ministry of Environmental Protection and Regional Development (VARAM) and the representative of Denmark Environmental Protection Agency (DEPA) in Latvia, s.c. “CARL BRO International”
  - Research of the existing situation in waste management in North – Vidzeme Region

ZAAO

ZAAO, was founded in 1998 by 82 North Vidzeme municipal governments with an aim to provide high quality waste management services. After administrative reform in 2021 ZAAO is 100% owned by 8 local municipalities.

- Operation area - **10 411 km2**
- Rural area – **98,7%**
- City area – 1,3 % (14 cities)
- Population ~ **159 564**
    - Rural ~ 52%
    - Cities ~48%



2022. gada 28. aprīlis

Waste managament regions in Latvia

ZAAO waste management system

Services

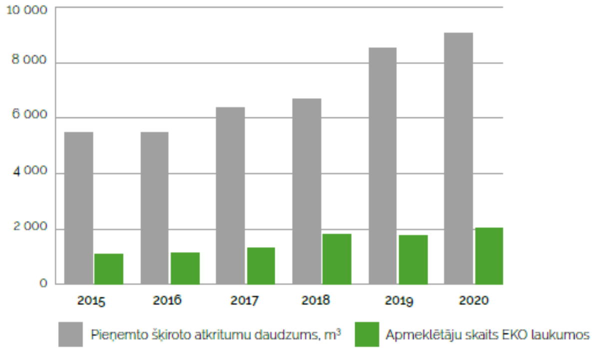
- MSW collection
- Source separate waste (packaging) management
- Waste disposal
- Environmental education

SERVICE OFFER

- Municipal solid waste management
- Online database of household waste management service agreements - available to municipalities for control.
- Separate waste collection throughout the region
- Collection of used household electrical appliances
- Collection of agricultural packaging (silage film)
- Bulky waste, green waste, construction, asbestos management
- Customer training
- Informative materials
- Public education - URDA Nature and Technology Park

SOURCE SEPARATE COLLECTION SYSTEM IN THE REGION

EKO laukumu darbības rādītāji 2015.-2020.gadā

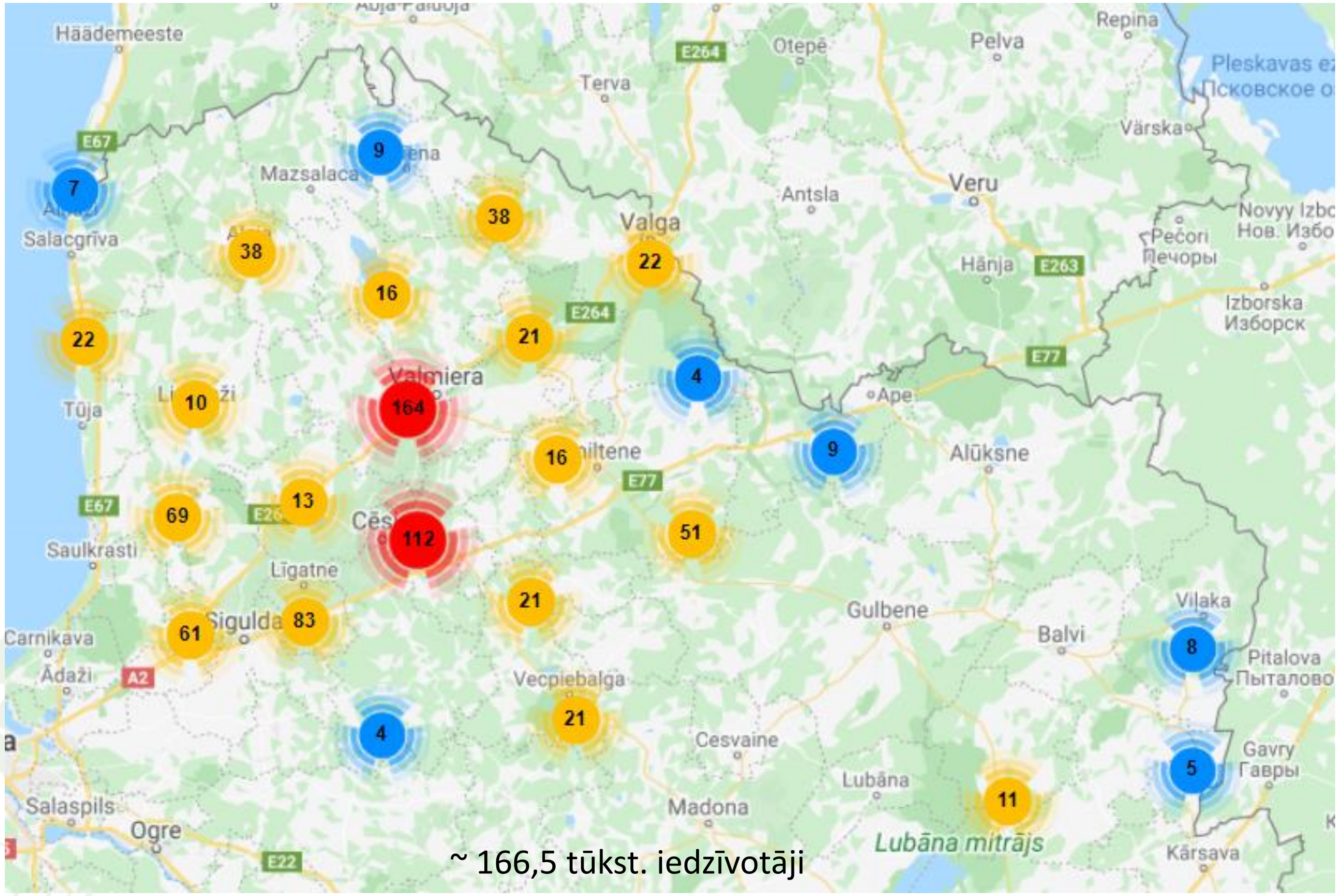


20 EKO laukumi

614 EKO punkti

108 PET režģi

154 konteineri dalītai vākšanai (papīram, metālam, plastmasai, stiklam) 84 vietās



- Additional services for the separate collection of waste
- ECO box in the stairwells of apartment houses
- Environmentally friendly office - for institutions
- Individual separate collection system

SEPARATE WASTE COLLECTION SYSTEM

For private houses in cities

- Container with a yellow lid for used packaging
- Container with black lid for bottle and jar glass
- Service Free of charge

For companies and public institutions

- Container for source separate packaging
- Separate container for glass


ZAAO
Regional waste management center «Daibe»
1
2
3
4
5
6
7
8
9
10
11
12
1 Materiālu uzglabāšanas laukums
2 Laukums tehnikas novietošanai
3 Atkritumu noglabāšanas krātuve
4 Notekūdeņu attīrīšanas iekārta
5 Bioloģiski noārdāmo atkritumu pārstrādes ražotnes komplekss
6 Kompostēšanas laukums asfaltbetona segumā
7 Komposta uzglabāšanas nojume
8 Infiltrāta uzkrāšanas baseins
9 Laukumu lietusūdeņu uzglabāšanas baseins
10 BNA aerobās stabilizācijas (kompostēšanas) iekārtas
11 Perspektīvās ražošanas ēkas
12 Piebraucamais ceļš asfaltbetona segumā

Managing of glass fiber waste in «Daibe» landfill

GLASS FIBER PRODUCTION WASTE

Mains types of glass fibre waste:

- filaments
- nets
- wool




DAIBE ZERO

ATKRITUMU PĀRSTRĀDES
VEICINĀŠANAS HAKATONS

“Air glass technology WOOL2 WALL”

Stikla šķedras

IDEJAS APRAKSTS
Idea description

Valmieras Stikla Šķiedras (Silica wastes) utilization into :

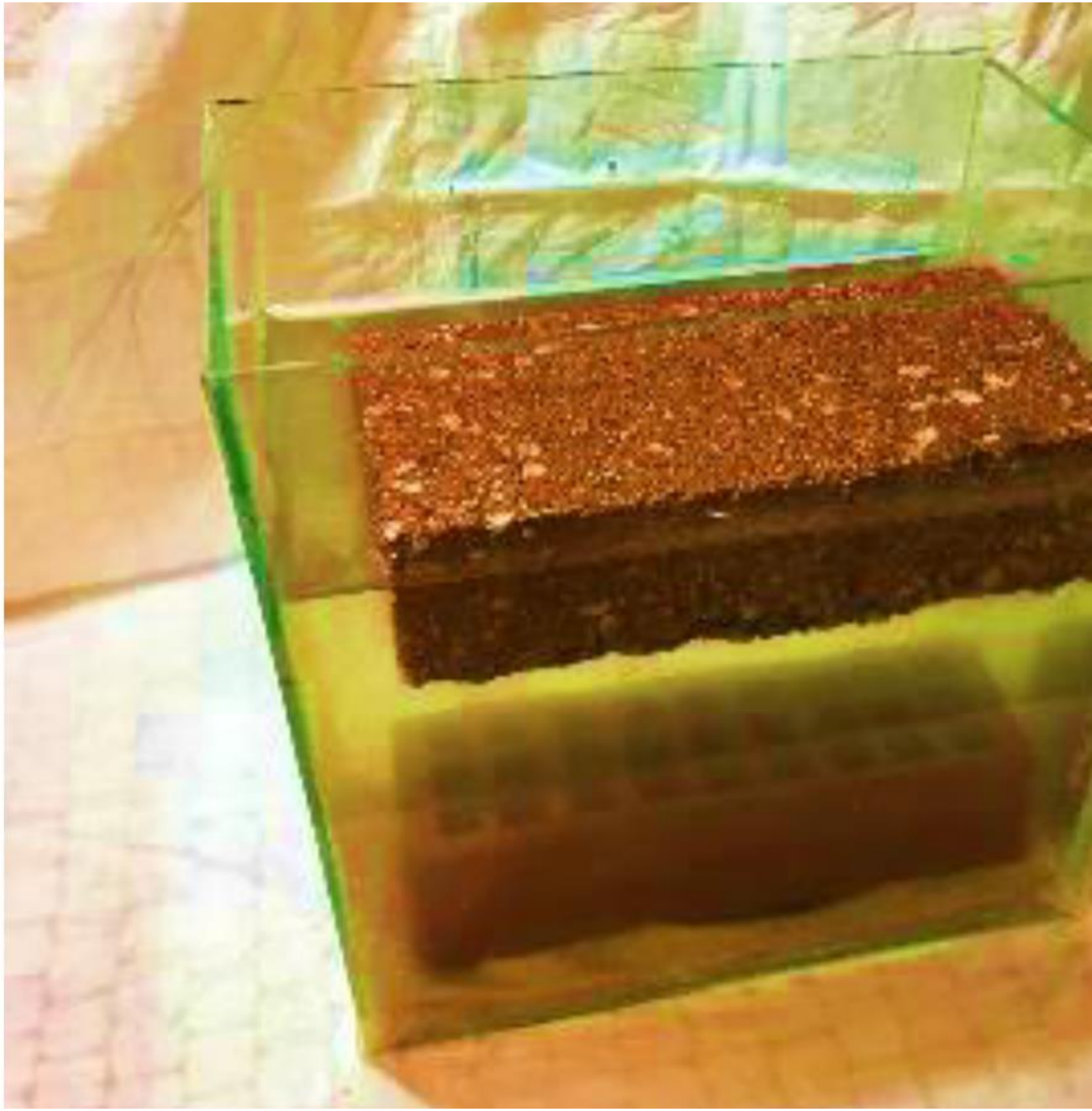
hollow ceramic materials «wool 2 wall»

Offering a new recycling road for glass wool waste – technology to transform glass wool waste to valuable material

New construction and design material bricks and ceramics blocs

Decrease CO_2

Patented product, technology and scalable worldwide



RISINĀJUMA NOVITĀTE (INOVITĀTE)

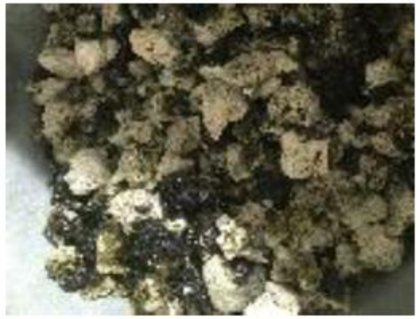
innovation uniquniess / the sample of processing with Valmiera waste glass fiber

Initial Valmiera waste glass fiber

Fiber glass inside crusher

Fiberglass after coarse crusher

Fiberglass mixed with reagents



Raw granules

Foamed granules

Foamed granules covered with clay

Mixture for formation in pressing form

Raw brick

Hollow brick

ZAAO, MSW landfill Daibe

Chief of development
Martins Niklass

martins.niklass@zaao.lv

Sustainability challenge for glass fiber composites prodution

GlassCircle Workshop 2023-09-15

Anders Holmberg. Hitachi Energy, Composites

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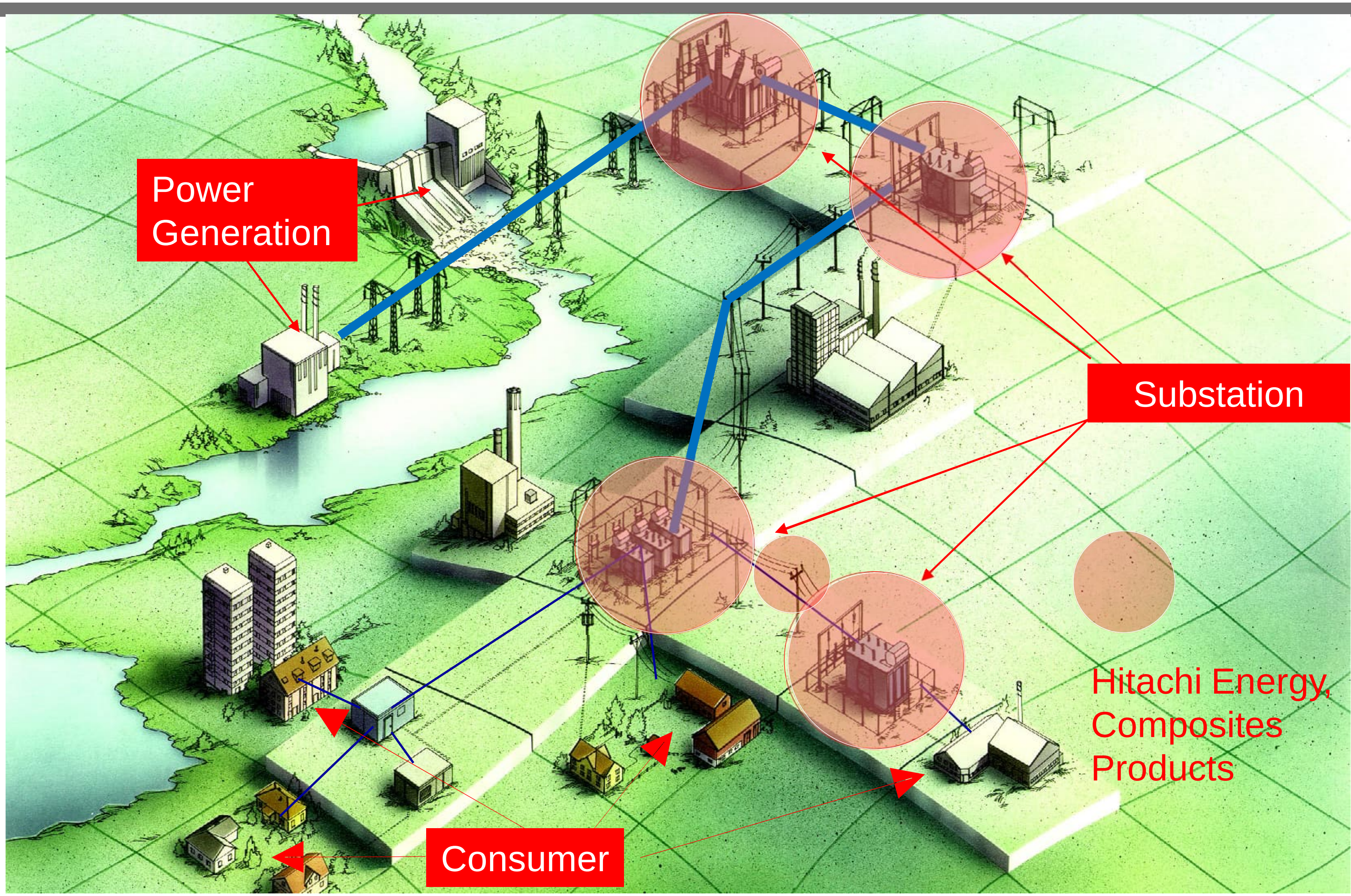
Hitachi Energy

Hitachi Energy, Composites

HITACHI
Inspire the Next

Power Transmission

Power Distribution



Internal
© 2023 Hitachi Energy. All rights reserved.

Hitachi Energy

420 kV substation

Internal
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Hitachi Energy, Composites main products

Glass fiber / epoxy cylinders

Conductive glass fiber / epoxy prepreg tape

Composite Insulators

Composite Utility Poles

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Hitachi Energy company purpose:
Advancing a sustainable energy future for all

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Hitachi Energy sustainability targets 2030

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OUR TARGETS

PLANET	Carbon-neutral in our own operations ↓ -50% CO_2e along the value chain ↓ -50% waste disposed ↓ -25% freshwater use ↓ -25% hazardous substances and chemicals
PEOPLE	Zero harm Top quartile health absence rates Life-long learning culture Increase female diversity from 19% to 25% by 2025
PEACE	Zero incidents of corruption and bribery
PARTNER-SHIPS	Increase involvement in multi-stakeholder partnerships

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LCA Analysis of composite utility pole

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Composite Utility Pole – System boundary

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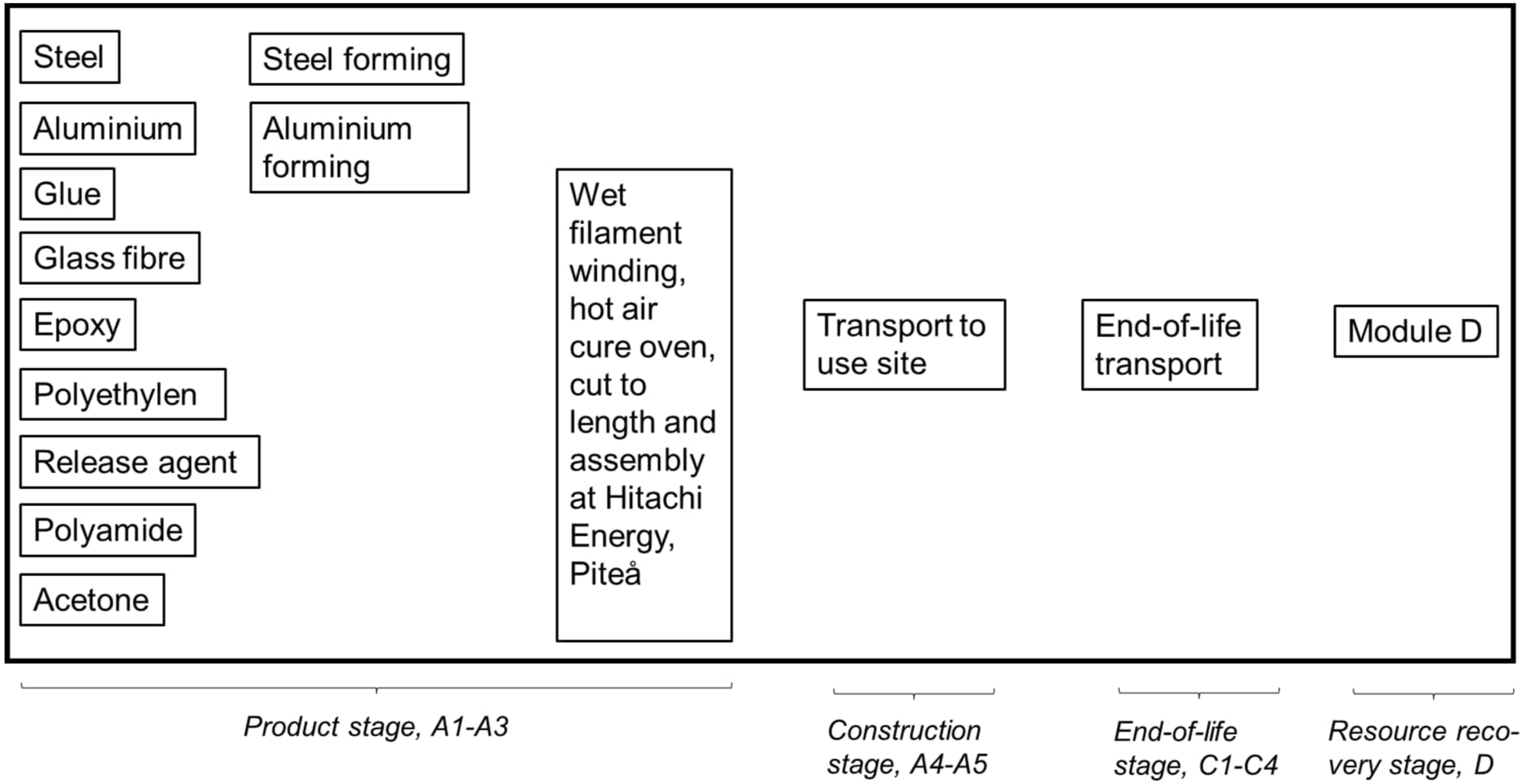

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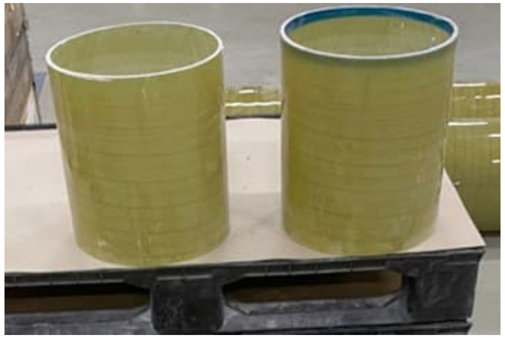
Composite utility pole production

Wet filament winding process

Production waste

Glass fiber roving

Tube ends



Tube cut-offs

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Climate impact of a 12 m Composite Utility Pole

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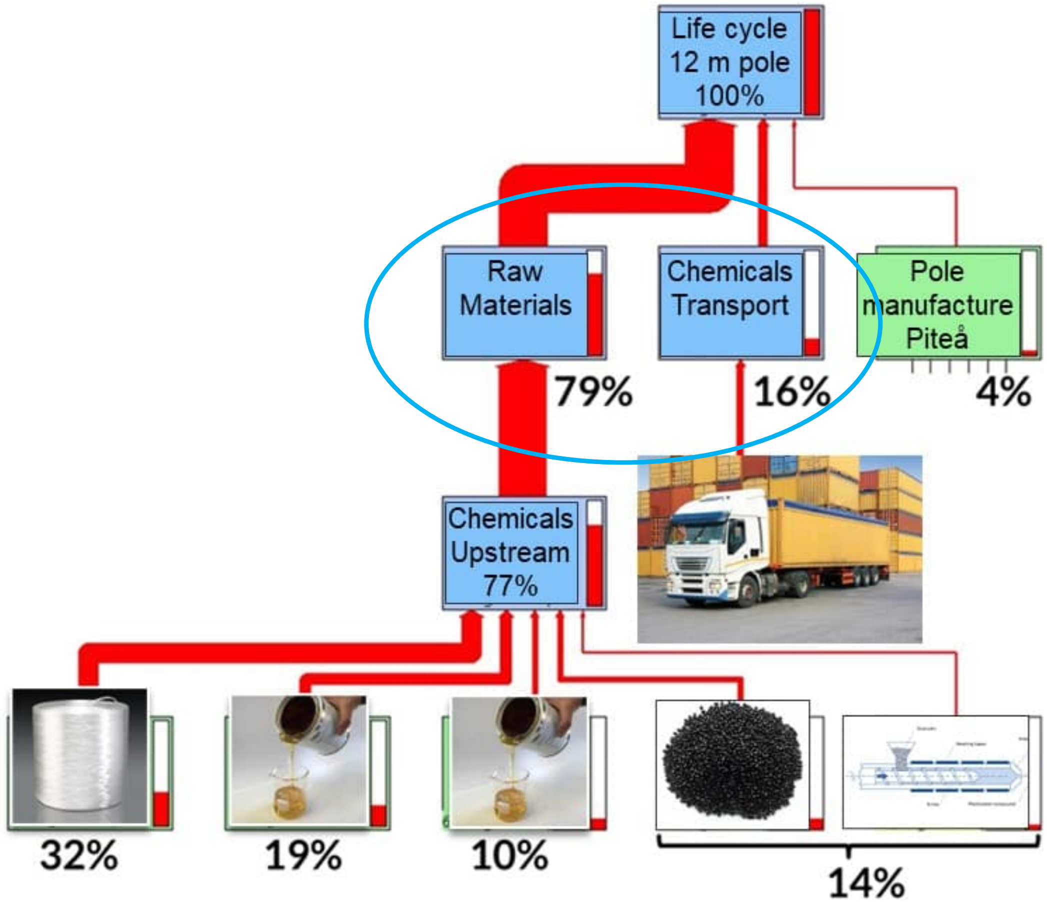

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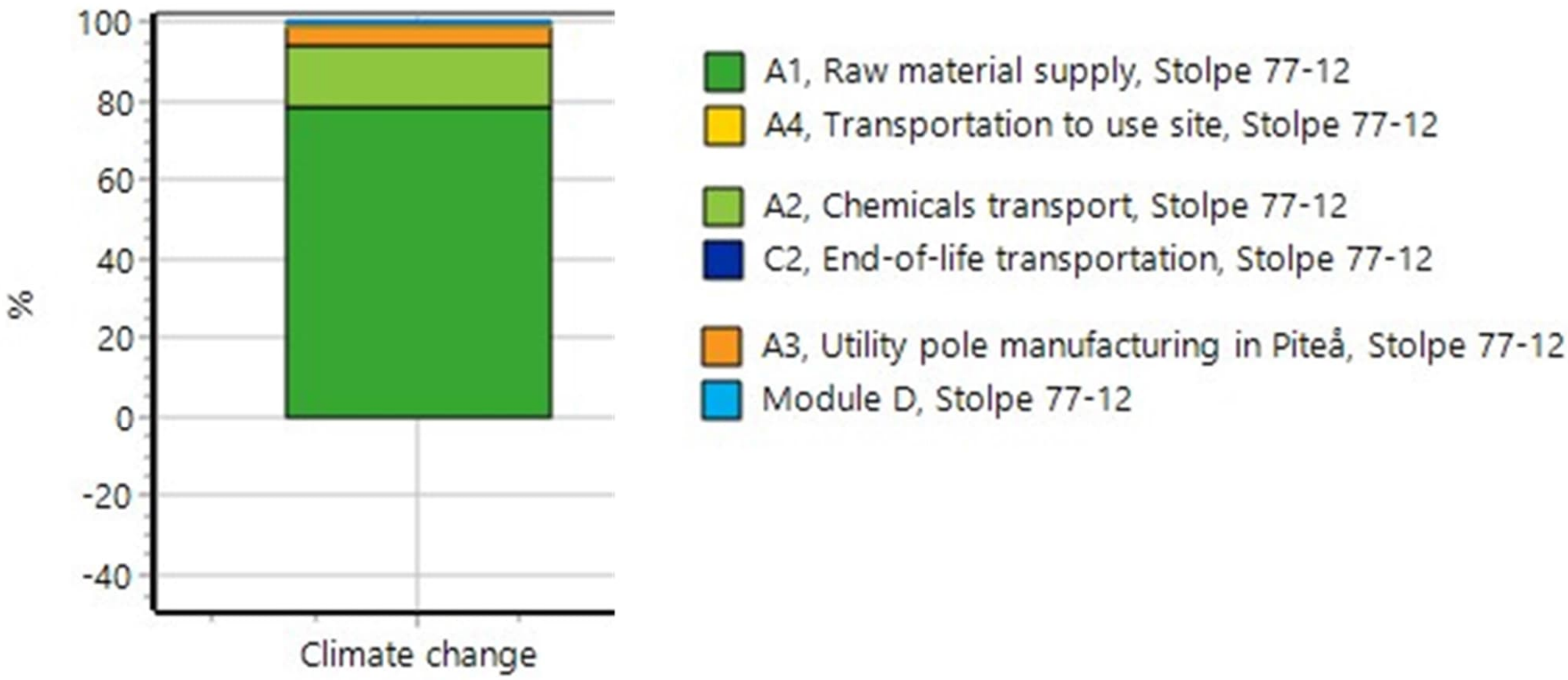

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BOM list of composite utility pole

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Name	Amount in pole* (%)	Spillage and consumables* (%)
Glass fibre roving	71	0.4
Epoxy resin	9	1.5
Hardener	8	1.3
Accelerator	0.1	0.0
Polyethylene	10	0.5
Polyamide	-	0.5
Acetone	-	1.6
Release agent	-	0.0
Steel foot	1	-
Aluminium lid	0.1	-
Total spillage/consumables		5.8
Total weight of pole tube blank	100	
Total weight of cut to length tube	93	7.0

*: Relative to weight of pole tube blank

Opportunities for improvement.

Possible to influence by product optimization and use of materials with higher performance
Reduce production scrap

Influenced by resin selection, process details and operating procedures

Regeneration or substitution of acetone?

Influenced by mandrel length etc.

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Conclusions

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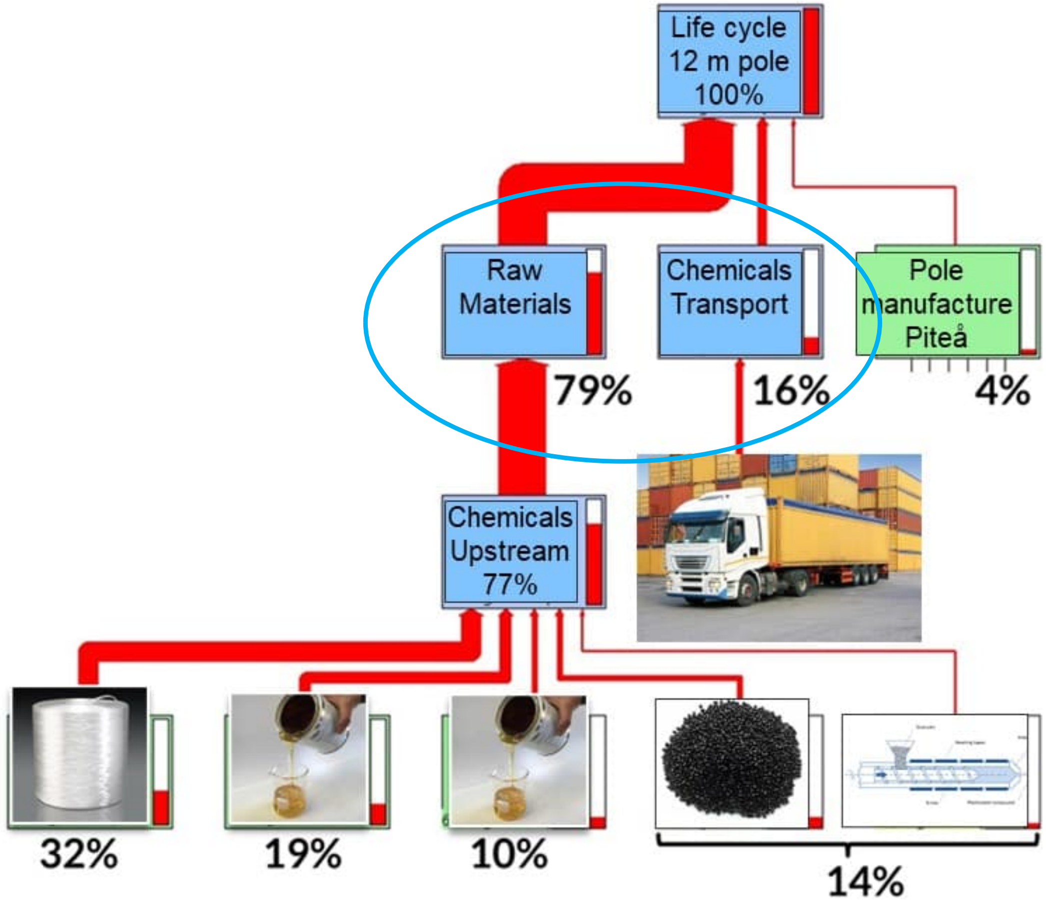

Main GWP impact is from raw materials and transport.

Total elimination of waste & spillage (unrealistic) → 12% reduction of GWP

20% weight saving → further 16% reduction of GWP

Conclusion: > 30% improvement by material suppliers needed.

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Close supplier cooperation will be necessary to reach -50% target

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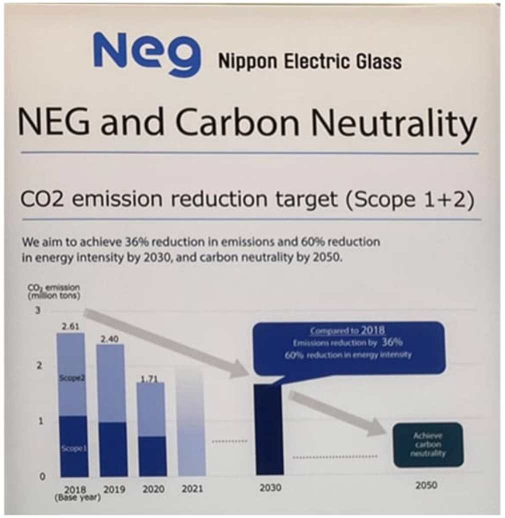

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PODCOMP

Glass fibre use and reuse at Podcomp

GlassCircle

2023- 09-15

Birgitha Nyström
Sustainability coordinator

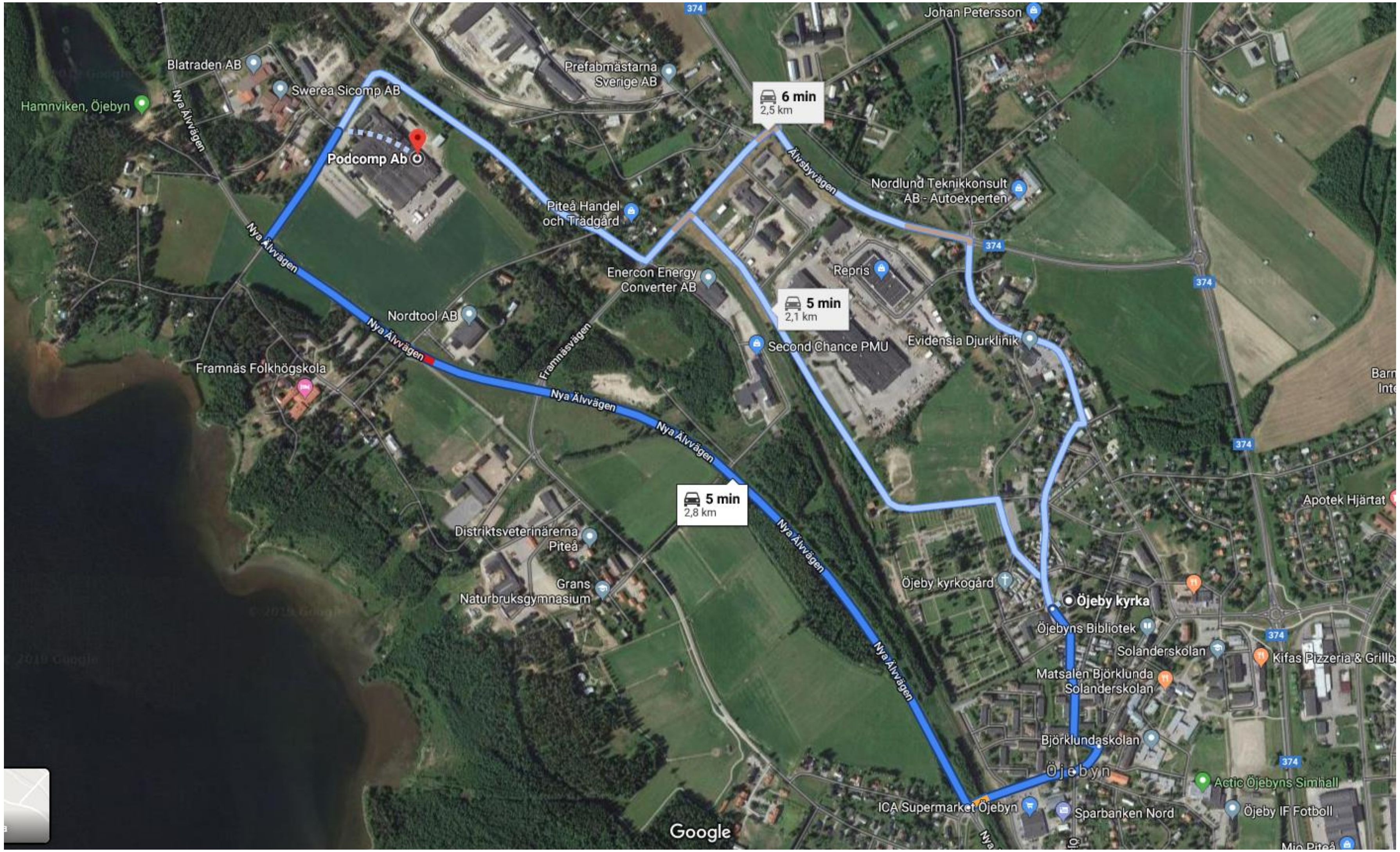
birgitha.nystrom@podcomp.se

Interreg Baltic Sea Region

Co-funded by the European Union

Podcomp on the map and the web

www.podcomp.se



Podcomp & main products

Podcomp is a composite manufacturing company in the north of Sweden

We have expertise in

- Composite materials in general
- Structural design of composites
- Automation and
- High volume production of composites

Our main product: bathrooms are made from glass fibre composite sandwich material

POD COMP

Other products

Flax and carbon fiber & epoxy skipoles for Kang company

Glass fibre/PET/polyester
Bicycle garages

Glass fibre/PET/polyester
Tank for road salt
Special purpose house

Main material used at Podcomp

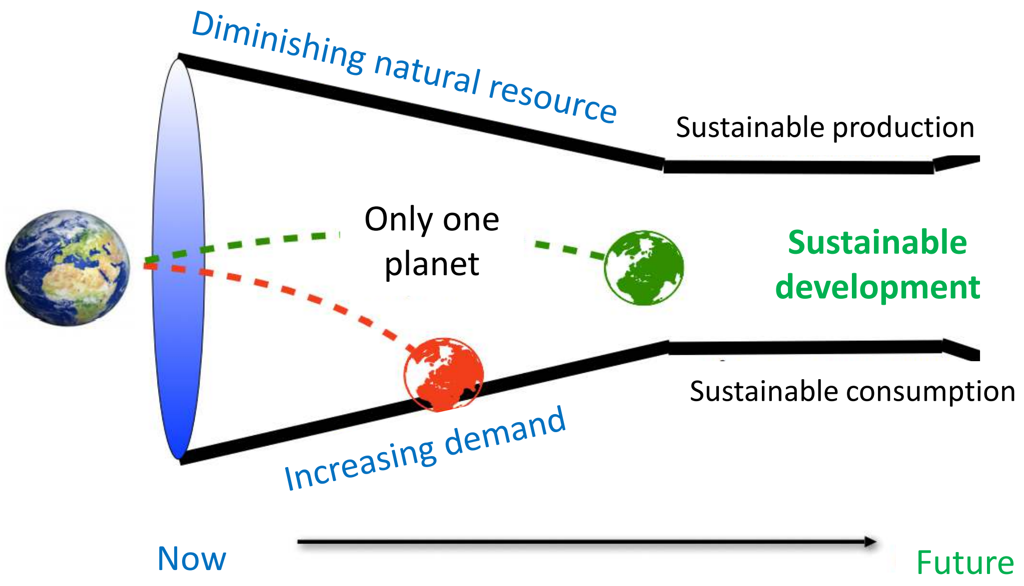
Main material consumption for pods 2022	Amount	
Glasfiber	52,8	%
Polyester	38,0	%
PET	9,2	%
	946	**ton**

Waste to landfill		
Waste to landfill (dry glass fiber, cut-off composite panel)	92	ton

Our motivation to reduce production waste

- Podcomp’s overarching environmental goal is to minimize carbon footprint
- ISO certified quality and environmental management systems 9001 and 14001
- Economic sense to not throw away perfectly good material
- Common sense to preserve resources, on a finite planet resources are not limitless

SP CERTIFIERAD ISO 9001 ISO 14001 Ledningssystem för kvalitet och miljö RI. SE



Why is glass fibre reuse and recycling important?

- Glass fibres constitutes more than 90 % of the composites industries fibre consumption
- Glass fibre reinforces plastics production was 10-12 million tons world wide while carbon reinforced plastics was only 0,14 million tons in 2019 (before pandemic), according to the AVK report, EuCIA - The European Composites Industry Association

Why is glass fibre reuse and recycling important?

- The main constituent in glass fibres is silica sand
- Silica sand is one of the planets most abundant resources
- However – due to increasing demand we risk unsustainable use of sand according to UNEP
- 40-50 billion tons of sand is extracted annually, or 18 kg per person per day, the second most exploited natural resource after water according to UNEP (United Nations environment programme)

Recommendation 8 : Promote resource efficiency & circularity

Summary

Reducing the demand for naturally occurring sand resources, substituting with viable alternatives, and recycling products, and designing products and buildings to extend their usable lifespan will be essential to keep the use of sand within sustainable limits.

UNEP 2022. Sand and sustainability: 10 strategic recommendations to avert a crisis. GRID-Geneva, United Nations Environment Programme, Geneva, Switzerland

How can we use so much??

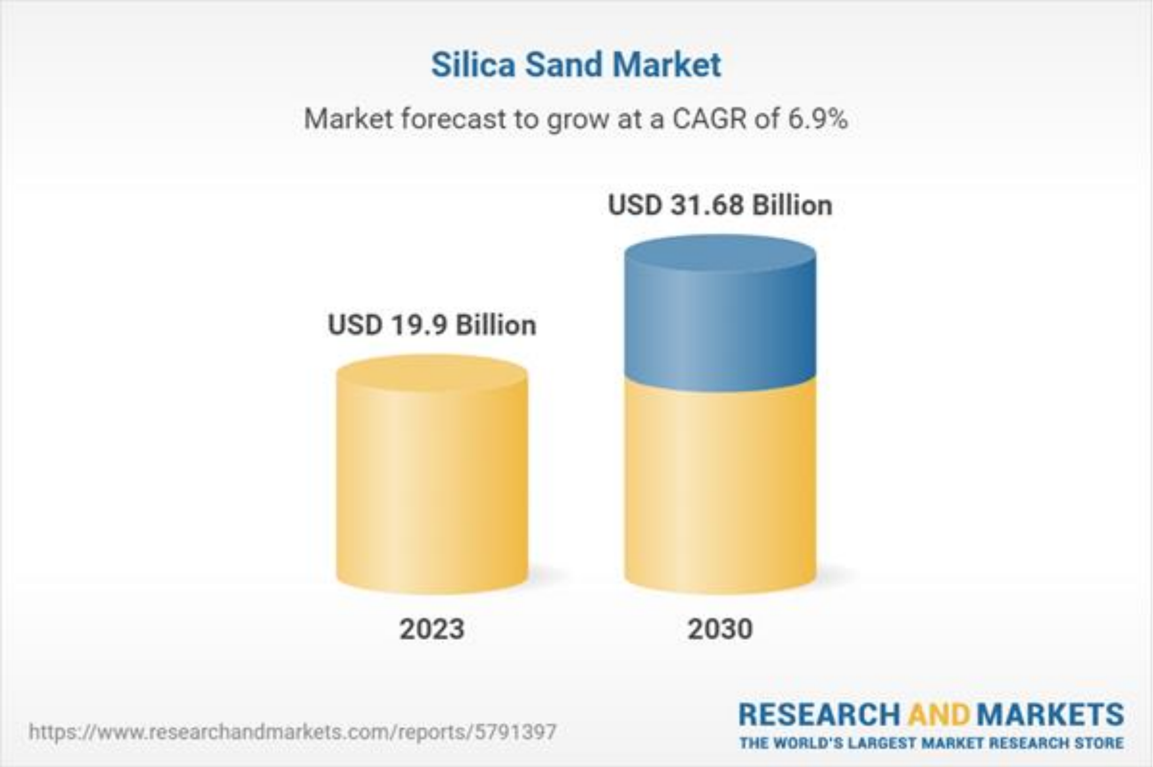
Silica sand has many application areas:

Typical traditional use:

- Golf courses & sports fields
- Industrial abrasives
- Filtration media
- Glassmaking
- Paints & coatings
- Ceramics
- Construction materials

Growing demand in essential sectors in present days:

- Photovoltaic solar panels
- Concentrated solar power
- Wind turbines
- Wind turbine wings
- Wind turbine foundations
- Geothermal reservoirs
- Geothermal heat pumps
- Fracking
- Computer screens, fibre optics, silicon chips



Glass fibre cut-offs at Podcomp-perfectly clean fibres

GLASS FIBRE	Supplier	Surface weight	Type	Glass type	Area weight		Sizing	Bindng thread	Weekly cutoff clean material	Type of cut-off
		g/m²			g/m²	%		%	kg	
Glass fibre fabric	Vitrulan	1700	0/90 NCF	E-glass 2400TEX	912	52,9	For polyester, vinyl ester and epoxy	0,6		Rectangular pieces of varied length and width. Can be several meters with 40-80 cm width.
				E-glass 1200TEX	803	46,6	For polyester, vinyl ester and epoxy			
				Polyester 7,6TEX	10	0,6	For polyester, vinyl ester and epoxy			
					1725				**200**	
Rovicor R300/D37300	Chomarat/ Gazechim		Random	E-glass 2400TEX, 50 mm long fibre	300		Binder 10g/m2	Polypropen 180g/m2	**10**	Irregular shapes

GlassCircle student project work on glass fibre cut-offs – *Transforming glass fibre production cut-offs to artistic or essential everyday products*

For inspiration

One of Podcomp founder’s company, APC, made art for the municipality of Luleå together with designer Ulrica Hydman Vallien

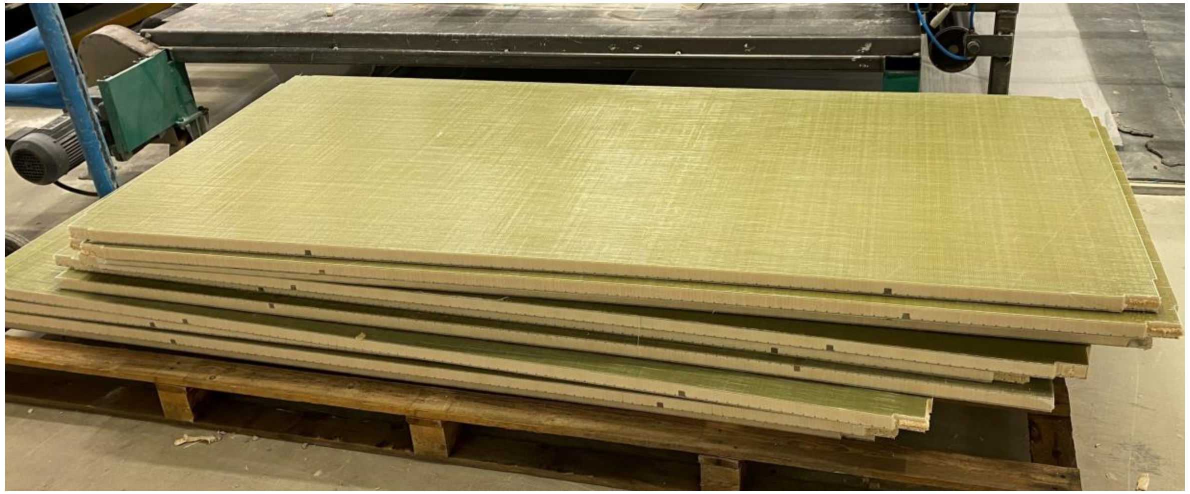
and APC made the entrance bear jaws at Luleå hockey, both from glass fibre and polyester and some core

Vintage glass fibre lamp-shades

With the right epoxy-glass fibre combination composite can be transparent like this bowl

Glass fibre sandwich panel cut-offs at Podcomp

COMPOSITE SANDWICH		Weight	Dimensions	Glass type	Resin type	Core type	Description
			mm w,l, t				
Doorblade	made at Podcomp	13kg/m2	900x2100x30	0/90 NCF	Polyester	PET	From every bathroom a door opening is cut out. We make up to 11 per day.
Ceiling openings	made at Podcomp	7kg/m2	~400x400	0/90 NCF	Polyester	PET	From the ceiling rectangular or squared pieces are cut out for installation of ventilation for example.
Cut-offs	made at Podcomp	Varying	Varying	0/90 NCF	Polyester	PET	From every infusion the ends are cut off. It can be from centimeters to decimeters wide, after the rough edge is cut off.



Door panel

Smaller cut-offs of various size and shape

GlassCircle sparked development of products from cut-offs

GlassCircle student project work on sandwich cut-offs
Innovative design of new products, reusing composite sandwich

Focus on developing efficient production of a product with a smart assembly mechanism

Movie for inspiration

- Minimal amounts of glass fibre was wasted when this building was created
- Making a longlasting product instead of waste should be an environmental benefit
- The alternative is to send the panels to landfill so making a product should be economically feasible, no cost for waste handling and no material cost
- But the new products must also be effectively produced with easy to assemble mechanisms and a system for marketing and selling is needed

Final remarks

- The virgin glass fibres and the virgin glass fibre composite panels that Podcomp can't use in our products should not go to landfill!

- The more composite industries that think this way the bigger the impact

- Demand from a whole range of industries of the rawmaterials for glass fibre makes circular use of glass fibres extremely important!

- GlassCircle and similar initiatives are very important for us as composite industry!

Thank you for listening!

Questions?

Succesful reuse of glass fibre composite sandwich cut-offs in my backyard

Interreg Baltic Sea Region

Co-funded by the European Union

2023

PROJECTS WITH VALMIERA GLASS WASTE FROM PRODUCTION

VALMIERA GLASS®

Approach

/ The applications differing from the use of the first-grade products are mainly considered

/ The markets and the products with lower technical requirements are also evaluated

/ Solutions must be cost and technologically effective

/ Several research projects initiated by the Universities or by the potential customers have been executed.

Coarse E-glass waste

Trimmed edge from construction mesh

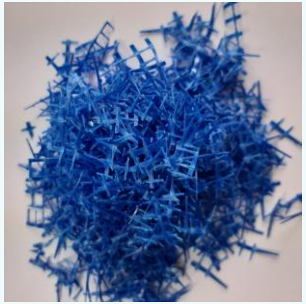
Internal recycling

/ Waste material from production is recycled in non-wovens

/ Recycling of the coarse fibres in the glass melting furnace – project in process, the production equipment is under construction

/ Majority of issues related to organic substances (sizing, finishing) applied on fibers during production processes

/ The rest of the issues are related to the impurities from the storage or transport, e.g.- dirt; as well as the mechanical resistance of the glass-fibres



Outsourced projects

/ Majority of projects executed together with the Universities and the potential customers.

/ Glass fibres as fillers in construction products:

- Concrete pavement and concrete masonry blocks
- Ceramic masonry blocks
- Bituminous mixtures

/ Main issues:

- Chaotic orientation of fibres
- Undefined surface properties of the glass fibre waste
- Low alkali resistance of E-glass
- Low surface friction / adhesion

Future challenges

/ The growing restrictions and the rising costs of the waste storage forces industry to be more active in research of the recycling possibilities

/ The solutions found, mostly, are no cost-effective or commercializable

/ The waste and emission treatment of chemical formulations like sizing, finishing and coating are not the least issues for the glass fibre producers

/ Environmentaly-friendly solution for the desizing and the solutions for waste logistics might be a game-changer for the use of the glass fibre waste in composites

VALMIERA GLASS®

Opportunities

/ The experience and the knowledge shared and gained through the projects like GlassCircle is appreciated by Valmiera Glass and may help in future projects

2023

PROJECTS WITH VALMIERA GLASS WASTE FROM PRODUCTION

VALMIERA GLASS®

Introduction to LCA

CircleGlass Project Meeting

Carmen Cristescu

Swedish University of Agricultural Sciences

2023-09-15

Earth's Carrying Capacity is Not Unlimited

Ability to Meet Our *Needs* Without Compromising the Ability of Future Generations to Meet Their Own Needs.

Brundtland's Commission on Sustainable Development in 1987

Abilities

Industrial Output

Economy

Governance

Societal Needs

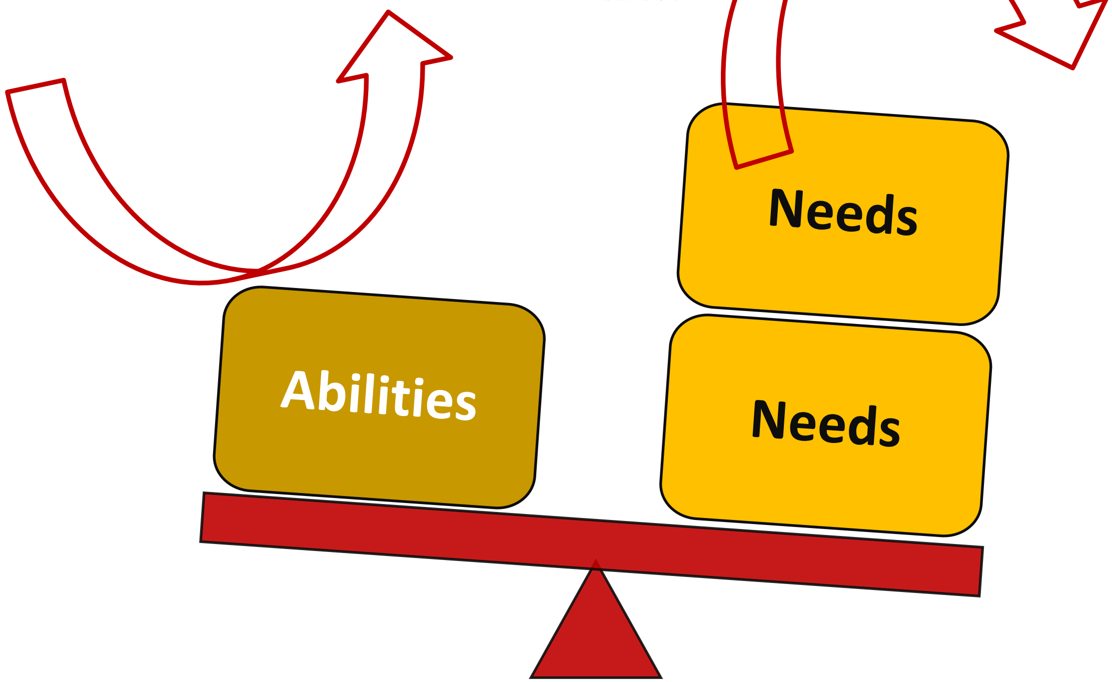
Food

Clothing

Shelter

Balancing Abilities and Needs is a Major Challenge

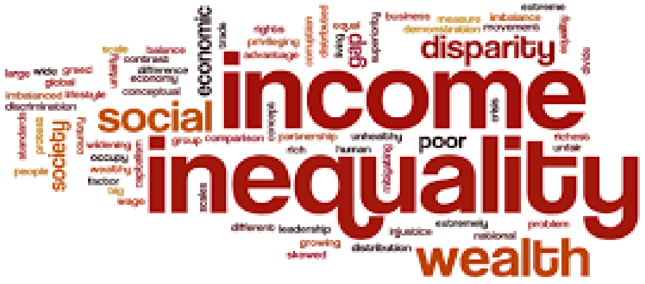
Linear Economies



Growing People

Growing People's Needs

Social Disparity



Why Systems Level Thinking is Important

Each product that we produce or that we buy, each process or service that we acquire, it does not only cost money but it also has an effect on our society, from micro to macro-level

- Resource Depletion (Water, Metal, Fossil Sources etc)
- Pollution (Air, Water, Soil Streams)
- Food Versus Fuel
- Geopolitical Risks
- Social Problems (e.g. Loss of Agriculture Due to Global Warming)

Definitions and purposes of LCA

An environmental management tool that determines the environmental impact of a product or system over certain stages or over its whole life – from production, through use and to recycling, reuse or disposal. It is a comprehensive and robust tool to help decision-making.

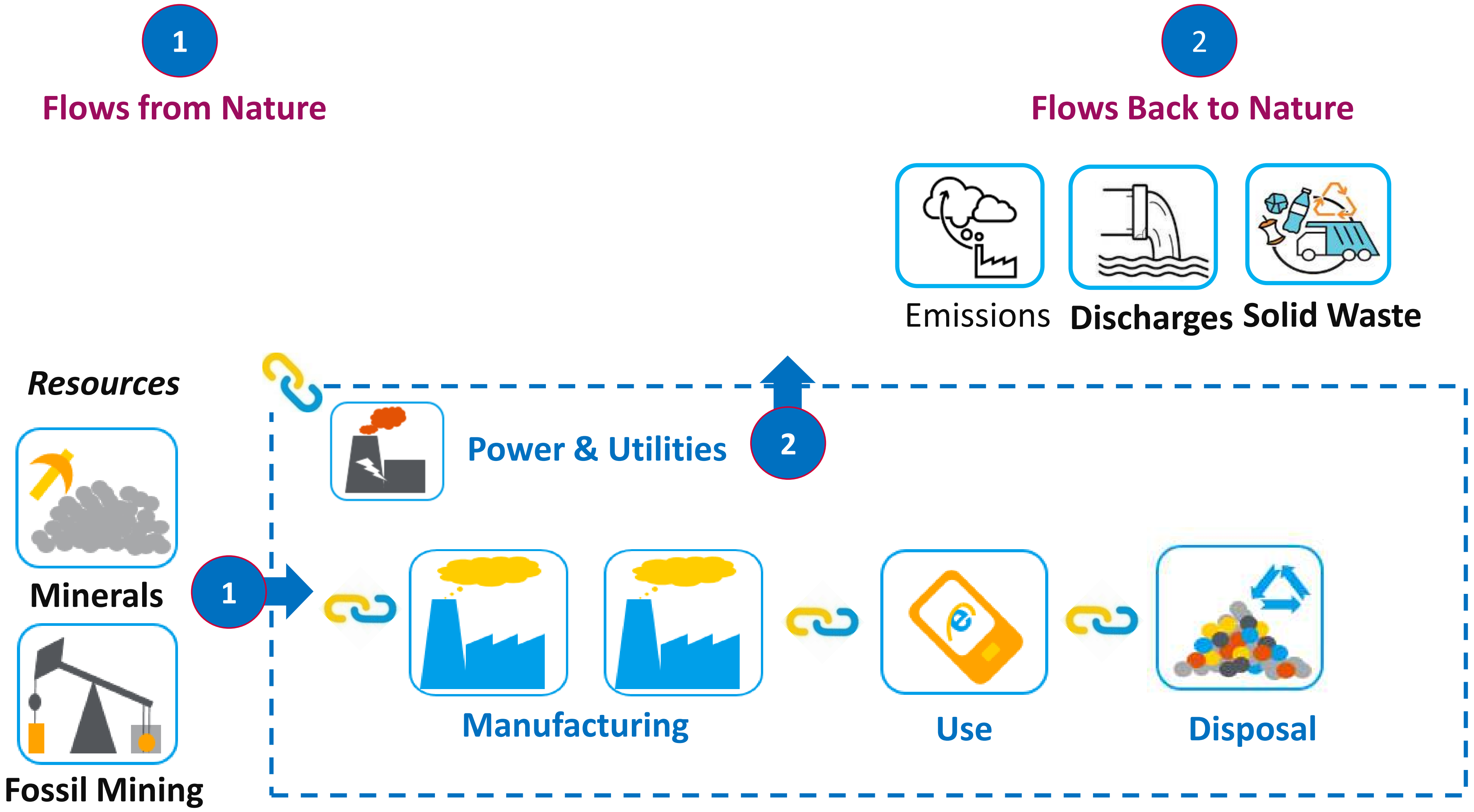
Applications at product level: during 1990s it was mainly used internally

- To identify hotspots in products and systems
- To optimize product and processes

It identifies the solutions that best support sustainable development.

What is Life Cycle Assessment (LCA) in Simple Sense?

Tracking All Interventions Associated with Life Cycle of an Application (e.g. a Product Process, Service etc) and Measuring Their Impact on Environment



LCA is quantitative

Q: ”how much does a product system potentially impact the environment?”

Part of the answer: ”The impact on climate change is e.g. 87 kg of CO2 equivalents”

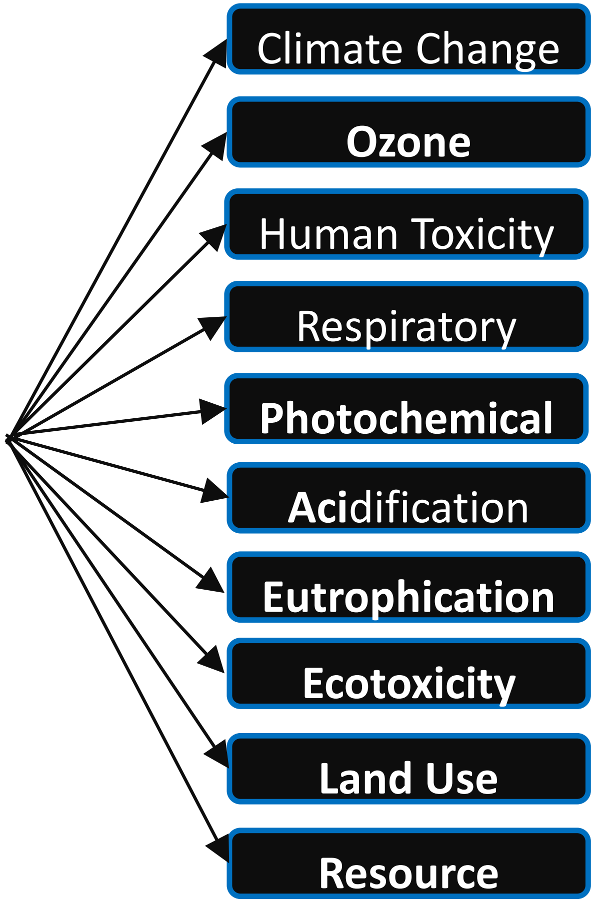
1) Mapping all emissions and resources used and, if possible, the geographical locations of these
2) Use factors derived from mathematical cause/effect models to calculate potential impacts on the environment from these emissions and resource uses

Step 1: involves thousands of emissions and resource uses, e.g. ”0,187 kg CO_2. 0,897 kg nitrogen to freshwater, 0,0000000859 kg dioxin to air, 1,54 bauxite, 0,331 m^3 freshwater”

Step 2: the complexity is reduced by classifying these thousands of flows into a manageble number of environmental issues, typically around fifteen (some of them divided into terrestrial and marine)

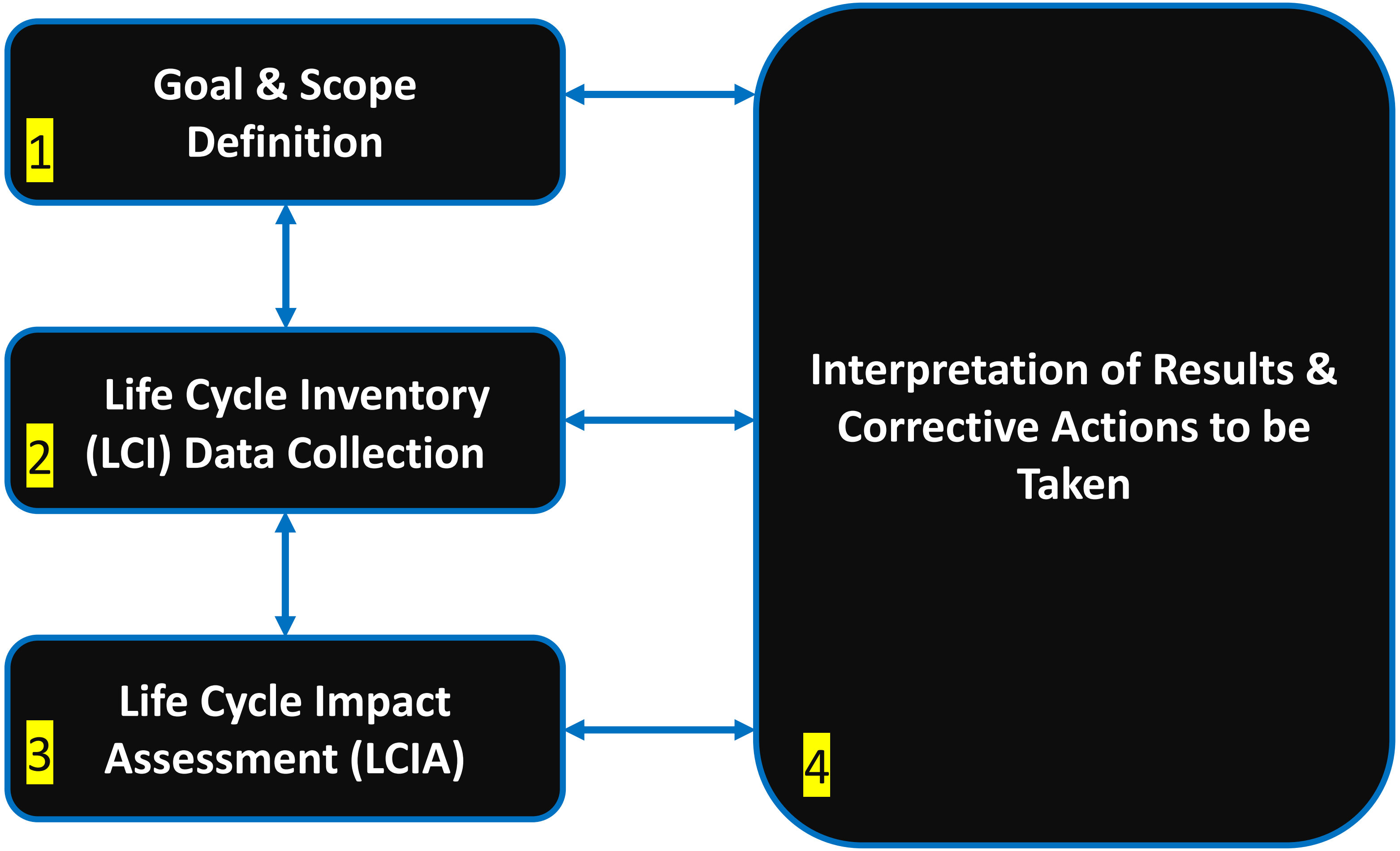
LCA covers a broad range of environmental issues:

Thousands of elementary flows (inventory)



The aim is to avoid burden shifting: efforts for lowering one type of environmental impact unintentionally increase other types of environmental impacts

Life Cycle Assessment (LCA) Steps



LCA Steps According to International Standards Organization (ISO) 14040 Standard

Goal & Scope Definition of LCA

- **What is the System I Wanted to Study? (Functional Unit Definition)**
  - ✓ Product (e.g. Plastic Bottle)
  - ✓ Process (e.g. Paper Making)
  - ✓ Service (e.g. Delivery of Goods via Amazon)
- **What is the Scope of my LCA?**
  - ✓ System Boundary What Life Cycle Stages are Includes
  - ✓ Scope of Study (Stages and Geographical Region)
    - E.g: Plastic bottle produced, used and disposed in European Region
- What are the Environmental Impacts I Wanted Measure?
  - ✓ e.g. Global Warming Potential, Acidification Potential, Eutrophication etc.

Functional Unit of LCA Study

- **Allows to Quantify the Environmental Performance Across the Life Cycle**
- Allows to Compare the Environmental Performance with Other System Having an Equivalent Function

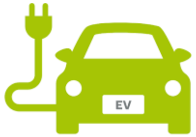
Env. Impacts of Plastic Coke Bottle Manufactured, Use and Landfilled in Europe

In Comparison With

Env. Impacts of Glass Coke Bottle Manufactured, Used and Recycled in Europe

Env. Performance of Driving Petrol Car for its Lifetime of 150,000 km.

In Comparison With



Env. Performance of Driving Electric Car for its Lifetime of 150,000 km.

Carefulness when compairing LCA results of building products

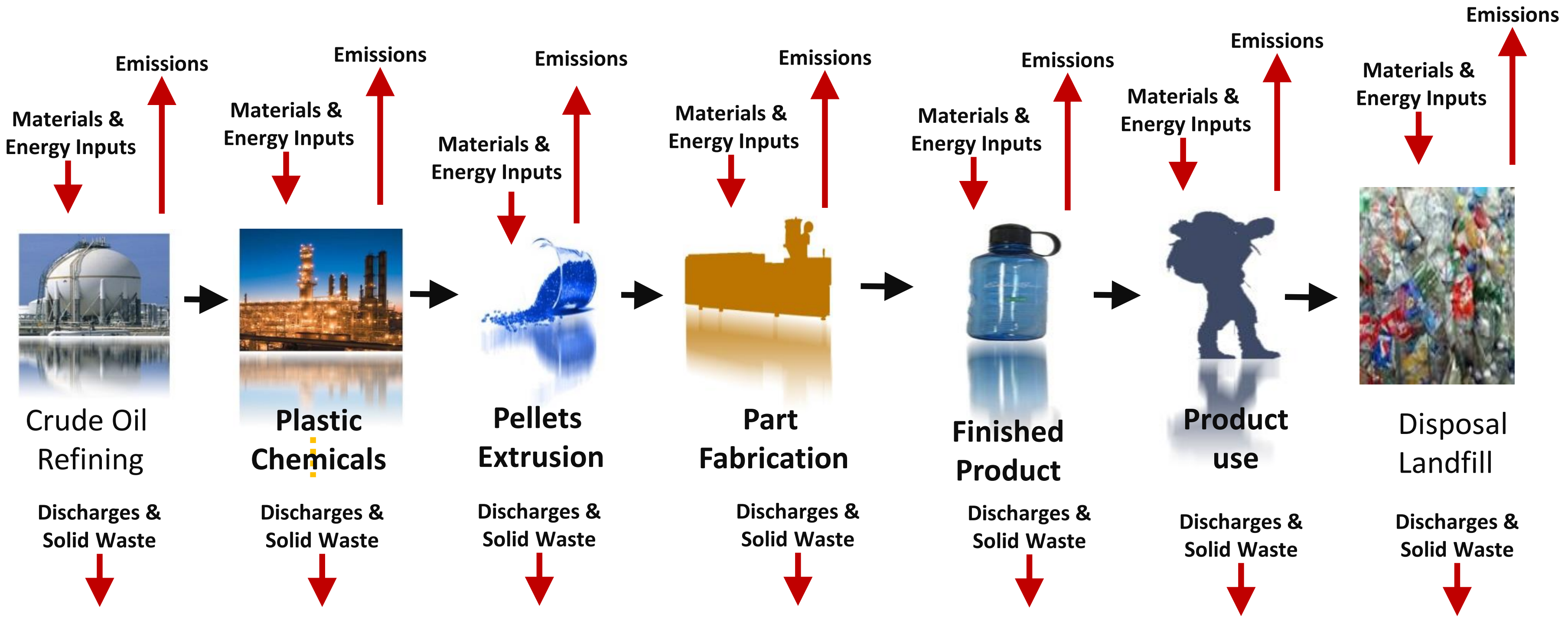
This Environmental Product Declaration (EPD®) describes the environmental impacts of 1 m² of mineral wool with a thermal resistance of 1.0 K*m2 *W-1

The mechanical and physical properties should also be comparable

Example from : EPD of ISOVER Glass wool insulation without facing

https://api.environdec.com/api/v1/EPDLibrary/Files/aca36a16-01fd-44c1-efbf-08d966bc9806/Data

Example of Life Cycle Inventory (LCI) Data Collection



LCI Data Collection Sheet

LCI Data	Amount
Plastic Pellets	75 g.
Energy Consumption for Production of 1 Bottle	1kWH
CO_2 emitted to air	2 g.
Solid Waste Generated (e.g. Packaging Material)	0.5 g.

Sources of Life Cycle Inventory (LCI) Data Collection

- Primary Data (You Collect from Onsite)
  - ➢ High Quality Data but skewed when larger industry perspective need to be understood
- Secondary
  - ➢ Databases: such as Ecoinvent
  - ➢ Environmental Product Declarations of suppliers’ products
- Industry Consortium and Industry Association
  - ➢ World Steel Association for Steel Data
  - ➢ Aluminum Association for Aluminum Data
- Reports, Patents and Academic Literature

SLU

Several databases can be accessed, the most important is Ecoinvent (it gets updated and re-published in a new version every year)

ei ecoinvent

AGRIBALYSE ®

carbonminds

WORLD FOOD LCA DATABASE

Agri-footprint
a Blonk solution

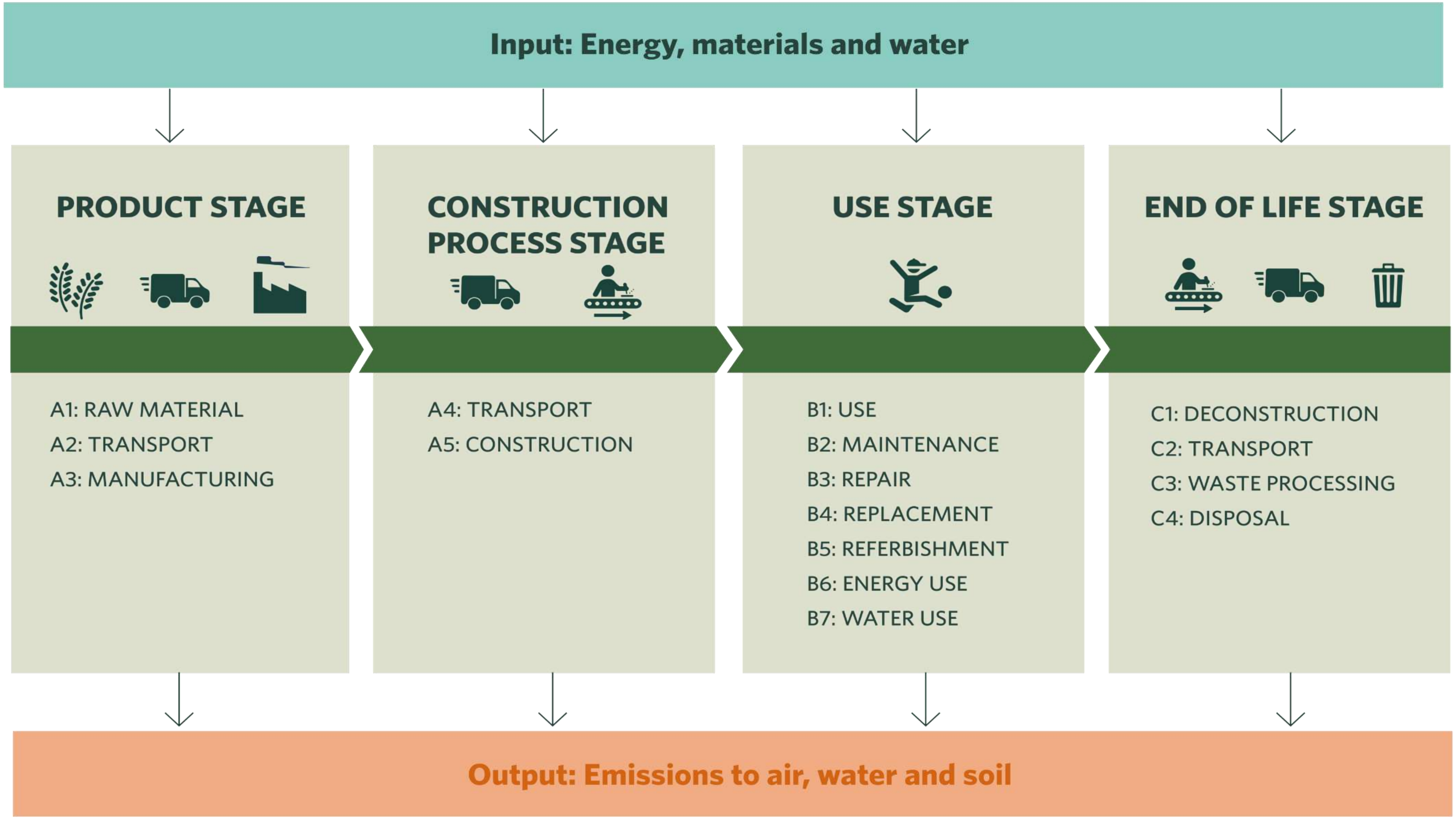
exiobase

shdb social hotspots database

DataSmart
Life Cycle Inventory Package

IDEA

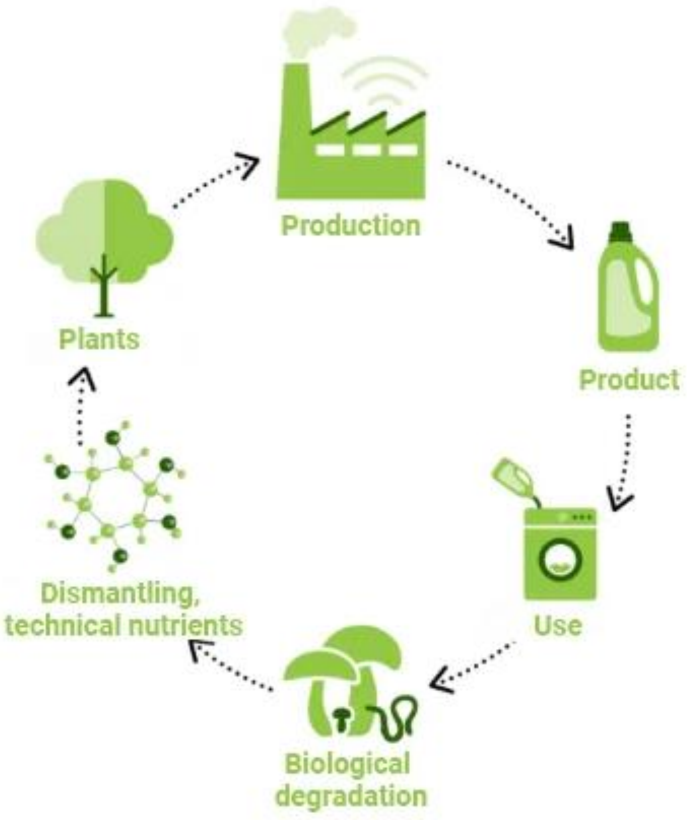
Processes and flows can be modelled in different stages of the life cycle

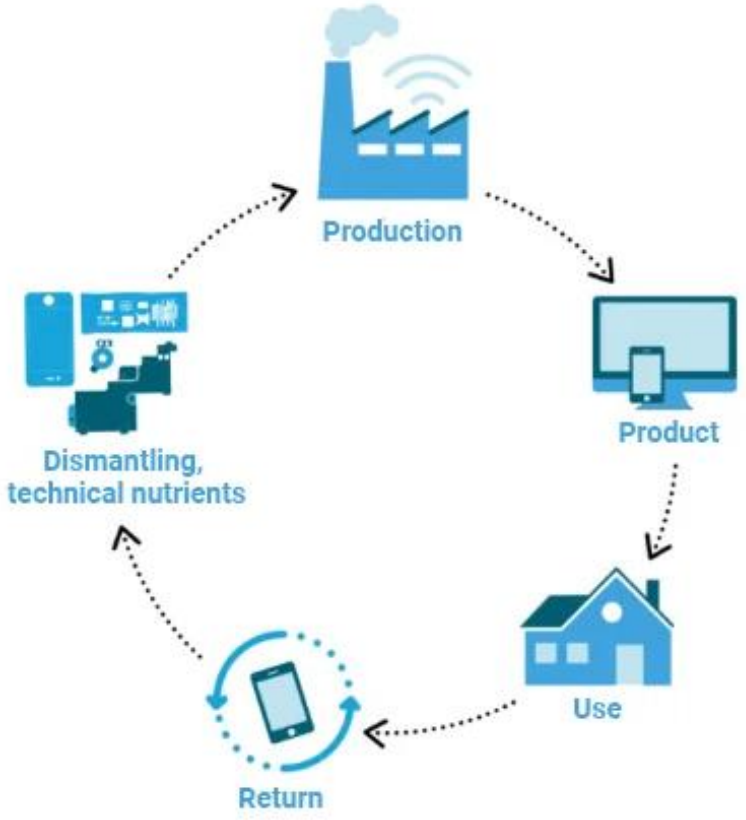


From cradle to gate (from A1 to A3)

From cradle to grave (from A1 to C4)

”Cradle to Cradle” = a system thinking used for design

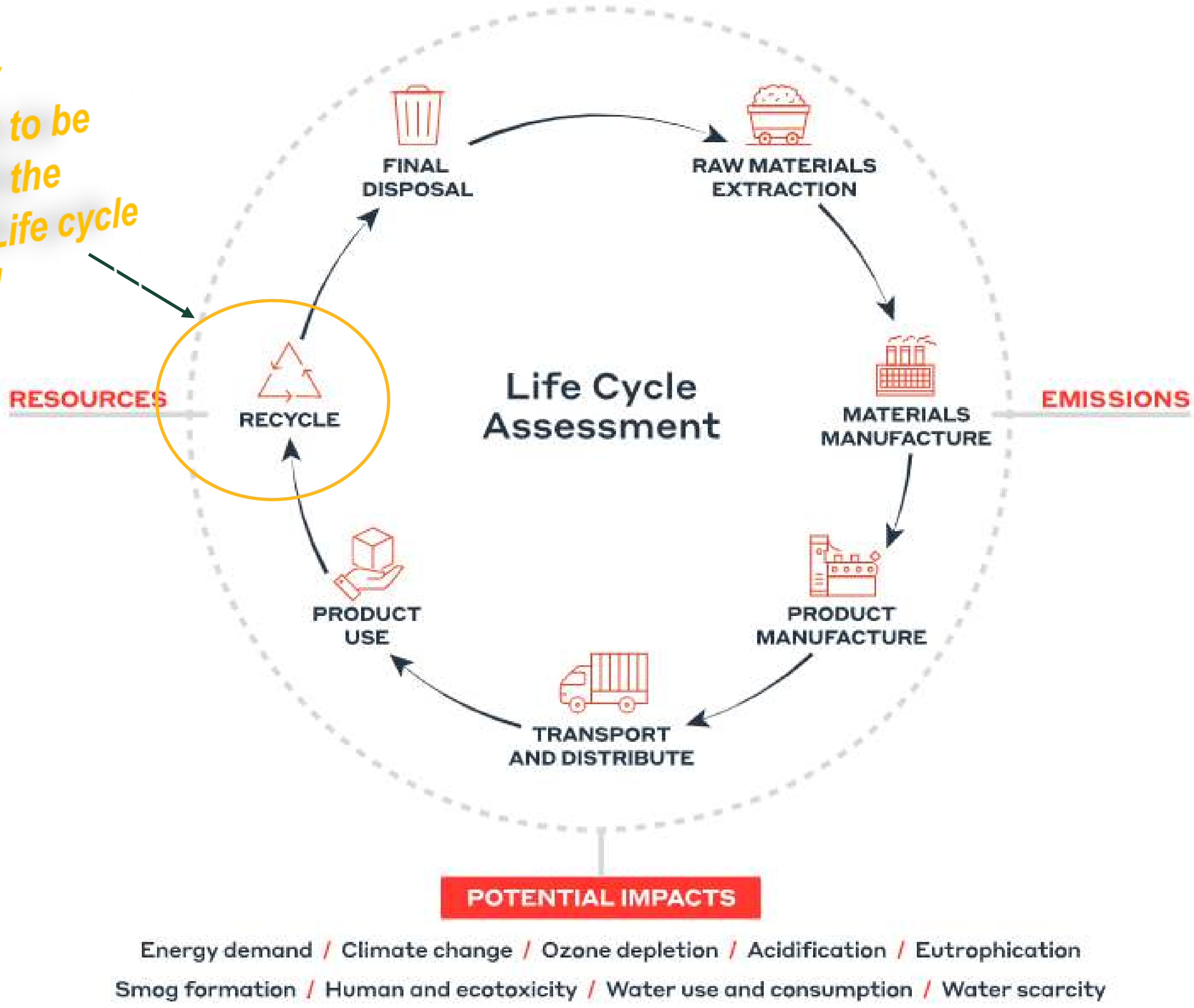




Picture: https://upcyclea.com/en/cradle-to-cradle/

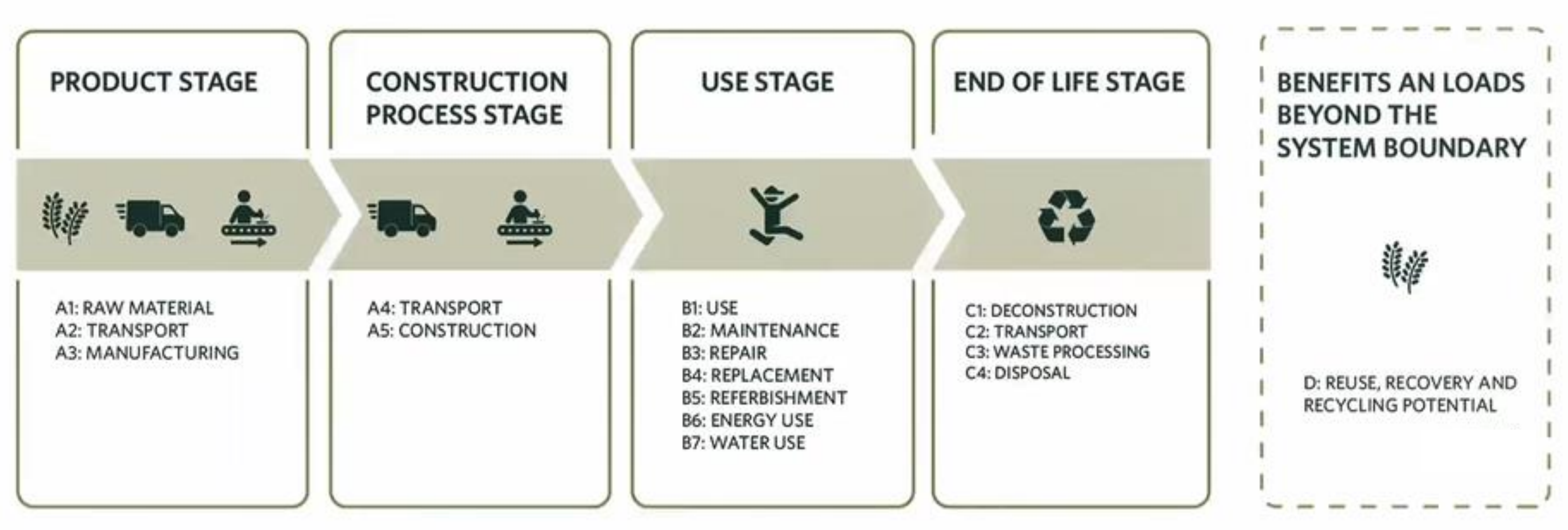
”Cradle-to-cradle” exists also as a product certification

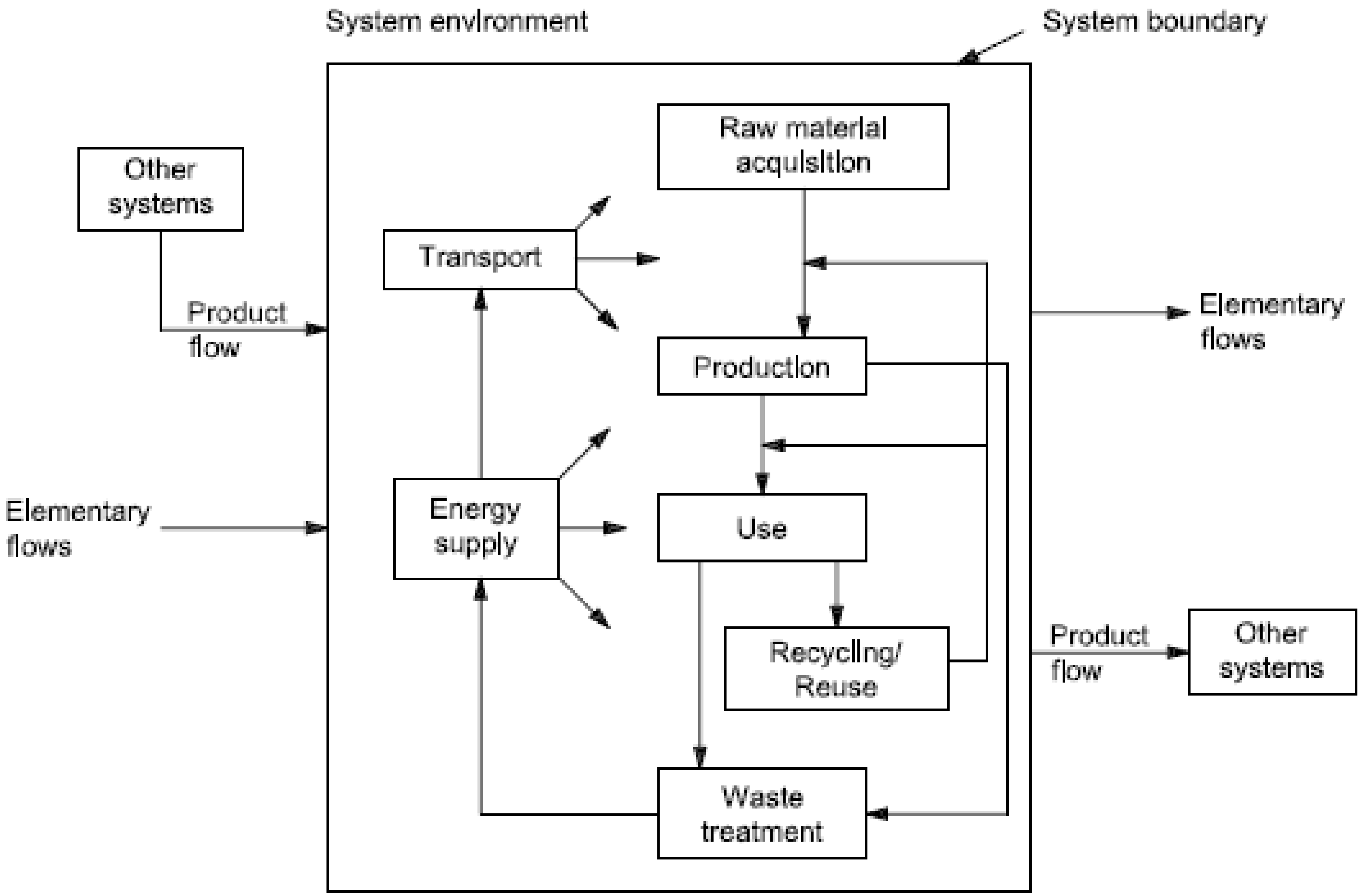
Only recently recycling got to be accounted in the standard of Life cycle of a product!



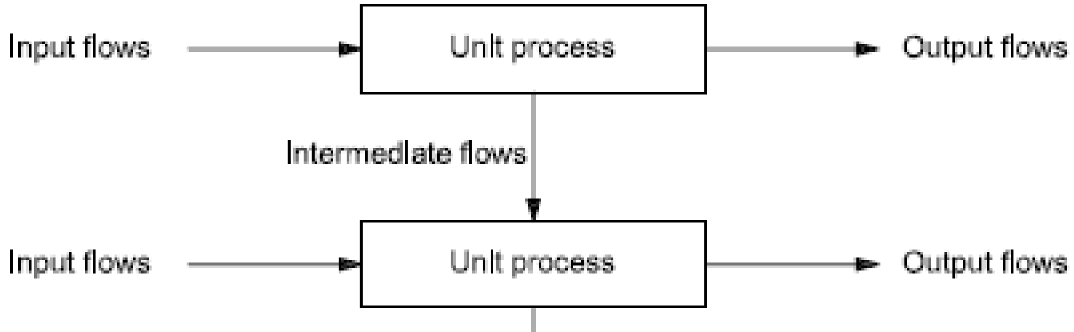
WSP 2022

Since 2019 the standard 15804 for Environmental Product Declarations studying Modul D (which looks at reuse, recovery and recycling potential) is compulsory. But the modul is placed beyond the system boundary:





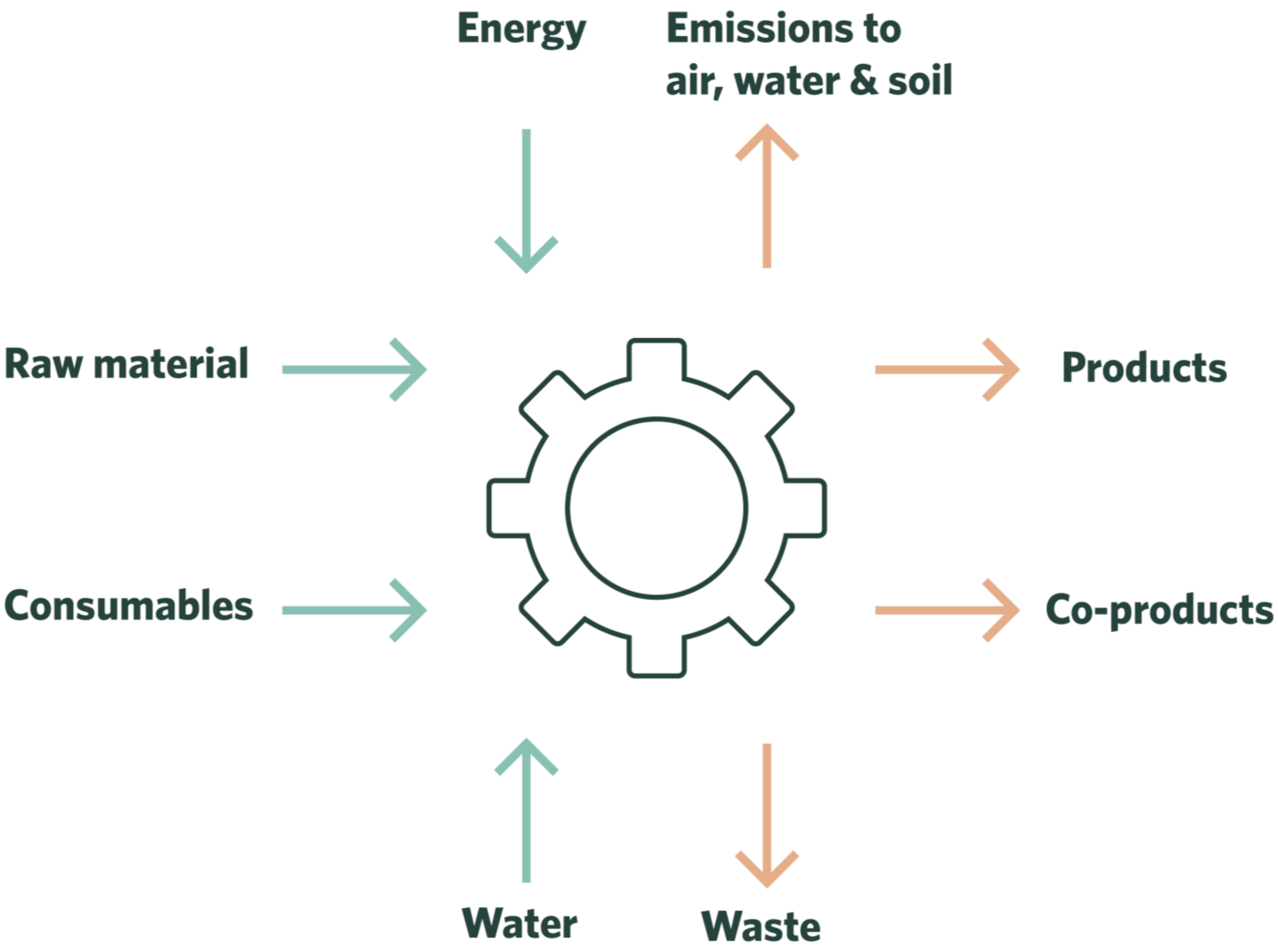
Example of a product system for LCA



https://www.sis.se/api/document/get/46612

SS-EN ISO 14040:2006 (E) Pg.10

Input to each process data set



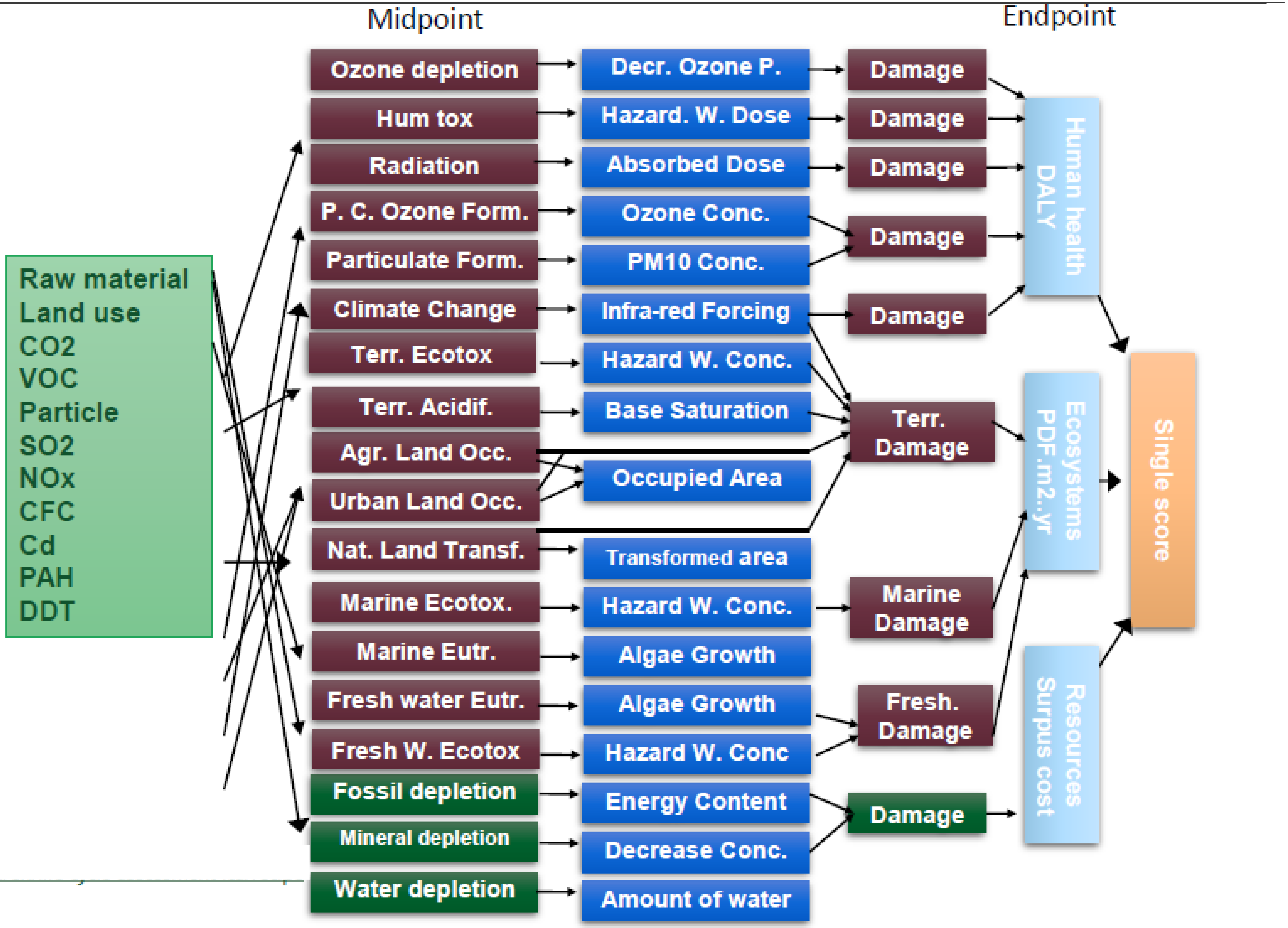
Different countries-different methodologies

Methodology	Developed by	Country of origin
CML2002	CML	Netherlands
Eco-indicator 99	PRé	Netherlands
EDIP97 – EDIP2003	DTU	Denmark
EPS 2000	IVL	Sweden
Impact 2002+	EPFL	Switzerland
LIME	AIST	Japan
LUCAS	CIRAIG	Canada
ReCiPe	RUN + PRé + CML + RIVM	Netherlands
Swiss Ecoscarcity 07	E2+ ESU-services	Switzerland
TRACI	US EPA	USA
MEEuP	VhK	Netherlands

European Commission, Joint Research Centre (2010)

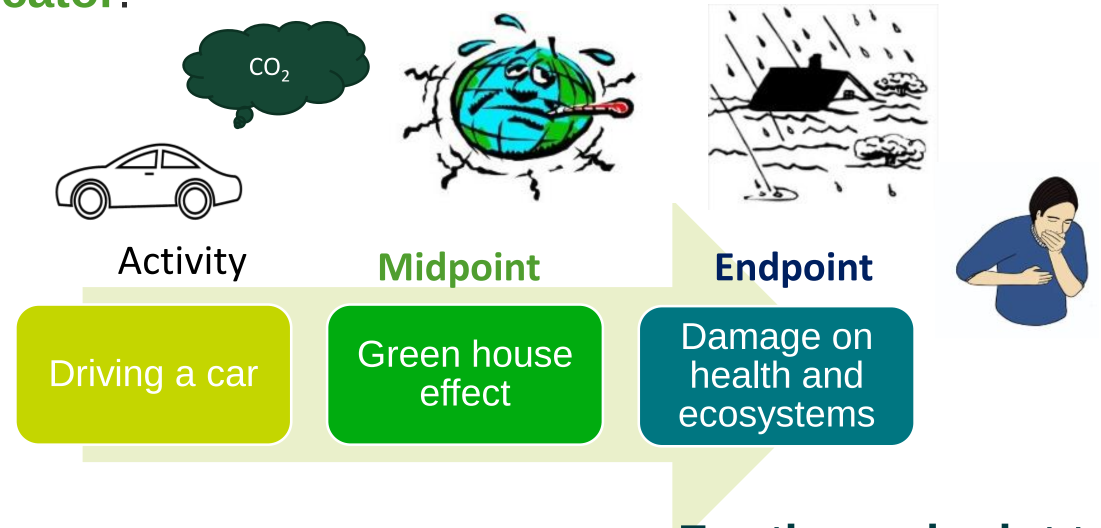
ReCiPe :

a method often used in research and scientific articles



SLU

Midpoint indicators are defined close to the emissions. The different greenhouse gases are expressed in terms of CO_2 equivalents to obtain a climate change indicator.

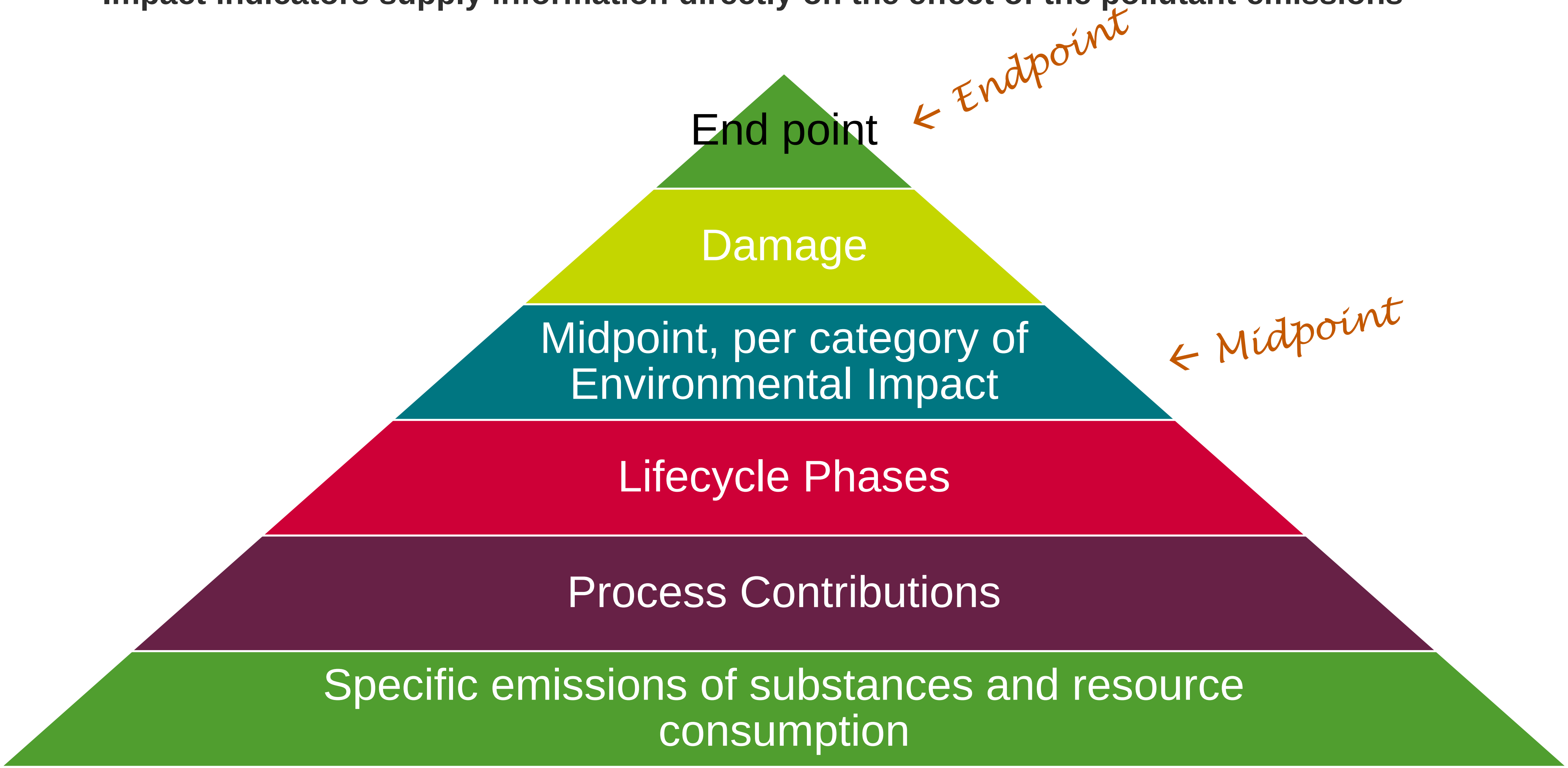


For the endpoint type, the emissions are aggregated at the level of category endpoints, which are variables of direct societal concern, such as: damage to ecosystem quality or damage to human health.

For instance, the effects of the emissions of different toxic substances could be modelled and expressed as a decrease of life expectancy.

Environmental impact aggregated and in detail

Impact indicators supply information directly on the effect of the pollutant emissions



Different sources of energy lead to different results: The cars example

Petrol Car

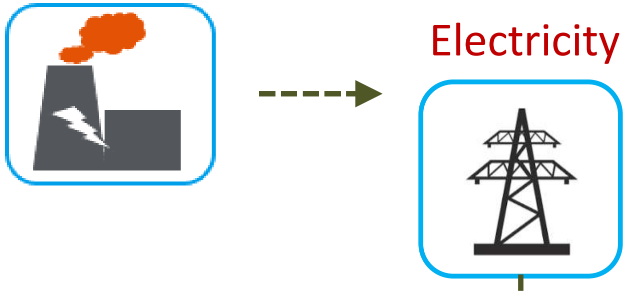
115 g CO_2 emissions / km

Electric Car

0 g CO_2 emissions / km

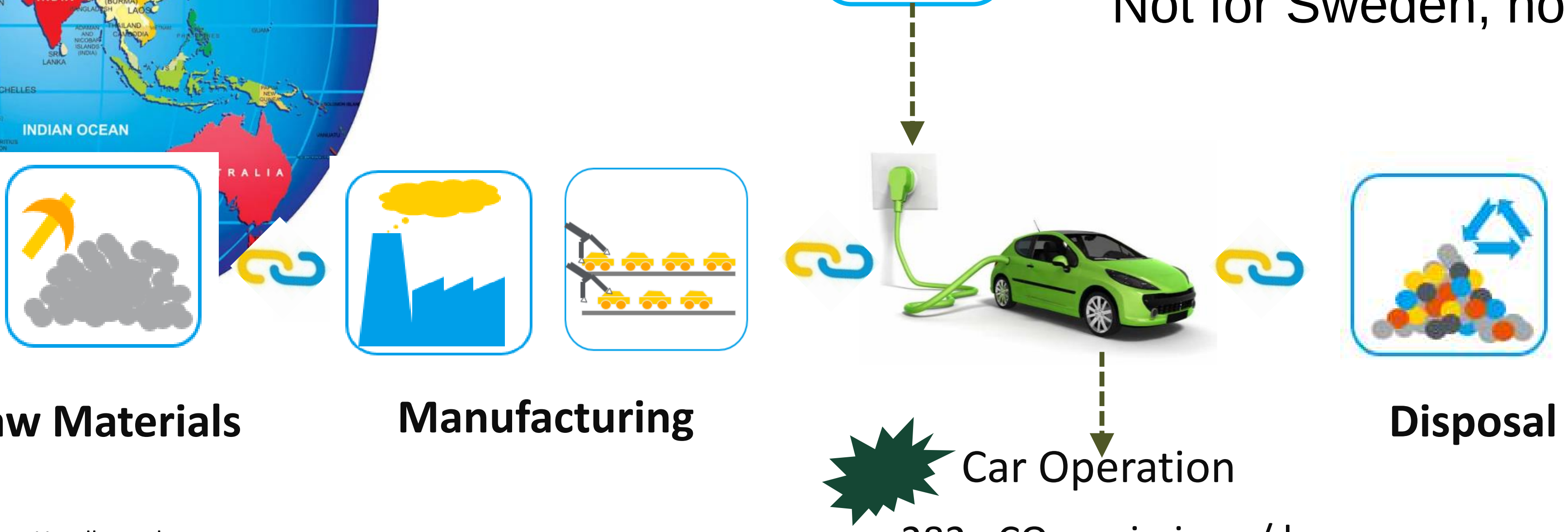
Coal Source

Electricity



The result is representative for India.

Not for Sweden, not for Denmark



Raw Materials **Manufacturing** **Disposal**

Car Operation

282 gCO_2 emissions / km

Krishna Upadhyayula
Umeå University & Scania

How LCAs and EPDs are Done?

➢ LCA Software

- ✓ **SimaPro – most used worldwide, first version released 1990 (in Netherlands)**
- ✓ GaBi – first commercial LCA software, first version released 1989
- ✓ **OpenLCA**
- ✓ Umberto
- ✓ **Excel**

SLU

Thank you for your attention!

Carmen Cristescu

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Department of Forest Biomaterials and Technology

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SCIENCE AND EDUCATION FOR SUSTAINABLE LIFE

ZAG

ZAVOD ZA GRADBENIŠTVO SLOVENIJE

SLOVENIAN NATIONAL BUILDING AND CIVIL ENGINEERING INSTITUTE

WOOL2LOOP

RW/GW→ AAM
LCA

Waste mineral wool upcycled into alkali-activated façade panels and cobblestones

with step-by-step Life Cycle Analysis

from Wool2Loop to GlassCircle

GlassCircle workshop Hackathon, Herning, Denmark

B. Horvat, D. Kvočka, F. Knez, V. Ducman

barbara.horvat@zag.si, davor.kvocka@zag.si, friderik.knez@zag.si, vilma.ducman@zag.si

The Department of Materials

Laboratory for Stone, Aggregates and Recycled Materials (420)

September 14th-15th 2023

Pilot products

We are always happy to collaborate!

Contact:
- alenka.mauko@zag.si,
- primoz.oprckal@zag.si
- vilma.ducman@zag.si

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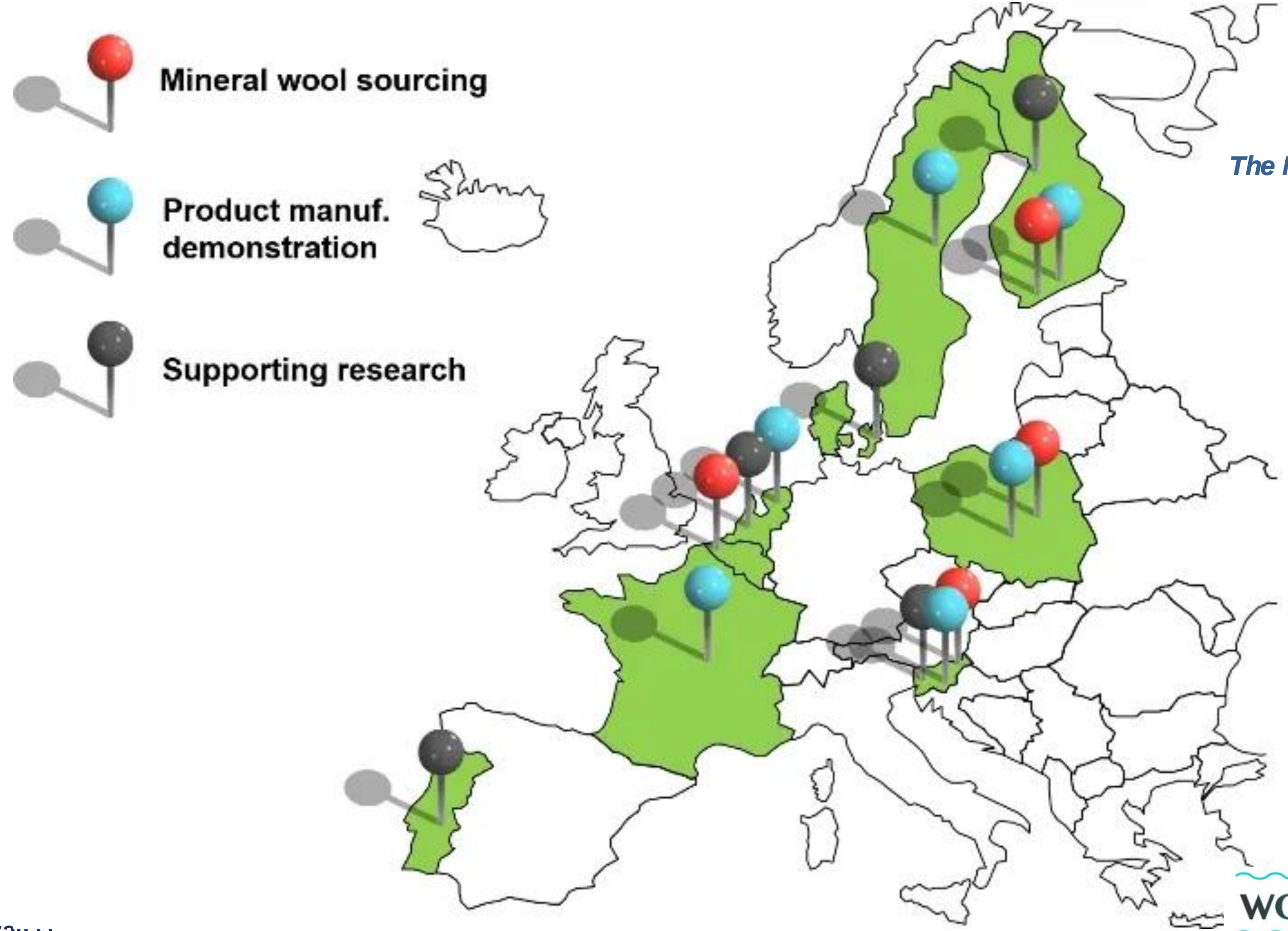
Horizon 2020 - 9 countries, 14 consortium partners



Belgium: 1
Denmark: 1
Finland: 3
France: 1
The Netherlands: 2
Poland: 1
Portugal: 1
Slovenia: 3
Sweden: 1

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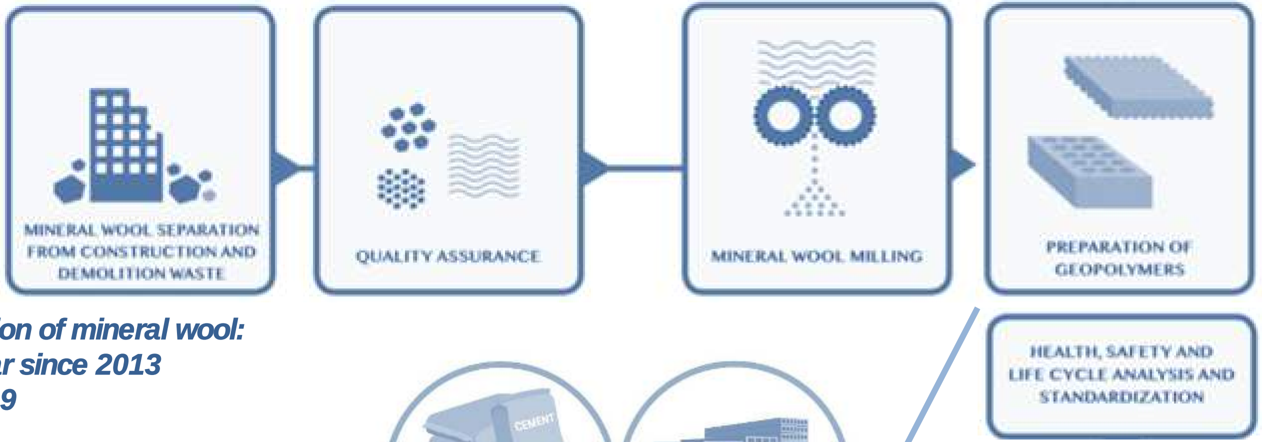
W2L Horizon 2020



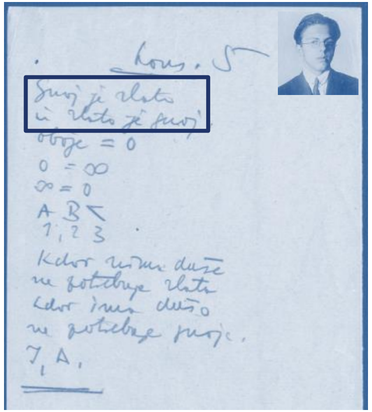
Global production of mineral wool:

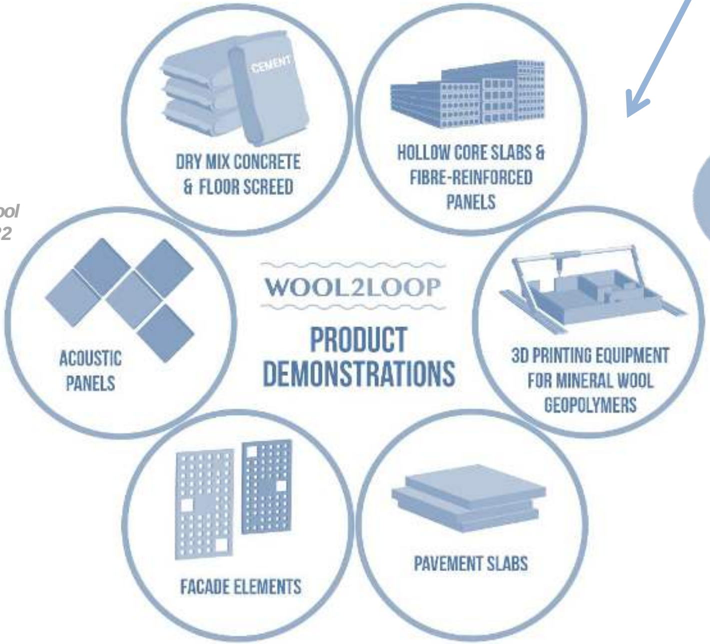
- ***+1.8 m%/year since 2013***
- ***19 Mt in 2019***

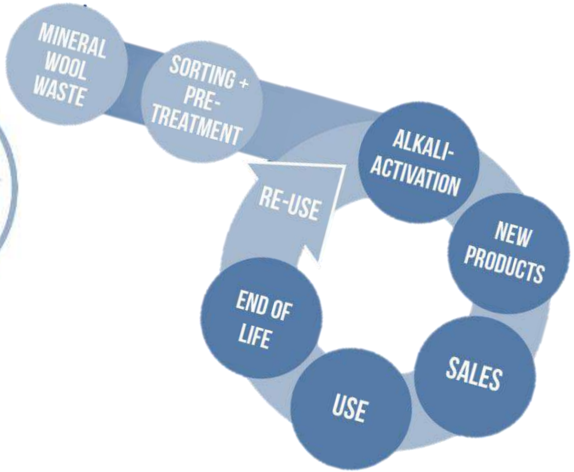
Waste mineral wool:

- ***Austria: 20-30 Kt/year***
- ***EU (calculated): 1-1.5 Mt***

Fibre Reinforced Alkali-Activated Rock Wool
doi.org/10.18690/um.fkkt.2.2022







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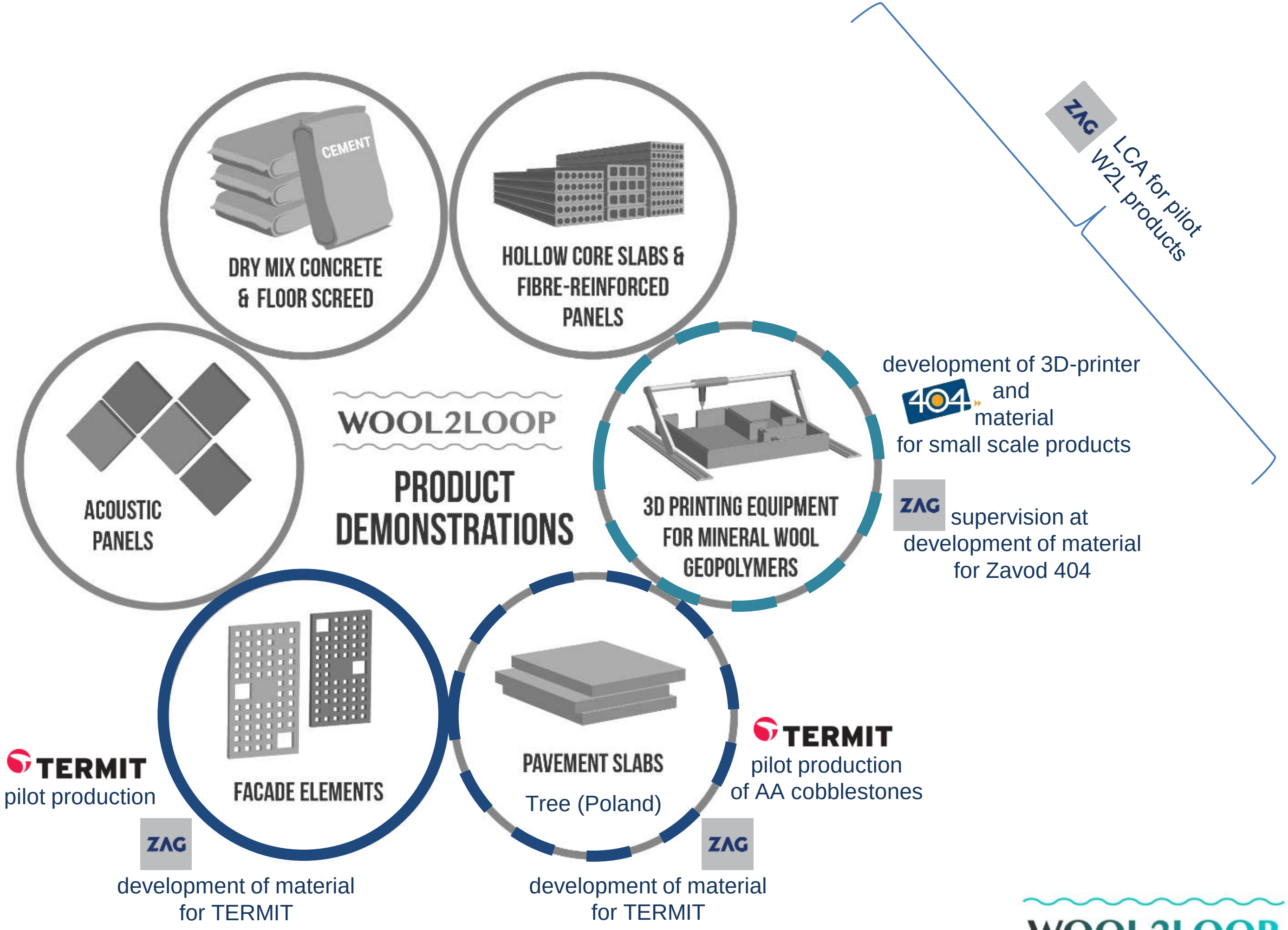
Horizon 2020 - products from Slovenia



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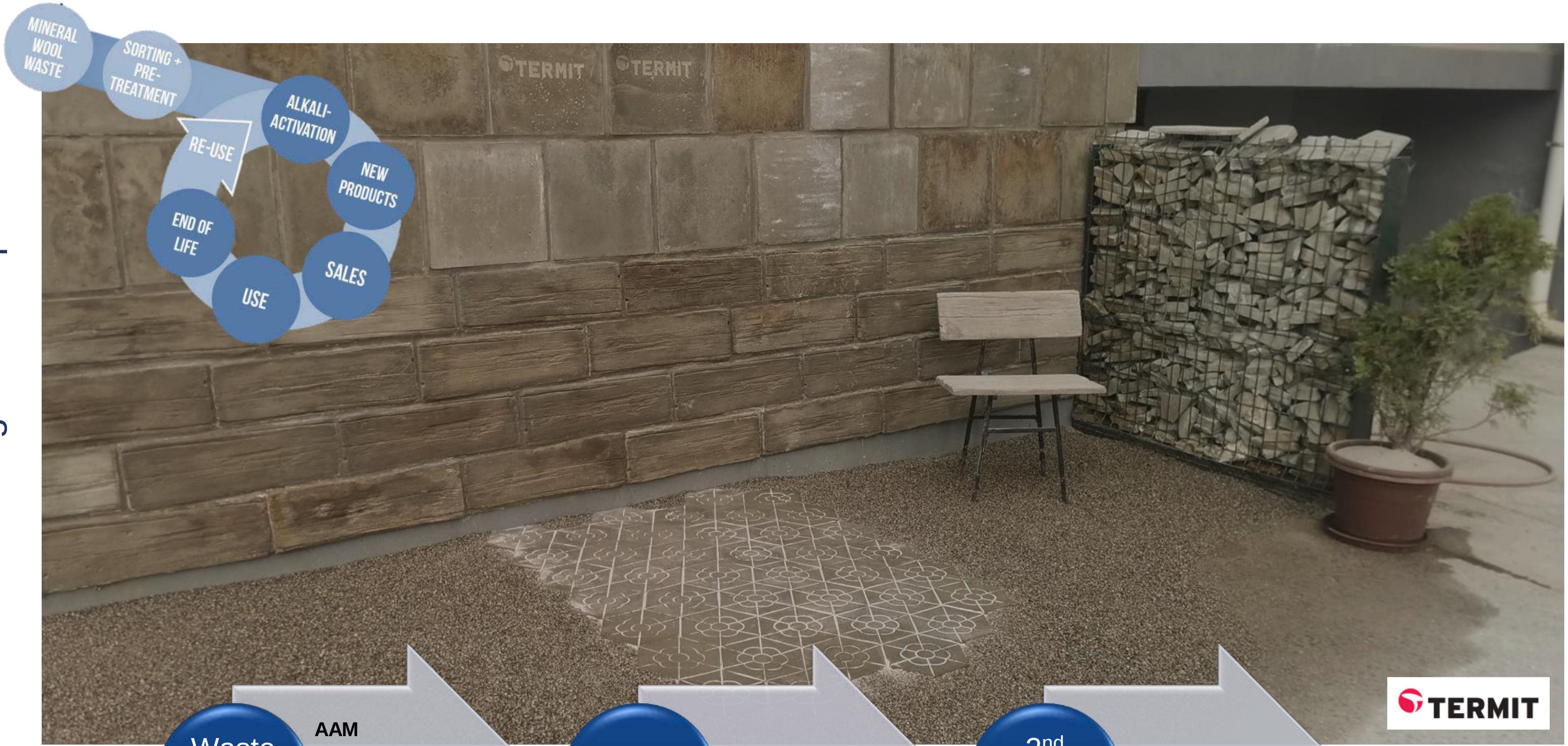
Horizon 2020 - Final testing field and products



Waste mineral wool → **AAM**
- Façade panels
- Cobblestones
- Chair (bench)
- …

Waste AAM →
- Fence
- …

2nd waste AAM → ?

WOOL2LOOP

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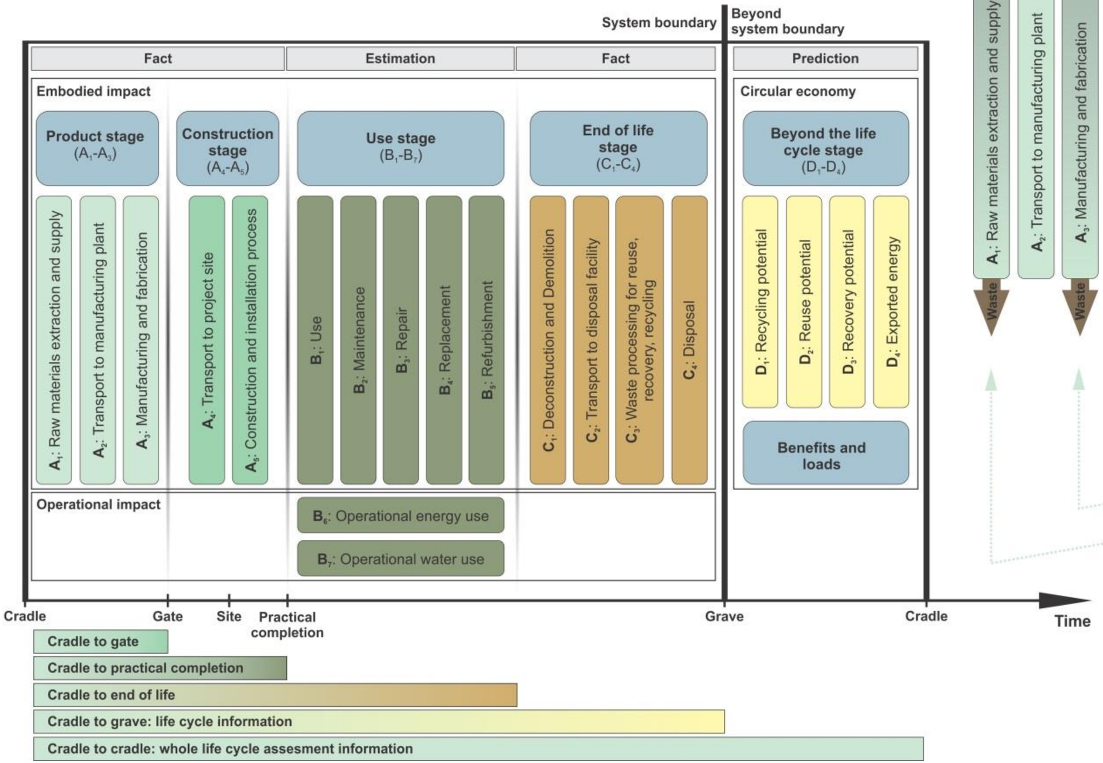
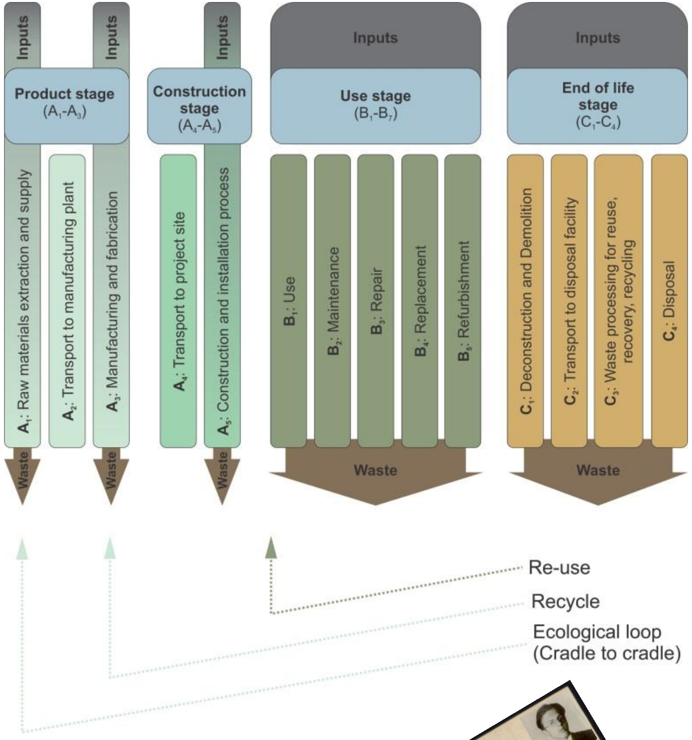
W2L

Fact - known

Estimation - using historical data, finding optimal parameters - a guess about the true state of nature

Prediction - a guess about another random value - larger uncertainty - research in the laboratory before pilot plant





LCA Basics

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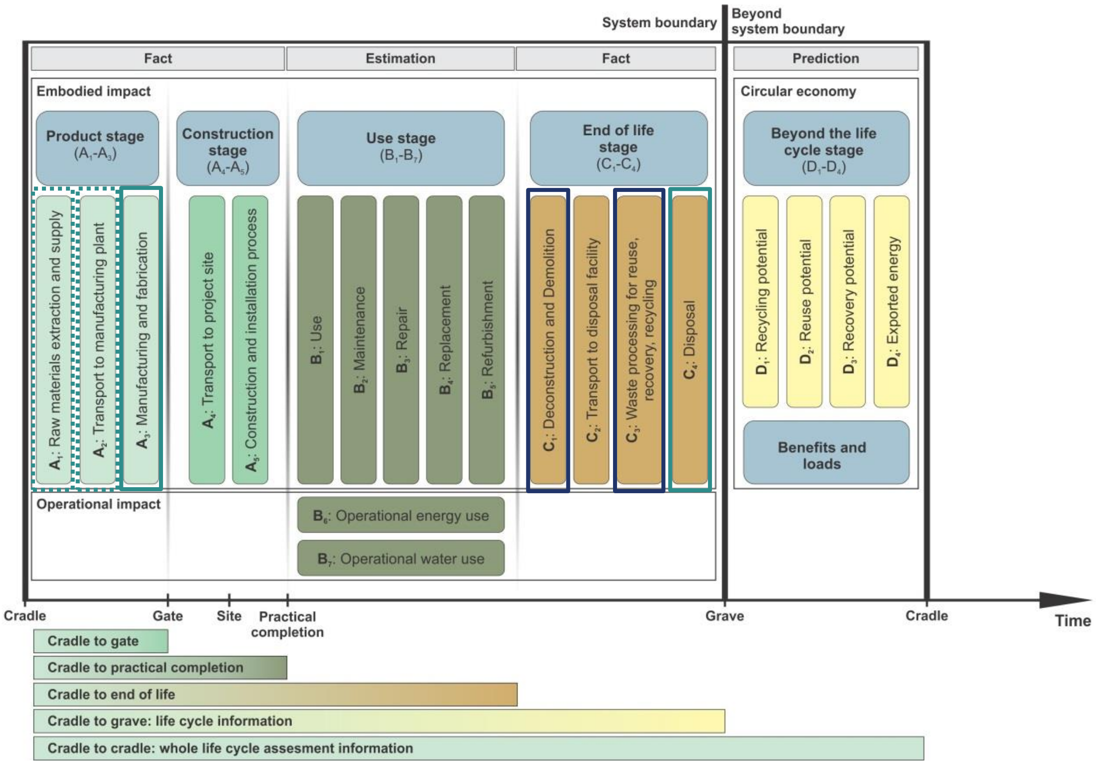
LCA

Getting the waste material into the “backyard”



Slovenia (and majority of Europe): high need for educating society about circular economy, benefits and as the only right way! There will be no raw materials left in the future…

Partner:

C_1 and C_3: step by step removal of walls, increased the time of demolition, decreased the time of waste processing, material was cleaner… more benefits overall = A_1 (no grave)

$C_2 = A_2$

C_4 does not exist (for mineral wool)

Slovenia:

$C_4 = A_3$: waste mineral wool was delivered to disposal facility and payed for disposal

A_4 does not exist (disposal facility = A_3 and pilot A_5)

Society has “circular economy drawbacks” regarding waste collection and processing!!!

Waste material → Raw material from the market (society is not mature yet even for “larger” research circular projects)

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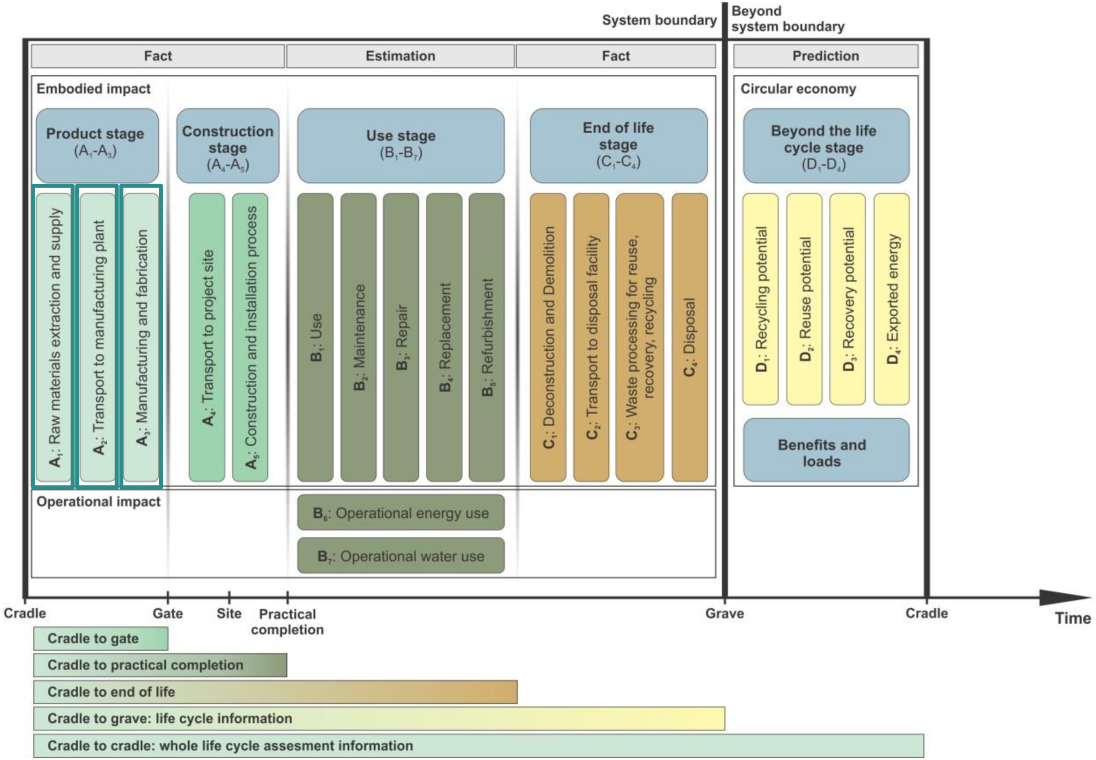
LCA

Getting all other materials into the “backyard”



Slovenia:

Alkali NaOH:
A_1: hydroxide was bough as clean raw material – for AAM its A_5 module is A_3

Alkali Na-water glass:
A_1: sodium silicate solution was bought, but then remodified into a new sodium silicate solution, available on the market under a different brand – for this brand its A_5 module is A_3, for AAM this A_3 is A_1 (no A_2 needed)
***A_3: another brand is available at location of manufacture (it does bring along** *“history”)*

Quartz sand:
A_1: produced on site

All other materials:
A_1: bought on the market as NaOH

Water for cleaning: reused, mixture was every time the same (contamination not possible)

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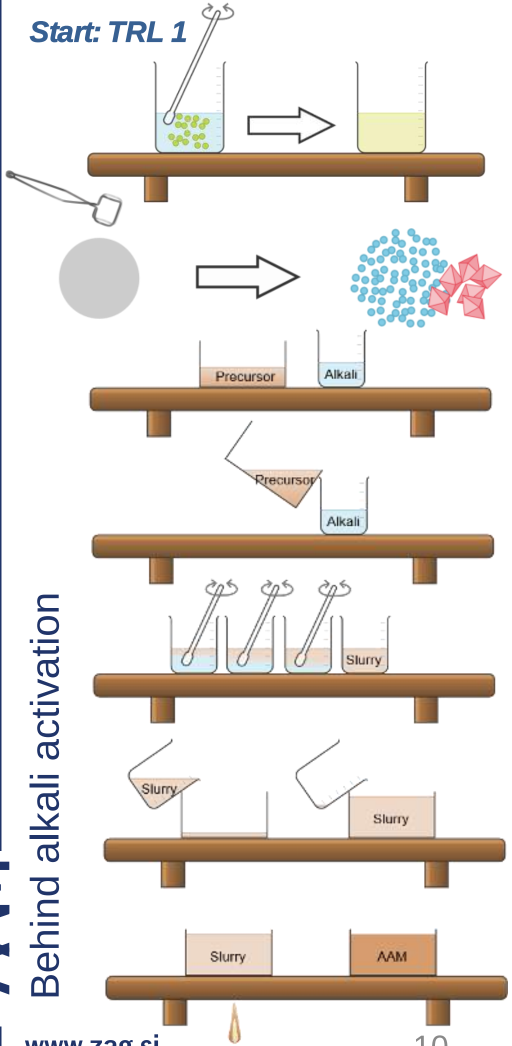
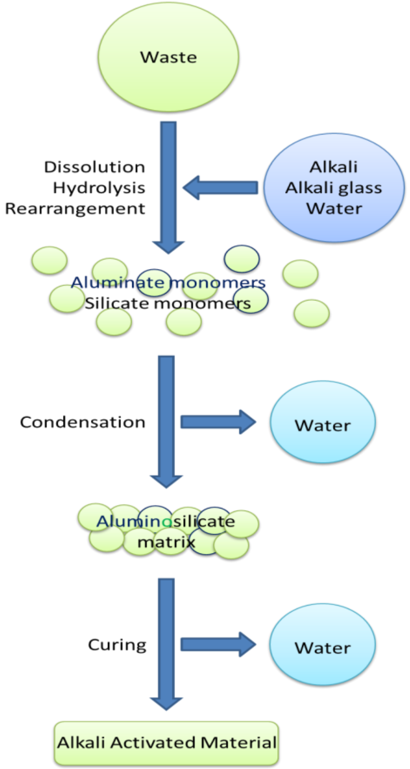
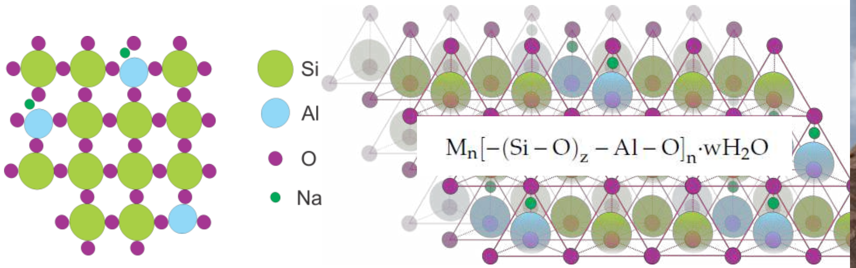
Start: TRL 1







AAM

Behind alkali activation

Acknowledgement: Project No. C3330-17-529032 "**Raziskovalci-2.0-ZAG-529032**" was granted by Ministry of Education, Science and Sport of Republic of Slovenia. The investment is co-financed by the Republic of Slovenia, Ministry of Education, Science and Sport and the European Regional Development Fund.

Start: TRL 4

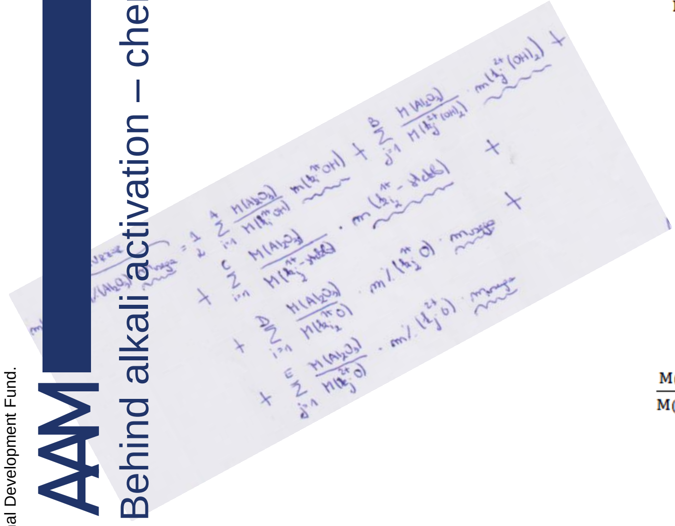
Wool\m%	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	BaO
RW	2,1	9,8	17,3	43,5	0,8	16,8	1,3	0,3	6,7	0,07
GW	16,5	3,7	2,5	65,9	0,3	7,1	0,1		0,6	

Waste mineral wool from landfill	Moisture [%]	LOI (950 °C)	Amorphous phase [m%]
RW	1,1	4,7	96,8
GW	2,2	8,5	92,4

Quartz, calcite, dolomite

Mineral wool	Si	Al	1st group
RW	2.1	1	0.2
GW	22	1	11
Ideal	1.9	1	1
Efflorescence		1	>1

Behind alkali activation – chemistry



$$\boxed{n_{Si} : n_{Al} = \alpha_1 = 1.9,} \tag{1}$$

$$n_{Cation^{1+}} : n_{Al} = \alpha_2 = 1, \tag{2}$$

$$\frac{1}{2} n_{Cation^{2+}} : n_{Al} = \alpha_2 = 1, \tag{3}$$

$$m_{\%p}{}^{XRF}(A) = x \cdot m_{\%p}{}^{XRF}(A_xO_y) \cdot \frac{M(A)}{M(A_xO_y)}, \tag{4}$$

$$m_{\%p}{}^{XRD}(B) = \sum\nolimits_{minerals\ "B"} z \cdot m_{\%p}{}^{XRD}(B_z \dots) \cdot \frac{M(B)}{M(B_z \dots)}, \tag{5}$$

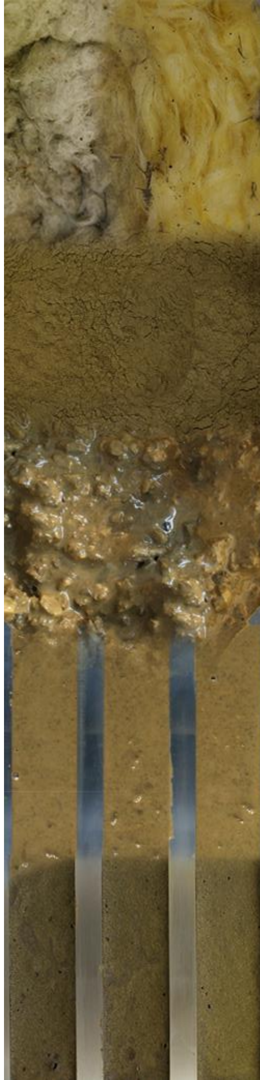
$$m_{\%p}{}^{amorphous}(A) = m_{\%p}{}^{XRF}(A) - m_{\%p}{}^{XRD}(A), \tag{6}$$

$$m_{Si_{add}} = \frac{m_0}{100} \cdot \left(\alpha_1 \cdot m_{\%p}(Al) \cdot \frac{M(Si)}{M(Al)} - m_{\%p}(Si)\right) = \begin{cases} \text{true, if} > 0;\ \text{do not add Al} \\ 0,\ \text{if} = 0;\ \text{do not add Al} \\ 0,\ \text{if} < 0;\ \text{add Al} \end{cases}, \tag{7}$$

$$m_{Al_{add}} = \frac{m_0}{100} \cdot \left(\frac{1}{\alpha_1} \cdot m_{\%p}(Si) \cdot \frac{M(Al)}{M(Si)} - m_{\%p}(Al)\right), \tag{8}$$

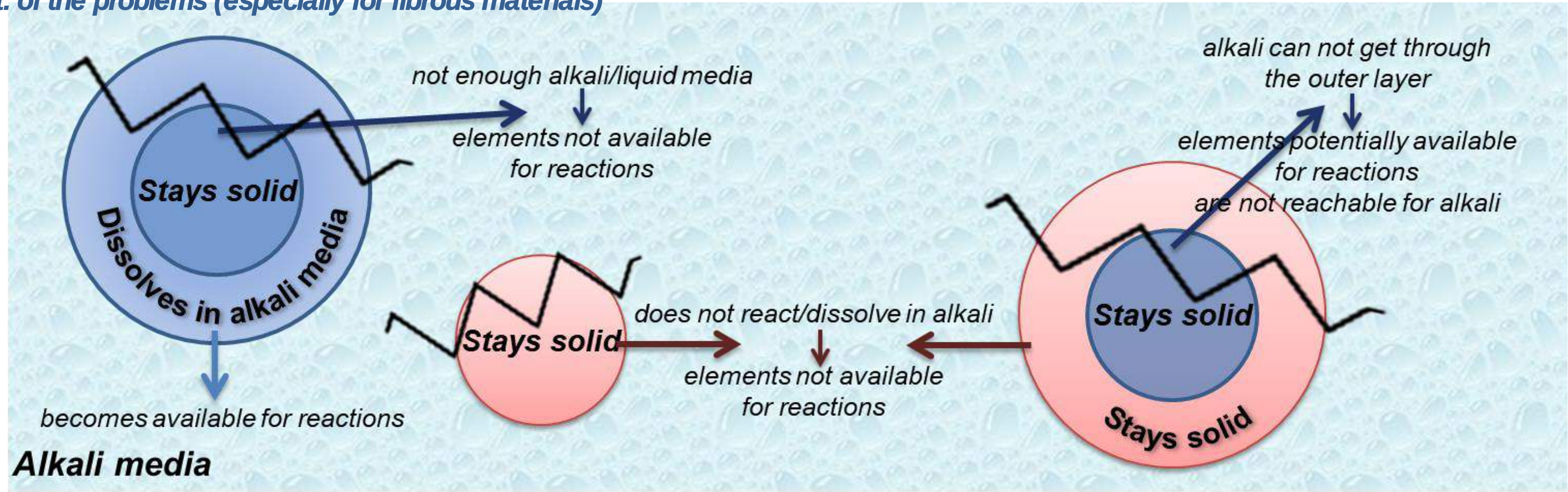
$$m_{Na_{add}} = \frac{M(Na)}{M(Al)} \cdot \left(\frac{m_0}{100} \cdot m_{\%p}(Al) + m_{Al_{add}}\right) \cdot \alpha_2 - \frac{m_0}{100} \cdot \left[\sum\nolimits_{Cation^{1+}} \left(\frac{M(Na)}{M(Cation^{1+})} \cdot m_{\%p}(Cation^{1+})\right) + \sum\nolimits_{Cation^{2+}} \left(2 \cdot \frac{M(Na)}{M(Cation^{2+})} \cdot m_{\%p}(Cation^{2+})\right)\right], \tag{9}$$

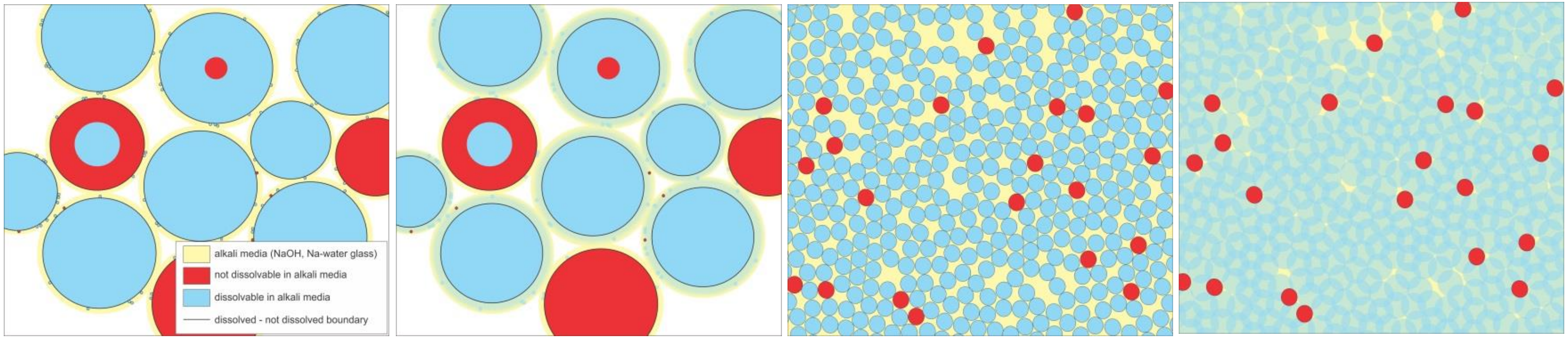
$$m_{K_{add}} = \frac{M(K)}{M(Al)} \cdot \left(\frac{m_0}{100} \cdot m_{\%p}(Al) + m_{Al_{add}}\right) \cdot \alpha_2 - \frac{M(K)}{M(Na)} \cdot m_{Na_{add}} - \frac{m_0}{100} \cdot \left[\sum\nolimits_{Cation^{1+}} \left(\frac{M(K)}{M(Cation^{1+})} \cdot m_{\%p}(Cation^{1+})\right) + \sum\nolimits_{Cation^{2+}} \left(2 \cdot \frac{M(K)}{M(Cation^{2+})} \cdot m_{\%p}(Cation^{2+})\right)\right]. \tag{10}$$



Acknowledgement: Project No. C3330-17-529032 "**Raziskovalci-2.0-ZAG-529032**" was granted by Ministry of Education, Science and Sport of Republic of Slovenia. The investment is co-financed by the Republic of Slovenia, Ministry of Education, Science and Sport and the European Regional Development Fund.

Start: of the problems (especially for fibrous materials)





*“Normal” materials (non-**fibrous): smaller particles, bigger surface area, more liquid***
Mineral wool (fibrous): smaller particles, bigger surface area, less liquid

Behind alkali activation – physics

AAM

Acknowledgement: Project No. C3330-17-529032 “**Raziskovalci-2.0-ZAG-529032**” was granted by Ministry of Education, Science and Sport of Republic of Slovenia. The investment is co-financed by the Republic of Slovenia, Ministry of Education, Science and Sport and the European Regional Development Fund.

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Horizon 2020 – “rocket science” workshops (milling)

WOOL2LOOP

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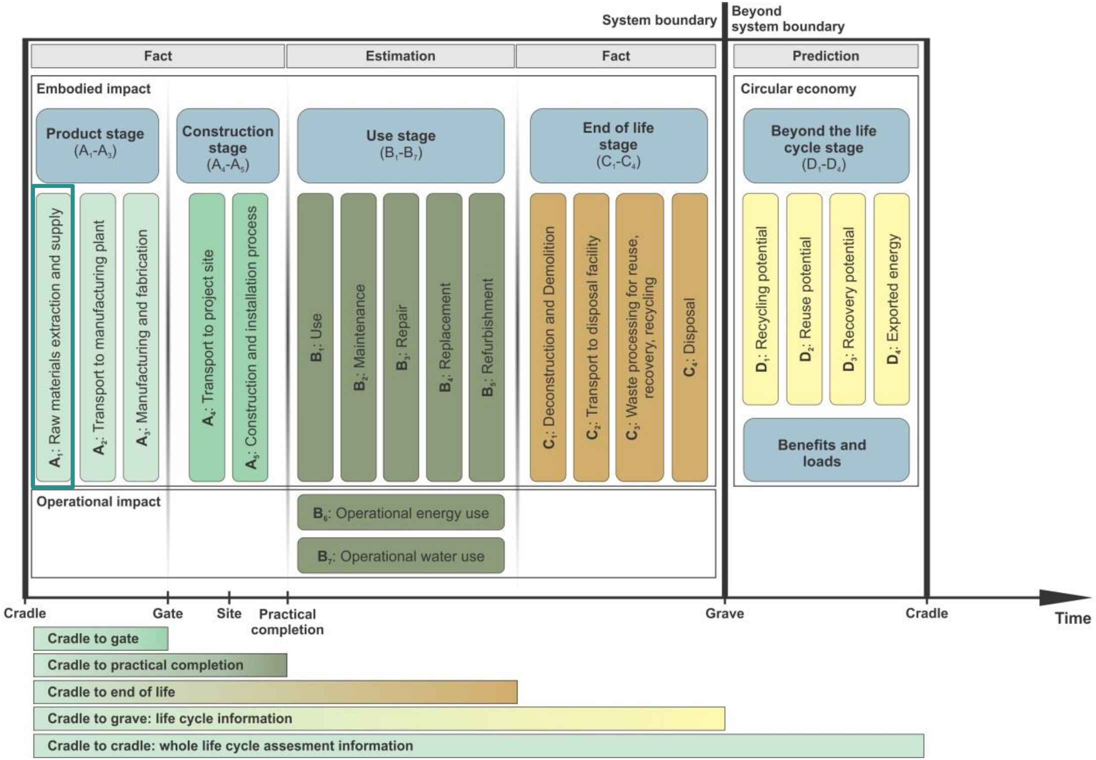
LCA

Getting the materials to module A_3 for AAM

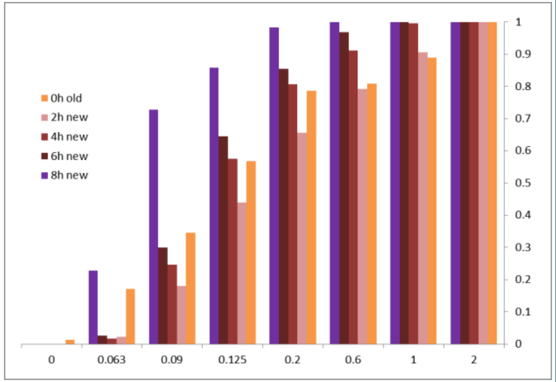


Slovenia:

Mineral wool preparation: MILLING!!!
A_1: A_5 for mineral wool (bought) is A_1 for AAM

Milling:

- ***Performed by another company that "produces" mineral wool (their waste was not put back into their production, but into the milling for W2L)***
- ***1st batches were perfect (before the agreement of cooperation)***
- ***All the rest were useless, total disaster…***
- ***Additional milling was performed at location of AAM pilot production***
- ***Tests of milling: 2h, 4h, 6h, 8h***



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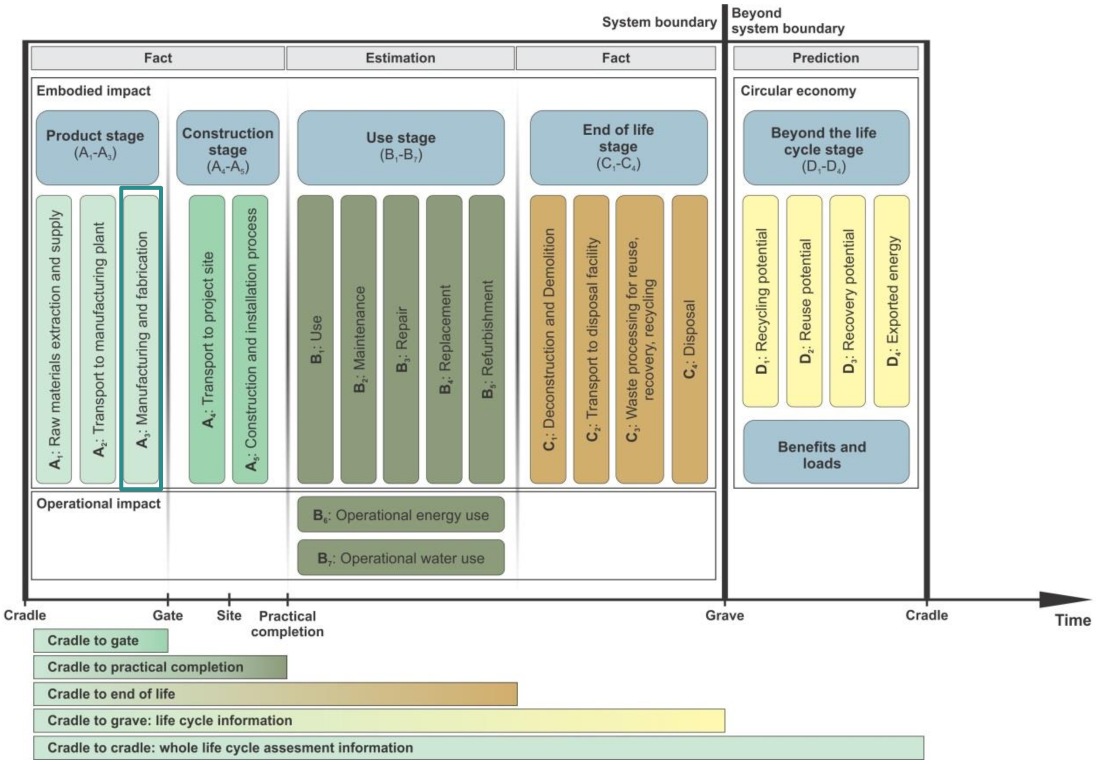
LCA

Getting the materials to module A_3 for AAM



Slovenia:

AAM synthesis:

After mixture of all ingredients was "finalised":

Need for heating!

- *Curing during winter in heated room (20 °C at least)!*

- *Room temperature curing was not enough because mineral wool is a slow curing material (not like slag or metakaolin, not even like fly ash),*
- *40 °C for 3 day is good,*
- *70 °C for 1 day is better.*

Curvature solution:

- *Curing in special chamber with constant and preselected humidity, not allowing the dehydration.*

Final choice of curing parameters:

- *Room condition for 3 days in PVC,*
- *60 °C at 60 % for 3 additional days.*

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Type	Indicator	Label	Unit
Enviornmental impact indictors	01 EN15804+A2 Climate Change - total [kg CO2 eq.]	GWP-total	[kg CO_2 eq.]
	02 EN15804+A2 Climate Change, fossil [kg CO2 eq.]	GWP-fossil	[kg CO_2 eq.]
	03 EN15804+A2 Climate Change, biogenic [kg CO2 eq.]	GWP-biogenic	[kg CO_2 eq.]
	04 EN15804+A2 Climate Change, land use and land use change [kg CO2 eq.]	GWP-luluc	[kg CO_2 eq.]
	05 EN15804+A2 Ozone depletion [kg CFC-11 eq.]	ODP	[kg CFC 11 eq.]
	06 EN15804+A2 Acidification [Mole of H+ eq.]	AP	[mol H^+ eq.]
	07 EN15804+A2 Eutrophication, freshwater [kg P eq.]	EP-freshwater	[kg PO_4^- eq.]
	08 EN15804+A2 Eutrophication, marine [kg N eq.]	EP-marine	[kg N eq.]
	09 EN15804+A2 Eutrophication, terrestrial [Mole of N eq.]	EP-terrestrial	[kg N eq.]
	10 EN15804+A2 Photochemical ozone formation, human health [kg NMVOC eq.]	POCP	[kg NMVOC eq.]
	11 EN15804+A2 Resource use, mineral and metals [kg Sb eq.]	ADP-minerals&metals	[kg Sb eq.]
	12 EN15804+A2 Resource use, fossils [MJ]	ADP-fossil	[MJ, net calorific value]
	13 EN15804+A2 Water use [m^3 world equiv.]	WDP	[m^3 world eq. deprived]
Ressource use indicators	01 EN15804+A2 Use of renewable primary energy (PERE) [MJ]	PERE	[MJ, net calorific value]
	03 EN15804+A2 Total use of renewable primary energy resources (PERT) [MJ]	PERT	[MJ, net calorific value]
	04 EN15804+A2 Use of non-renewable primary energy (PENRE) [MJ]	PENRE	[MJ, net calorific value]
	06 EN15804+A2 Total use of non-renewable primary energy resources (PENRT) [MJ]	PENRT	[MJ, net calorific value]
	10 EN15804+A2 Use of net fresh water (FW) [m3]	FW	[m^3]
Output flows and waste categories	01 EN15804+A2 Hazardous waste disposed (HWD) [kg]	HWD	[kg]
	02 EN15804+A2 Non-hazardous waste disposed (NHWD) [kg]	NHWD	[kg]
	03 EN15804+A2 Radioactive waste disposed (RWD) [kg]	RWD	[kg]
Optional indicators	01 EN15804+A2 Particulate matter [Disease incidences]	PM	[disease incidence]
	02 EN15804+A2 Ionising radiation, human health [kBq U235 eq.]	IRP	[kBq U235]
	03 EN15804+A2 Ecotoxicity, freshwater [CTUe]	ETP-fw	[CTUe]
	04 EN15804+A2 Human toxicity, cancer [CTUh]	HTP-c	[CTUh]
	05 EN15804+A2 Human toxicity, non-cancer [CTUh]	HTP-nc	[CTUh]
	06 EN15804+A2 Land Use [Pt]	SQP	[-]

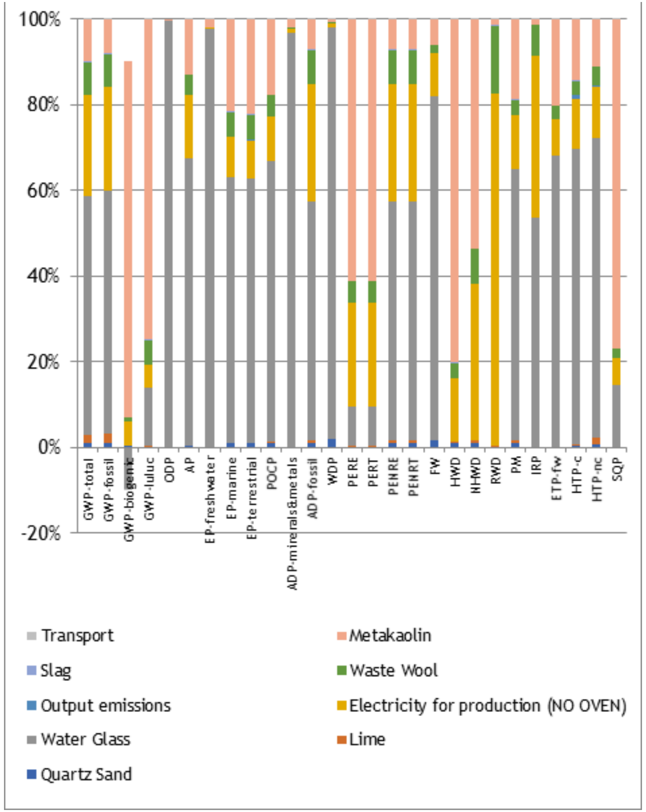
Adapted from software GaBi, standard EN 15804

LCA

A_1-A_3 façade panel/cobblestone and pavement slab

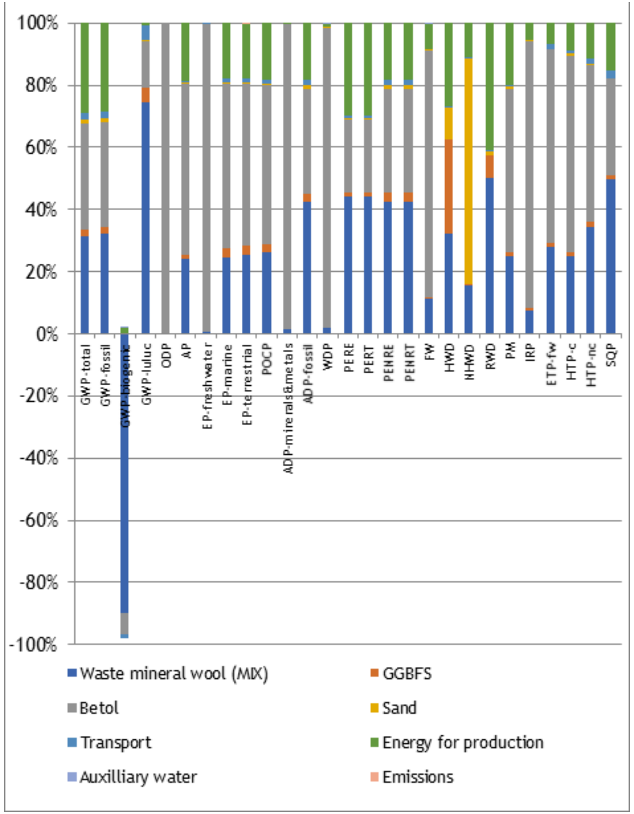
Slovenia, Termit (recipe development by ZAG):

Façade panel/cobblestone: room temperature curing



Poland, Tree (recipe development by UOLU, Finland):

Pavement slab: room temperature curing



A. Lešek, F. Knez

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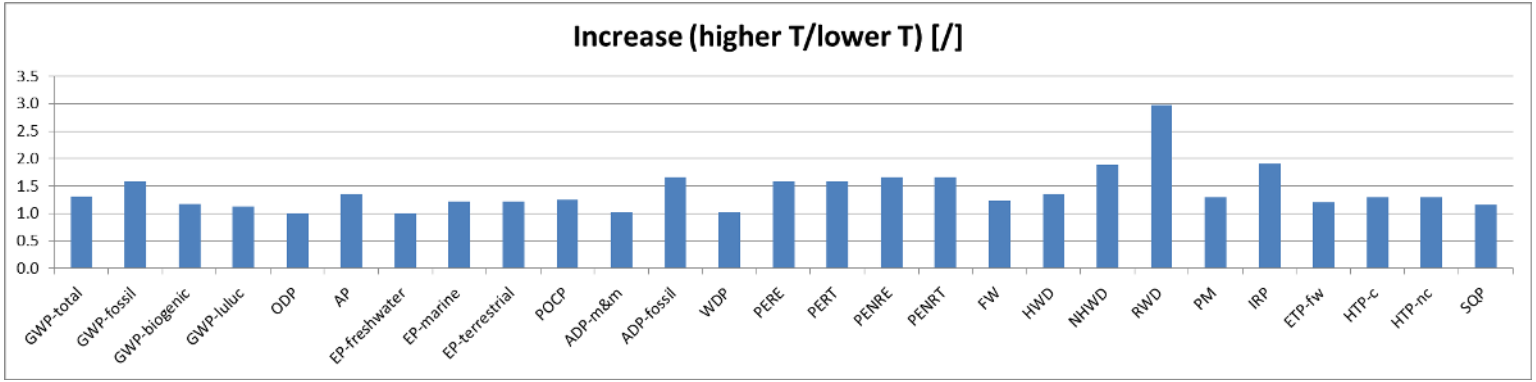
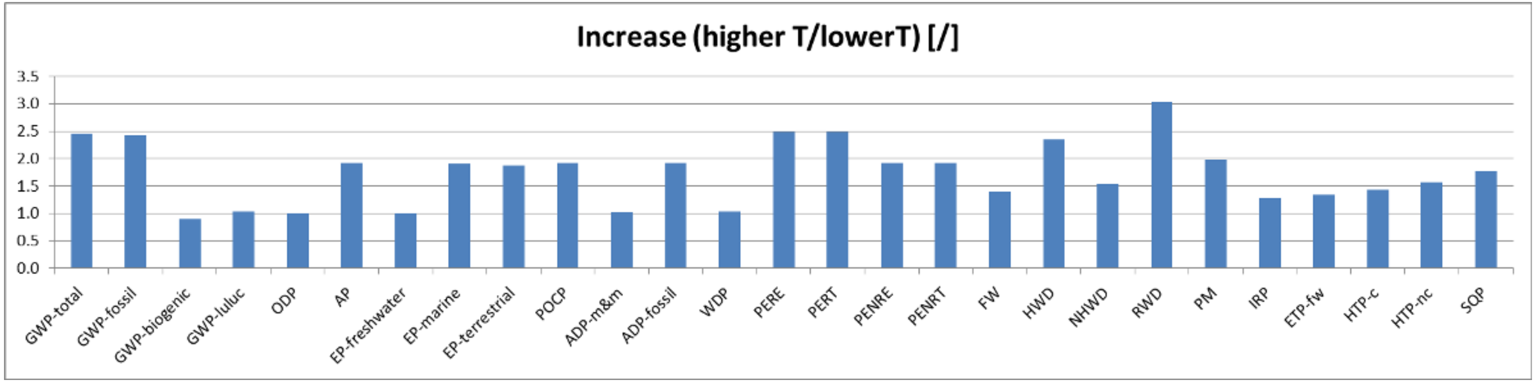
LCA

A_1-A_3 façade panel/coblestone and pavement slab



Slovenia, Termit (recipe development by ZAG).



Poland, Tree (recipe development by UOLU, Finland).

Calculated from data of A. Lešek, F. Knez

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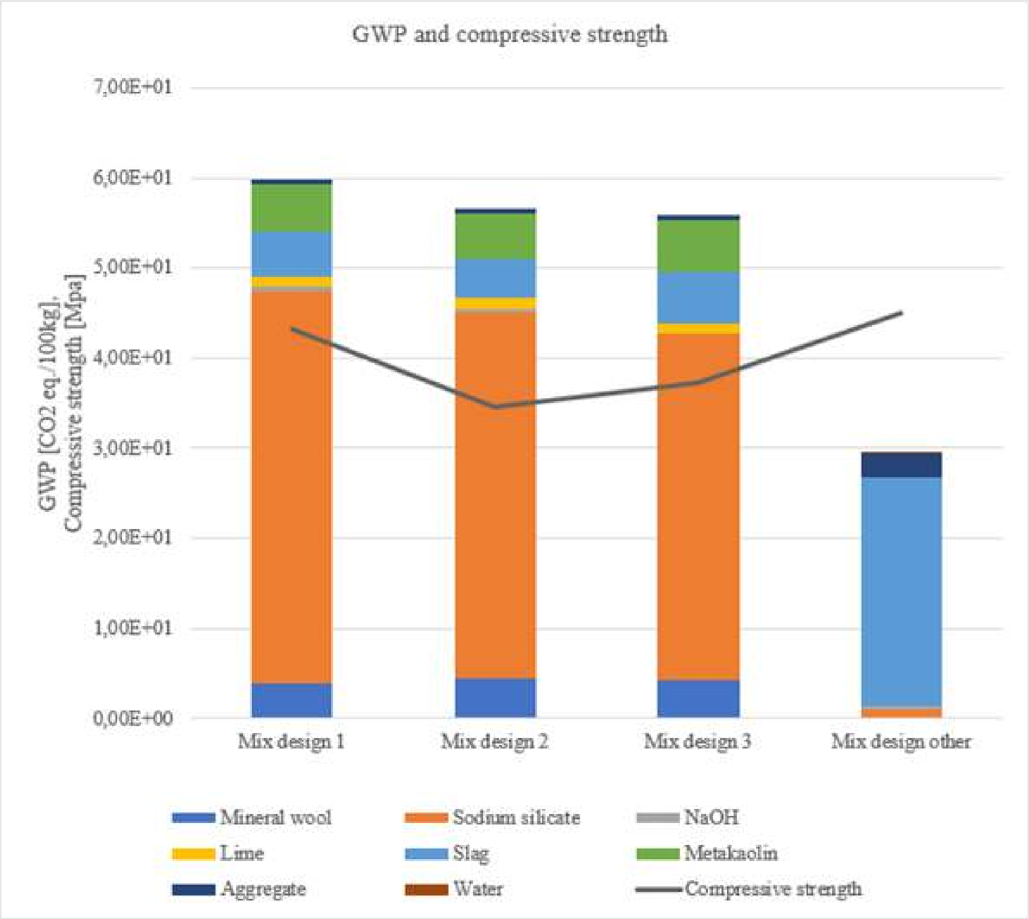
LCA

At module A3

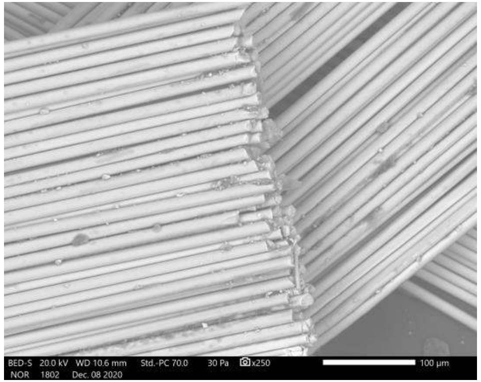


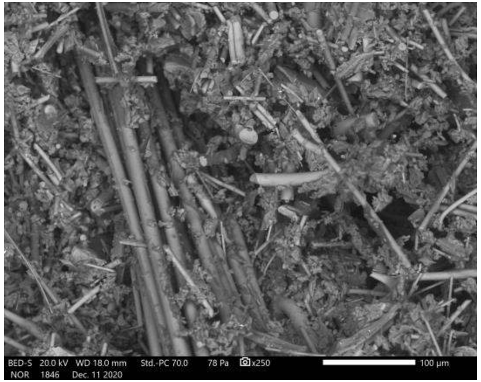
A. Lešek, F. Knez

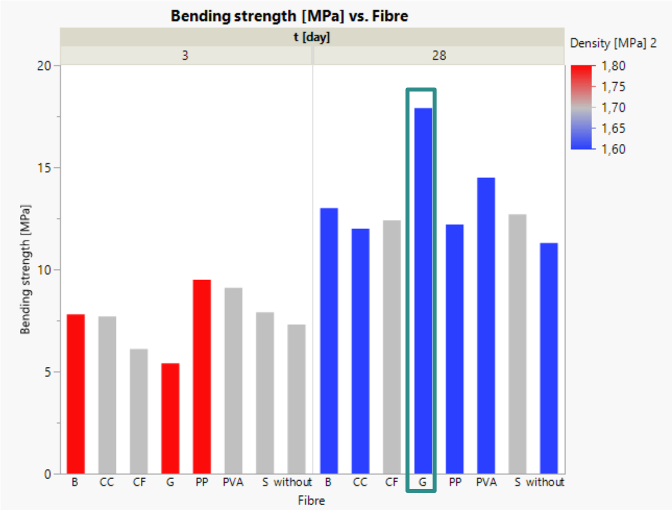
Acknowledgement: H2020 **Wool2Loop** has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 821000. The opinions expressed in this document only reflect the authors' view and in no way reflect the European Commission's opinions. The European Commission is not responsible for any use that may be made of the information it contains.

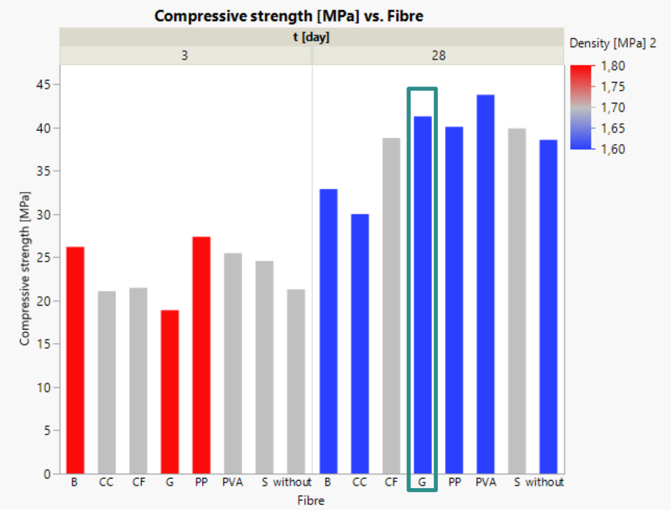
HEADS UP

W2L + glass fibres









Fibre Reinforced Alkali-Activated Rock Wool
doi.org/10.18690/um.fkkt.2.2022

QUESTIONS?

Thank you!

from Wool2Loop to GlassCircle

ALL THE BEST!

ADRESSING ESCALATING ENVIRONMENTAL ISSUES

Miljøskærm® has independently developed innovative recycling solutions

Miljøskærm®

A combination of the Danish words for 'environment' and 'shield' implying to shield the environment from waste and citizens from exposure to excessive noise

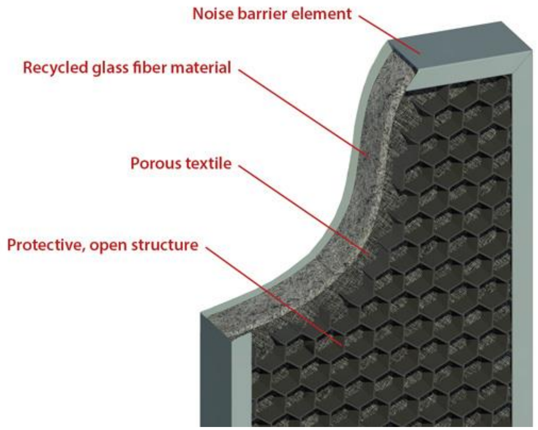
Recycling technology and services offering quality products manufactured of recycled material

Contributing to a cleaner environment reducing accumulation of problematic waste through innovative recycling

Creating new jobs in the clean tech sector by offering innovative solutions to environmental issues

Our Solution

By a mechanical process we manufacture a fibrous material that, packed and formed into a porous product has excellent insulating properties



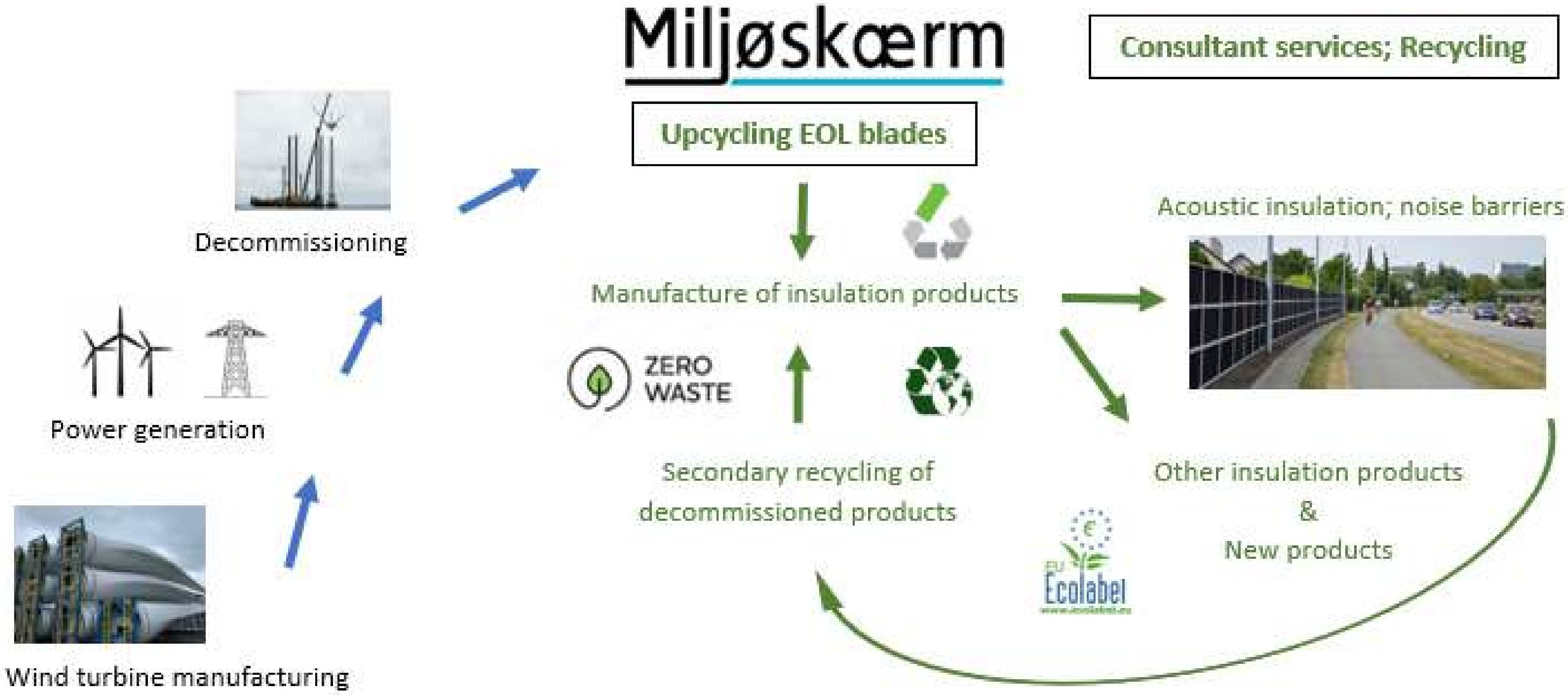
Processing of fiberglass is a challenge in itself

It is a well-known fact that fiberglass exerts severe wear and tear on mechanical shredders and in the absence of a market demand, no technology or purpose-built machinery for this application is offered on the market

As a pioneer within recycling of fiberglass we have modified existing technology and developed purpose-built machinery and components for the process

No existing material classification or standard cover recycled composite material

From linear to circular



Creating value from the recycled material is key

We do not transform the material by advanced industrial processes or make it disappear

We focus on applications of our recycled material utilizing the inherent valuable properties of the material, a light weight and durable material, suitable for rough applications

- Acoustic insulation in noise barriers is our first line of products
- Innovative thermal insulation products are in the pipeline
- We experience an increasing interest from various European industries for our recycled fibers indicating an emerging market mechanical applications

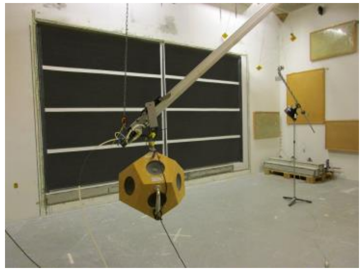
Our products of recycled material add value to the application

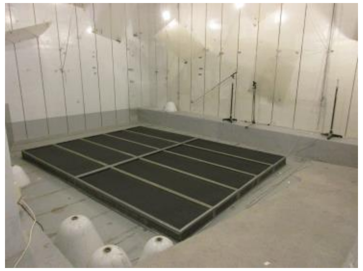
Due to the very good durability of the recycled fiberglass our products add value to the environment by:

- Reducing accumulation of waste
- Replacing existing products requiring more energy to manufacture
- Replacing products that are not recycled
- Contributing to the circular economy: Subject to a suitable financial model we foresee to be able to offer our products on a rental basis allowing our clients to return them at a later point in time
- Non-degradable and robust products without requirement for regular maintenance as painting, cleaning and repairs

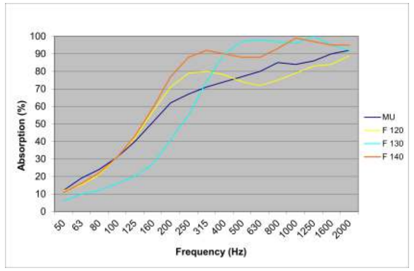
Sustainable, efficient noise barrier

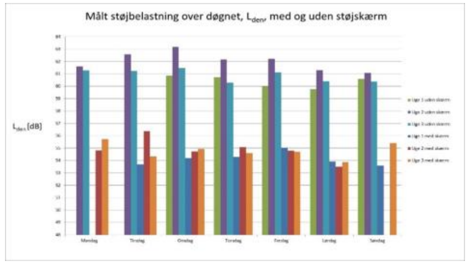
Noise barriers are our first line of products





Full scale tests at the accredited test institute Delta supported by on-site measurements document meeting European standards for EN 1793-1/2 for acoustic noise barriers





Next step

Based on our compiled knowledge and hands-on experience within materials and processing we are confident to be able to present new results of our development work

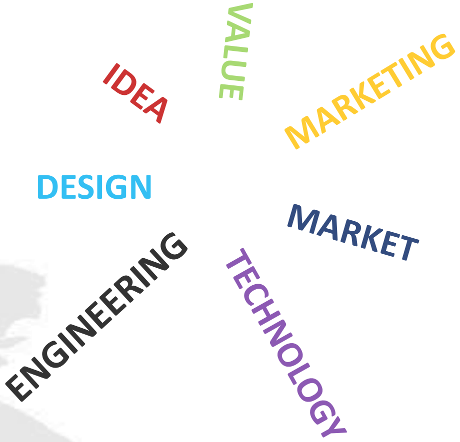
Improved process technology and Innovative products and applications

Expanding business opportunities

Bridging industry and universities efforts within
- Material science
- Recycling technology
- Development of products and applications

Addressing commercial recycling market

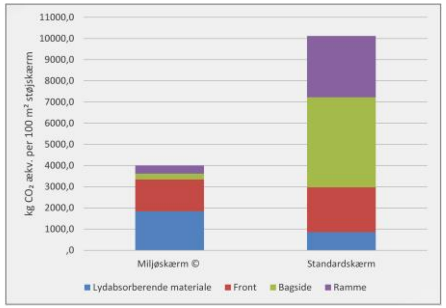
International corporation



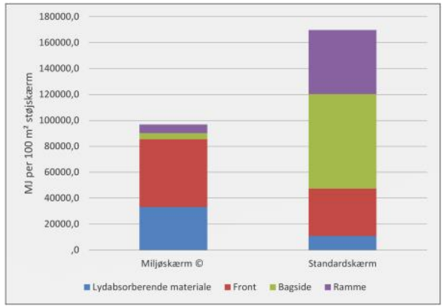
Meeting market demands

We face sharply rising focus on and demand for

- Reduced material consumption
- Reduced energy consumption
- Contribution to circularity of materials



60% reduced CO_2 emission



40% reduced energy consumption

Environmental screening by COWI comparing the manufacture of our noise barriers with mainstream products

Facing the challenges

Traditional materials, processes and constructions

- No robust market for recycled materials
- Low priced virgin materials
- Low flexibility on pricing

The market

Large stakeholders dominate the market for energy generation and recycling in a field of rising political interest and environmental concern

Innovation, however, is not a matter of company size – merely ideas and dedication

Miljøskærm offers:

- Industrial expertise
- Scaleable recycling concept
- Unique recycling path
- IP rights


Credit Wind Denmark


Credit State of Green

The market

We need clean energy and wind power is inexhaustible

– wind turbines have but a limited lifespan

Miljøskærm address the market for:

- Waste reduction
- Energy savings
- Circular Economy
- Creation of jobs in the cleantech sector

offering unique solutions with huge business potentials in Europe and abroad

Perspective

The current political situation has altered many priorities and calls for innovative solutions

The world needs clean renewable energy, and huge investments are made in:
- Wind and solar power
- Electrical transport
- Electrical heating




Recyclable blades have been introduced making promises for a cleaner world

Sustainable solutions for disposal of conventional fiberglass will yet be in demand, regardless of the fuel road traffic and machinery will yet be noisy and energy savings required

THANK YOU FOR YOUR ATTENTION

LEARN MORE ABOUT OUR SOLUTIONS

www.miljoskarm.dk

Interreg
Baltic Sea Region

Co-funded by
the European Union

CIRCULAR ECONOMY
GlassCircle

Exploring full cycle circular economy for glass fibre industry

Aarhus, DK | 01/03/2024
Michail Beliatis

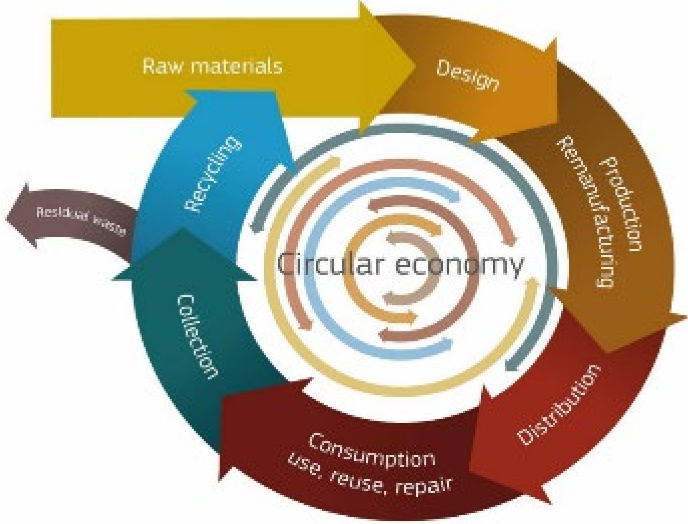
interreg-baltic.eu/project/glasscircle

Background

How it all came together:

During glass fibre manufacturing, as well as in many composite manufacturing processes a significant amount of residue material is generated.

Currently, a large amount of this residue glass fibres product is buried in a landfill



Background

How it all came together:

Part of this residue consists of relatively good-quality glass fibres or fabrics

This problem of glass fibre residue is common for many companies dealing with glass fibre or composite manufacturing – thus it would be more efficient to work together to solve this issue

In this project we want to promote the circular economy/ use in glass fiber industry as possible solution to mitigate the generated large amount of residue glass fibre.

GlassCircle

Objectives

The goal of the project: To create a public awareness and a **strong cluster** consisting of key players within the **glass fibres life cycle** (manufacturers, users, re-users, recyclers, etc.) within the Baltic Sea region

The project aims to **bring together** *industry*, *experts*, and *scientists*, as well as *public authorities* within the field – to **exchange knowledge** and **discuss the possible solutions** and **necessary next steps** for faster change from a linear to a circular economy within the glass fibre and composite industry.

Reaching UN sustainability goals

Project funding

Interreg Baltic Sea region

This project funded by European Union for 2 years and this project call funds four priorities:

1. Innovative societies;
2. Water-smart societies;
3. **Climate-neutral societies**;
4. Cooperation governance

Project consortium

Partners from Latvia, Sweden, Denmark

Project lead partner:

Riga Technical University (Latvia)

Contact person: Liva Pupure, Liva.Pupure@rtu.lv

Project partners:

Lulea University of Technology (Sweden)

Contact person: Roberts Joffe, Roberts.Joffe@ltu.se

Aarhus University (Denmark)

Contact person: Michail Beliatis, mibel@btech.au.dk

Podcomp AB (Sweden)

Hitachi Energy Sweden AB, Composites (HPAG) (Sweden)

Valmiera Municipality Government (Latvia)

Project activities

Timeline

Project starts

October

2023

1) Hackathon «GlassCircle»

2) Workshop on the circularity of glass fibers

Survey of communities a
the circularit
glass fibre

2024

3) Workshop «Business model for circular economy»

Conference session GlassCircle – structural use of glass fibre composite materials»

Project ends

September

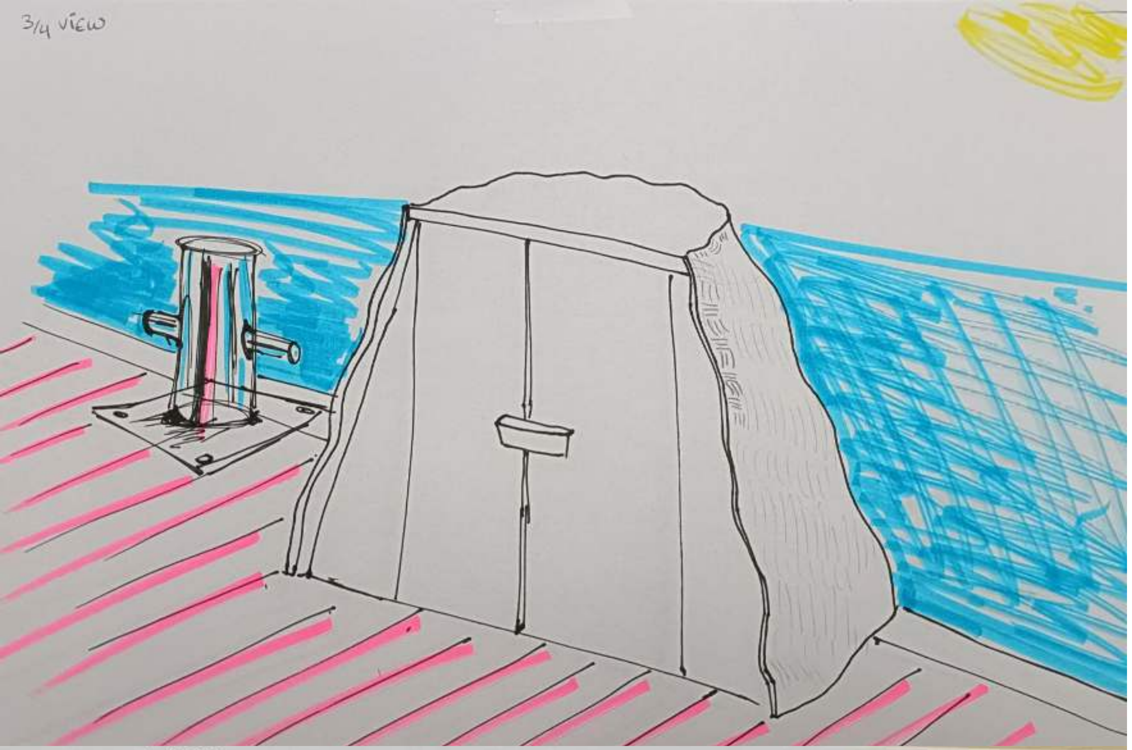
Previous 1st activity

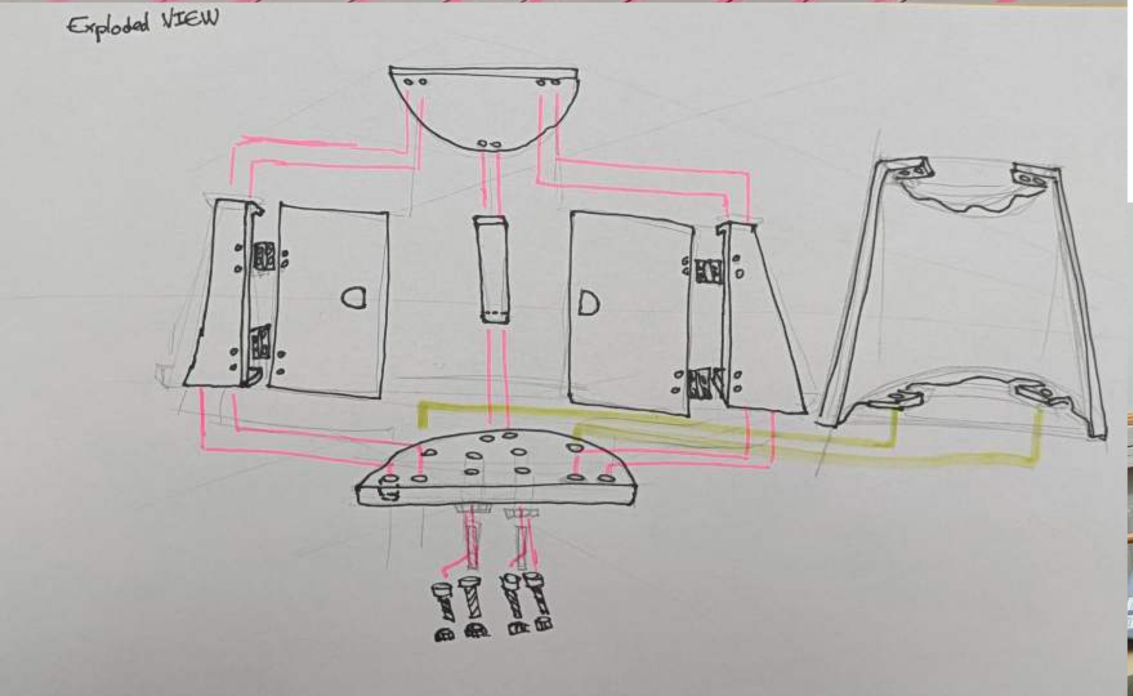
Hackathon «GlassCircle»

<u>**Hackathon «GlassCircle»**</u>

1. Participants from Latvia, Denmark and Sweden
2. Five new ideas generated
3. Student groups did excellent in the short time span they got.


WINNERS
AWARD
500€
VALMIERA GLASS
GROWTH
AWARD
250€
VALMIERA GLASS





Winners:

Team 2: Interior design or furniture elements with specific requirements:

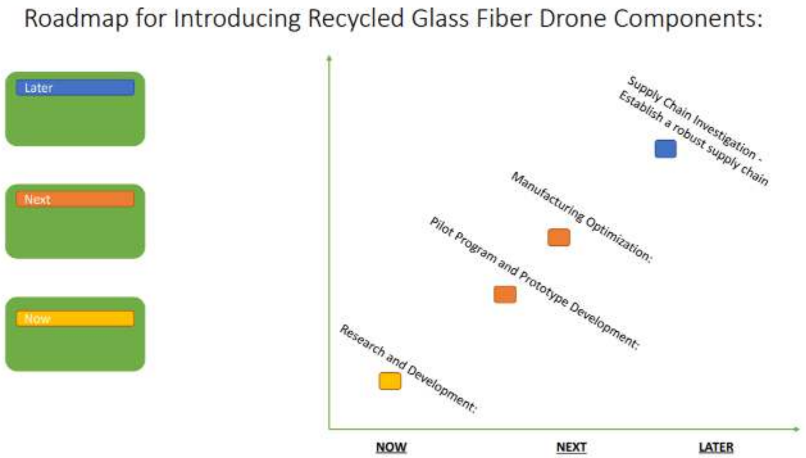
Locker out of glass fibers – from marine industries residue.

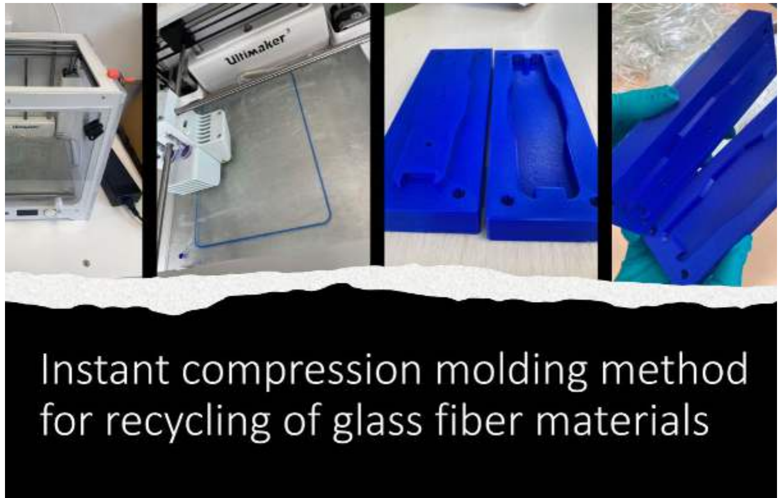
2nd Place

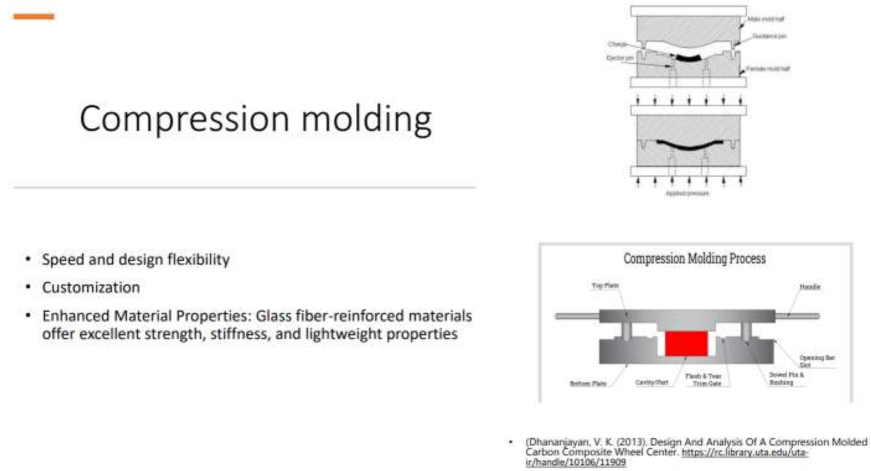

EcoFlight Component
Designed and manufactured using recycled glass fiber materials
Compression molding with 3D-printed molds – 1st draft!
Sustainable alternative to traditional RC drone components made from virgin materials
This component is placed within the structural frame
Offers comparable performance to conventional components while reducing the reliance on new raw materials


EcoFlight Component
Housing for different IoT and Remote-control toys
Mads & Anders MSc Technology Based Business Development
AARHUS UNIVERSITY


Business Case (CE): Recycled Glass Fiber Drone Components
Market Demand: Customers who prioritize eco-conscious practices that values sustainable and environmentally friendly solutions
Cost Savings: Recycling glass fiber drone components can lead to significant cost savings for both manufacturers and end-users - reduce the need for raw materials and lower production costs
Sustainability and Corporate Social Responsibility (CSR): aligns businesses with sustainability goals and demonstrates a commitment to CSR
Regulatory Compliance: Recycling initiatives are gaining momentum globally, and governments are increasingly implementing regulations and incentives to promote recycling practices
Long-Term Cost and Supply Chain Stability: Reducing reliance on virgin materials, less vulnerable to price fluctuations and disruptions
Reduce Environmental Footprint
Green products
non-toxic, long-life, recyclable
Cleaner production
using fewer resources
Generate Increased Income
Circular Economy
Recycle waste, reuse resources
Better service
to extend lifespan
Collect at end-of-life, remanufacture
Minimize Waste
Reduce Resource Dependency


Roadmap for Introducing Recycled Glass Fiber Drone Components:
Later
Next
Now
Supply Chain Investigation - Establish a robust supply chain
Manufacturing Optimization:
Pilot Program and Prototype Development:
Research and Development:
NOW
NEXT
LATER


Ultimaker
Instant compression molding method for recycling of glass fiber materials

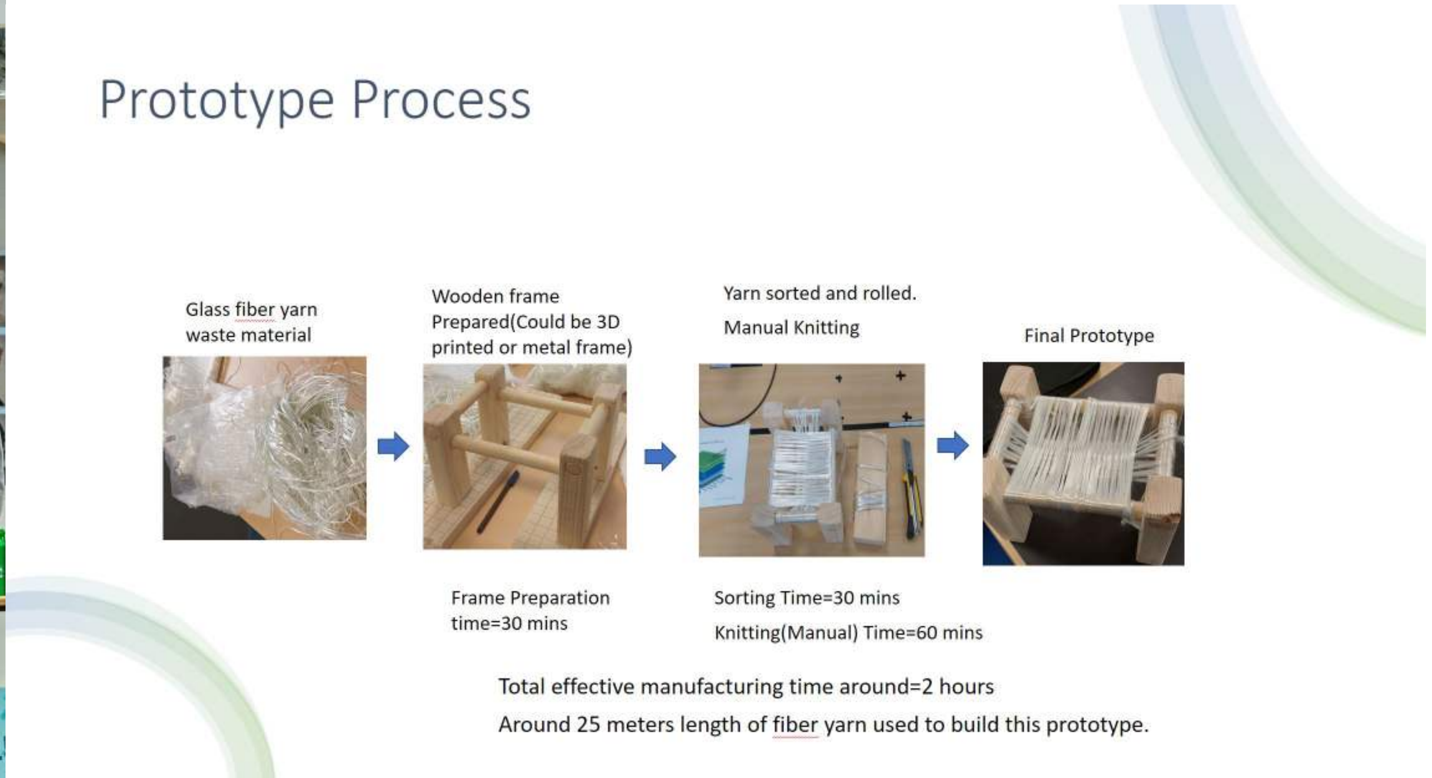

Compression molding
Speed and design flexibility
Customization
Enhanced Material Properties: Glass fiber-reinforced materials offer excellent strength, stiffness, and lightweight properties
Compression Molding Process
(Dhananjayan, V. K. (2013). Design And Analysis Of A Compression Molded Carbon Composite Wheel Center. https://rc.library.uta.edu/uta-ir/handle/10106/11909

3rd place:

Team 3: Glass fiber textiles as a framework for concrete

Team 1: Transforming wind turbine blades into practical objects

Team 5: Reuse of glass fiber – home furniture



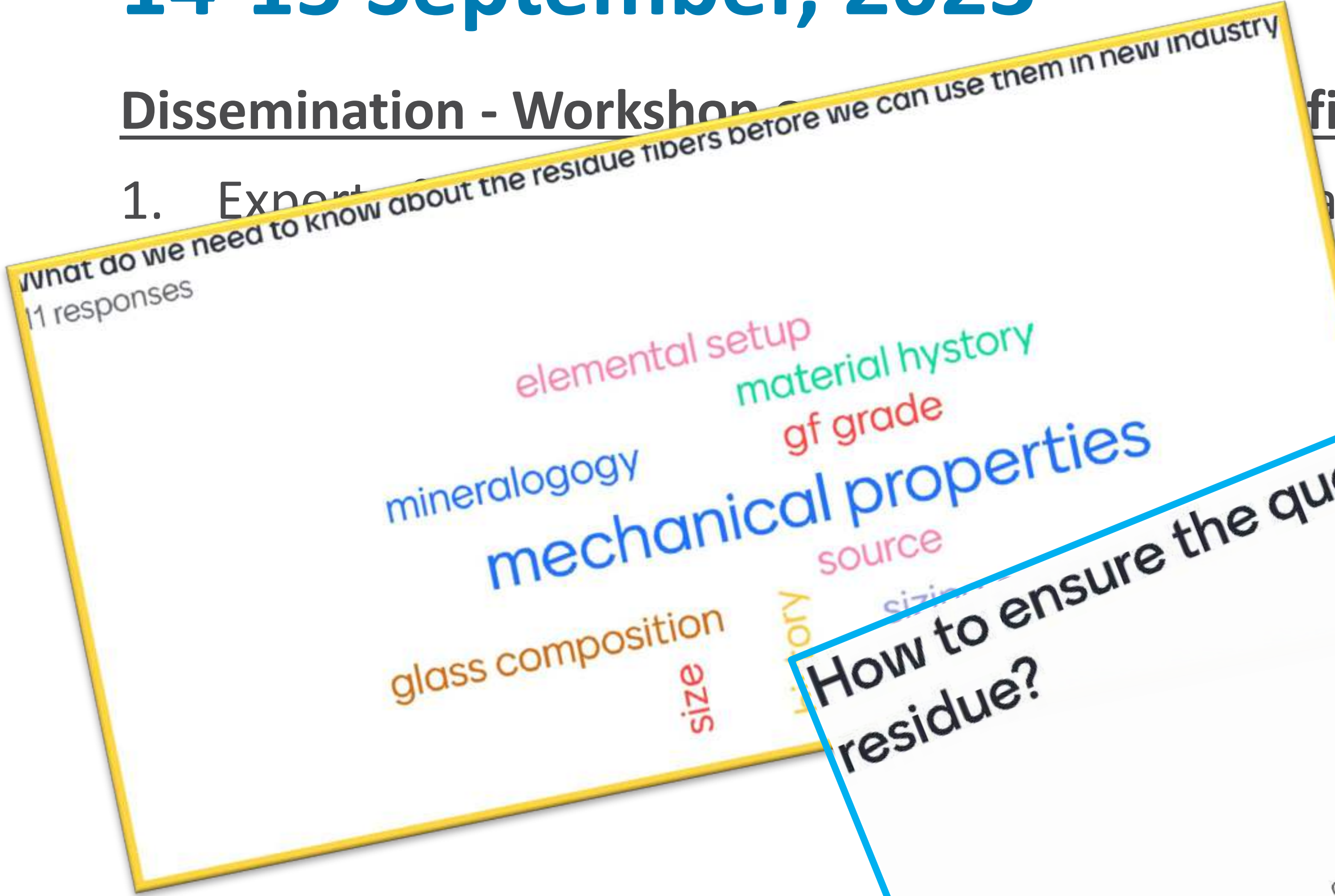
Previous activity 2nd Workshop

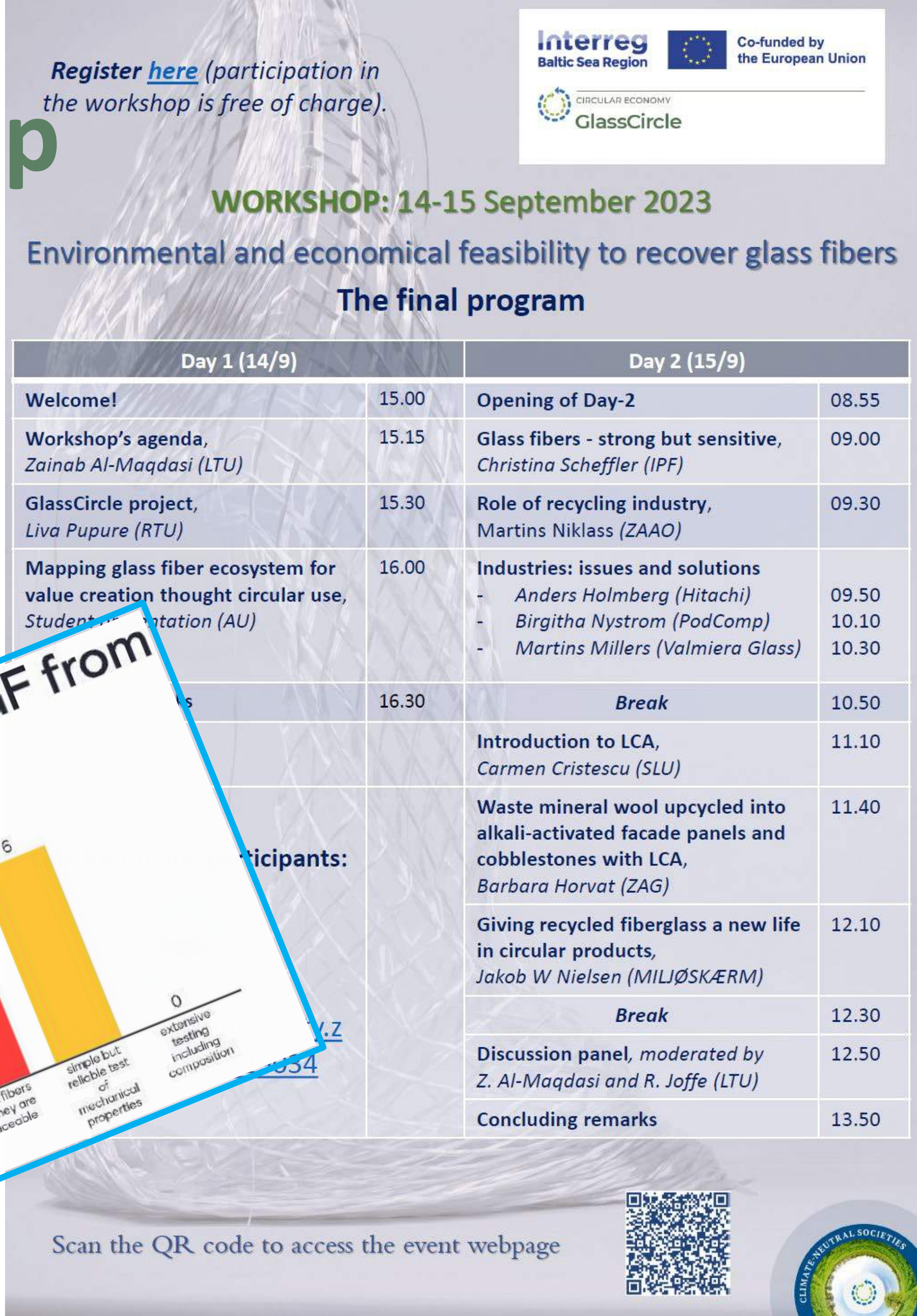
14-15 September, 2023

Dissemination - Workshop o… fibres

1. Expert… …akers will

…ill have





Day 1 (14/9)		Day 2 (15/9)	
Welcome!	15.00	Opening of Day-2	08.55
Workshop's agenda, *Zainab Al-Maqdasi (LTU)*	15.15	Glass fibers - strong but sensitive, *Christina Scheffler (IPF)*	09.00
GlassCircle project, *Liva Pupure (RTU)*	15.30	Role of recycling industry, Martins Niklass *(ZAAO)*	09.30
Mapping glass fiber ecosystem for value creation thought circular use, *Student …ntation (AU)*	16.00	Industries: issues and solutions - *Anders Holmberg (Hitachi)* - *Birgitha Nystrom (PodComp)* - *Martins Millers (Valmiera Glass)*	 09.50 10.10 10.30
…s	16.30	***Break***	10.50
		Introduction to LCA, *Carmen Cristescu (SLU)*	11.10
…icipants:		Waste mineral wool upcycled into alkali-activated facade panels and cobblestones with LCA, *Barbara Horvat (ZAG)*	11.40
		Giving recycled fiberglass a new life in circular products, *Jakob W Nielsen (MILJØSKÆRM)*	12.10
…y.z …034		***Break***	12.30
		Discussion panel, *moderated by Z. Al-Maqdasi and R. Joffe (LTU)*	12.50
		Concluding remarks	13.50

Scan the QR code to access the event webpage

GlassCircle 2nd Hackathon & Workshop

14-15 September, 2023

Register here (participation in the workshop is free of charge).

Interreg Baltic Sea Region

Co-funded by the European Union

GlassCircle

WORKSHOP: 14-15 September 2023

Environmental and economical feasibility to recover glass fibers

The final program

	Day 2 (15/9)	
15.00	Opening of Day-2	08.55
15.15	Glass fibers - strong but sensitive, *Christina Scheffler (IPF)*	09.00
15.30	Role of recycling industry, *Martins Niklass (ZAAO)*	09.30
16.00	Industries: issues and solutions - *Anders Holmberg (Hitachi)* - *Birgitha Nystrom (PodComp)* - *Martins Millers (Valmiera Glass)*	 09.50 10.10 10.30
16.30	**Break**	10.50
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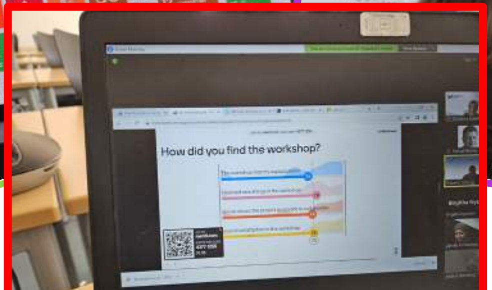
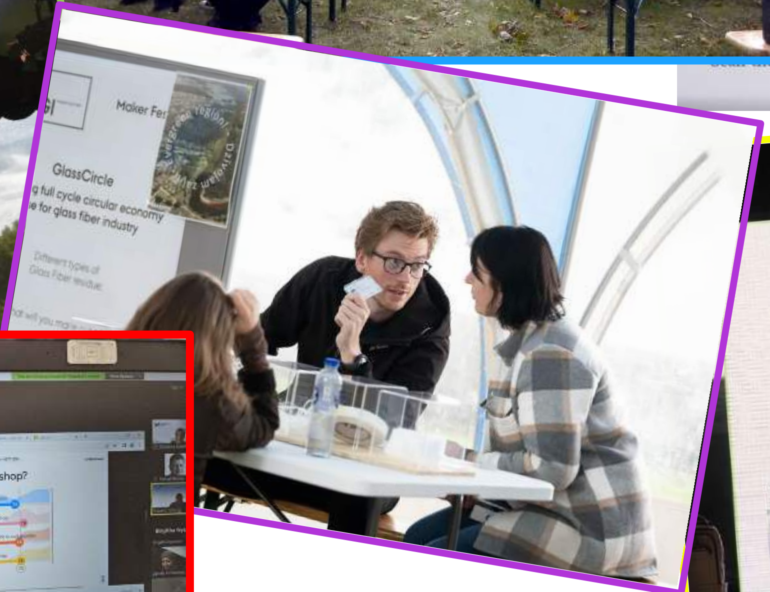
	Concluding remarks	13.50

the event webpage



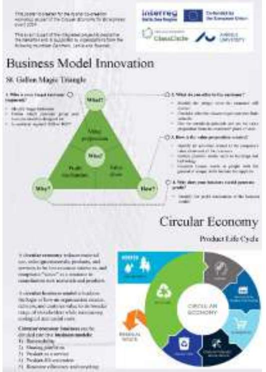


Current activity 3rd Workshop

1st March, 2024

Dissemination - Workshop on Business Model co-creation for Fiber Glass circular economy

1. Experts from industry, academia and policy makers will come together to present successful circular economy cases and co-create about GF business models;
2. During the workshop participating companies will have the possibility to describe their needs in terms of recycling glass fibres and have the opportunity for networking with leading experts in LCA as well as composite professionals




Register here (participation in the workshop is free of charge).

Interreg Baltic Sea Region — Co-funded by the European Union — Circular Economy GlassCircle

Co-creation WORKSHOP: 1st March 2024

Business Model Co-creation / Ideation for Digital Circular Economy in GlassFiber Large Scale Manufacturing

The final program for GlassCircle parallel session

Type of presentation (on-site or on-line)	Day 1 (01/03/2024) CET Time	
	Opening of Day Project CircleGlass, Michail J. Beliatis (AU-BTECH)	10.00
Address for on-site participants: AU campus Navitas, Inge Lehmanns Gade 10, 8000 Aarhus C. Room: Navitas Auditorium	**Inspirational case: The ecosystem of the glass fiber industry and tools for promoting the transition to a circular economy,** Līga Biezipa (Valmiera municipality)	10.10
	Kuusakoski Recycling - Circular economy solution for wind blades, Anu Söderena (Kuusakoski Oy)	10:25
Link for on-line participants: Only for registered	**Project EPICENTER Industry LCA cases for young professionals,** *Laura (RTU)*	10.35
	Inspirational case: Glassfiber cutting machines for recycling, Pavel Chvojka (Advantis)	10.40
	EoLO-HUBs: Circular Business Models and knowledge sharing regarding wind turbine blades *Nina Vielen-Kallio (echt)*	10.50
	Project DigiGlass Inspiration business case, digital systems for GF sorting challenge, *Michail J. Beliatis (AU-DIGIT)*	11.00
	Co-Creation / Ideation & Discussion panel, *moder… Justina & Michail (AU)*	11:10
	Concluding remarks	

Scan the QR code to access the event webpage

CLIMATE-NEUTRAL SOCIETIES

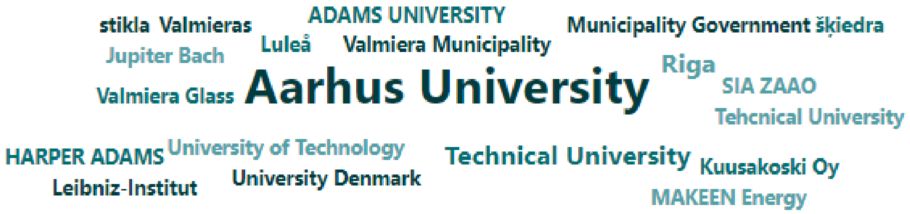
More about current activity

1st March, 2024

Attendee confirmation for GlassCircle Workshop (3) Business Co-Creation

42 Responses | 13:00 Average time to complete | Active Status

9 respondents (21%) answered **Aarhus University** for this question.



6. Purpose of joining this event.

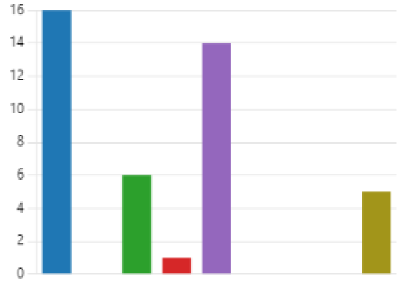
More Details

- Get better understanding of late... 21
- Get inspired and hear about stat... 29
- Brainstorm & Co-create new dir... 18
- Other 8

7. In which country are you based ? (only for statistical purpose reporting in the project)

More Details Insights

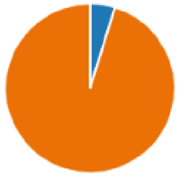
Denmark	16
Norway	0
Sweden	6
Finland	1
Latvia	14
Estonia	0
Poland	0
Lithuania	0
Other	5



8. Would you be interested to participate in an Interview/Survey later on?

More Details Insights

- Yes 2
- No 40

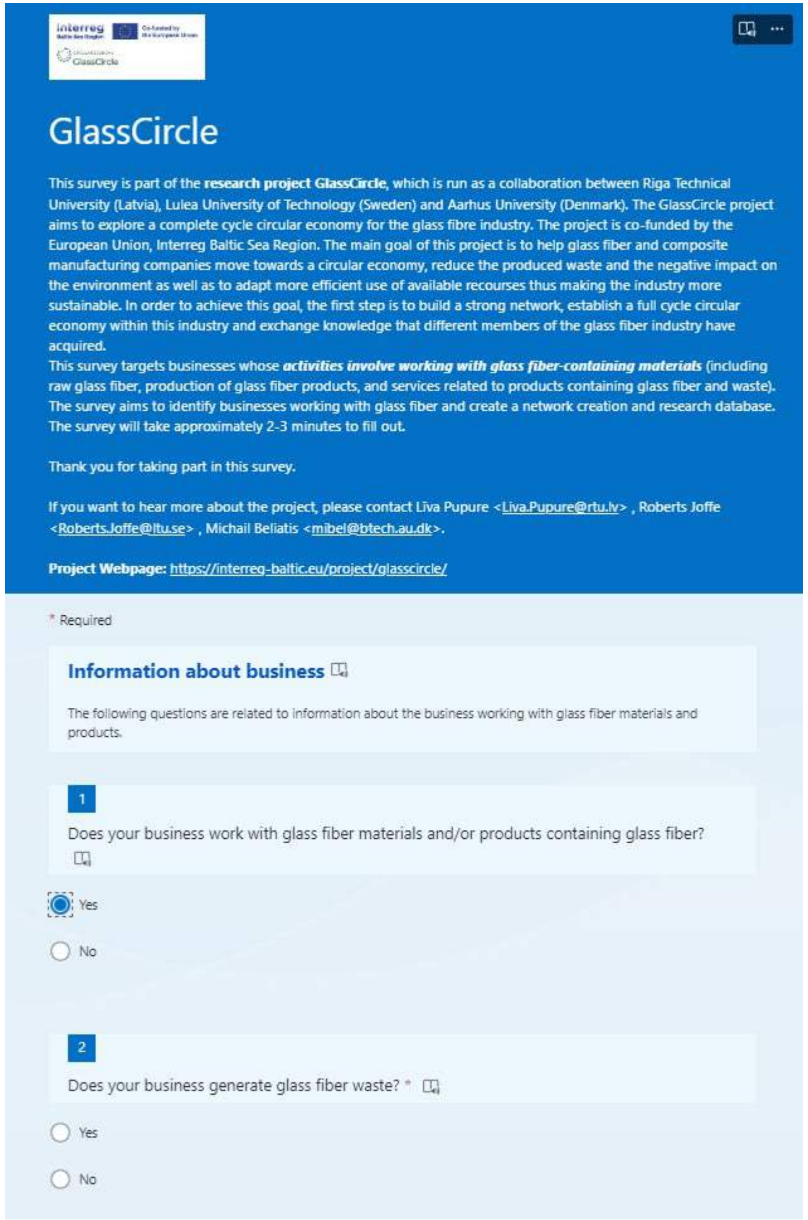


The workshop is organized as parallel session within Circular Economy for Enterprises event organized by Aarhus University, CircThread, Clean Cluster, and TechCircle.

Digital Survey/Interview for developing strong cluster establishment

https://forms.office.com/e/Q6rxpnU89M

A Digital Survey as entry point to digital Atlas tool for mapping the GlassFiber Circular Economy Ecosystem in Nordic/Baltic Countries and identify successful green business cases as *light-houses* of circular economy among different ecosystems as well as bottlenecks in Horizontal and Vertical applications.



GlassCircle

This survey is part of the **research project GlassCircle**, which is run as a collaboration between Riga Technical University (Latvia), Lulea University of Technology (Sweden) and Aarhus University (Denmark). The GlassCircle project aims to explore a complete cycle circular economy for the glass fibre industry. The project is co-funded by the European Union, Interreg Baltic Sea Region. The main goal of this project is to help glass fiber and composite manufacturing companies move towards a circular economy, reduce the produced waste and the negative impact on the environment as well as to adapt more efficient use of available recourses thus making the industry more sustainable. In order to achieve this goal, the first step is to build a strong network, establish a full cycle circular economy within this industry and exchange knowledge that different members of the glass fiber industry have acquired.
This survey targets businesses whose ***activities involve working with glass fiber-containing materials*** (including raw glass fiber, production of glass fiber products, and services related to products containing glass fiber and waste). The survey aims to identify businesses working with glass fiber and create a network creation and research database. The survey will take approximately 2-3 minutes to fill out.

Thank you for taking part in this survey.

If you want to hear more about the project, please contact Līva Pupure <Liva.Pupure@rtu.lv> , Roberts Joffe <Roberts.Joffe@ltu.se> , Michail Beliatis <mibel@btech.au.dk>.

Project Webpage: https://interreg-baltic.eu/project/glasscircle/

* Required

Information about business

The following questions are related to information about the business working with glass fiber materials and products.

1

Does your business work with glass fiber materials and/or products containing glass fiber?

Yes

No

2

Does your business generate glass fiber waste? *

Yes

No

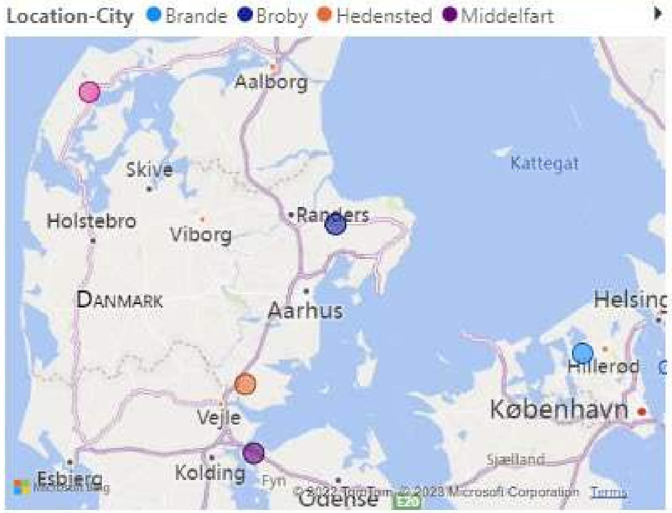
CircleGlass- Digital tool for mapping the GlassFiber Circular Economy Ecosystem in Nordic Countries

Get access in the open digital Atlas tool it allows you to:

Map key players for Glass Fiber within the glass fibers life cycle (manufacturers, users, re-users, recyclers, etc.) within the Baltic Sea region and

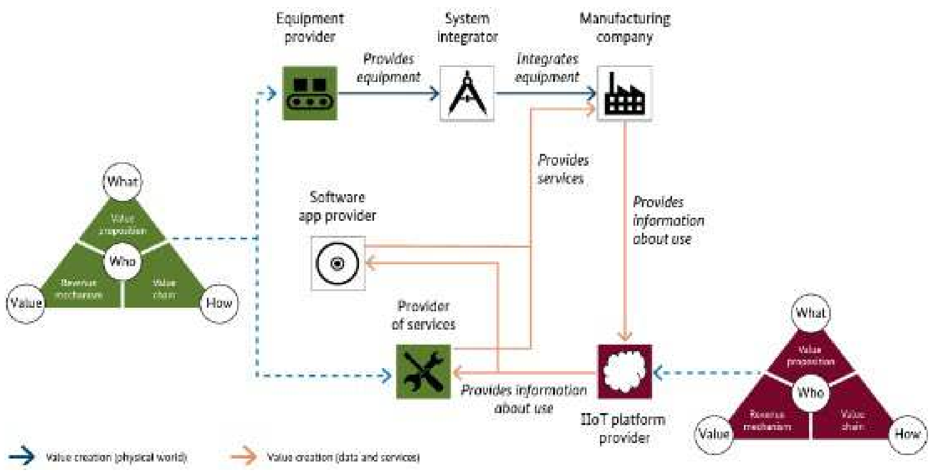
Create a value circular network mapping to foster best practices & connections between glass fiber residue donors with possible receptors for boosting circular use of fiberglass.

First Name of company and First Location-Address by Location-Country and Location-City



Location-Country	Location-City	Name of company	Production	Re-use/repair	Recycle	Supply Chain	Consumption
Denmark	Brande	Siemens Gamesa					X
Denmark	Broby	Dansk Polyglas A/S	X				
Denmark	Hedensted	Poca	X				
Denmark	Middelfart	Fiberline composites					
Denmark	Ringkøbing	Gurit Wind Systems A/S					
Denmark	Roslev	ReFiber			X		

Successful circular economy case



One demo product from Glass Fiber reuse


Supplementary Material

Circular Economy Strategies at Nordic Industrial Ecosystems: Creating Additive Value from Residue Glass Fiber & Circular Business Model Innovation

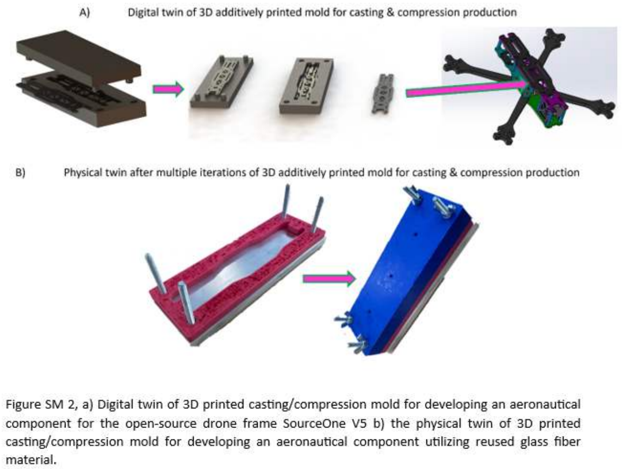
Mads K. Nielsen, Anders M. S. Jakobsen, Michael Lystbæk, Michail J. Beliatis*

Department of Business Development and Technology, Aarhus University, Birk Centerpark 15, 7400 Herning, Denmark

*Corresponding author: mibel@btech.au.dk

a) b)

c) d) e)


A) Digital twin of 3D additively printed mold for casting & compression production

B) Physical twin after multiple iterations of 3D additively printed mold for casting & compression production

Figure SM 2, a) Digital twin of 3D printed casting/compression mold for developing an aeronautical component for the open-source drone frame SourceOne V5 b) the physical twin of 3D printed casting/compression mold for developing an aeronautical component utilizing reused glass fiber material.

Developed one demo product from Glass Fiber reuse

To be published soon

Supplementary Material

Circular Economy Strategies at Nordic Industrial Ecosystems: Creating Additive Value from Residue Glass Fiber & Circular Business Model Innovation

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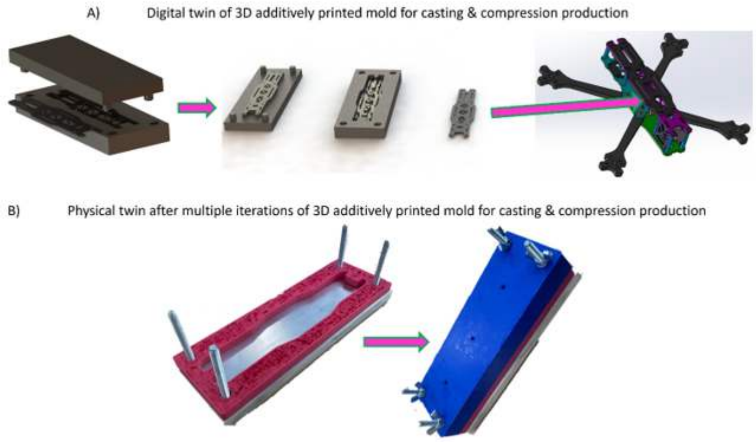


Figure SM 2, a) Digital twin of 3D printed casting/compression mold for developing an aeronautical component for the open-source drone frame SourceOne V5 b) the physical twin of 3D printed casting/compression mold for developing an aeronautical component utilizing reused glass fiber material.

Other Planned activities

Beginning of 2024

Workshop «Business model for circular economy»

1. **Survey and Mapping** of the fibre glass manufacturers and users during various activities at the project Industry. Relevant actors in the fibre glass industry are mapped across the different Baltic sea regions in order to locate the critical subprocesses in the industry that could be supported by digitalization and a circular economy; ON-GOING
2. **Identification of case companies.** Suitable companies that could benefit from the developed digitalization and circular economy solution are identified in corresponding municipalities/countries. 3-5 actors are selected to create a focus group within a specific part of the value chain to co-create a prototype and test the effect before the solution is applied to a larger part of the industry. ON-GOING we welcome suggestion from industry
3. **Development of white paper** with findings from the glass fibre industry on transitioning to a circular economy ON-GOING we welcome contributions from industry and academia

Other Planned activities

Middle of 2023-2024

Survey of communities about the circularity of glass fibre

1. Important information about society's view of glass fibre and its circularity will be obtained;
2. This will also be a way to ask the larger society about their needs since they represent the product end-users
3. Awareness raising of the glass fibre residue waste issue in the larger society

Planned activities

Autumn of 2024

Conference session «GlassCircle – structural use of glass fibre composite materials»

1. Gathering experts from academia and industry to present the latest innovation in the field of reuse, recycling, or recovery of glass fibres;
2. It is planned to have a special issue within a scientific journal with all the session presentations;
3. Separate session where policymakers meet and discuss their approaches, success stories and problems

Database «GlassCircle cluster»

Main outcome of the project

- During the project interested companies will have the opportunity to join our GlassCircle cluster in a form of a database;
- Our target audience is mainly small and medium enterprises, however, we welcome also large enterprises, that produce a large amount of this residue material;
- With the help of this database, we hope to foster practices of the circular economy;
- There is hope, that we might connect glass fibre residue donors with possible receptor companies;
- This database is an opportunity to create new networks and use the obtained information and connections to create further cooperation initiatives

Interested in joining our database?

- Liva (RTU, Latvia):
  Liva.Pupure@rtu.lv
- Roberts (LTU, Sweden):
  Roberts.Joffe@ltu.se
- Michail (Aarhus, Denmark):
  mibel@btech.au.dk

- Or join via our digital survey:
  https://lnkd.in/dUmiUDd8

- More information can be found on the project web-page:
- **interreg-baltic.eu/project/glasscircle**

GlassCircle V2a

Acknowledgments

This project has been funded by European Union

Interreg
Baltic Sea Region

Co-funded by
the European Union

CIRCULAR ECONOMY
GlassCircle

Register *[here](#) (participation in the workshop is free of charge).*

Co-creation WORKSHOP: 1st March 2024

Business Model Co-creation / Ideation for Digital Circular Economy in GlassFiber Large Scale Manufacturing

The final program for GlassCircle parallel session

Type of presentation (on-site or on-line)	Day 1 (01/03/2024) CET Time	
	Opening of Day Project CircleGlass, Michail J. Beliatis (AU-BTECH)	10.00
Address for on-site participants: AU campus Navitas, Inge Lehmanns Gade 10, 8000 Aarhus C. Room: Navitas Auditorium	**Inspirational case: The ecosystem of the glass fiber industry and tools for promoting the transition to a circular economy,** Līga Biezịņa (Valmiera municipality)	10.10
	Kuusakoski Recycling - Circular economy solution for wind blades, Anu Söderena (Kuusakoski Oy)	10:25
Link for on-line participants: Only for registered	**Project EPICENTER Industry LCA cases for young professionals**, *Laura (RTU)*	10.35
https://aarhusuniversity.zoom.us/j/65274254226	**Inspirational case: Glassfiber cutting machines for recycling**, Pavel Chvojka (Advantis)	10.40
	EoLO-HUBs: Circular Business Models and knowledge sharing regarding wind turbine blades *Nina Vielen-Kallio (echt)*	10.50
	Project DigiGlass Inspiration business case, digital systems for GF sorting challenge, *Michail J. Beliatis (AU-DIGIT)*	11.00
	Co-Creation / Ideation & Discussion panel, *modera[...] Justina & Michail (AU)*	11:10
	Concluding remarks	

Scan the QR code to access the event webpage

CLIMATE-NEUTRAL SOCIETIES

The Ecosystem of the Glass Fiber industry and Tools for Promoting the Transition to a Circular Economy

Liga Biezina,
Valmiera Municipality
Government, 01/03/2024

Valmiera

Founded in
1283

19,35
km^2 area

24 868
Population

Valmiera county

Founded in
2021

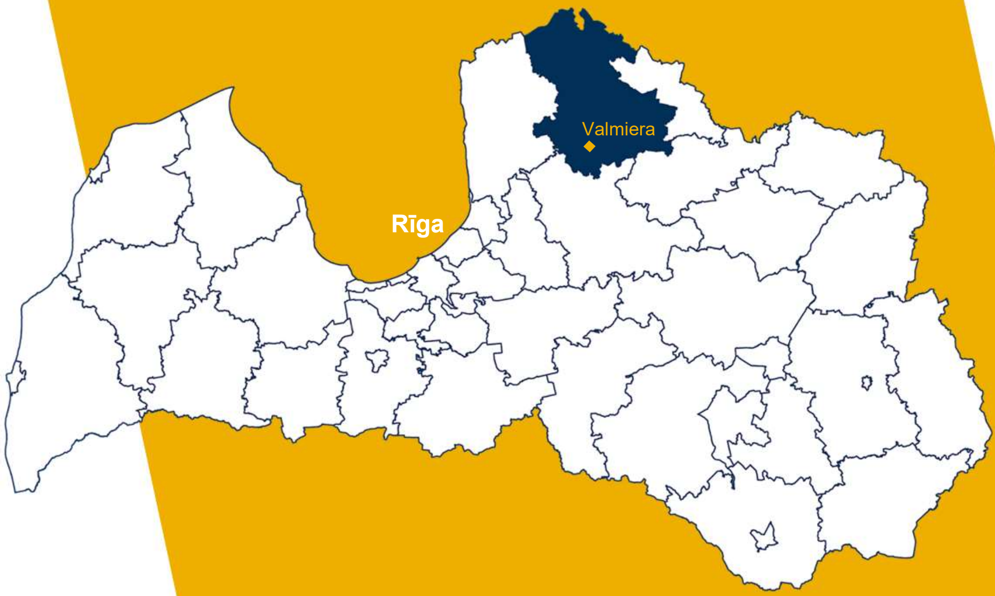
2946
km^2 area

54 642
Population

Valmiera (state city) as a development center

+ 4 cities (incl. Rūjiena, Mazsalaca, Strenči, Seda)

+ 26 parishes



VALMIERAS NOVADS.

The 2nd largest county in Latvia

Valmiera City is an **industrial city** of national importance – it is the **second leading city** in the country in terms of per capita output and exports. The manufacturing industry represents 25% of turnover in Valmiera region and 28% in Valmiera City.

4649

the number of companies in the county

33 806

Population of working age

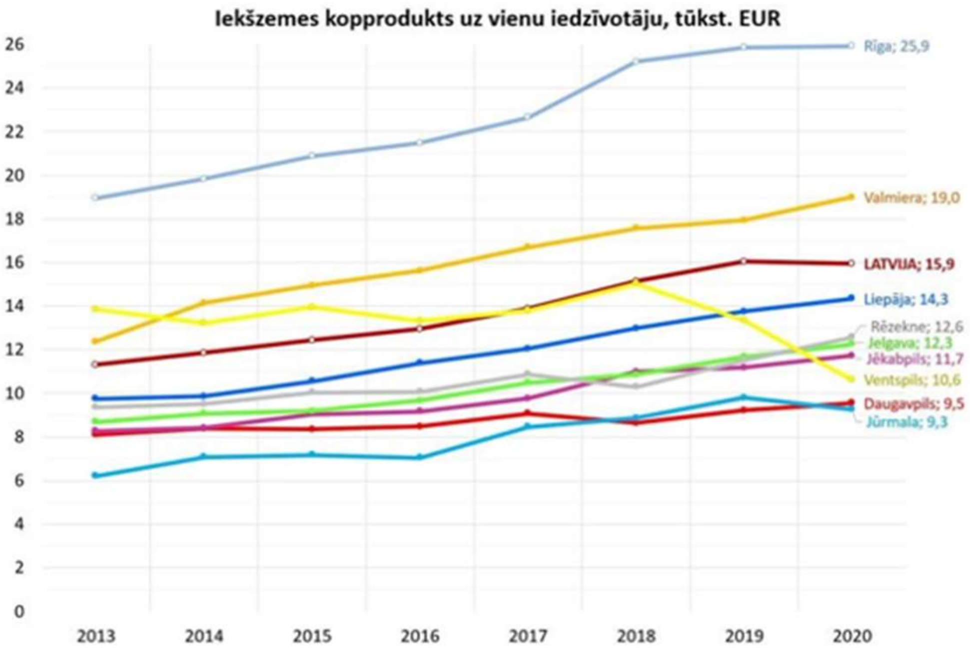
2,8 % in Valmiera
3,3 % in county

unemployment rate

VALMIERAS NOVADS.

An industrial micro-city

Gross domestic product in 2nd place after Riga
EUR 19 000 (2020) per capita



VALMIERAS
NOVADS.

Turnover share of TOP business sectors of Valmiera region

28% agriculture, forestry, fisheries	**17%** wholesale and retail
11% **glass fiber production**	**11%** construction
5% food and beverage production	**5%** health and social care
4% production wood and paper products and furniture	**3%** mechanical engineering and metalworking

Glass fiber industry in Valmiera region

Number of companies
4

The largest companies in the sector by turnover:
- **VALMIERA GLASS Jsc**
- **CULIMETA BALTICS Ltd.**
- **PADTEX INSULATION Ltd.**
- **THERMAL TEX Ltd.**

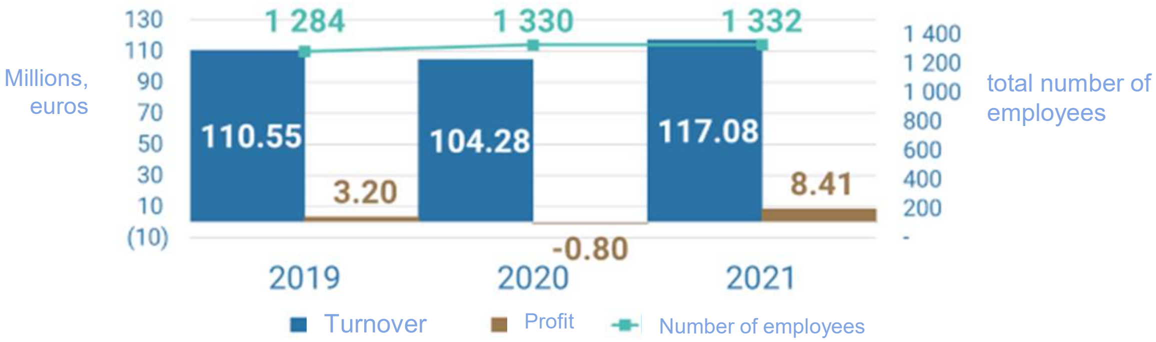
total number of employees:
1332

turnover, euro:
117 078 825

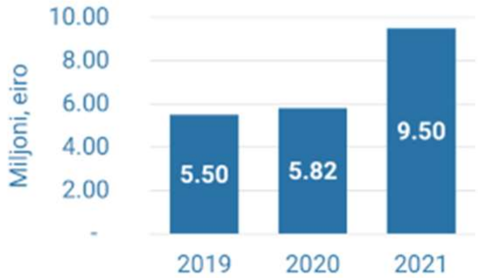
profit, euro:
8 414 613

tax payments to the state budget, euro:
9 504 530

DYNAMICS OF THE GLASS FIBER INDUSTRY 2019 – 2021 [source: Lursoft, 2022]



Tax payments to the state budget 2019 – 2021 [source: Lursoft]



VALMIERAS NOVADS.

* Financial data are presented for the years 2019 - 2021. The data summary shows data for 3 companies, not including SIA Thermal-Tec, which was founded in 2022.

Glass fiber industry in Valmiera region

Products

- fiber thread
- carved fiber
- fabrics and filters
- textile membranes
- steam, gas and sound turbine insulation solutions
- fire blankets
- heat and sound insulation materials

Export countries

- Germany
- Finland
- Belgium
- Czech Republic
- United Kingdom
- United Arab Emirates
- Italy
- Poland

VALMIERAS
NOVADS.

Valmiera Glass

VALMIERAS
NOVADS.

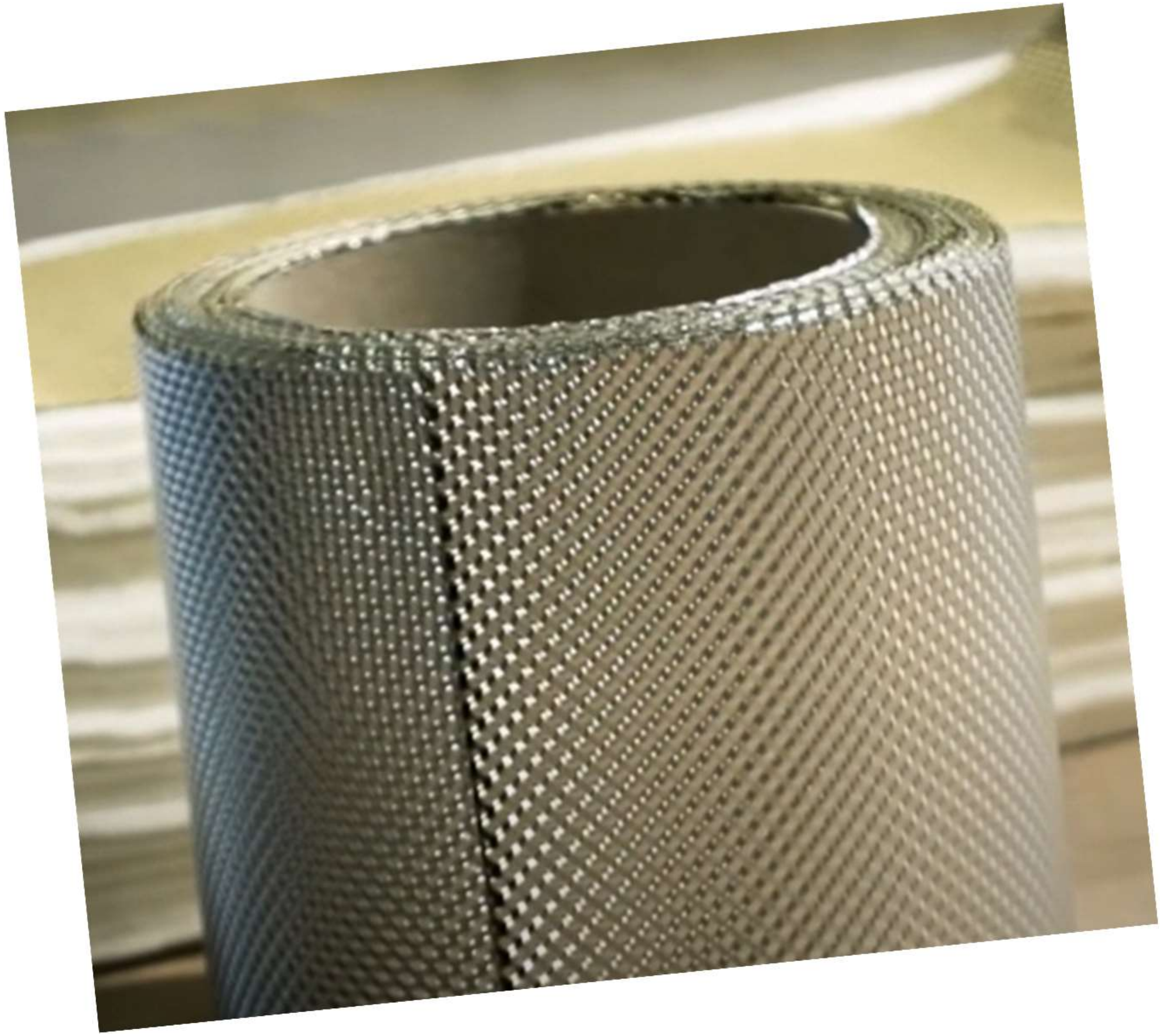
Culimeta Baltics

VALMIERAS
NOVADS.

Padtex Insulation

VALMIERAS
NOVADS.

Thermal - Tec



VALMIERAS
NOVADS.

The circularity challenge

- Growing restrictions and rising costs of the waste storage
- The solutions found, mostly, are not cost-effective or commercializable
- The waste and emission treatment of chemical formulations like sizing, finishing and coating are not the least issues for the glass fibre producers
- Environmentally-friendly solution for the desizing and the solutions for waste logistics might be a game-changer for the use of the glass fibre companies

VALMIERAS
NOVADS.

Municipal tools for promoting transition

- Planning documents
- Green public purchase
- Support for business reorientation through structural funds of the European Union
- Citizen information and promotion of collective consciousness
- Application of circular economy principles in the daily operation of the municipality, e.g.,
  - responsible consumption of resources,
  - the use of smart technologies,
  - digitization of processes,
  - recycling

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Planning documents – EU level

- European Green Deal
- Agenda to transform EU economy into a circular one
- The new Circular Economy Action Plan as part of the New Industrial strategy

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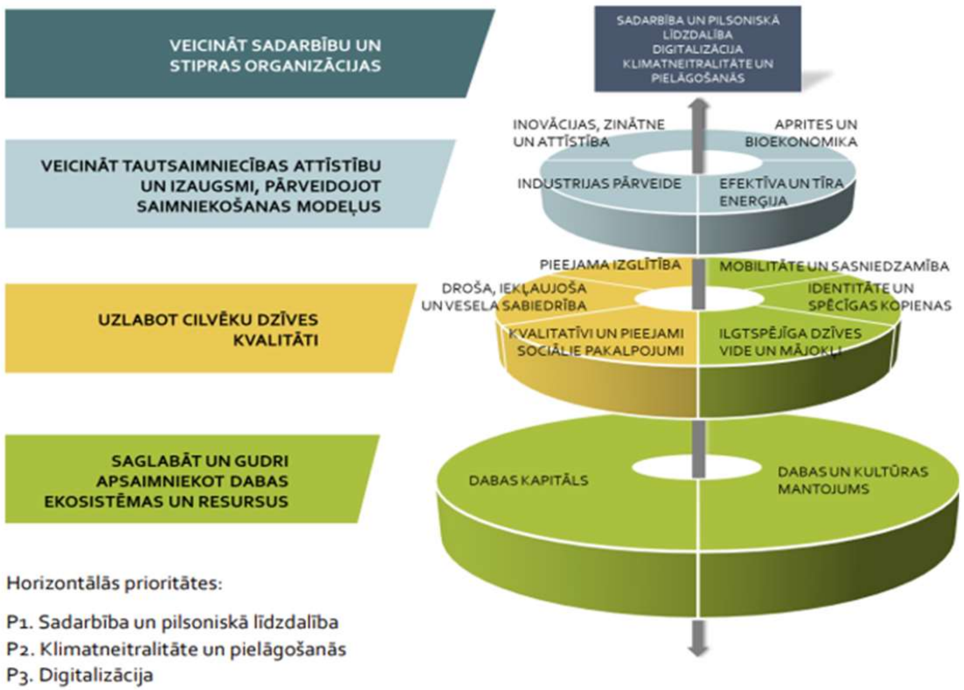
NOVADS.

Planning documents – national level

- Latvian Strategy for Reaching Climate Neutrality by 2050
- Action plan for the transition to the circular economy 2020-2027
- National waste management plan 2021-2028

Planning documents – regional level

- Development programme 2022-2027 of Vidzeme Planning Region
- Vidzeme Regional waste management plan for 2023 - 2027



Planning documents – municipal level

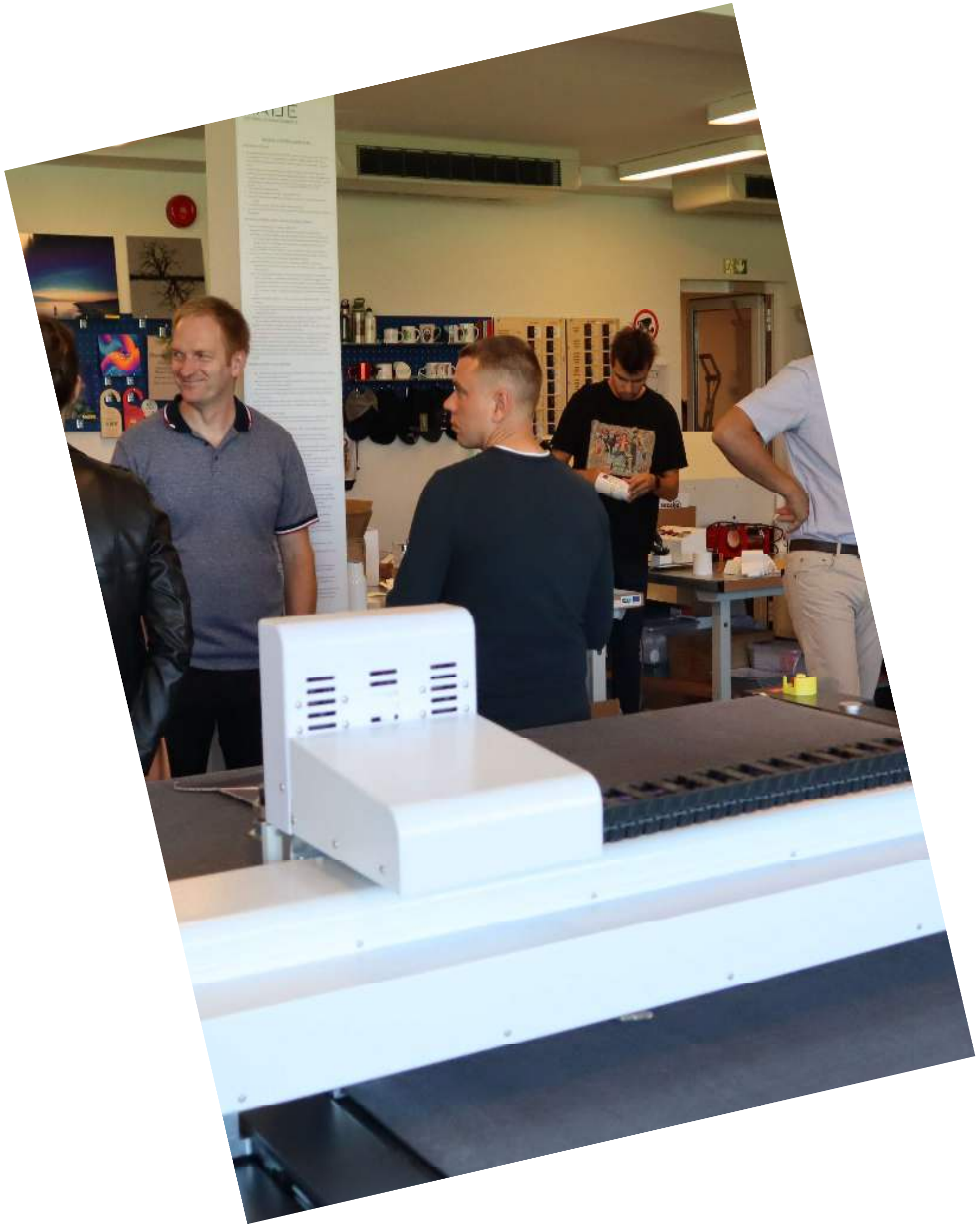
- Sustainable Development Strategy 2022 – 2038
  - industrialization and growth of circular economy as part of the vision
  - Every economic sector as a sector of circular economy
  - The promotion of wider application of circularity principles within the current companies

- Development programme 2022 – 2028
  - Circularity within the top-down priorities
  - Circularity within the horizontal priority – "Climate change policy (the Green Deal)"

Waste management & circular economy & Climate neutral society

For fostering the transition to circular economy three projects financed by the INTERREG programme are being implemented:

- Glass Circle
- BALTIPLAST
- Circular Spaces



VALMIERAS NOVADS.

Hackathon “Daibe Zero”

www.daibezero.lv

DaibeZero2o21 and DaibeZero2023

VALMIERAS NOVADS.


VALMIERA

Co-funded by the European Union

EPICENTRE

Educational Platform lIfe Cycle assEssmeNt sTRucturEs

Laura Vitola

Aarhus, 1.03.2024.

Co-funded by the European Union

The European Institute of Innovation and Technology RawMaterials connects stakeholders and actors from different parts of the raw materials value chain creating a unique collaborative environment for breakthrough innovations.

EPICENTRE

Synergy

Synergies between academia and industry are vital for the development of society

Sustainability

Sustainability is the main key to preserving our planet

Policies

The GreenDeal aims to to set the EU on the path to a green transition, with the ultimate goal of reaching climate neutrality by 2050.

LCA/LCC

Increasing demand for life cycle assessment in both academia and industry

EPICENTRE

The team of EPICENTRE

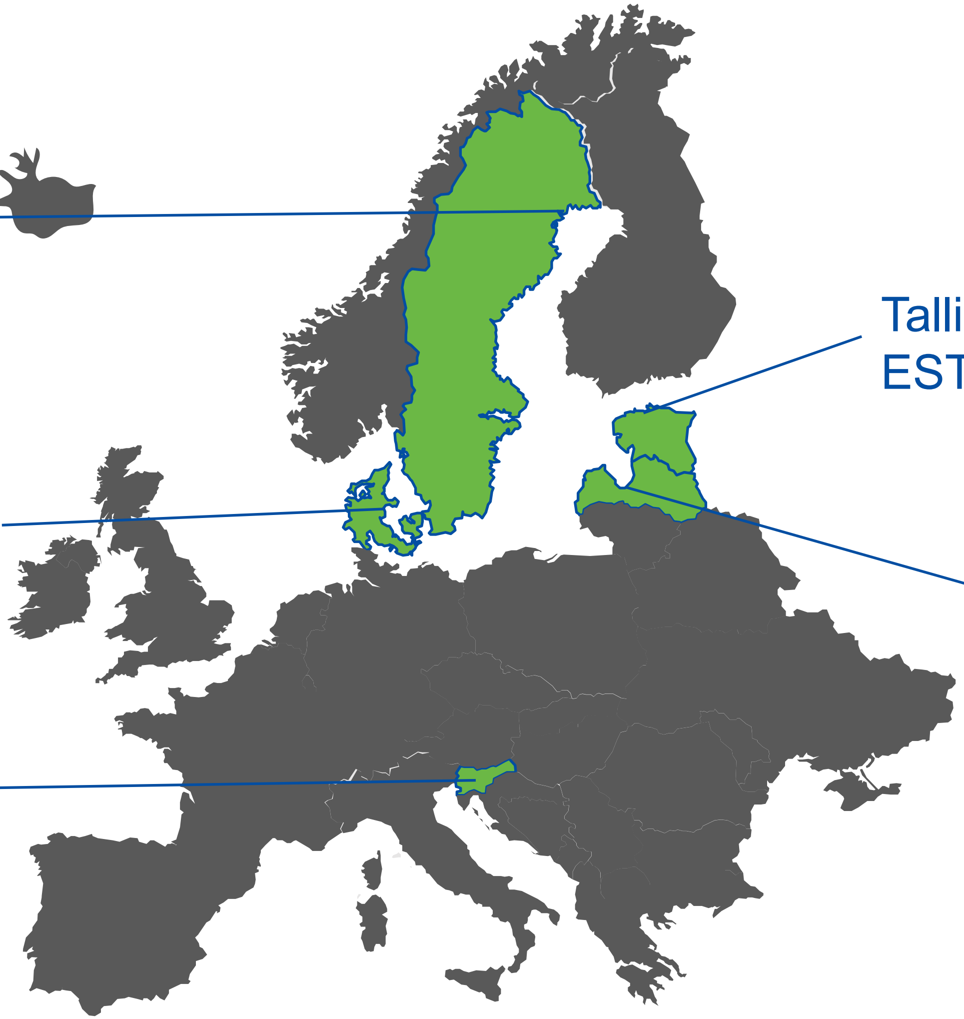
Lulea University of Technology
SWEDEN

Tallinn University of Technology
ESTONIA

Aarhus University
DENMARK

Riga Technical University
LATVIA

Slovenian National Building
and Civil Engineering Institute
SLOVENIA



1862
RIGA TECHNICAL UNIVERSITY

LULEÅ UNIVERSITY OF TECHNOLOGY

TAL TECH

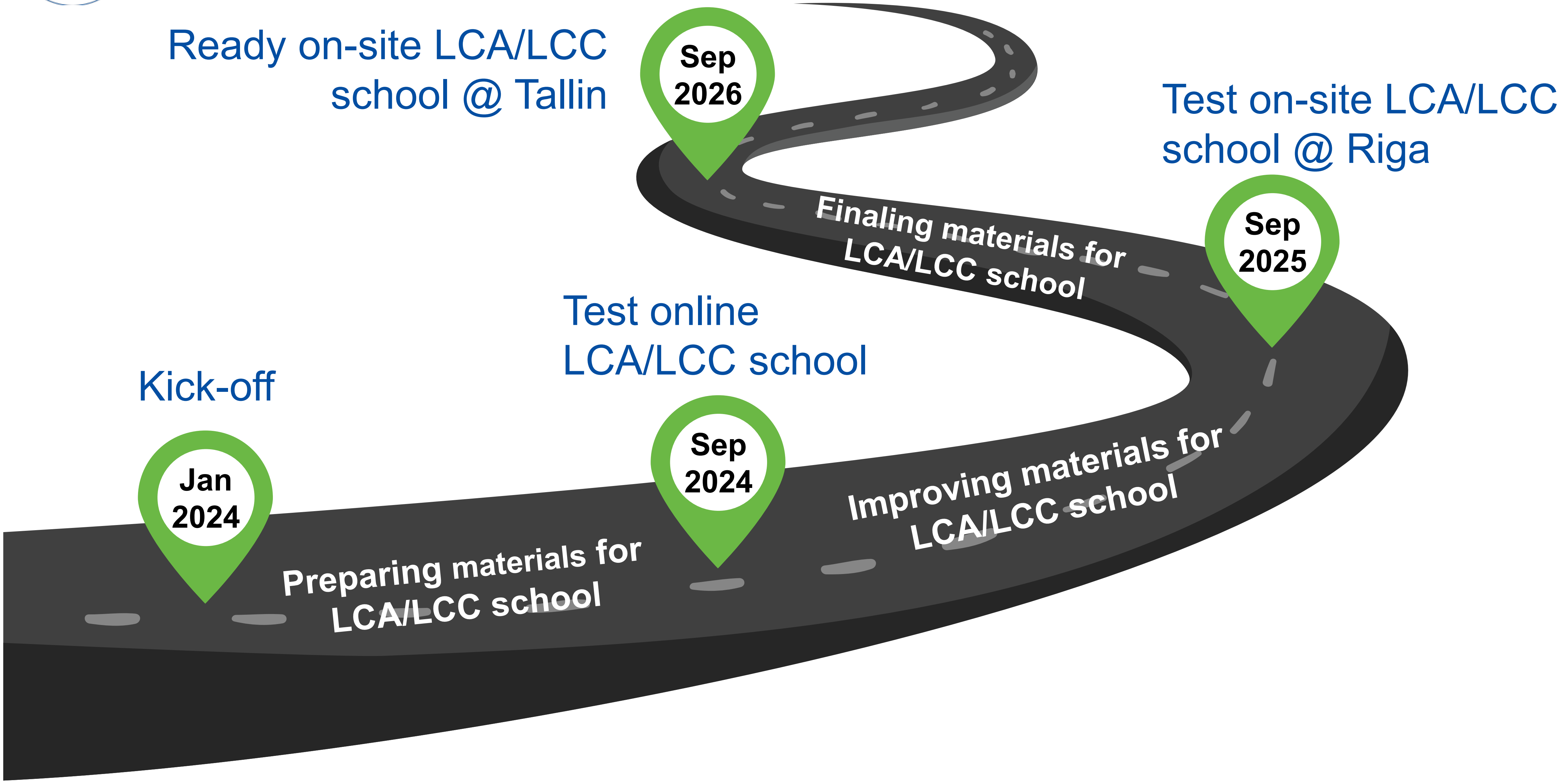
AARHUS UNIVERSITY

ZAG
ZAVOD ZA GRADBENIŠTVO SLOVENIJE
SLOVENIAN NATIONAL BUILDING AND CIVIL ENGINEERING INSTITUTE

The aim of EPICENTRE

To fill a critical gap in the sector's education and training programs by providing an **innovative and dynamic platform** for learning, assessing, and improving **LCA/LCC methodologies**.

The roadmap of EPICENTRE

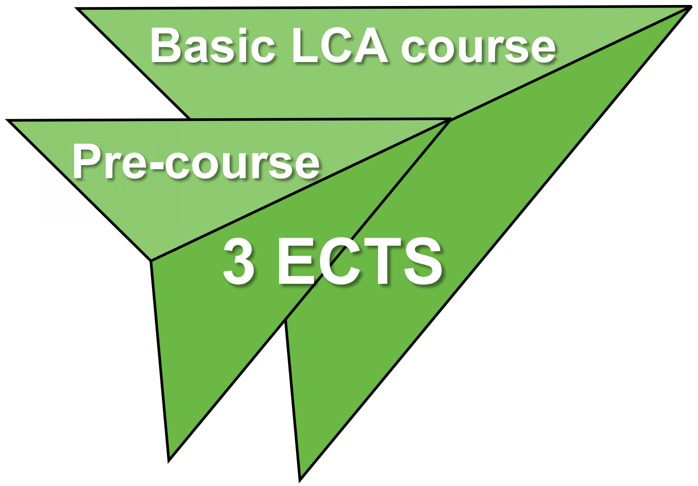


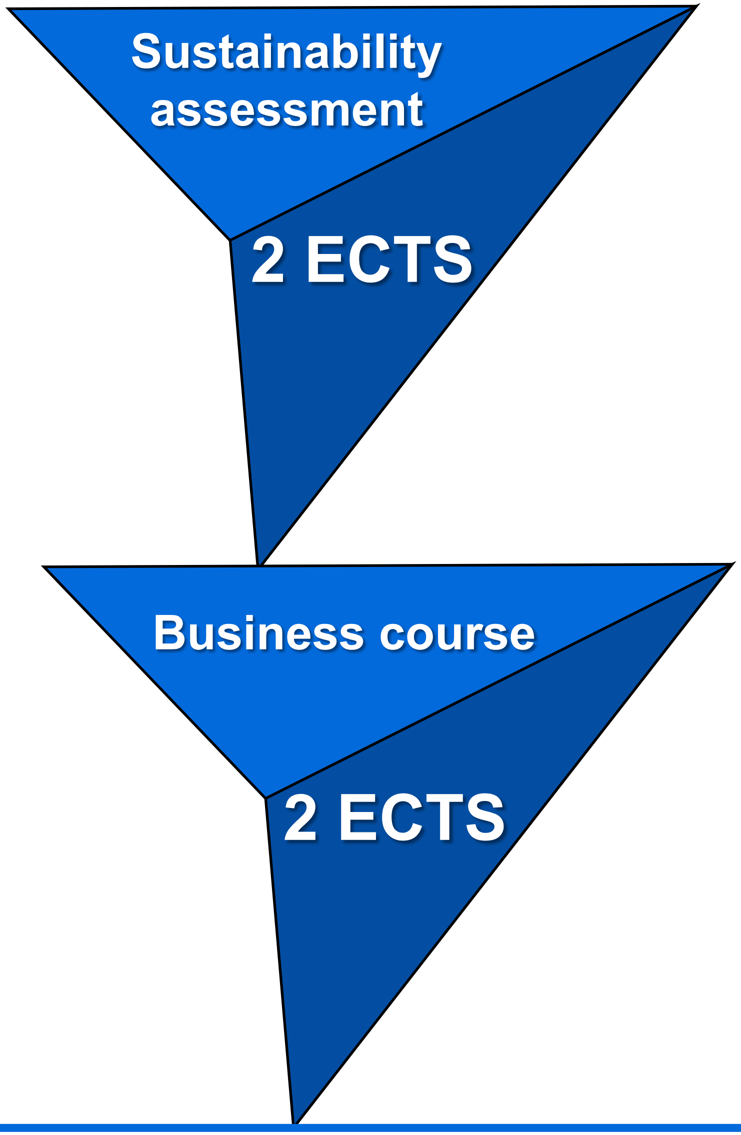
Structure LCA/LCC school

EPICENTRE

Basic level

- Online pre-course (3-4 weeks)
- On-site Basic LCA course (2 days or 16 acad. hours)
- Independent work
- Includes mentoring





Advanced level

- On-site LCA and LCC course (3 days or 12 acad. hours)
- On-site Business course (3 days or 12 acad. hours)
- Independent work
- Includes mentoring

EPICENTRE

Be ambitious and take the opportunity to understand the life cycle of your product/technology/process!

Join EPICENTRE LCA/LCC school!

@RTU
Diana Bajare
diana.bajare@rtu.lv

@TalTech
Veiko Karu
veiko.karu@taltech.ee

@LTU
Roberts Joffe
roberts.joffe@ltu.se

@AU
Michail Baliatis
mibel@btech.au.dk

@ZAG
Davor Kvocka
davor.kvocka@zag.si

EIT RawMaterials
Connecting matters

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EPICENTRE
for sustainable future

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LULEÅ UNIVERSITY OF TECHNOLOGY

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SLOVENIAN NATIONAL BUILDING AND CIVIL ENGINEERING INSTITUTE

AARHUS UNIVERSITY

ADVANTIS ENGINEERING

DEVELOPMENT OF FLEXIBLE WTB CUTTING SYSTEM FOR END-OF-LIFE BLADES

ADVANTIS, Project Engineer – Pavel Chvojka

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ADVANTIS ENGINEERING

- Advantis Founded in 2017 by Allan Wad Petersen, Kim D. Jensen & Peter Ejs Eltzholtz
- Consulting Mechanical Engineering Company
- Office and Prototype Facilities in Hinnerup, Denmark
- Currently 12 Mechanical Engineers & 2 Projects Managers
- Renewable Energy Sector – OEMs - Vestas & Siemens Gamesa
- Strategy of Incubating Own Products - Development and Commercializing of Own Products e.g. Flexible Blade Cutter System -> To be separated into own entity “SUSTEQ”
- Partnering and Exploring New Business Opportunities

ADVANTIS ENGINEERING

Wind industry calls for Europe-wide ban on landfilling turbine blades by 2025

https://windeurope.org/newsroom/press-releases/wind-industry-calls-for-europe-wide-ban-on-landfilling-turbine-blades/

Vattenfall commits to landfill ban and to recycle all wind turbine blades by 2030

https://group.vattenfall.com/press-and-media/pressreleases/2021/vattenfall-commits-to-landfill-ban-and-to-recycle-all-wind-turbine-blades-by-2030

Ørsted commits to either reuse, recycle, or recover all of the wind turbine blades in its global portfolio of onshore and offshore wind farms upon decommissioning

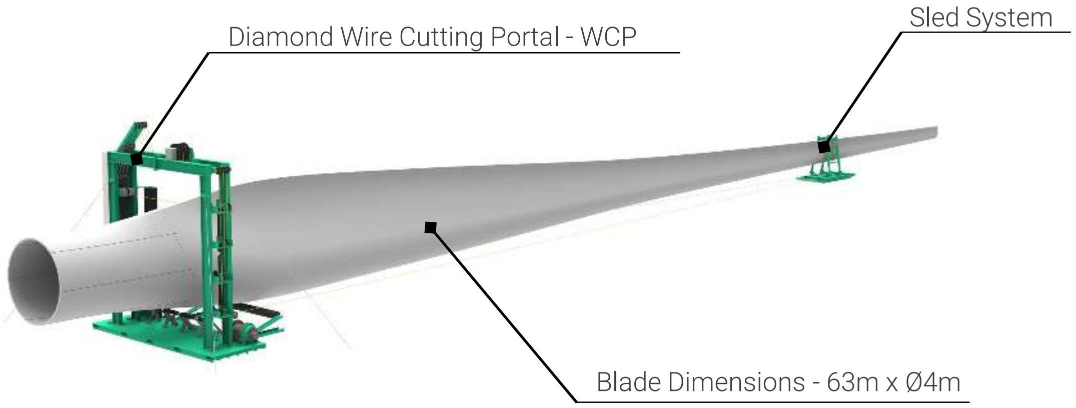
https://orsted.com/en/media/newsroom/news/2021/06/702084352457649

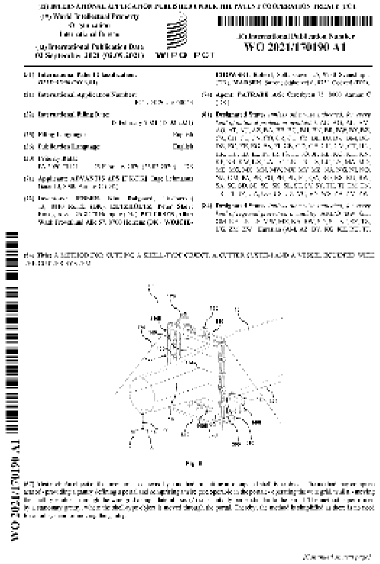
Equipment developed by Advantis

(WO2021/170190 A1 [A method for cutting shell-type object, a cutter system and a vessel equipped with the cutter system])

Features

- Diamond Wire Cutting Portal – WCP
- Environmental Protection System – Dust Collection System
- Fully scalable solution – Can handle all current existing turbine blades on the marked
- On-site solution – reduction of CO2 emissions and cost related to blade return transport
- Semi-automatic wire guiding feeding system
- Light equipment weight to size ratio (5-7 tons pr. system)
- Several systems can be fitted on standard truck 20” HQ Containers
- Sectioning in manageable pieces before pre-shredding (utilizing commercially available pre-shredding systems)
- Sectioning in customized pieces allowing for several post treatment options




WO 2021/170190 A1

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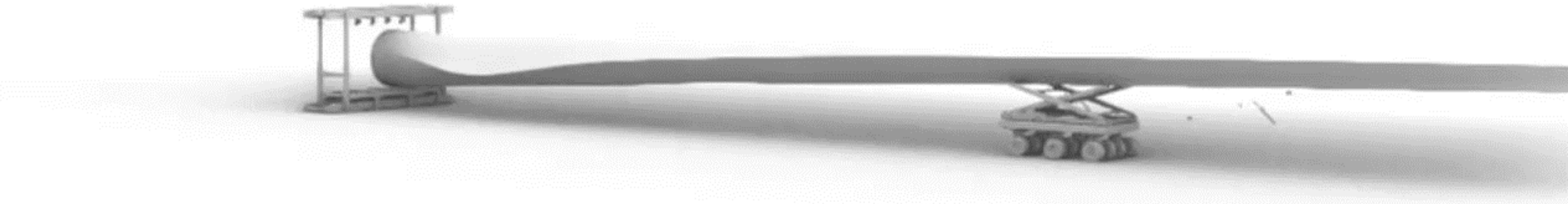

European project EoLO-HUBs will develop innovative solutions to recycle high value materials from wind turbine blades

PARTNERS

Co-funded by the European Union

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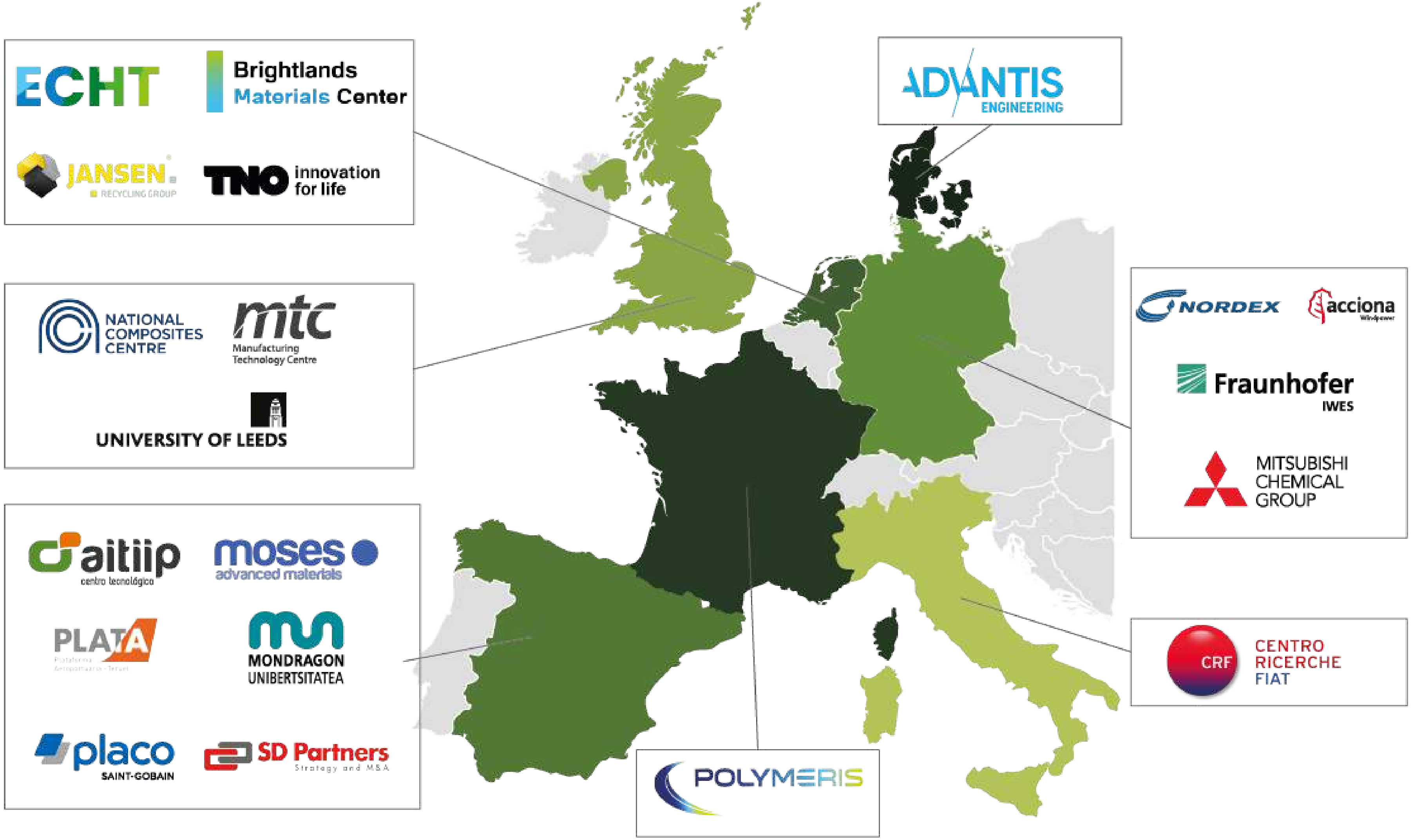
ECHT
Brightlands Materials Center
JANSEN RECYCLING GROUP
TNO innovation for life
NATIONAL COMPOSITES CENTRE
mtc Manufacturing Technology Centre
UNIVERSITY OF LEEDS
aitiip centro tecnológico
moses advanced materials
PLATA
MONDRAGON UNIBERTSITATEA
placo SAINT-GOBAIN
SD Partners Strategy and M&A
ADVANTIS ENGINEERING
NORDEX
acciona Windpower
Fraunhofer IWES
MITSUBISHI CHEMICAL GROUP
CRF CENTRO RICERCHE FIAT
POLYMERIS

ADVANTIS ENGINEERING

European project EoLO-HUBs will develop innovative technologies to recycle high value materials from wind turbine blades

EoLO-HUBs, co-funded with almost 10 million euros by the European Union, **will recover glass and carbon fibre from large thermoset structures** which have reached the end of their useful life.

EoLO-HUBs' solution will provide an answer to the three main areas involved in the decommissioning and recycling of end-of-life wind turbines:

1.**Decommissioning and pre-treatment of wind turbine blades**, including handling, non-destructive inspection tools, cutting, shredding, and sorting.

2.Sustainable **fibre reclamation processes** addressing two alternative technologies: Low carbon pyrolysis and green chemistry solvolysis.

3.**Upgrading processes for the recovered fibres**, including both glass fibre and carbon fibre.

Goal of the WTB cutting machine

- **Decrease costs** associated with WTB decommissioning by introducing an automated process
- **Improve workplace safety** by automating the process of cutting, and de-creasing exposure to hazardous dust.
- **Increase the possibilities and likelihood of recycling WTBs** through separation of un-wanted material
- Create **new business and product opportunities** with precise and repeatable cutting into more desirable objects that require less processing down the line.

Many more creative possibilities where that came from

Previous studies by **Genvind**, a similar recycling consortium show **favorable conclusions with direct re-use of WTB's in second life application**

QUESTIONS or IDEAS?

Pavel Chvojka

pch@advantis.dk

Linkedin.com/in/pavelchvojka/

CONFIDENTIAL

Circular Business Models and knowledge sharing regarding wind turbine blades

Co-funded by the European Union

EoLO HUBS

ECHT
Nina Vielen-Kallio
Lead of Circularity in Energy Transition

Date: 1st of March 2024

Intro

EoLO HUBS

ECHT

ECHT directs and accelerates sustainable strategic transitions to concrete business in the blue and green economy

Nina Vielen-Kallio
Lead of Circularity in Energy Transition
Nina@echt.community

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Agreement No 101096425 - EoLO-HUBs - HORIZON-CL5-2022-D3-01

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EoLO HUBS

01 Project

What is EoLO-HUBs

1 Project – High overview

- Horizon Europe, 10 MEUR, 18 partners

- 1. **Decommissioning and pre-treatment** of wind turbine blades, including handling, non-destructive inspection tools, cutting, shredding, and sorting.

- 2. **Sustainable fibre reclamation** processes addressing two alternative technologies: Low carbon pyrolysis and green chemistry solvolysis.

- 3. **Upgrading processes** for the recovered fibres, including both glass fibre and carbon fibre

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1 Project - Partners

EoLO HUBS

aitiip centro tecnológico
ADVANTIS ENGINEERING
Brightlands Materials Center
CRF CENTRO RICERCHE FIAT
ECHT
Fraunhofer
JANSEN RECYCLING GROUP
MITSUBISHI CHEMICAL GROUP
MONDRAGON UNIBERTSITATEA
moses advanced materials
mtc Manufacturing Technology Centre
NATIONAL COMPOSITES CENTRE
NORDEX
acciona Windpower
placo SAINT-GOBAIN
PLATA Plataforma Aeroportuaria - Teruel
POLYMERIS
SD Partners Strategy and M&A
TNO innovation for life
UNIVERSITY OF LEEDS

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EoLO HUBS

02 Circular and Sustainable Business Models (CSBM)

How are CSBM developed in the project

2. Circular and Sustainable Business models

- Often Business Models developed bottom up and driven by technology
- Holistic approach missing, which is crucial for Circular Business Models (by default, larger group of stakeholders involved)
- EoLO-HUBs assesses successful Circular Business Models (theory and practice)
- Key focus on development of **Decision Making Framework** with top-down approach
- = Circular and **SUSTAINABLE** Business Models (CSBM)

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2. CBM – Examples of drivers

EoLO HUBS

- Political, such as net zero targets
- Economic (growth)
- Social / job opportunities
- Technical (innovations)
- Environmental / carbon savings
- Legal in waste management

Built based on research of A. Velenturf et co, University of Leeds

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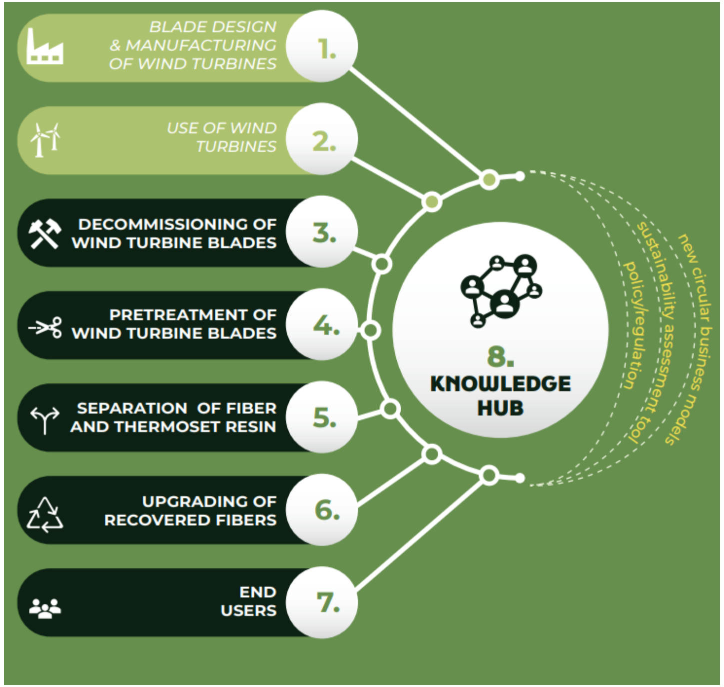
03

Knowledge sharing

Knowledge Hub

3. Knowledge Hub content



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EoLO HUBS

04 Invitation

Opportunity to become part of the solution

4. Join, learn, share

EoLO HUBS

- Knowledge Hub of EoLO-HUBs is interactive
- Wind Turbine Blades, but also other composites
- Connected with sister projects
  - Baldes2Build
  - ReFresh

- **Website** https://www.eolo-hubs.eu/

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Nina Vielen-Kallio
Lead of Circularity in Energy Transition
Nina@echt.community
+31 6 520 90 273

CO-CREATION WORKSHOP

CASE STUDY DIGI-GLASS INSPIRATION BUSINESS CASE, DIGITAL SYSTEMS FOR GF SORTING CHALLENGE

VALUE NETWORK CHAIN ECOSYSTEM IN CIRCULAR ECONOMY

VALUE NETWORK CHAIN ECOSYSTEM FOR CIRCULAR ECONOMY

Step 1 Map your Value Chain Ecosystem to Identify Potential CE Opportunities
Step 2 Map your Business and Production Processes to Identify CE Hindering Bottlenecks

Sorting of scrap/residue materials can be resource challenging hindering CE business processes

WHY move from Linear to Circular Economy?

1. Towards Zero Waste
2. Resource Conservation
3. Sustainability
4. Economic Growth
5. Social Benefits, local jobs

AN ID & VERIFIED BOTTLENECK FOR CE IN GF IS SORTING SCRAP/RESIDUE IN SHOP FLOORS

In your opinion, what hinders the use of GF residues/waste?
10 responses

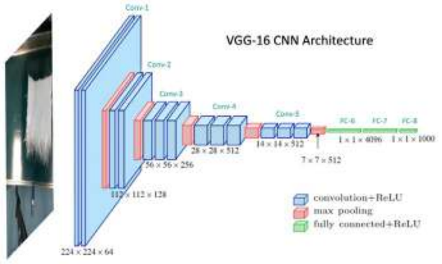
- Uncontrollable/unknown properties
- Not enough information about the availability and quality of fibers
- Lack of communication between actors
- Uncertain supply chain/amounts
- No local availability
- mostly downcycling happens - as such industries outside of common continuous fibre application must step in
- It is not economically feasible
- Logistics
- Unawareness

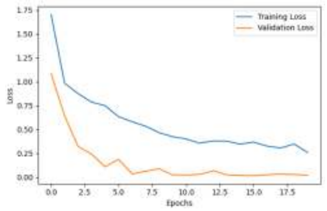
DIGI GLASS: ROBOTIC – MACHINE VISION AS A PROPOSED SOLUTION FOR ENABLING AUTONOMOUS SORTING #TESTING FEASIBILITY IN DIGITAL TWINS

Development flow of AI-based robotic sorting of residue glass fiber waste

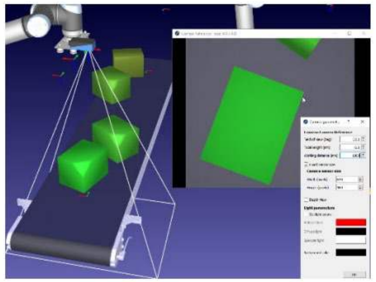
Decide on different dry residue glass fibers

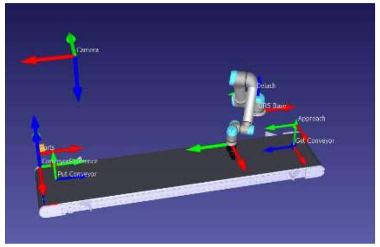
Dataset creation through testing and image construction





Creation training/ testing of Convolutional neural network

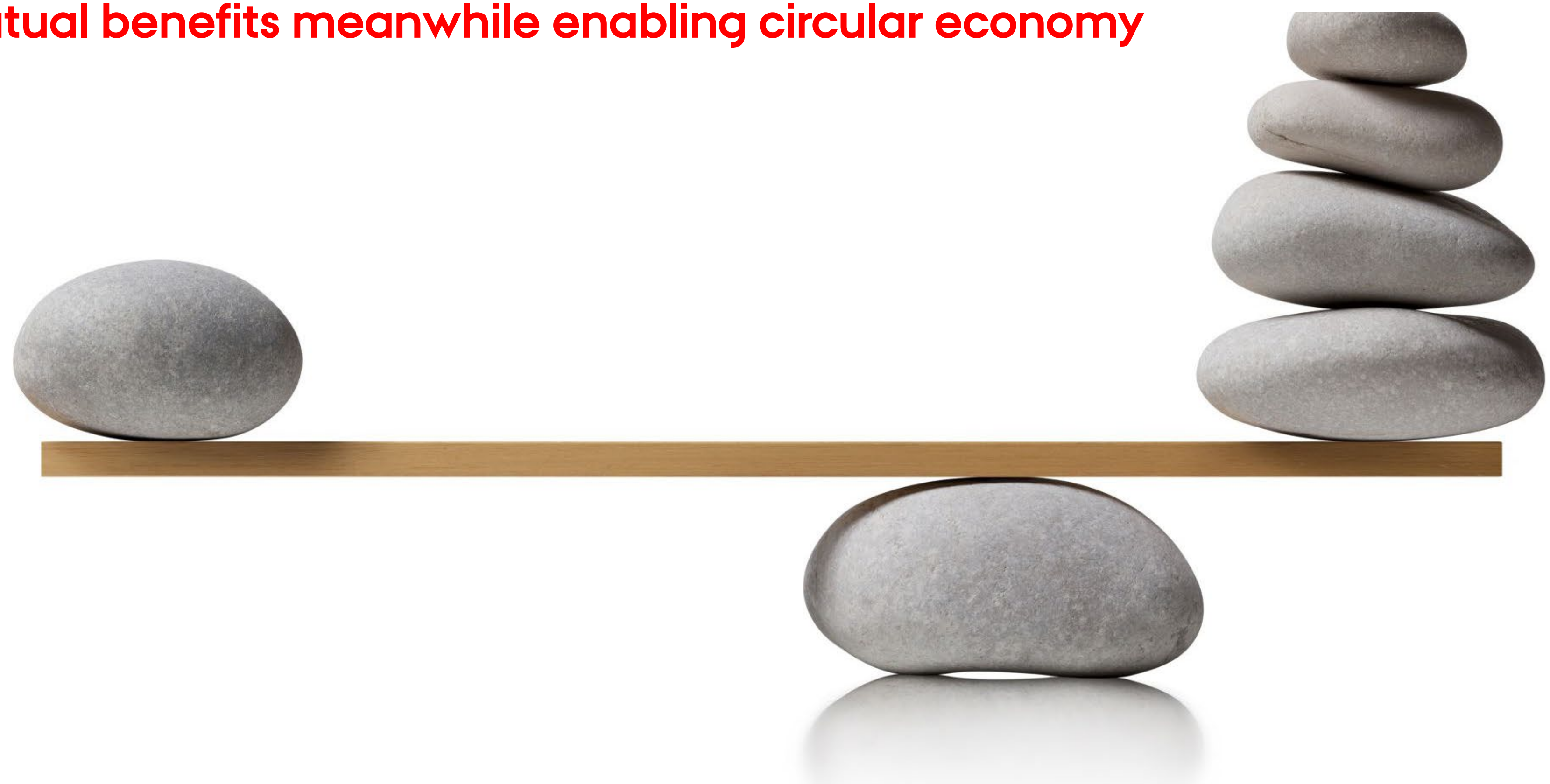




Creation of "Digital Twin" of the system

STEP 3 CO-CREATE BUSINESS MODELS FOR MUTUAL BENEFIT

Co-create / Ideate new business models with your value network chain ecosystem aiming to generate mutual benefits meanwhile enabling circular economy



STEP 3 CO-CREATE BUSINESS MODELS FOR MUTUAL BENEFIT

Co-create / Ideate new business models with your value network chain ecosystem aiming to generate mutual benefit

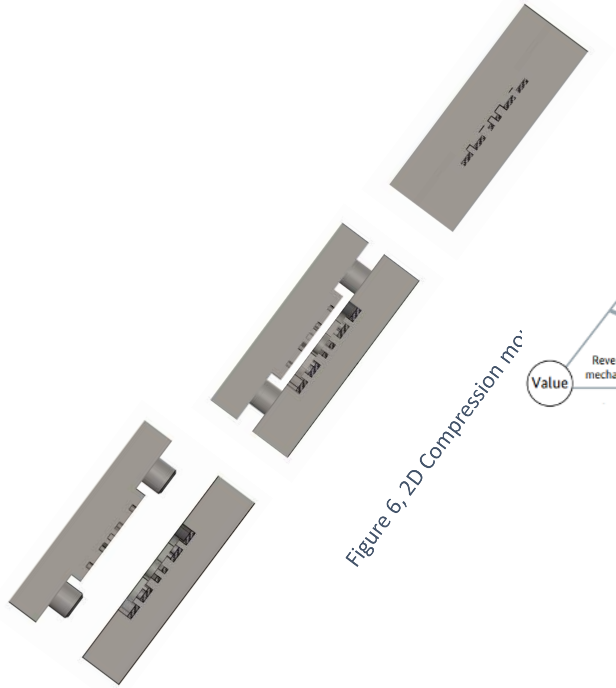


Figure 6, 2D Compression mo

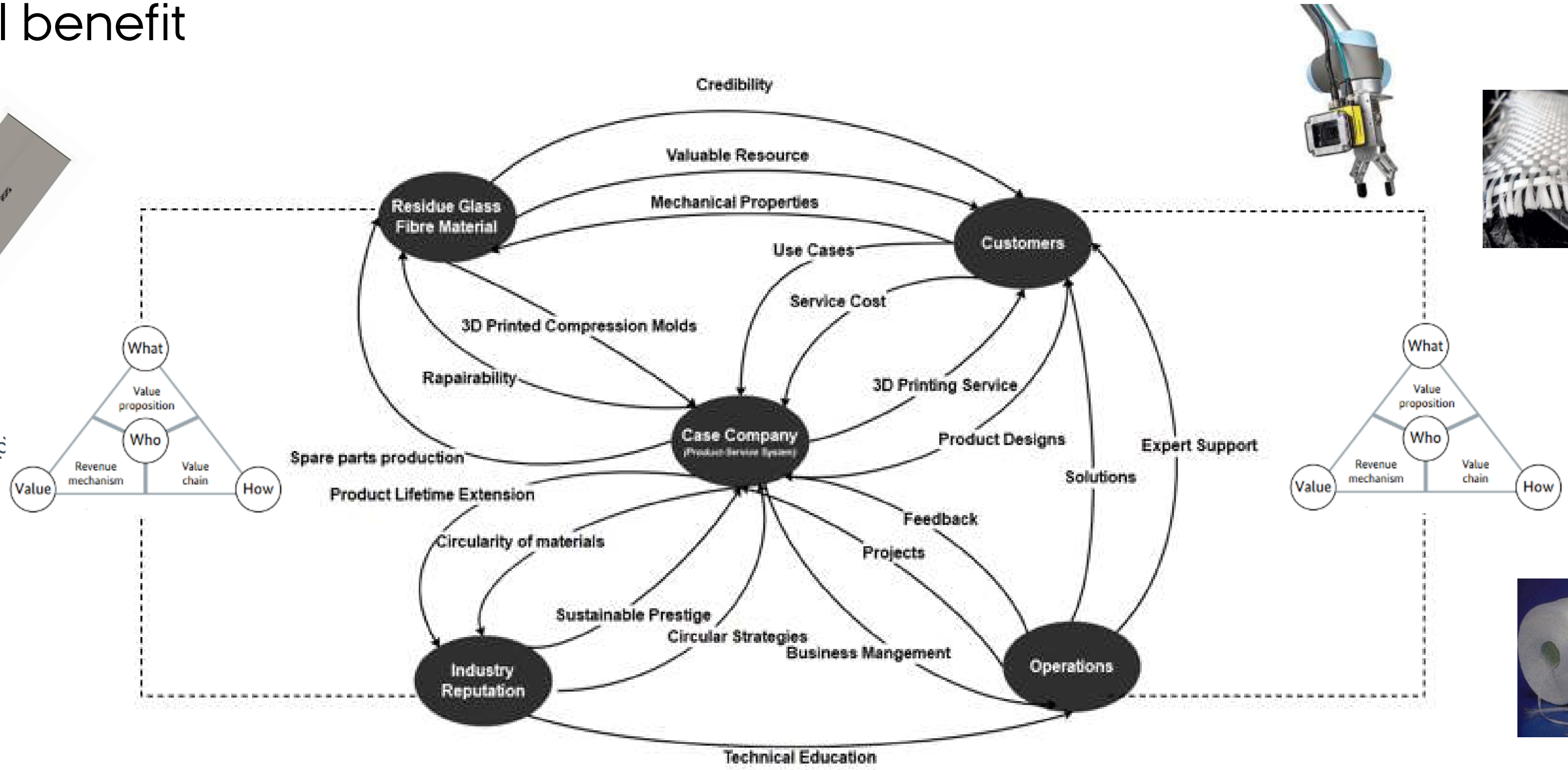


Figure 9. Analysis of business models within the case' business value network, based on St. Gallen Business Model Navigator

Automatic sorting system

INSTRUCTIONS: TAKE THE BUSINESS MODEL TEMPLATE FROM LINK

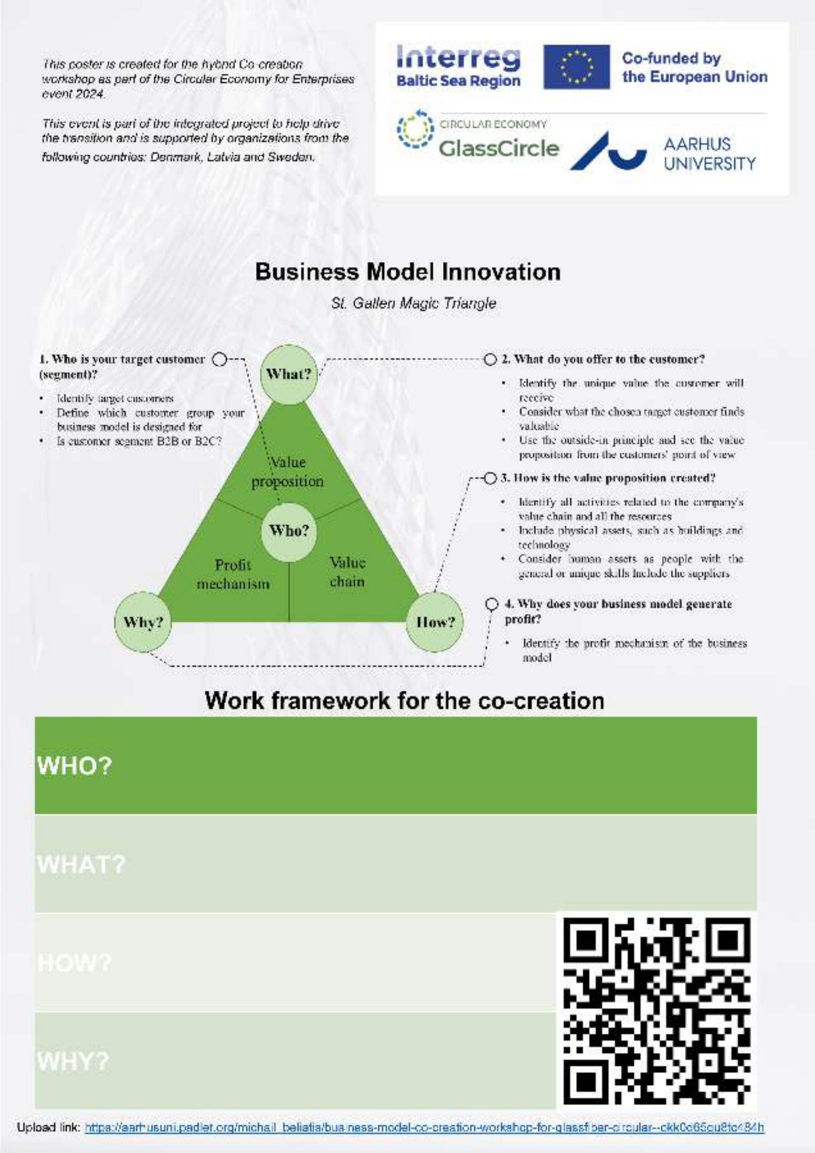
Step 0 Download/Upload Link : https://aarhusuni.padlet.org/michail_beliatis/business-model-co-creation-workshop-for-glassfiber-circular--okk0d65gu8tc484h

Step 1 Map your Value Chain Ecosystem to Identify Potential CE Opportunities (identify a customer or supplier who could use your GF residue/scrap)

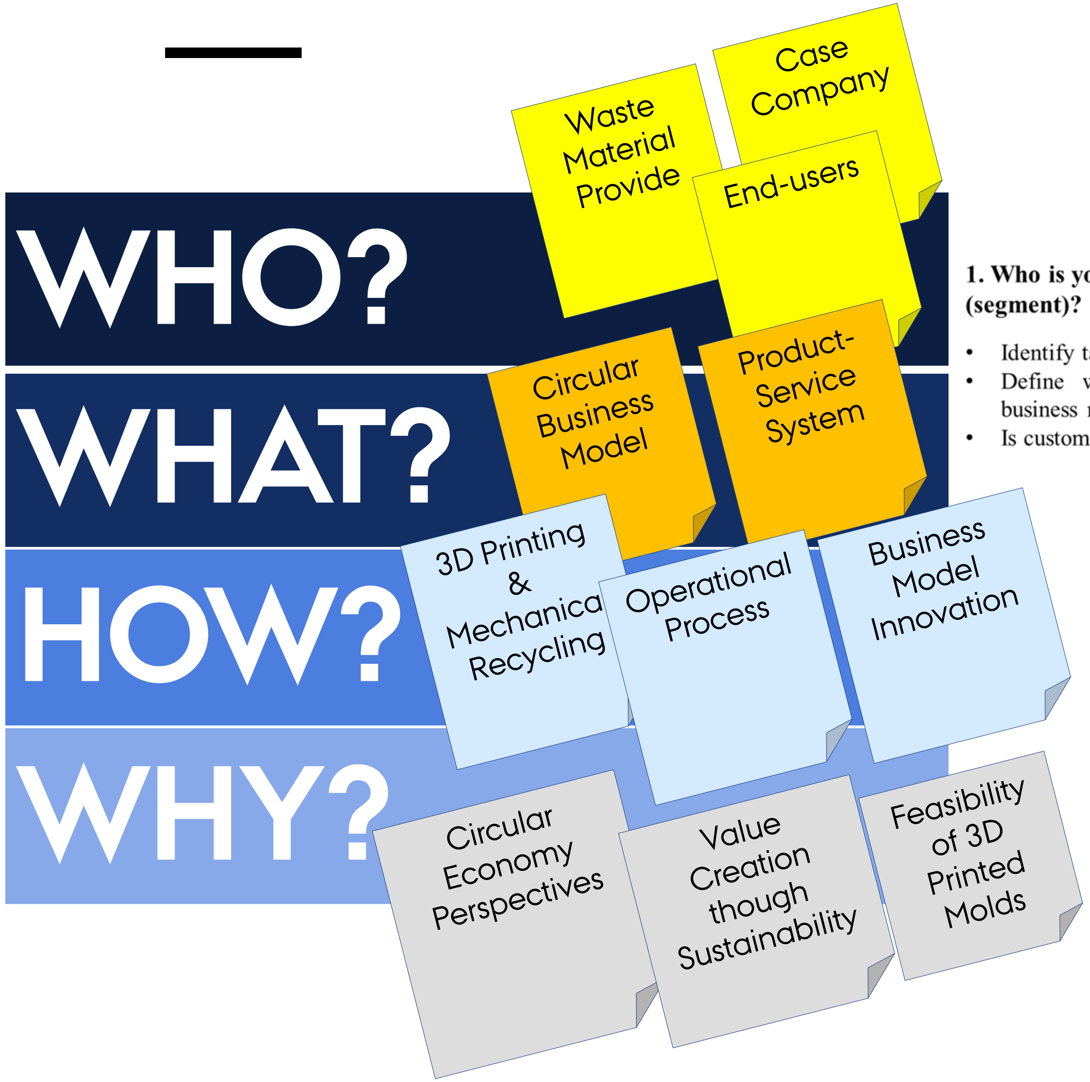
Step 2 Map your Business and Production Processes to Identify CE Hindering Bottlenecks (would a robotic shorting of GF residue could support your manufacturing process for CE? Let us know)

Step 3 Create a Business Model with value proposition (what) aiming for mutual benefit filling the template and then take a photo and upload you it at online dashboard

Step 4 Write some feedback comment or wish to be pashed it at EU commission and national policy makers

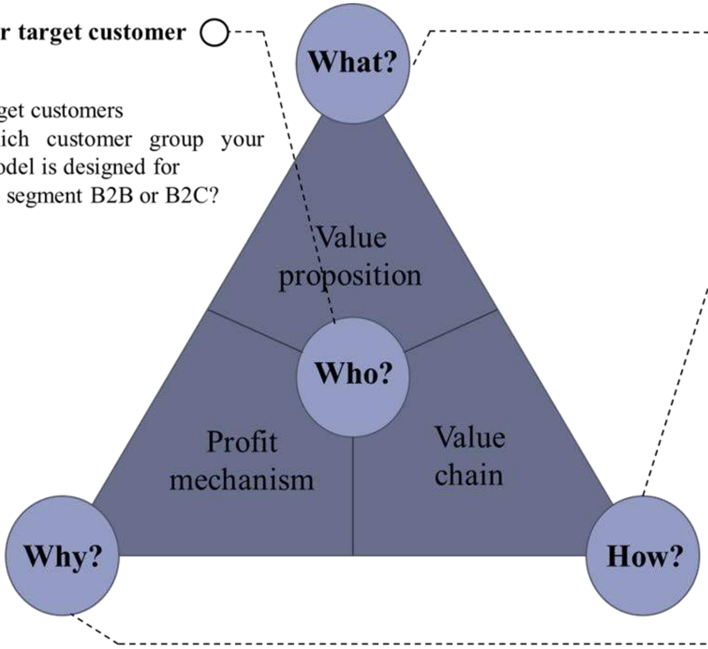


ANY VOLANTER CASE?



1. Who is your target customer (segment)?

- Identify target customers
- Define which customer group your business model is designed for
- Is customer segment B2B or B2C?



2. What do you offer to the customer?

- Identify the unique value the customer will receive
- Consider what the chosen target customer finds valuable
- Use the outside-in principle and see the value proposition from the customers' point of view

3. How is the value proposition created?

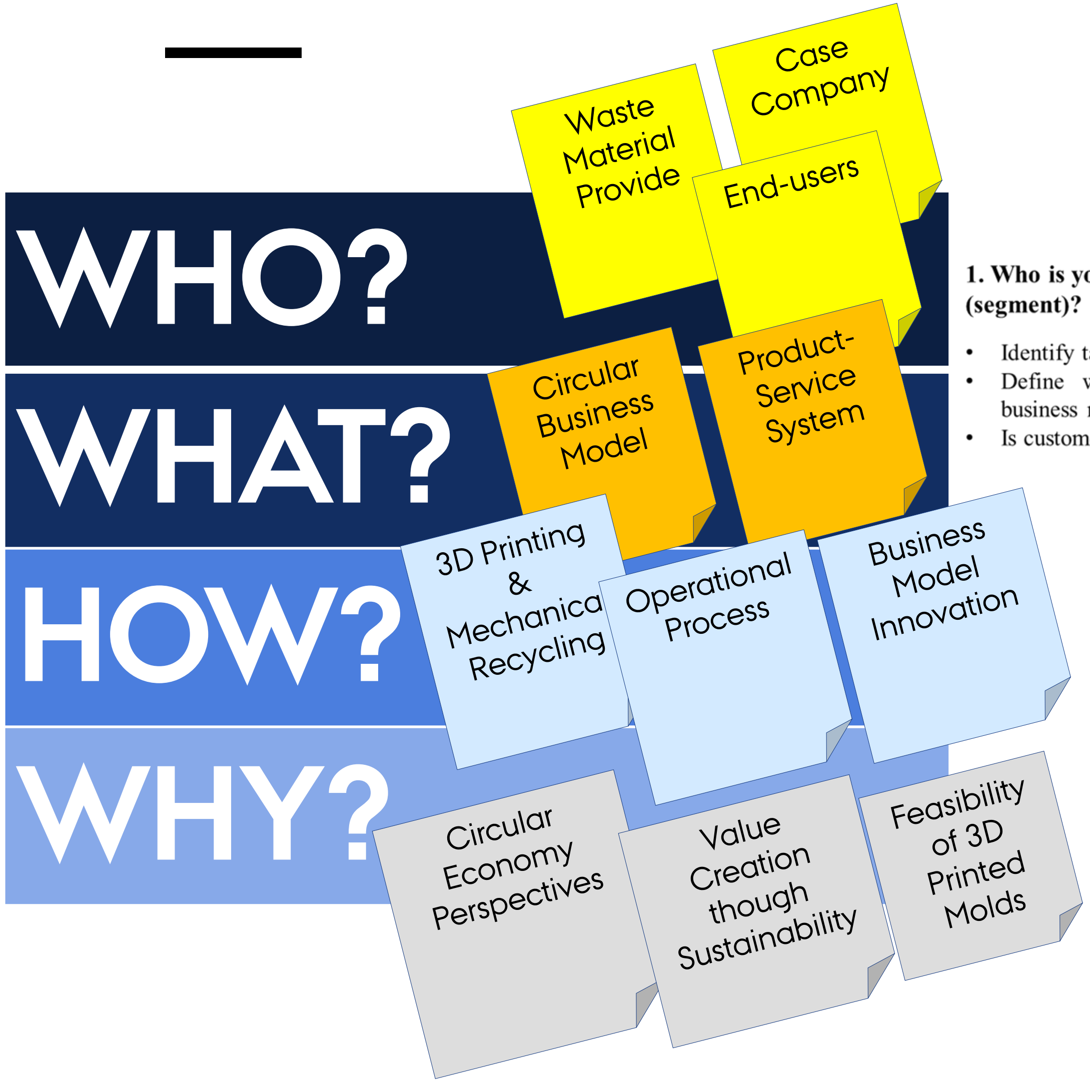
- Identify all activities related to the company's value chain and all the resources
- Include physical assets, such as buildings and technology
- Consider human assets as people with the general or unique skills Include the suppliers

4. Why does your business model generate profit?

- Identify the profit mechanism of the business model

INSPIRATION CASE FOR BUSINESS MODEL INNOVATION WITH THE ROBOTIC SOLUTION & ST. GALLEN MAGIC TRIANGLE

Interreg Baltic Sea Region
Co-funded by the European Union
CIRCULAR ECONOMY GlassCircle



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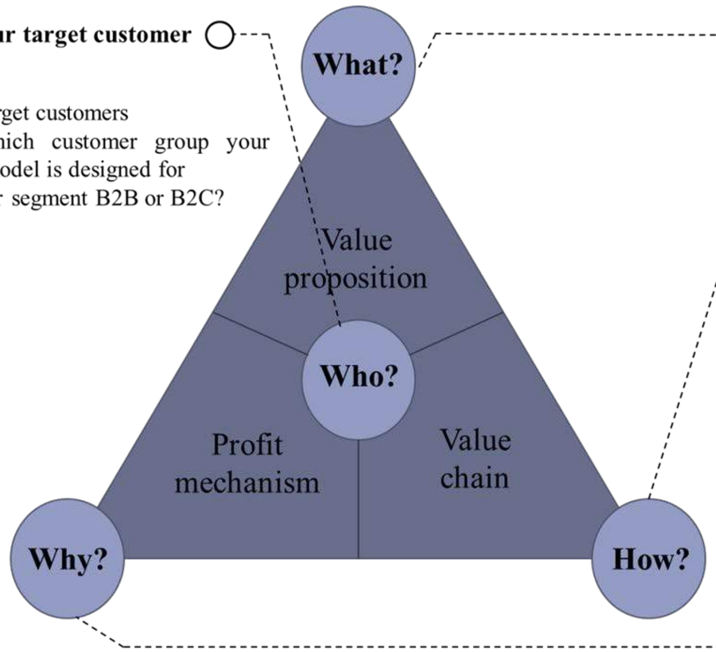

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- Identify the profit mechanism of the business model

FULL WORKSHOP FEEDBACK

Got to **menti.com** the code **2717 4050**

Or

https://www.menti.com/alpuiqm1yyoq

DEPARTMENT OF BUSINESS DEVELOPMENT AND TECHNOLOGY
AARHUS UNIVERSITY

Interreg
Baltic Sea Region

Co-funded by
the European Union

CIRCULAR ECONOMY
GlassCircle

Exploring full cycle circular economy for glass fibre industry

Riga | 25/09/2025
Liva Pupure

interreg-baltic.eu/project/glasscircle

Background

How it all came together:

During glass fibre manufacturing, as well as in many composite manufacturing processes a significant amount of residue material is generated.

Currently, a large amount of this residue glass fibres product is buried in a landfill

Background

How it all came together:

Part of this residue consists of relatively good-quality glass fibres or fabrics

This problem of glass fibre residue is common for many companies dealing with glass fibre or composite manufacturing – thus it would be more efficient to work together to solve this issue

GlassCircle

Objectives

The goal of the project: To create a **strong cluster** consisting of key players within the **glass fibres life cycle** (manufacturers, users, re-users, recyclers, etc.) within the Baltic Sea region

The project aims to **bring together** *industry*, *experts*, and *scientists*, as well as *public authorities* within the field – to **exchange knowledge** and **discuss the possible solutions** and **necessary next steps** for faster change from a linear to a circular economy within the glass fibre and composite industry.

Project consortium

Partners from Latvia, Sweden, Denmark

Project lead partner:

Riga Technical University (Latvia)

Contact person: Liva Pupure, Liva.Pupure@rtu.lv

Project partners:

Lulea University of Technology (Sweden)

Contact person: Roberts Joffe, Roberts.Joffe@ltu.se

Aarhus University (Denmark)

Contact person: Michail Beliatis, mibel@btech.au.dk

Podcomp AB (Sweden)

Hitachi Energy Sweden AB, Composites (HPAG) (Sweden)

Valmiera Municipality Government (Latvia)

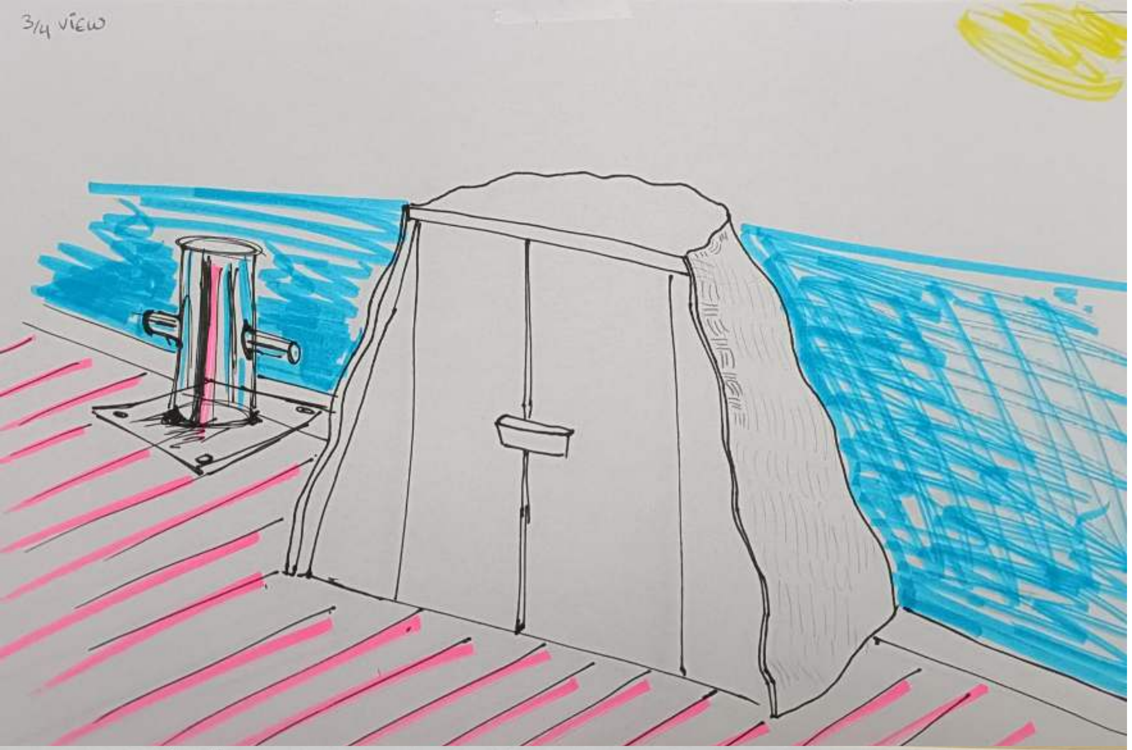
Passed activities

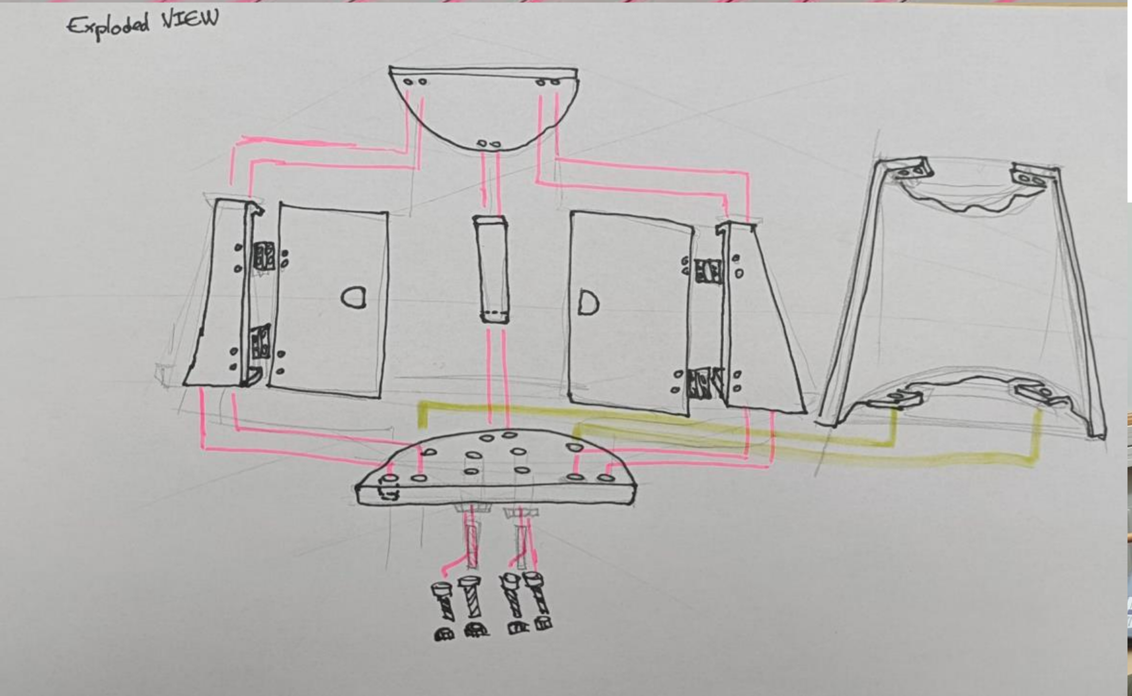
Hackathon «GlassCircle»

Hackathon «GlassCircle»

1. Participants from Latvia, Denmark and Sweden
2. Five new ideas generated
3. Student groups did excellent in the short time span they got.


WINNERS
AWARD
500€
VALMIERA GLASS
GROWTH
AWARD
250€
VALMIERA GLASS





Winners:

Team 2: Interior design or furniture elements with specific requirements: **Locker out of glass fibers – from marine industries residue.**

11:10 - 11:40

Giving boats manufacturing waste a new life and sailors more,

Augustine Hueso and Maria Bohic, Luleå University of Technology former students

Passed activities

14-15 September, 2023

Workshop on Environmental and economical feasibility to recover glass fibers

- LCA of glass fiber;
- Best practice stories from the industry

Register here (participation in the workshop is free of charge).

Interreg Baltic Sea Region
Co-funded by the European Union
CIRCULAR ECONOMY GlassCircle

WORKSHOP: 14-15 September 2023

Environmental and economical feasibility to recover glass fibers

The final program

Day 1 (14/9)		Day 2 (15/9)	
Welcome!	15.00	**Opening of Day-2**	08.55
Workshop's agenda, *Zainab Al-Maqdasi (LTU)*	15.15	**Glass fibers - strong but sensitive,** *Christina Scheffler (IPF)*	09.00
GlassCircle project, *Liva Pupure (RTU)*	15.30	**Role of recycling industry,** Martins Niklass *(ZAAO)*	09.30
Mapping glass fiber ecosystem for value creation thought circular use, *Student presentation (AU)*	16.00	**Industries: issues and solutions** - *Anders Holmberg (Hitachi)* - *Birgitha Nystrom (PodComp)* - *Martins Millers (Valmiera Glass)*	 09.50 10.10 10.30
Concluding remarks	16.30	***Break***	10.50
		Introduction to LCA, *Carmen Cristescu (SLU)*	11.10
Link for on-line participants: zoom https://aarhusuniversity.zoom.us/j/64855629034		**Waste mineral wool upcycled into alkali-activated facade panels and cobblestones with LCA,** *Barbara Horvat (ZAG)*	11.40
		Giving recycled fiberglass a new life in circular products, *Jakob W Nielsen (MILJØSKÆRM)*	12.10
		Break	12.30
		Discussion panel, *moderated by Z. Al-Maqdasi and R. Joffe (LTU)*	12.50
		Concluding remarks	13.50

Scan the QR code to access the event webpage

CLIMATE-NEUTRAL SOCIETIES

Passed activities

1 March, 2024

Co-Creation Workshop: Business Model Co-creation / Ideation for Digital Circular Economy in GlassFiber Large Scale Manufacturing

Agenda

Time	Item
10:00 - 11:45	• 10:00 – Opening of Day Project CircleGlass, Michail J. Beliatis (AU-BTECH) • 10:10 – Inspirational case: The ecosystem of the glass fiber industry and tools for promoting the transition to a circular economy, Līga Bieziņa (Valmiera municipality) • 10:25 – Kuusakoski Recycling – Circular economy solution for wind blades, Anu Söderena (Kuusakoski Oy) • 10:35 – Project EPICENTER Industry LCA cases for young professionals, Laura Vītola (RTU) • 10:40 – Inspirational case: Glassfiber cutting machines for recycling, Pavel Chvojka (Advantis) • 10:50 – EoLO-HUBs: Circular Business Models and knowledge sharing regarding wind turbine blades Nina Vielen-Kallio (echt) • 11:00 – Project DigiGlass Inspiration business case, digital systems for GF sorting challenge, Michail J. Beliatis (AU-DIGIT) • 11:10 – Co-Creation / Ideation & Discussion panel, moderated by Justina & Michail (AU) • 11:30 – Concluding remarks & feedback

Survey of General public

2023-2024

<u>**Survey of communities about the circularity of glass fibre**</u>

1. Important information about society's view of glass fibre and its circularity will be obtained;
2. This will also be a way to ask the larger society about their needs since they represent the product end-users
3. Awareness raising of the glass fibre residue waste issue in the larger society

12:40 - 13:10

Results of survey about glass fiber residue of general public,

Liga Biezina, Valmiera municipality

Database «GlassCircle cluster» and success story

Interreg Baltic Sea Region

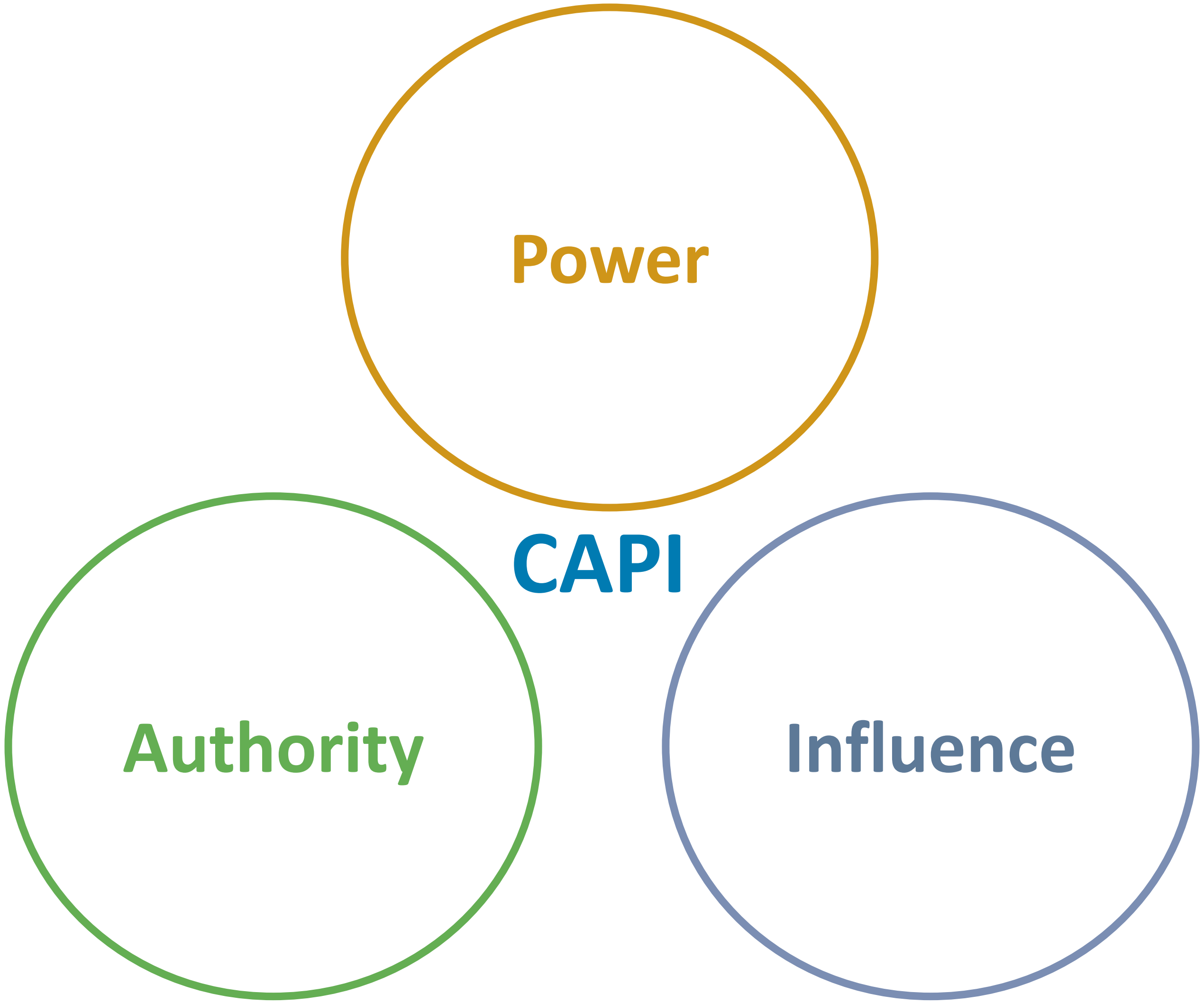
Co-funded by the European Union

CIRCULAR ECONOMY
GlassCircle

Interested in joining our database?

Liva (RTU, Latvia): Liva.Pupure@rtu.lv
Roberts (LTU, Sweden): Roberts.Joffe@ltu.se
Michail (Aarhus, Denmark): mibel@btech.au.dk

What is needed to implement change



CAPI - Coalesced Authority, Power and Influence

Final conference

Exploring full cycle circular economy for the glass fiber industry

We have CAPI in the same room – let’s make the change happen!

Recycling of fibre composites

Anders Sjögren

Department of Design Sciences
Lund University, Sweden

Disposition

- Sustainable use of fibre composites
- Recycling processes
- Future developments

Sustainable use of composites

[Farplas]

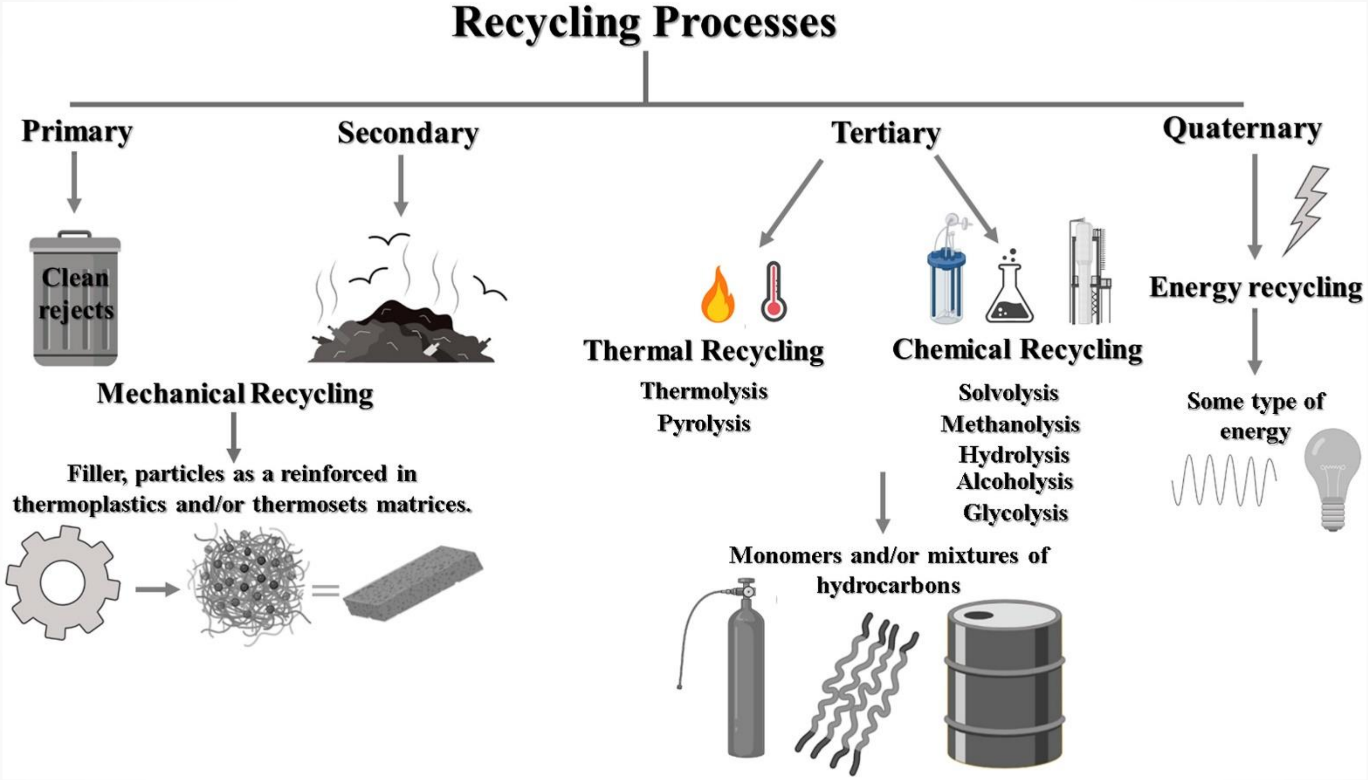
Problems with recycling

- Costly
- Degradation of the fibres
- Degradation of the matrix
- Deteriorated bonding between fibre and matrix
- Uneven quality

Recycling processes

- Mechanical recycling
- Physical recycling
- Chemical recycling
- Thermal recycling
- Energy recycling
- Biological degradation

Recycling processes

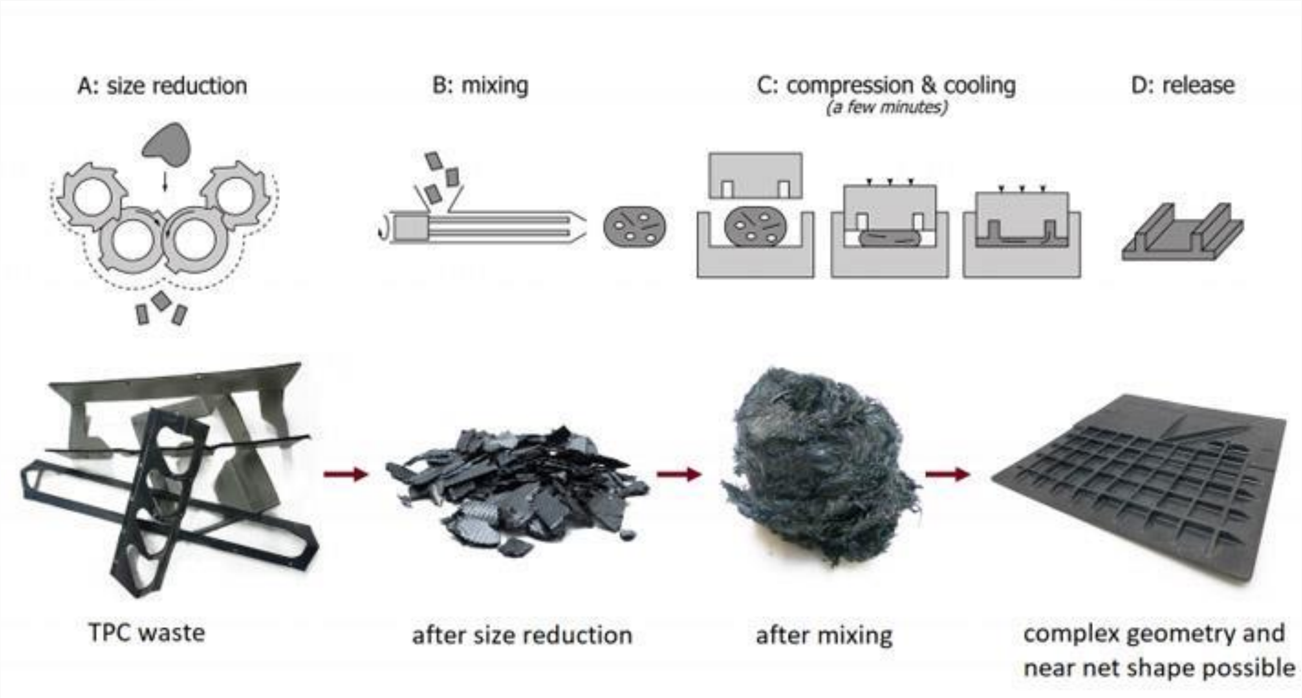


Recycling of carbon fiber-reinforced thermoplastic and thermoset composites: A review, L.S. Montagna et al., Journal of thermoplastic composite materials, 2022.

Choice of process

- Type of material
- Volume of waste
- Area of use for the recycled material

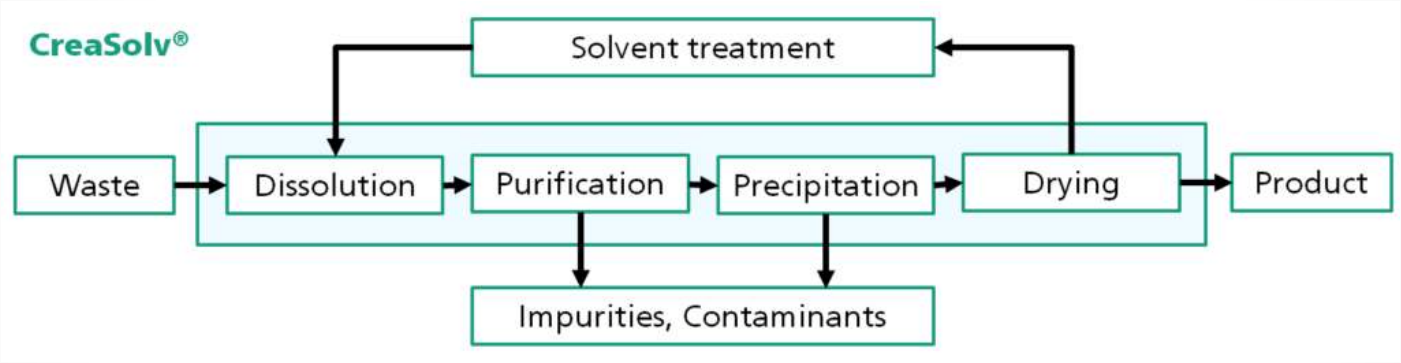
Mechanical recycling



[Technical Textile]

Properties

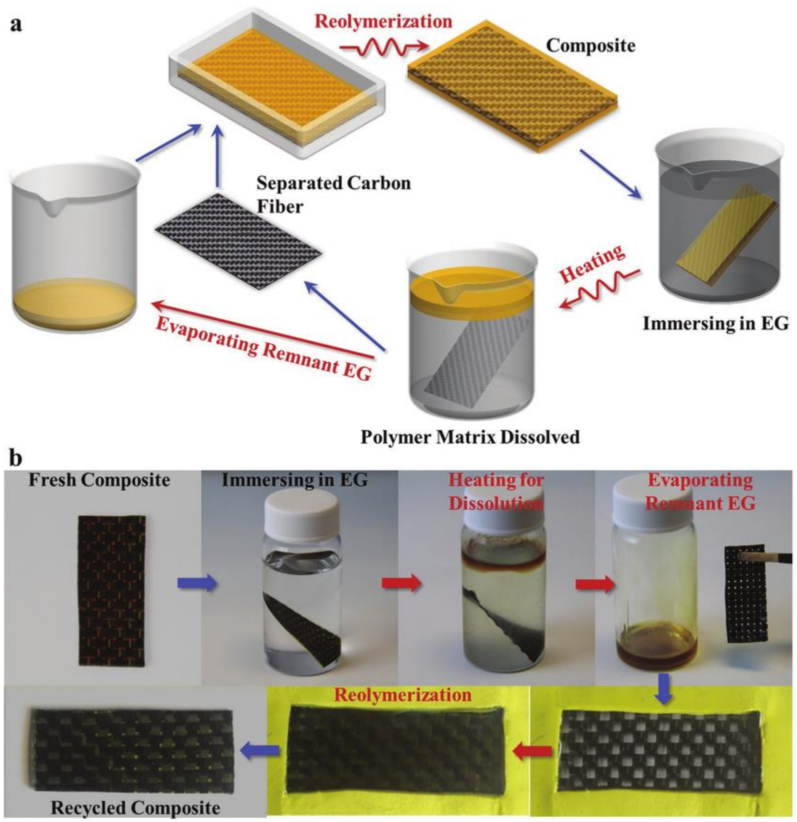
Physical recycling



[ResearchGate]

Properties

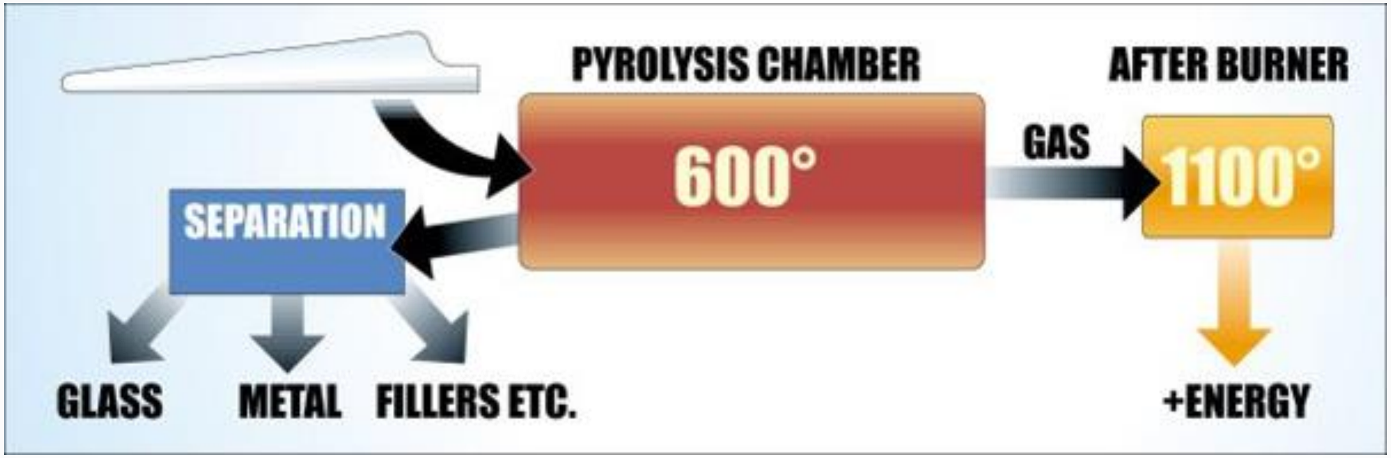
Chemical recycling



[ResearchGate]

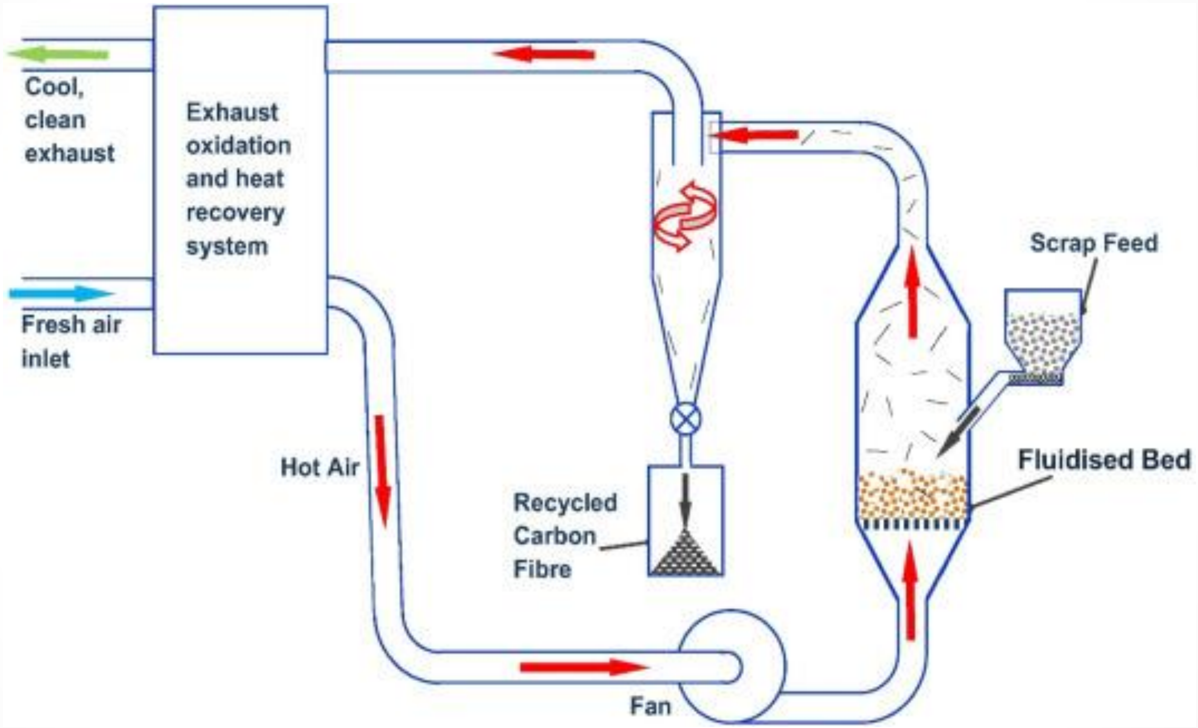
Properties

Thermal recycling



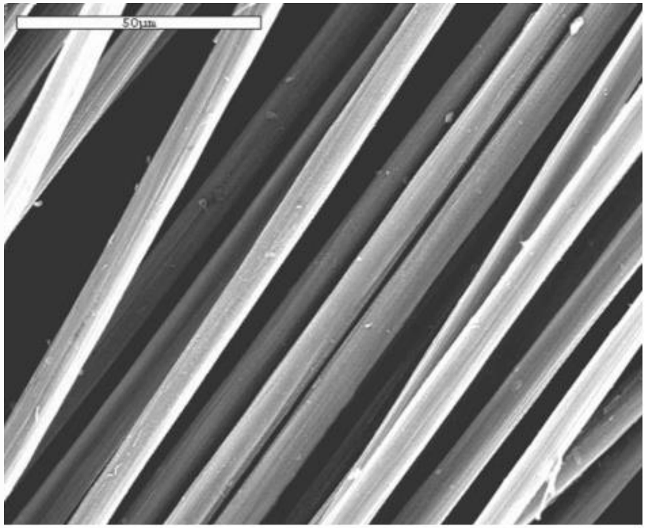
[ReFibre]

Thermal recycling

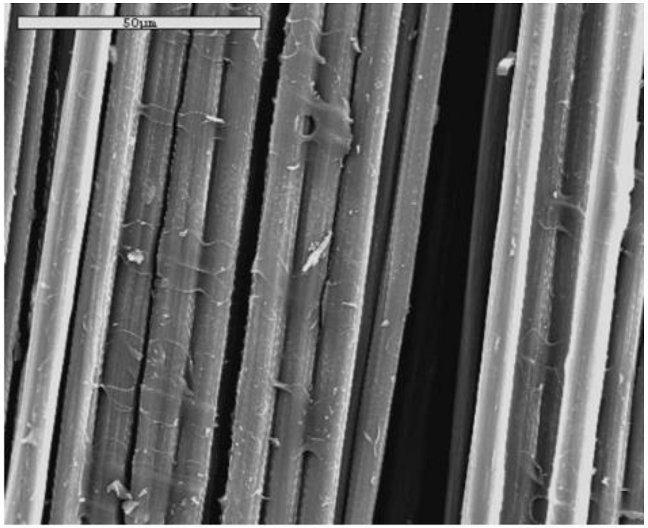


[ScienceDirect]

Properties



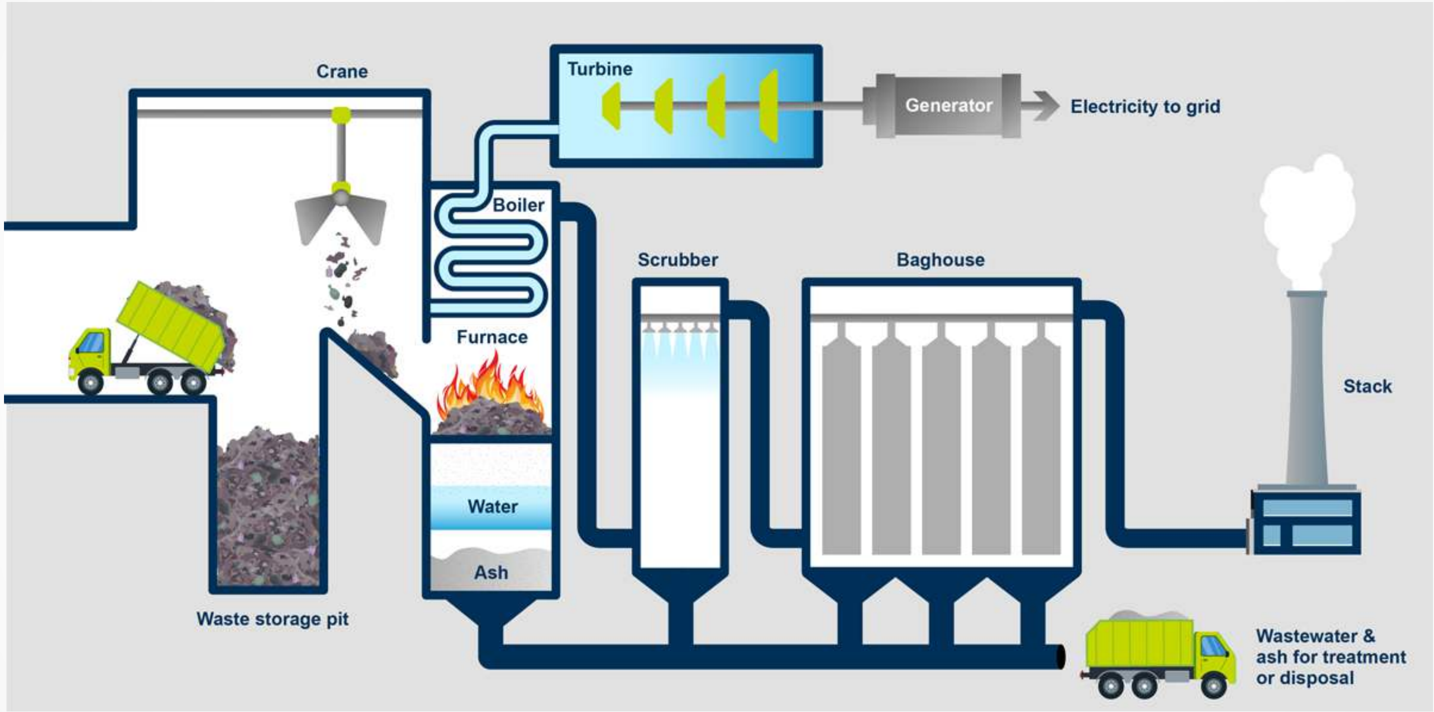
(a) Clean recycled fibres.



(b) Recycled fibres with char residue.

Recycling carbon fibre reinforced polymers for structural applications: technology review and market outlook
S.Pimenta, S.Pinho; waste Management, 2011

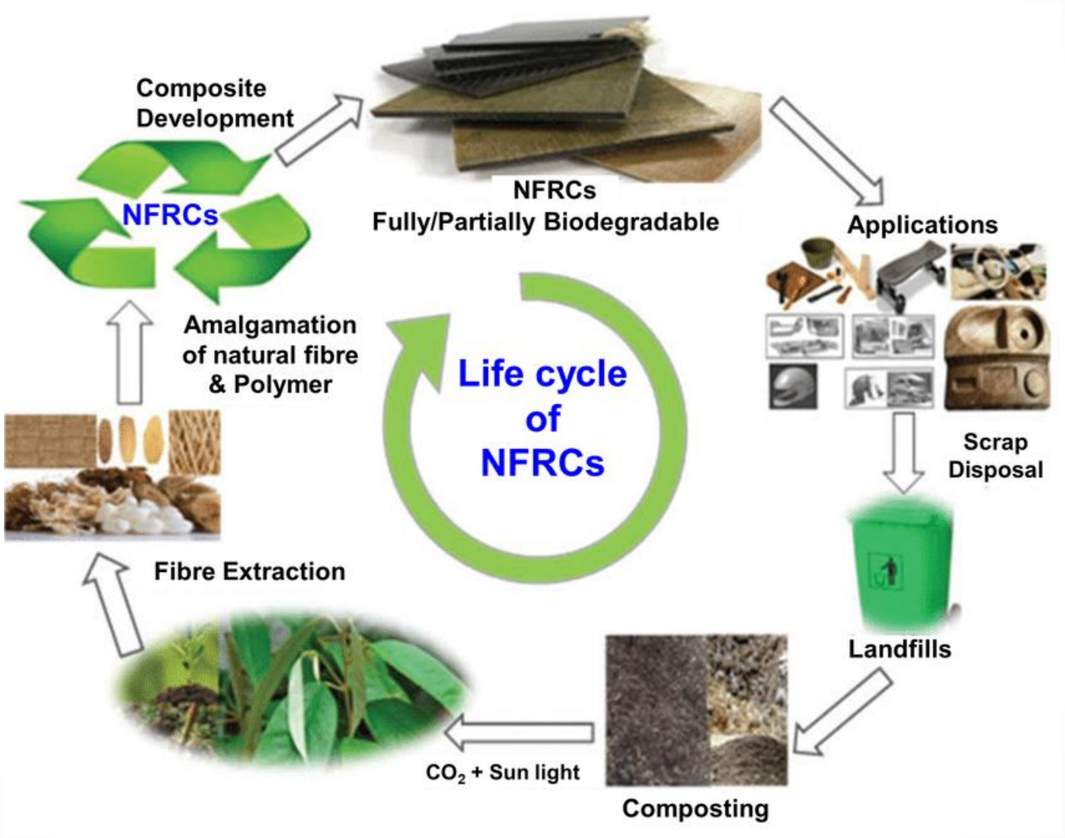
Energy recycling



[FutureLearn]

Energy recycling

Biological degradation



[ResearchGate]

Recycling of GFRP into concrete

Recycling technology of epoxy glass fiber and epoxy carbon fiber composites used in aerospace vehicles
R.T. Selvan et al., Journal of composite materials, 2021.

Future developments

LUNDS
UNIVERSITET

Thank you for listening!

Waste management challenges with wet filament winding

GlassCircle Final Conference. Riga 2024-09-26.

Anders Holmberg. Engineering manager. Hitachi Energy, Composites..

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Hitachi Energy

Outline

- Hitachi Energy
- Wet filament winding process
- Waste generated
- Waste treatment challenges
- Conclusions

Internal
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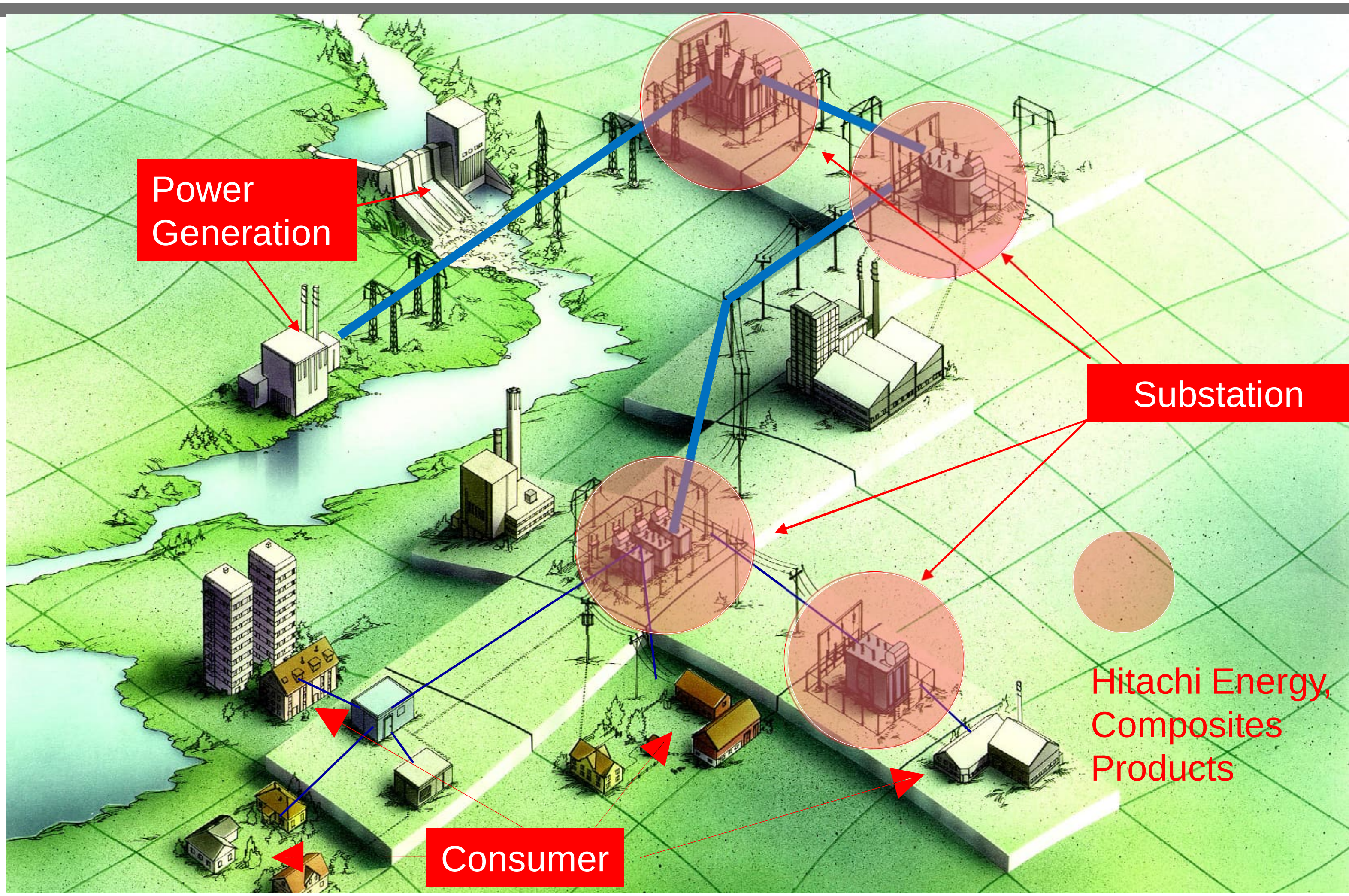
Hitachi Energy, Composites

HITACHI
Inspire the Next

Power Transmission

Power Distribution



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Hitachi Energy

420 kV substation

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Hitachi Energy, Composites main products

Glass fiber / epoxy cylinders

Conductive glass fiber / epoxy prepreg tape

Composite Insulators

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Hitachi Energy company purpose:

Advancing a sustainable energy future for all

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Hitachi Energy

Hitachi Energy sustainability targets 2030

HITACHI
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OUR TARGETS

PLANET	Carbon-neutral in our own operations ↓ -50% CO_2e along the value chain ↓ -50% waste disposed ↓ -25% freshwater use ↓ -25% hazardous substances and chemicals
PEOPLE	Zero harm Top quartile health absence rates Life-long learning culture Increase female diversity from 19% to 25% by 2025
PEACE	Zero incidents of corruption and bribery
PARTNER-SHIPS	Increase involvement in multi-stakeholder partnerships

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Hitachi Energy

Wet filament winding process

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Types of waste 1 (3)

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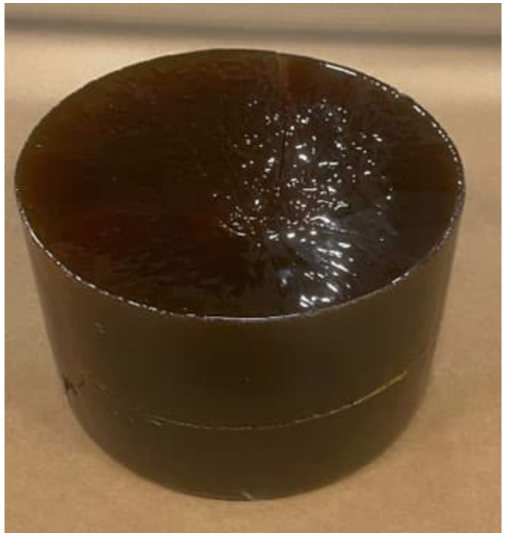
Used acetone

End of fleece and peel ply rolls

Waste resin



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Types of waste 2 (3)

Glass fiber roving

Splicing minimize waste

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Types of waste 3 (3)

HITACHI
Inspire the Next

Epoxy impregnated peel ply

Tube ends

Longer tubes

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Waste treatment

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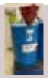
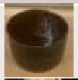
Type		Waste amount	Classification	Present waste treatment	Preferred solution
Acetone / epoxy mix		Medium	Hazardous waste	Sent for destruction	Recovery by distillation
Non-woven		Small	Non-hazardous combustible waste	Incineration with energy recovery	Thermoplastic recycling
Peel ply		Small			
Cured epoxy		Medium			Pyrolysis
Cured epoxy + peel ply		Small			
Glass roving		Small	Non-hazardous incombustible waste	Land fill	Glass remelting?
Cured tube end pieces		Large	Non-hazardous (combustible) waste. • Heat of combustion: 20 MJ/kg • Ash content 70-80% (hazardous waste)	Land fill or incineration with energy recovery	Mechanical recycling Cement co-processing Pyrolysis Solvolysis
Cured tube cut off pieces		Large			
Non-conforming tubes		Medium			

Internal
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Hitachi Energy

Product portfolio 72 – 1100 kV (0.5 - 12 m), Applications

HITACHI
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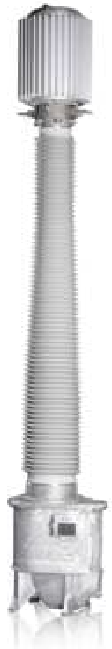
Circuit Breakers

Cable Terminations

Bushings

Instrument Transformers



Surge Arresters

Post insulators

Challenge: wide product portfolio with rather small quantities of each product

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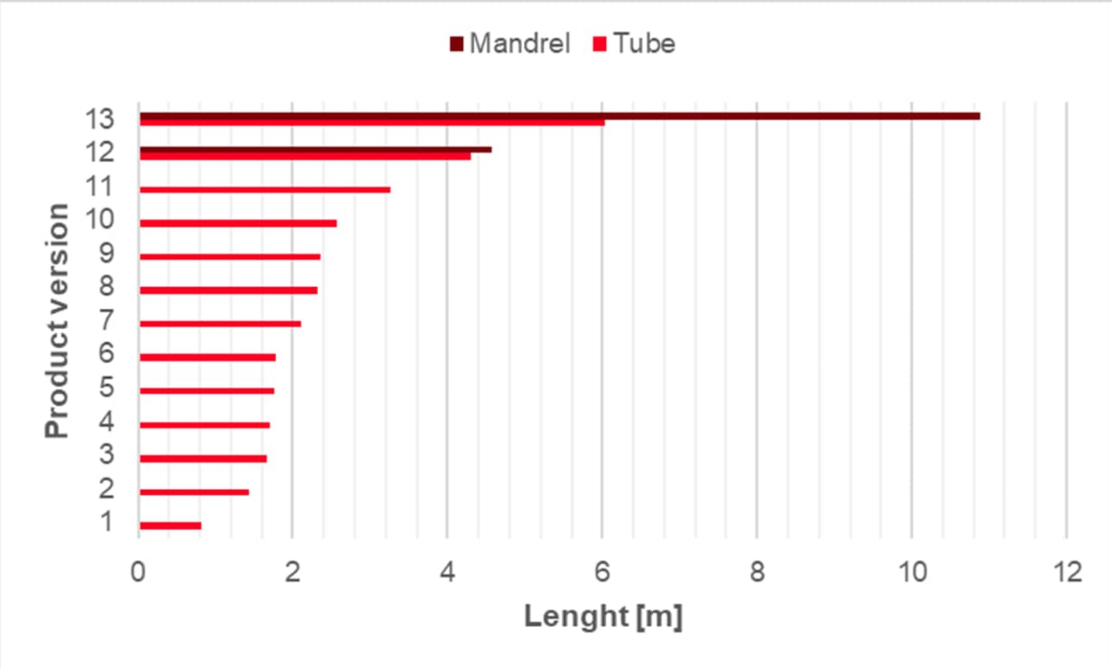
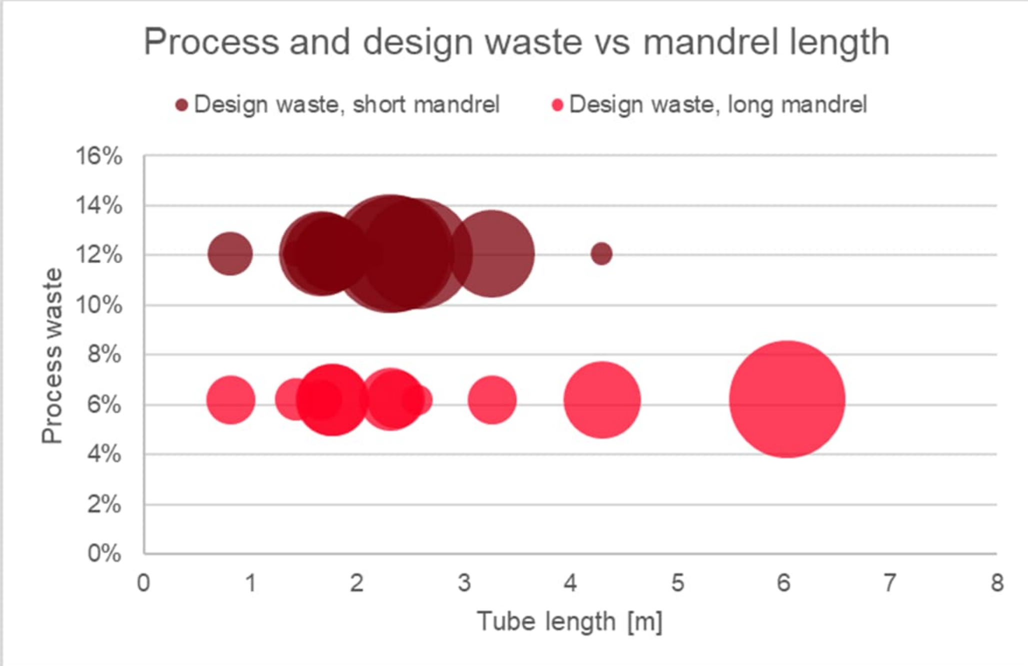
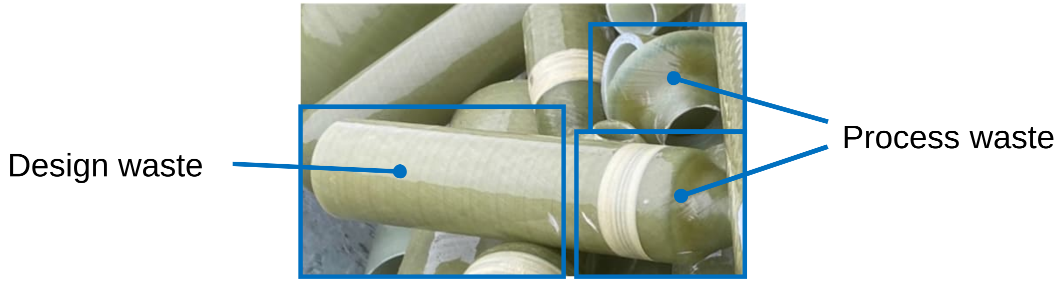
Illustration: 1 tube diameter, several product lengths







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Conclusions

Most manufacturing methods for continuous fiber reinforced polymers, including wet filament winding, are not net shape processes.

- Significant amounts of production waste is generated.

Today most of the production waste is incinerated with energy recovery or discarded as land fill.

Higher level recycling is technically possible but logistic chains and economy of scale is still missing.

Hitachi Energy, Composites, have the in-house logistics (sorting) in place for higher level recycling and are searching for collaboration with partners that can use the waste material as resource.

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Results of survey about glass fiber residue of general public

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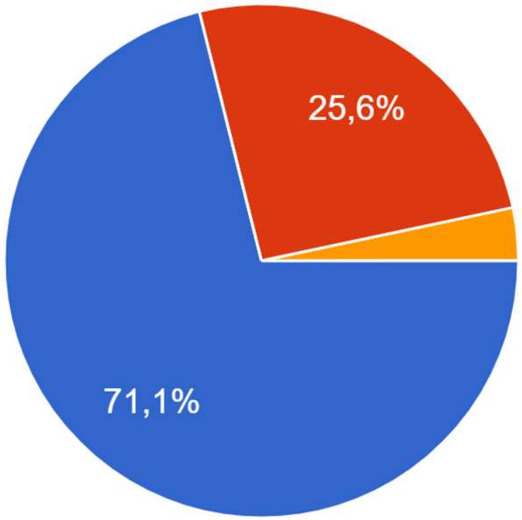
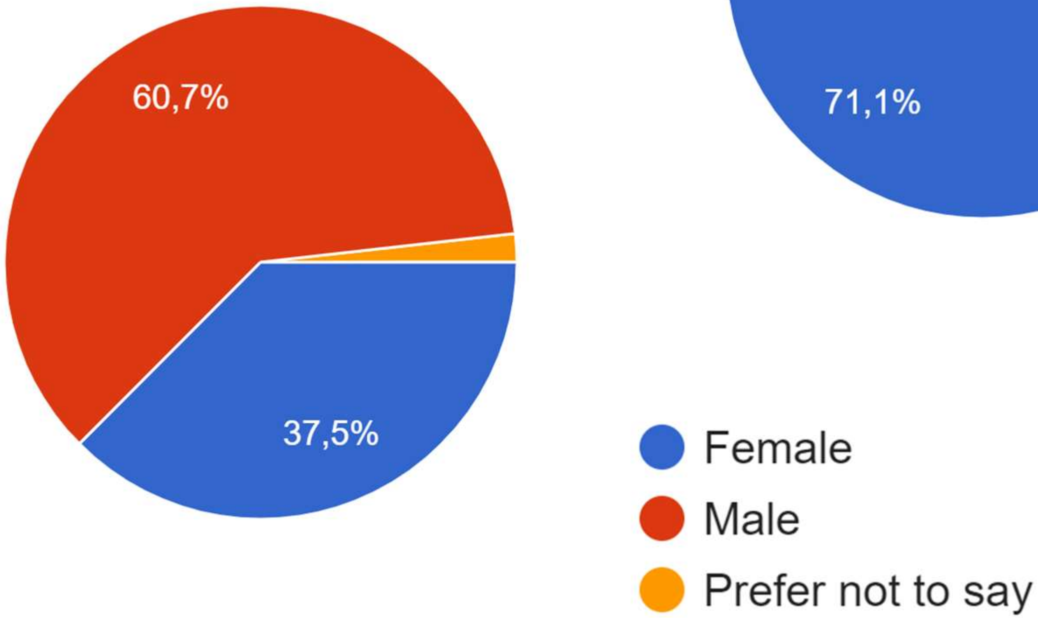
Gender

- **90** answers in Latvia

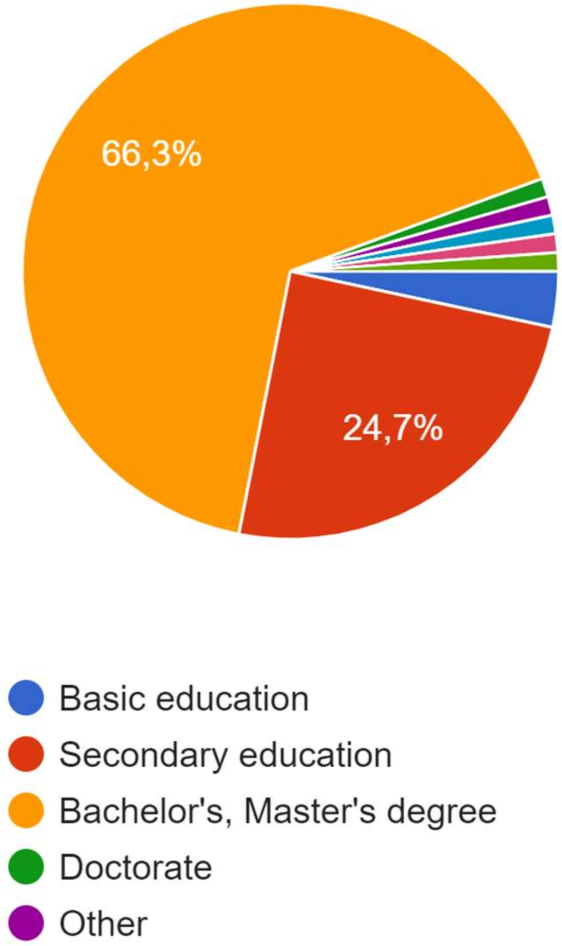


- **56** answers in other countries

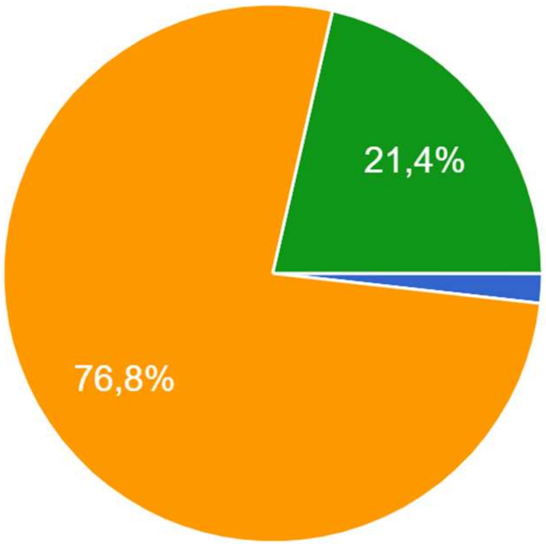


Educational level

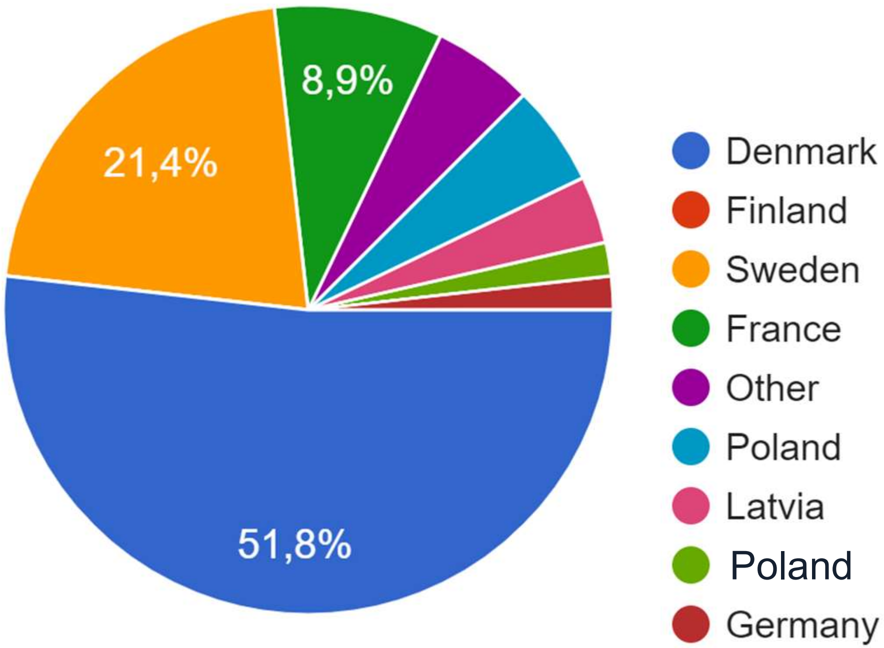
- In Latvia

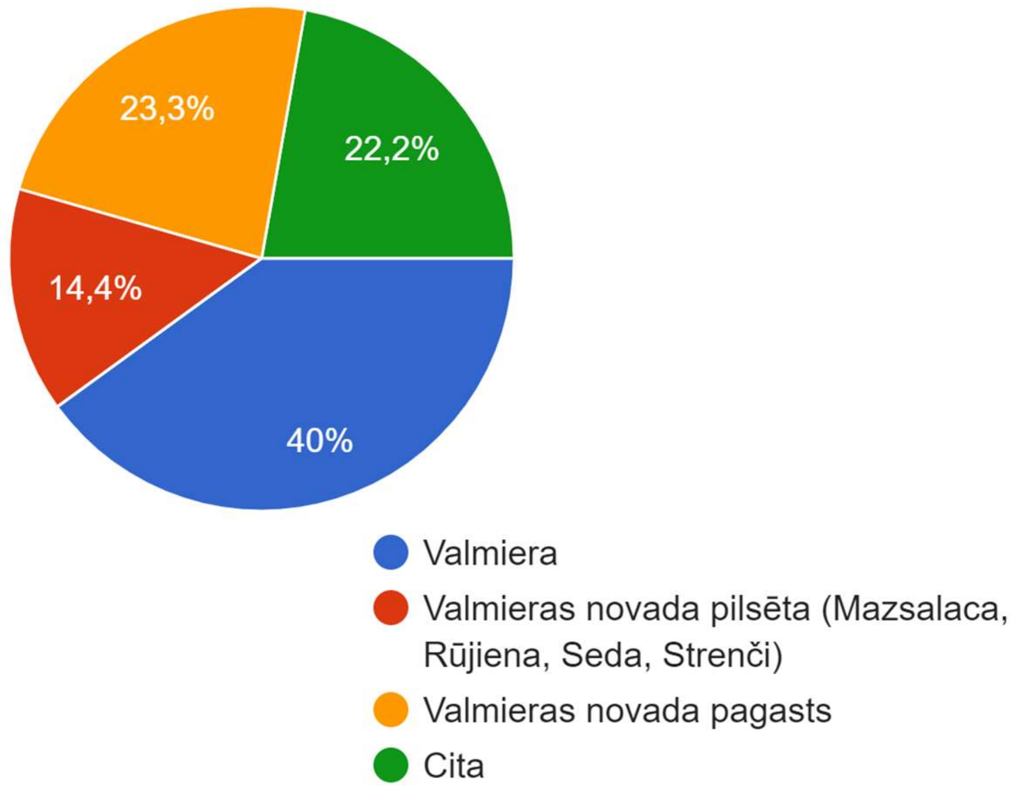


- In other countries



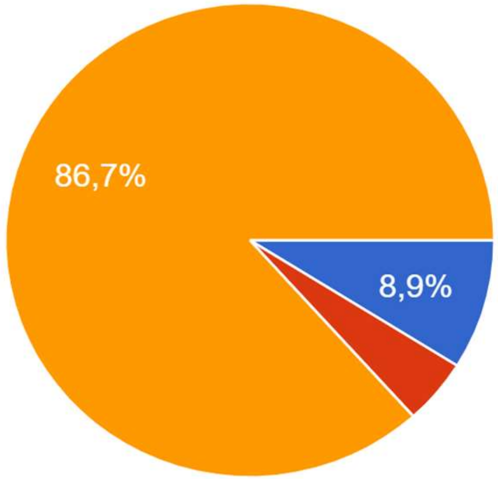
Place of residence



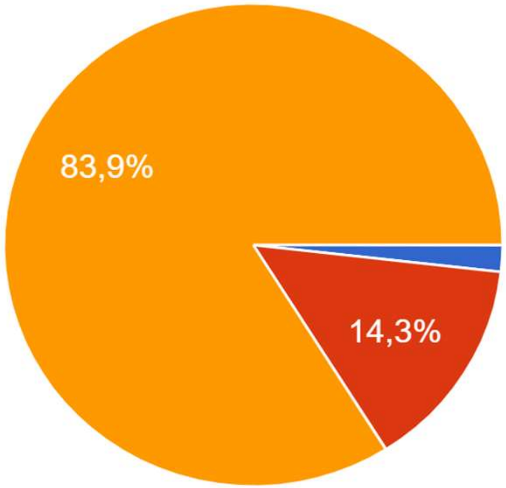


In what field are you employed?

- In Latvia



- In other countries



- In the sphere related to the production of glass fiber
- In the sphere related to the use of glass fiber or its products as raw material in the production process
- Other sphere

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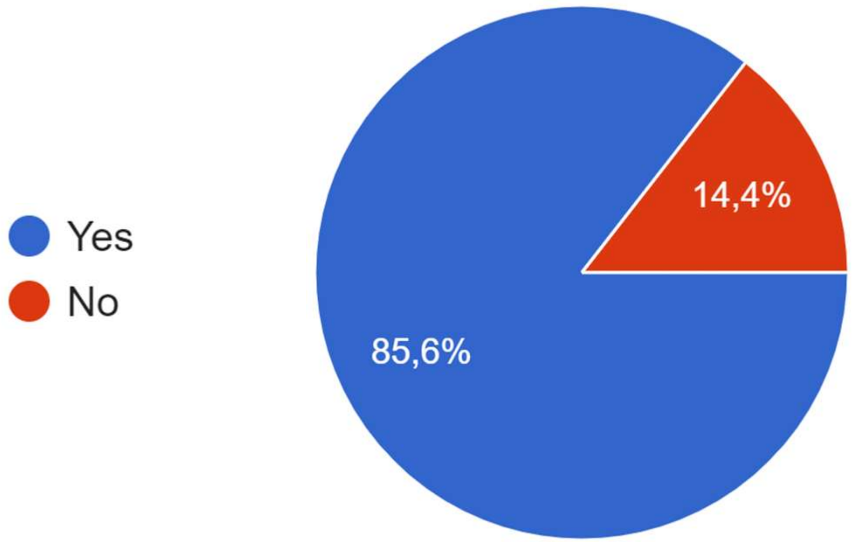
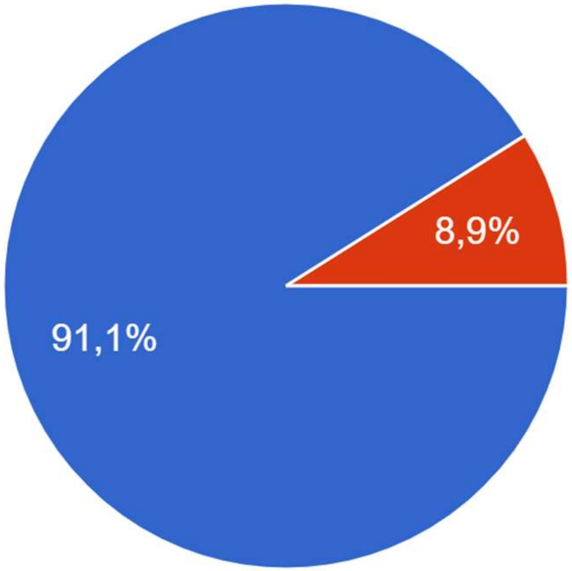
Is waste sorting carried out in your household?

- In Latvia



- In other countries



Name any products or objects that are made using fiberglass that you know

- **Some parts in body of cars, water tanks;**
- **Boats;**
- **Wind turbine blades, water tanks, pipes;**
- **Hockey sticks;**
- **Windmill wings, car parts, flags, building materials - glass wool, resin additive (tanks), roofing;**
- **Cables for internet supply, tension link for geotechnical anchors;**
- **Sports equipment, glides, wind mills;**
- **Aircrafts;**
- **Flask for household gas;**
- **Beer kegs, Propane gas bottle, Bikes, Golf rackets, boats, planes etc.**





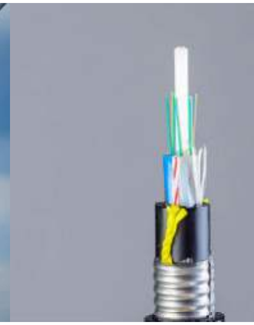


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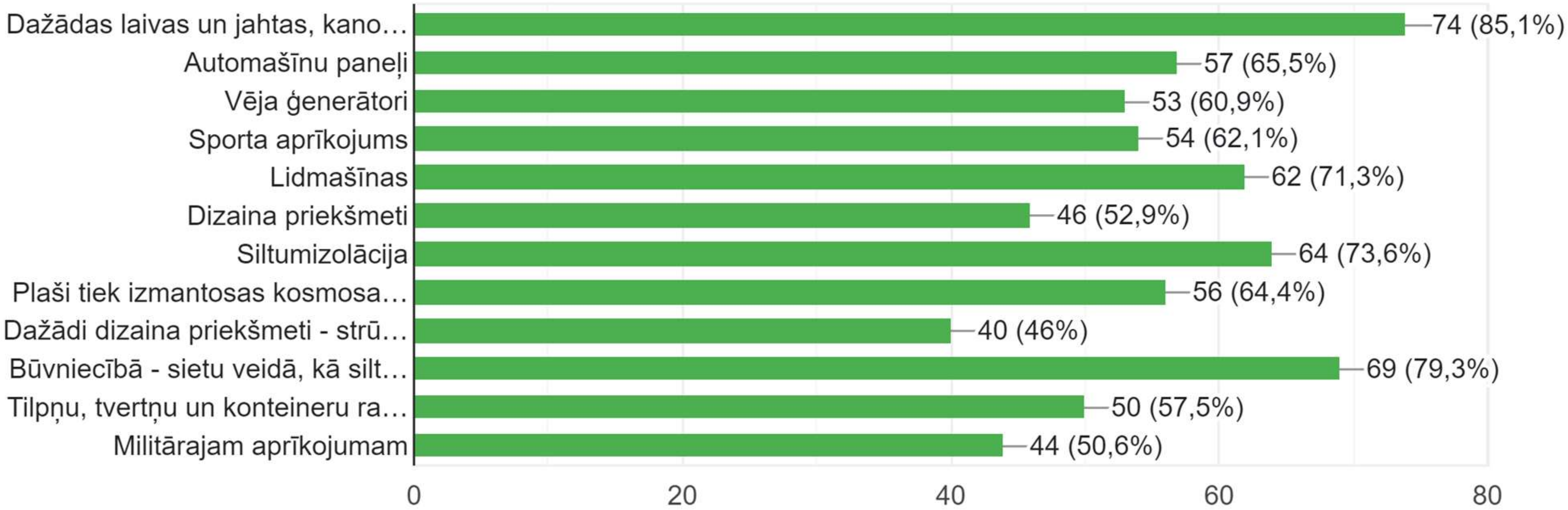
Photo from internet resources

Select the items you know they contain glass fiber!

- In Latvia



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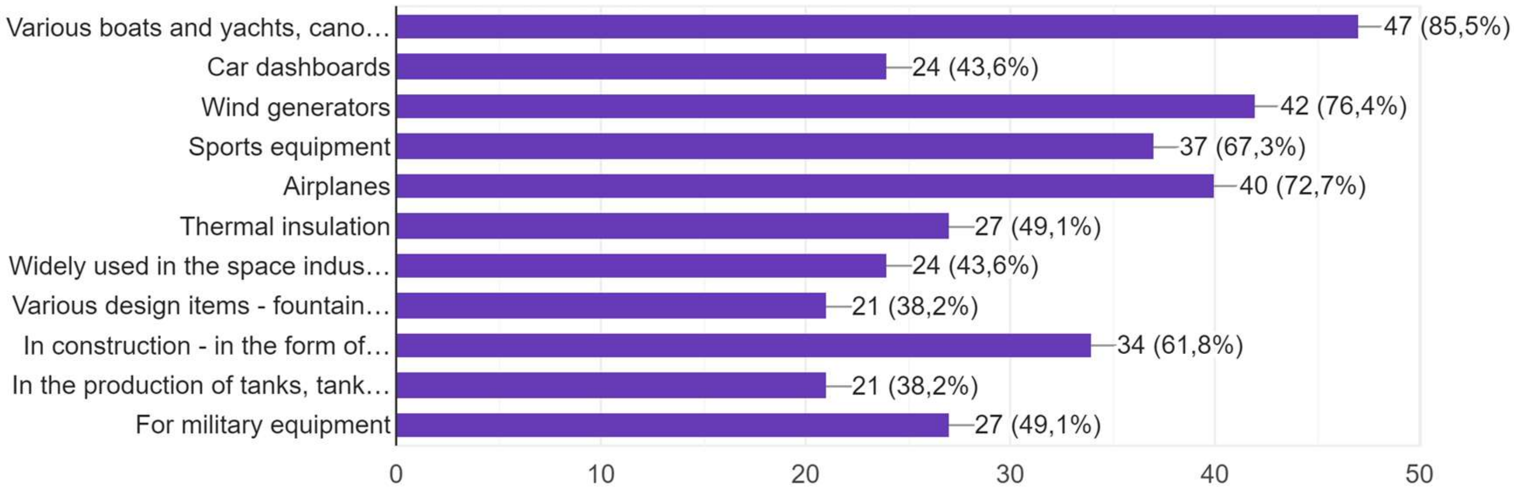
Select the items you know they contain glass fiber

- In other countries



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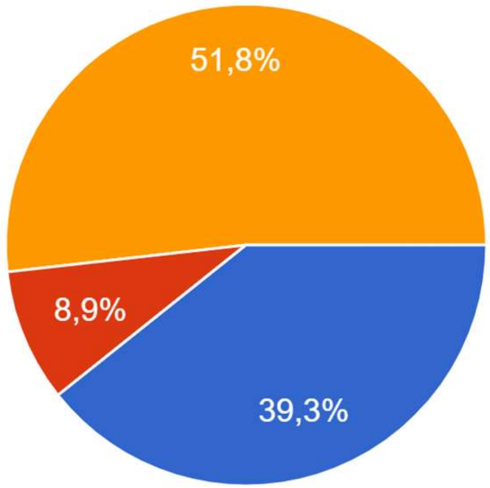
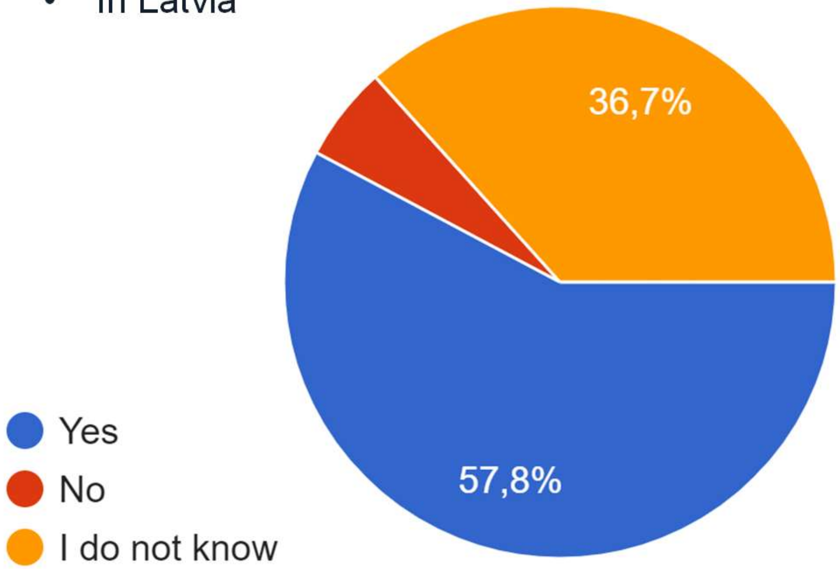
Do you have anything in your household that contains fiberglass?

- In Latvia

- In other countries





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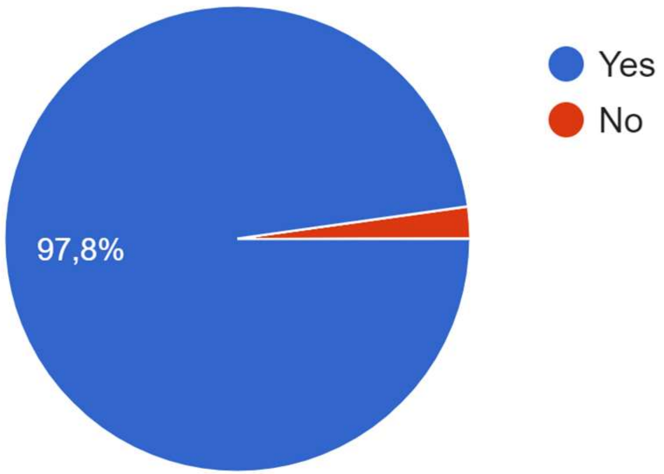
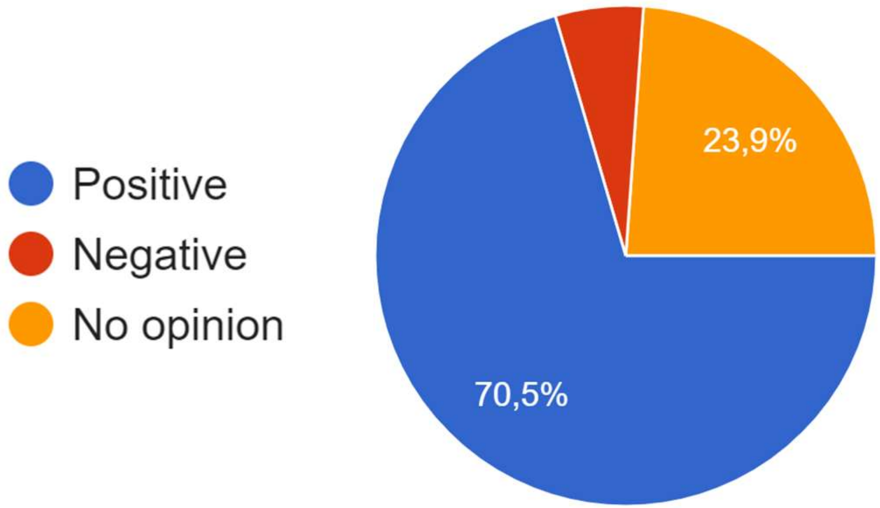
Did you know that there is a large glass fibre production plant in Valmiera?



What is your opinion of this plant?



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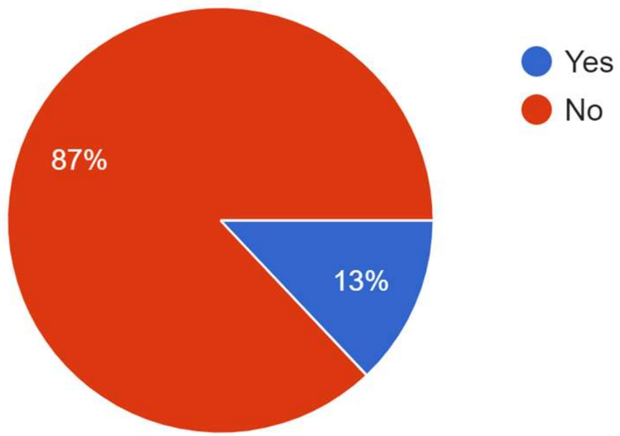
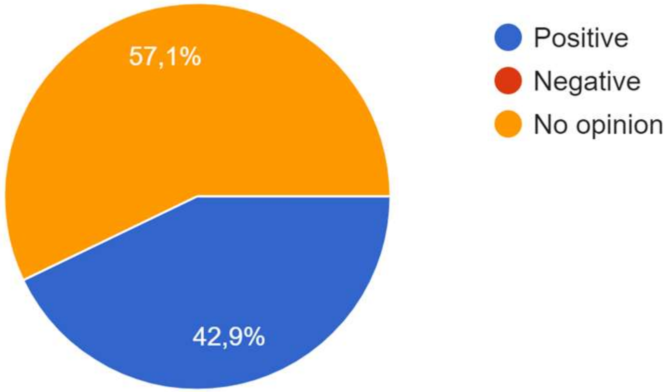
Is there a fiberglass factory near where you live?



What is your opinion about this factory near where you live?



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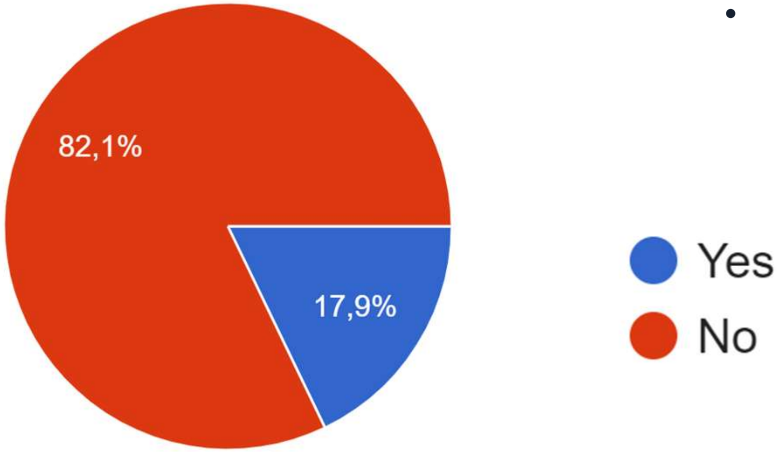
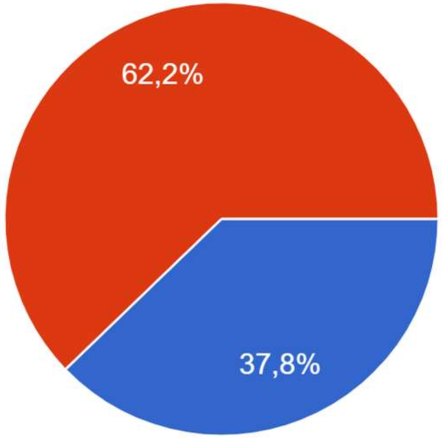
Do you know what surpluses occur in the glass fiber production process?

- In Latvia

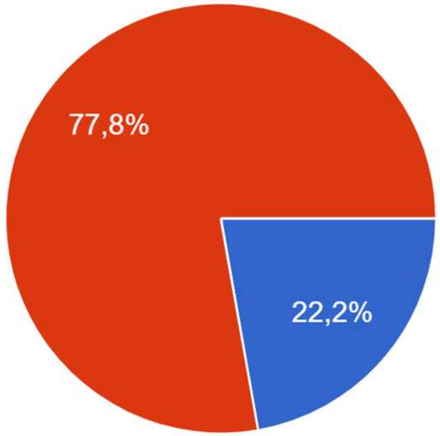
- In other countries



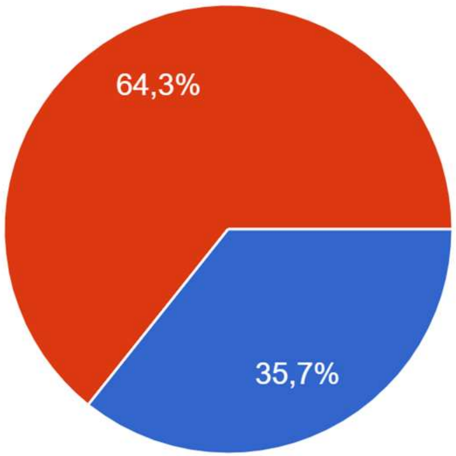


Have you heard where it is possible to use the leftovers from the fiberglass production process?

- In Latvia



- In other countries



Yes
No

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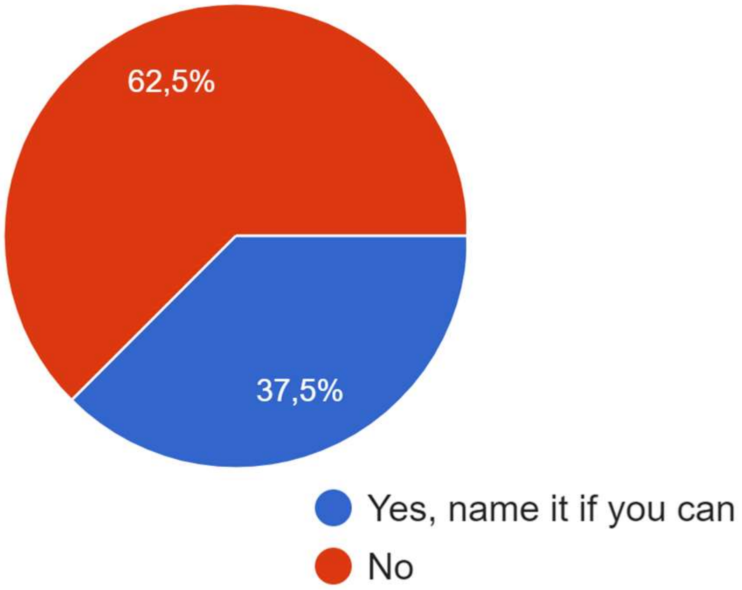
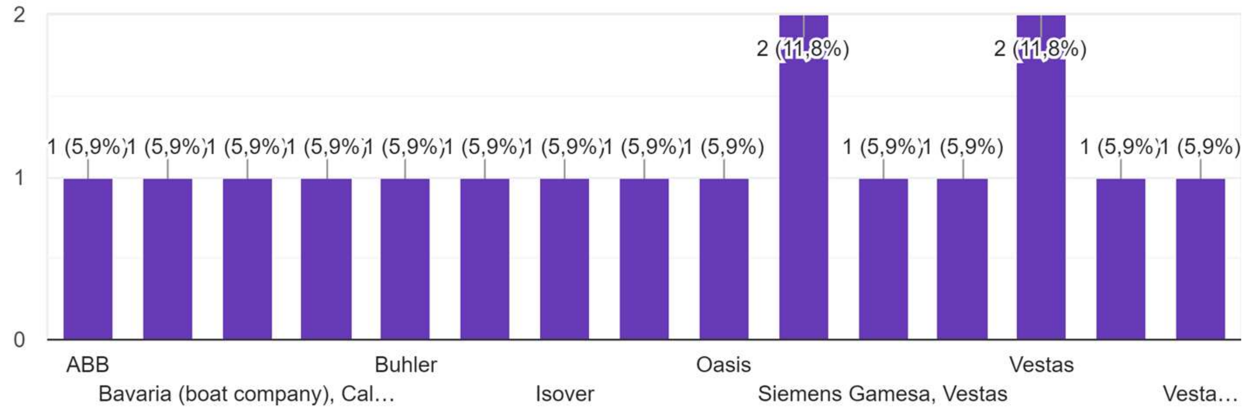
Do you know of a company that uses fiberglass as a raw material in their production? (in other countries)





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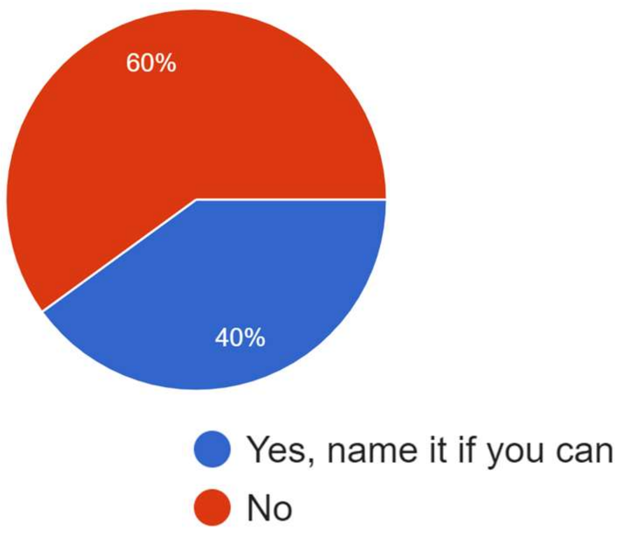
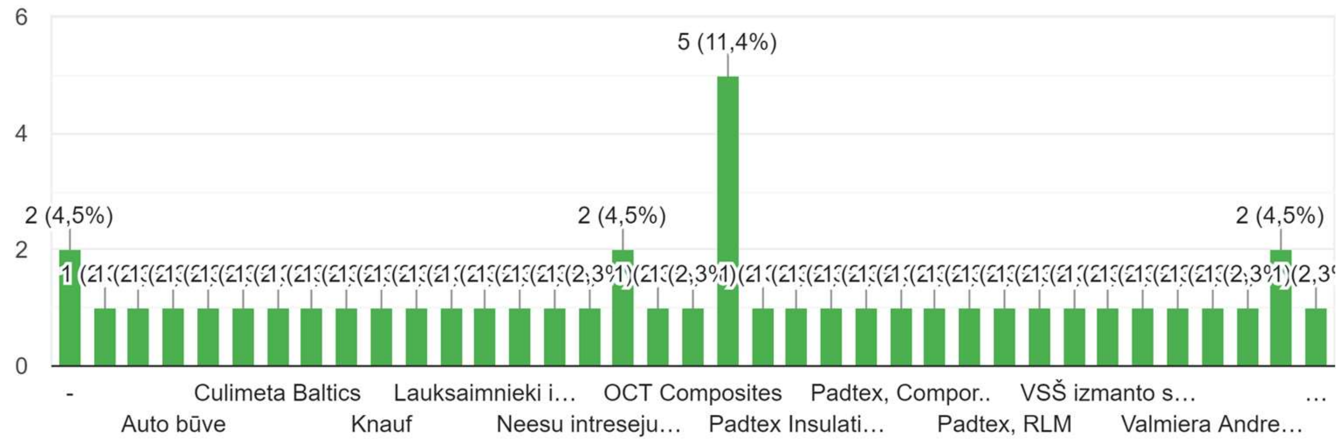
Do you know of a company that uses fiberglass as a raw material in their production? (in Latvia)





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Proposals for reuse or re-purpose of glass fiber production waste

◆ In construction and building

- Clean and grind to obtain amorphous silica powder for production of building materials;
- Composite Materials for Construction;
- Reinforcement in Concrete;
- Manufacture of Insulation Materials;
- modular urban green spaces;
- biofiltration systems for water,
- energy efficient house component

◆ New products

- furniture in public places, sun and rain protectors in cars' and bike's parkings;
- Storage boxes
- Products for decoration;

◆ General ideas

- Recycling into New Fiberglass Products;
- Meld them individually down to raw materials;
- Energy generation

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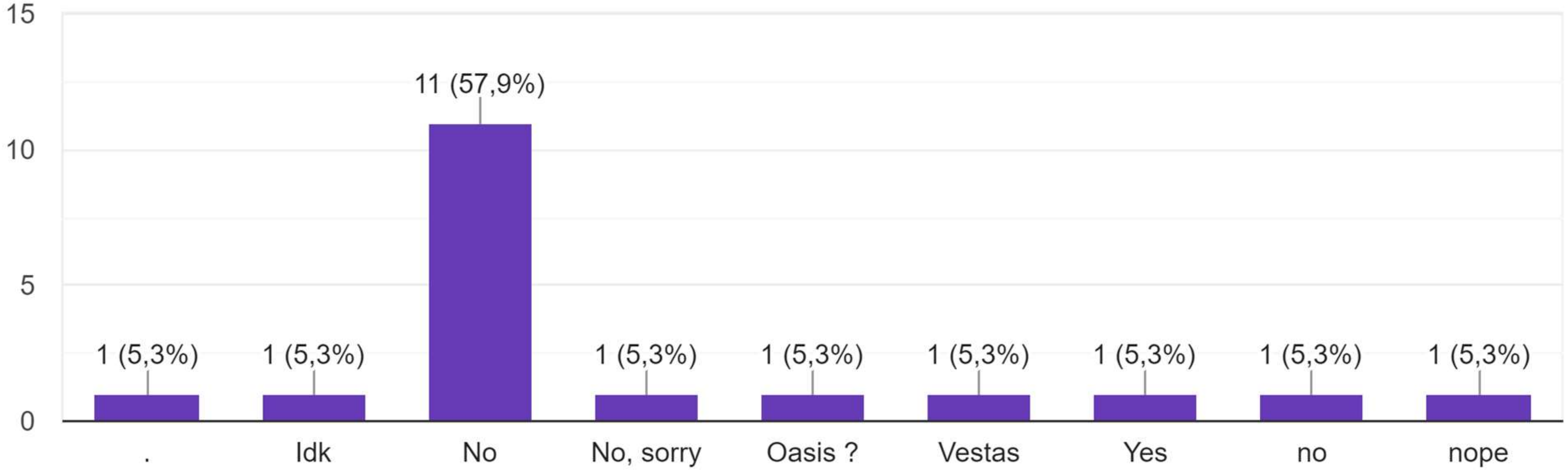
Do you know of a company that uses waste surpluses of glass fibers in their production?



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Conclusions/ Discussion

- Most of the people in Valmiera are aware of glass faser production in Valmiera region
- Few are aware about the glass-faser eco-system
- Little knowledge and information on glass-faser products, their caracteristics and related challenges
- Rather positive attitude towards glass-faser factory

→ Transition to circular economy related to complex factors, including awareness building.

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Results of survey about glass fiber residue of general public

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Strategic framework: reusable dishes and public events in Tallinn

Tallinn

Liina Kanarbik
Lead Specialist
Circular Economy Department
Tallinn Strategic Management Office
26.09.2024

Is it possible to serve food and drinks from reusable dishes in a mass event where there are 80 000 participants?


THE 13TH
YOUTH SONG & DANCE
CELEBRATION
30.06–2.07.2023

The strategic framework and journey to banning single-used dishes in public events …

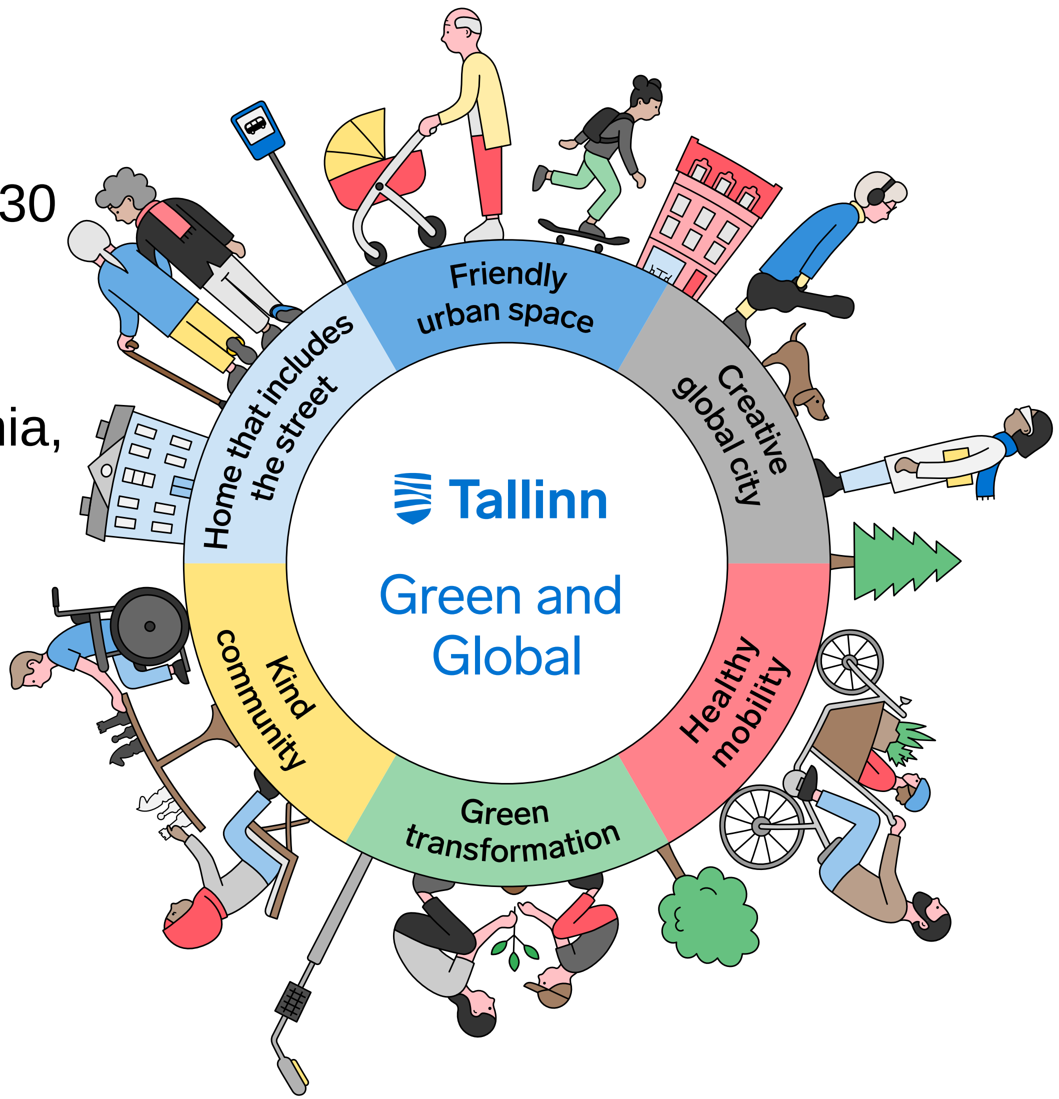
Strategic framework related to sustainability and circular economy

- Moving towards a circular economy requires a systemic and strategic approach on a local level

- Harmonized guidance is needed to develop a suitable strategic framework that contributes to the reduction of single-used products

Strategic framework related to sustainability and circular economy

- Tallinn 2035 Development Strategy
- Tallinn Sustainable Energy and Climate Action Plan 2030
- Tallinn Waste Management Plan 2022-2026
- OECD report on the Circular Economy in Tallinn, Estonia, 2023
- Tallinn Waste Management Regulations



Tallinn

Strategic framework for waste prevention and reduction in Tallinn

- **First level (strategies and action plans)** – at the top of the pyramid are long-term goals and targets for the sustainable use of materials
  - Tallinn waste management plan 2022-2026
- **Second level (legal framework: rules/regulations)** – based on the strategy/action plan, the municipality adopts necessary legal acts
  - Tallinn Waste Management Regulations
  - Procedure for organising and holding public events in City of Tallinn
  - Guidelines for organizing sustainable events by city authorities
- **Third level (guidance documents)** – various operational guidelines for external/internal stakeholders
  - Recommendations for event organisers

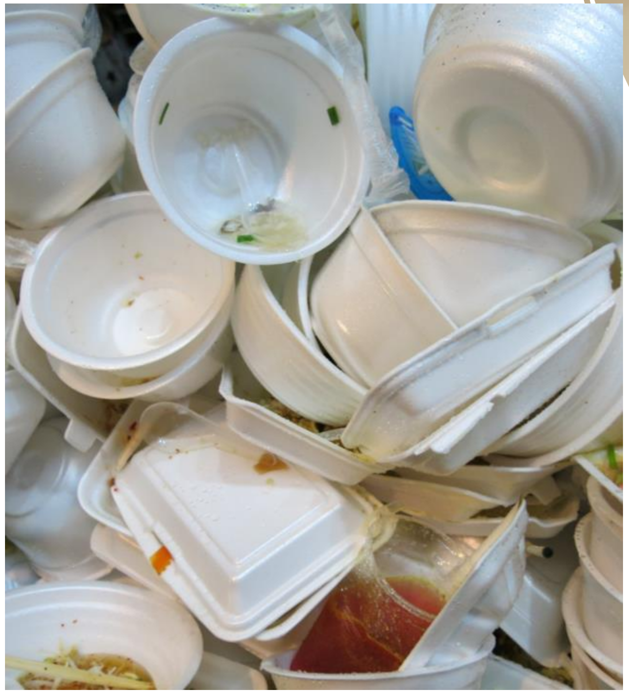
The concept for the strategic framework. Source: SEI Tallinn

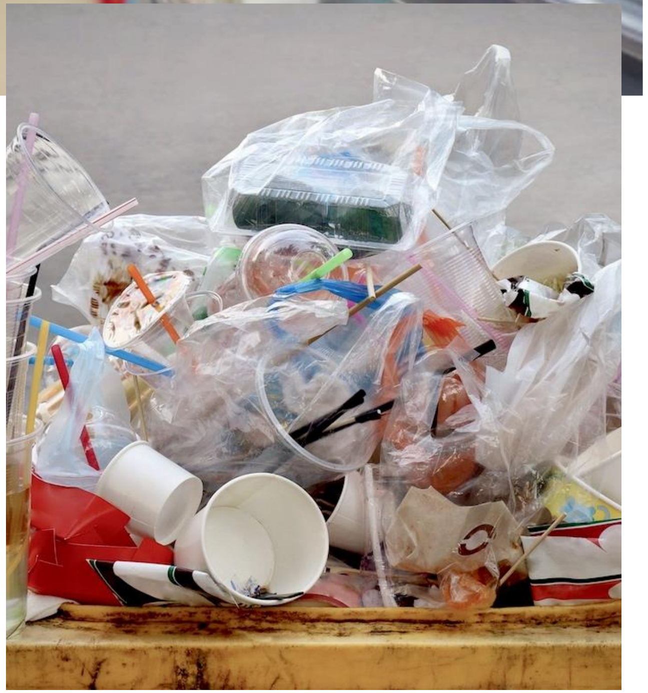
Tallinn

Waste prevention/reduction and public events in Tallinn

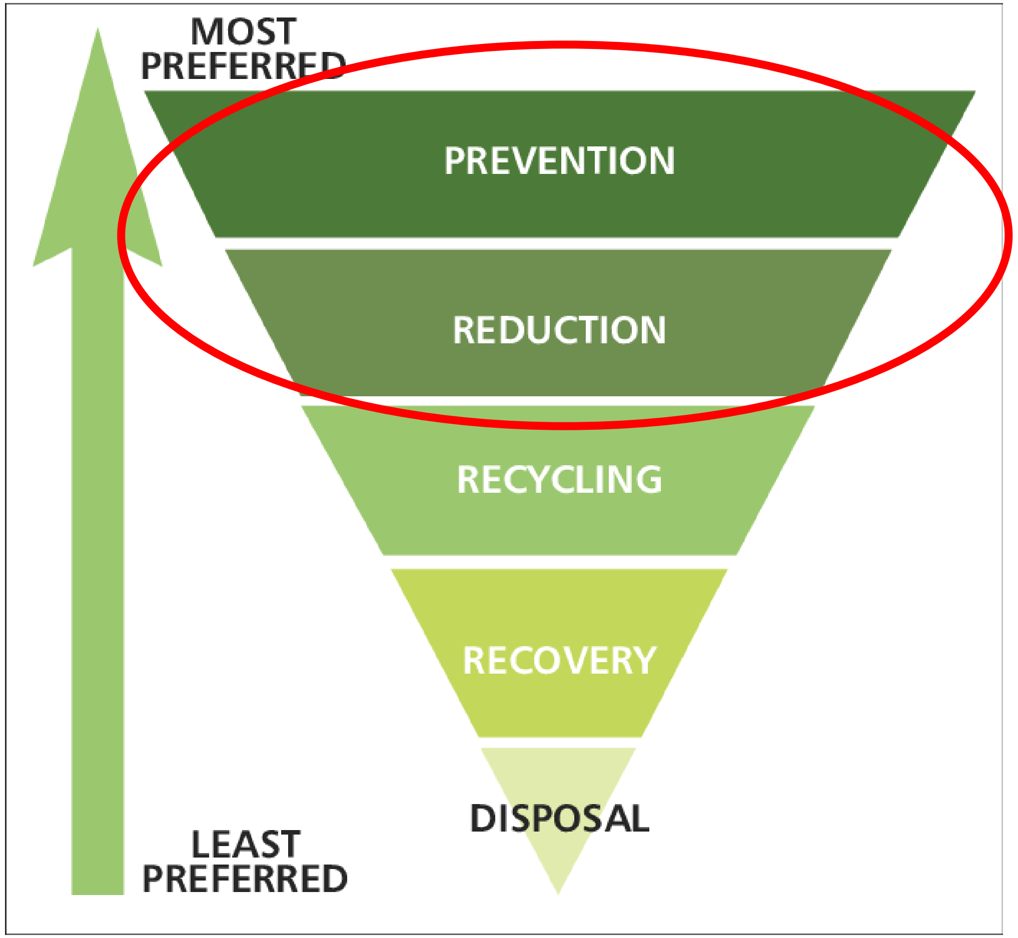
- October 2019 - Tallinn banned single-used plastic cups, plates, cutlery
- Only compostable dishes, cutlery (EN 13432) were allowed

Replacing the material of a disposable product does not solve the waste problem!





Tallinn


MOST PREFERRED
PREVENTION
REDUCTION
RECYCLING
RECOVERY
DISPOSAL
LEAST PREFERRED

Tallinn

Strategic framework for waste prevention and reduction

STEP 1: Get organised

↓

STEP 2: Assess the current situation

↓

STEP 3: Formulate the strategic document

↓

STEP 4: Implement the strategic document

Process

Moving towards reusables…

2021-2022
Assessing situation

- Tallinn waste management plan 2022-2026 promotes moving towards a circular economy
- Assessing the current reuse situation

Spring 2022
Onboarding events

- Draft ready - Guidelines for organizing sustainable events
- Finding event organizers to test the guidelines

Summer 2022
Testing the guideline

- 2 sports events
- Music festival
- Family festival

2022 – 2023
Formulating the regulation

- Meeting stakeholders
- Formulating the strategic document

March 2023
Announcing the new regulation

- Implementing city regulations
- June 2023 – only reusable dishes allowed in public events

Tallinn

TALLINN winner 2023 EUROPEAN GREEN CAPITAL

Tallinn City Council introduced new regulations in spring 2023:

1. [Tallinn Waste Management Regulations]
2. [Rules for organising and holding public events in city of Tallinn]


Riigi Teataja

Lihtne otsing seaduste ja üleriigiliste määruste tervikteksti pealkirjadest | Sisesta akti nimi, märksõna või ametlik lühend | OTSI

Täpne otsing | Liigitus | Statistika | Viited | Eelnõud | Kohtuteave | Õigusuudised | Abi | English | Minu RT

KOV määruste valdkondlik liigitus: Korrakaitse → Avaliku ürituse kord

Teksti suurus: A A A

Tallinna linnas avaliku ürituse korraldamise ja pidamise kord

Meeldetuletused | Laadi alla | Trüki | RSS | Abiinfo

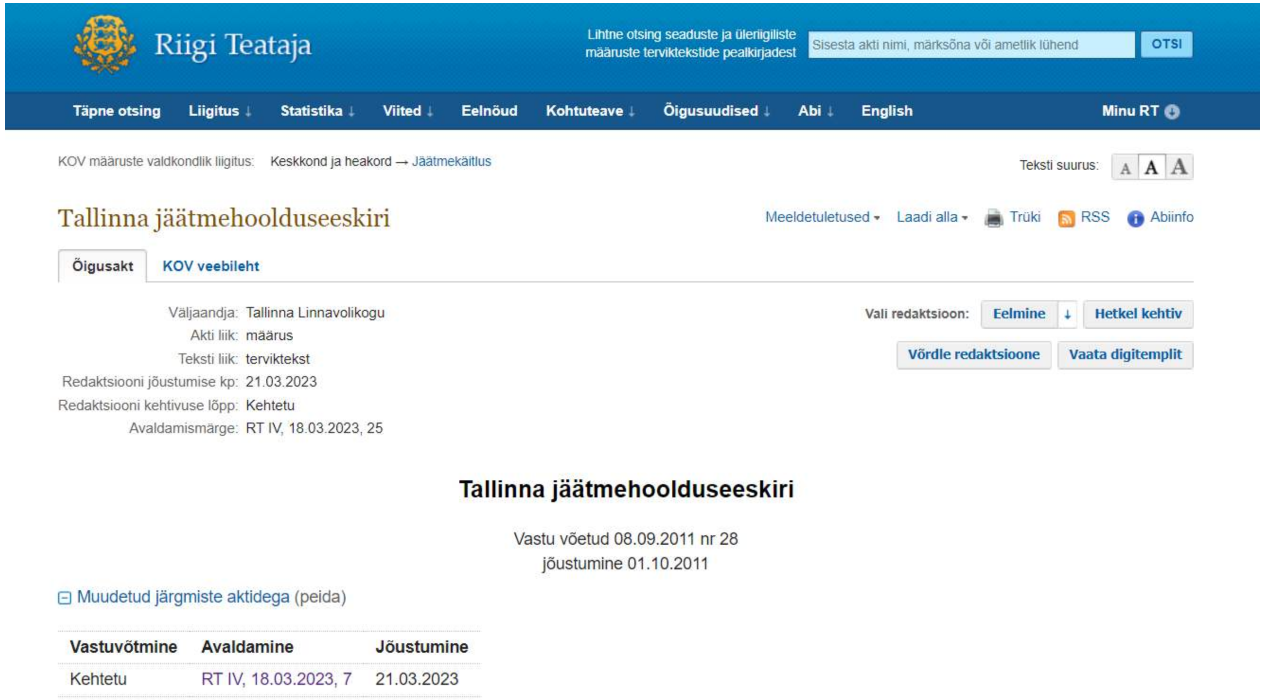
Õigusakt | KOV veebileht | Andmekogud

Väljaandja: Tallinna Linnavolikogu
Akti liik: määrus
Teksti liik: terviktekst
Redaktsiooni jõustumise kp: 21.03.2023
Redaktsiooni kehtivuse lõpp: Hetkel kehtiv
Avaldamismärge: RT IV, 18.03.2023, 20

Vali redaktsioon: Eelmine | Hetkel kehtiv
Võrdle redaktsioone | Vaata digitemplit

Tallinna linnas avaliku ürituse korraldamise ja pidamise kord

Vastu võetud 29.05.2014 nr 12
RT IV, 10.06.2014, 16
jõustumine 01.07.2014


Riigi Teataja

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Täpne otsing | Liigitus | Statistika | Viited | Eelnõud | Kohtuteave | Õigusuudised | Abi | English | Minu RT

KOV määruste valdkondlik liigitus: Keskkond ja heakord → Jäätmekäitlus

Teksti suurus: A A A

Tallinna jäätmehoolduseeskiri

Meeldetuletused | Laadi alla | Trüki | RSS | Abiinfo

Õigusakt | KOV veebileht

Väljaandja: Tallinna Linnavolikogu
Akti liik: määrus
Teksti liik: terviktekst
Redaktsiooni jõustumise kp: 21.03.2023
Redaktsiooni kehtivuse lõpp: Kehtetu
Avaldamismärge: RT IV, 18.03.2023, 25

Vali redaktsioon: Eelmine | Hetkel kehtiv
Võrdle redaktsioone | Vaata digitemplit

Tallinna jäätmehoolduseeskiri

Vastu võetud 08.09.2011 nr 28
jõustumine 01.10.2011

Muudetud järgmiste aktidega (peida)

Vastuvõtmine	Avaldamine	Jõustumine
Kehtetu	RT IV, 18.03.2023, 7	21.03.2023

Public events in Tallinn since June 2023

- June 2023 – food and drinks may only be served in reusable containers (e.g. plates, bowls, drinking glasses, coffee cups) and use only reusable cutlery (e.g. knives, forks, spoons, chopsticks) in public events **up to 30 000 visitors/day in Tallinn**.
- January 2024 – only reusable dishes are allowed in public events **in whole Estonia** regardless the number of visitors.
- **Public event** = an entertainment event, competition, performance, trade event or other similar gathering of people that takes place in a public place and is open to the public with or without a ticket.

The power of regulation as a peakon!

The regulation gave an exception to events with more than 30 000 visitors/day.
3 such events in the summer of 2023. All of them **voluntarily** opted for reusable dishes.

The Weeknd
55 000 visitors
Reusable cups ☺

Depeche Mode
40 000 visitors
Reusable cups ☺

Youth Song and Dance Festival
80 000 participants
100% reusable dishes and cutlery ☺


THE 13TH
YOUTH SONG & DANCE
CELEBRATION
30.06–2.07.2023

Dance Celebration performance "Bridges"

Total performers and visitors

46 828

XIII Youth Song Festival "Holy is the Land"

Total performers and visitors

84 811

30.06-02.07.2023

70 waste collection points

11 reusable dishes collection points

- Around 100 „green ambassadors“
- 70 waste collection points
- 11 reusable dishes collection points

Youth Song & Dance Festival 2023

- ~ 100 000 people
- 85 000 pcs reusable cups
- 155 000 pcs reusable plates/bowls
- 161 500 pcs reusable cutlery
- 22,1 tons of waste vs 40 tons of waste

in 2019

22,1 tons of waste out of which:

- Biowaste 8,3 tons
- Mixed waste 7,9 tons
- Plastic and metal packaging waste 3,9 tons
- Paper and cardboard waste 0,5 tons
- Glass packaging waste 1,5 tons

Amount of mixed waste per person reduced

2019	2023
178g	60g

Reusable dishes

Guidelines for Organizing Sustainable Events

Tallinn

Guidelines for Organizing Sustainable Events

- mayor’s directive
- since April 5th 2023
- conference, seminar, reception, charity or entertainment event, competition, performance, trade event or other similar gathering of people
- all city institutions

Tallinna linnapea

KÄSKKIRI

05.04.2023 nr T-4-1/23/6

Keskkonnahoidliku ürituse korraldamise reeglid

Kohaliku omavalitsuse korralduse seaduse § 50 lg 1 p 3 alusel, kooskõlas Tallinna Linnavolikogu 9. märtsi 2023 määruse nr 3 „Tallinna jäätmehoolduseeskiri“ § 4 lõigetega 1 ja 2 ja 17. detsembri 2020 määruse nr 26 „Tallinna arengustrateegia „Tallinn 2035““ strateegilise sihiga „Roheline maailmalinn“ ning tulenevalt vajadusest kehtestada Tallinna linna asutuste korraldatavatele üritustele ühtsed reeglid, et hoida ürituste keskkonnamõju võimalikult väike

1. **Üldsätted**

1.1 Käskkirjas määratakse kindlaks Tallinna linna asutuste (edaspidi *korraldaja*) korraldatavate ürituste keskkonnahoiureeglid, mille täitmise peab tagama korraldaja.

1.2 Käskkirjas mõistetakse ürituse (edaspidi *üritus*) all konverentsi, seminari, vastuvõttu, tänu- ja heategevusüritust, lõbustusüritust, võistlust, etendust, kaubandusüritust või muud sellesarnast inimeste koos olemist, mis ei ole koosolek, sh Tallinna linna asutuste siseüritust.

1.3 Korraldajal tuleb Tallinna linna sõlmitavates üritust puudutavates lepingutes määratleda lepingu teise poole kohustus järgida käskkirjas kindlaks määratud reegleid.

2. **Jäätmete vähendamine ja ringlussevõtt**

2.1 Korraldaja on kohustatud tagama üritusel jäätmete liigiti kogumise.

2.2 Eraldi tuleb koguda vähemalt biolagunevad jäätmed, paberi- ja kartongijäätmed, segaolmejäätmed ning klaas-, sega- ja pandipakend, kui seda üritusel tekib.

2.3 Üritusel kasutatavad jäätmemahutid või -raamid peavad olema tähistatud sinna kogutava jäätmeliigi nimetusega eesti keeles ja vajadusel ka võõrkeeltes ning õiget värvi piktogrammiga vastavalt Tallinna jäätmehoolduseeskirjale.

2.4 Korduskasutatavate anumate ja söögiriistade kogumiskoht (nt kast, automaat) peab olema jäätmemahutitest selgelt eristatav.

2.5 Liigiti kogutud jäätmed tuleb üle anda vastavat keskkonnakaitseluba omavale jäätmekäitlejale. Avaliku ürituse korraldaja peab jäätmete üleandmist ja koguseid tõendavad dokumendid esitama e-posti aadressil jaatmed@tallinnlv.ee.

3. **Materjalid ja ostud**

3.1 Inventari, materjale ja muid asju tuleb tellida mõõdukas koguses, et ülejääk oleks võimalikult väike. Dekoratsioonid peavad olema korduskasutatavad või nende materjalid ringlussevõetavad. Ürituse korraldamiseks vajalike asjade, sh dekoratsioonina kasutatavate (kunst)taimede ostmise asemel tuleb neid võimalusel üürida.

3.2 Kutsed, infomaterjalid jms tuleb võimalusel esitada elektrooniliselt. Paberi kasutamisel peab see olema ökomärgisega.

Guidelines for Organizing Sustainable Events

Focus areas

- **Materials and Purchases**
- **Catering and Water Use**
- Waste Management
- Transport
- Energy and Resource Efficiency
- Taking Into Account the Environment and Community
- **Communication and impact on the venue**

Source: Acento

Materials and Purchases

- **Decorations must be reusable** or their materials recyclable
- **Renting** instead of buying
- Only eco-labeled paper shoud be used
- Printing only when nessecary
- E-invitations, information materials
- **Name card holders and neckbands must be reusable**
- Souvenirs and gifts must be shared as little as possible. Local products (food/drinks) preferred.
- In case of goods, souvenirs, gifts - unnecessary packaging must be avoided.
- Cleaning products (e.g. hand soap, tissue paper) must be **eco-labelled**
- **Refillable containers** must be used instead of disposable containers (e.g. soap dispensers).

Waste Management

- **Separate waste collection (at least bio, packages and mixed waste**; paper, glass and deposit bottles if generated)
- Waste containers/frames/labels used at the event must be marked with correct color, pictograms, in foreign languages
- **Reusable dishes must be collected separately, clearly visable**
- **Proof (documents)** of separately collected waste (amounts, types) **must be provided**

Tallinn

Catering and water use

- Food and drinks may only be served in **reusable containers** and use only reusable cutlery
- **Tap water** (instead of bottled water) should be preferred as drinking water
- Fill glasses only when needed
- **Small food packets are not allowed** (e.g. salt, sugar, pepper, coffee cream, honey).
- **Remaining food must be distributed** to organisers, visitors or donated to other partners in reusable containers
- **Local, seasonal, organic food is preferred, vegan food should be served**

Communication and impact on the venue

- Local property owners must be informed about the event
- After event the venue must be cleaned, land restored
- **Sustainability** (use of transportation, using own bottle, reusables, etc) **of the event must be available to the visitors**, e.g. on the website/tickets, during the event with signs, by host, …
- **Using „green ambassadors“ to raise the awareness of the green event**

Tallinn

New strategical document:

- Strategical document – **„Tallinn's Circular Economy Development Plan 2035"** preparation was launched by the City Council in Feb 2024
- Focus areas:
  - Built environment
  - Circular products and servces
  - Sustainable food and bioeconomy
  - Green procurements
  - Raising awareness
  - Waste management
- Prepared from February 2024 to June 2025

Paldies!
Aitäh!
Thank you!

Liina Kanarbik
Lead Specialist
Circular Economy Department
City of Tallinn
Liina.Kanarbik@tallinnlv.ee

Giving Boat Manufacturing Waste a New Life and Sailors More Storage

Augustin HUESO & Maria BOHIC

Who are we ?

Maria Bohic

Material engineering student (soon graduated)

Former material engineer apprentice at CEA-INES

Former LTU student and intern

EEIGM

Apprenticeship

cea

ines
INSTITUT NATIONAL
DE L'ENERGIE SOLAIRE

Augustin Hueso

Material engineering student (soon graduated)
&
Material engineer at Nicomatic

EEIGM

Apprenticeship

NICOMATIC

Both at the LULEÅ UNIVERSITY OF TECHNOLOGY in Erasmus exchange working on a 3 months lab project

Hackathon

Interreg
Baltic Sea Region

Co-funded by
the European Union

CIRCULAR ECONOMY
GlassCircle

Hackathon challenge

Hackathon challenge

Purpose

« Design a solution to reuse production's waste of a glass fibre manufacturer in 48h »

Hackathon challenge

Planning

12:00 AM	Day 1	10:00 PM
Starting speech	Pre-concept	

8:00 AM	Day 2	11:00 PM
Concept	Study	Mock-up

8:00 AM	Day 3	12:00 AM	3:00 PM
Mock-up	Closure	Presentation	Results

Hackathon challenge

Skills required

Pre-concept

Imagination, Incubate, Define, …

Concept

Devellop futhermore, add meaning, …

Study

Search, Analyse coherence, create the design, …

Mock-up

Test, Try, Show the possibilities, …

Closure

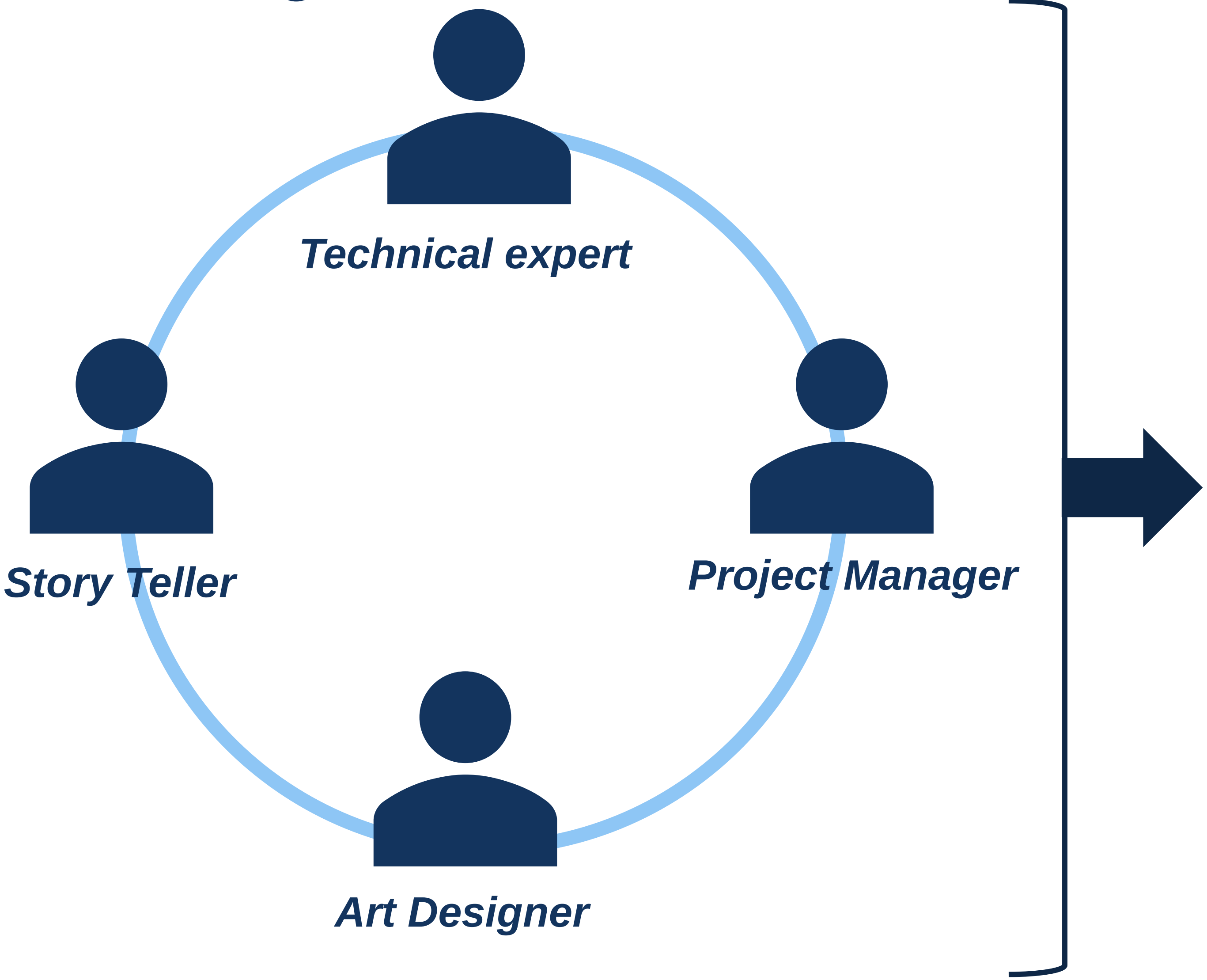
Review the 48h's goals, Sumarise, …

Presentation

Eloquence, Confidence, Passion, …

Hackathon challenge

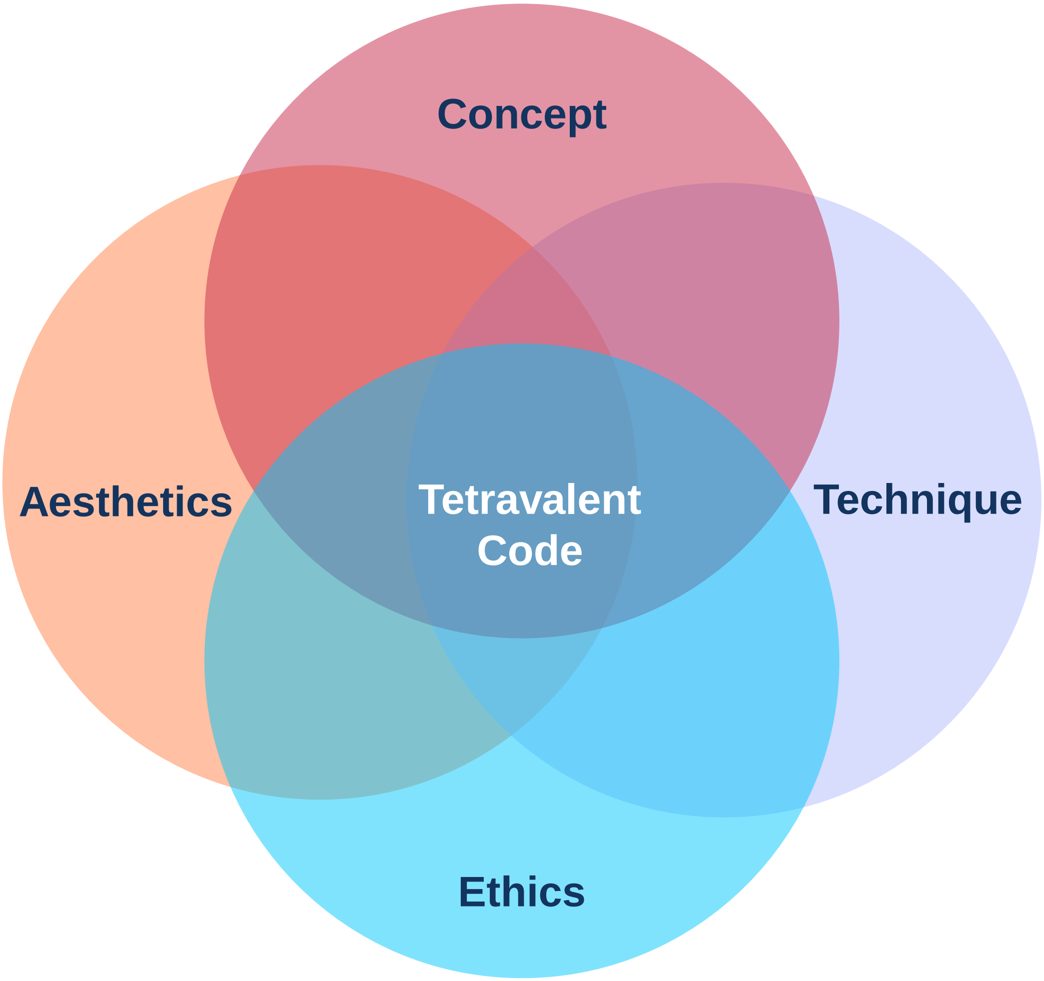
Skills required



Method

Tetravalent code

Or the way to design a product thinking as an arty designer



Concept ➔ describe, express and bring new aspect

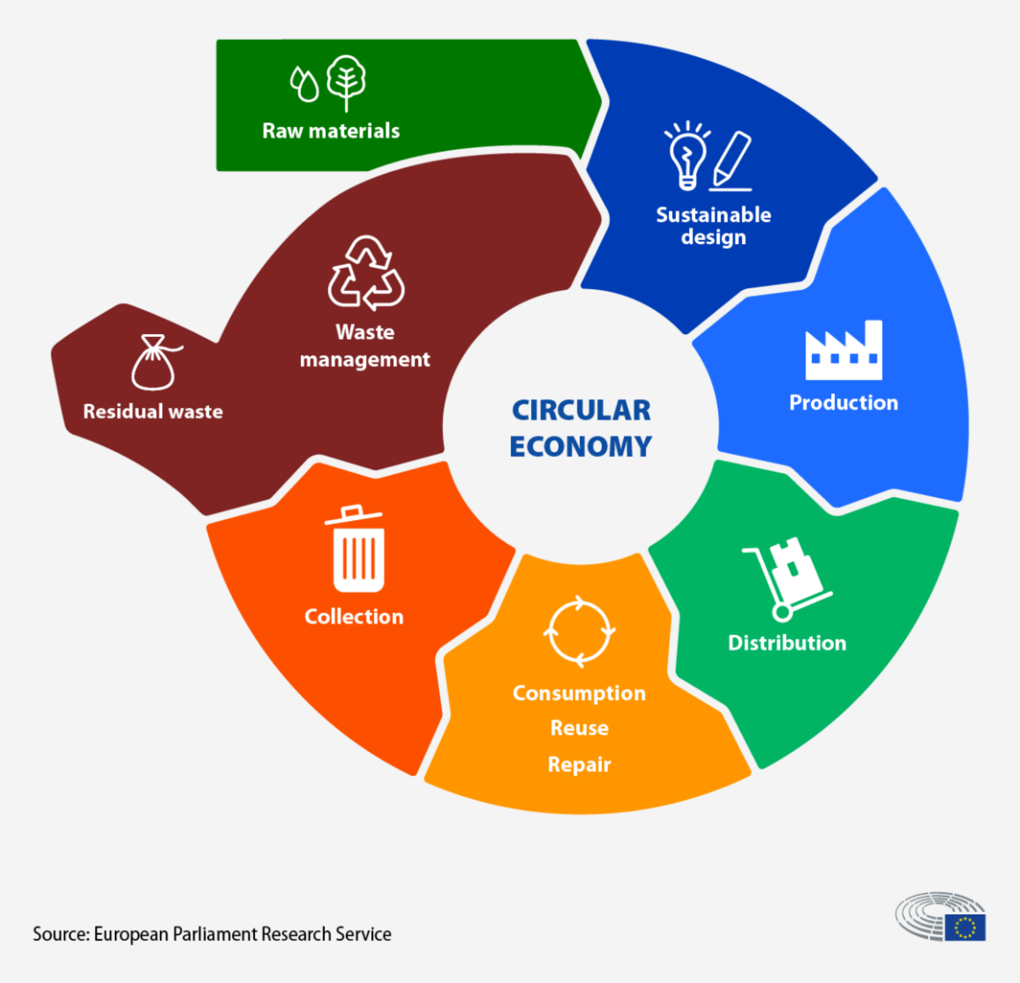
Aesthetics ➔ Material, texture, colors and references

Technique ➔ Process used, cost, production size, assembly, …

Ethics ➔ The target, purpose of the project, social & economical concerns.

Circular Economy

Or the way to have less raw material, less waste and fewer emissions



Luleå University Composite Laboratory

Additonal materials for prototype manufacturing → Epoxy resin, Paint, Molds

Laboratory infrascturcture to work → Fume hoods, Specific table

Thoughts

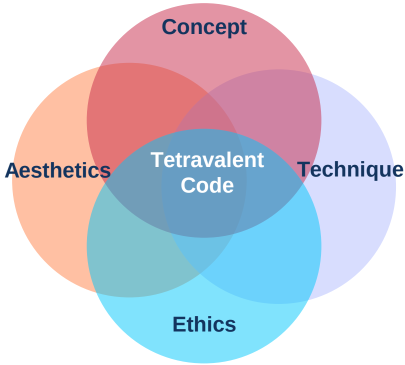
Glass fibres

(Chongqing Dujiang Composites Co., Ltd.)

(Mid-Mountain Materials, Inc.)

Tetravalent code

Or the way to design a product thinking as an art designer



Concept

➔ A storage for personal goods
➔ A sit to change ourselves after a boat trip (ex: remove the shoes)

Aesthetics

➔ Make a product from glass fiber waste & epoxy
➔ A wavy design that reminds of the sea/ocean

Technique

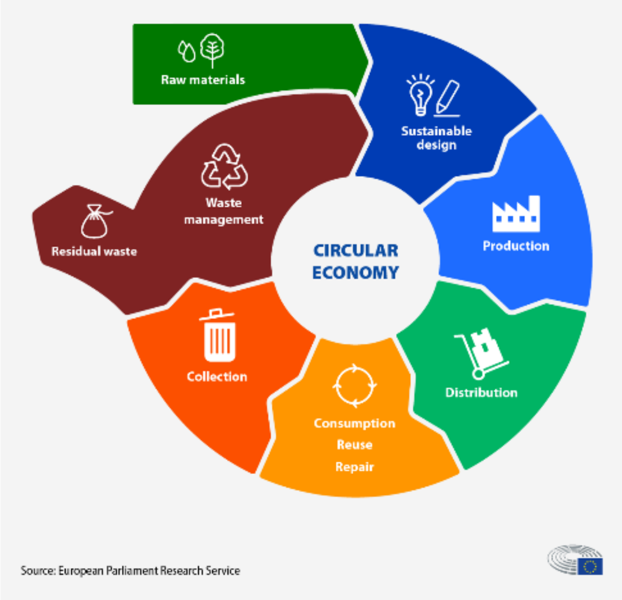
➔ Use the same process as boat's crafting.
➔ Human scale production on request + Nut and bolt assembly
➔ Glass fiber properties sustain salty atmospher

Ethics

➔ Product for marina's sailors
➔ User of the harbour as an incu; Create additonal jobs in the naval factory + a glass fiber school

Circular Economy

Or the way to have less raw material, less waste and fewer emissions

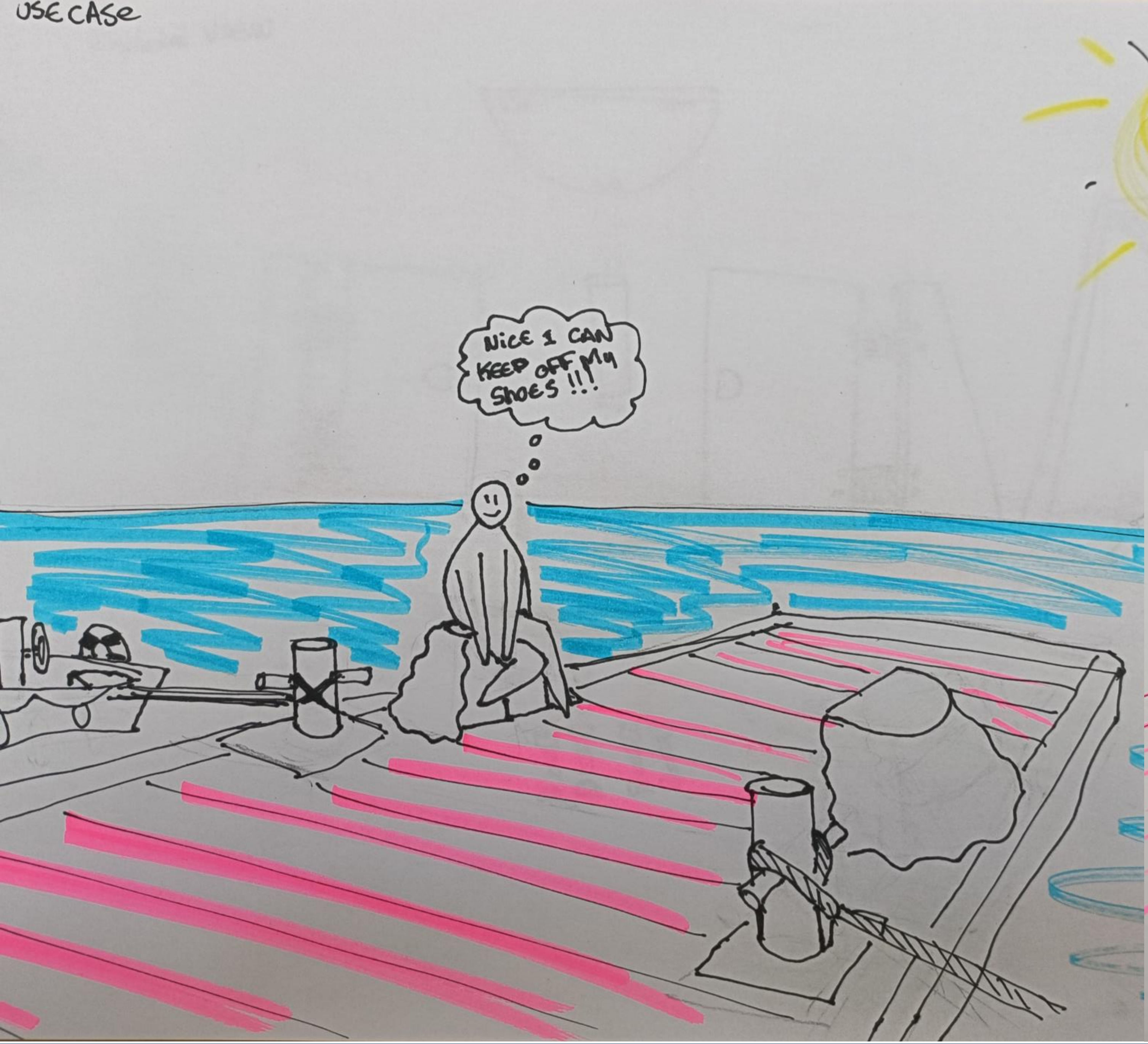


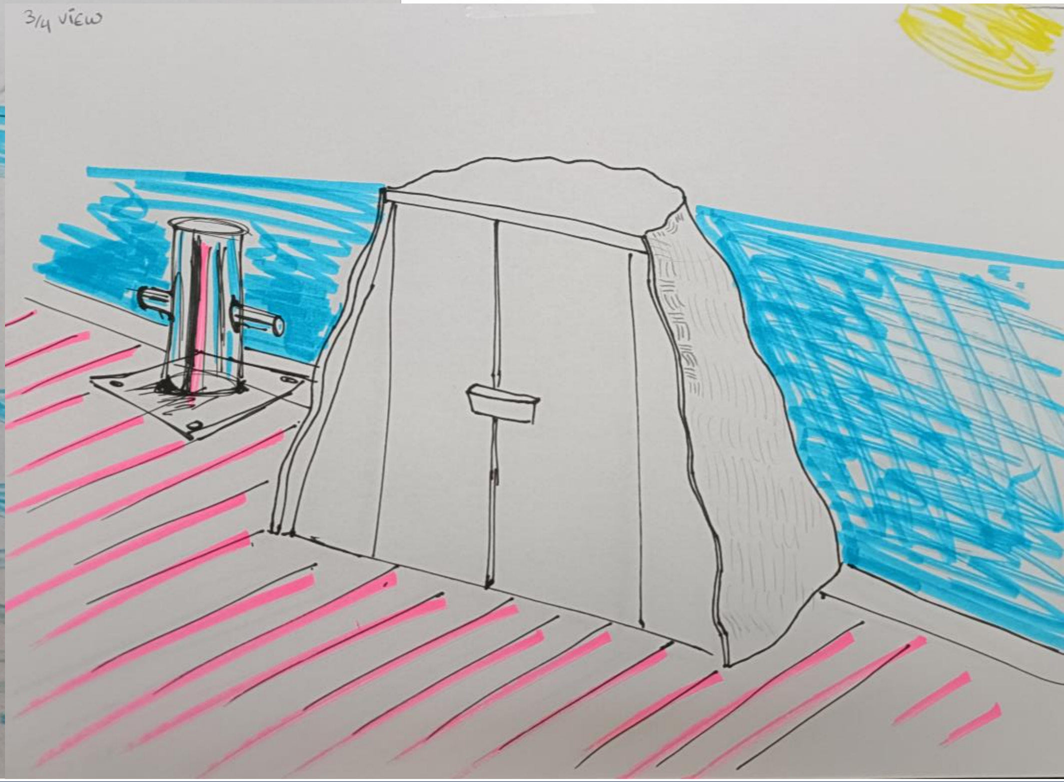
Raw material
➔ Waste from the manufacturer supply with the orders
Sustainable Design
➔ One material & few parts
Production
➔ Reuse the current ones availble in the marina
Distribution
➔ Done locally
Consumption, Reuse, Repair
➔ Interchangeable parts in case of damage + high performance material (no volontary obsolescence)
Collection
➔ Use the one of the marina
Residual waste
➔ Crush and reuse inside of matrix composite or concrete (but mechanical properies reduced)

Business Model

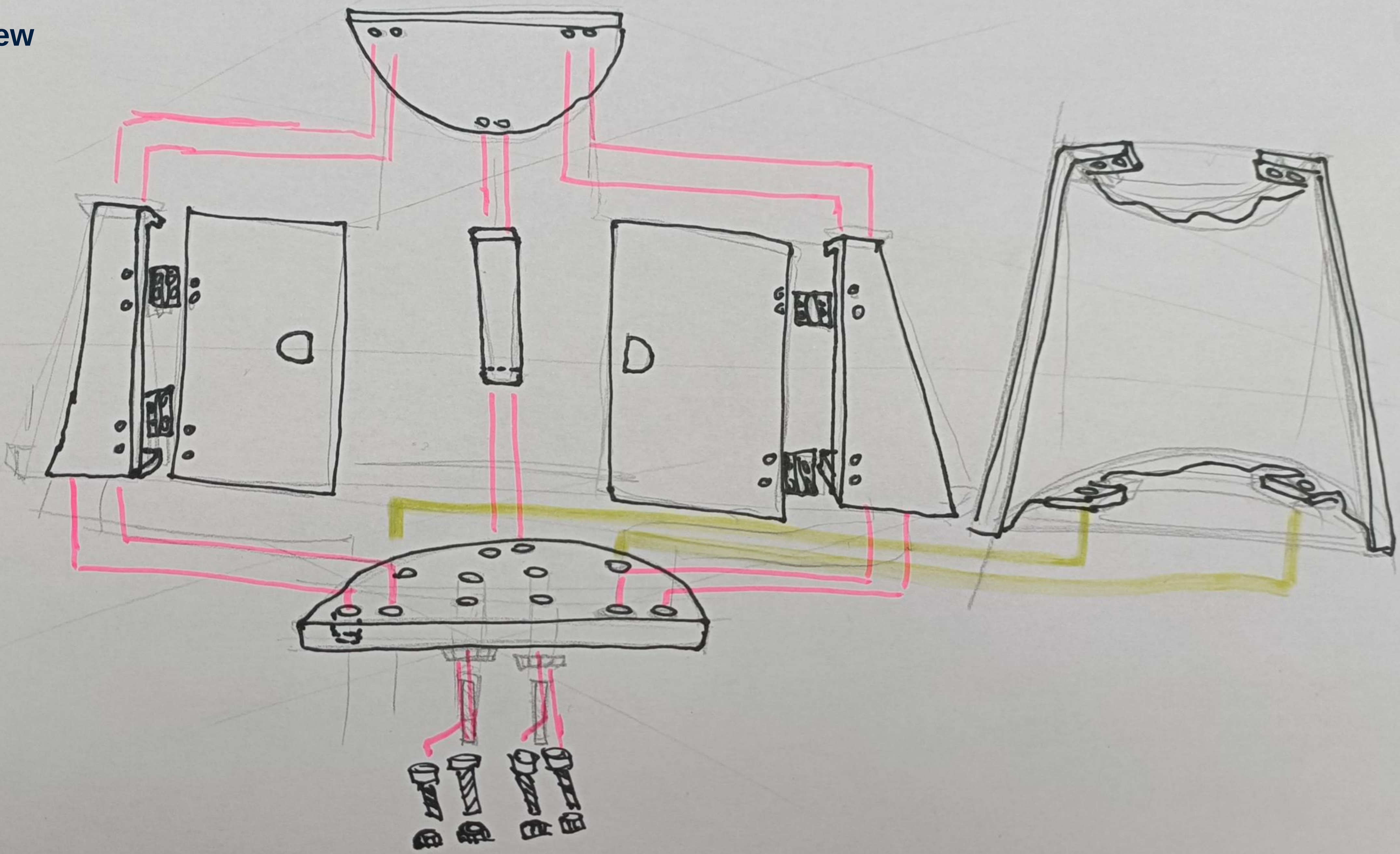
Or the local ecosystem economy

Result


USE CASE
NICE I CAN KEEP OFF MY SHOES !!!


3/4 VIEW

Exploded view



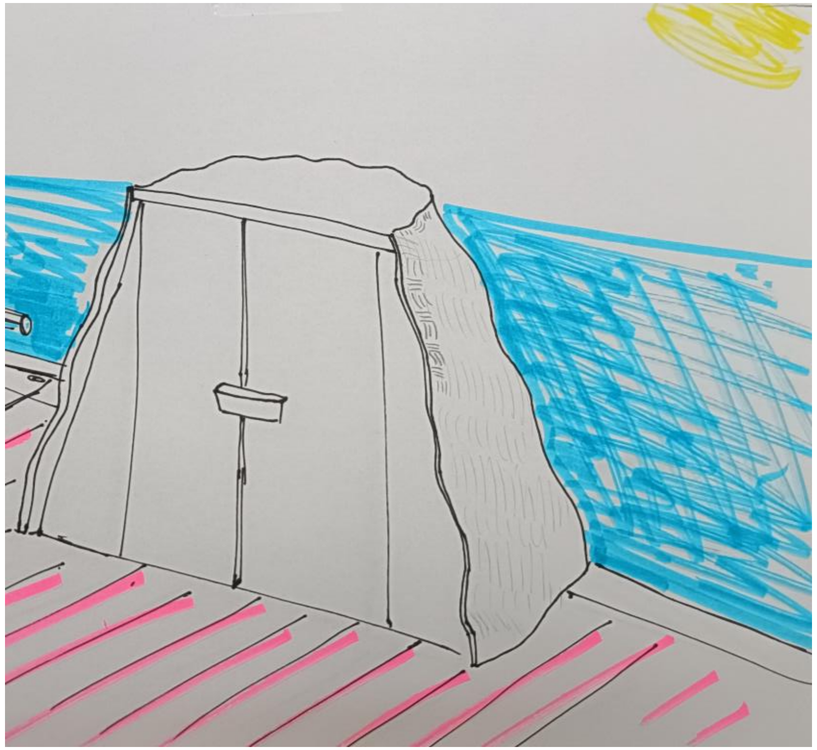
Prototype made

Test on how feasible was the texturing on glass fiber

Conclusion

Conclusion

Project



➔ Show how local actor can be part of sustainable developpement

➔ Add more concrete application on our expertise

➔ Give freshly news vision to the GlassCircle project & its Ecosystem

Conclusion

Our Hackathon feedback

"A Hackathon lets you realize that in 48 hours you are four people at the same time: the technical expert, the communicator, the artist, and the storyteller."

"I enjoyed participating to the hackathon and I appreciated working within a team to find a solution for a more sustainable world."

Conclusion

After Hackathon

Continued working as an apprentice at CEA-INES on Perovskite-Silicon solar cells until August 2024

Did an internship at Luleå University of Technology on biobased thermosets for applications in regenerated cellulose fibers composites

Today

Presented both my aprenticeship and intership for my final defence

Official graduation is now approaching

I want to continue in that path of working in recycling of polymer materials or working on new materials that can be recycled easily or that are more sustainable for my future job

Conclusion

After Hackathon

I participate to create a sustainability team in my company by giving my material expertise. Exchanging on LCA feasability and waste reprocessing.

As an example, we have one project on how implement regenerative material in our products.

Today

Working 2 years in Singapore. The goals is to spread for the Asian hub of my company an efficient material management (including ecodesign aspect for the CSR strategy)

CSR = Corporate Social Responsibility

Any questions ?

Otherwise, thank you for your attention

LULEÅ
UNIVERSITY
OF TECHNOLOGY

Tire & textile sorting in Latvia: reuse and recycle practices

Uldis Skrebs, Board Member
AS AJ Power Recycling

FOUNDED IN 2014

AJ POWER GROUP

Leading privately-owned group of energy and waste management companies in Latvia. **TOP 100** of Latvian companies.

2023 group turnover **EUR 100+ million**.

Team of 55 employees including **experienced and certified** electrical engineers and designers.

The fastest growing energy and waste management group in the Baltic states.

Cooperation with **500+ business clients**.

AJ POWER

AJ Power Group

AJ Power

ELECTRICITY TRADING

AJ Power Gas

NATURAL GAS TRADING

Cactus

SOLAR POWER & ENERGY PROJECTS

ProMC

ENERGY PROJECT MANAGEMENT

AJP Capital AIFP

ALTERNATIVE INVESTMENT FUND MANAGER

AJP Charge

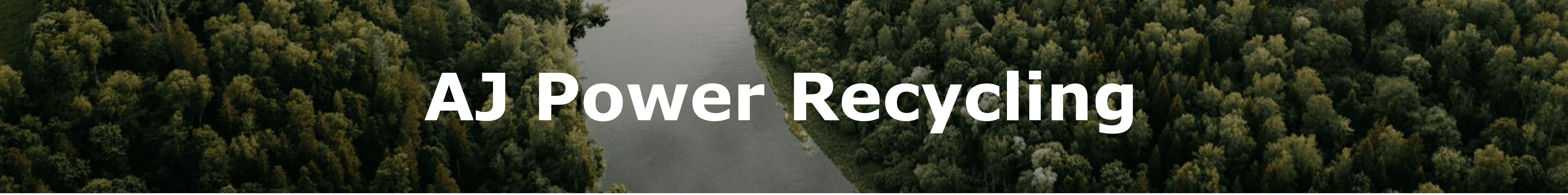
EV CHARGE SOLUTIONS

AJ Power Recycling

WASTE MANAGEMENT & NATURAL RESOURCES TAX

PEM Consulting

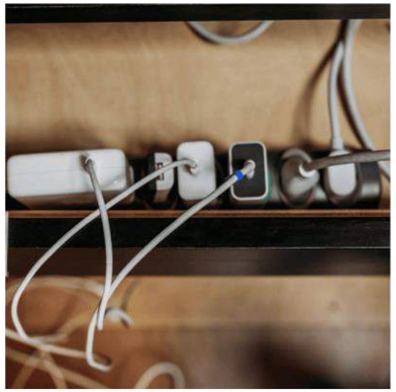
ELECTRICITY & NATURAL GAS MARKET CONSULTING



AJ Power Recycling

WASTE MANAGEMENT SYSTEMS

Textile products



Electrical & electronic equipment

Packaging, single-use, tableware accessories

Environmentally harmful products
(incl. tires)

Our management systems are supervised by the State Environmental Service

State Environmental Service
Republic of Latvia

Controls the compliance with the laws and regulations regarding to the output and utilization of the natural resources and the protection of the nature.

AJ POWER

Tire waste & recycling management system

AJ POWER

Key numbers in Latvia

16 000 tonnes
of tires in Latvia are
worn down each year.

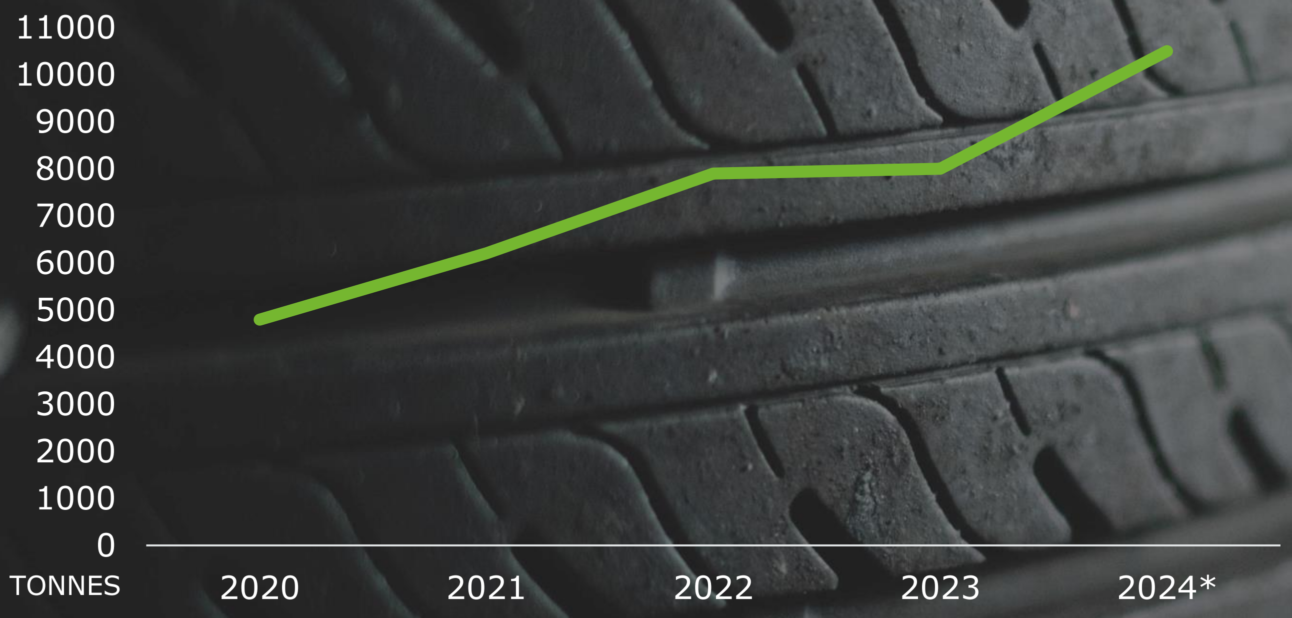
1 500+ tonnes
old tires we collect
in landfill sites.

60-80%
of used tires each year are collected
for recycling or reuse.

250+ tonnes
old tires collected during
our seasonal campaigns.

AJ POWER

The volumes of worn-out tires collected for recycling in Latvia



* Forecast for 2024. 80% of all worn-out tires collected in Latvia.

We work with 200+ companies in the industry.

Specialized area for the collection and pre-treatment of worn-out tires.

Widest collection network of worn-out tires in Latvia.

Service of specialized containers throughout the territory of Latvia.

Specialized IT solution with customer database, trackable data and tire volumes.

AJ POWER

Responsible and clear recycling of tires

SPECIALIZED AREA FOR TIRE COLLECTION AND PRE-TREATMENT


We have an important role to play in dealing with environmental issues locally
AJ POWER

Annual environmental campaign Give Tires a Second Life

To **reduce the amount of accumulated worn-out tires and promote responsible recycling**, campaigns has been organized for already the 6 years by AJ Power Recycling and partners.

During the campaign, motorists can hand in worn-out tires free of charge in many cities across Latvia.

Several hundred tons of used tires are collected annually to be disposed of in a responsible manner.

AJ POWER


ORGANIZĒ: AJ POWER
DOD RIEPĀM
OTRU DZĪVI
AICINA:
SCANIA
JAUNAS UN LIETOTAS AUTOMAŠĪNAS
SCHMITZ CARGOBULL
SECOND HAND FIRST CLASS

DOD RIEPĀM
OTRU DZĪVI!


DOD RIEPĀM
OTRU DZĪVI


AJ POWER
DOD RIEPĀM
OTRU DZĪVI!

Pantera
Serviss
MA-7851

Illegal tire piles in Riga

Six years after the public drew officials' attention to the huge mound (~3,000 tonnes) of old tires in Riga, Starta Street, we had the opportunity to take the initiative and promptly solve the problem that had plagued neighborhood for years.

Huge piles of tyres have been dumped out in the open for a long time, creating dangerous conditions for residents of the neighborhood.

The process attracted wide media and public interest, as the long-standing problem that threatened Riga was finally resolved.

AJ POWER

© Lauris Aizupietis / f64


Archive photo


Archive photo


Archive photo

Textile sorting & recycling management system

AJ POWER

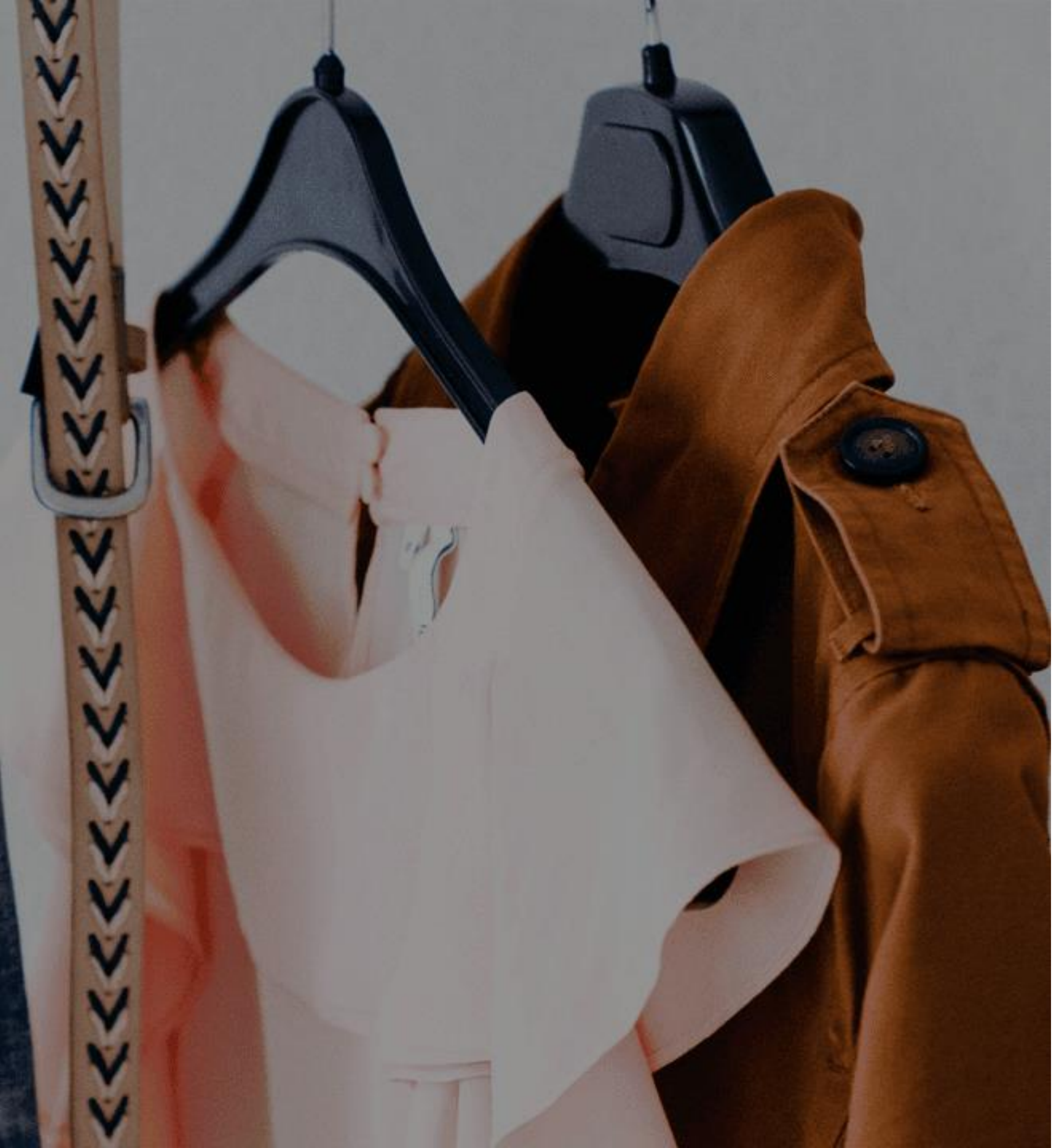
From 2023,

collection and sorting of textile waste is mandatory in Latvia

AJ POWER

Natural Resources Tax (NRT) for textile products

In Latvia from July 1, 2024



NRT for textile products

Textile pollution has been increasing
over recent years, reaching 92 million tonnes per year worldwide.

The amount of textile products imported
in Latvia significantly (as much as 46 times) exceeds the amount of waste collected in Latvia.

The Directive of the European Parliament and of the Council provides that, as of 2025, the member states of the European Union, including Latvia will have to ensure the separate collection of textile materials.

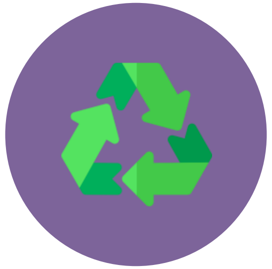
AJ POWER

How does it work?

By concluding a contract with AJ Power Recycling, the company receives a 100% exemption from NRT.

An importer / manufacturer of textiles

Becomes a payer of Natural Resources Tax (NRT).



Concluding a contract with AJ Power Recycling

The company transfers liability for the further management of textile products and receives an exemption from NRT.

AJ Power Recycling

producer responsibility scheme

Collects and manages textile products in accordance with the laws and regulations (submits for recycling, regeneration), thus reducing environmental hazards.

Liability for the failure to pay Natural Resources Tax.

The Natural Resources Tax Law provides that in the event of the failure to comply with the requirement to pay NRT, a fine in double the amount of the unpaid tax, in accordance with the base rates, shall be enforced.

AJ POWER

What textiles are NRT taxable?

Textile products imported to and sold in Latvia (incl. second-hand textiles)	Textile products that are manufactured and sold in Latvia

Clothes, footwear, bags, belts and other accessories consisting of textiles

Home textile, rubber products

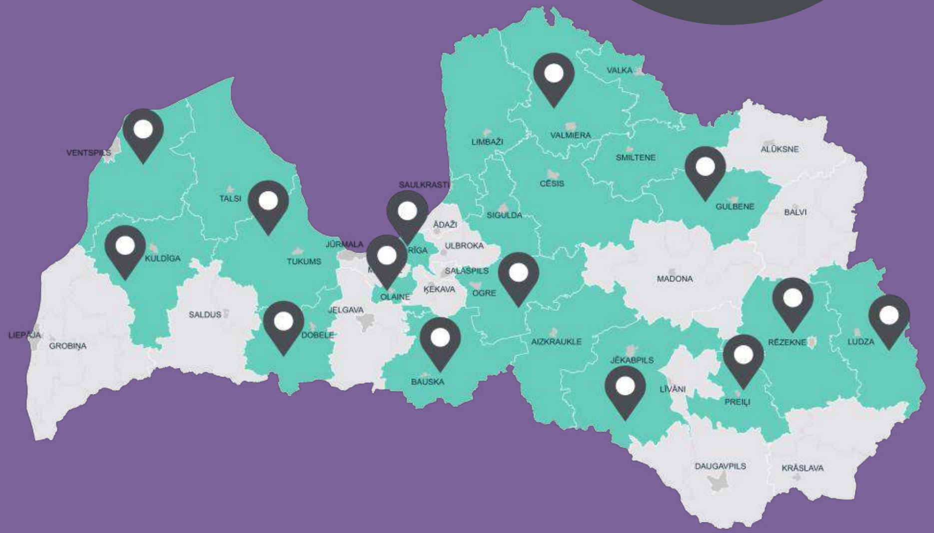
AJ POWER

Textile collection and sorting system with most extensive regional coverage

2 500+ tonnes of clothing, footwear, accessories and home textiles collected

250+

specialized containers for the sorting of textile products



AJ POWER

What happens to the textiles after they are collected?

AJ POWER

1. We deliver textiles to the sorting point and re-sort them.

2. We analyse the content and quality of the collected textiles.

3. For materials that are in good condition, we are looking for opportunities to reuse them here in Latvia or in other countries around the world.

4. For textiles that are not suitable for secondary use, we look for recycling options or use in energy production.

We are involved in the development of the textile sorting system

AJ POWER

Ierīko tekstila šķirošanas konteinerus

Pie tirdzniecības centra *Spice* Rīgā izvietoti pirmie *AJ Power Recycling* tekstila šķirošanas konteineri Rīgā, kuros var nodot nevajadzīgo apģērbu, apavus un citus tekstila izstrādājumus, tādējādi nodrošinot to atkārtotu izmantošanu un pārstrādi, nevis nonākšanu kopējos atkritumos. "Ar šo projektu mēs gribam vērst sabiedrības uzmanību uz iespējām mums kā modes industrijas patērētājiem būt ilgtspējīgiem. Šie tekstilizstrādājumi, ja vairs nav lietojami, var būt noderīgi kā materiāli jaunas izejvielas ražošanā vai visbeidzot kā izejviela enerģijas ieguvei," stāsta *AJ Power Recycling* vadītāja Solveiga Grīsle. Tekstila šķirošanas konteineru apsaimniekošanu nodrošina *AJ Power Recycling* sadarbības partneris SIA *3R*.

Ja mājās ir nevajadzīgs tekstils, jāmeklē violeti konteineri

UZZIŅAI

—Sandra Pētersone

Iedzīvotāju interese šķirot krasi palielinās: līdz šī gada beigām plāno uzstādīt vēl pustūkstoti konteineru tekstila šķirošanai

Palielinoties pieprasījumam pēc tekstila konteineriem un izpratnei par atbildīgu šķirošanu, AS "AJ Power Recycling" sadarbībā ar SIA "3R" un vairākiem lielākajiem reģionālajiem atkritumu apsaimniekošanas uzņēmumiem jau vairāk nekā 30 Latvijas pilsētās ir izvietojuši publiski pieejamus tekstila šķirošanas konteinerus iedzīvotāju nevajadzīgajiem un nolietotajiem apģērbiem un apaviem. Šogad "AJ Power Recycling" mērķi ir ambiciozi – ņemot vērā lielo interesei par tekstilizstrādājumu šķirošanu, līdz šī gada beigām tiks plānots izvietot papildu 500 konteineru.

Tuvojas tekstila nodoklis

Ilgi mocītie grozījumi Dabas resursu nodokļa likumā nokļuvuši līdz finišam

Dace Skreija

DABAS resursu nodokļa likumā ir plānoti grozījumi, kas cita starpā paredz paplašināt ar nodokli apliekamo bāzi, tas ir, attiecināt to arī uz tekstila izstrādājumiem – apģērbu, mājas tekstilu, apģērbu aksesuāriem, somām un apaviem.

Lielai daļai uzņēmumu šādas

Vairāk iespēju nodot tekstilu

Aizkraukles novadā cilvēkiem ir plašākas iespējas nodot nevajadzīgos apavus un apģērbu. Nu to var izdarīt arī Skrīveros un Koknesē.

SANDRA PUMPURE

Vienlaikus ar "Eco Baltia vide" sarkanajiem konteineriem Aizkrauklē šiem šķirotajiem atkritumu veidiem Koknesē un Skrīveros pieejā...

Foto no AS "AJ Power Recycling"

...zmantot ik... ...iadzīgo ap... ...būt ievieto... tam cieši aizsietā maisā, vēl derīgam atkārtotai izmantošanai, tīram un sausam. ◆

Nedēļas laikā Preiļos savāktas 4,67 tonnas tekstila materiālu

23. maijā, tieši nedēļu pēc tekstila materiālu šķirošanai paredzēto konteineru uzstādīšanas Preiļos, tie pirmo reizi tika iztukšoti. SIA "Preiļu saimnieks" Atkritumu apsaimniekošanas daļā pavēstīja, ka konteineri ir bijuši pilni, kā rezultātā savāktas 4,67 tonnas tekstila materiālu.

Ivars Soikāns

Kā "Latgales Laiku" informēja Preiļu novada pašvaldībā, tekstila konteineros atstātie tekstilizstrādājumi tiks nodoti SIA "3R", kas pēc materiālu atkārtotas pāršķirošanas tekstilu nodos atkārtotai lietošanai vai pārstrādei.

Iepriekšējā nedēļā SIA "Preiļu saimnieks" sadarbībā ar AS "AJ Power Recycling" un SIA "3R" izvietoja Preiļos septiņus publiski pieejamus tekstila šķirošanas konteinerus, kuros iedzīvotāji bez maksas var nodot nevajadzīgo apģērbu, apavus un citus tekstila izstrādājumus – mājas tekstilu, somas un jostas, tādējādi nodrošinot to atkārtotu izmantošanu un pārstrādi, nevis nonākšanu atkritumu poligonos.

Publicitātes foto

Violetie tekstila šķirošanas konteineri pieejami atkritumu šķirošanas laukumos Preiļos: Aglonas ielā 29, Celtnieku ielā 9, Viļānu ielā 6, N. Rancāna ielā 5, Rēzeknes ielā 30, Daugavpils ielā 66 un Mehanizatoru ielā 1. Tuvākajā laikā tekstila šķirošanas konteinerus plānots izvietot arī novada teritorijā.

Tekstila šķirošanas konteineros drīkst nodot nesabojātus, nesaplēstus, tīrus, sausus kreklus, bikses, kleitas, svārkus, vestes, jakas, mēteļus, šalles, cimdus, zeķes, apakšveļu, cepures, dvieļus, aizkarus, gultas veļu, pārklājus, spilvenus segas, paklājus ne lielākus par 1,5x2 metriem, jostas, somas, kā arī valkāšanai derīgus apavu pārus.

Tekstila materiālus pirms nodošanas šķirošanas konteinerā nepieciešams ievietot stingri aizsietā, caurredzamā maisā.

Nedrīkst nodot saplēstu, sabojātu apģērbu, audumu atgriezumus, tekstilu, kas ir sasmērēts ar sadzīves ķīmiju vai motoreļļām, mitru, sapelējušu tekstilu, matračus, mīkstās rotaļlietas, kā arī bojātus apavus, gumijas zābakus, ziemas sporta apavus un bižutēriju.

Uzņēmumā "Preiļu saimnieks" pauž gandarījumu par to, ka pilsētas iedzīvotāji savā ikdienā aktīvi iesaistījušies arī tekstila materiālu šķirošanā, domājot par materiālu atkārtotu izmantošanu un pārstrādi, nevis nonākšanu atkritumu poligonos.

Aptauja: 56% iedzīvotāji ir kaut reizi nodevuši tekstilu pārstrādei

BNN 2023.gada 28.marts

Foto: Alex Fu/Pexels

Iedzīvotāju aptaujas rezultāti parāda, ka aptuveni 61% respondentu reizi sezonā vai pat biežāk iegādājas jaunus tekstilizstrādājumus, kas tikai vēļ vairāk pastiprina vajadzību pēc drošām un atbildīgām tekstila nodošanas iespējām norāda AS *AJ Power Recycling* valdes loceklis Uldis Skrebs.

Arī Koknesē un Skrīveros varēs nodot nevajadzīgo tekstilu

Rēzeknē sāk šķirot tekstilu

Lai veicinātu vēl lietojama apģērba, apavu un mājas tekstila nodošanu atkārtotai izmantošanai, kā arī samazinātu kopējo sadzīves atkritumu apjomu, SIA "ALAAS" apkalpošanas reģiona iedzīvotājiem ir iespēja bez maksas nodot sašķiroto tekstilu.

Ivars Soikāns

Rēzeknes pilsētas pašvaldībā "Latgales Laiku" informēja, ka SIA "ALAAS" sadarbībā ar SIA "3 R" un SIA "AJ Power" ir uzstādījusi tekstila konteinerus divos šķiroto atkritumu laukumos – Rīgas ielā 21B, Rēzeknē un sadzīves atkritumu poligonā "Križevņiki" Ozolaines pagastā.

Nodot drīkst nesabojātu, nesaplēstu, tīru visa veida un materiālu apģērbu – kreklus, bikses, kleitas, svārkus, vestes, jakas, mēteļus, šalles, cimdus, zeķes, apakšveļu, cepures u.tml.; nesabojātu, nesaplēstu, tīru visa veida un materiālu ...

... aizsietā maisā. Sašķiroto materiālu nedrīkst novietot pie konteineriem, jo tas var kļūt mitrs, netīrs un tālākai lietošanai nederīgs.

Viss tekstila šķirošanas konteineros ievietotais materiāls tiks nodots SIA "3 R", kas to nogādās šķirošanas centros. Pēc materiāla atkārtotas pāršķirošanas tekstils tiks nodots dažādām labdarības organizācijām atkārtotai lietošanai vai pārstrādei sadarbības partneriem ārpus Latvijas, vai enerģijas ieguvei.

SIA "ALAAS" aicina iedzīvotājus izvērtēt nepieciešamību iegādāties jaunus tekstila izstrādājumus. Tāpat ...

Collaborations and joint projects


NODOD APĢĒRBU UN APAVUS ŠEIT!
Drīkst mest
Nedrīkst mest
Ļauj modei dzīvot ilgāk!
Kas neder tev, noderēs citam


NODOD APĢĒRBU UN APAVUS ŠEIT!
Drīkst mest
apģērbus
apavus
mājas tekstilu
somas, jostas
Nedrīkst mest
sadzīves atkritumus
mitru, pelējušu apģērbu, apavus
Ļauj modei dzīvot ilgāk!
Kas neder tev, noderēs citam
AJ POWER
O3R
spice

AJ Power Recycling
Riga Fashion Week 2023
the official sustainability partner

AJ POWER

RECYCLED COLLECTION CREATED WITH
ART ACADEMY OF LATVIA (AAL) FASHION DESIGN DEPARTMENT


nansija_g
7,721 followers


betabeidz
35.4K followers

A special exhibition dedicated to textile recycling
Shopping center SPICE

A special exhibition dedicated to textile recycling
Shopping center SPICE

AJ Power

Innovative energy and waste management solutions

Feel free to connect with me on LinkedIn

Uldis Skrebs

AJ Power Recycling Board Member
Mob: +371 26434506
E-mail: uldis.skrebs@ajpower.lv

AJ Power Group

Address: 21 Daugavgrivas Street, Riga, LV-1048, Latvia
www.ajpower.lv

AJ POWER

LCA AS A PRACTICAL TOOL FOR ENVIRONMENTAL IMPACT ASSESSMENT

Dr. Viktoria Voronova
E-mail: viktoria.voronova@taltech.ee

WHAT IS LIFE CYCLE ASSESSMENT (LCA)?

- **Life Cycle Assessment (LCA)** is a practical tool used to evaluate the environmental impacts of a product, process, or service throughout its entire life cycle.
- It systematically assesses the environmental effects from the extraction of **raw materials (cradle)** to the **disposal or recycling (grave)**, covering all stages in between, such as production, transportation, use, and end-of-life treatment.

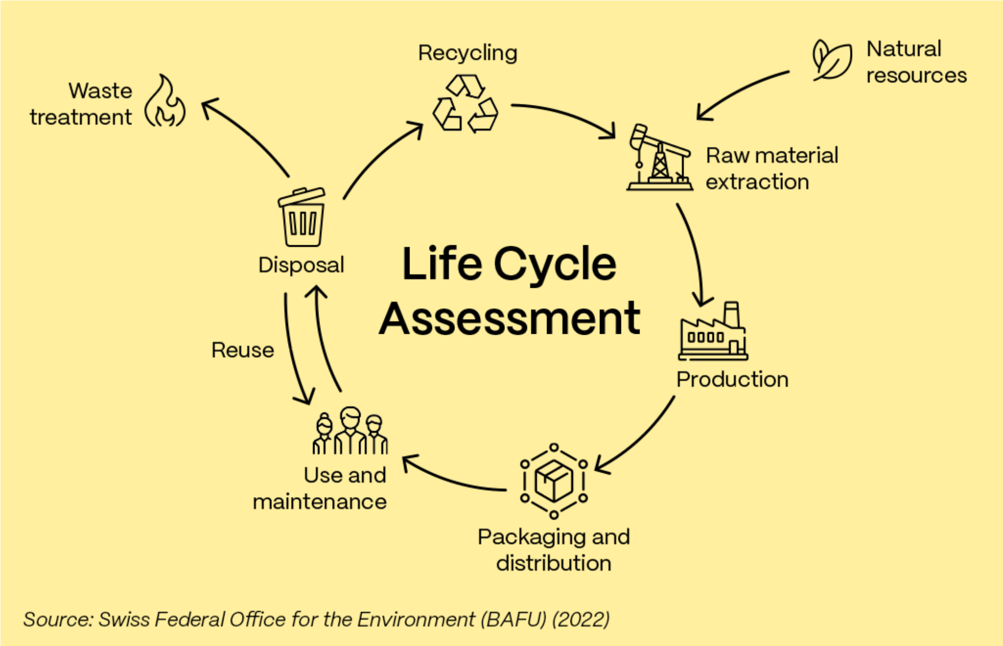
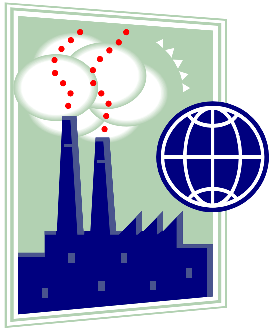


Fig. 1. Stages of life cycle assessment (*Source: Ecoinvent, 2024*)

1. Priorities for the environment



Industry

Environmental policy

Control of emissions → End of pipe solutions ?

- Expressions of risks
- Environmental impact within all phases (raw material extraction, production, use, end of life)

Not enough anymore!

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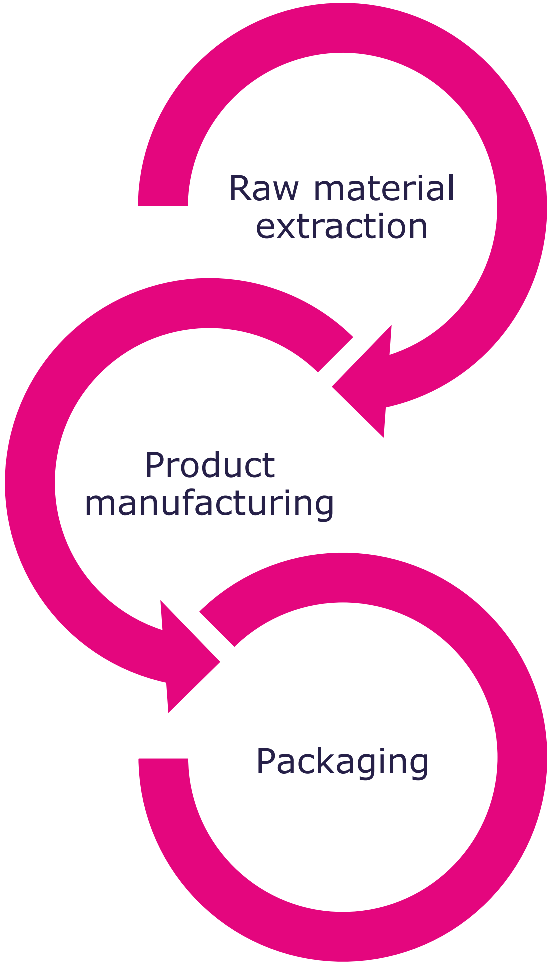
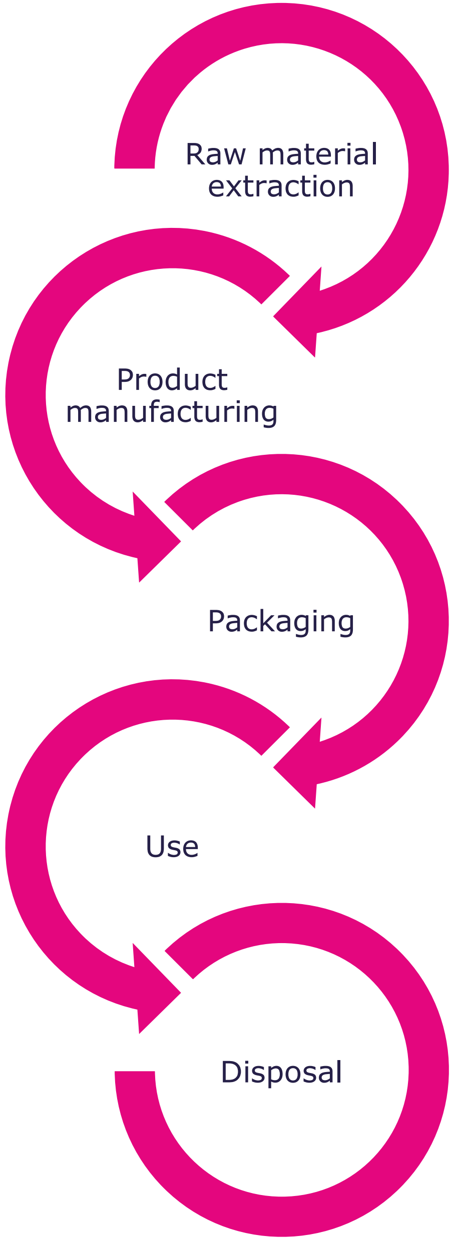
Cradle to gate approach



Cradle to grave approach



What is the environmental impact?

How it can be measured?

TALTECH

Environmental impact refers to the direct effect of socio-economic activities and natural events on the components of the environment and human health.

In the frame of **Life cycle assessment** environmental impact can be measured through environmental indicators.

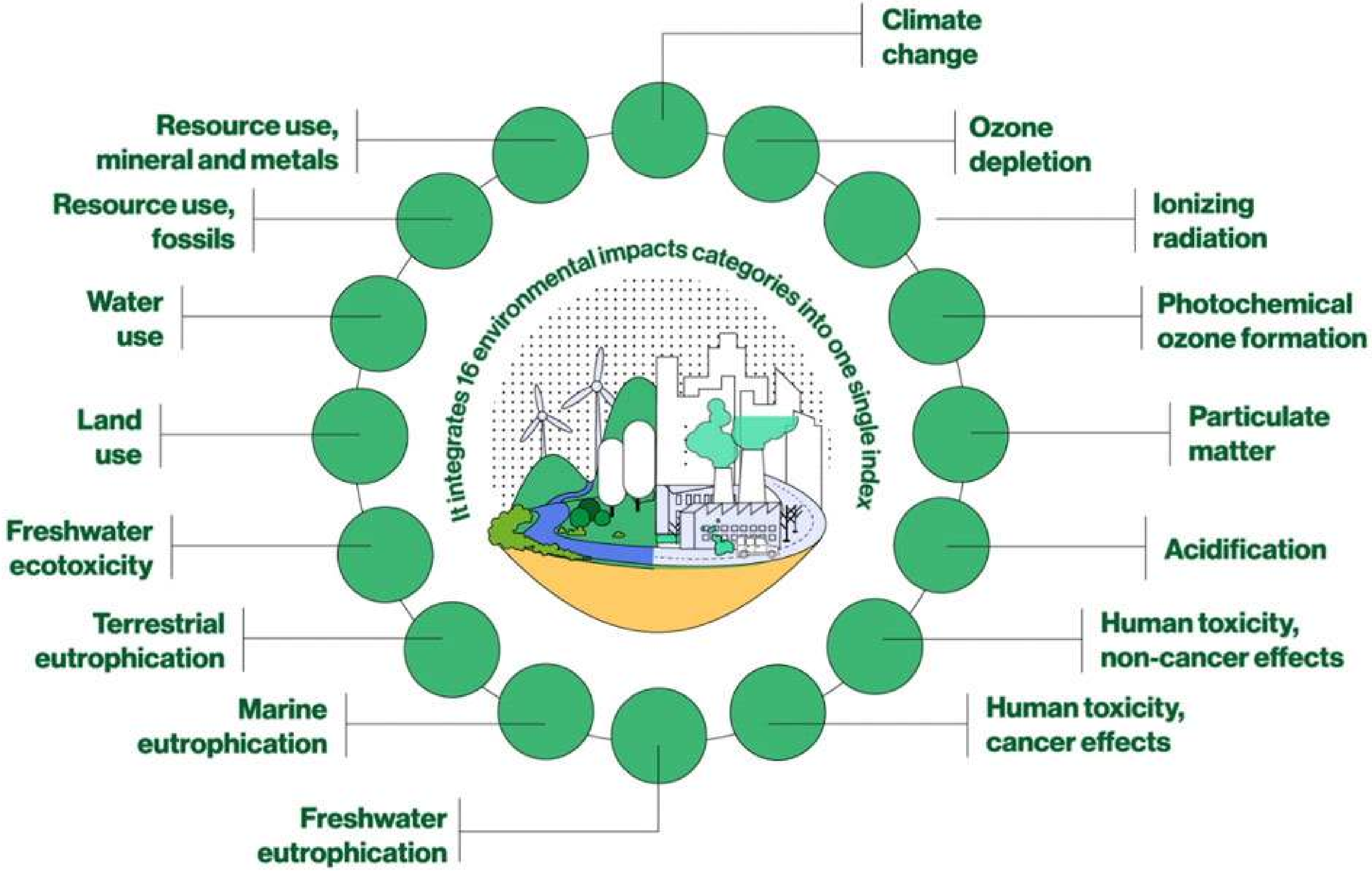


Fig.2 Environmental indicators
(*Photo:Enviroscore, 2024)*

TAL TECH

LCA STANDARDS

ISO 14040 and ISO 14044 on life cycle assessment

ISO 14040:

- Establishes the principles and framework for LCA, covering the goal, scope, inventory analysis, impact assessment, and interpretation.
- It ensures consistency in methodology, providing a clear and structured approach for organizations to assess the environmental aspects of products or services throughout their life cycles.

ISO 14044:

- Expands on ISO 14040 by detailing the specific requirements and guidelines for conducting LCAs, including how to quantify and interpret results.
- It outlines the steps necessary for conducting a life cycle inventory (LCI) and life cycle impact assessment (LCIA), ensuring that assessments are transparent, comprehensive, and comparable.

LCA STANDARDS

ISO 14067 on the carbon footprint of products

- ISO 14067 is an international standard that focuses on the quantification and communication of the carbon footprint of products (CFP).
- It provides guidelines for calculating the total greenhouse gas (GHG) emissions associated with the life cycle of a product, from raw material extraction through production, distribution, use, and disposal.
- ISO 14067 defines the methodology for quantifying GHG emissions and removals, using reliable and consistent data sources. It applies life cycle assessment (LCA) principles aligned with ISO 14040 and ISO 14044 but focuses specifically on carbon-related emissions.
- The standard requires transparency in the reporting process and ensures that CFP assessments can be compared between products.
- It also provides guidelines on how the CFP should be communicated to stakeholders, ensuring clarity, accuracy, and relevance, whether the footprint is shared through labels or environmental reports.

LIFE CYCLE IMPACT ASSESSMENT (LCIA)-EXAMPLE CALCULATION OF GLOBAL WARMING POTENTIAL (GWP)

- In the LCIA phase, the potential climate change impact (global warming potential) is calculated by multiplying the mass of GHG released or removed by the 100 – year potential given by IPCC in units of „kg of CO_2 equivalents per kg emission".
- **Global warming**

Many of the substances emitted to the atmosphere as a result of human activities contribute to this manmade greenhouse effect and must be classified in this impact category. Listed in order of importance:

- ✓ CO_2 (carbon dioxide)- 60%
- ✓ CH_4 (methane) – 15%
- ✓ N_2O (nitrous oxide) - 4%
- ✓ Halocarbons (hydrocarbons containing chlorine, fluorine or bromine) – 10%

LIFE CYCLE IMPACT ASSESSMENT (LCIA)-
EFECT OF THE GREENHOUSE GASES

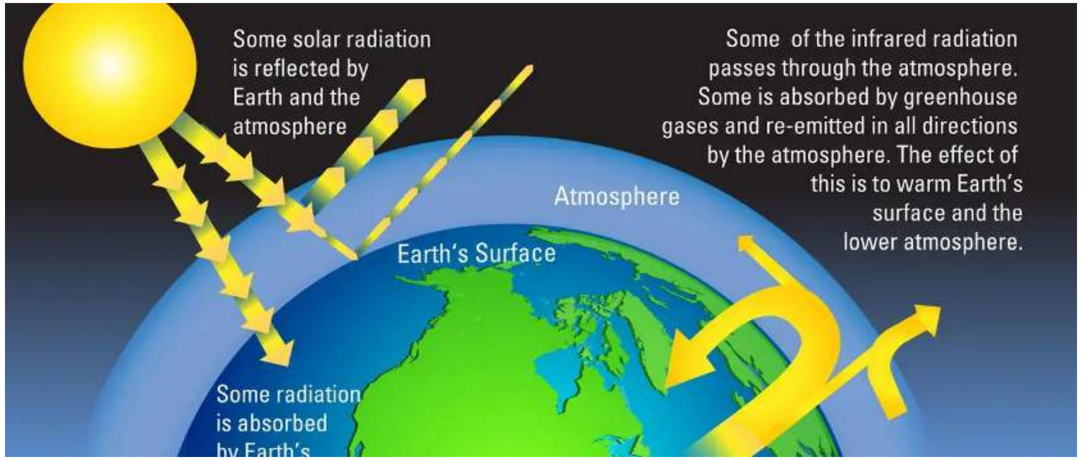


Figure 3: Greenhouse gas effect *(Source: Earth Journalism Network, 2024)*

Table 1 Global warming potential (GWP) values relative to CO2 *(Source: IPPC, 2024)*

Industrial designation or common name	Chemical formula	GWP values for 100-year time horizon		
		Second Assessment Report (SAR)	Fourth Assessment Report (AR4)	Fifth Assessment Report (AR5)
Carbon dioxide	CO_2	1	1	1
Methane	CH_4	21	25	28
Nitrous oxide	N_2O	310	298	265

EXAMPLE – CALCULATION OF CARBON FOOTPRINT FOR GREEN EVENTS IN ESTONIA

The main objective was to calculate the carbon footprint of reusable plastic dishware used at the Green Events in Estonia:

- production of the materials
- end-of-life points
- comparison with SUP dishware options

Events are:

- "Youth Song and Dance Celebration" in Estonia in 2023
- LHV Maijooks in Estonia 2022
- LHV Maijooks in Estonia 2023
- Merepäevad in Estonia 2023
- Tallinna maraton in Estonia 2022
- Tallinna maraton in Estonia 2023

GREEN EVENTS

EIA METHODOLOGY - CARBON FOOTPRINT CALCULATION

Data from a green event

- Number of visitors
- Number of reusable caps, packages, and cutlery used

Data from a catering service*

- Number of reusable cycles
- Type of dishwasher
- Amounts of water and electricity used
- Defect rate

Alternative scenario if SUP is used

- Same number of visitors
- Single-use caps, packages, and cutlery

Use ELCD database available free of charge on openLCA Nexus

Carbon footprint

Comparison

Reusability Cycles needed

*in case appliable

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GREEN EVENTS

EIA METHODOLOGY – EMISSION FACTORS

Name in the table	Material, description	Emissions, kg CO_2 eq/ kg of material	Emission factor source
Bio-PP	Bio Polypropylene	-0,06	Greenhouse Gas Emission Reduction Potential of European Union's Circularity
PP	Polypropylene granulate (PP), production mix, at plant	2,12	OpenLCA ELCD database, Impact assessment method - CML-IA baseline, Global warming (GWP100a)
Wood fiber	Graphic Paper, production mix, at plant, technology mix, 79% primary fibre, 21% recycled fibre	0,83	
PS	Polystyrene (general purpose) granulate (GPPS), production mix, at plant	3,80	
PET	Polyethylene terephthalate (PET) granulate, production mix, at plant, amorphous	3,56	
-	1 kg waste (incinerated)	3,23	
PP	1 kg recycled polypropylene (PP)	0,22	US EPA, AR5 method

GREEN EVENTS

INITIAL DATA

	Reusable dishware		
	Cups	Plates/Food package*	Cutlery
1. Youth Song and Dance Celebration			
Pieces, #	85 000	155 000	161 500
Weight, g	43	125	7
Material	PP	PP	Wood fibre 60%, Bio-PP 40%
2. LHV Maijooks 2022			
Pieces, #	14 610		
Weight, g	15		
Material	PP		
3. LHV Maijooks 2023			
Pieces, #	17 260	1 289	3 250
Weight, g	14	116	5
Material	PP	PP	PP
4. Merepäevad 2023			
Pieces, #	10 242	7 469	28 450
Weight, g	52	76	6
Material	PP	PP	PP
5. Tallinna maraton 2022			
Pieces, #	9 110	3 900	
Weight, g	24	52	
Material	PP	PP	
6. Tallinna Maraton 2023			
Pieces, #	72 919	1 389	6 000
Weight, g	12	72	6
Material	PP	PP	PP

ALTERNATIVE SCENARIO

For comparison purposes, the alternative scenario with SUP was calculated.

	Single use dishware			
	Cups	Plates	Food packaging	Cutlery
Weight, g	7	20	125	1,5
Material	PP	PP	PP	PS

Quantities of the SUP dishware are the same as for the corresponding green event.
Reiteration (100-120 events) was used.

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GREEN EVENTS

INITIAL DATA

Dance Celebration - Hobart™ industrial tunnel washer data:		
Total loading	26,9	kWh
Blow drying	5,4	kWh
Other events - MEIKO™ K 200KVP conveyer dishwasher:		
Total loading	31,33	kWh
All events - Capacity		
Emission factor for 1 kW	0,715	kg CO_2-eq*
Cups/Food package	4000	pc/h
Cutlery	8000	pc/h

*Elering 2022 report

https://www.hobart-export.com

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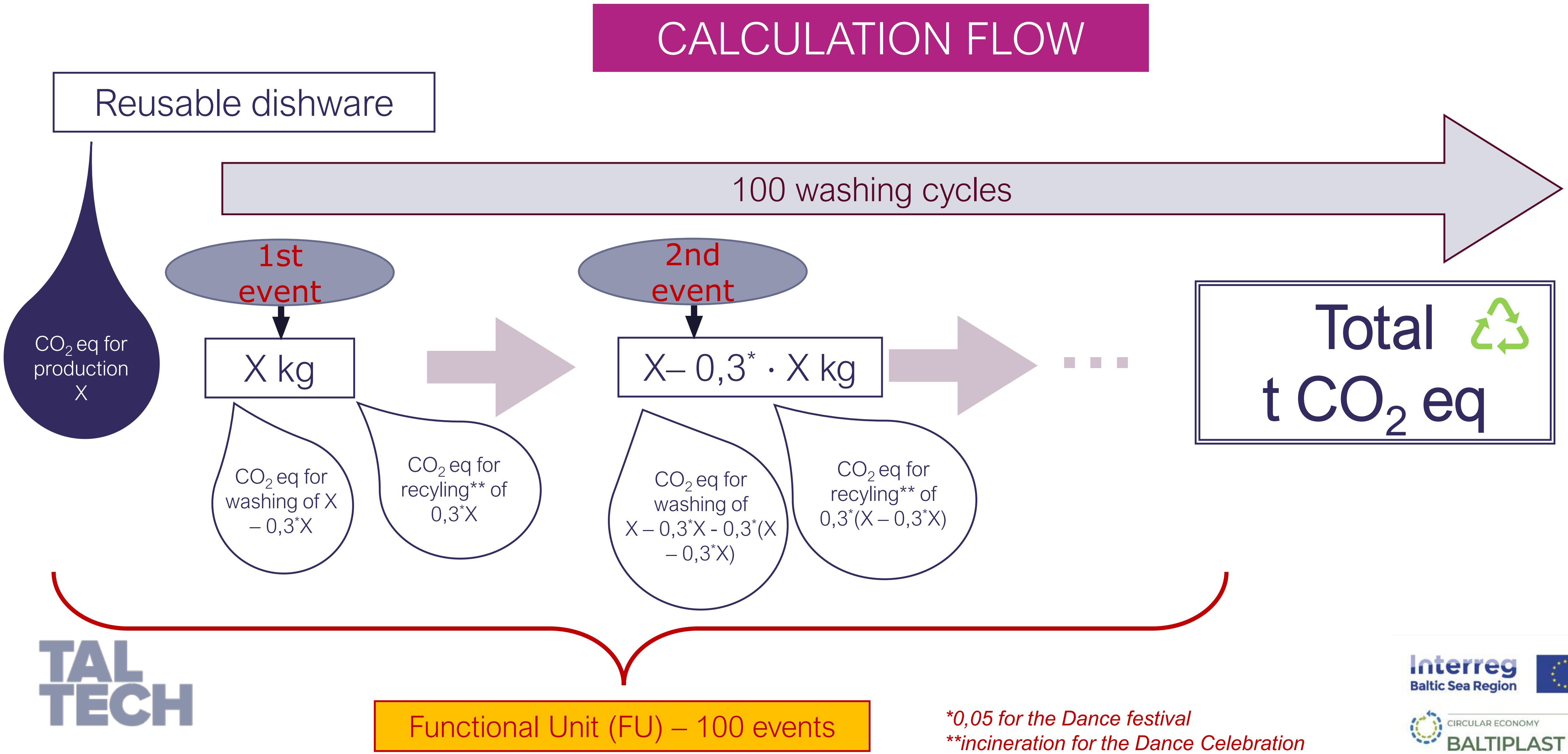
GREEN EVENTS

CARBON FOOTPRINT CALCULATION



**0,05 for the Dance festival*
***incineration for the Dance Celebration*

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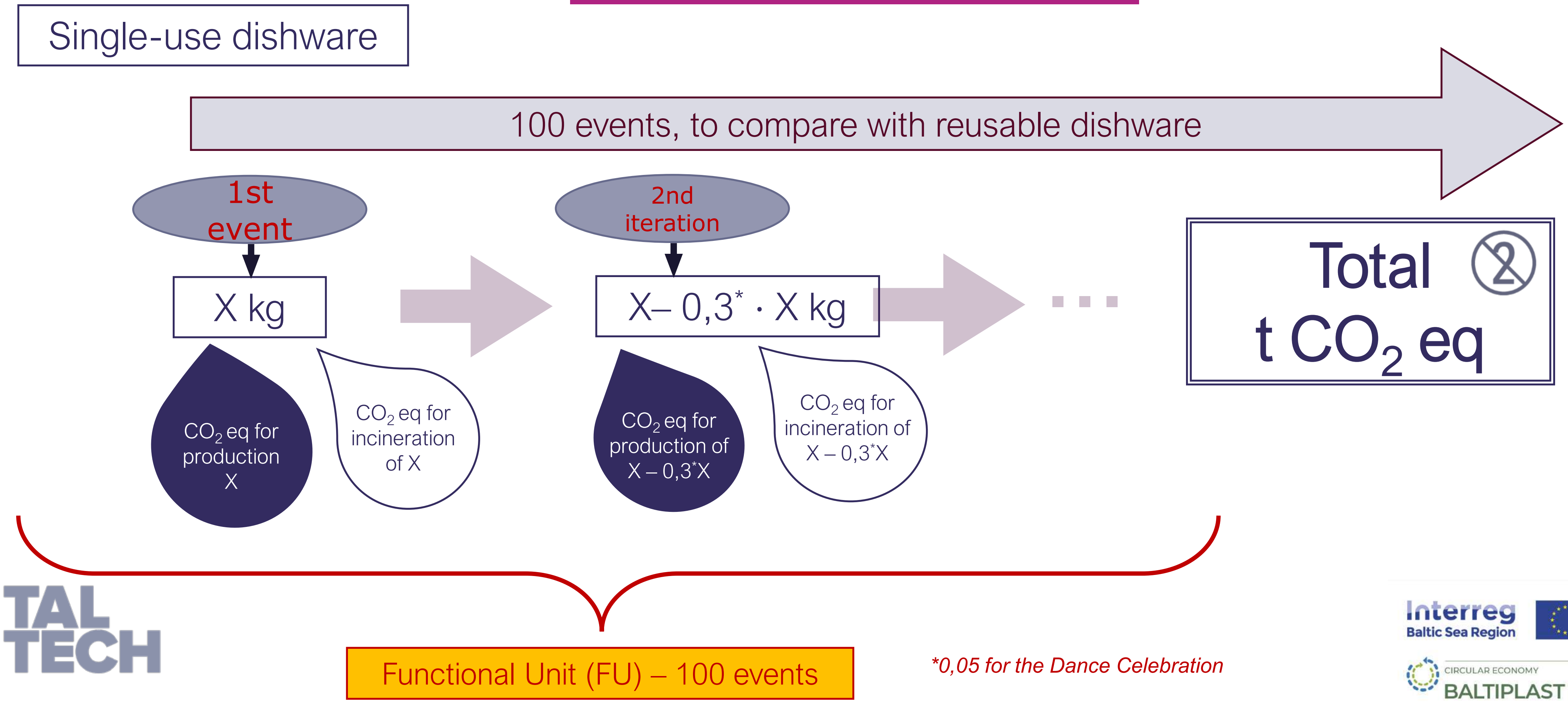
GREEN EVENTS

CARBON FOOTPRINT CALCULATION

CALCULATION FLOW



*0,05 for the Dance Celebration

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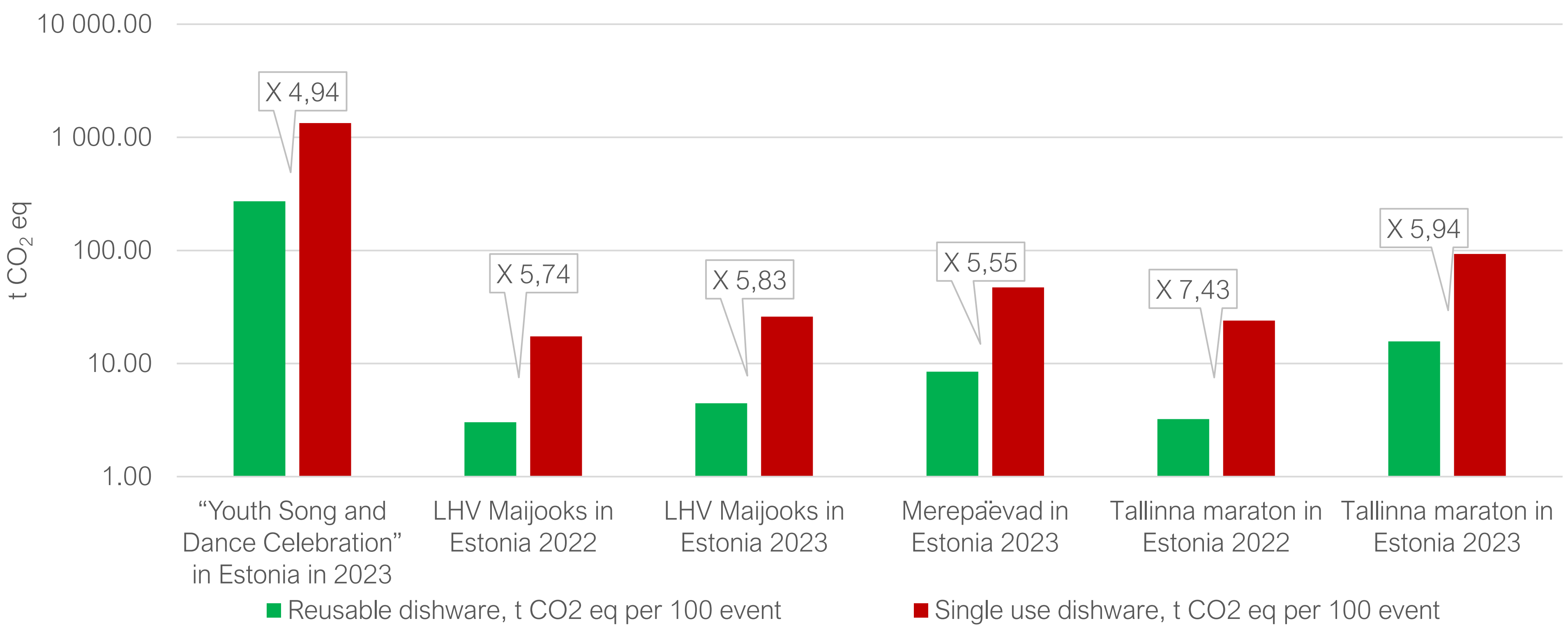
GREEN EVENTS

RESULTS



The results show, that in the case of **reusable dishware** usage total emissions in t CO_2 eq are **4,94 – 7,43 times** less than in the case of **single-use plastics**.

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BENEFITS FOR THE COMPANY

LCA helps organizations pinpoint the stages in their product’s life cycle or operations that have the highest environmental impacts, reducing resource consumption, energy use, and emissions, ultimately lowering the company's ecological footprint.

By identifying inefficiencies in resource use and energy consumption, LCA can help organizations optimize processes, reduce waste, and lower operational costs.

LCA provides a comprehensive framework to assess and report environmental performance, ensuring that organizations stay compliant with current regulations (e.g., carbon emissions, waste management) and are better prepared for future regulatory changes.

LCA brings competitive advantage in markets where customers, investors, and partners prioritize environmental responsibility.

LCA provides a scientifically robust and transparent way to communicate environmental impacts, making sustainability reports more credible and comprehensive.

LCA can help organizations move toward circular economy principles by assessing opportunities for recycling, reuse, and resource recovery. This supports waste reduction and encourages the design of products that have a longer life span or are easier to disassemble and recycle at the end of their life.

LEARNING OPPORTUNITIES

EPICENTRE

The educational platform for life cycle assessment structures

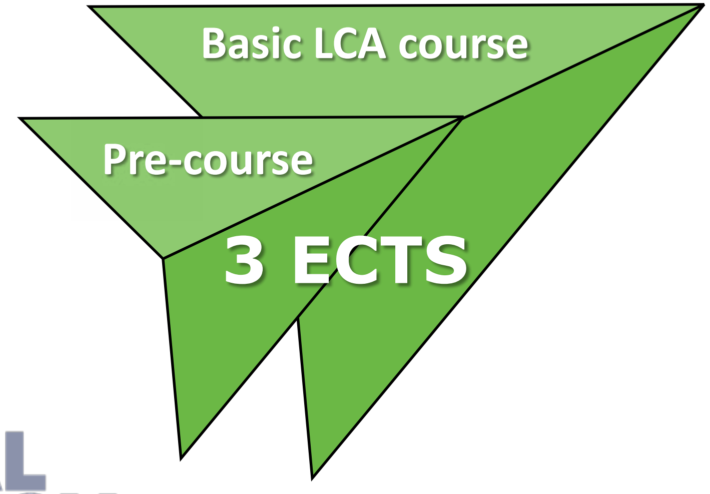
EPICENTRE

EPICENTRE addresses a critical need in the professional community by focusing on enhancing understanding and communication regarding Life Cycle Assessment (LCA) & Life Cycle Cost (LCC) analysis, and new Business Development

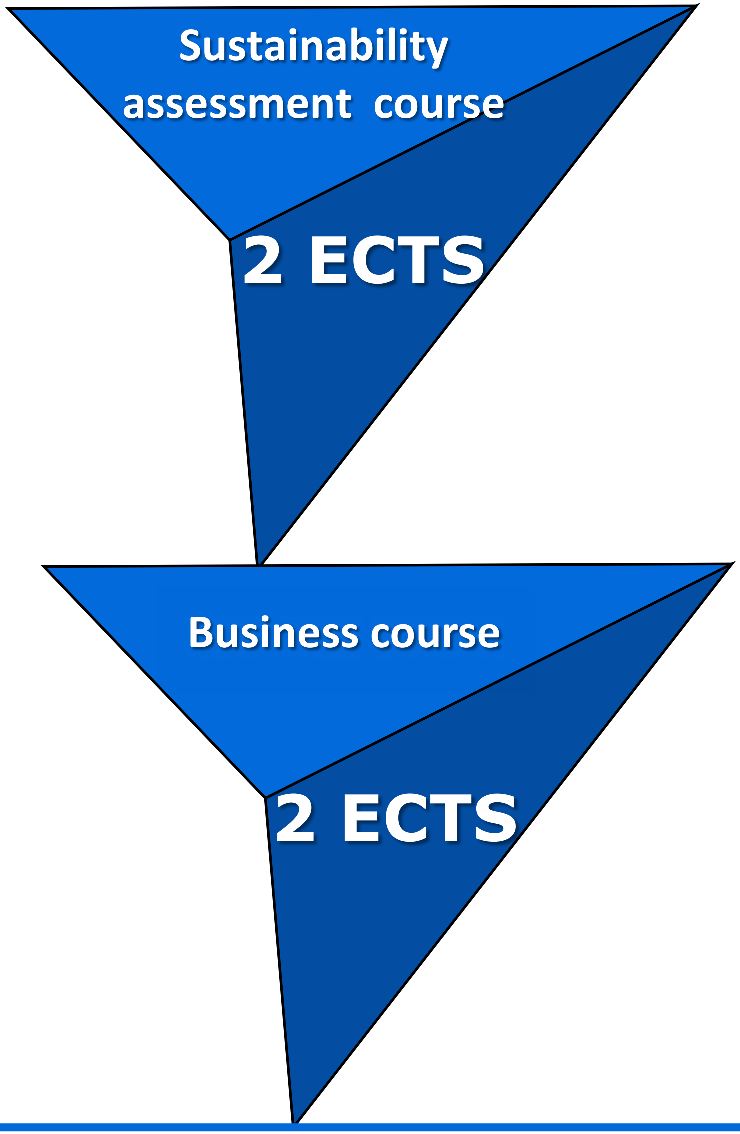
Two level courses of summer school

Basic level

- Online pre-course (3-4 weeks)
- On-site Basic LCA course (2 days or 16 acad. hours)
- Independent work
- Includes mentoring



**Includes learning materials and short introduction about Sustainability assessment and Business*

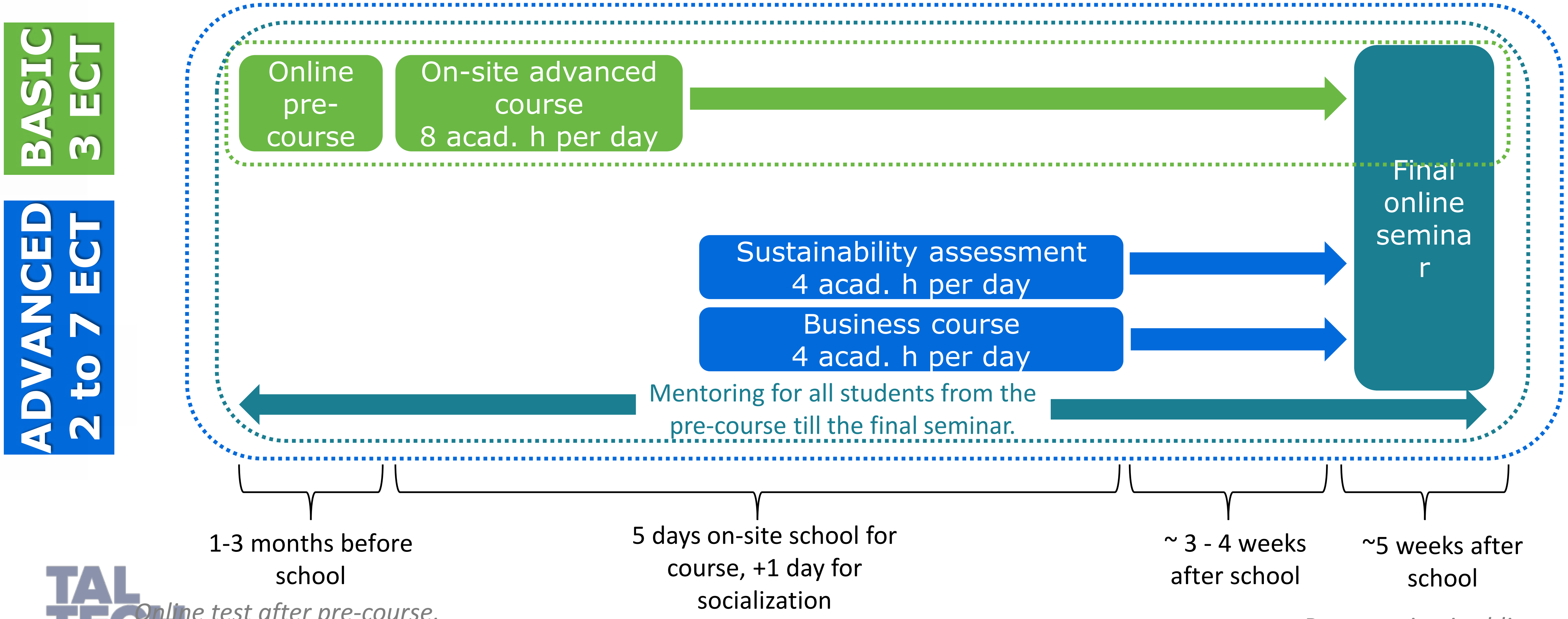


Advanced level

- On-site LCA and LCC course (3 days or 12 acad. hours)
- On-site Business course (3 days or 12 acad. hours)
- Independent work
- Includes mentoring

The structure summer school

1 ECT = 27 acad. h



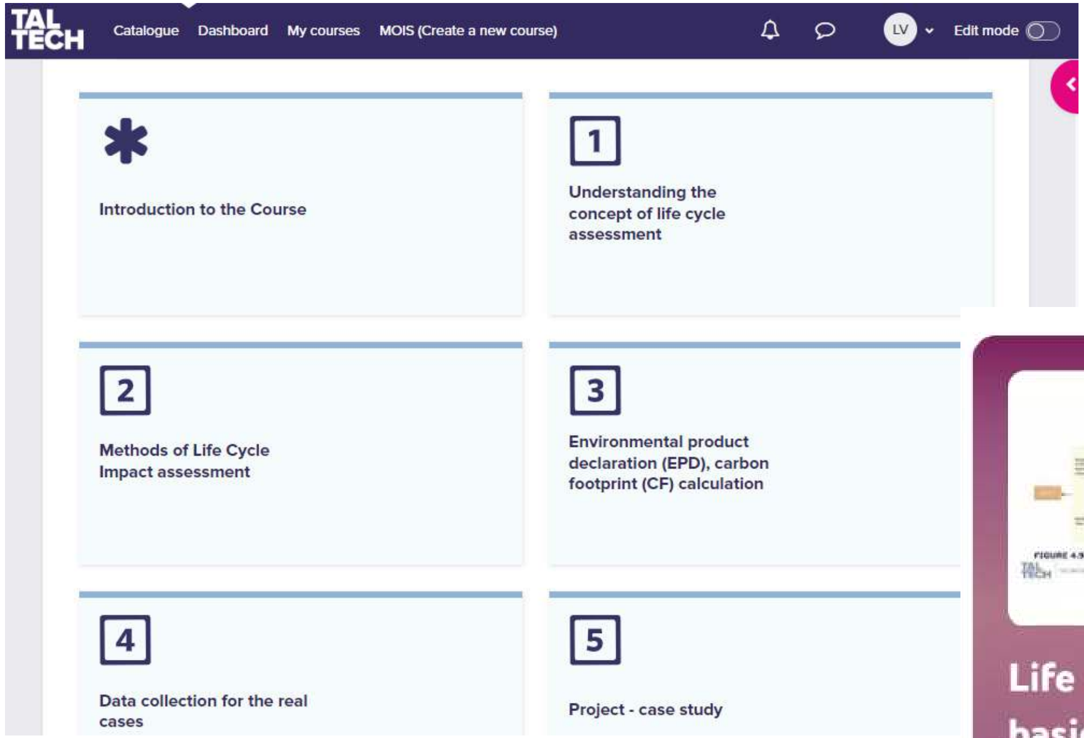
Online test after pre-course, can take test to prove previous knowledge and skip the pre-course

Submits and presents the project 3-5 weeks after school

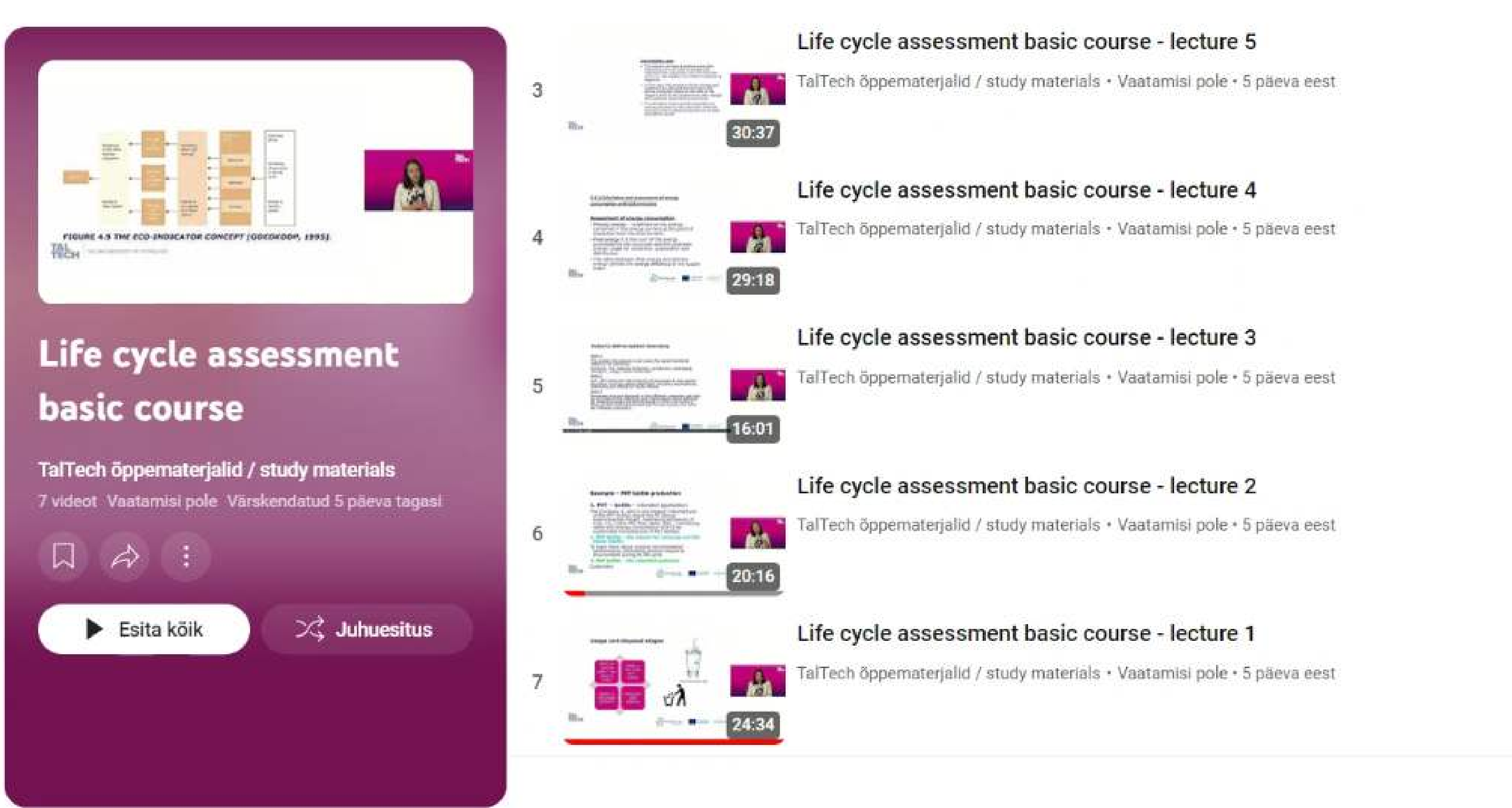
Presentation is obligatory to receive certificate

Learning **platform & materials**

User friendly learning platform organized and maintained by TalTech.

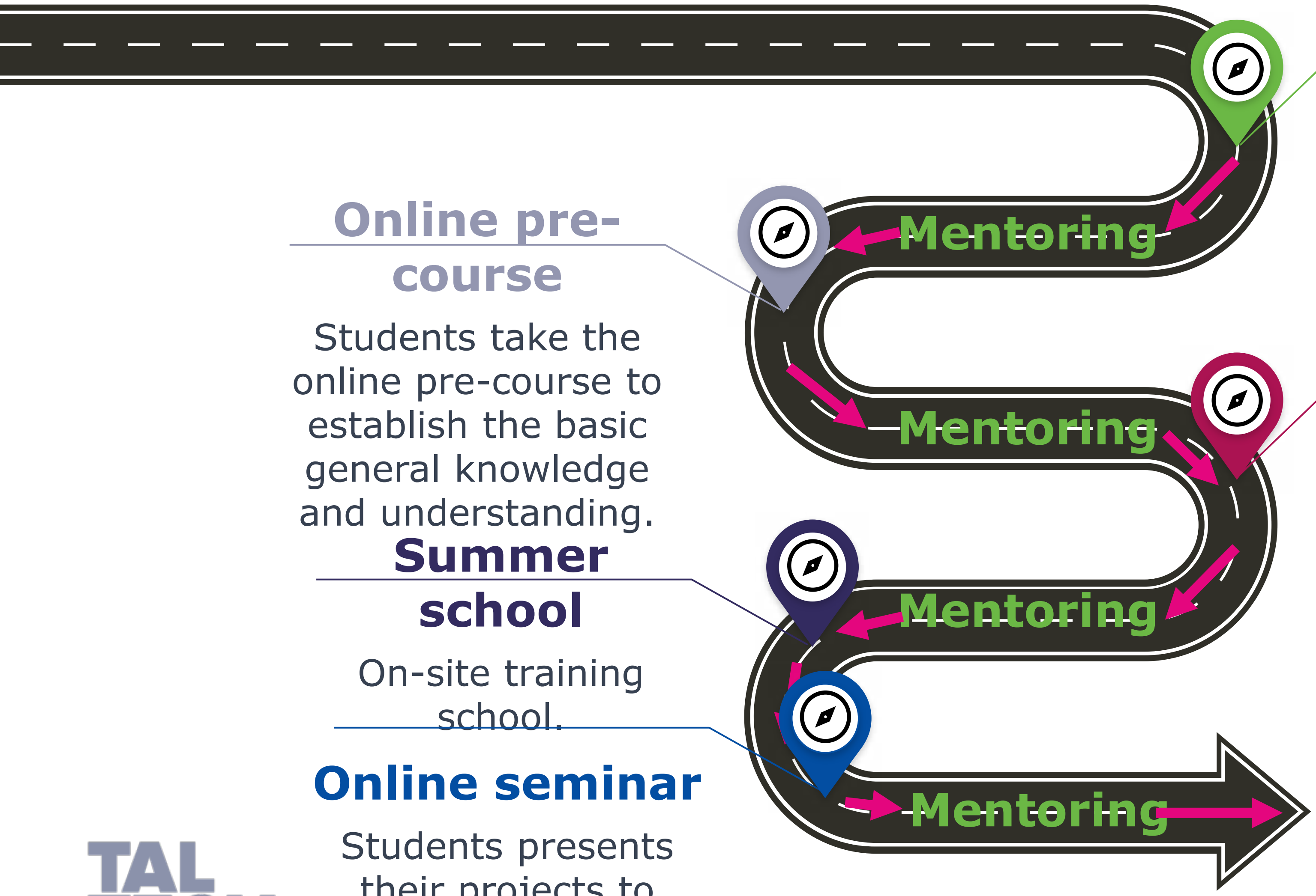


Modern and comprehensive learning materials.



Roadmap of summer school

EPICENTRE



Application

Students fill the application form and are divided into groups for mentoring.

Online pre-course

Students take the online pre-course to establish the basic general knowledge and understanding.

Online test

Online test to evaluate the knowledge level.

Summer school

On-site training school.

Online seminar

Students presents their projects to receive the certificate and receive feedback.

CERTIFICATE &

Understanding
Contacts
Experience

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EPICENTRE

LCA/LCC summer school for professionals

18th – 23rd September 2025 @Riga

More information about the project: https://epicentre.rtu.lv/

General plan:

- 18th September – Introduction, basic LCA course
- 19th September – Basic LCA course
- 20th September – Sustainability assessment course & Business course
- 21st September – Excursion & socialization
- 22nd September – Sustainability assessment course & Business course
- 23rd September – Sustainability assessment course & Business course

TAL TECH

THANK YOU!

E-mail: viktoria.voronova@taltech.ee

Composite recycling in Finland

KiMuRa Route

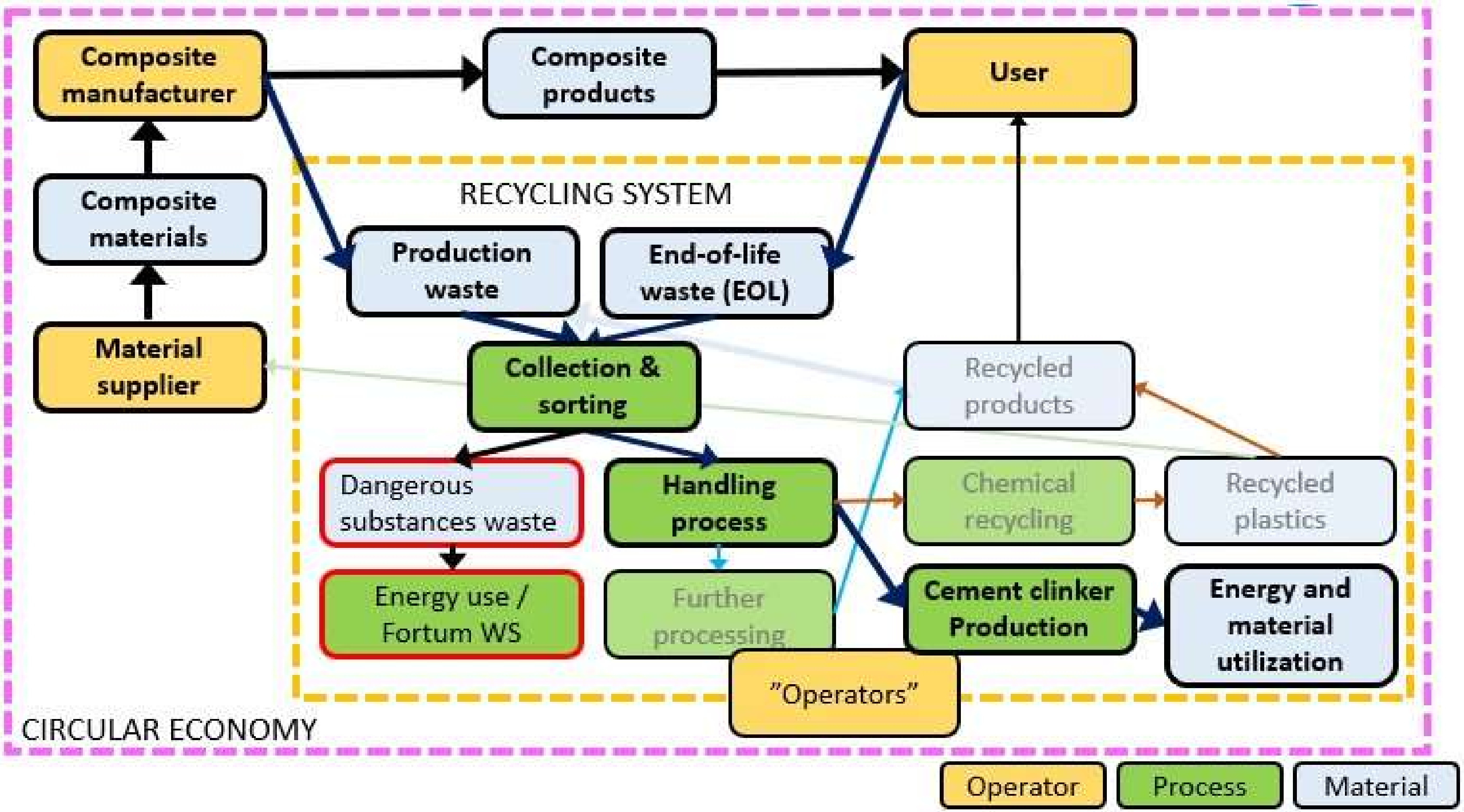
Collected, shredded composite waste
for co-processing in cement industry

Pirjo Pietikäinen
Finnish Plastics Industries Federation
Composites Group

GlassCircle Final Conference
September 26th, 2024
Riga

The Circular Economy Model for Composites Products

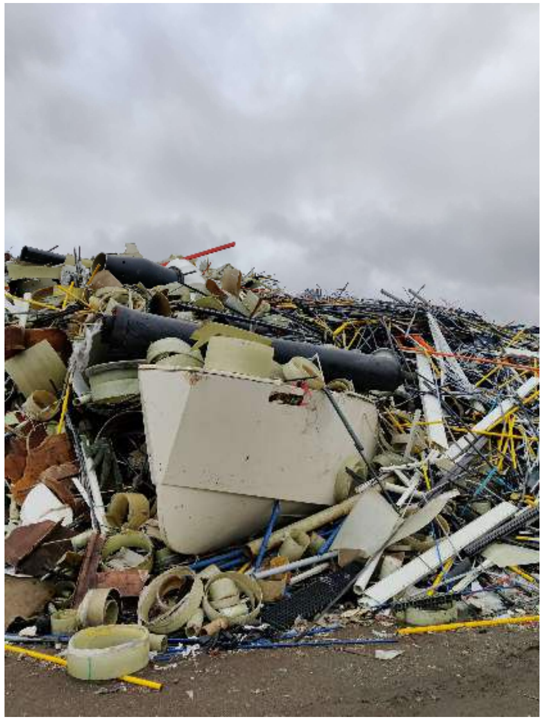
MUOVITEOLLISUUS RY
COMPOSITES GROUP
Finnish Plastics industries Federation



Development

MUOVITEOLLISUUS RY
COMPOSITES GROUP
Finnish Plastics industries Federation

- Initiative form industry 2020
    - Two trials earlier 2012 and 2014
- Landfill ban for organics 2016
- Year 2023 1000 tons waste recycled
  Year 2024 2000 tons expected
- EOL products recycled
    - Windmill blades, boats, process pipelines, gas bottles, skies…



Recycling technologies for Composites

MUOVITEOLLISUUS RY
COMPOSITES GROUP
Finnish Plastics industries Federation

- Mechanical grinding
  - Mixing e.g. with thermoplastics
- Pyrolysis
- Electromechanical treatment
- Solvolysis
- Fluidized bed
- Use in a co-processing in cement production

Cement route
in composite waste recycling

- The glass fibre in composite will be mineralized into raw material of clinker
  - Replaces silicates (limestone etc.)
  - On average > 60% in fibre reinforced plastics ≅ Recycling
  - NO ASHES!
- The resin replaces fossil fuels with other SRF

- A good video explaining the cement route
  https://www.youtube.com/watch?v=Oeosm8KeXjw&t=5s

Discussion about the cement route

- The amount of composite waste is too small?
  - Finnsementti Oy: It is easy to run composite as side stream
  - Plastic in composite does not play an important part of SRF
- Dust during processing
  - There are technologies to solve this i.e. water mist
- Transporting big parts like windmill blades
  - Mobile cutting systems

Practical advice for companies starting (composite)waste collection

MUOVITEOLLISUUS RY
COMPOSITES GROUP
Finnish Plastics industries Federation

- Plan the collection on site
  - Bins inside production area and labs
  - Large dumpsters outside, covered
  - Transportation to recyclers

- Important to involve workers
  - Clear instructions
  - Checking of bins is important in the beginning
  - Developing the procedures

Example of instruction sheet

SORTING OF COMPOSITE PRODUCTION WASTE

Suitable

- laminated waste pieces (containing wood)
- core materials NOT CONTAINING CHLORINE e.g.: Coremat, Gurit Kerdyn Green

IMPORTAT! KEEP ALL THE MATERAL DRY!

Contact the recycler before sending in

glass fibre matt

polymerized resin

Not suitable for recycling

- PVC
- core materials containg chlorine (e.g. Divinycell)
- structures containing chlorine
- metal parts
- inorganic materials, stone, tiles etc.
- wood, carat board, paper
- paint, varnish, glue
- hoses
- shoes, clothing, equipment

KiMuRa: It works out!

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COMPOSITES GROUP
Finnish Plastics industries Federation

- Compsite companies
  - Collect their waste as advised
    - The cement industry sets the rules
  - Organize the transportation of composite wase
    - Might be different location that the mixed waste
  - The largest ones are delivering to KiMuRa

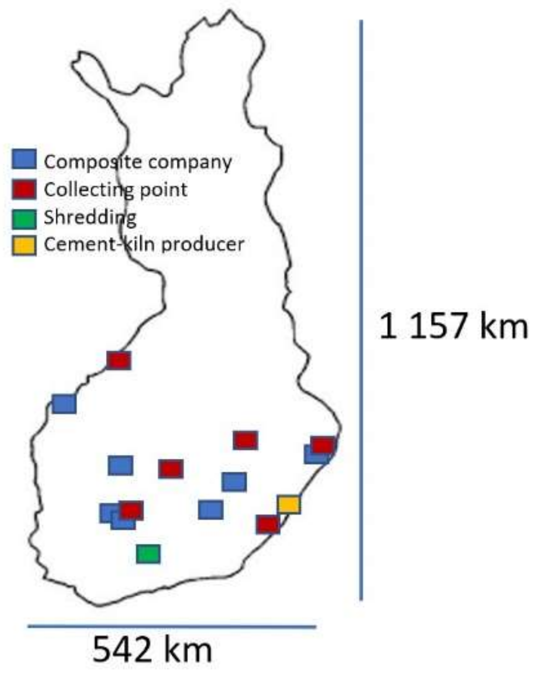
- Kuusakoski Oy
  - All 17 locations ready to take composite waste
  - Optimises the shredding and logistics

- Finnsementti Oy
  - Runs co-processing as usual

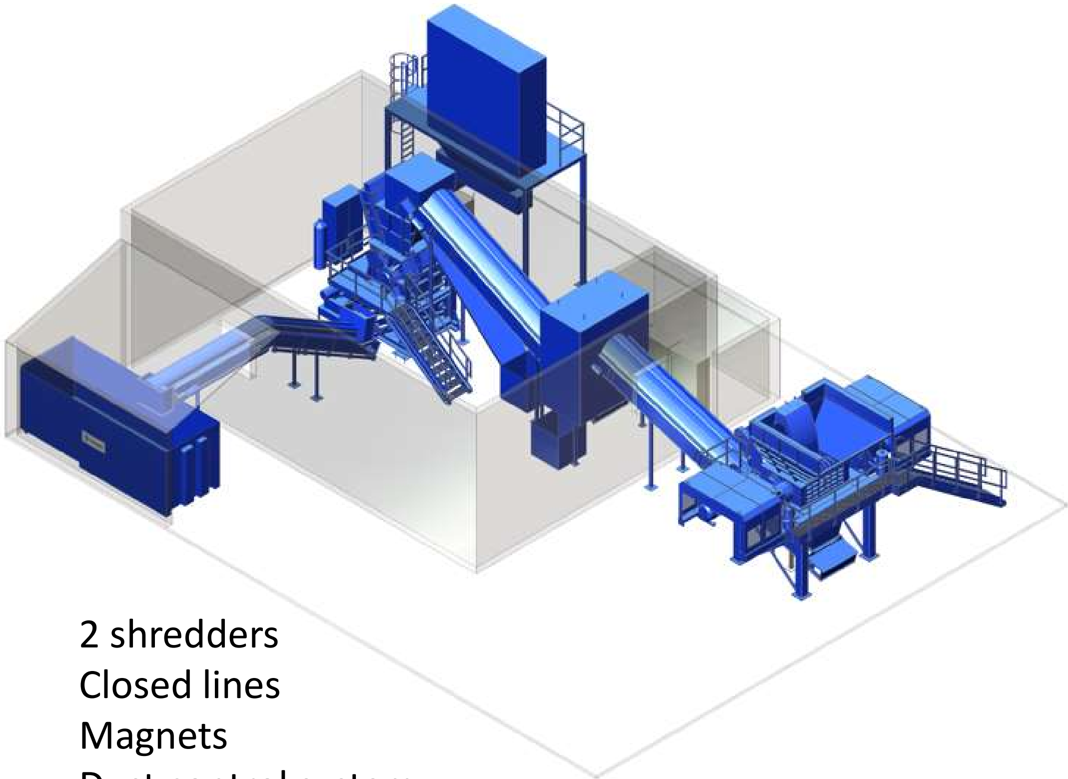
- The first trials with windmill blades, summer 2022
  - In Finland larger amounts of windmills will come to EoL in 2030's

- BUT: System for collecting from consumers is missing

Situation in the beginning of KiMuRa



Development steps

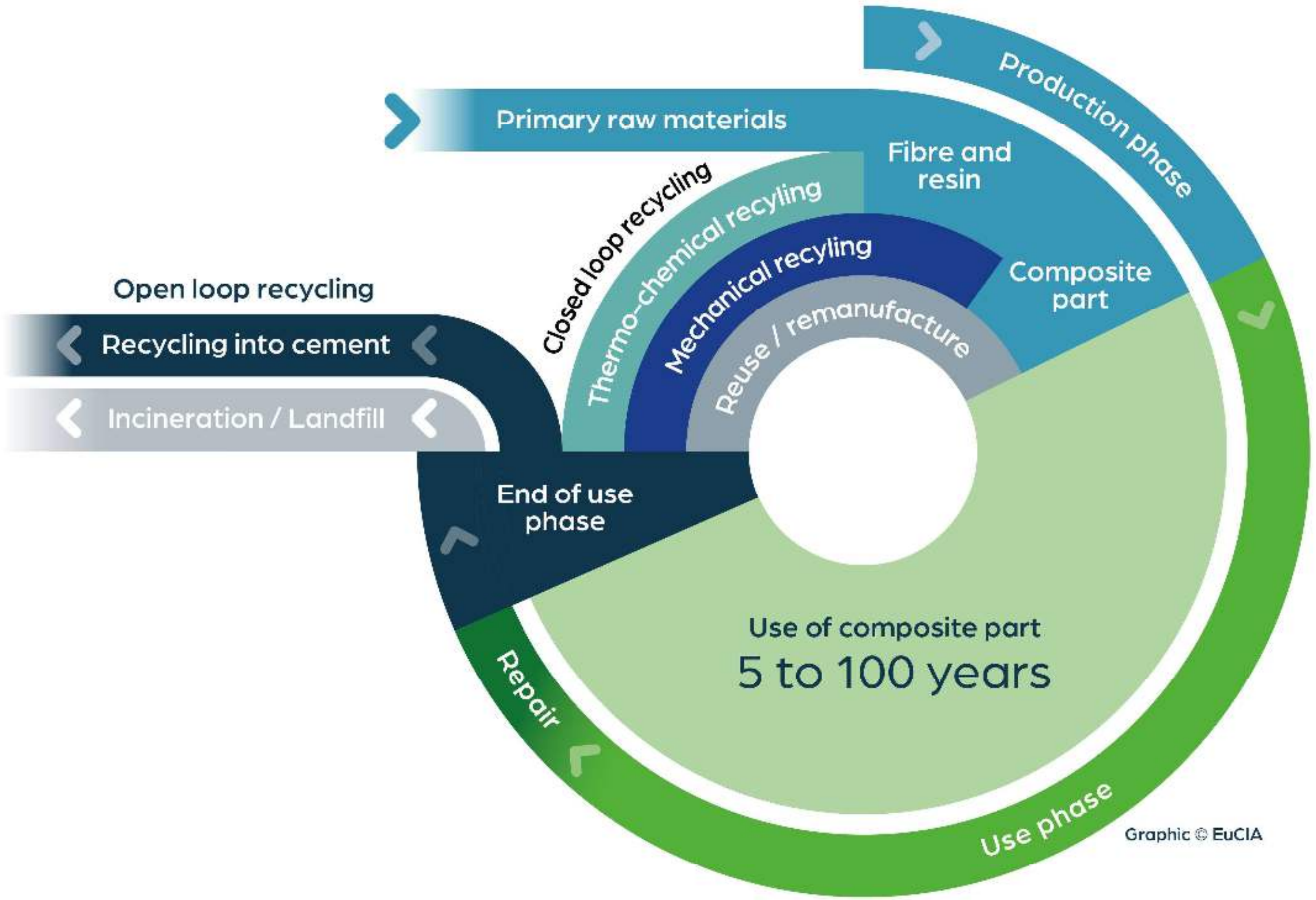


2 shredders
Closed lines
Magnets
Dust control system

- The recycling company has built a new shredding process
  - Financial support from BF 35 %
  - New technology
  - Possibility to increase the capacity up to 10 000 tons
  - Test runs in July 2024
  - Full capacity ready in September 2024

- 50 % of composite companies are using KiMuRa-route
  - All the big ones are in

https://eucia.eu/



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COMPOSITES GROUP
Finnish Plastics industries Federation

Information and contact

- https://www.plastics.fi/kimura/(in Finnish)
- https://www.plastics.fi/kimuraeng/

- Pirjo Pietikäinen
  Finnish Plastics Industries Federation
  Composite Group
  pirjo.pietikainen@plastics.fi

Managing End-of-Service Composite Structures

Challenges And Case Studies With Focus On Repurposing

Alann André – alann.andre@ri.se

Göteborg/Riga – GlassCircle Final conference, 2024-09-26

Alann André

- PhD in Timber Structures (Strengthening of timber beams with Fibre Reinforced Polymers) (Chalmers, Sweden), Mechanical Engineer background (France)
- **Senior Researcher at RISE** (Research Institute of Sweden):
  - Re-purpose of decommissioned FRP structures
  - Application of composite in the infrastructure sector
  - Modelling of composite structures
- **Since 2018**: Together with my colleague Cecilia Mattsson, initiating and leading several R&D projects related to the sustainable management of decommissioned composite structures (RECINA, RECOMP, IEA Wind task 45, REKOVIND2, COSOVI, CIRCUBLADE, SVPI LAB)

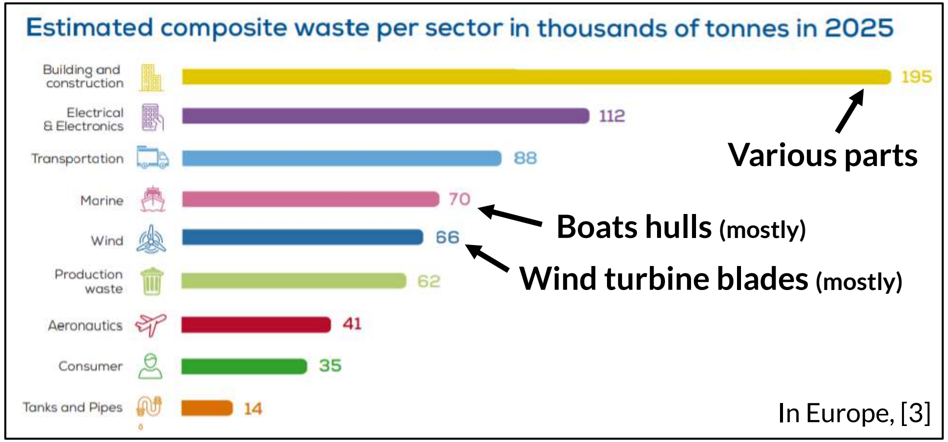
Glass fibre Reinforced Polymers (GFRP)
→ Type of structures, Volume and End-of-Service (EoS)

In 2021:

World
12 Million tons of FRP
[1]

Europe
1 Million tons of GFRP
[2]

98 % GFRP
in marine, wind and automotive
[3]



Sources:
[1] JEC Group, 2022. JEC Observer Overview of the global composites market, 2021-2026
[2] Tiseo, I., 2022. Production of glass fiber reinforced plastics (GRP) in Europe 2000-2021. Glass Fiber Reinforced Plastic Production in Europe 2021. Statista.
[3] ETIPWind (2019), HOW WIND IS GOING CIRCULAR blade recycling https://etipwind.eu/files/reports/ETIPWind-How-wind-is-going-circular-blade-recycling.pdf

Why managing EoS GFRP is challenging?

1. Most GFRP are made with **thermosets** resin (~75%)

2. If only GF and thermoset resin are used in the part:
   → **Very difficult to separate** them due to the chemical structure (cross linking)

3. **In most cases, other materials** are also used:
   → Increased complexity: Need to separate these other materials before separating the fibres from the matrix

4. If separation of GF and thermoset is done:
   → The **recovered material** (fibre and resin) are **not (yet) able to compete** with virgin material

Complex structures with integrated functions and materials. Ex: Wind turbine blades

Photo: Cecilia Mattsson, RISE

- ❑ Blades: composite materials (GFRP and CFRP), 80% in weight + several other materials
- ❑ Very strong, stiff and durable structure, but difficult to separate when reaching decommission
- ❑ Approx. 30% organic material

Circular management of EoS GFRP:
→ 3 main pillars missing today

Policies and Guidelines for circular management

Circular and sustainable Value chains

Technologies not always available at scale

→ + tough economically

- Competition with price of new glass fibres (1-2 €/kg)
- Cheapest EoL route: incineration or landfill (130-140 €/ton)

Repurposing EoS GFRP: What advantages?

→ **Great potential within construction and infrastructure**

- Resource efficient solution - transform waste material into resource
- Uses material that goes to landfill/energy recovery
- Strong and durable material
- Low maintenance costs
- Replace high CO_2 emission materials such as concrete and steel

Content

1. Managing EoS Wind Turbine Blades
   → *looking at the Swedish case*

2. How simple and innovative concepts can help repurposing EoS GFRP
   → *Concept of a pedestrian bridge deck system*

3. Conclusion and Future Work

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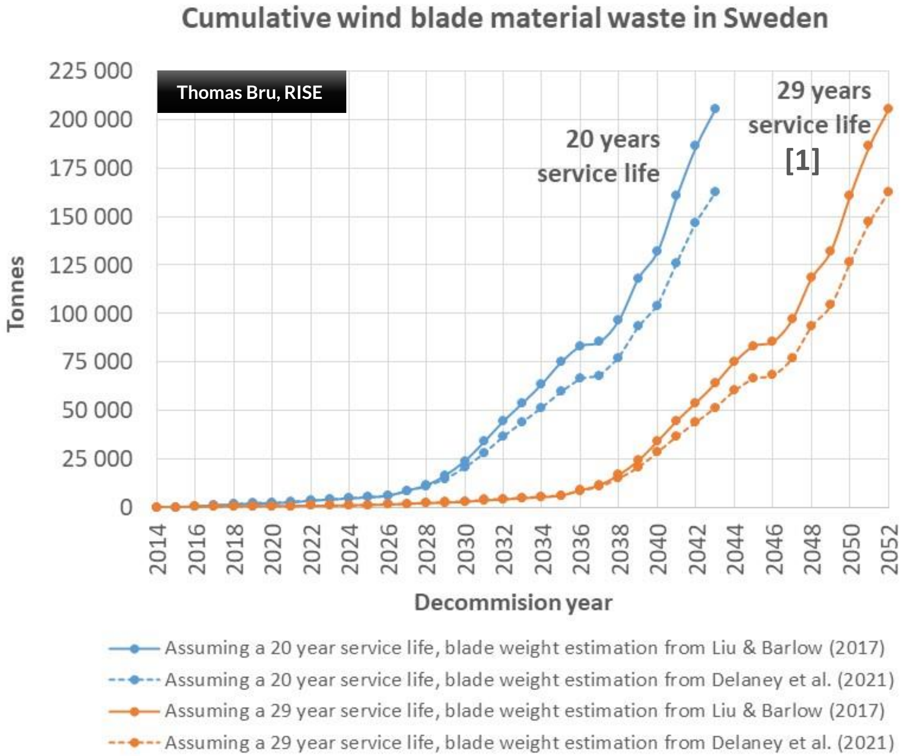
Ageing wind park in Sweden
→ Many turbines to be decommissioned in the coming years!



The number of wind turbine blades to be decommissioned is expected to **increase significantly** in the coming years.

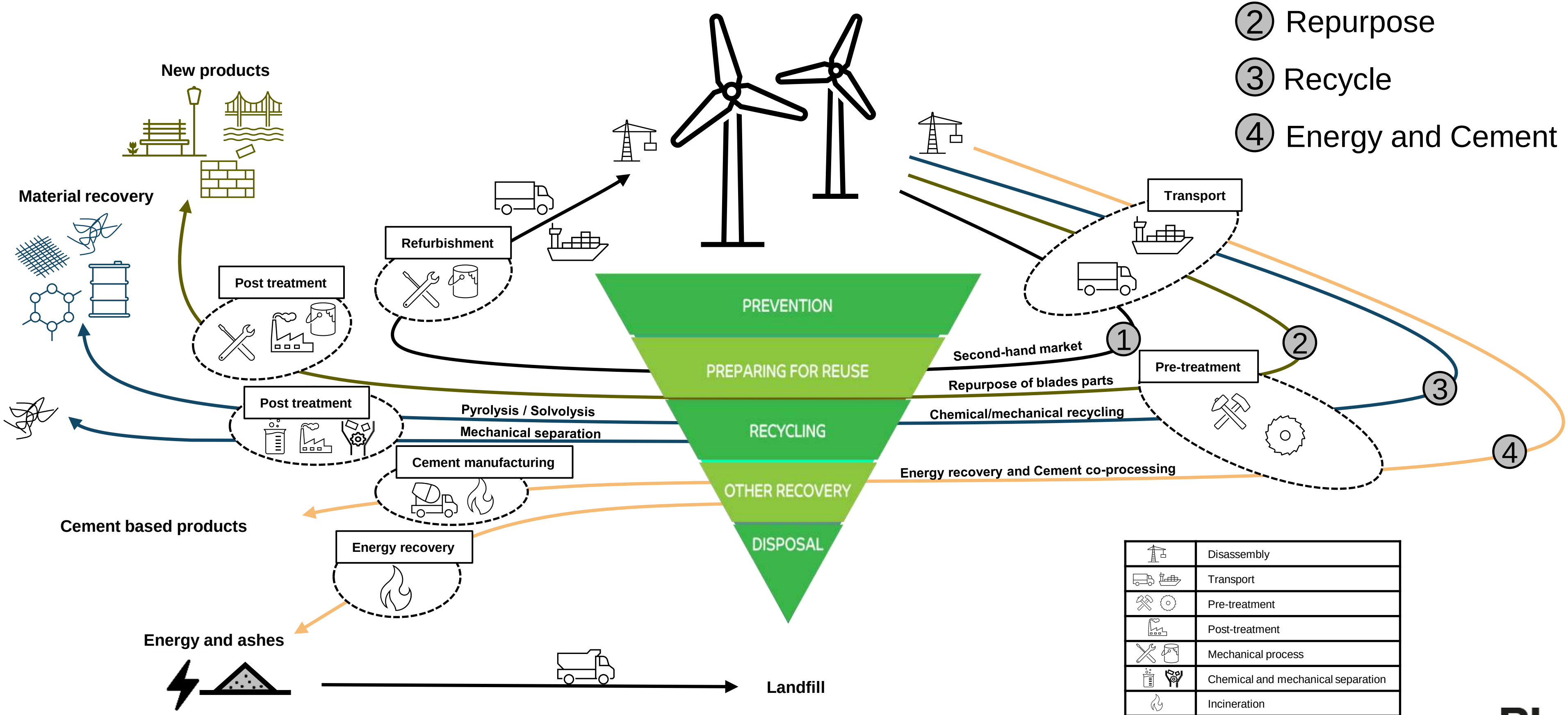
There is today **no industrial and established value chain** to secure a sustainable management of these decommissioned blades.

More than	Till 2030	service life
5000	1500	20
turbines	reach EoS	years

[1] **"Method for estimating the future annual mass of decommissioned wind turbine blade material in Denmark",** Abrahamsen et al (2023) DOI:10.22541/au.168105743.37926484/v1

What alternatives?

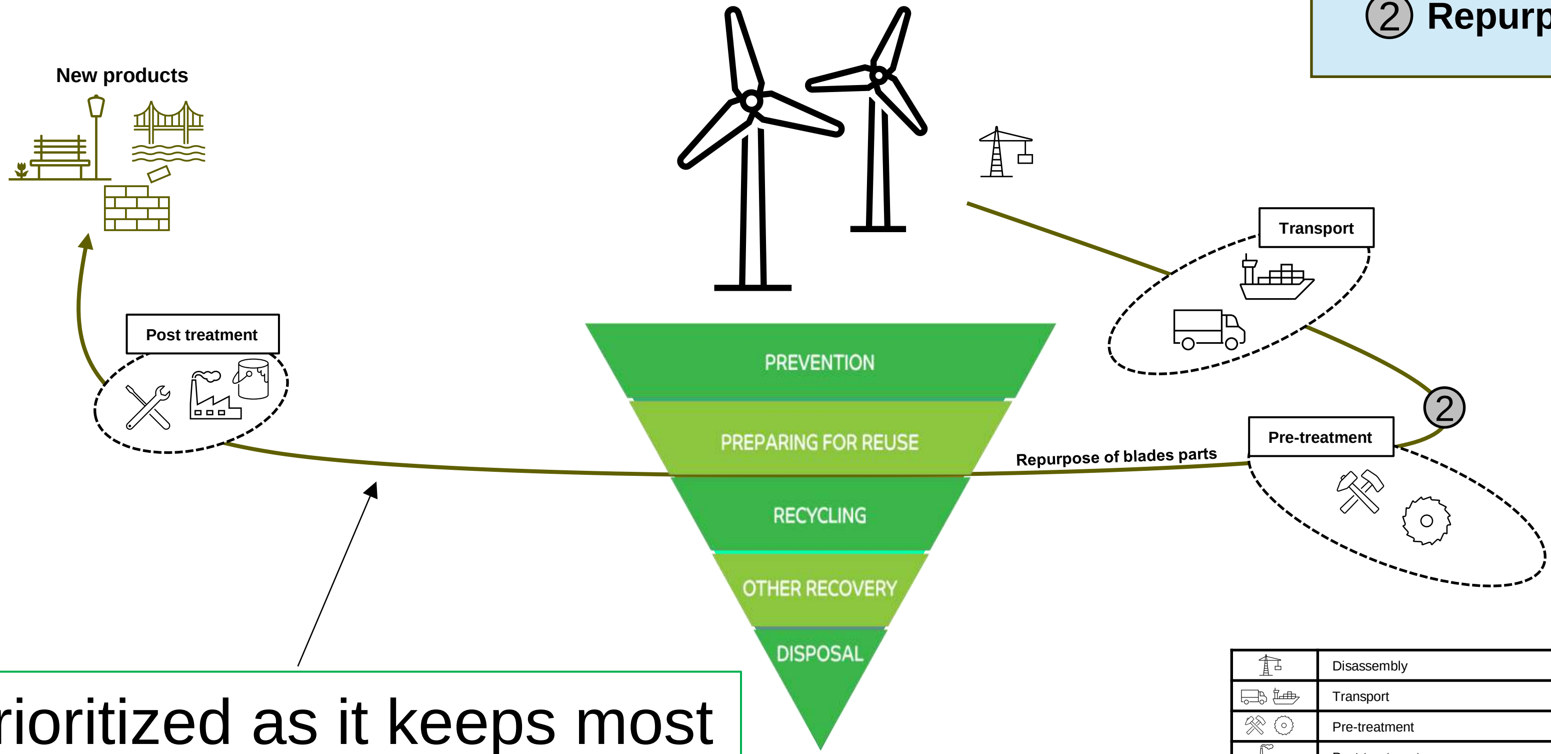
1. Second hand
2. Repurpose
3. Recycle
4. Energy and Cement



	Disassembly
	Transport
	Pre-treatment
	Post-treatment
	Mechanical process
	Chemical and mechanical separation
	Incineration
	Energy recovery
	Landfill / Ashes

What alternatives?

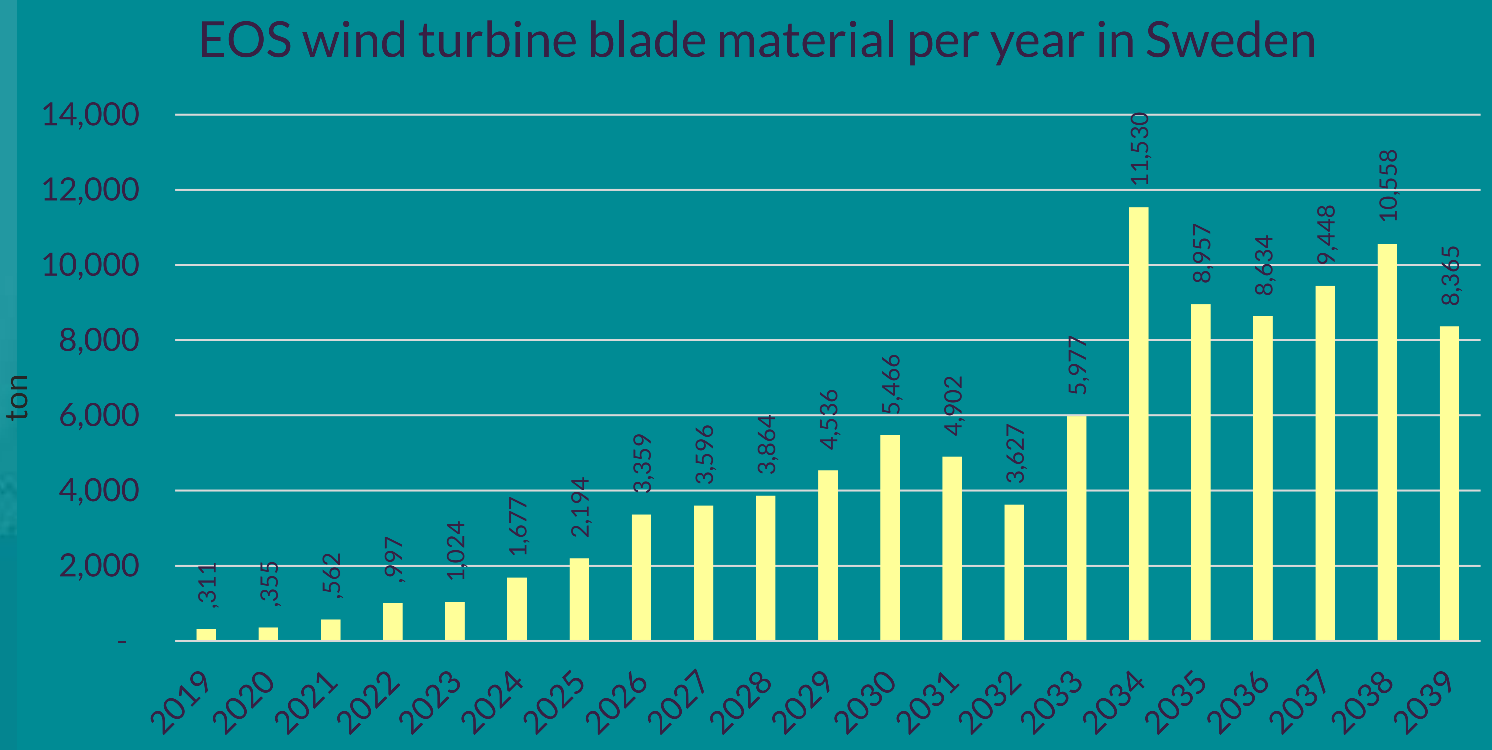
② Repurpose



Prioritized as it keeps most of the blade inherent value

	Disassembly
	Transport
	Pre-treatment
	Post-treatment
	Mechanical process
	Chemical and mechanical separation
	Incineration
	Energy recovery
	Landfill / Ashes

SWEDEN – What are the numbers?



Within 5 year | **970 blades** | **6800 tons**

Circular management of EoS GFRP:
→ 3 main pillars missing today

Policies and Guidelines for circular management

Circular and sustainable Value chains

Technologies not always available at scale

For potential value chain actors:
need to know the volumes and their availability (in space and time)
→ data needed!

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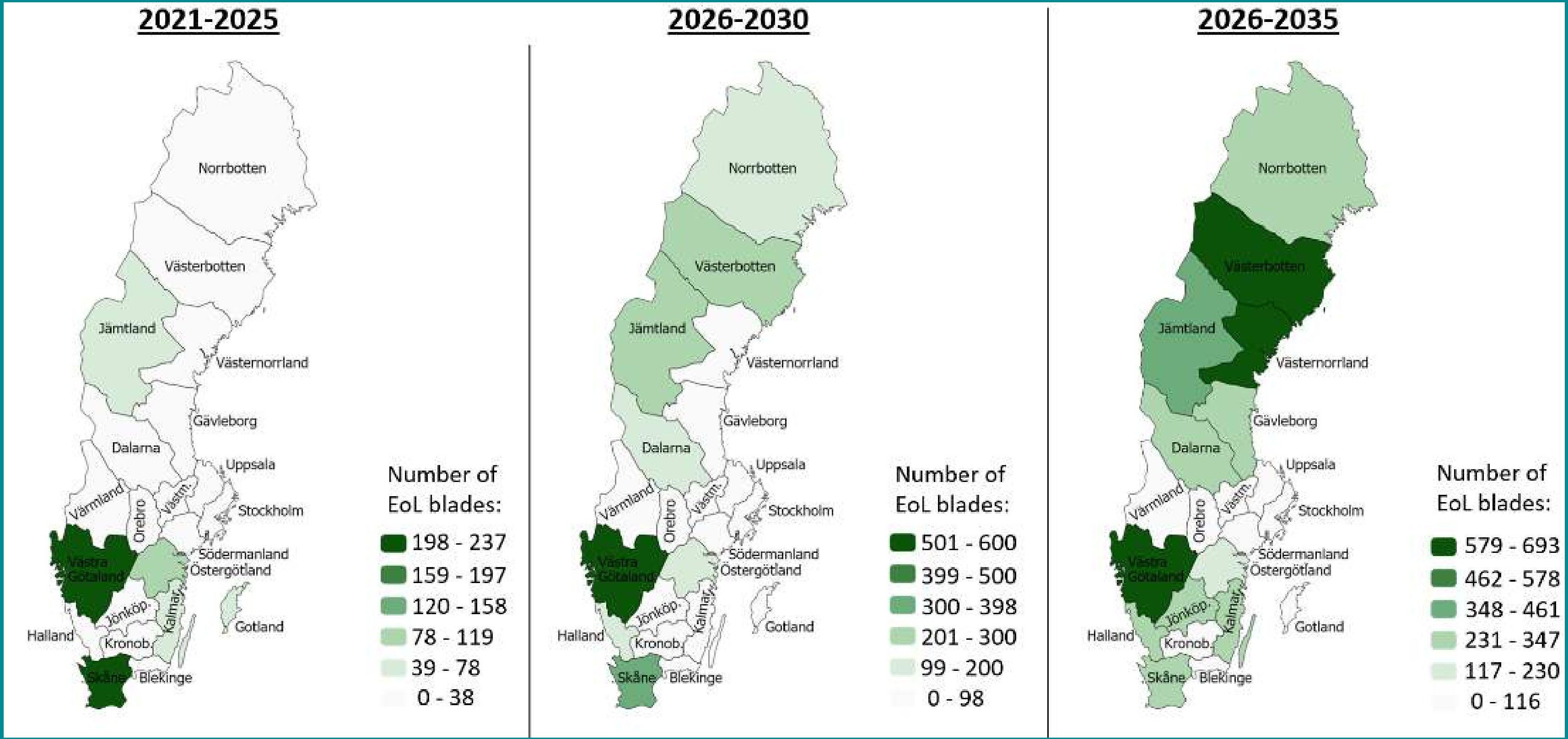
SWEDEN – What are the numbers? + When and Where!!

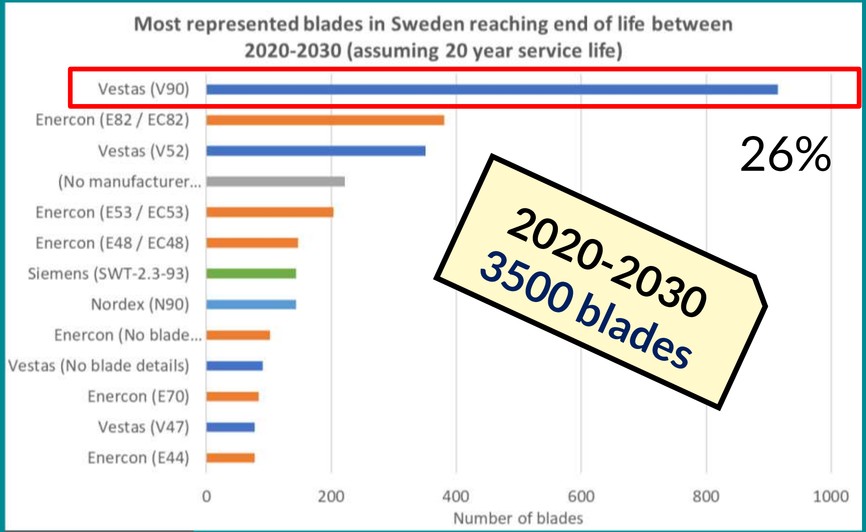


Thomas Bru, RISE

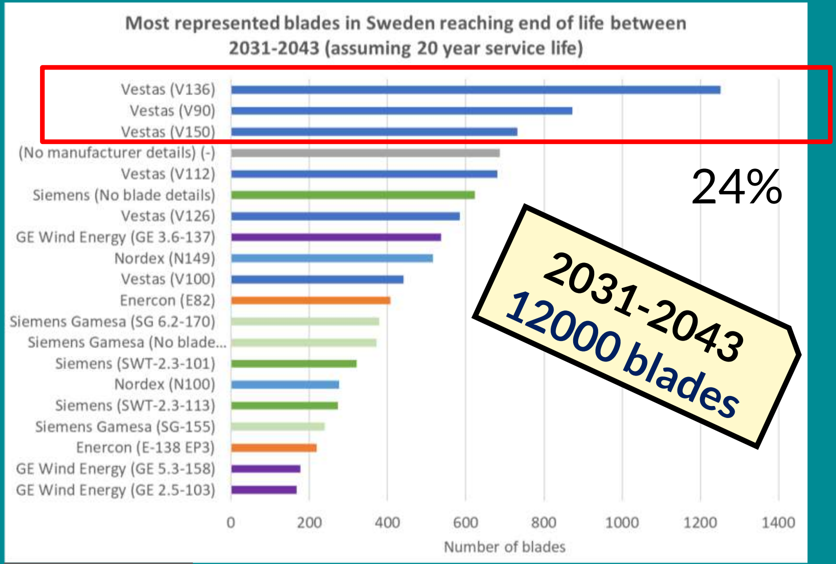
SWEDEN – What are the numbers? + What type!!

Data collection

Estimated number of decommissioned blades by type and year



Thomas Bru, RISE

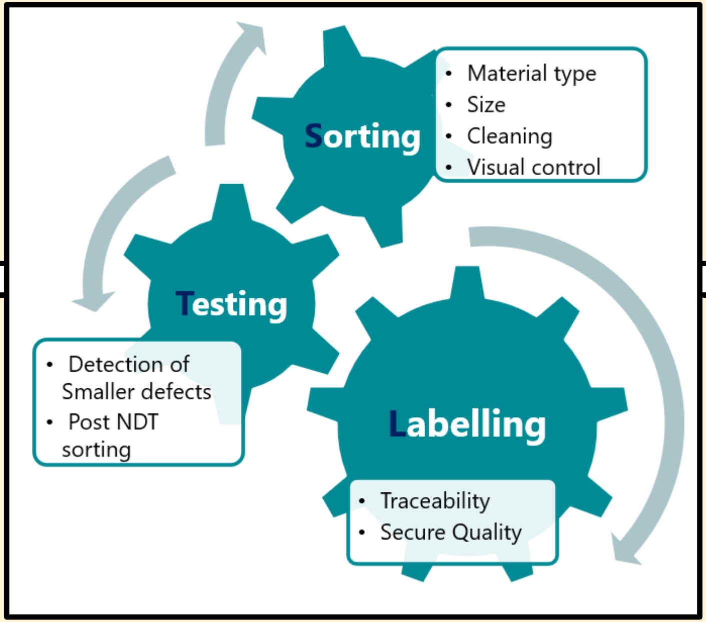


Thomas Bru, RISE

How to repurpose the blades at scale?

Need robust certification processes

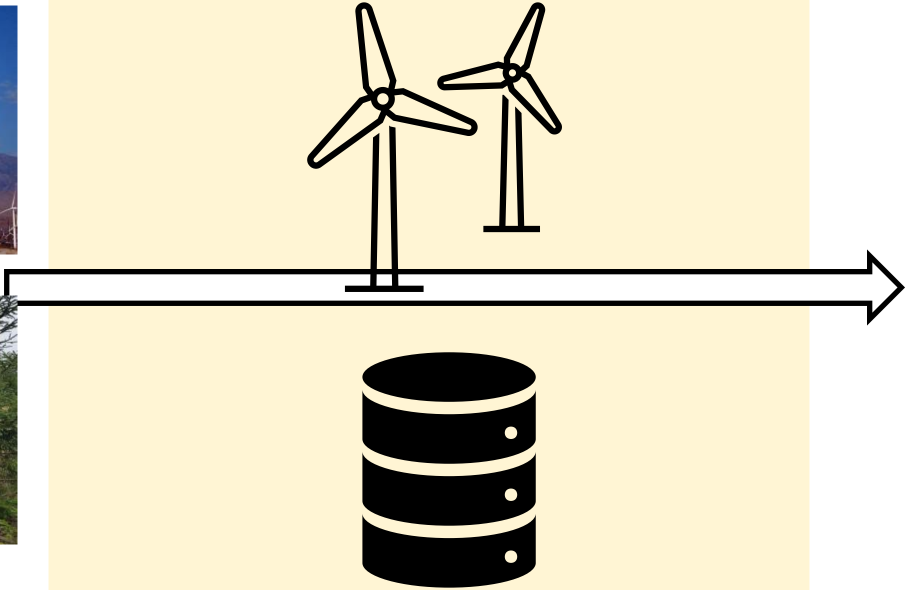
Circularity enabler

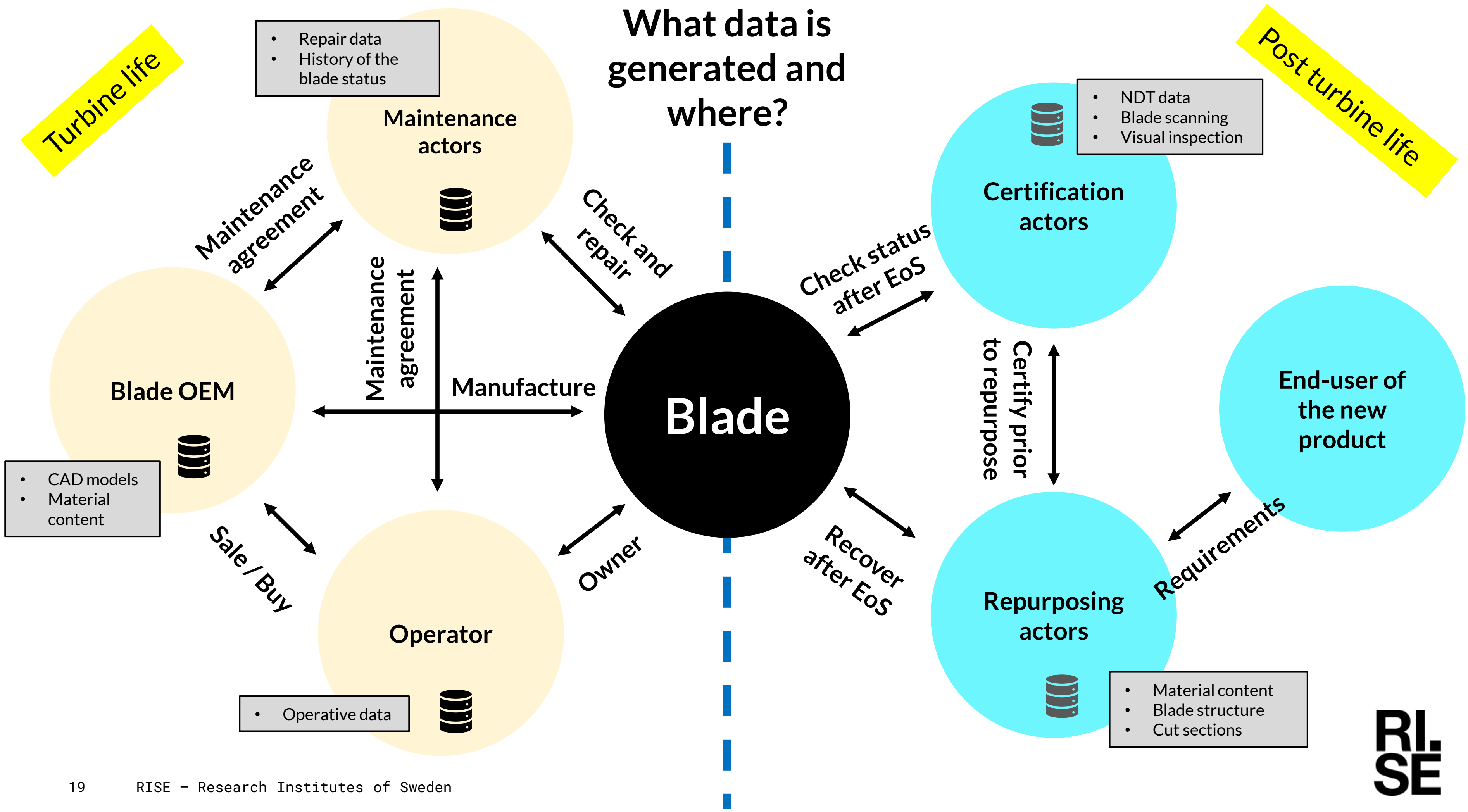


How to repurpose the blades at scale?

Need access to blade data

Circularity enabler

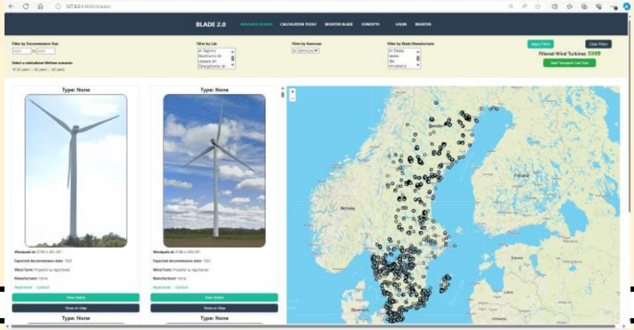


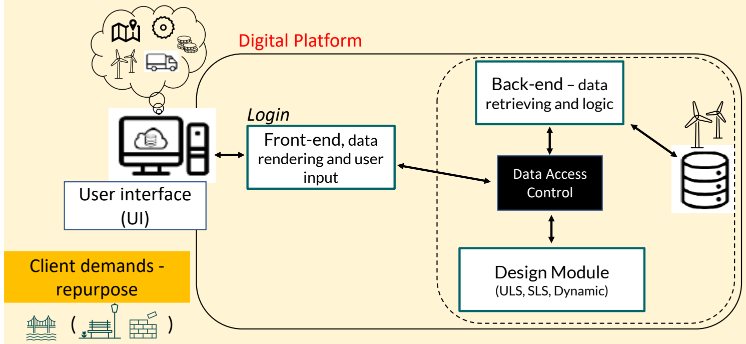

What data is generated and where?
Turbine life
Post turbine life
Repair data
History of the blade status
Maintenance actors
Maintenance agreement
Check and repair
Blade OEM
CAD models
Material content
Maintenance agreement
Manufacture
Blade
Sale / Buy
Owner
Operator
Operative data
Certification actors
NDT data
Blade scanning
Visual inspection
Check status after EoS
Certify prior to repurpose
End-user of the new product
Recover after EoS
Requirements
Repurposing actors
Material content
Blade structure
Cut sections

How to repurpose the blades at scale?

Need to use new digital tools

Circularity enabler





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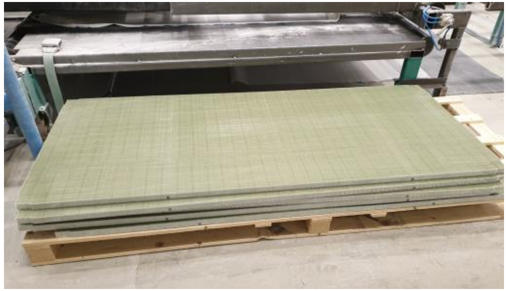
Case study – pedestrian bridge deck

- ***Objective***

Repurpose of EoS GFRP structures in new products

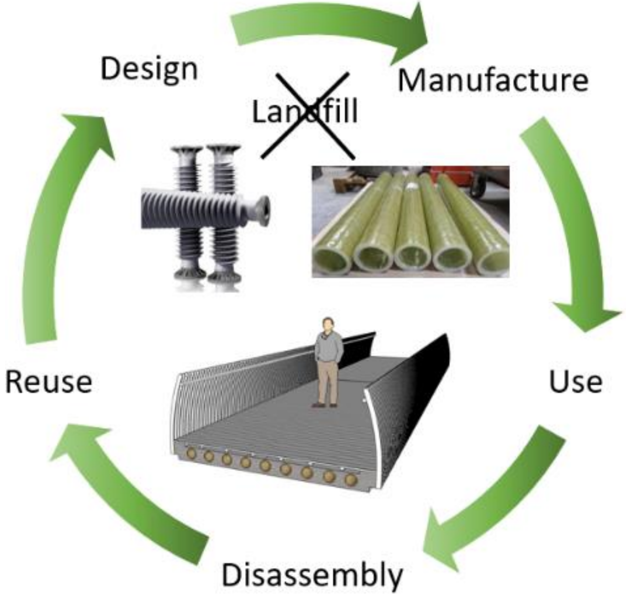


- ***Current End-of-Service***

Landfill or incineration

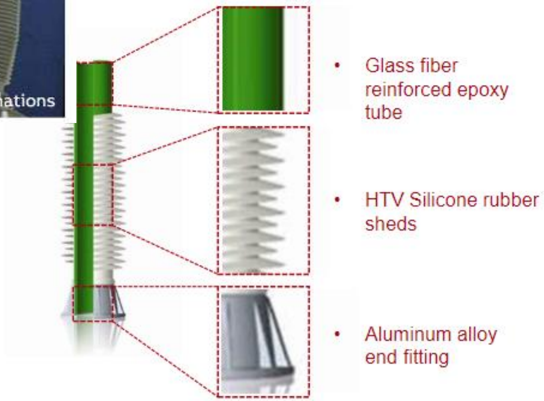
- ***Aimed Application area***

Bridge deck, balcony, wall elements



Case study

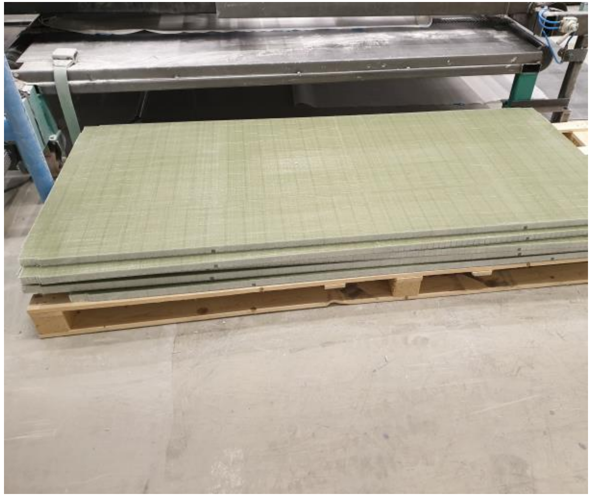
- *Material* ***Repurposed*** **– GFRP pipes aiming for landfill**



Material Source →

Case study

- *Material **Repurposed*** - GFRP sandwich panels aiming for incineration



Material Source → POD COMP

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Conceptual design – What solutions for a robust design?

Objective: Develop a resilient deck design (KISS principal).

Key Requirements:

- Accommodate various GFRP pipe lengths and diameters.
- Adapt to pipe availability.

Challenges:

- Unpredictability of production waste exact nature and volume

Solution:

→ Create a flexible concept to effectively utilize GFRP pipes of varying dimensions.

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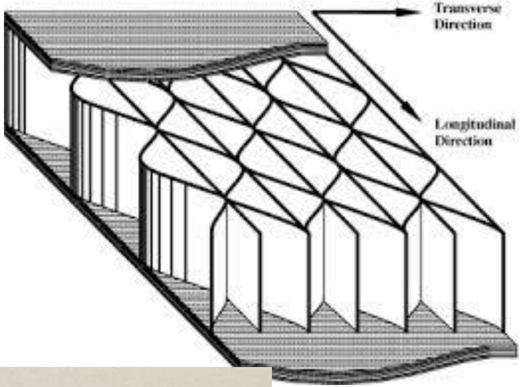
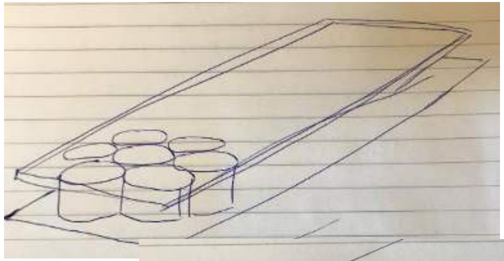
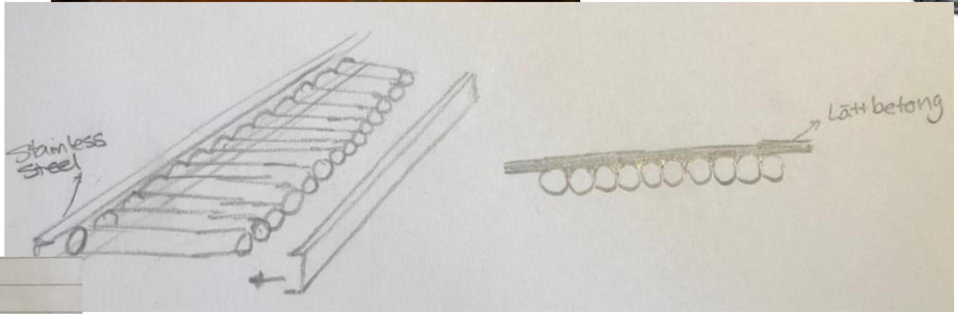
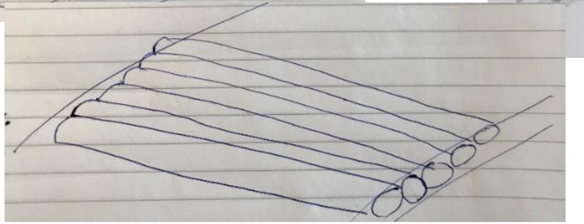
SE

Conceptual design – What solutions for a robust design?

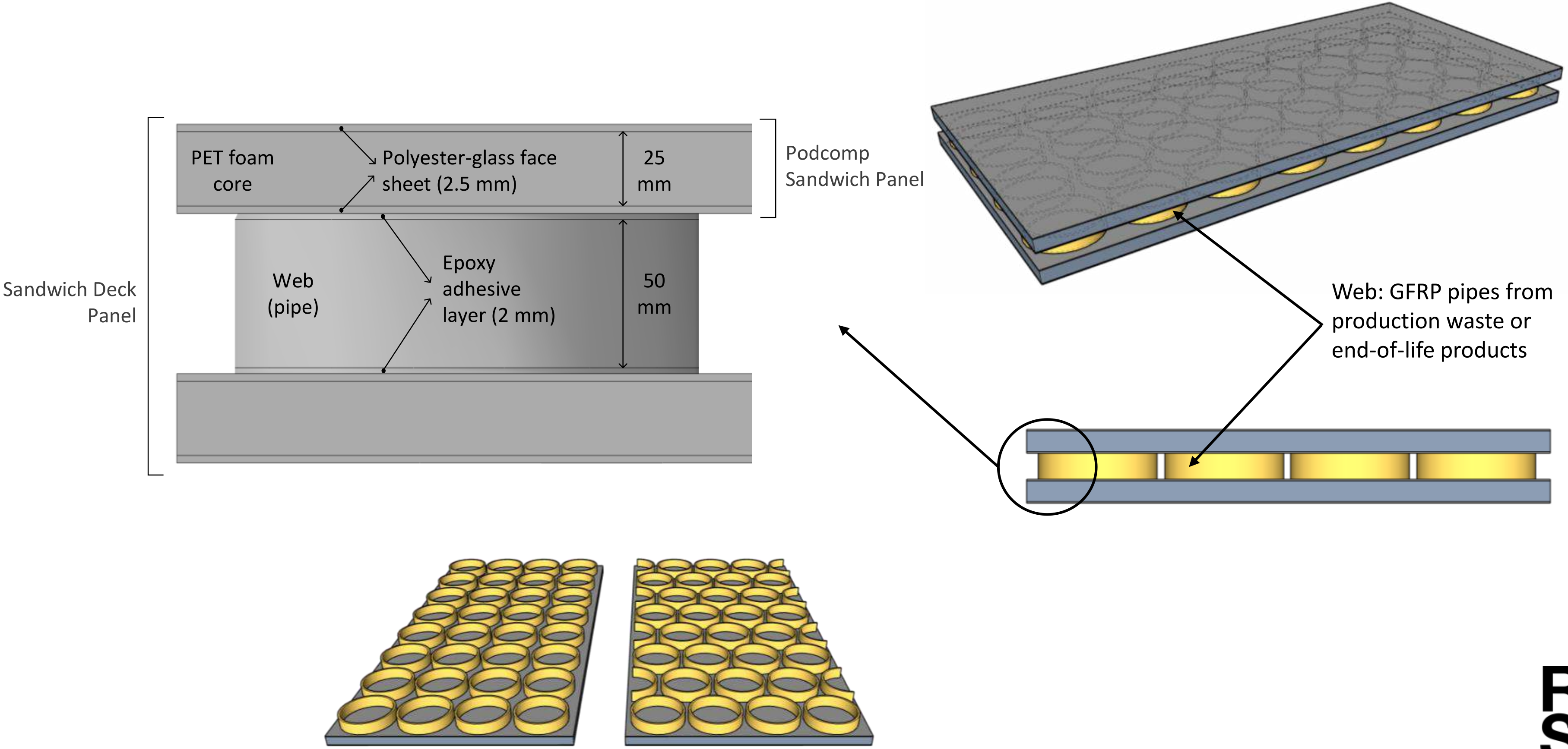




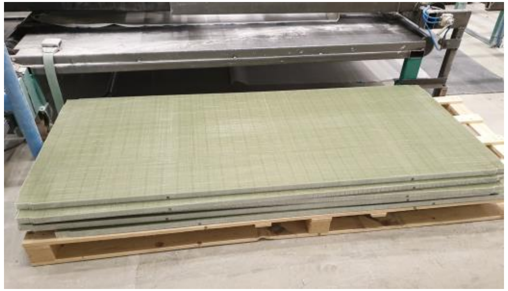




Conceptual design: sandwich panel

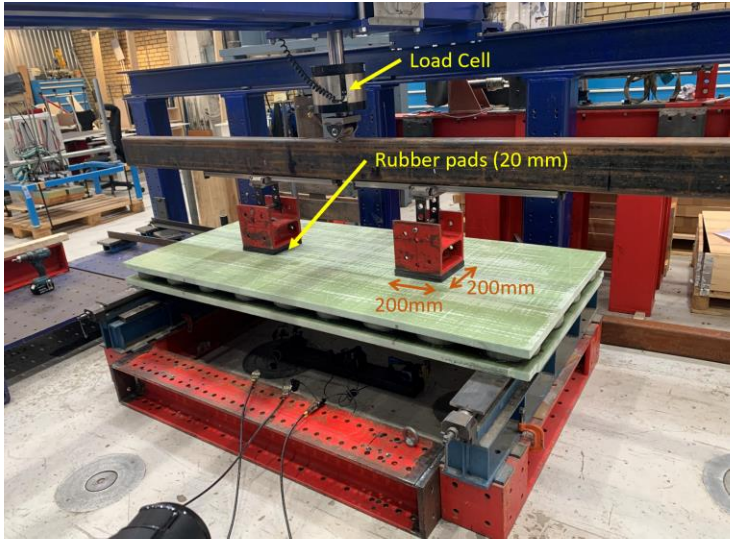


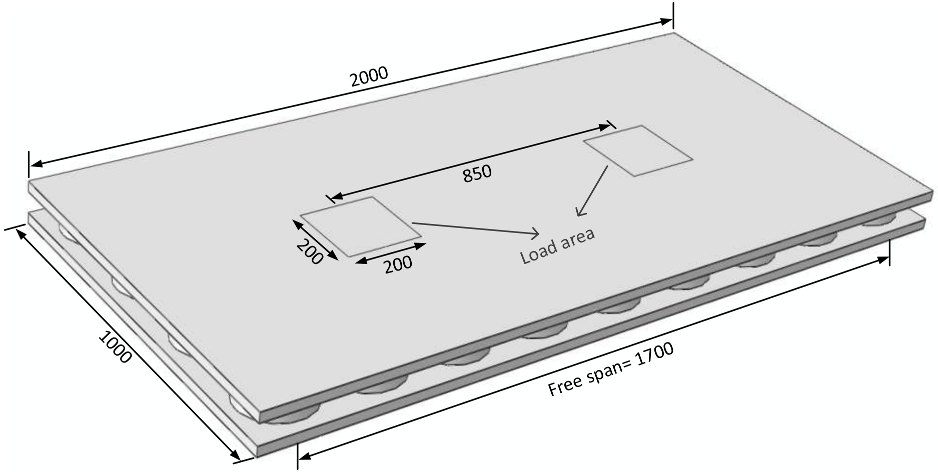
Manufacturing of a bridge deck panel



- Two step assembly
- Adhesive bounding
- Press

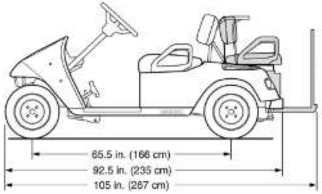
Experimental tests



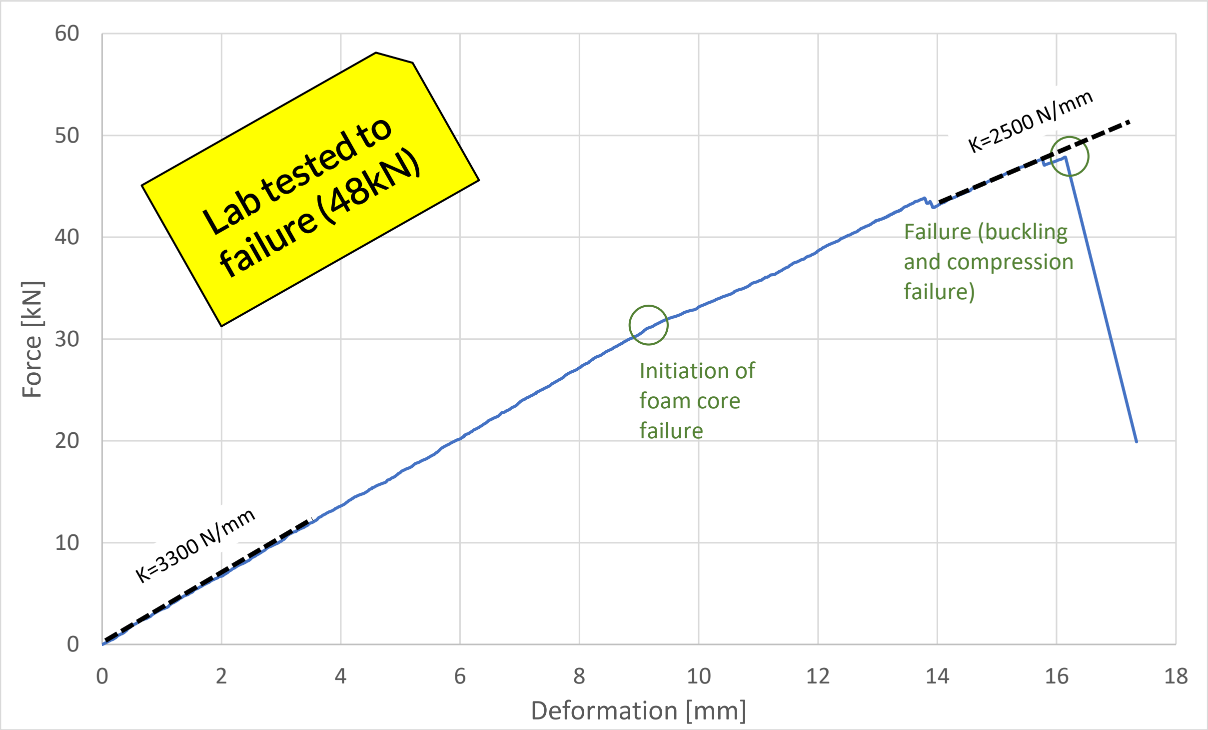


Very light: 35kg/m2

Design load: 15kN (Golf cart)



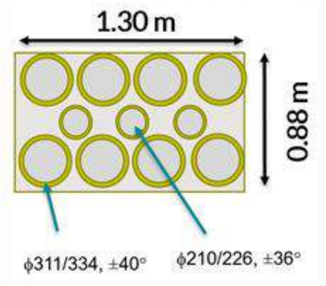
Experimental tests

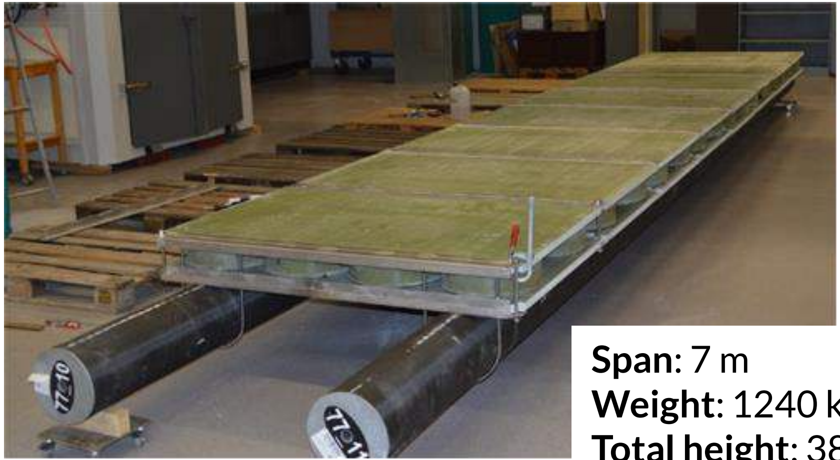


Shear failure running through the top and bottom skin of the sandwich panel.

Manufacturing bridge prototype

- 8 deck panels with pipes of different diameter
  → robust design
- Girder made of discarded GFRP poles
- Circular design for easy disassembly

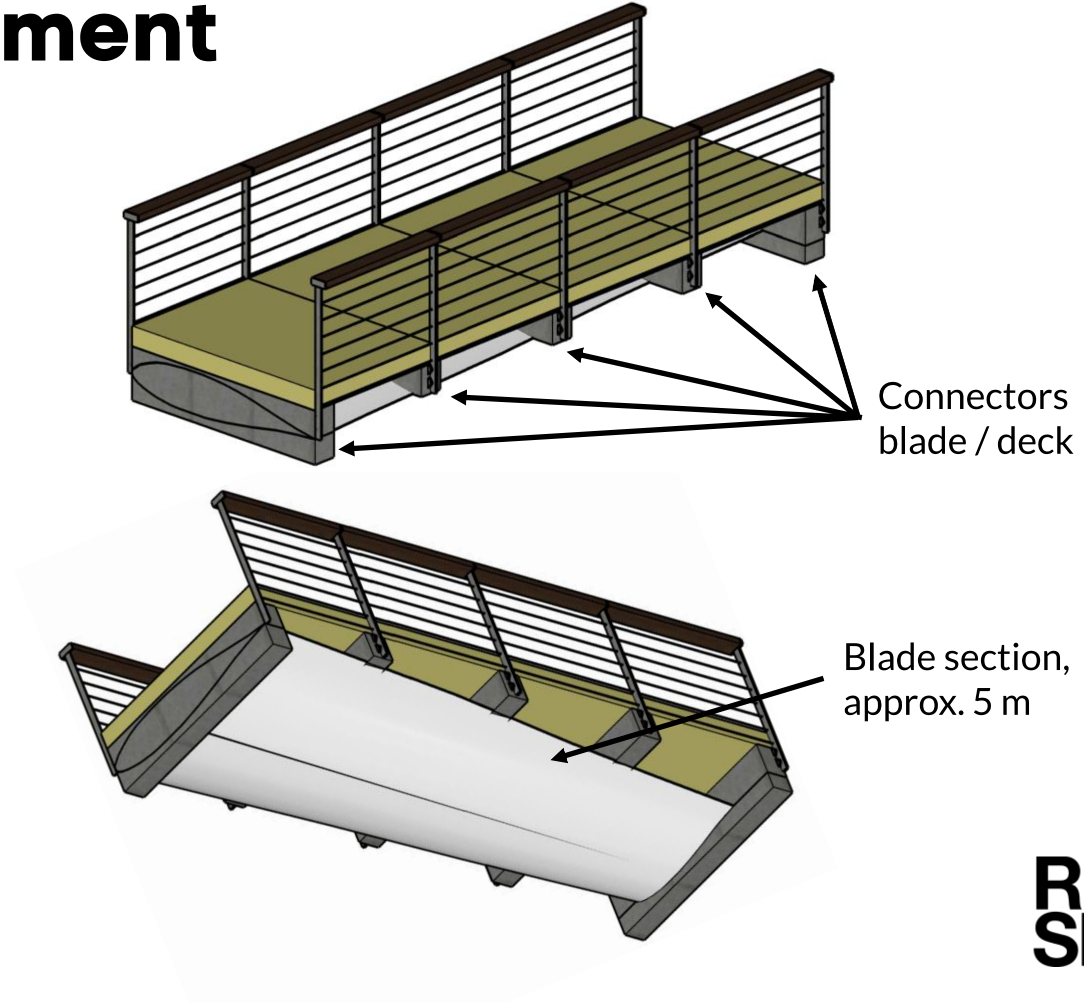




Span: 7 m
Weight: 1240 kg
Total height: 388 mm

Further development

- Section of a decommissioned wind turbine blade used as girder
- Custom made support between the blade section and the deck panels
- Mechanical test of prototype planned for the coming weeks



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Circular management of EoS GFRP:
→ 3 main pillars missing today

Policies and Guidelines for circular management

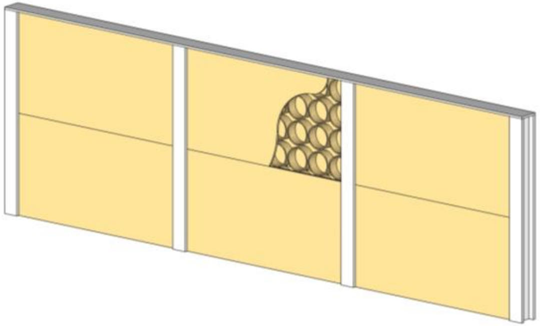
Circular and sustainable **Value chains**

Technologies not always available at scale

For potential End-users:
Which products are available and are they as good as traditional ones?
→ to pass this threshold: **Simple concepts needed**

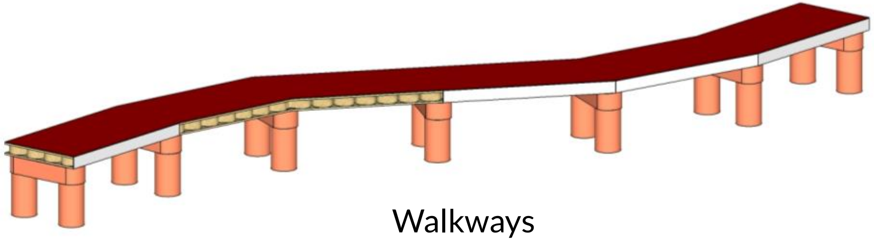
Other potential applications

Roofing panels



Sound barrier walls

Balconies



Walkways

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Conclusion and Future work

1. We have **large volumes** of EoS GFRP structures to manage (e.g. wind turbine blades, boats, … B&C 😱 !)

2. **High competition** with virgin GF and cheap EoS routes (e.g. incineration)

3. **Policies and value chains** missing for sustainable management at scale

4. **Repurposing EoS GFRP structure:** keep their inherent value (high up on the waste hierarchy)

Conclusion and Future work

5. Repurposing blades needs **robust certification processes** and access to **blade data** – work is ongoing, but more is needed!

6. Establishment of a **digital platform for data access** will ease repurposing

7. **We need simple concepts** to trigger end-users to choose product made of repurposed GFRP

8. **New policies are needed** to accelerate the creation of economically sound value chains

Sol Vind Policy Innovation Lab - SVPI Lab

Ongoing

Recent publications for further reading

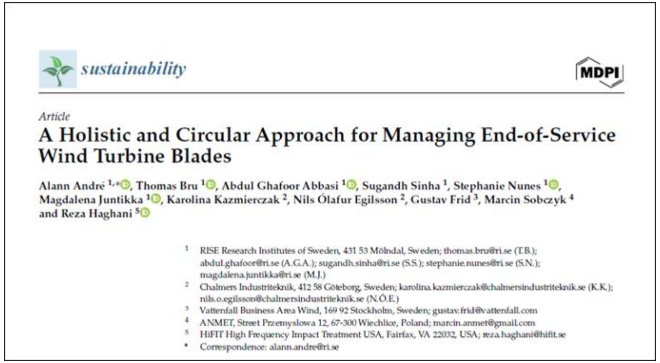
Journal of Environmental Management
Volume 367, September 2024, 122015

Research article

Sustainable repurpose of end-of-life fiber reinforced polymer composites: A new circular pedestrian bridge concept

Alann André [a], Magdalena Juntikka [a], Cecilia Mattsson [a], Torun Hammar [b], Reza Haghani [c]

[a] RISE Research Institutes of Sweden, Argongatan 30, 431 22, Mölndal, Sweden
[b] RISE Research Institutes of Sweden, Stockholm, SE-114 86, Sweden
[c] HiFIT USA LLC, Fairfax, VA, USA



sustainability MDPI

Article

A Holistic and Circular Approach for Managing End-of-Service Wind Turbine Blades

Alann André [1,*], Thomas Bru [1], Abdul Ghafoor Abbasi [1], Sugandh Sinha [1], Stephanie Nunes [1], Magdalena Juntikka [1], Karolina Kazmierczak [2], Nils Ólafur Egilsson [2], Gustav Frid [3], Marcin Sobczyk [4] and Reza Haghani [5]

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[4] ANMET, Street Przemyslowa 12, 67-300 Wiechlice, Poland; marcin.anmet@gmail.com
[5] HiFIT High Frequency Impact Treatment USA, Fairfax, VA 22032, USA; reza.haghani@hifit.se
* Correspondence: alann.andre@ri.se

2024

Cirkulärt omhändertagande av solcellspaneler och vindturbinblad för vindkraftverk

https://www.sciencedirect.com/science/article/pii/S0301479724020012

https://www.mdpi.com/2071-1050/16/17/7858

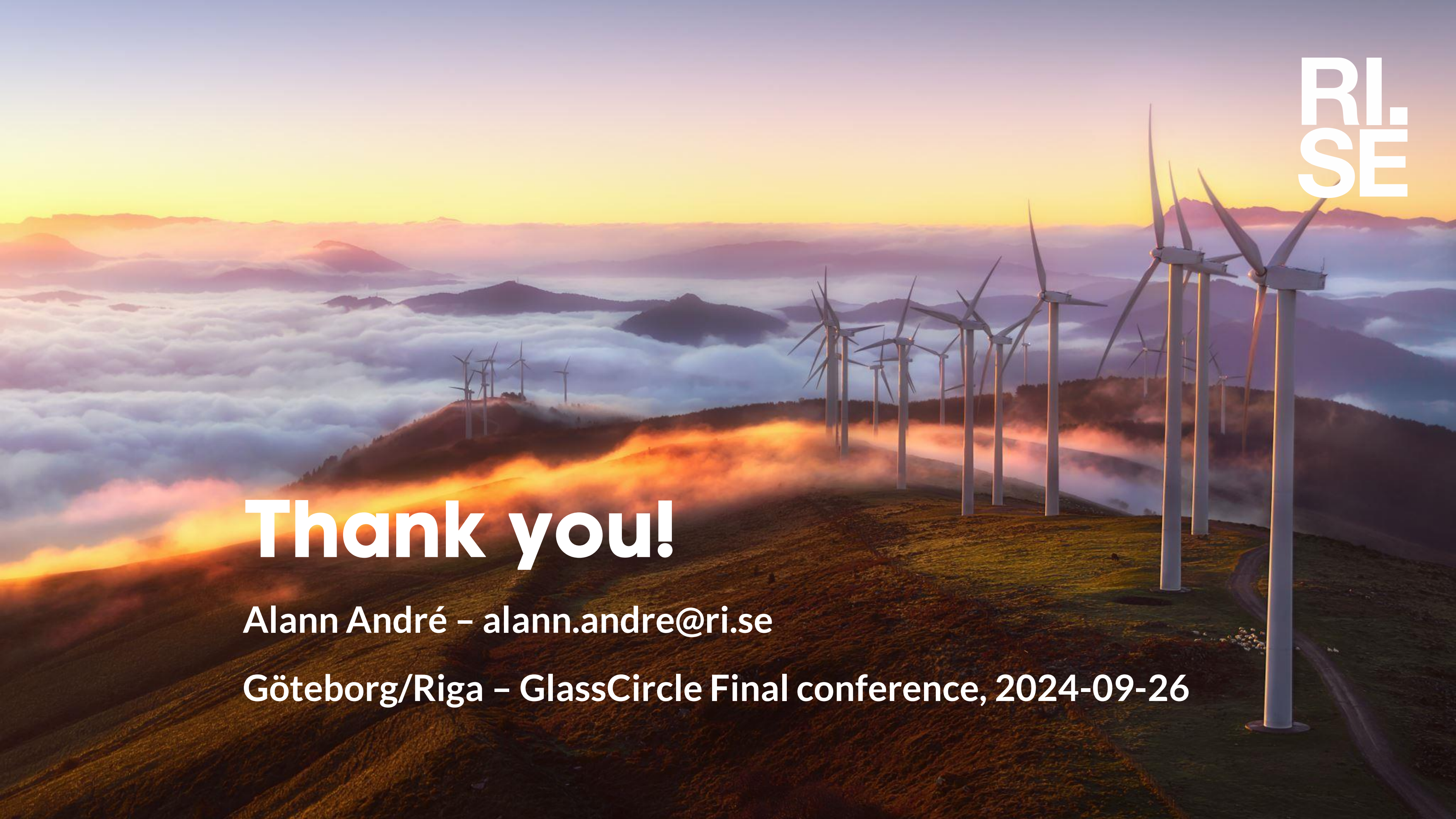
https://ri.diva-portal.org/smash/record.jsf?pid=diva2%3A1855222&dswid=1660

Thank you to all project partners!

RECINA project: REuse of Composite parts for Infrastructure Applications

CIRCUBLADE project: Circular approach for end-of-life wind turbine blades

Financial support: Innovations program RE:Source, Vinnova,and Energimyndigheten



Thank you!

Alann André – alann.andre@ri.se

Göteborg/Riga – GlassCircle Final conference, 2024-09-26

Alann André

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Post-Election Europe: a Clean Industrial Deal for a sustainable, competitive and circular EU

Glass Circle Final Conference, 26 September 2024

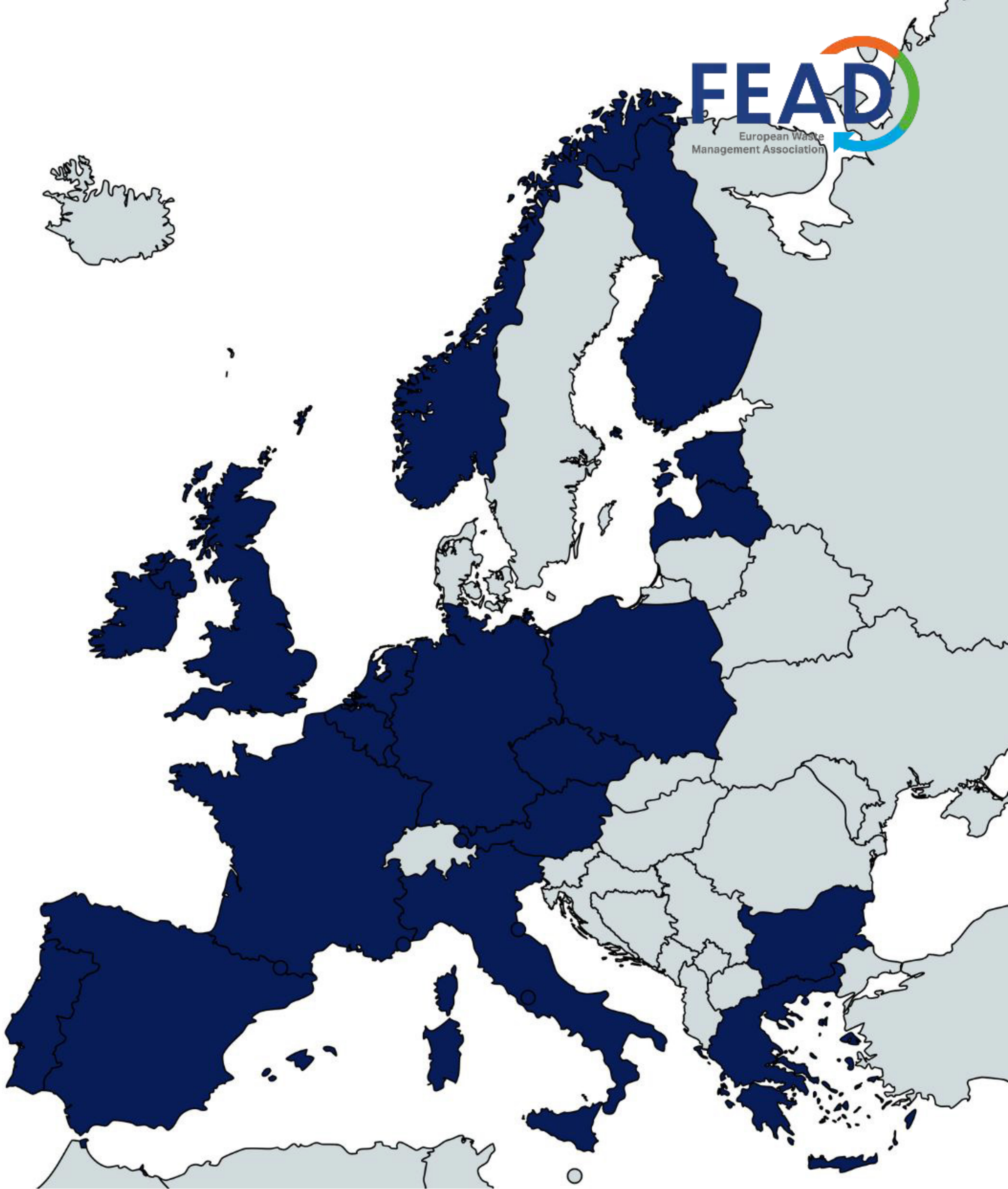
Presentation by Aizea Astor Hoschen, legal & policy officer at FEAD

FEAD
European Waste Management Association

FEAD
The voice of Europe's Private resource and waste management industry

We represent **19 national associations** from the EU, EFTA and the UK, steering Europe towards a circular economy for **over 40 years** today

Our members represent the **entire waste management value chain**, which allows us to offer a **holistic overview** on the industry that provides a second life to waste and resource

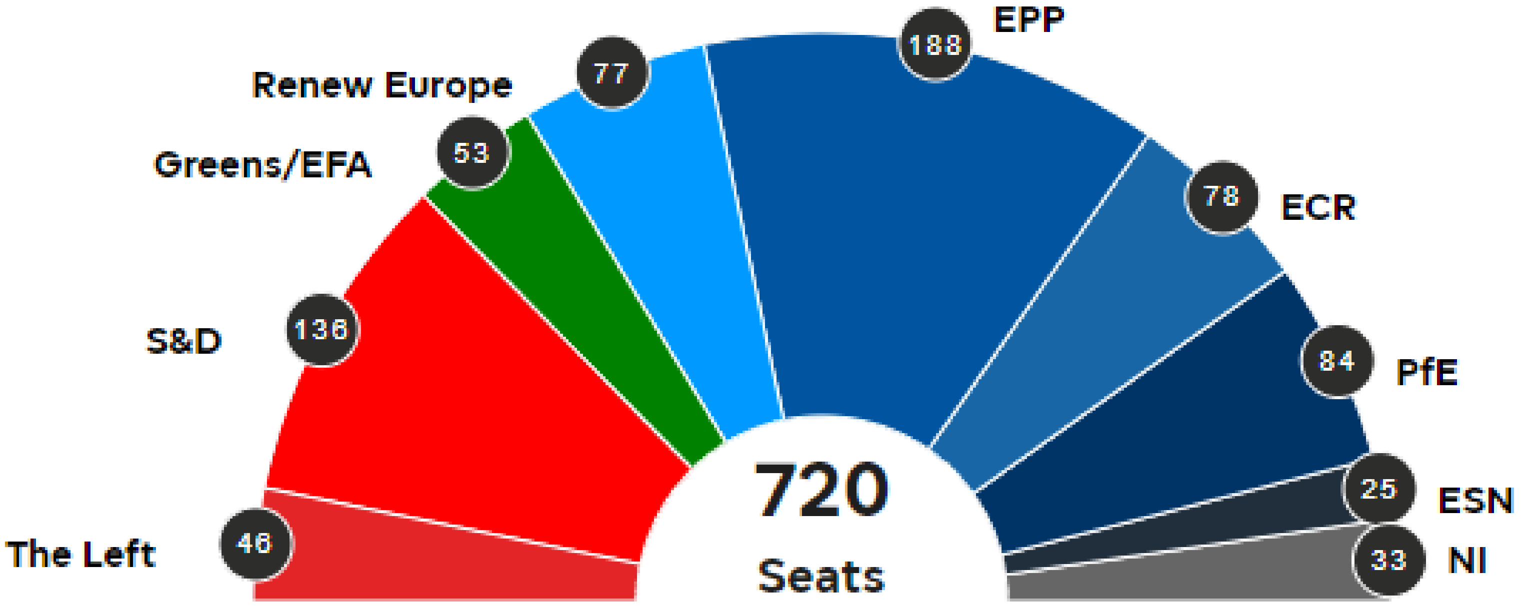


Our objective is to advocate for a **better regulatory framework** for the waste management sector, to achieve the best economic and environmental outcomes, and to **strengthen the circular economy in Europe**.

FEAD
European Waste Management Association

European Parliament 2024-2029

Constitutive session



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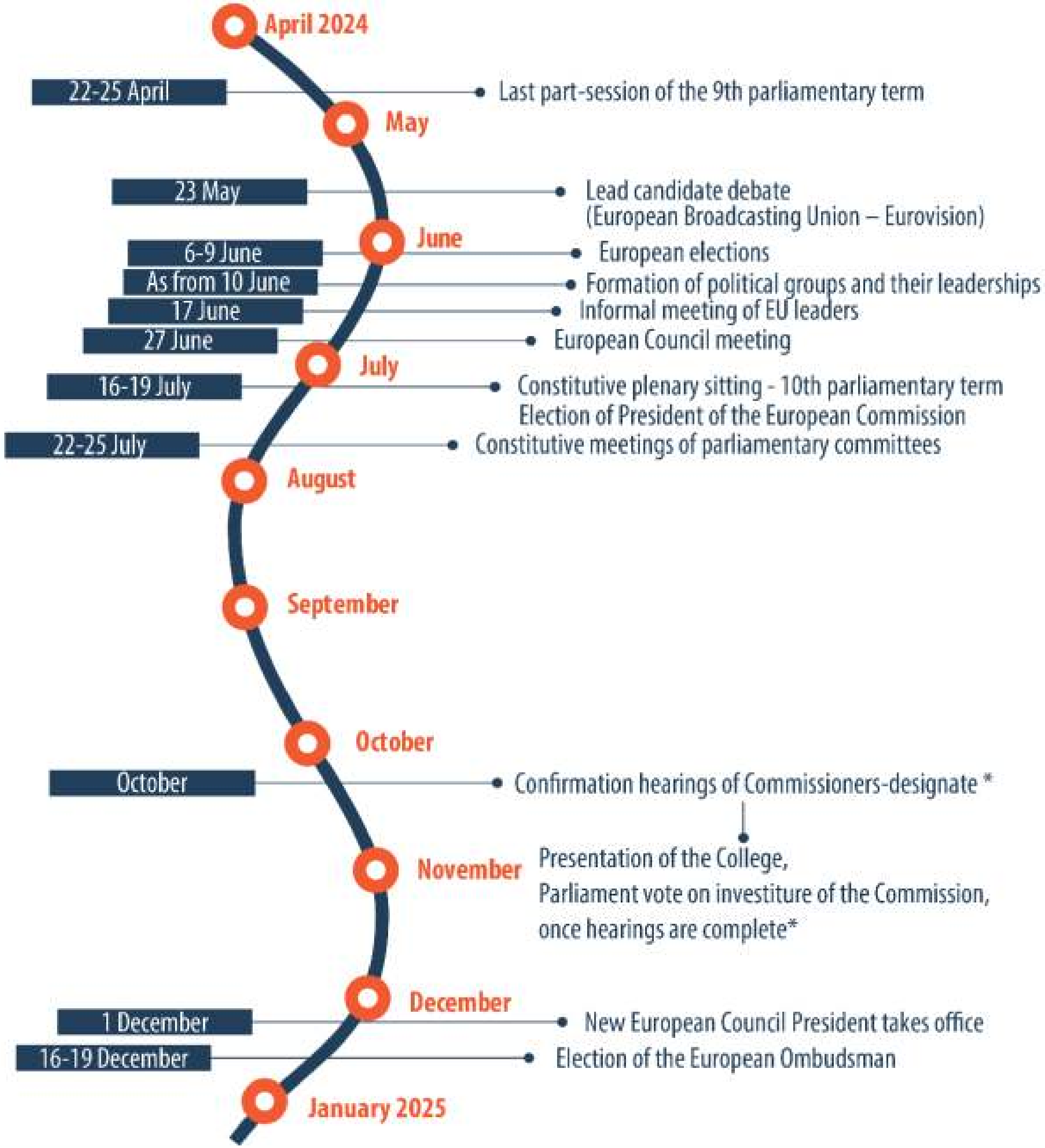

FEAD
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Management Association

A new plan for Europe's sustainable prosperity and competitiveness

- Make business easier and deepen our Single Market
- A **Clean Industrial Deal** to decarbonise and bring down energy prices
- Invest massively in sustainable competitiveness
- 90% emission-reduction target for 2040
- A more **circular** and resilient economy
  - A new Circular Economy Act, helping to create market demand for secondary materials and a single market for waste
- A new chemicals industry package

FEAD
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European Commission

SEPTEMBER 2024

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European Commission

MISSION LETTER

Brussels, 17 September 2024

Ursula von der Leyen
President of the European Commission

Jessika Roswall

Commissioner-designate for Environment, Water Resilience and a Competitive Circular Economy

Dear Jessika,

European Waste Management Association

A new industrial strategy for Europe

Three transformations ahead for Europe:

1. *Accelerate innovation and find new growth engines*
2. *Bring down high **energy prices** while continuing to **decarbonise** and shift to a **circular economy***
3. ***React** to a world of less stable geopolitics*

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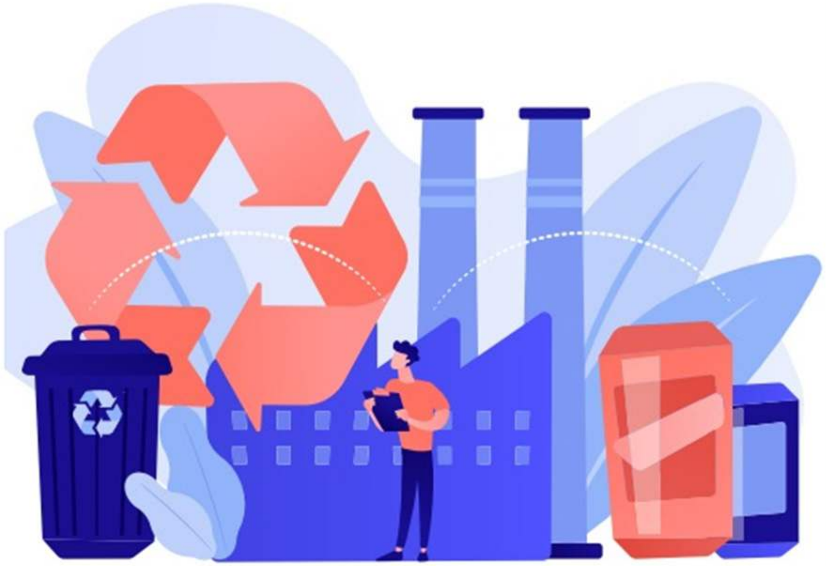
EU 2024 - 2029



1. **Reindustrialisation**
   - ➢ Clean technologies
2. **Strategic sovereignty**
   - ➢ Reduce dependencies in energy and raw materials
3. **Competitiveness**
   - ➢ Sustainable & innovative
4. **Circular economy**
   - ➢ Focus on CRM

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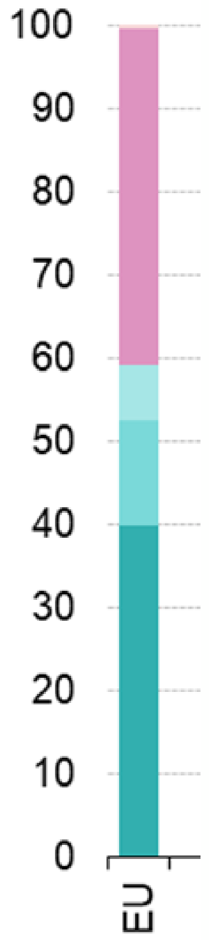
STATE OF PLAY – WASTE TREATMENT IN THE EU



In the EU in 2020:

- more than a half (**59.1 %**) of the waste was treated in **recovery operations**
  - recycling (39.9 % of the total treated waste)
  - backfilling (12.7 %)
  - energy recovery (6.5 %).

- **40.9 %** was **disposed**
  - landfilled (32.2 %)
  - incinerated without energy recovery (0.5 %)
  - disposed of otherwise (8.2 %).

- **Significant differences** could be observed among the EU Member States.

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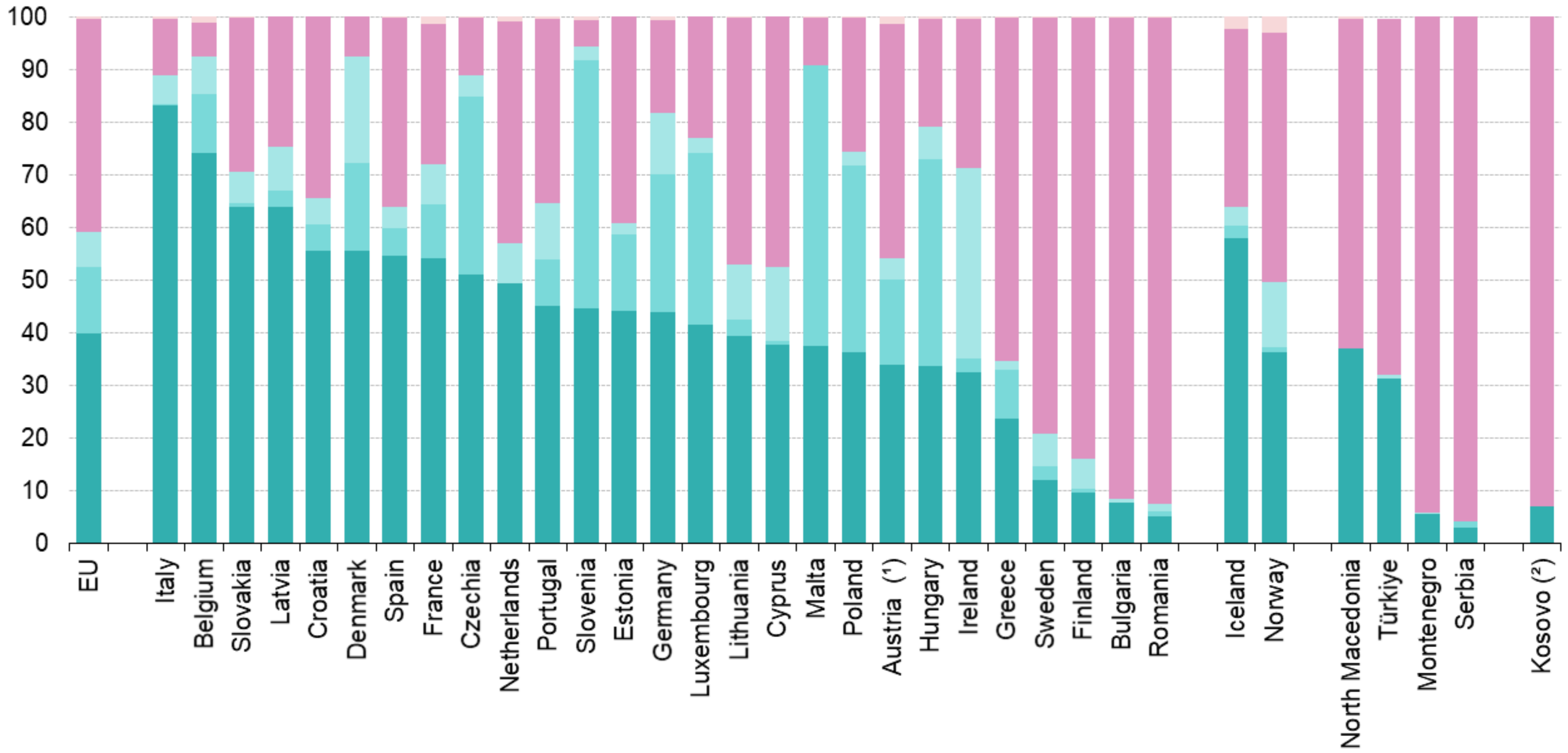
Waste treatment by type of recovery and disposal, 2020
(% of total treatment)



(¹) Value of incineration for Austria estimated by Eurostat.

(²) This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo Declaration of Independence.

Source: Eurostat (online data code: env_wastrt)

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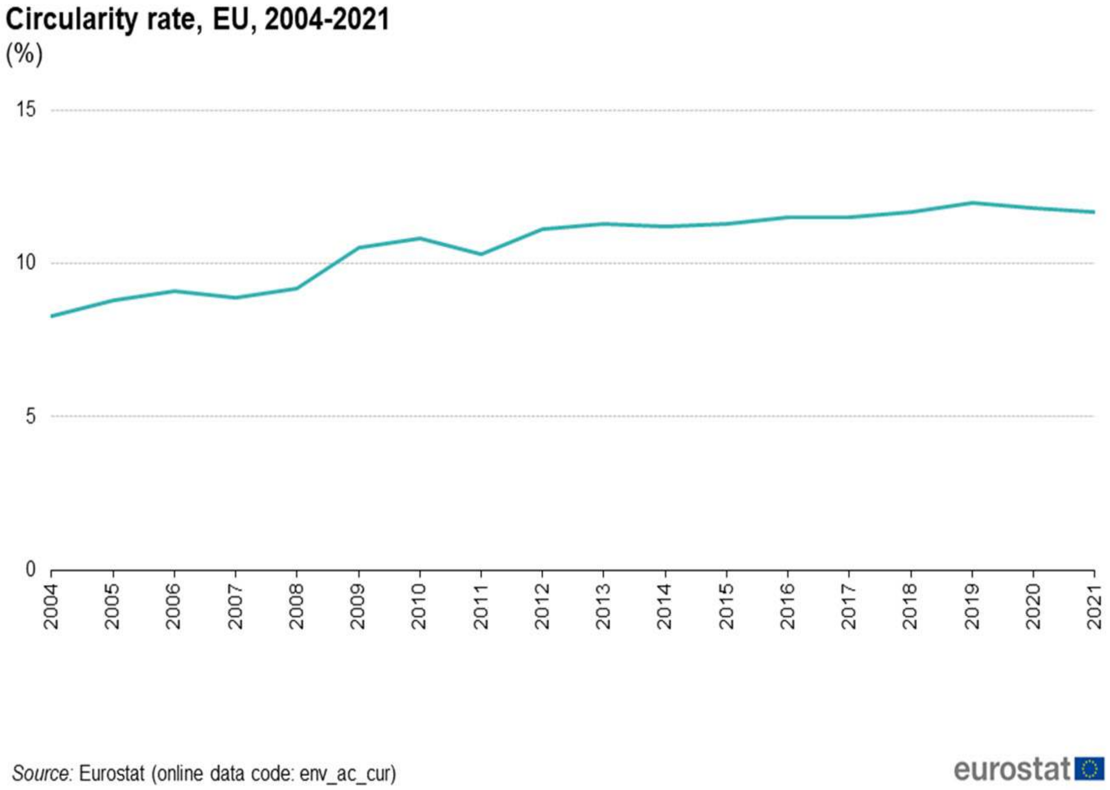
eurostat

STATE OF PLAY – CMUR IN THE EU



In the EU in 2022:

- **the circular material use rate** (referred to as the circularity rate; the share of used material resources which came from recycled waste materials) **reached 11.5%**, meaning that 11.5% of material resources used in the EU came from recycled waste materials.

FEAD's VISION

- Shifting Europe's overall material use towards **recycled materials through industrial excellence** in waste management

25%
CMUR

75%
RECYCLING

FEAD's MISSION

- Supply the European economy with **secondary raw materials and energy**
- Managing waste in a **safe and** environmentally **responsible** way

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EUROPEAN INDUSTRIAL DEAL

FEAD called for a **European Industrial Deal** to be the priority for this new term of the European institutions, in order to make Europe's industry sustainable, competitive and circular.

- **Sustainable**, by meeting the climate objectives in the Green Deal.
- **Competitive**, by supporting a solid manufacturing base in Europe.
- **Circular**, by shifting Europe's overall material use towards recycled materials.

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Circular resources for a European Industrial Deal

- Aligning industrial production to the circular economy
- Provide economic & fiancial incentives for the circular economy
- Harnessing the potential of waste management and the circular economy towards climate change mitigation measures
- Strengthening EU autonomy over its supply of resources
- Establishing an enforcement mechanism for European waste management legislation
- Ensuring there is a competitive market for waste management

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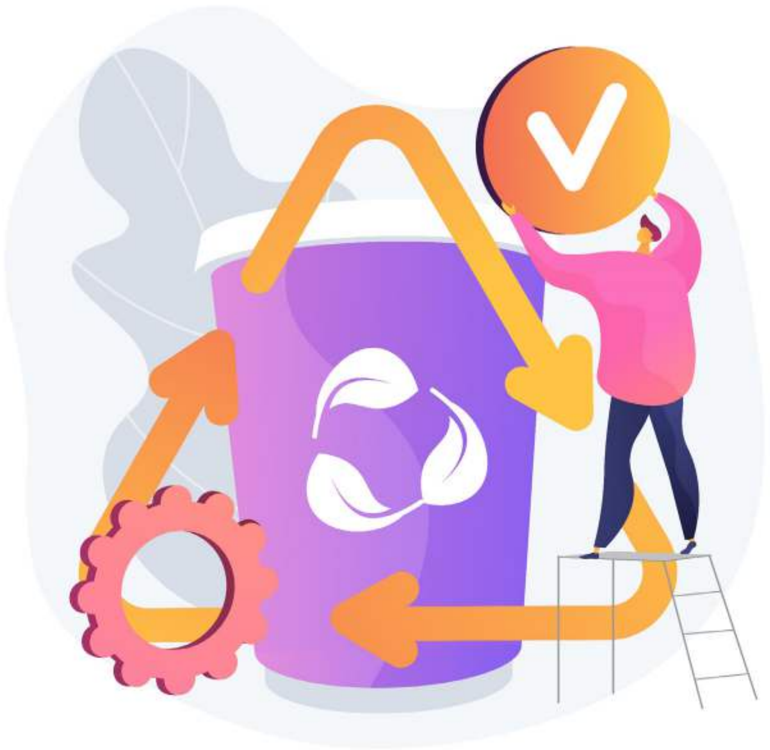
The central role of waste management

- Policies
- Investments
- Innovation



- Sustainability
- Competitiveness
- Circularity

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Thank you for your attention!

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Social media:

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