June 2026

Machinery manufacturing in the circular economy – an unexplored ally in the circular transition?

Report of the CIRCOMOD webinar at Circular Talks held June 17, 2026

www.circomod.eu

Funded by the European Union under Grant Agreement No. 101056868

Machinery manufacturing in the circular economy – an unexplored ally in the circular transition?

Report of the CIRCOMOD webinar at Circular Talks held June 17, 2026

Webinar has been Co-organised by CIRCOMOD project and the European Circular Economy Stakeholder Platform

Report prepared by A. Doranova

Table of Contents

CIRCOMOD project has received funding from the Horizon Europe research and innovation programme under grant agreement No 101056868

Funded by the European Union

Summary

This EU Circular Talk explored the role of machinery manufacturing in Europe's circular transition, with a particular focus on how circular economy strategies can support climate mitigation, resource security, industrial resilience and competitiveness. The workshop was organised within the European Circular Economy Stakeholder Platform framework and drew strongly on results from the CIRCOMOD project, a Horizon Europe initiative that has developed new modelling, data and policy-relevant insights on the circular economy, material consumption and greenhouse gas emissions.

The event combined a policy overview from the European Commission, research findings from CIRCOMOD, and industrial examples showing how circular strategies are already being implemented in machinery value chains. Discussions highlighted that machinery is both a resource-intensive product category and an enabler of circularity across the wider economy. Speakers emphasised that machinery determines how products are made, how efficiently materials are used, and how components can be maintained, upgraded, refurbished, remanufactured or recovered.

A central message was that circular economy strategies in machinery manufacturing are not marginal improvements. The evidence presented showed substantial potential for material savings, lower embodied greenhouse gas emissions, cost reductions and skilled employment, provided that business models, data systems, quality assurance frameworks and policy conditions evolve together. The interactive discussion focused on barriers such as waste classification, trust in remanufactured components, data gaps, inconsistent definitions across legislation, and the need for digital product passports and accessible information on the condition of used components.

1 Workshop objectives and speaker profiles

1.1 Workshop objectives

- Situate machinery manufacturing within the broader European circular economy agenda and the work of the European Circular Economy Stakeholder Platform.
- Explain the current and emerging EU policy landscape relevant to machinery, circular products, repairability, recycled materials, critical raw materials and product documentation.
- Share CIRCOMOD research findings on the economic importance, material footprint and greenhouse gas implications of machinery and equipment.
- Present life cycle assessment evidence on industrial machinery technologies and discuss which circular economy strategies are most relevant for different machinery archetypes.
- Show industrial examples of material reduction, reuse, remanufacturing and circular business models in practice.
- Collect stakeholder views on policy bottlenecks, untapped opportunities and practical asks for scaling circular machinery and equipment.

1.2 Speaker profiles

Speaker	Role	Profile and contribution
Martin Böhme	Opening host; member of the European Economic and Social Committee, Civil Society Organisations Group.	Martin Böhme opened the workshop by situating it within the European Circular Economy Stakeholder Platform. He underlined the importance of the machinery sector for competitiveness, resource security and industrial resilience, and linked the discussion to the EESC's work on the proposed Machinery Regulation.
Sebastian Edmaier	Policy Officer, DG GROW, European Commission.	Sebastian Edmaier works in the European Commission's Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, in the Machinery, Equipment & AI unit. His work covers product harmonisation laws relevant to engineering industries, including pressure equipment, standardisation and the functioning of the EU internal market. In the workshop, he explained how machinery legislation intersects with sustainability, circularity and upcoming product-policy initiatives.
Edgar Hertwich	Professor at the Norwegian University of Science and Technology and Principal Research Scholar at the International Institute for Applied Systems Analysis.	Edgar Hertwich is a leading industrial ecology scholar whose research addresses climate mitigation, sustainable consumption and production, trade, resources and the environment. He has contributed to international assessments of material efficiency and circular economy strategies, including work on the climate benefits of circularity for buildings, transport systems, machinery and equipment.
Alejandro Arias Castillo	Researcher at the Institute for Industrial Ecology, Pforzheim University.	Alejandro Arias Castillo is a research associate working on industrial ecology, environmental assessment, circular economy and sustainable material cycles. His contribution focused on life cycle assessment evidence for industrial machinery technologies and on how different machinery archetypes can guide the choice of circular economy strategies.
Tobias Viere	Professor of Energy and Material Flow Analysis at the Institute for Industrial Ecology, Pforzheim University.	Tobias Viere's research focuses on quantitative sustainability assessment in corporate and industrial contexts, including energy and material flow analysis, life cycle assessment, resource efficiency, material flow cost accounting and circular economy strategies. He is also active in teaching and programme leadership in life cycle and sustainability education at Pforzheim University.
Dominic Schultze	Circularity expert and engineer at Herrenknecht.	Dominic Schultze works on circularity in the tunnel-boring machinery sector. He presented Herrenknecht's REBUILD approach, showing how high-value parts from tunnel boring machines can be bought back, remanufactured and integrated into new machines while maintaining performance and warranty expectations.

2 Workshop programme

Session	Content
Opening	Welcome, event framing and introduction to the European Circular Economy Stakeholder Platform.
Policy landscape	Sebastian Edmaier, DG GROW: EU machinery policy, sustainability legislation and upcoming circular product-policy initiatives.
CIRCOMOD research results	Edgar Hertwich: macro-level evidence on the economic importance, embodied metals and greenhouse gas footprint of machinery and equipment.
CIRCOMOD / Pforzheim LCA results	Alejandro Arias Castillo: life cycle climate impacts of industrial machinery technologies and circular strategy archetypes.
Industry perspectives	Tobias Viere and Dominic Schultze: industrial success stories on material reduction, reuse, remanufacturing and REBUILD by Herrenknecht.
Interactive session and Q&A	Mentimeter-based stakeholder exchange on barriers, opportunities and policy asks.
Closing	Summary of messages, invitation to contribute to the wider CIRCOMOD stakeholder consultation, and signposting to future European Commission consultations.

3 Presentations

3.1 Opening remarks and event framing - Martin Böhme / moderator

The opening remarks framed the circular economy as a strategic imperative for Europe rather than only an environmental ambition. The European Circular Economy Stakeholder Platform was presented as a multi-stakeholder space that brings together businesses, industry associations, trade unions, civil society, public authorities, researchers and practitioners to exchange knowledge and identify practical solutions.

The machinery sector was described as uniquely positioned to drive circularity, because machinery shapes how products are manufactured, how efficiently resources are used and how materials can be recovered and reintroduced into production cycles. The workshop was therefore positioned as an opportunity to discuss circular business models, enabling policy and collaboration across the machinery value chain.

The moderator introduced CIRCOMOD as a Horizon Europe project launched in 2022 to improve modelling at the nexus of circular economy strategies, material consumption and greenhouse gas emissions. The project has produced an open data repository, an analytical framework linking circular economy strategies to climate scenarios, and policy-relevant insights for European and global decision makers.

3.2 Policy landscape - Sebastian Edmaier

Sebastian Edmaier explained that machinery products are covered by specific EU legislation. The Machinery Directive 2006/42/EC is being replaced by the Machinery Regulation 2023/1230 as of 20 January 2027. The core purpose of this framework is safety, health protection and free movement of machinery products in the internal market. Its scope is broad, including power tools, garden equipment, robotics, industrial equipment, cranes and non-road mobile machinery.

He emphasised that machinery legislation sets essential health and safety requirements and relies on harmonised standards for technical compliance. New requirements from 2027 will include cyber-safety and self-learning machinery, but the machinery framework itself does not impose circularity or sustainability requirements.

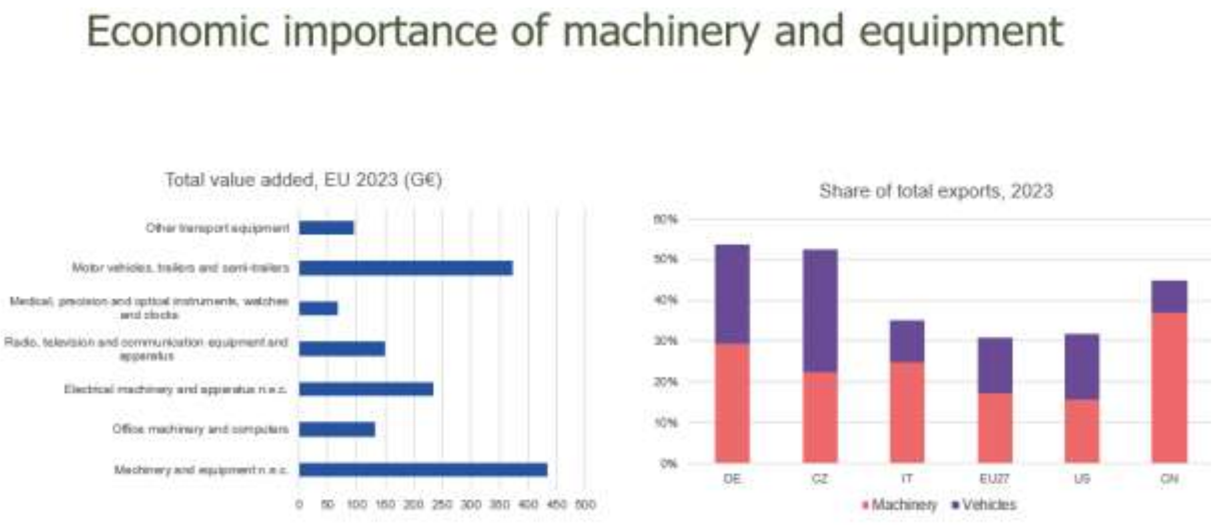
He then mapped the broader sustainability legislation relevant to machinery, including the WEEE Directive, the Ecodesign for Sustainable Products Regulation, the Directive on repairability, the Critical Raw Materials Act, RoHS, REACH, the Corporate Sustainability Due Diligence Directive and the Corporate Sustainability Reporting Directive. Because definitions and scopes vary across laws, not all machinery products are affected in the same way.

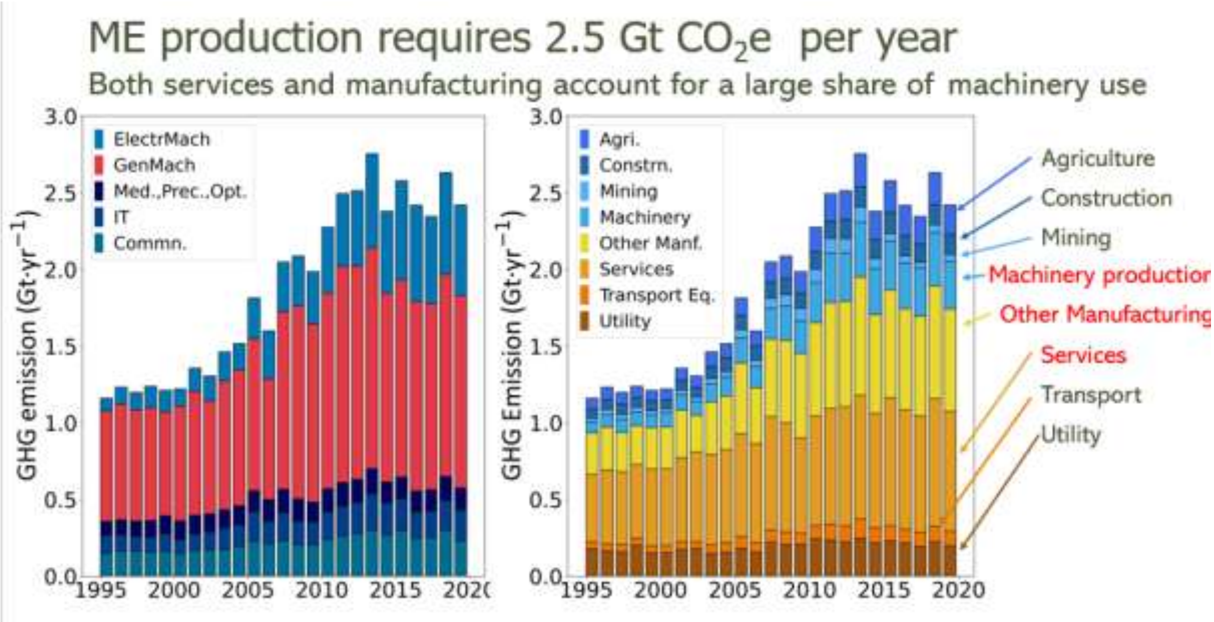
Looking ahead, he highlighted two important upcoming initiatives: the Circular Economy Act, expected to promote circular business models, secondary raw materials and smoother movement of circular products and waste; and the European Product Act, which is intended to revise product rules, clarify requirements for circular products and operators, introduce more digitalised documentation such as digital product passports, improve market surveillance, and ensure that reused, repaired, refurbished or remanufactured products remain safe and compliant.

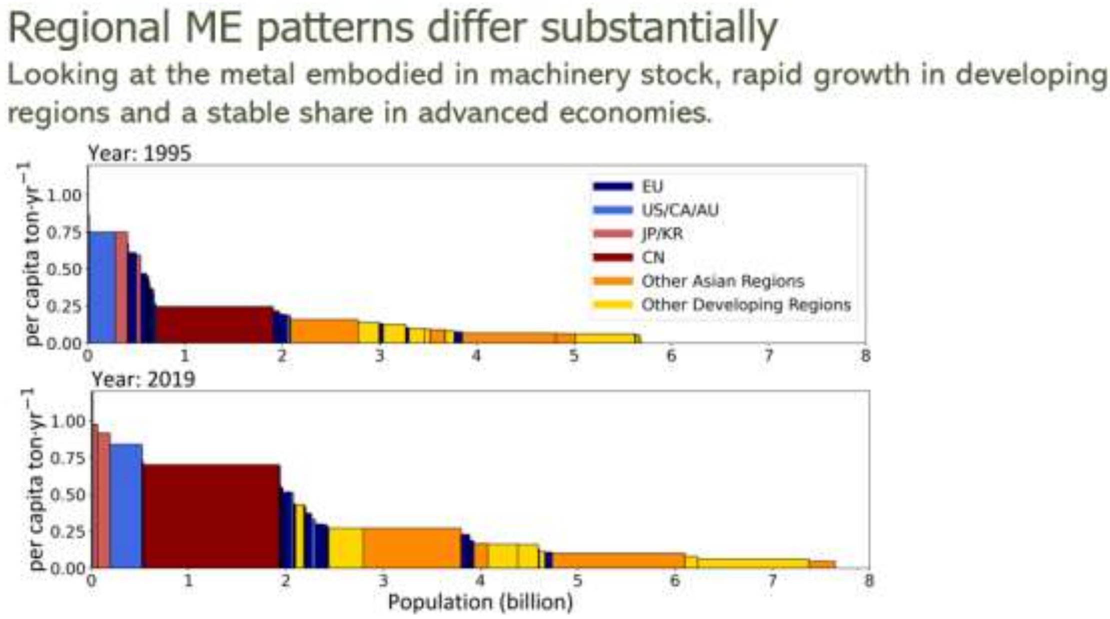
3.3 Economic importance and footprint of machinery and equipment - Edgar Hertwich

Edgar Hertwich explained why machinery and equipment deserve greater attention in circular economy research and policy. Machinery and equipment enable production across the economy and are also significant users of metals, including high-value alloys. He noted that machinery and equipment production contributes around 5% of global greenhouse gas emissions through material use, and that the sector is highly relevant to Europe's industrial competitiveness.

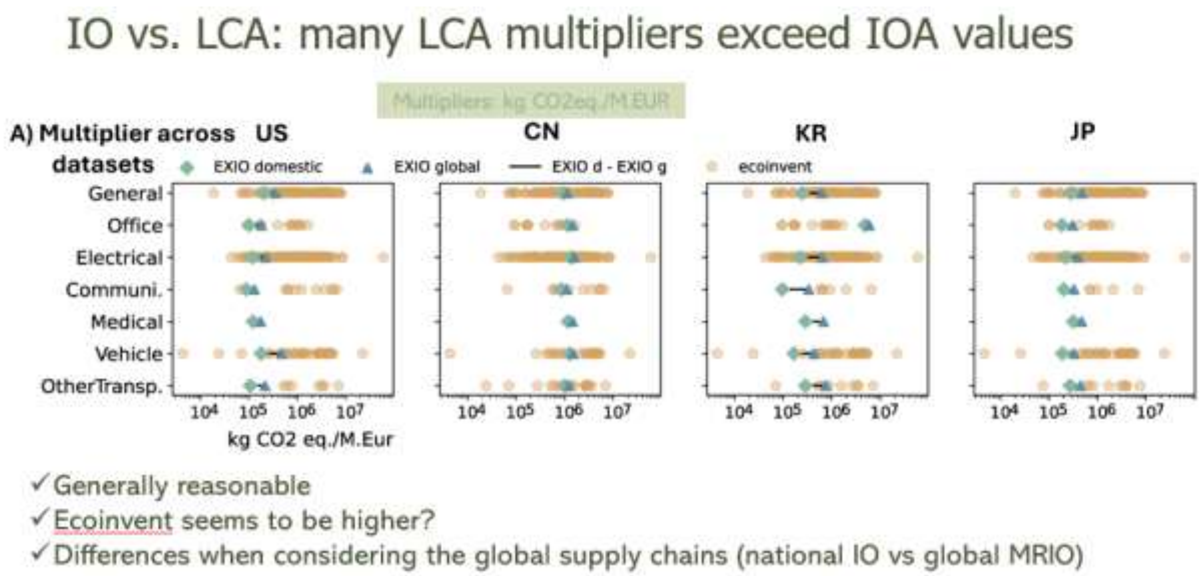
Using macro-level evidence, he showed that machinery and equipment are major contributors to European value added and exports. Machinery and equipment are not only important in heavy industry: services and other manufacturing sectors are also large users of machinery. Regional patterns differ substantially, with rapid growth in machinery stocks in developing regions and more stable shares in advanced economies.







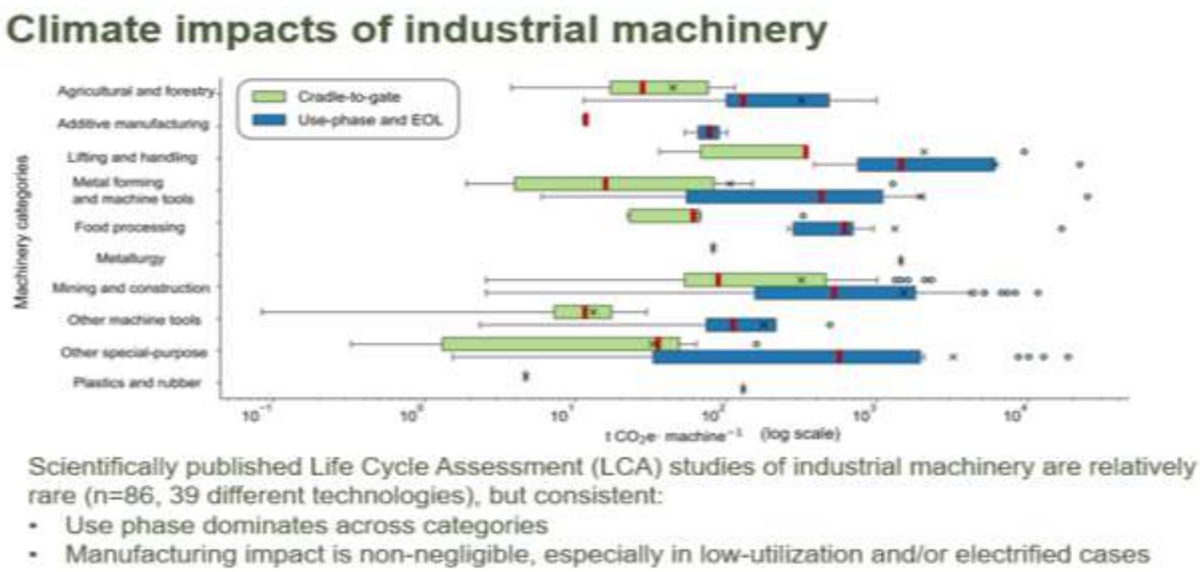
He compared life cycle assessment and input-output assessment evidence, noting that available studies show large variation in greenhouse gas multipliers for machinery and equipment. Some variation reflects real differences across machinery types, but some may arise from methodological differences, inconsistent boundaries and limitations in available data. He argued that better systematic evidence is needed so that firms and policymakers can identify where interventions would genuinely move the needle.



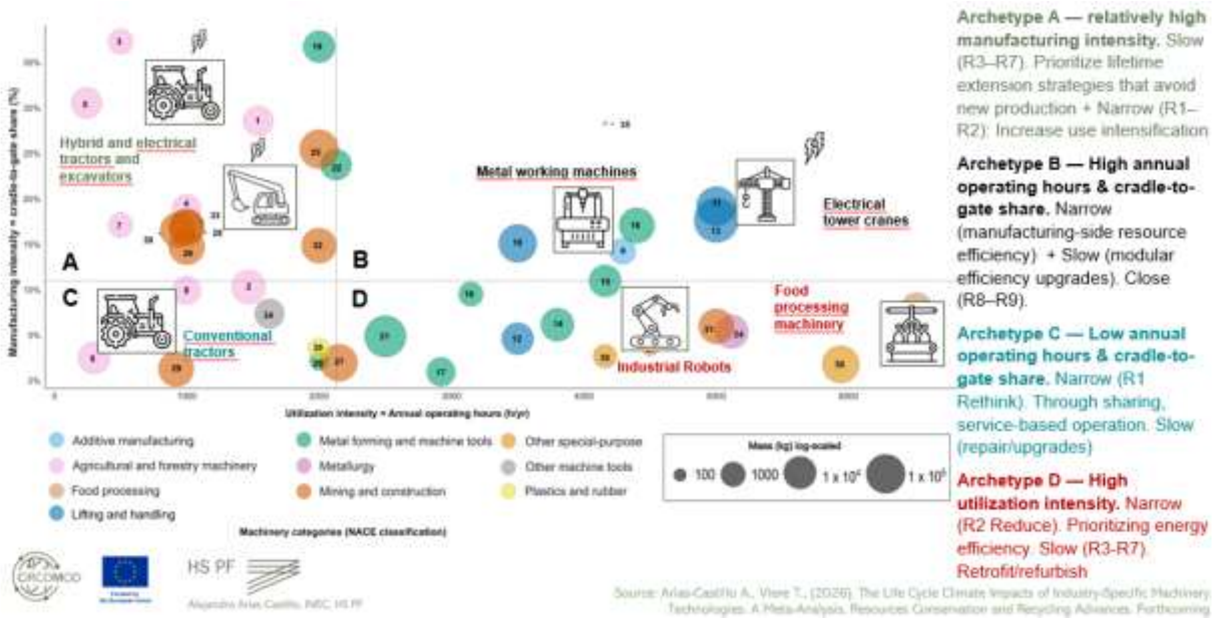
3.4 Life cycle climate impacts of industrial machinery - Alejandro Arias Castillo

Alejandro Arias Castillo presented a bottom-up review of life cycle assessment studies for industrial machinery. The work focused on selected machinery categories, including agricultural and forestry machinery, metal forming machinery, and other special-purpose machinery such as mining, construction, plastics and rubber machinery.

The review found 86 LCA studies covering 39 machinery technologies. Across categories, the use phase generally dominates climate impacts, but manufacturing impacts are not negligible. Manufacturing becomes especially important in cases of low utilisation and electrification, where burdens may shift from the use phase to the production phase in a way similar to the shift observed for electric vehicles.



The presentation introduced an exploratory archetype map based on annual operating hours and the cradle-to-gate share of climate impacts. Technologies with high manufacturing intensity and low utilisation, such as hybrid and electric tractors or excavators, may benefit from lifetime extension and greater use intensification. High-utilisation and high-manufacturing-intensity technologies may require manufacturing-side resource efficiency, modular upgrades and high-quality recycling. Low-utilisation conventional machinery may be suited to sharing or service-based models, while high-utilisation machinery may prioritise energy efficiency, retrofitting and refurbishment.

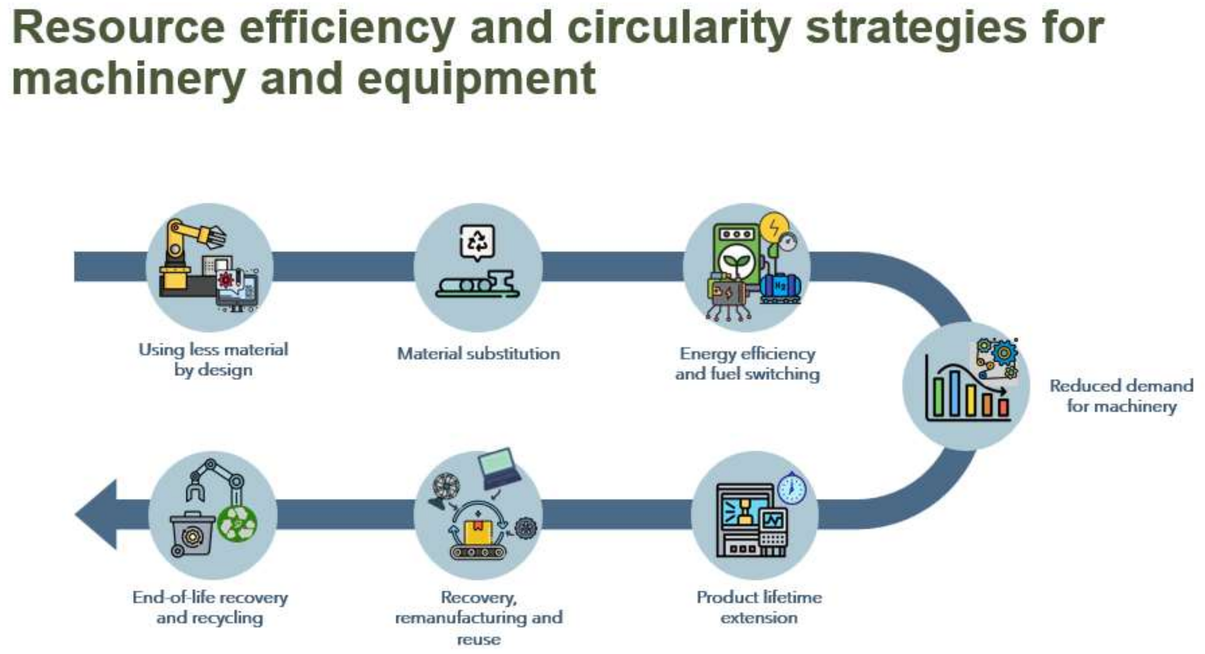


3.5 Industry perspectives and success stories - Tobias Viere

Tobias Viere presented circularity strategies for machinery and equipment, including material reduction by design, material substitution, energy efficiency, fuel switching, reduced demand, lifetime extension, recovery, remanufacturing, reuse and end-of-life recycling. He stressed that circular strategies can generate substantial business and environmental benefits, not merely marginal improvements.

He presented three industrial examples. At ELWEMA Automotive GmbH, reducing the steel wall thickness of machine beds in automotive assembly machinery delivered around two tonnes of weight reduction and around 17% greenhouse gas savings; substituting steel with plastics in feeding systems reduced weight by around 600 kg and delivered further carbon savings. At Bosch's Feuerbach plant, internal reuse of around 1,500 industrial machines generated major cash, steel, aluminium, copper and plastic savings. At Liebherr Components AG, remanufacturing hydraulic pumps, gearboxes and engines delivered 75-78% primary material savings and up to 53% reductions in embodied greenhouse gas emissions.

He concluded that circular machinery strategies require adapted business models, cost strategies, highly skilled jobs, and long-term trusting collaboration within value chains, especially for quality control of remanufactured components. He also emphasised that as use phases are decarbonised and electrified, the relative importance of machinery manufacturing impacts increases.



3.6 REBUILD by Herrenknecht - Dominic Schultze

Dominic Schultze presented Herrenknecht's circular economy approach for tunnel boring machines. These machines are highly customised, large and project-specific, often weighing thousands of tonnes, but they contain many valuable parts that can be recovered and reused in follow-up projects. Herrenknecht has therefore developed a buy-back approach that allows tunnel boring machines and components to return after use.

The REBUILD model helps clients avoid storage burdens and gives Herrenknecht access to components, quality feedback and shorter delivery times. At its dedicated workshop in Kehl, near Strasbourg, Herrenknecht rebuilds around 50,000 components per year. The approach follows International Tunnelling Association guidelines and focuses primarily on remanufacturing rather than simple repair, because components must meet the requirements of new, project-specific machines.

The reported LCA-based results show a reduction of more than 71% in carbon footprint for remanufactured components compared with newly produced components, corresponding to a saving of 2,937.42 kg CO_2e per tonne of component. The result was linked to a master's thesis with Pforzheim University and verified through a greenhouse gas declaration by TÜV SÜD.

4 Key takeaways

- Machinery is an underexplored but strategic circular economy sector. It is both a major material- and emissions-relevant product category and a key enabler of circular production across the wider economy.
- The current machinery framework is safety-oriented. EU machinery legislation secures safety and free movement, while circularity is mainly addressed through adjacent sustainability and product-policy frameworks.
- New EU policy initiatives could be decisive. The Circular Economy Act and European Product Act could improve rules for circular products, secondary raw materials, documentation, digital product passports and market surveillance.

- **Data quality is a major bottleneck.** LCA and input-output evidence show the scale of the issue, but results vary widely. Better, more systematic data on material composition, use, condition, maintenance history and end-of-life pathways are needed.
- **Use-phase impacts dominate today, but manufacturing will matter more.** As machinery becomes more energy efficient and electrified, embodied emissions and material choices in manufacturing become more important.
- **Circular strategies should be tailored to machinery archetypes.** Low-utilisation and high-manufacturing-intensity machinery may call for lifetime extension and sharing, while high-utilisation machinery may call for energy efficiency, retrofitting and modular upgrades.
- **Industrial cases show substantial savings.** Examples from ELWEMA, Bosch, Liebherr and Herrenknecht demonstrate large potential for material savings, cost savings and embodied carbon reductions.
- **Trust and quality assurance are central.** Clients need confidence that remanufactured parts are safe, certified, reliable and equivalent in performance to new parts. Diagnostics and information on the state of health of used components could help.
- **Waste classification can constrain circularity.** Participants highlighted that returning products and components for reuse or remanufacturing can trigger waste-related obligations, creating legal and logistical barriers, particularly across borders.
- **Circularity requires value-chain collaboration.** Successful reuse and remanufacturing depend on long-term relationships, supplier cooperation, feedback loops, quality control, and business models that allow components to return after use.
- **Digital product passports are promising but not sufficient alone.** They can support transparency and compliance, but their value depends on what data they contain, how accessible the data are, and how the information is used to enable practical decisions.
- **Policy alignment matters.** Stakeholders called for better alignment across product safety, chemicals, repairability, waste, raw materials and sustainability reporting frameworks, while recognising that policy must balance circularity with safety, environmental protection and competitiveness.

5 Workshop follow up

The video recording of the event is avaiable at https://www.youtube.com/watch?v=4qE_i7Ko6C0 . No feedback from the online participants was collected after the webinar.