

# Fraunhofer flagship project »ORCHESTER«: Digital ecosystem for a resilient and sustainable supply of functionally reliable materials



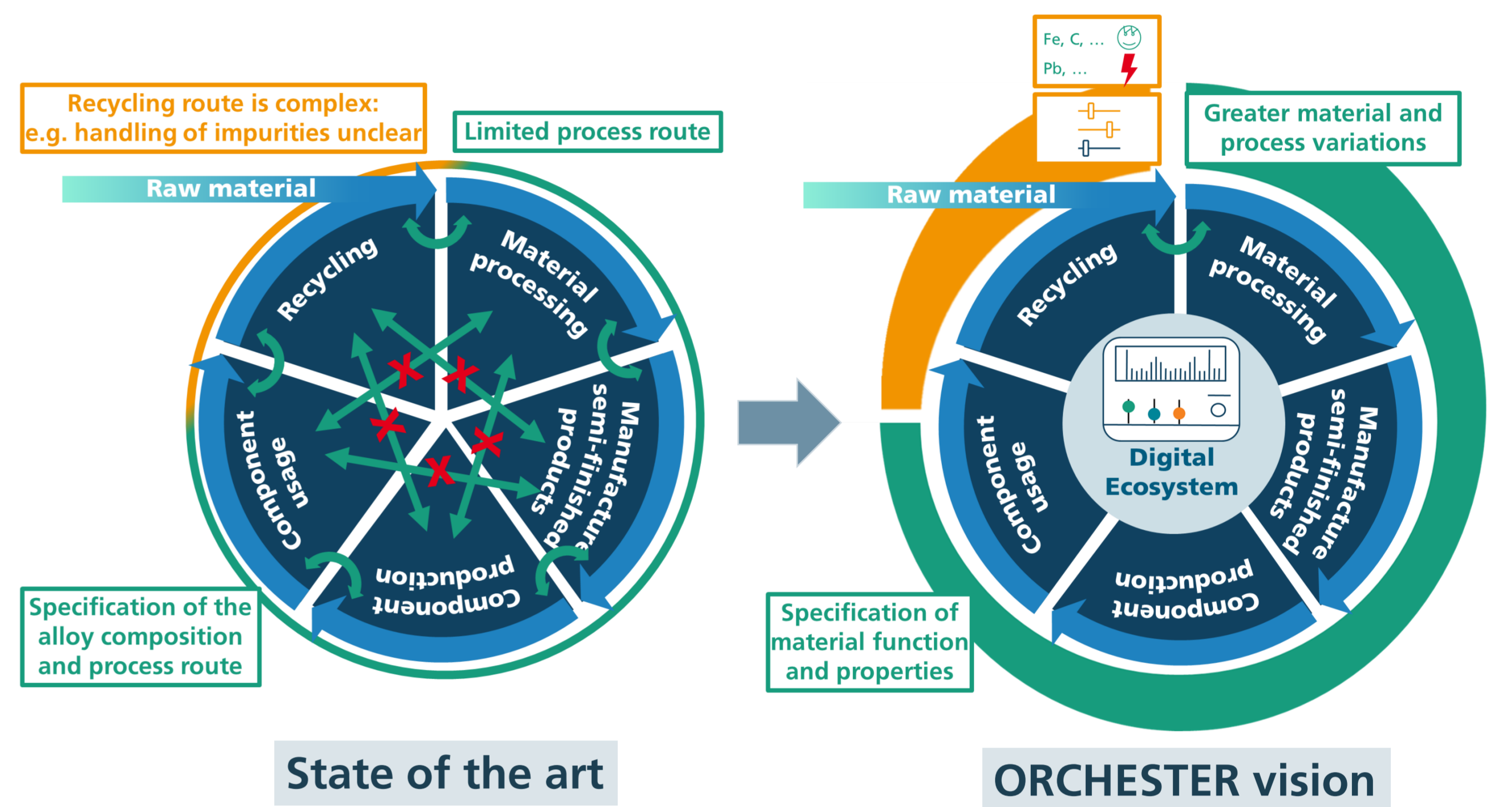
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## Global challenges and regulatory requirements drive the need for sustainable and resilient materials

In view of finite resources, increasing material requirements, volatile supply situations and growing climate impacts, it is essential to **reconcile value chains with climate and nature conservation** and to **ensure security of supply**. As unexpected events such as the pandemic and the war in Ukraine have shown, the high degree of optimization and specialization means that **value chains are becoming more susceptible to disruption**. Social drivers such as the energy transition are leading to radical changes in material flows, an increased need for resources and massive dependencies on raw materials. In the event of bottlenecks in the supply of materials, sustainable and economical material substitution solutions must be found quickly. **Recycled materials** play a special role in material supply but can jeopardize the functional safety of components due to **chemical contamination**. For a sustainable and resilient supply of functionally reliable materials, the entire value chain must be orchestrated in a digitally and physically networked manner. This is not yet possible with the technologies available on the market.

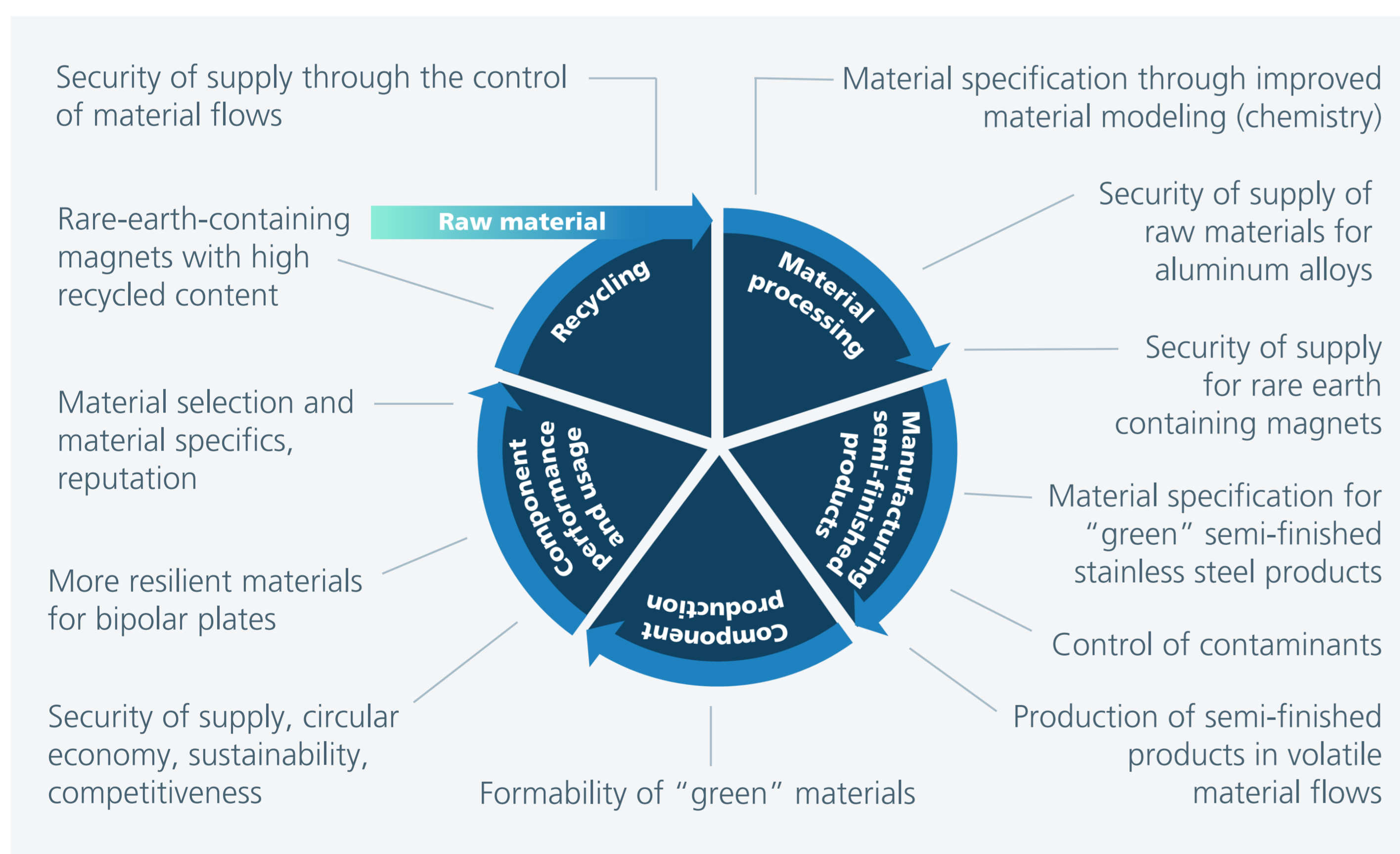
 Ensuring human rights & environmental standards in supply chains	 Managing volatile material flows due to geopolitical uncertainties	 Covering increasing material requirements with limited resources	 First climate neutral continent with green processes & products
EU Supply Chain Act since 01.01.2023	German National Circular Economy Strategy (NKWS)	EU Critical Raw Materials Act (CRMA) until 2030	European Green Deal (climate protection targets 2030 & 2050)

## Mapping the value chain and closing the "recycling gap"

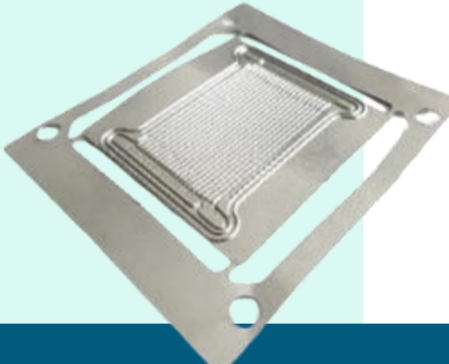

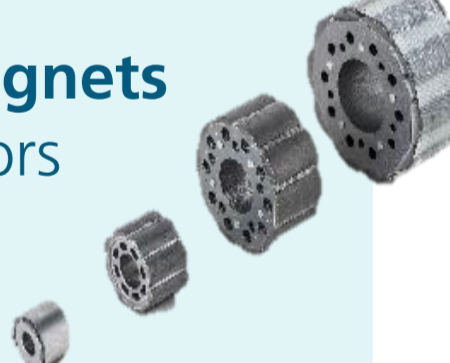


Safe material supply requires the **coupling of screening methods and digital products** for the holistic and rapid evaluation of process and functional safety, resilience & sustainability in a digital ecosystem. For this purpose, we are combining **experimental, simulation-based, process, sensor and digital technologies** into a **digital ecosystem**. The participating Fraunhofer Institutes contribute instruments such as high-throughput screening, sensorized manufacturing and production processes as well as process simulations and knowledge graphs for linking material and process data with models and expert knowledge.

## Challenges of our industry partners along the value chain



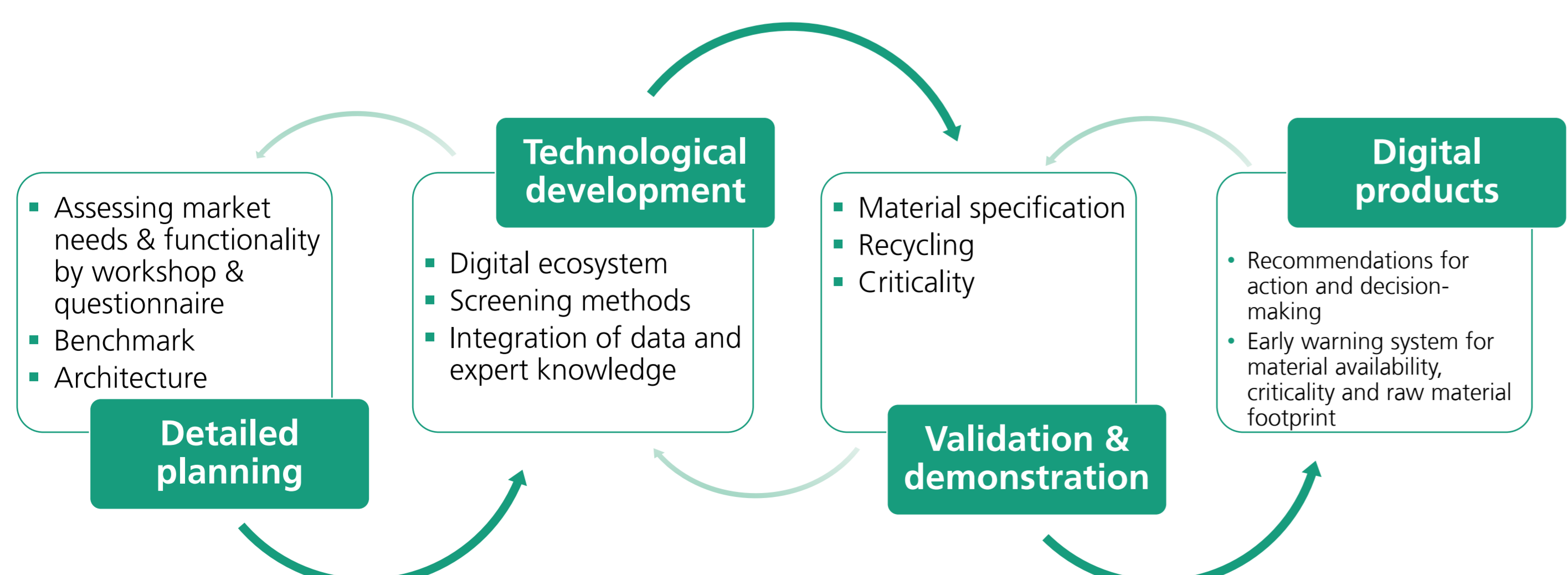
## Our demonstrators in the context of the energy transition

 <b>Bipolar plates</b> for electrolyzers & fuel cells	 <b>Compressor wheels</b> for hydrogen pipelines, fuel cells & heat pumps	 <b>Permanent magnets</b> for electric motors & wind turbines
<b>Material and their core issues</b>		
<b>Stainless steels with high Ni content:</b> Availability of Ni in crises and raw material costs (Ni is 50x more expensive than Fe)	<b>Al alloys:</b> Impurities in the secondary material content are problematic	<b>Magnetic material with rare earths:</b> Dependence on China in particular, no established secondary cycle
<b>Increasing resilience</b>		
<b>Wider specification windows</b> allow greater choice of materials	<b>The control of impurities</b> allows a higher proportion of secondary material	<b>Intelligent sorting and substitution</b> allow the use of <b>used magnets</b>

## ORCHESTER creates added value and measurable improvements

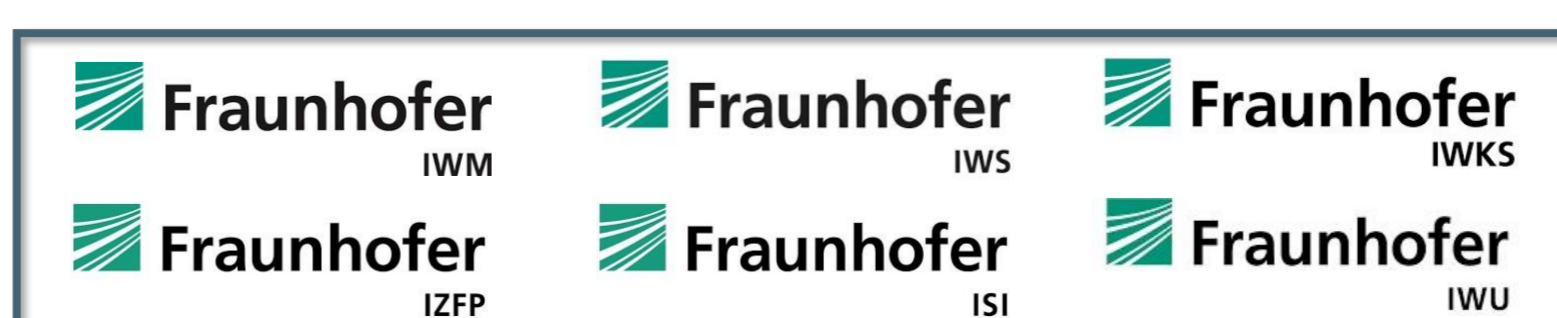
Range of materials	☆ x5
Recycling content in process routes	♻️ + 50%
Development time for alloys	🕒 - 50%
Rare earths from primary production	📉 - 25%
Increasing resilience	➔ + 30%

## Creating new opportunities with customized digital products



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