

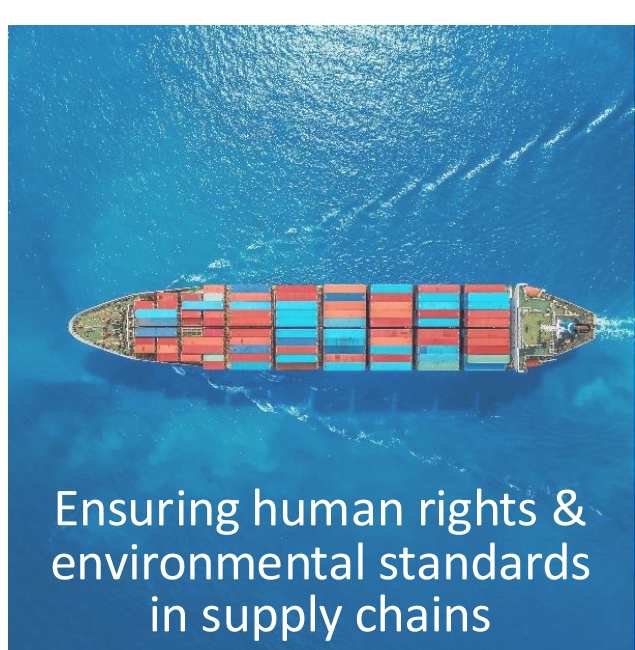
Fraunhofer flagship project »ORCHESTER«: Digital ecosystem for a resilient and sustainable supply of functionally reliable materials



A. Kugele¹, M. Rabung², R. Tschuncky², C. Schweizer¹, D. Helm¹, P. Gumbsch¹

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

EU Supply Chain Act since 01.01.2023



Managing volatile material flows due to geopolitical uncertainties

German National Circular Economy Strategy (NKWS)



Covering increasing material requirements with limited resources

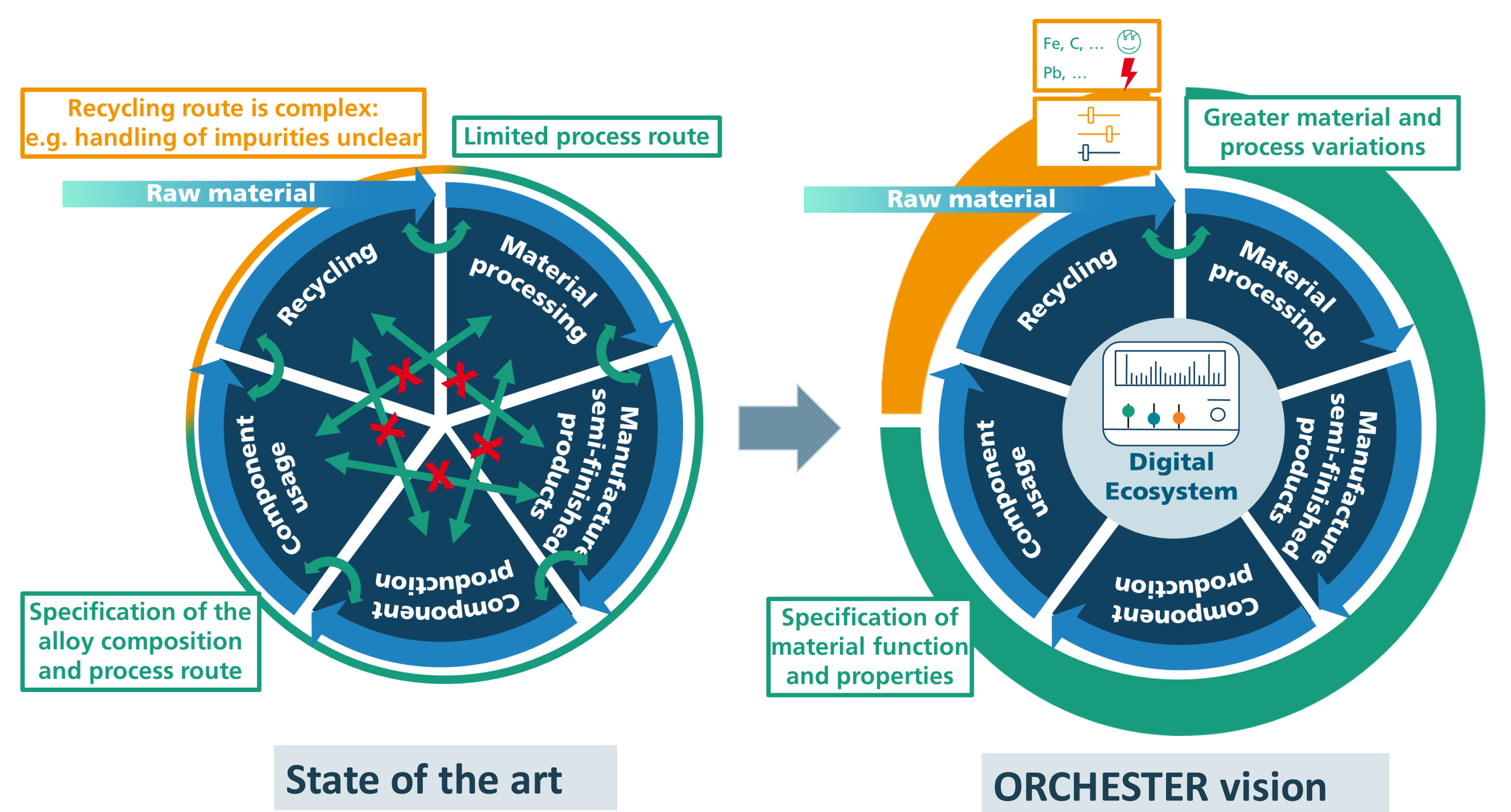
EU Critical Raw Materials Act (CRMA) until 2030



First climate neutral continent with green processes & products

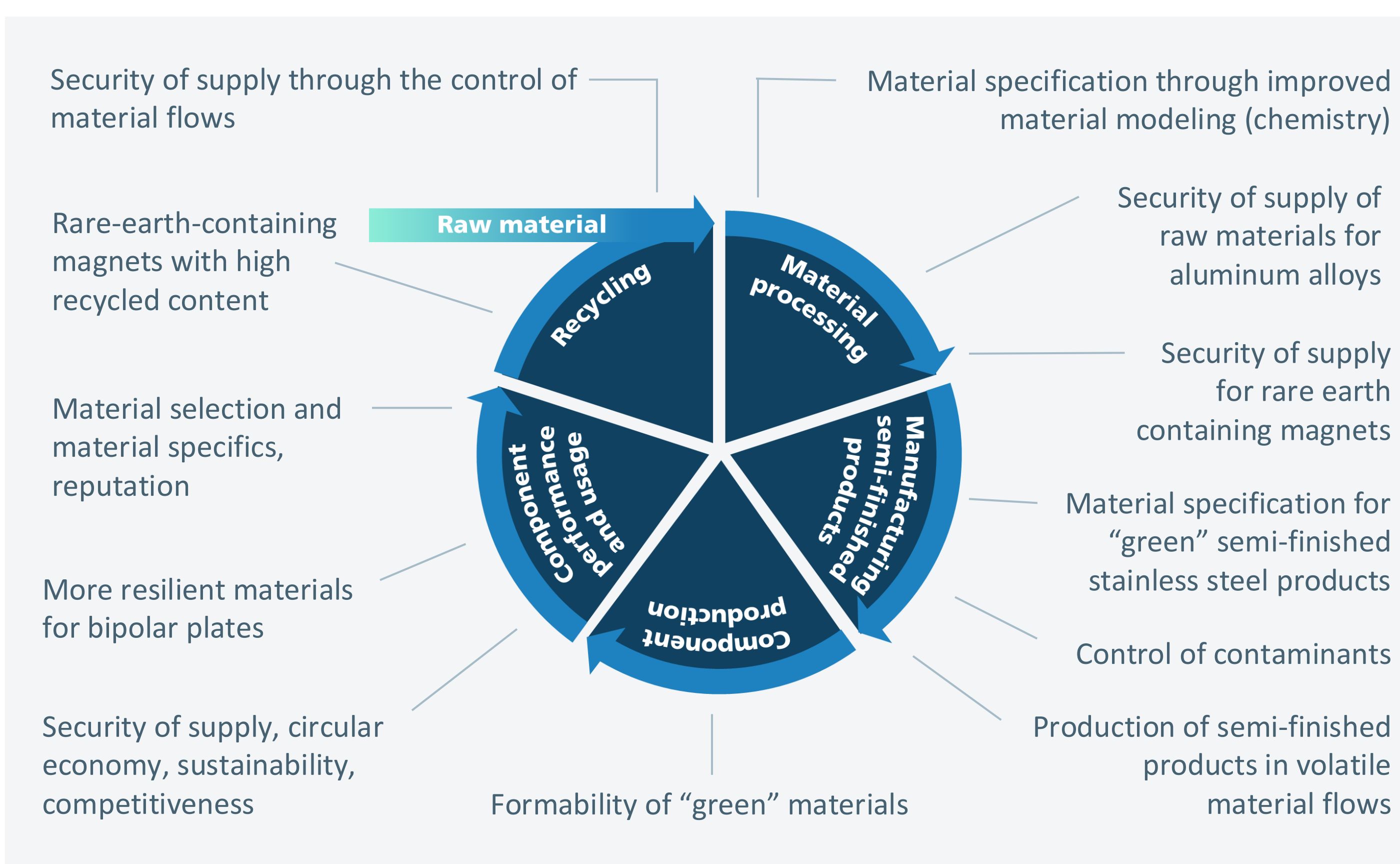
European Green Deal (climate protection targets 2030 & 2050)

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



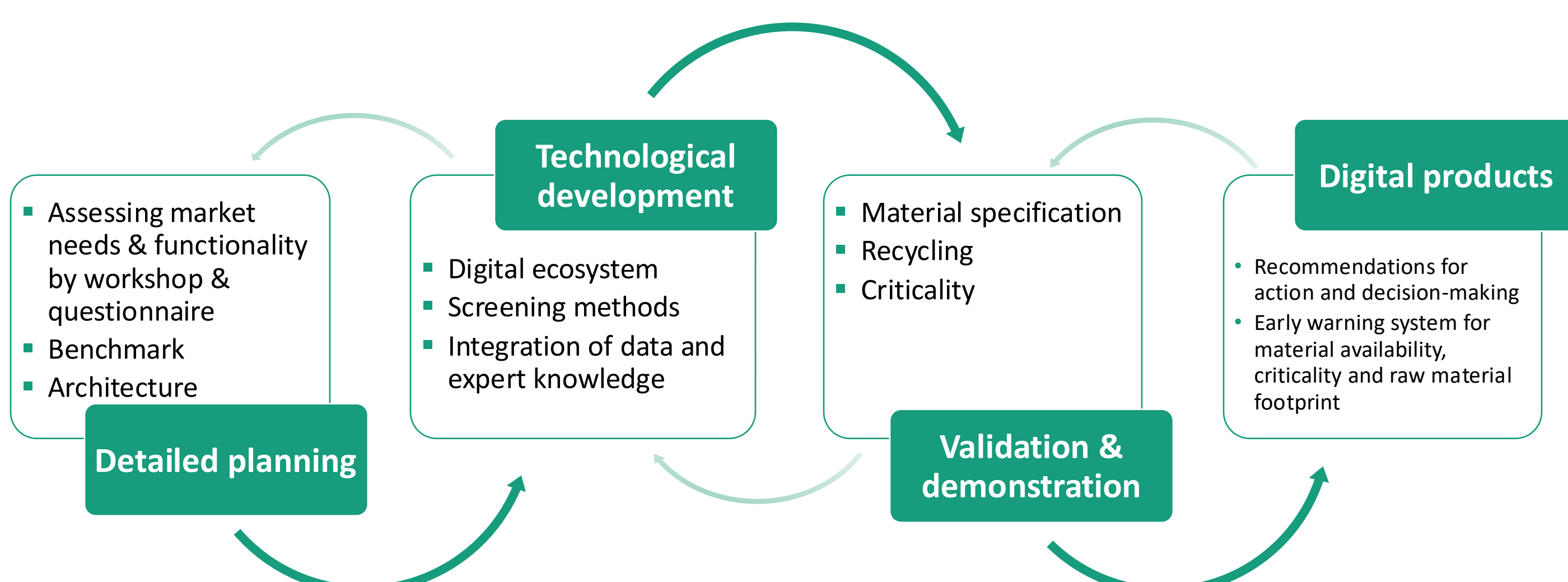
Our demonstrators in the context of the energy transition

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

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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This work was supported as a Fraunhofer FLAGSHIP PROJECT.



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ZAB 84, Andande office



Bereich
für Logos

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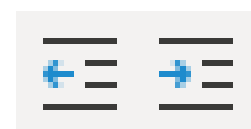
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- Fünfte Ebene
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- 1. Siebte Ebene
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- Neunte Ebene

Mit der Nutzung eines Platzhalters
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kann automatisch eingerückt werden.

Erfolgt mit Stufen höher/tiefer

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Designfarben



Hintergrund / Text

Akzent 1

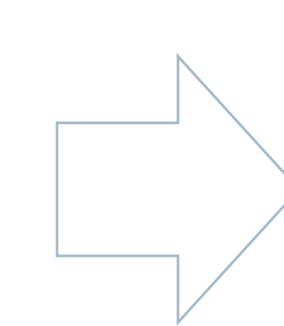
Akzent 2

Akzent 3

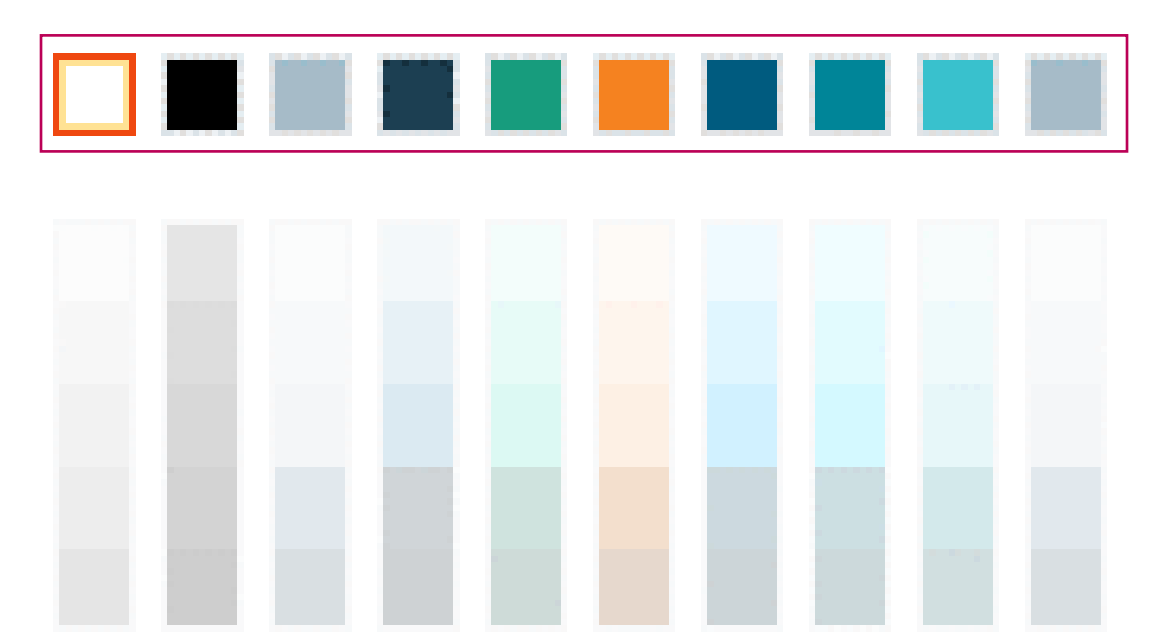
Akzent 4

Akzent 5

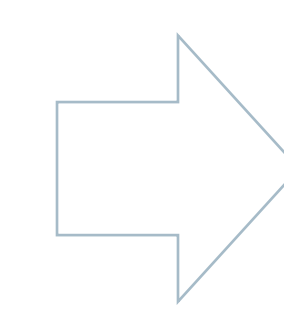
Akzent 6



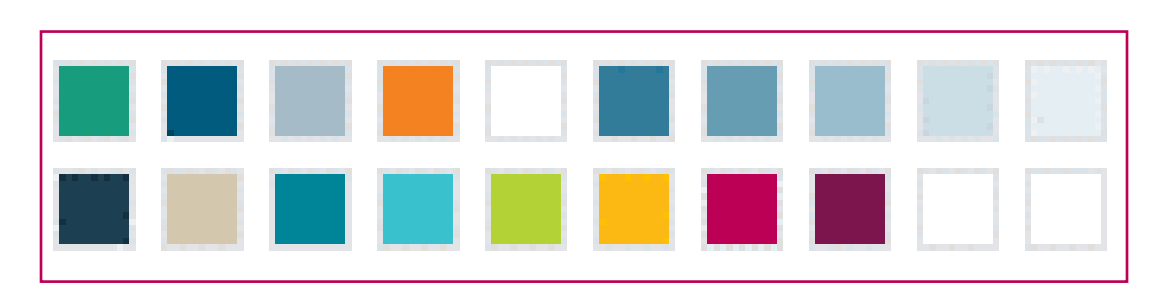
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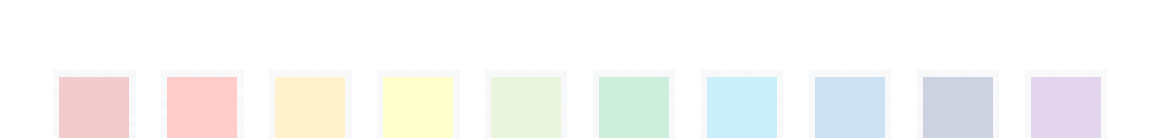
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Benutzerdefinierte Farben



Standardfarben



Optionaler Bereich für Cobranding

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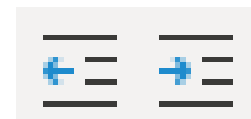
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Neunte Ebene

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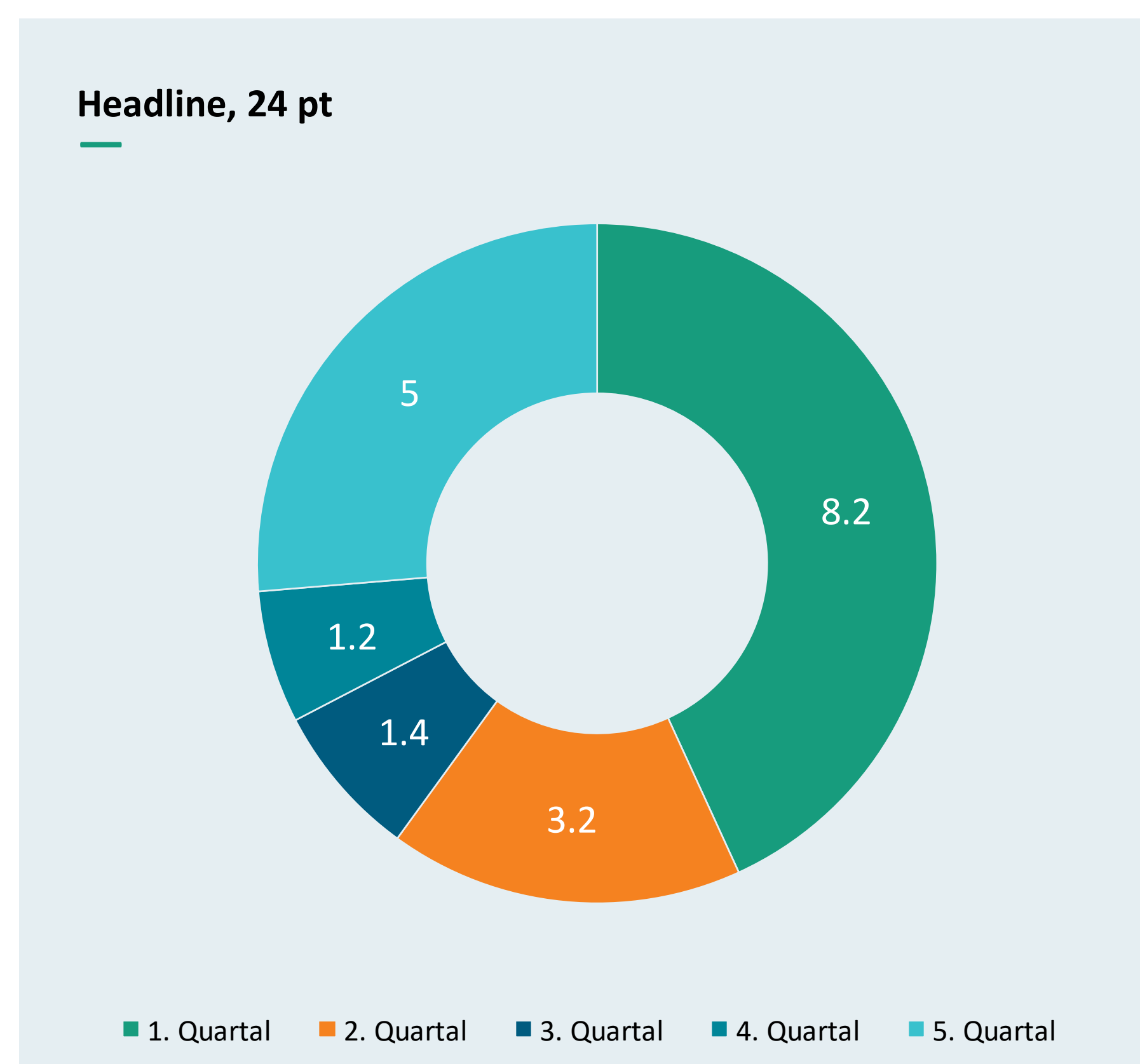


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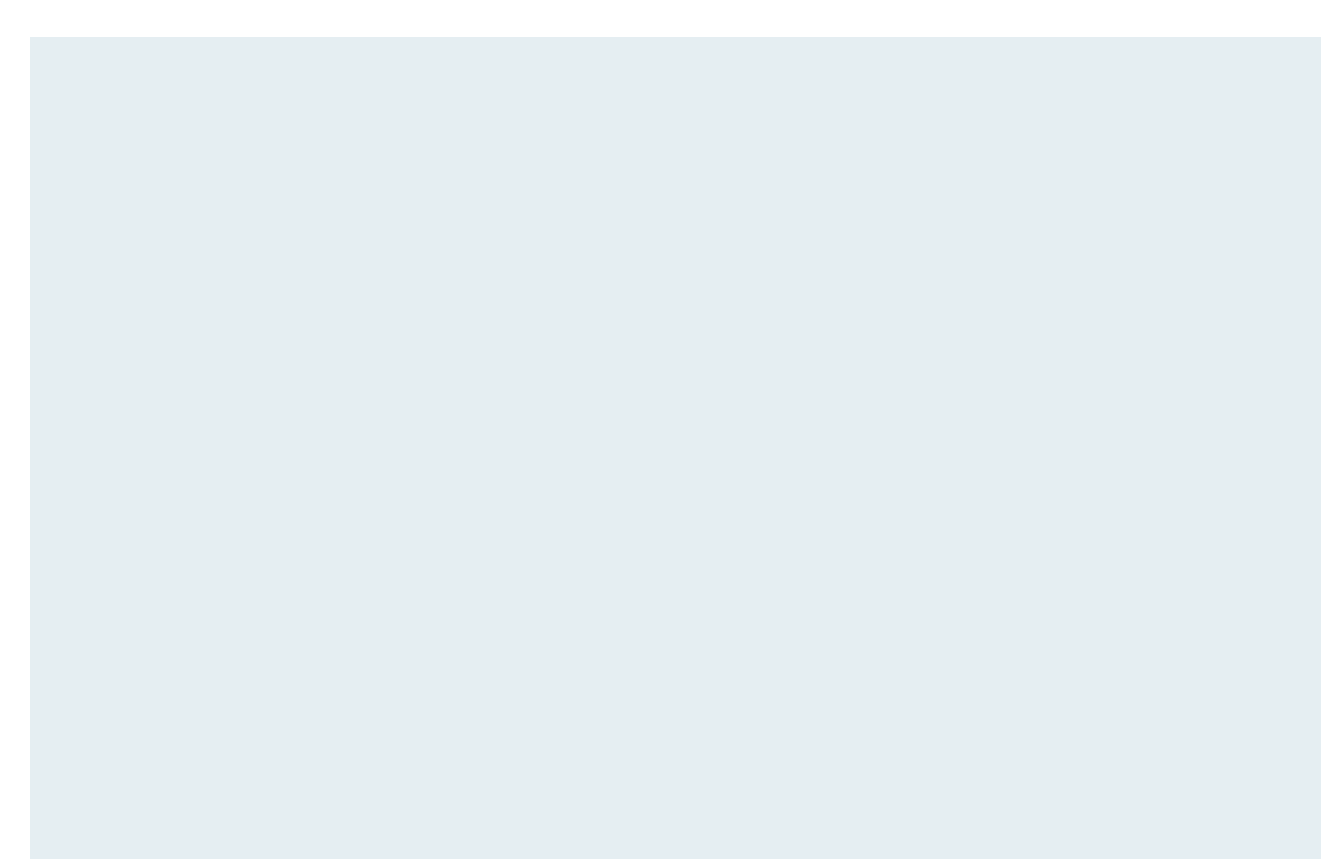
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