DATAWEEK
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Circular TwAIn

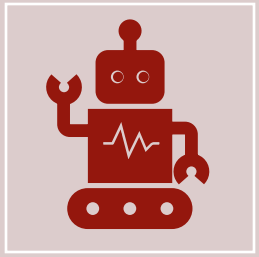
Circular TwAIn – Digital Twins and Data Space for Circular Manufacturing

Digital Twins with Data Spaces and Standards
June 13th, 2023 15:30 – 17:00

EUHUBS4DATA

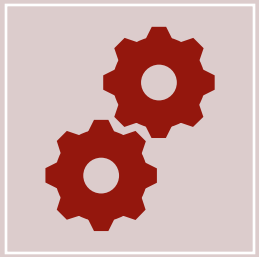
BDV BIG DATA VALUE ASSOCIATION

Circular TwAIn - TWIN TRANSITION 07: AI for sustainable agile Manufacturing



Provide a **unique** AI platform for manufacturing and process industry towards **sustainable, eco-friendly and circular production**.

Full integration among systems, through AI digital twins for each level (product/process/value chain) leading to the **'Circularity by-design'**.



Showcase how digital twins and AI algorithms help in the **optimization of sustainability aspects for products, production lines and production processes**, maximizing the performance across the circular value chain.

Improve and promote circular activities like remanufacturing, de-manufacturing and waste recycling, leading to a **reduction of production waste**.

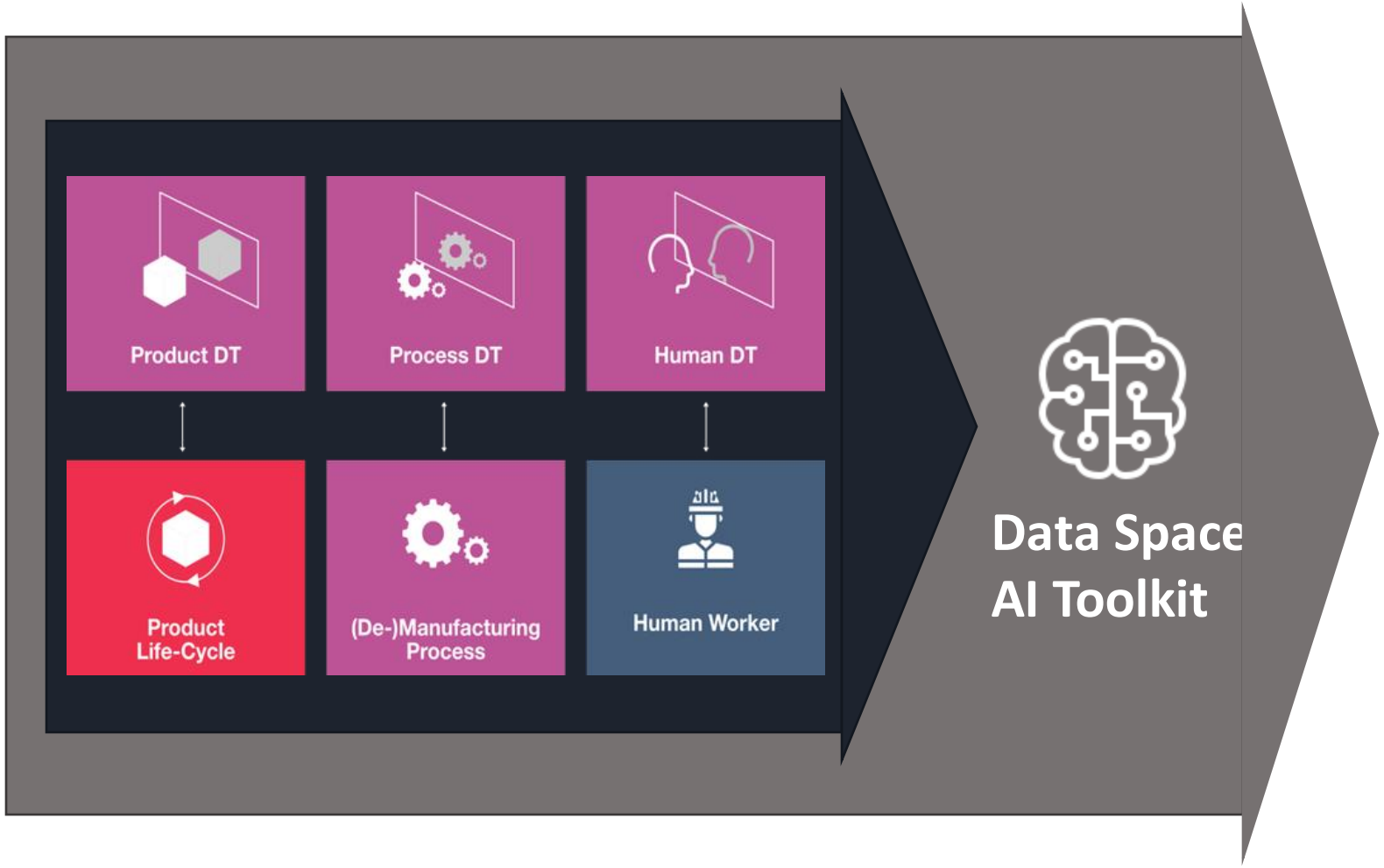
21
PARTNERS

11
COUNTRIES

36
MONTHS

7.2M
BUDGET

The Technical approach: Dtwin interoperability



Circular TwAIn

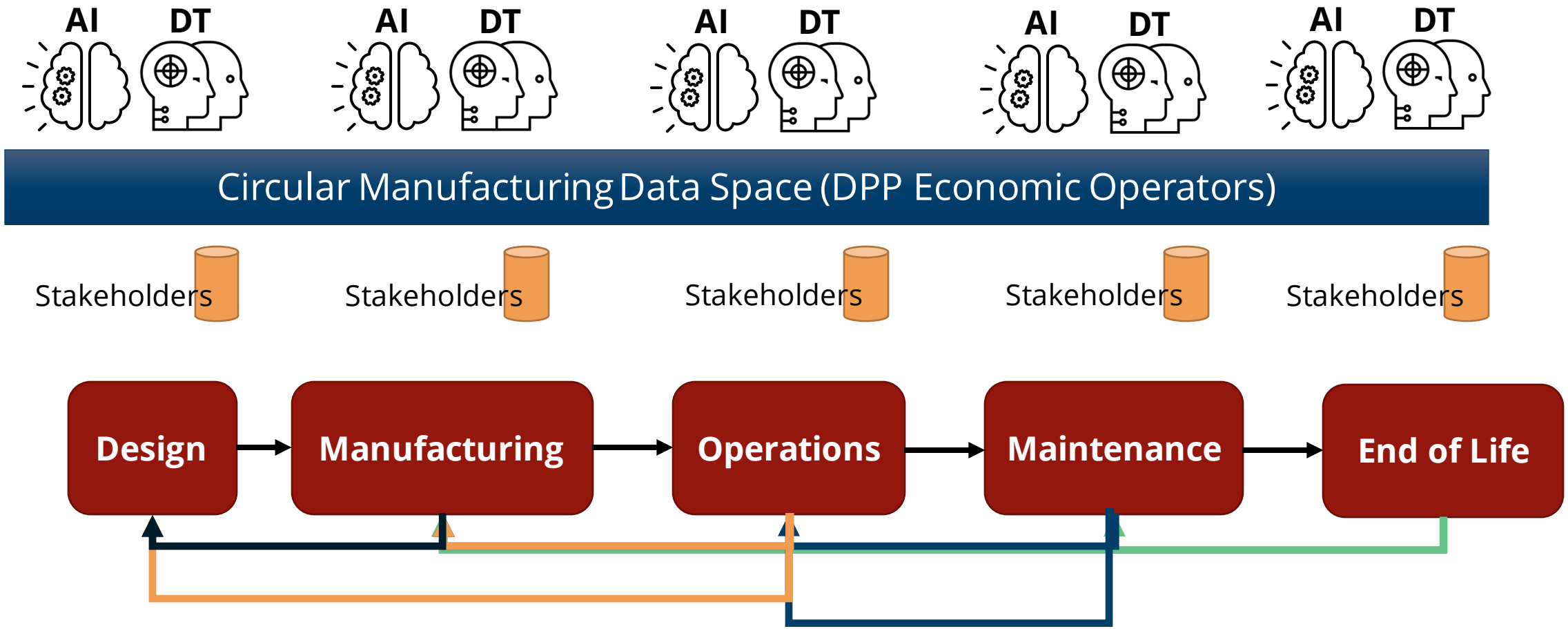
Main Application:
Circular Scenarios

Landscape – Circular Economy Action Plan 2020

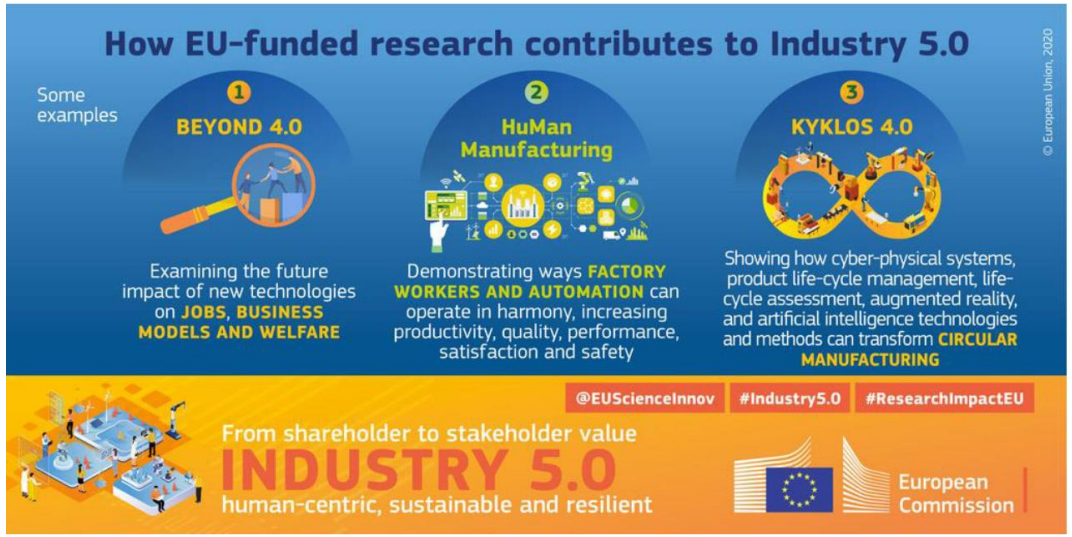
Key objectives:

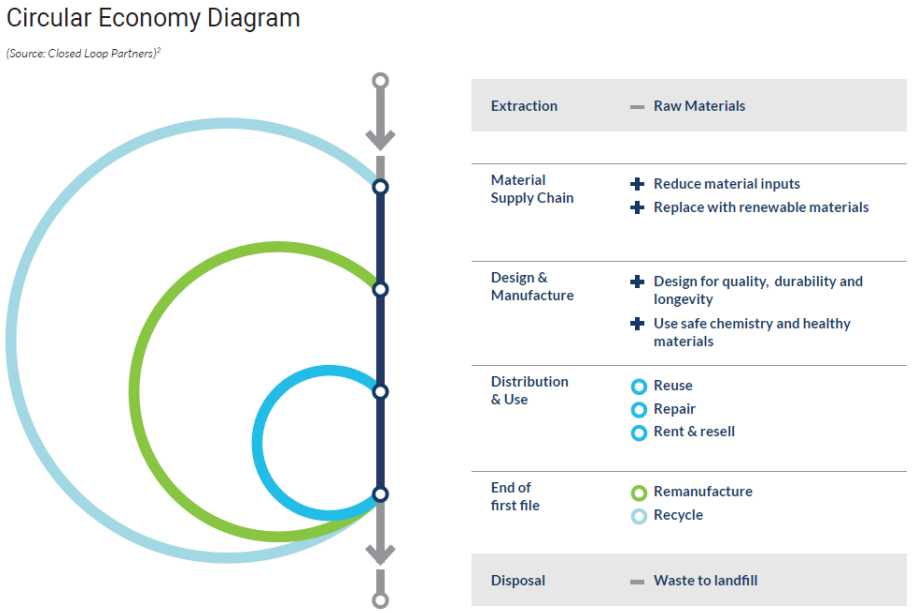
- improving product **reusability** and **reparability**;
- enabling **remanufacturing** and high-quality **recycling**;
- **restricting single-use** and countering premature obsolescence;
- introducing a ban on the **destruction of unsold** durable goods;
- mobilising the potential of **digitalisation** of product information, including solutions such as **digital passports**, tagging and watermarks;

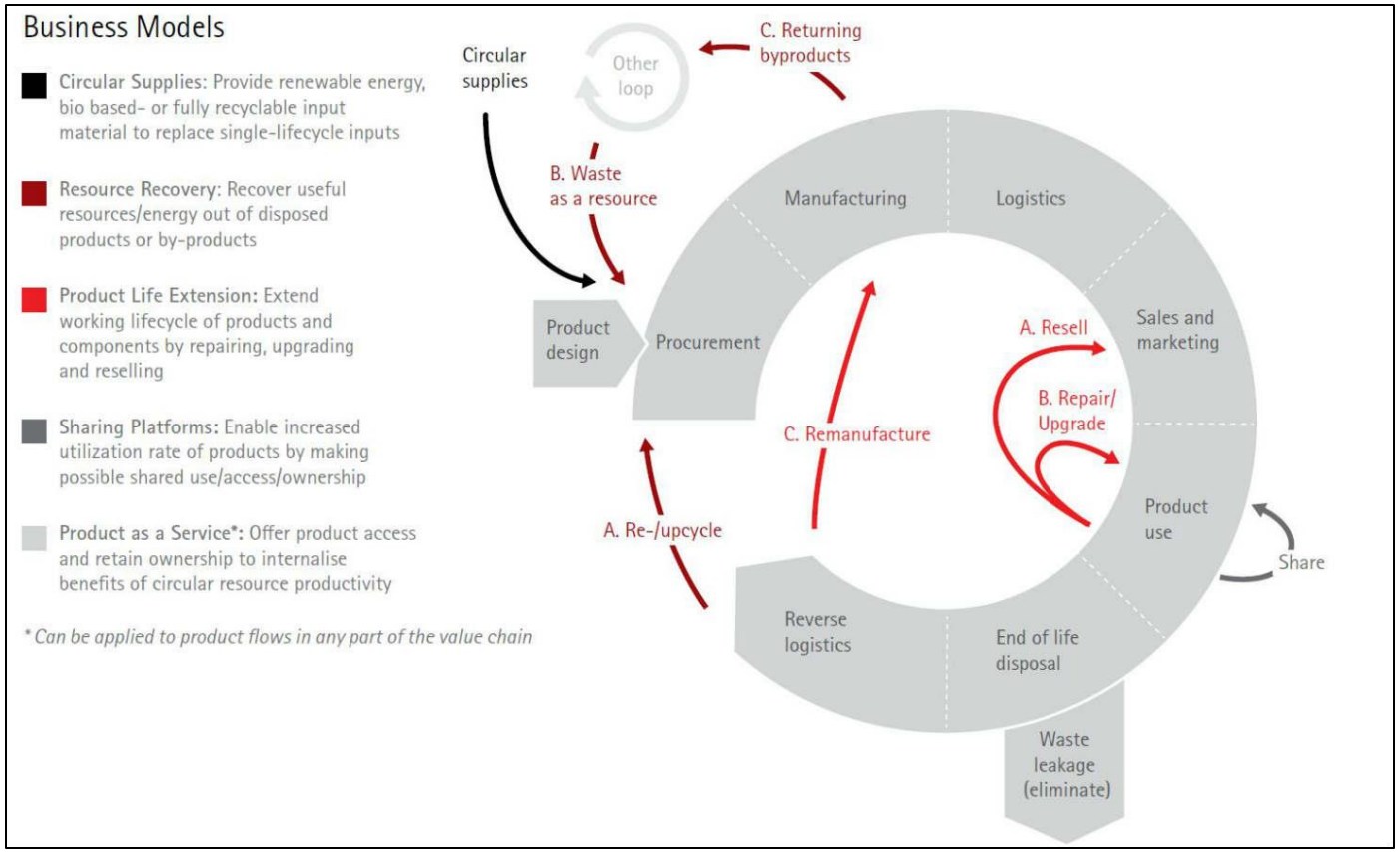
Circular TwAIn – Circularity Value Networks



Circular Manufacturing and Industry 5.0







Use Cases

De- and Re-manufacturing of Li-Ion battery packs in e- mobility

Remanufacture and the re-use of the disassembled cells with proper residual characteristics into second-life stationary applications

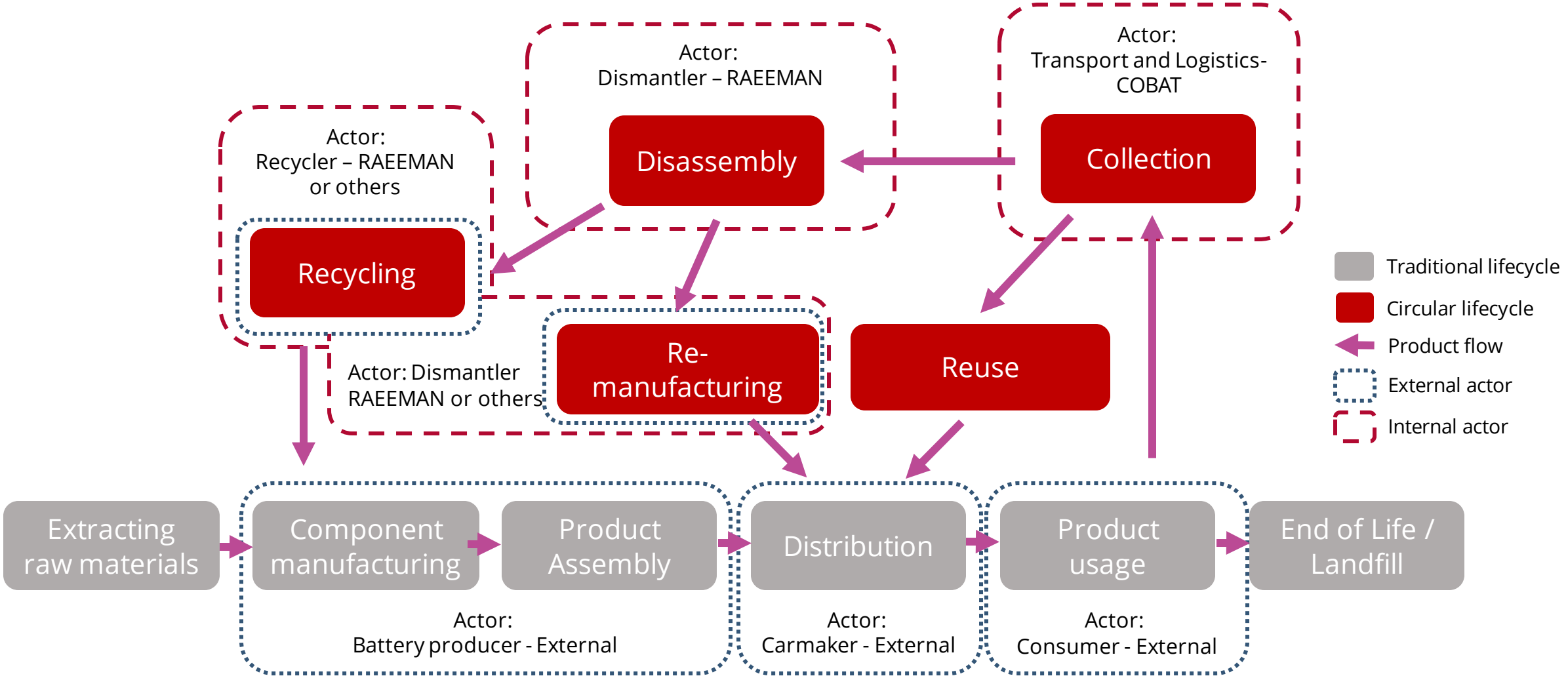
De- and Re- manufacturing of consumer WEEE

Overcome limitations in the de-manufacturing and re-manufacturing of consumer WEEE

Petrol-Chemical Pilot: Hybrid Circular Twins for Process Industry

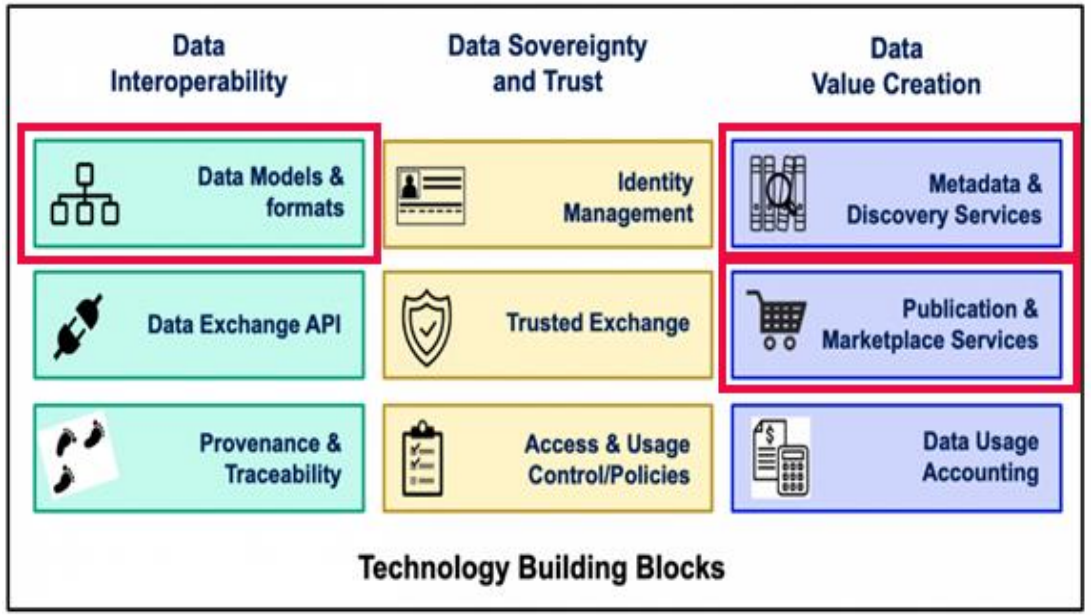
Reduce the CO2 emissions and energy consumption from the production of Ethylene Oxide and Ethylene Glycol

Battery Pilot - Circularity scenario



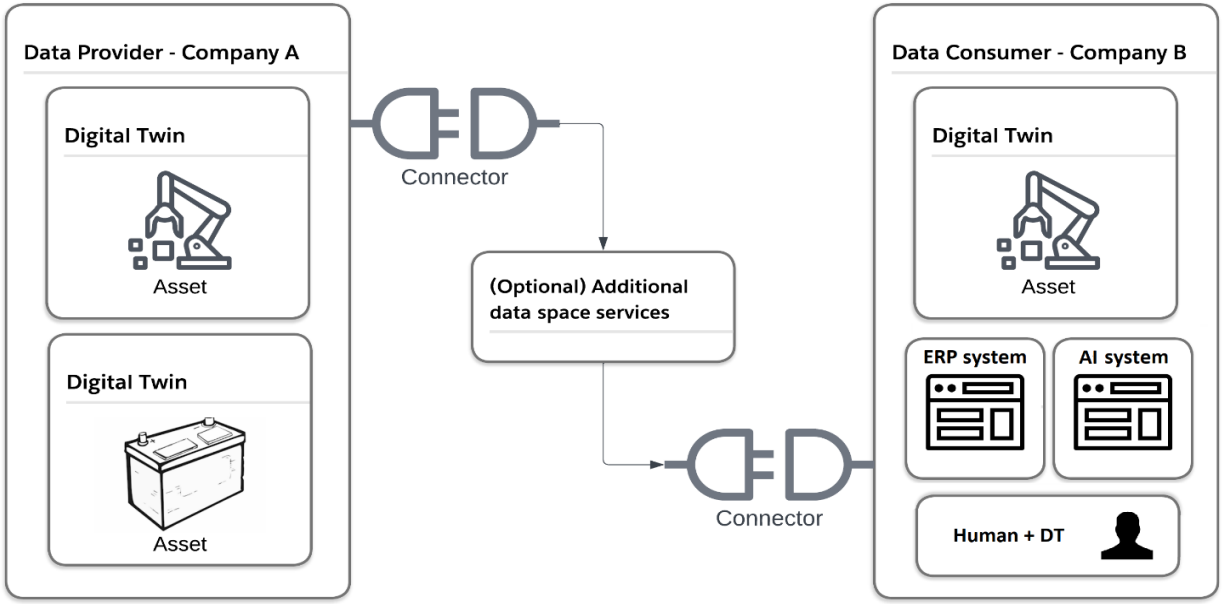
Data Spaces Building Blocks and Digital Twins

- The data space building blocks specified by the OPEN DEI project are used as a starting point
- Building blocks relevant to digital twins and the circular economy have been identified
  - *The integration and combination of different technologies like digital twins and data spaces components on cloud and edge level along horizontal and vertical transfers is a current research topic*
- Existing open source implementations to realize the building blocks have been analyzed
  - E.g. IDS connectors like EDC, TRUE, etc.
- Extensions required to support CircularTwAIn use cases have been described and to some extent implemented



Edge to Cloud Data Space for digital twins

- Circular TwAIn in general proposes DTs for the products, processes, and humans and usage of the **AAS** as a standard for realising DTs
- Advantages:
  - AAS provides a standardised meta-model, a uniform API, a set of defined communication protocols and a set of domain-specific standardised submodel templates
  - It can itself synchronize several data sources into a logical unit like a digital product passport (DPP)
  - The DT of a product can provide a DPP (e.g. DPP4.0)
    - The two terms are not synonyms since a DT can provide additional functionality like simulation or data-driven services

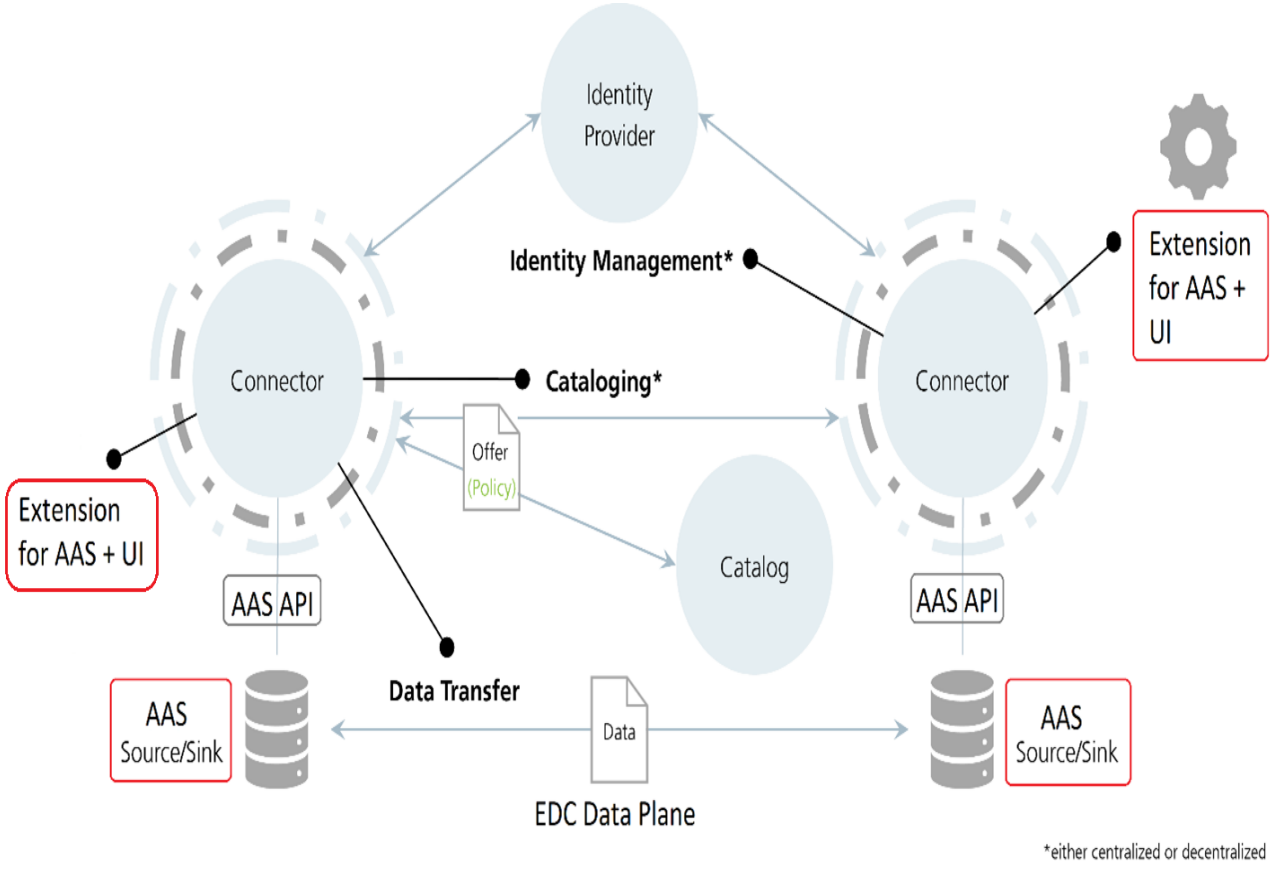


- DTs and IDS connectors can both be deployed inside a company or on cloud infrastructure and used independently
- DTs usually represent a physical asset found in the company while IDS connectors are gateways to data spaces across company borders

Minimal Data Sharing Space for DPP and Circularity

- **Step 1 "DT modelling"**: The DT model is based on the AAS specification and the relevant sub-model templates
  - E.g. Product carbon footprint
- **Step 2 "DT service creation"**: The DT software counterpart is created based on the DT model and configuration file, if available
  - FA³ST – Fraunhofer Advanced AAS Tools
  - NOVA Asset Administration Shell
- **Step 3 "DT connection with DS"** : The DT service is integrated with an IDS connector to enable cross-company exchange of DTs in a secure, trusted and semantically interoperable way
  - EDC extension for AAS

EDC Extension for AAS



CircularTwAIn contribution to the standardization of AAS-compliant DTs

- CircularTwAIn partners are actively involved in the **Industrial Digital Twin Association** (IDTA)
- This not only ensures that the Circular TwAIn project is informed about all activities related to the AAS specification, but more importantly that **feedback** on the specification is provided
  - Two implementations of the AAS specification (namely FA³ST and NOVAAS) are being used and further developed in the project
- IDTA **WGs** relevant to CircularTwAIn:
  - Open Technology WG to contribute to and provide feedback on the AAS specification
  - AAS Repository WG to contribute to the Eclipse AA4J project on the core AAS model
  - IDTA Carbon Footprint Submodel to share information about the carbon footprint of an asset between value chain partners (e.g. demonstrator for HMI 2023)
  - IDTA Time Series Submodel to support AI/ML methods (e.g. GitHub - FraunhoferIOSB/FAAAST-Service at feature/SMT-TimeSeriesData)

Circular TwAIn

Funded by the European Union

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GFT
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Thank you!

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