IOTWeek

Dublin — June 20-23, 2022

Digitizing the Circular Chain with IoT and Digital Product Passports: a Cross-Sector approach

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GLOBAL VISION:

IoT TODAY AND BEYOND

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Motivation (Circular Manufacturing): The Policy Context

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Paris Climate Accords

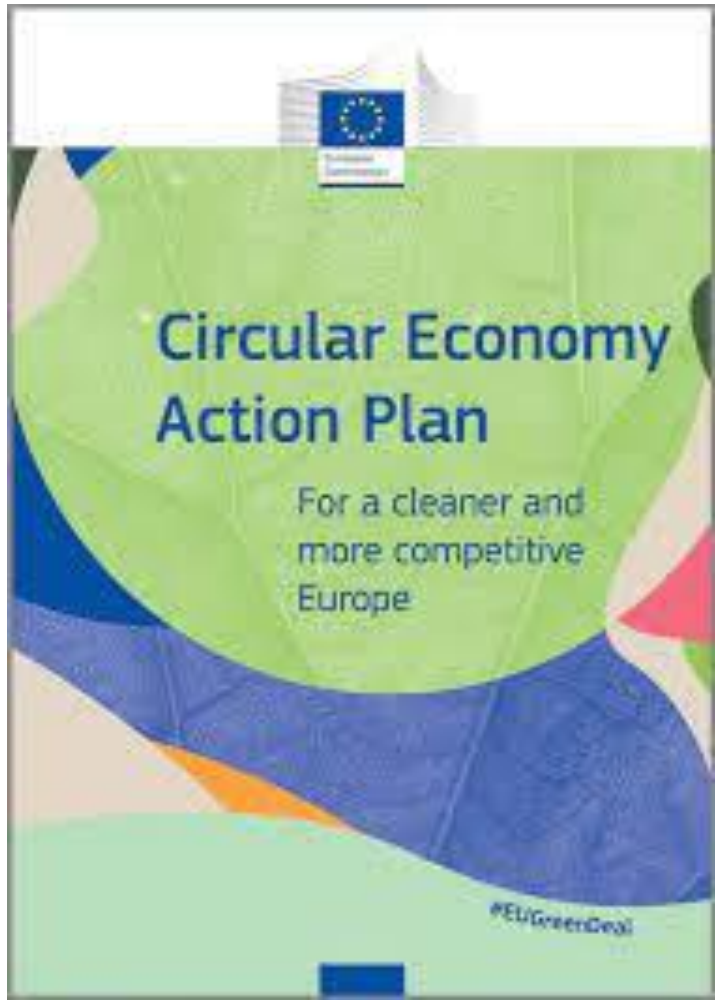
European Green Deal

European Circular economy action plan (CEAP)

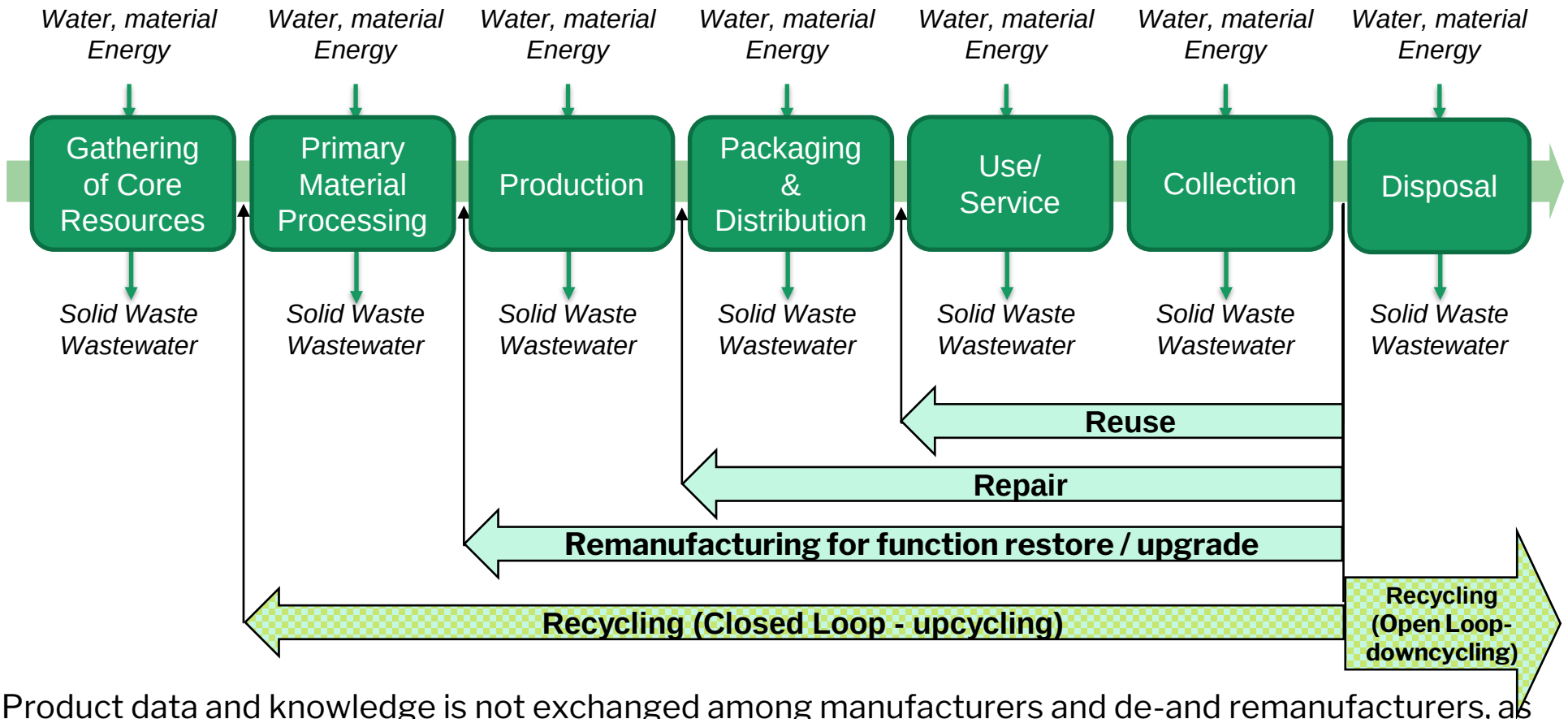
80% of the CO2 savings in Smart Production will come from Sustainable-By-Design Production

“New EU Battery Regulation’

Expected to come into force on 01/01/2026 for all batteries (with an internal storage capacity of 2 kWh and above)



Motivation: The Industrial Challenge



Product data and knowledge is not exchanged among manufacturers and de-and remanufacturers, as well as among sectors leading to unlocked cross-sectorial material re-use opportunities.

Lack of certification protocols for secure re-used materials and components transfer among sectors.

Poor acceptability of products embedding recycled materials by end-customers.

The Solution: Digitizing the Circular Chain

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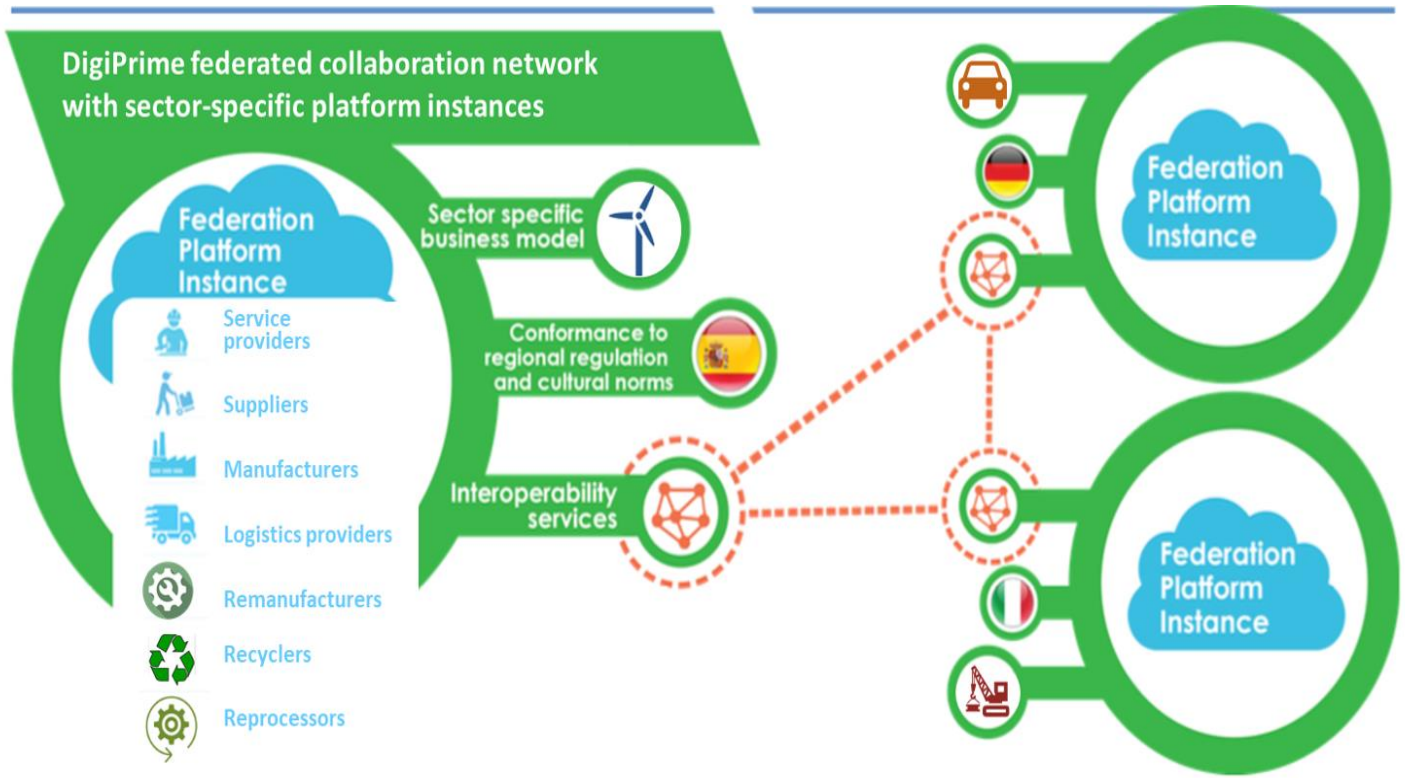

DigiPrime

POLITECNICO MILANO 1863

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H2020-DT-ICT-07- 2018-2019 Project

36+ Partners, ~20 million EUR Budget

Coordinator: Politecnico di Milano

Platform Pillars

Multi-node federation structure for cross-sectorial circular value-chains.

Semantic data infrastructure for information standardization across heterogeneous nodes.

Data Policy Framework to ensure privacy, security, authentication and authorization policies

DigiPrime: A Digital Platform for the Circular Economy

New concept of overcoming current information asymmetry among value-chain stakeholders

Unlocking new data-driven circular business models based on the data-enhanced recovery and re-use of functions and materials from high value-added post-use products with a cross-sectorial approach.

The DigiPrime IoT Architecture

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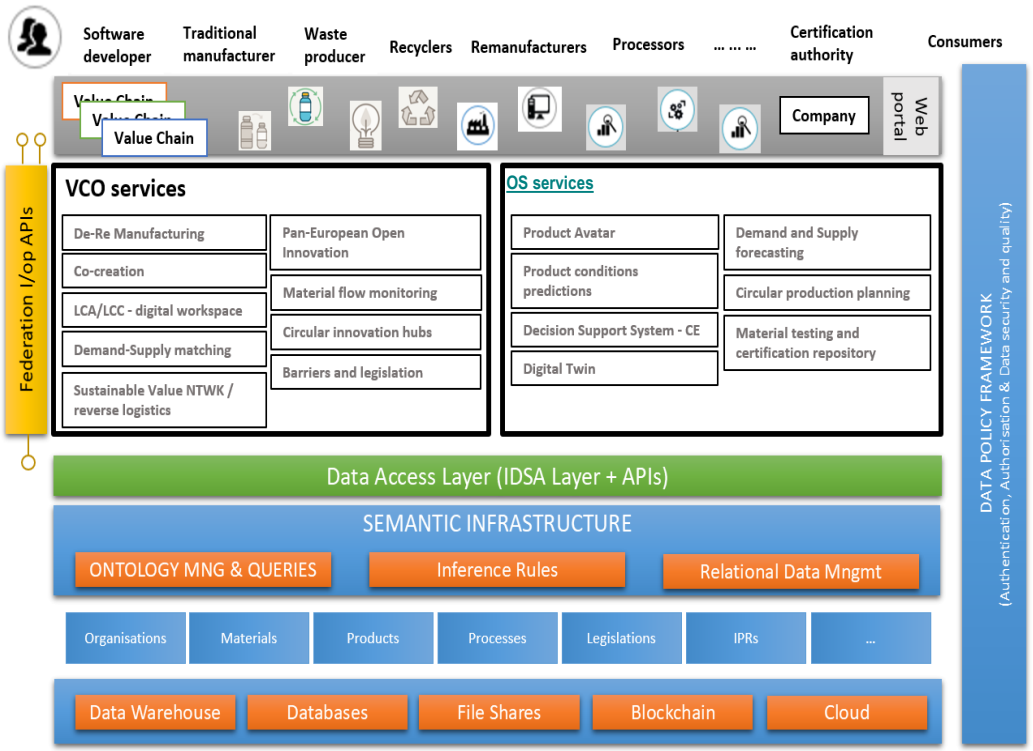

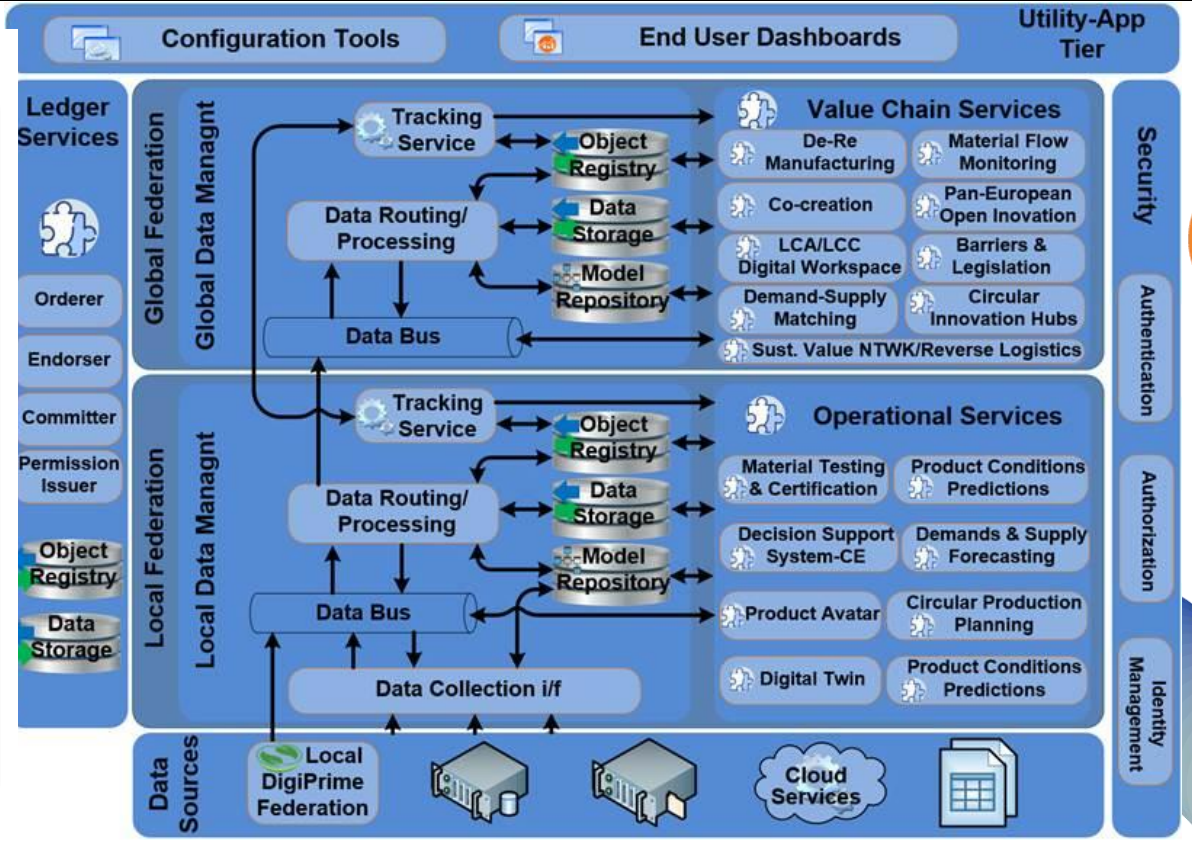

Inspired by Industrial Internet Reference Architecture (IIRA)

Mixing Cloud/Edge and Blockchain Services

Supports Value Chain & Operational Services over IoT/Cloud Data

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The DigiPrime Data Provenance & Traceability System

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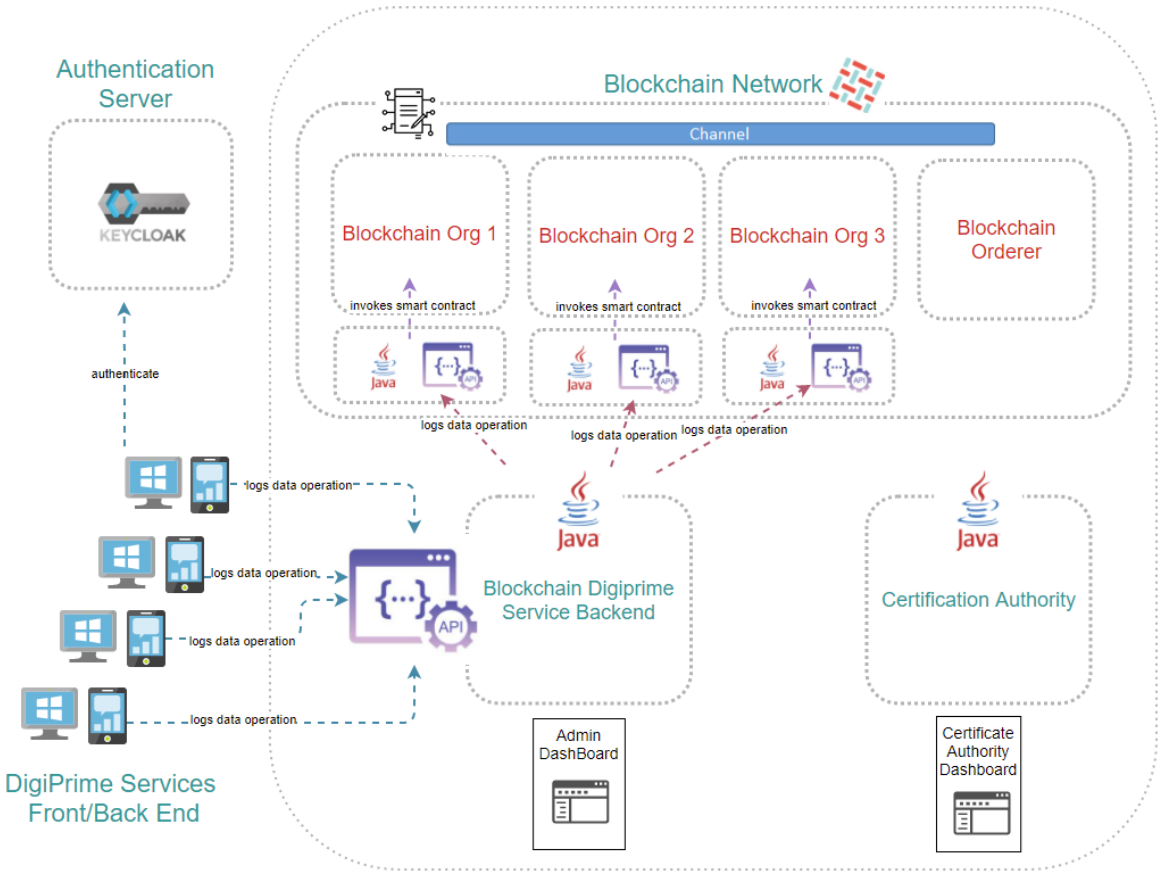

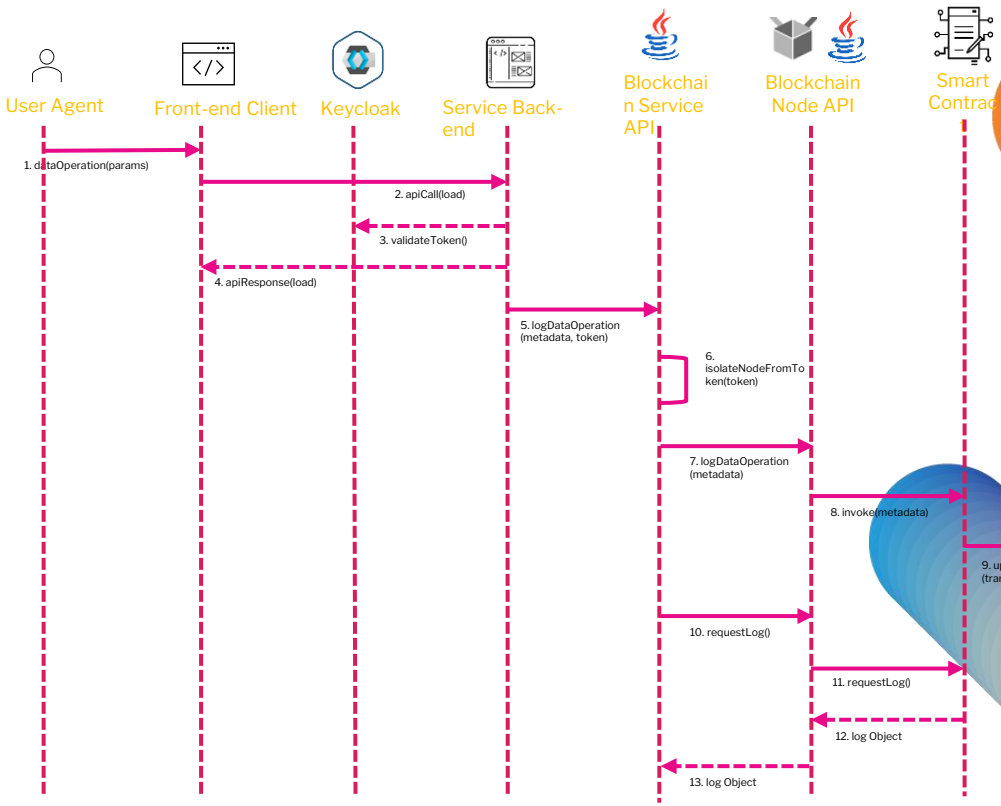

Metadata about data shared across stakeholders are stored in the blockchain

Stakeholders interact through trusted channels of the value chains where they participate

Ownership and data integrity issues can be tracked & traced at all times

The DigiPrime Value Chain Services

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De- and remanufacturing data management and share

- Allows users to have access to a large amount of information provided by the entire ecosystem, even far away from their vertical chain.

Co-creation environment to collect and share ideas on new product/processes

- Enables actors from every node of the federation to contribute with their competences to the improvement of the circular ecosystem

LCA/LCC tool

- Identification of new potential sustainable circular routes for the products, across different value-chains starting from the design phase.

Demand-Supply matching tool

- Search criteria on products, and support to negotiation and traceability

Value-network configurator

- Supports actors to maximize the cross-sectorial performance guiding users in identifying partners in the ecosystem

Pan-European Open-Innovation suite

- Involves stakeholders from different sectors, enabling the creation of new unexpected opportunities, the catalysation of knowledge and contamination of experiences.

Material flow monitoring system

- Aggregated view of components and materials that circulates across the nodes, with advanced visualization interface.

Circular Innovation hubs integration

- connects networks of pan-European innovation infrastructures and offers a complete representation of available services

Support tool for Barriers and Legislation

- collects criticalities from stakeholders, reports to institutions & policy makers

The DigiPrime Operational Services

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Product Avatar tool

- Acquires and stores product lifecycle information to support end-of-life decision making.

Product conditions prediction

- **C**alculates correlations between the product use-phase and the current product condition

Decision Support System for CE

- Defines the best strategy for post-use (re-use, recycle, substitution, remanufacturing)

Digital Twin

- Support adapting the process-chain depending on the identified product conditions.

Demand and Supply forecasting tool

- from product sales and in-use data forecasts the need of components, supporting actors in planning and assessing their circular business cases.

Circular production planning

- Integrates existing production planning with DSS for CE recommendations and indicators

Material Testing and Certification

- Collect past-experiences to define a procedure for materials

Example: Remanufacturing & Reuse of Batteries

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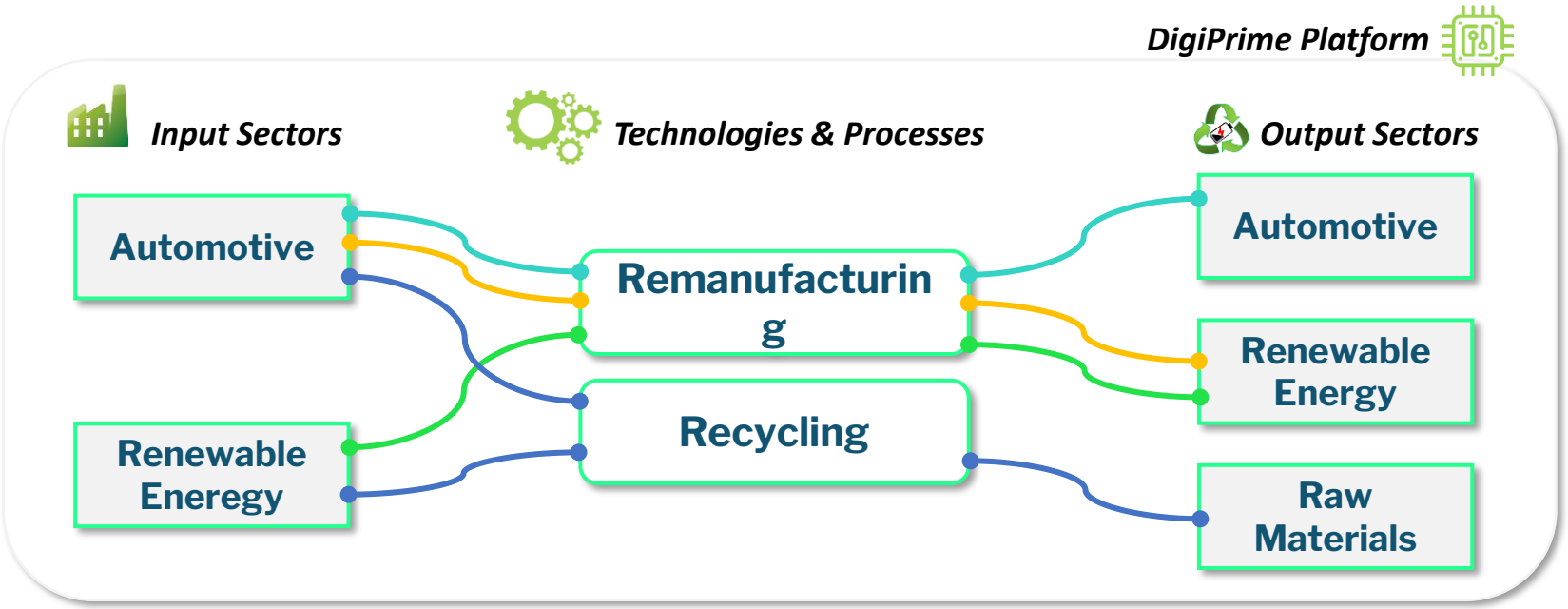

Remanufacturing and re-use of second life Li-Ion battery cells

Cross-sectorial approach linking the e-mobility sector and the renewable energy sector

Focusing on solar and wind energy applications

Pilot Leader: Cobat

cobat

Example: Remanufacturing & Reuse of Batteries

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	Service
VOS	De- and remanufacturing oriented product information management
	Product co-creation
	LCA-LCC for eco-design
	Demand-supply matching
	Sustainable value network and reverse logistics configuration
	Identification of cross-regional value-chains through open innovation
	Material flow monitoring and aggregated system oriented KPIs
	Circular Innovation hubs integration
	Barriers identification and legislation support
OS	Product in-use phase monitoring and data acquisition
	Artificial Intelligence for prediction of product conditions
	De-and remanufacturing decision support system
	Digital twin for de- and remanufacturing adaptation to product conditions
	Demand and supply forecasting
	Circular production planning and control
	Material testing and certification

Using the DigiPrime Platform & Value Chain Services

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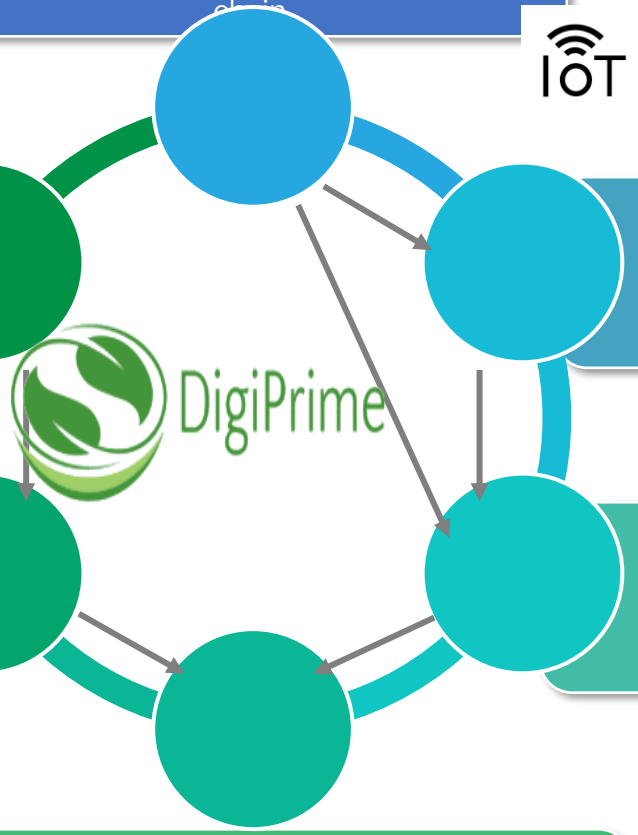
Goal: Create efficient strategies for **sharing and transferring of important product information** among all the actors in the de- and remanufacturing value-chain

IoT

Li-ion



Monitoring of emerging limitations and barriers to Li-Ion battery related circular second-life business

Match-making between the demand and supply of post use Li-Ion batteries and components across the involved stakeholders and sectors

Support decision makers and institutions while **defining directives o new legally binding requirements** to influence circular economy practices

High-level simulation-optimization for the definition of the **best reverse logistics configuration** of the post-use battery supply chain

IoT

Identification of **cross-sectorial and cross-regional circular economy value-chains** through an open innovation mechanism, providing policies, identifying priorities, strategies and initiatives

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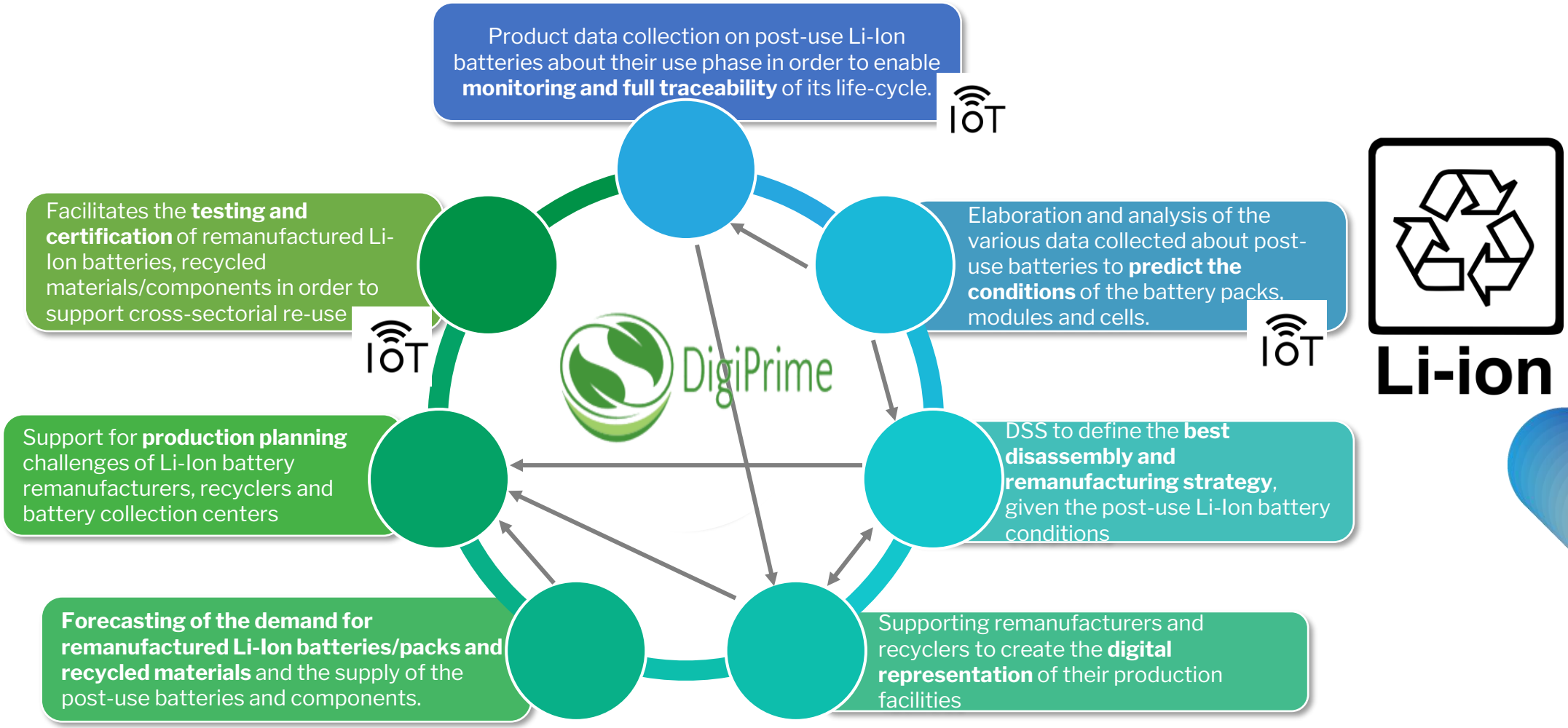

Future Outlook: The Digital Product Passport

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Electronic information exchange system & Passport scheme

Information available electronically in a machine-readable format

Unique for each product (“identifier”)

Accurate, Complete & Up-to-Date info

Sample Contents

- Hazardous substances, Performance and Durability, Recyclable content, Removability, Replaceability, Carbon footprint, proof of due diligence in responsible sourcing of raw materials.

Benefits

- Auditing, Transparency, Process Automation, Informed Decisions, Integration with CO2 & Logistics Processes etc.

DPP Technical Building Blocks

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DPP Open Data Space

- Data Collection (Product Data Sheets)
- Decentralized Storage (No Single Actor owning the DPP information)

Decentralized Identifiers & Verifiable Credentials

- Circular Actor ID
- Product ID
- Human ID

Blockchain Infrastructure

- Decentralized implementation / Decentralized Trust
- Increased Security

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Thank you!

Find more:

DigiPrime: https://www.digiprime.eu/

John Soldatos: https://www.linkedin.com/in/johnsoldatos/

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