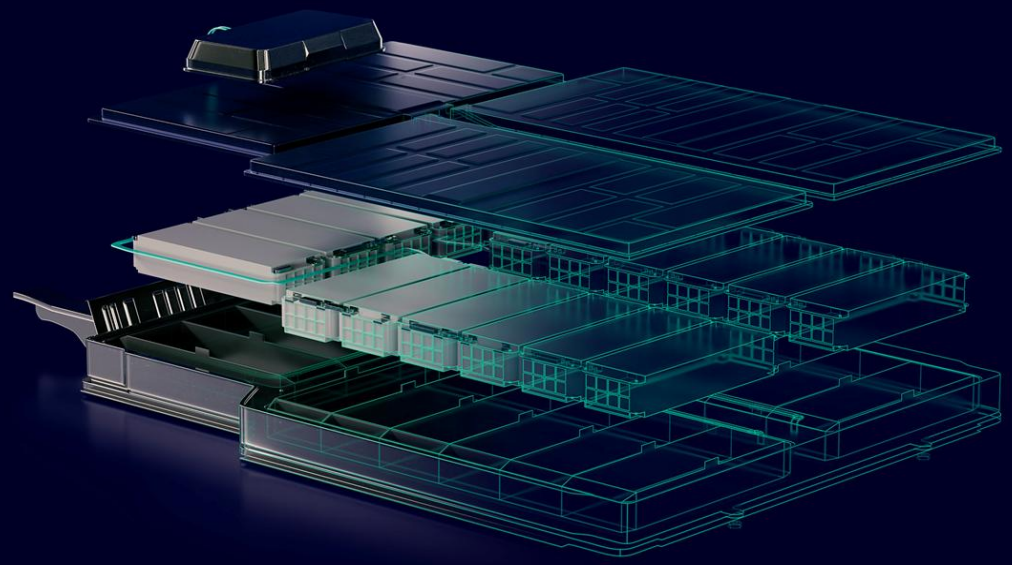

Turning Trash into Treasure

Supporting Chemical Recycling to save and reuse valuable materials in a sustainable world

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Businesses that prioritize sustainability, efficiency and innovation will be the ones that thrive into the future

Paul Polman – former CEO Unilever

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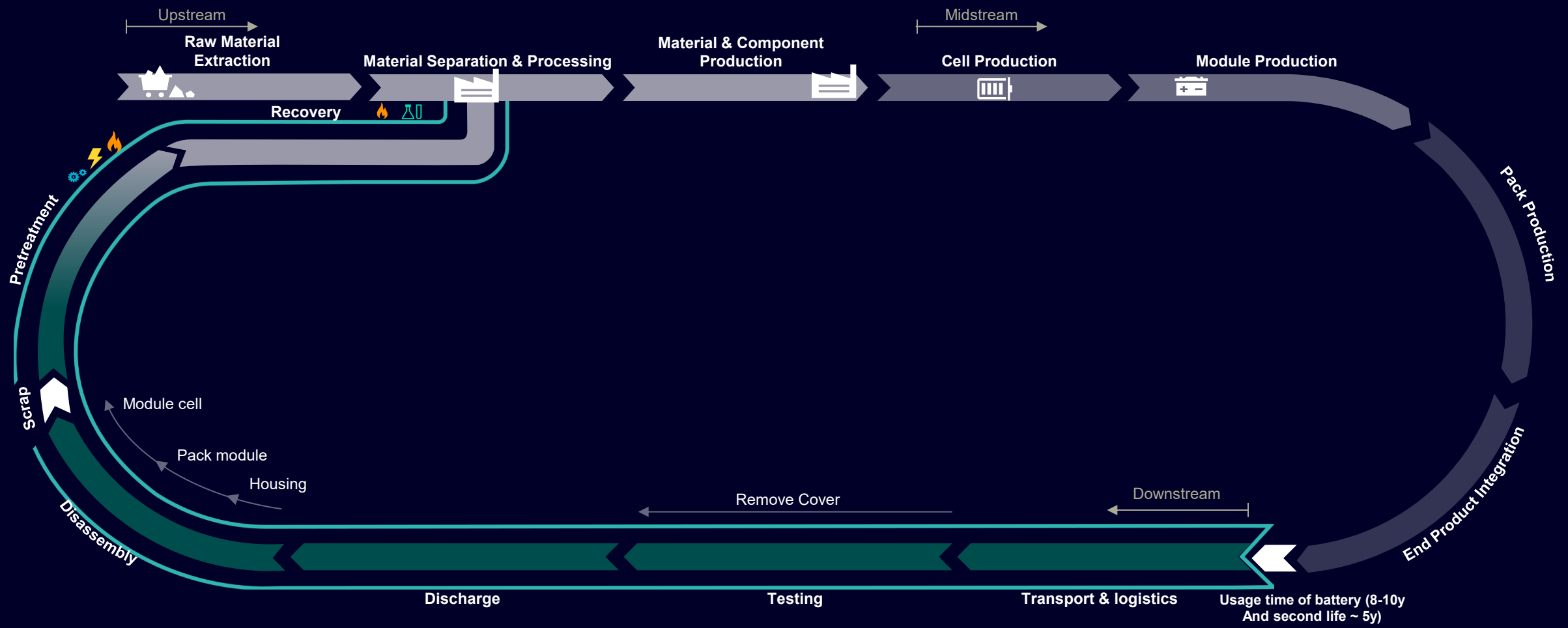
Circular Economy @ Battery Industry



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We expect the market for battery recycling to grow esignificantly driven by rapid increase of BEV, material shortages and regulation

Typical lifespan of battery first life

8 – 10 years

(guaranteed by OEMs for > 70% original capacity, e.g., Tesla and Hyundai)

Lithium demand exceeds capacity by

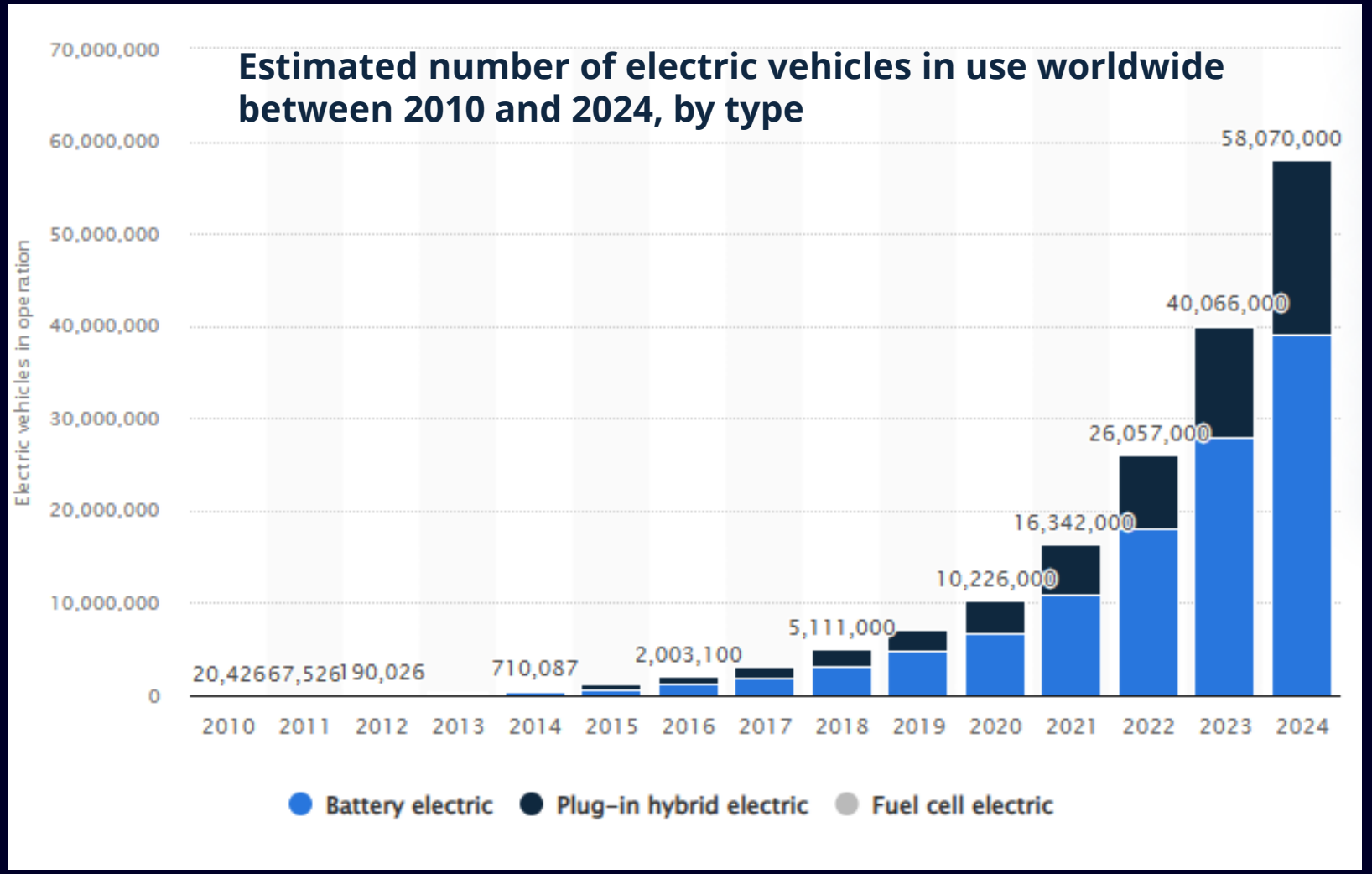
2025 – 2030

(1.4 million tons of lithium carbonate equivalent; S&P Global Market, BCG 2022)

Recycling target EU

95% of material

(by 2031 for nickel, cobalt, copper, lead according to EU regulatory framework for batteries)



Source: Statista 2026

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Battery recycling value stream

Manufacturing Scraps

Transport and logistics

Adaptive Pack Opening

Discharging

Module Cell Disassembly

Housing | Pack module | Module cell

Pretreatment: Shredding, Drying, Sorting & Seving

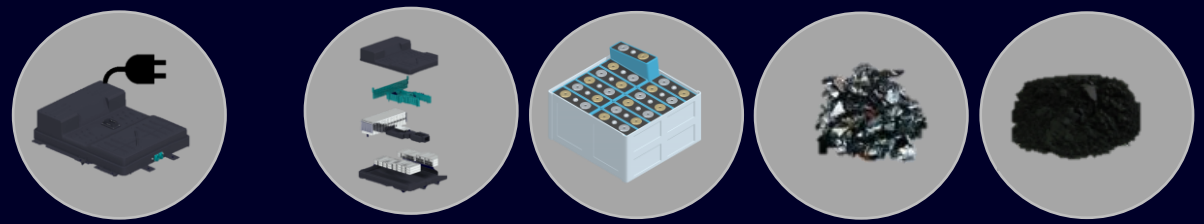
Recovery

Energy

Housing, copper, aluminum, plastic

Black Mass

Cobalt, nickel, manganese, lithium



Mechanical | Electrohydraulic | Pyrometallurgic | Hydrometallurgic

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Operators of battery material industry need to address central challenges to prepare their business for the future

Fast-developing market with high cost-pressure

- Fulfill new requirements originating from progress in battery technology
- Meet rising demand and increased flexibility requirements
- Stay competitive in a fast-changing environment with global competition

Stringent & ever increasing quality requirements

- Meet stringent quality requirements of cell manufacturers
- Assure process stability to assure efficient use of resources
- Strive for uniform high quality from globally distributes sites

Shortage of skilled & experienced workers

- Hire and train sufficient personnel for various functions in plant operation
- Assure high quality onboarding and training to overcome lack of experience in fast growing workforce
- Facilitate knowledge sharing and know-how exchange across sites

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Holistic Siemens portfolio addresses main challenges and thereby ensures plant operators' future-readiness

Operator's challenges in the battery material industry	Siemens Value Proposition
Fulfill requirements originating from progress in battery technology, meet rising demand and stay competitive in a fast-changing market.	**Digital Twins of process and plant allow fast reaction to changing requirements and enable efficient engineering for new facilities.**
Meet stringent quality requirements, assure process stability and strive for uniform high quality from globally distributed sites.	**Integration of operations with business processes assures efficiency, high quality and comparability over a growing fleet of plants.**
Overcome personnel shortages and ensure sufficient staff training in fast changing and rapidly developing battery material industry environment.	**Siemens' portfolio including automation and operator training addresses labor shortage and rapid skill development requirements.**

SIEMENS

Digital Twins

Siemens Digital Twins allow fast reaction to changing requirements and enable efficient engineering for plant modifications and new facilities.

- Simulation of process changes to maximize confidence before the actual plant is modified
- Consistent high quality engineering data for maintenance, modifications / optimizations and as reliable basis for new plant investments
- Fast and efficient execution of capital projects with minimal risk
- Fast and secure transfer from engineering data to automation
- Reduced commissioning time and significantly shortened time-to-market

Digital Twins

Use case 1: Simulation

Use case 2: Virtual commissioning

Use case 3: Integrated engineering

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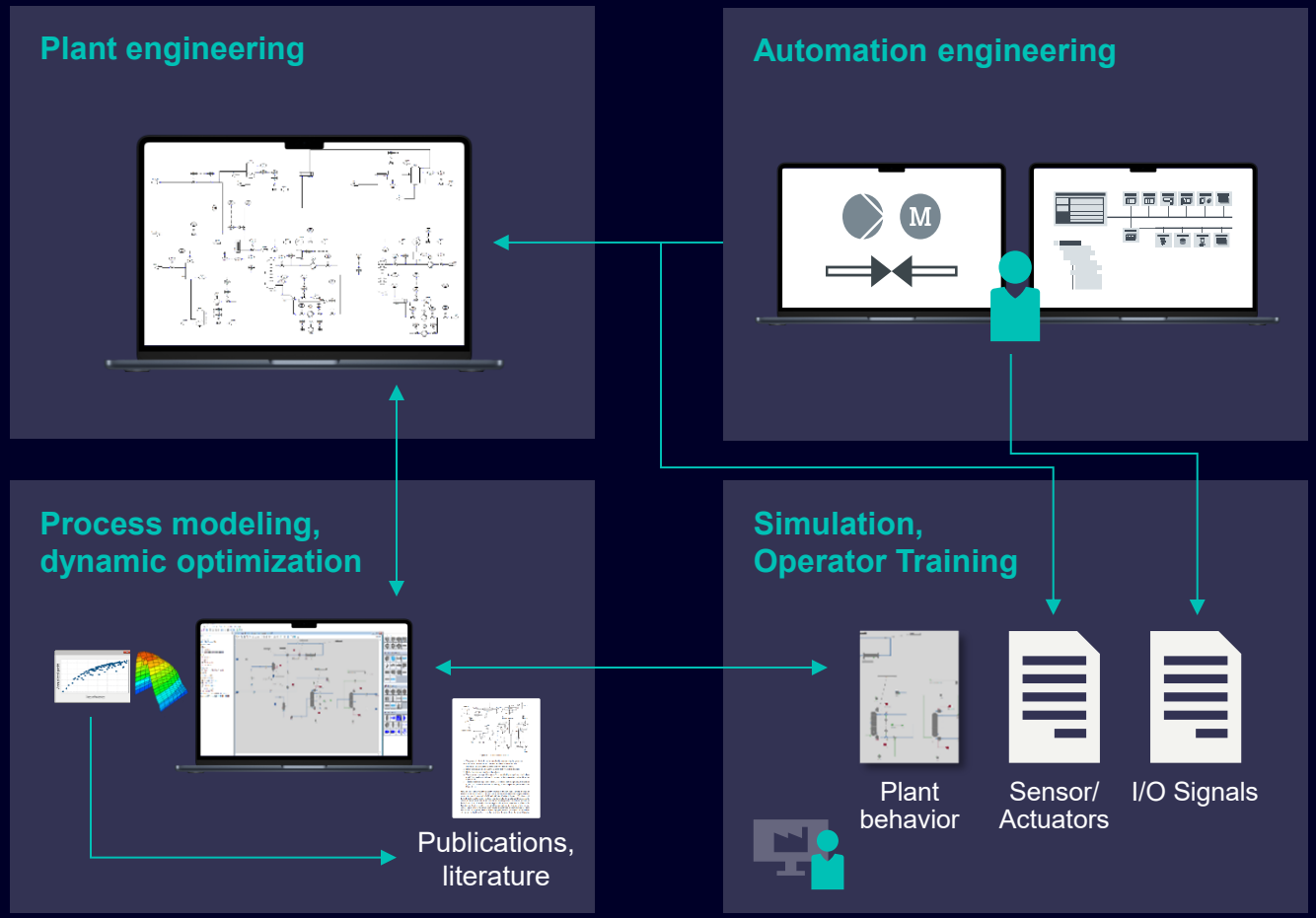
Digital Twin
Example: Integrated engineering



Integrated engineering

Challenge
Plant scale-up needs to be fast while the plant efficiency needs to increase with each plant.

Solution
Simulation and modelling tools ensure efficient plant design, commissioning and reproducibility for a fast and efficient way from pilot to commercial scale-up. Simulation tools help optimize plant operation and maintenance.

Value
- Central data hub ensures seamless information flow
- Availability of entire plant data & actual as-built status of plant at all times
- Highest data consistency eliminates time searching for the right data as well as potential data-based errors
- Integrated view from project planning to maintenance
- Seamless data handover across all plant lifecycle phases
- Integration platform for all technical information of plant and equipment
- Operator training for optimized maintenance

Products & Services
- COMOS/SIMIT/gPROMS
- SIMATIC PCS 7/PCS neo

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Digitally integrated operations

Digital integration of plant operations based on Siemens technology assures stable production processes and uniform high quality.

- Digital representation of the supply chain to assure data transparency and efficient material handling
- Protecting the plant in a flexible and user-friendly way
- Security in accordance with regulations and guidelines
- Maintain a secure and responsible plant management at all times

Digitally integrated operations

Use case 1: Plant-wide automation with overarching DCS

Use case 2: FMCS – Facility Monitoring and Control System

Use case 3: Cybersecurity for process control systems

Use case 4: Integrated solution for access control

Use case 5: Integrated plant monitoring

Use case 6: Ensuring continuity with fire protection systems all over the plant

Use case 7: Intelligent tracking and tracing

Use case 8: Wireless connectivity for production flexibility, reliability and safety

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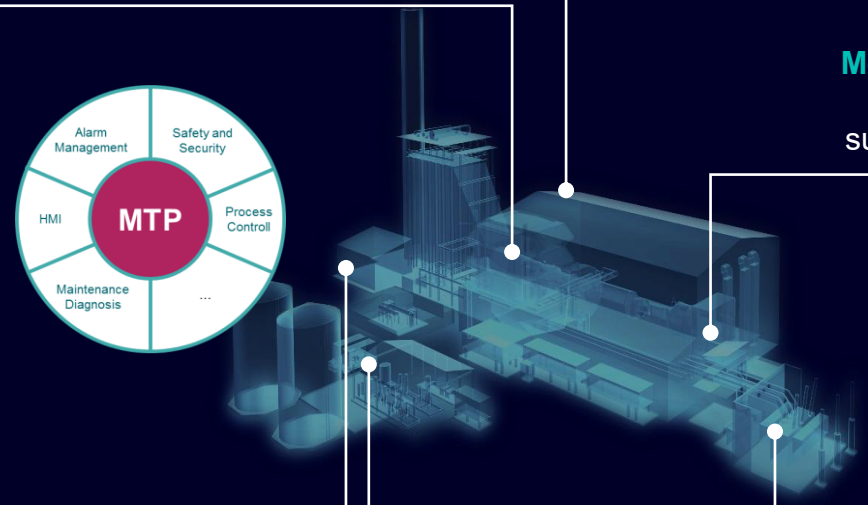
Digitally integrated operations

Plant-wide automation with overarching DCS

Advanced automation and process control systems maintain processes stable and enable scalability

Plantwide communications network meeting highest security standards

Measurement Intelligence transforming data into sustainable customer value



Functional Safety for robust and safe production

PLC Automation for pre-processing of material

Industrial Edge technology to support data driven decisions

Plant-wide automation with overarching DCS

Challenge

A typical battery material recycling plant includes multiple package units and OEM machines that need to be integrated in the overall plant operation concept. It is important to create and maintain an adaptable plant design by integrating units through standard interfaces.

Solution

Plant-wide automation with overarching DCS enables a flexible integration of package units and single devices using standardized interfaces shorten engineering and commissioning time. Use of intelligence for predictive calculation.

Value

- Easy and intuitive user interface; all tasks in one workbench (Administration, Engineering, Monitoring & Control)
- Reduce inconsistencies and manual work; Integration of sub-systems through standardized interfaces
- Improve plant uptime and asset performance

Products & Services

- Distributed control systems PCS 7/PCS Neo integrating OEM package units through MTP
- PLC based automation for package units
- Continuous Gas Analytics/Measurement Intelligence
- Power supplies and network components
- Industrial Edge

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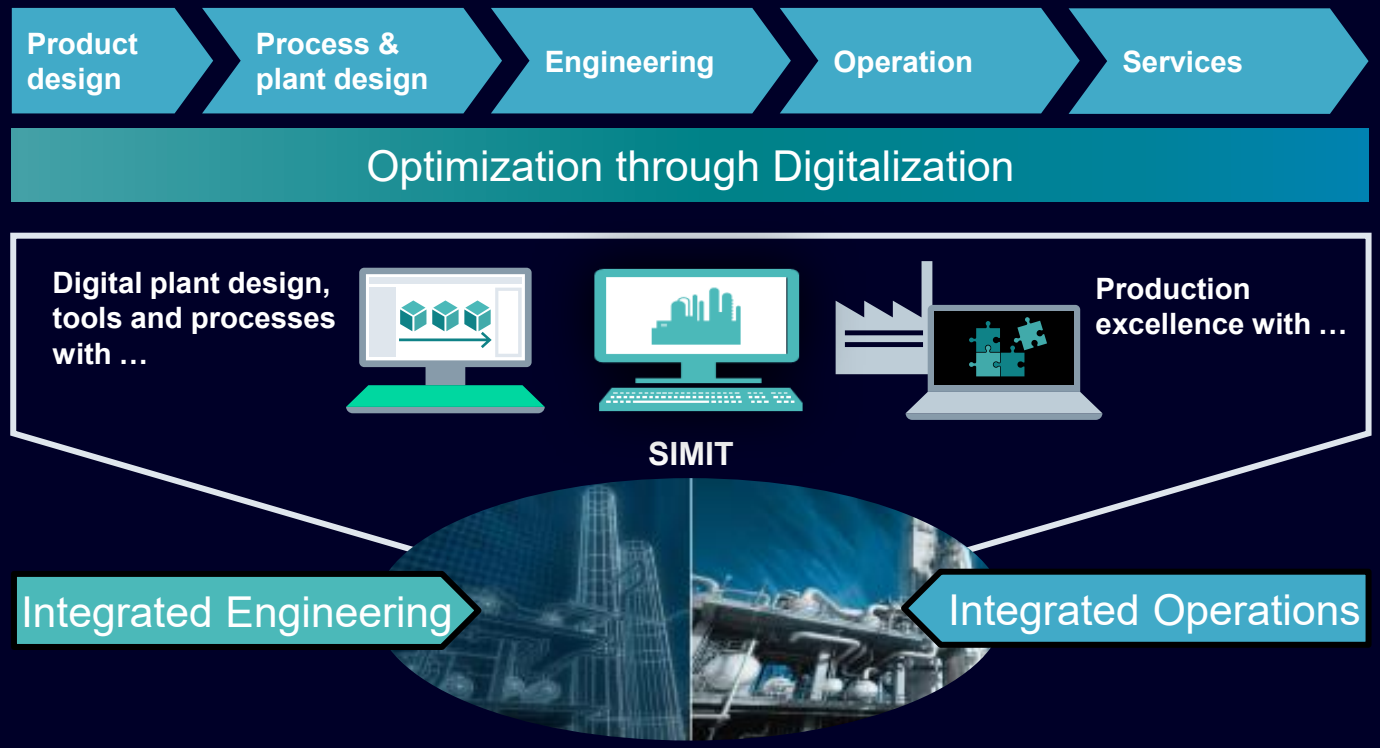
Digitally integrated operations

FMCS – Facility Monitoring and Control System



FMCS – Facility Monitoring and Control System

Challenge

Need to increase process efficiency and reliability along the plant life cycle. Need for execution of operation and maintenance tasks without media breaks due to a seamless transition and the consistent data flow between engineering and plant operation.

Solution

Integrating engineering information and processes on the basis of one data model with the interface/interplay of different engineering and automation systems. Execution of operation and maintenance tasks without media breaks due to a seamless transition and the consistent data flow between engineering and plant operation.

Value

- Quick overview of complete plant availability
- Analysis of KPI´s and gaining Business Intelligence
- Enable further business models with suppliers and OEMs
- Using edge computing for Artificial Intelligence
- Efficient maintenance
- Faster trouble shooting
- Central as-build documentation

Products & Services

- HVAC Heating, Ventilation and Air Conditioning
- Waste Water Treatment (WWT)
- Gases and Chemicals
- Low Voltage & Medium Voltage distribution
- Fire Safety
- Security

SIEMENS

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Digital Tools

Digital tools from Siemens ensure optimal work force training and efficient day to day operations

- Wireless real-time communication combined with PROFIsafe to implement safety over IWLAN ensures a flexible, efficient and safe production
- RFID, OID, RTLS and Location Intelligence make digitally coordinated and aligned processes possible and provide real-time data
- Digitizing all workflows in process plants and overcoming pen-and-paper processes always ensures easy access to all information

Digital Tools

Use case 1: Digital Worker Logistics

Use case 2: Digital Worker Maintenance

Use case 3: Asset monitoring

Use case 4: Paperless production MES

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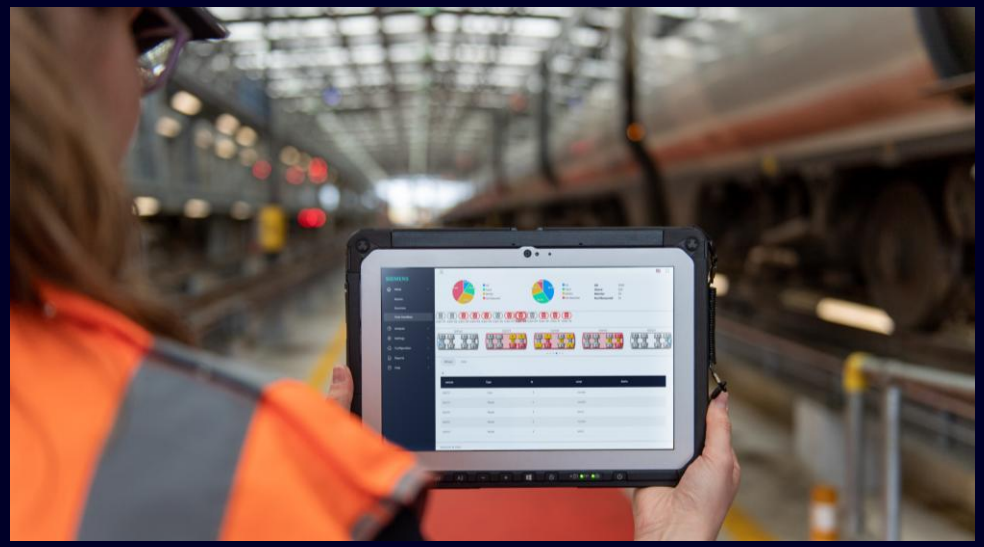
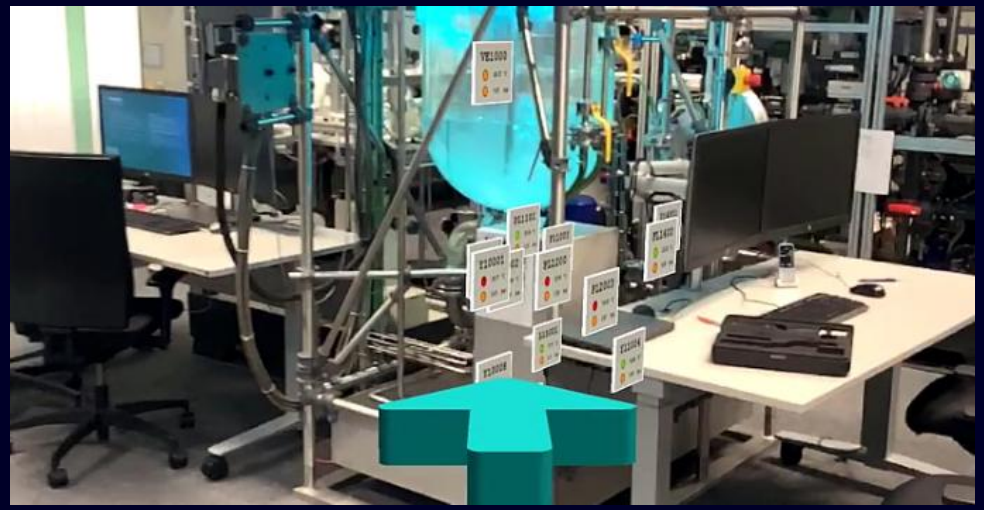
Digital Tools
Digital Worker: Maintenance





Digital Worker: Maintenance

Challenge
Constant pressure to reduce maintenance costs leads to centralization and outsourcing of operation and maintenance activities which produces large and fragmented data pools.

Solution
Siemens digital worker makes all needed documents available up-to-date and thereby enables a paperless work execution for operators. Further, Siemens solutions make localization, navigation, and identification throughout the whole plant possible.

Value
- Higher efficiency (for available work force)
- Faster completion
- Reduction of errors
- Electronic documentation on the fly
- Enhanced safety and security
- Save time while searching assets
- Location based issue reporting and service management

Products & Services
- 5G
- RTLS

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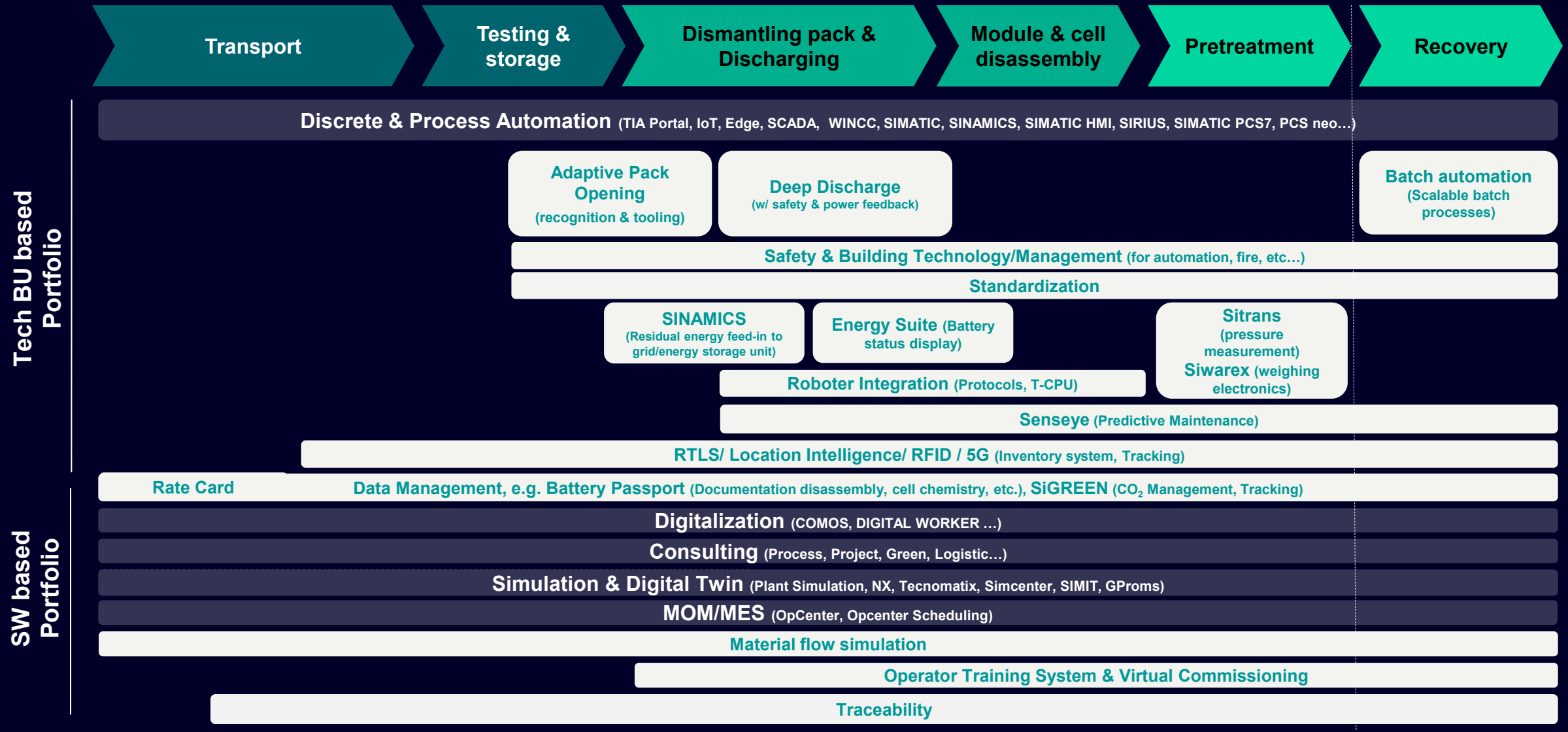
Summary: How do we address the recycling target ?

Battery recycling value chain: Siemens portfolio



Siemens Standard Portfolio | Use Cases

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We build technologies with purpose. They’re never an end in them-selves, they help customers achieve more with less.

Siemens CEO Roland Busch
on sustainability

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