



Future Battery Technology & Engineering

Striving for Sustainability and Cost
Effectiveness

Martin Weinzerl, ATZ/MTZ Webinar Matinee Battery 4.0, July 2023

Martin Weinzerl

AVL at a Glance



1948

Founded



26

Countries Represented



11,200

Employees Worldwide



11 %

Of Turnover Invested in Inhouse R&D

75

Years of Experience

45

Global Tech and Engineering Centers

68 %

Engineers and Scientists

2,200

Granted Patents in Force

Environmental Sustainability

We have already taken numerous actions to reach CO₂ neutrality at our headquarters.

- Global energy consumption and CO₂ monitoring
- 100 % renewable electricity
- Solar facility (>3,300 m²)
- System for infrastructure waste heat recovery
- >50 % electric or hybrid vehicles in our carpool

Certificates



ISO 14001

ISO 9001

ISO 27001

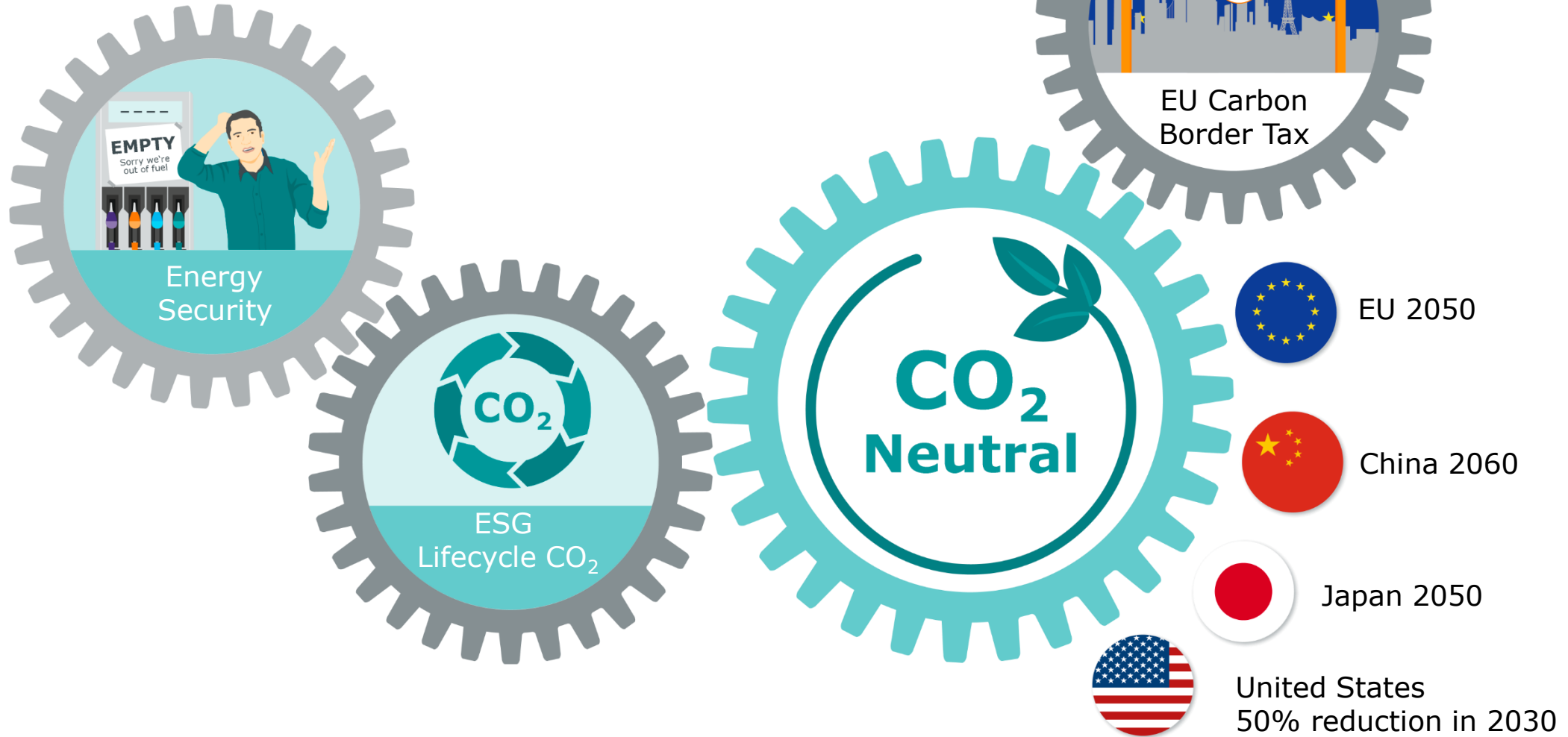
ISO 45001

ECOPROFIT®

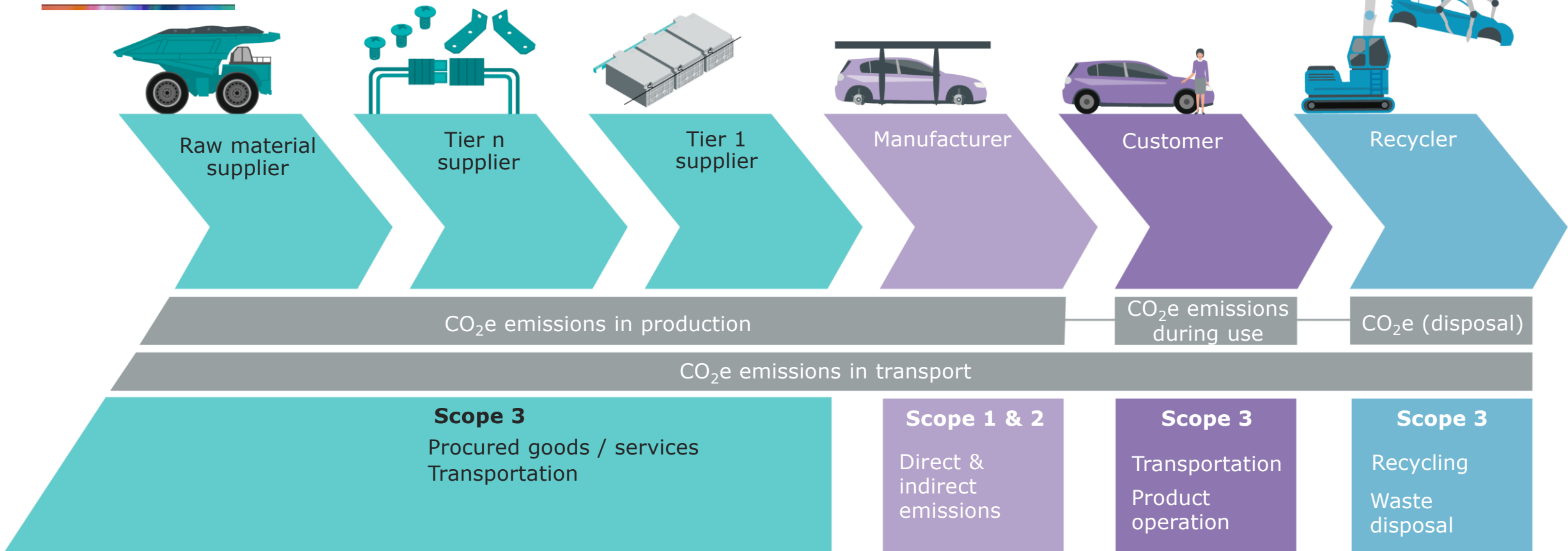
Ford Q1 Award



On the Roadmap to Carbon Neutrality

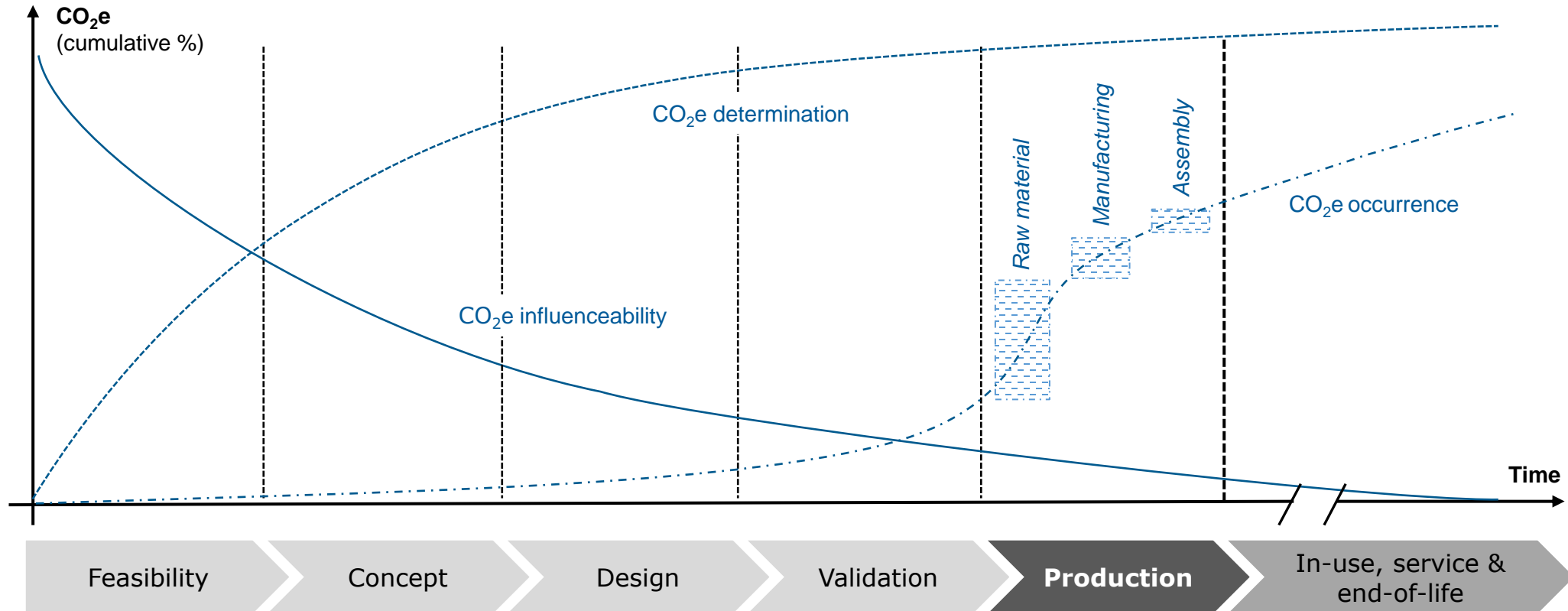


Emission Scopes can be mapped onto the different Stages of the Value Chain



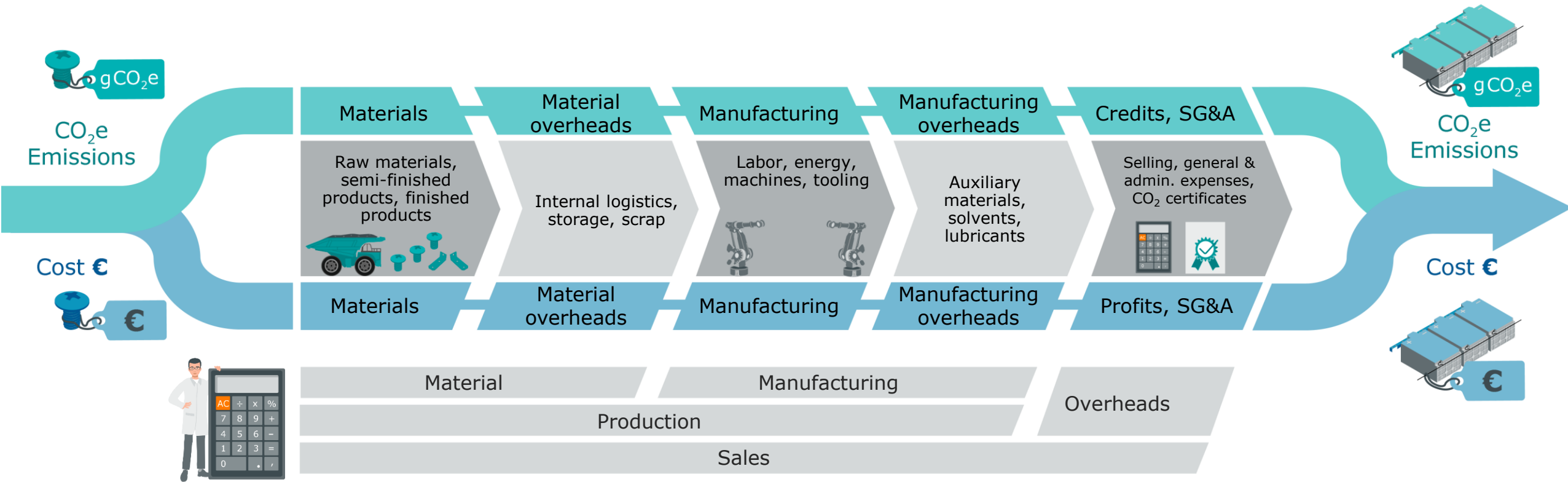
By far the largest share of emissions are assigned to Scope 3 and includes all upstream and downstream activities of a legal entity

Product Lifecycle Model with qualitative Patterns for CO₂e Influenceability, Determination and Occurrence



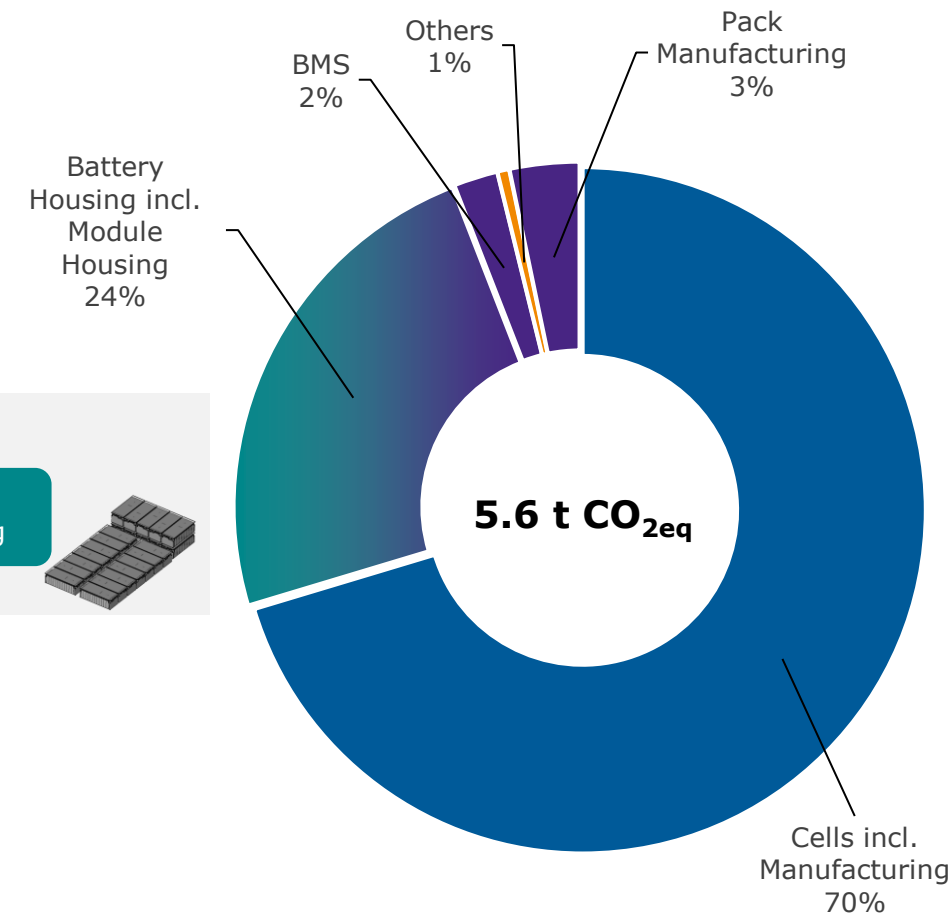
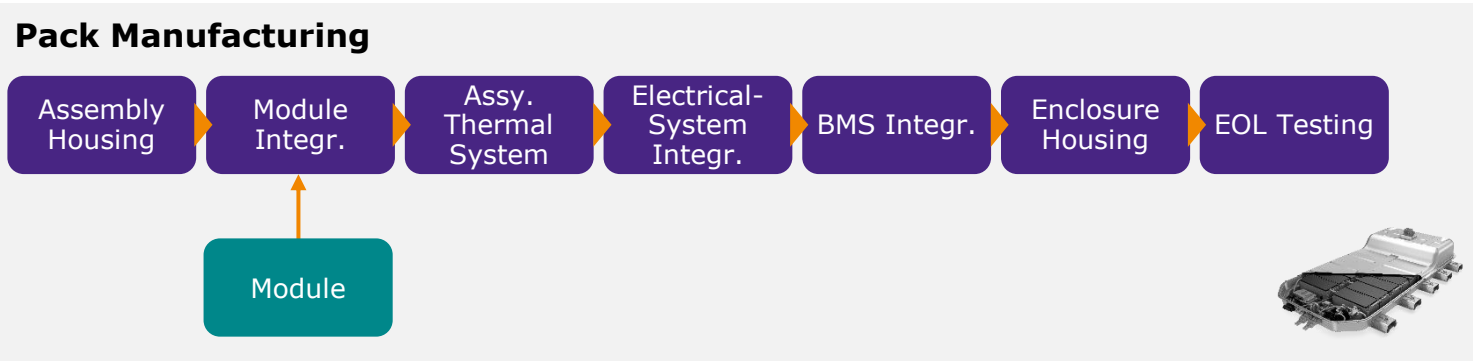
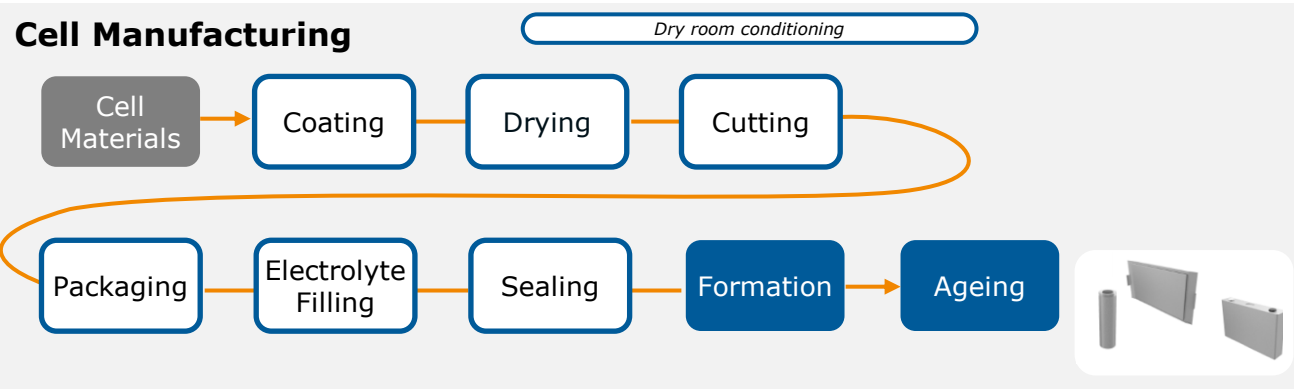
Significance of early development phase for lifecycle CO₂e

Simultaneous Assessment of Product Cost and CO₂e



Bottom-up calculation for optimized cost and CO₂e balancing in production

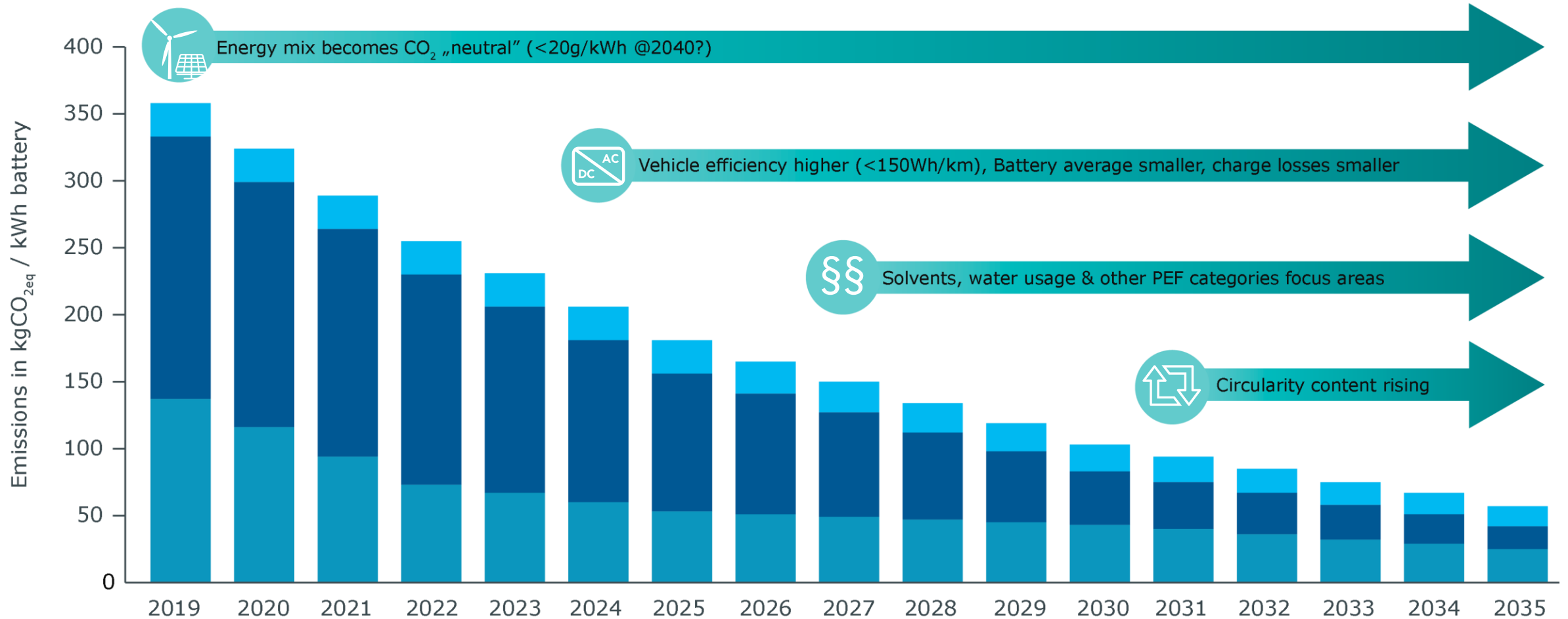
Battery Pack Production – CO₂ Emissions



Battery Size: 60 kWh
 (C-Segment Vehicle with 300-400 km range)
 Total Pack Weight: 390 kg

C-Segment Vehicle with 300-400 km Range 200,000km Use Phase in EU

■ Recycling
■ Use
■ Production



CO_{2eq} improvements 2019-2023 **35%**

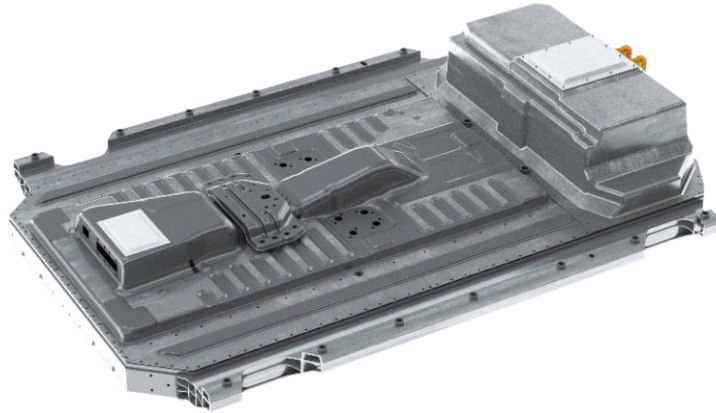
Design to CO_{2eq} guidelines

CO_{2eq} improvements 2019-2023

35%

CO_{2eq} improvements 60kWh

7.6t



56Mio.^{*)}

new BEV vehicles in EU 2026-31

CO_{2eq} savings for 56Mio. new BEV vehicles

426Mt



^{*)} Source: IHS, 10/2022

Design to CO_{2eq} is essential for future path to net-zero



IPCEI BATTERIES BIC nextGen

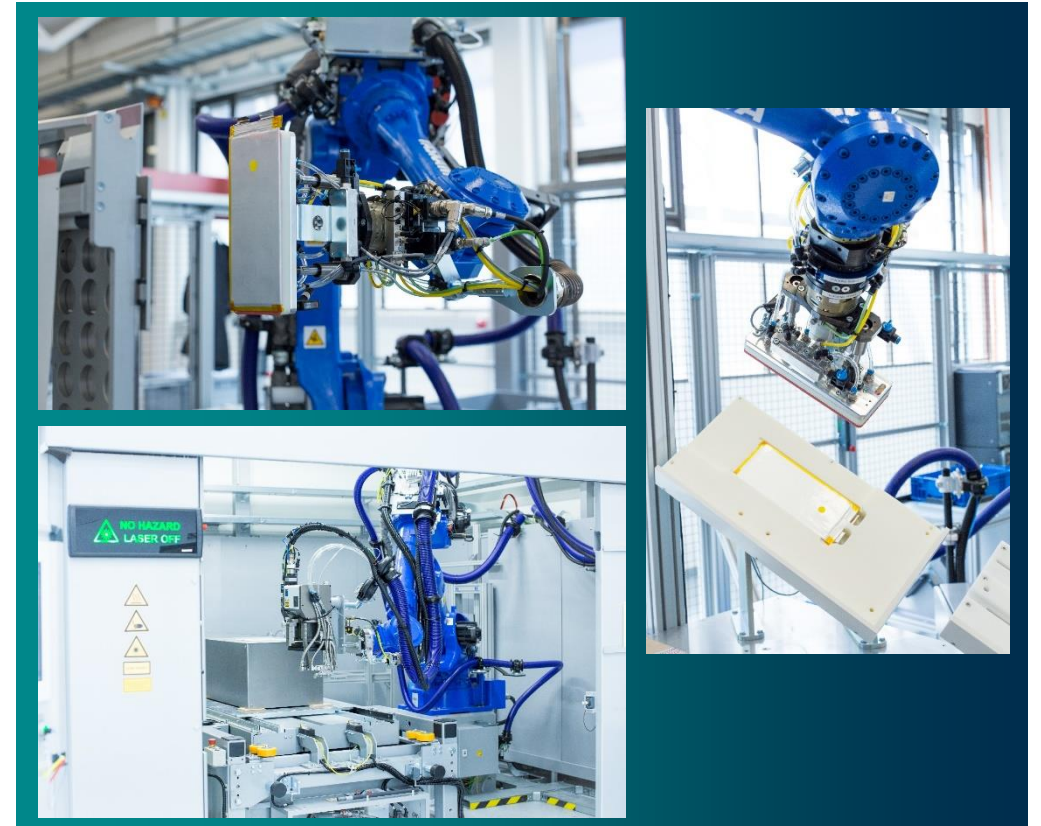


 Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

austria
wirtschafts
service 

 **FFG**
Promoting Innovation.

Implementation: AVL Battery Innovation Center



Research on the future of battery production → CO₂eq is a main parameter

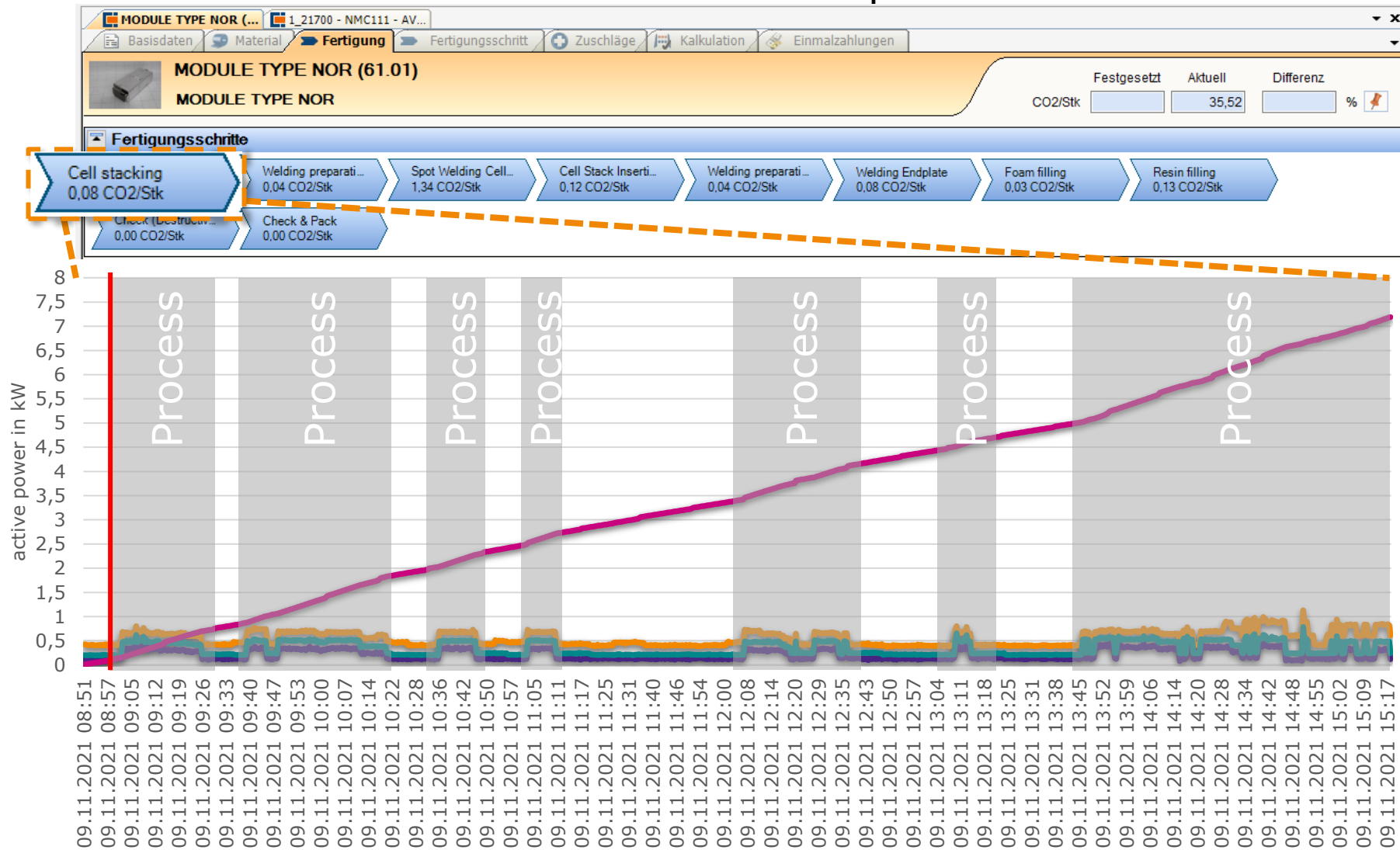
Development of sustainable production processes by avoiding non-reversible processes

Measurement of energy, CO₂eq and harmful gaseous emissions

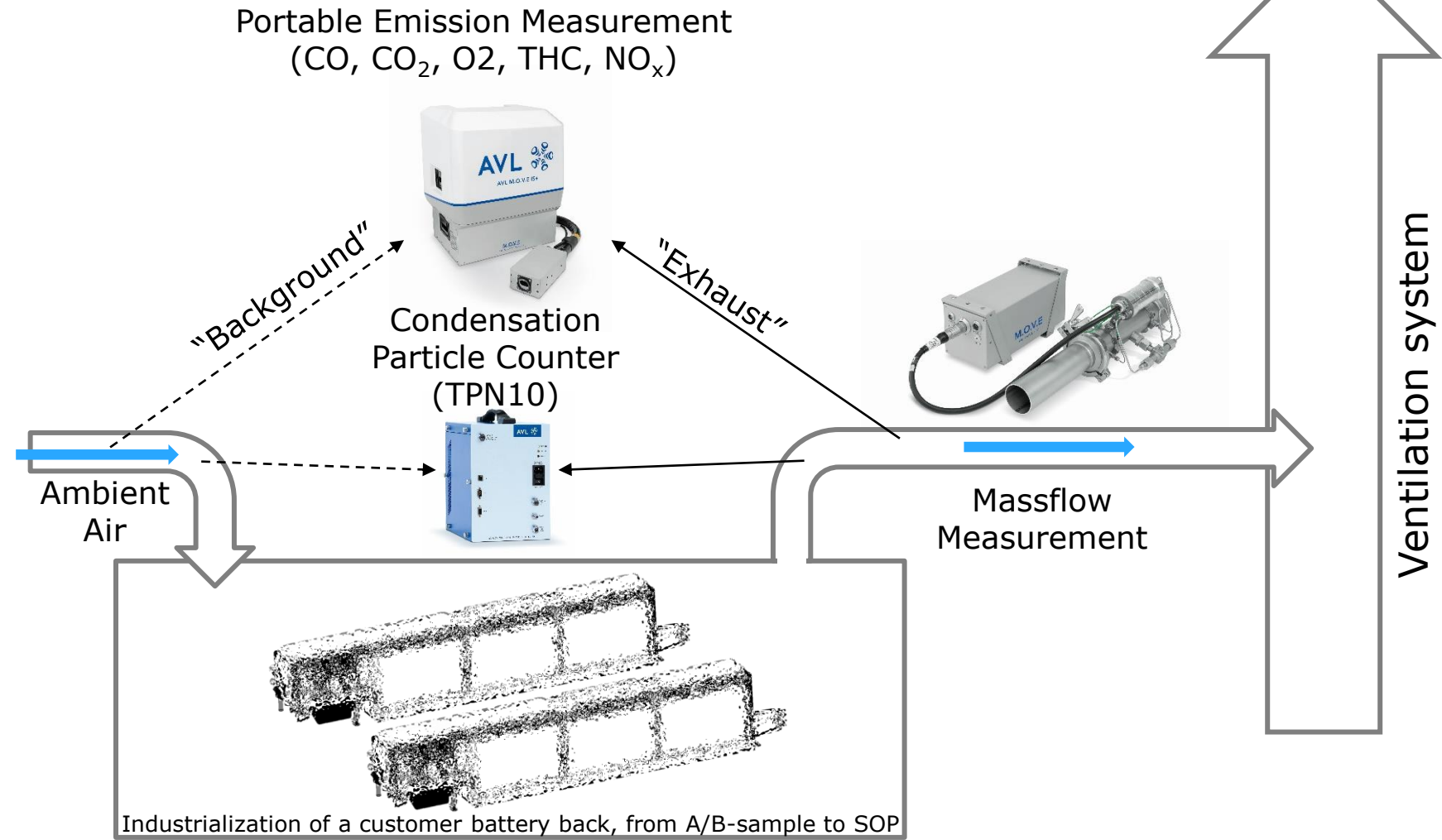
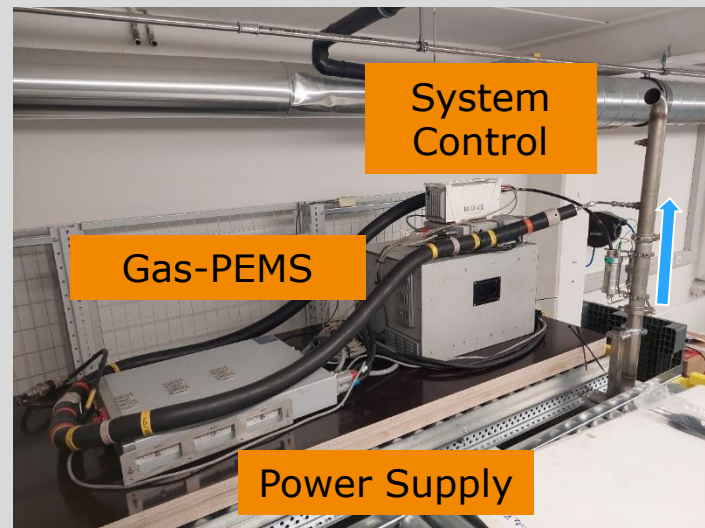
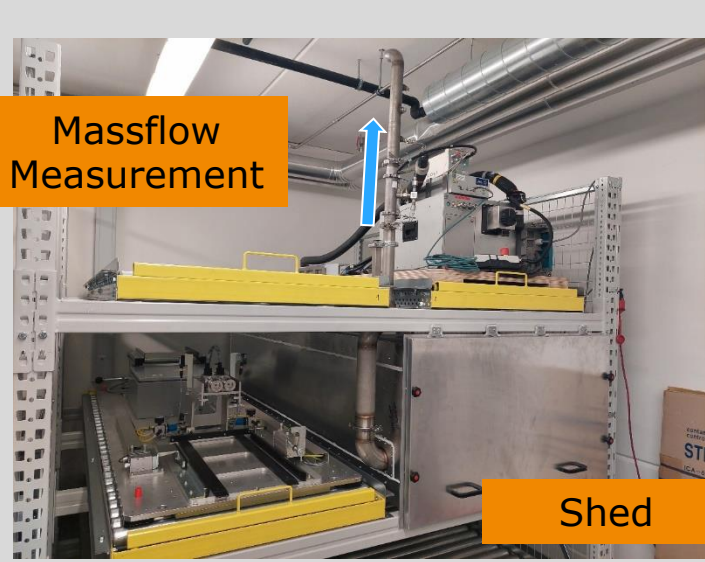
Implementation: Energy measurement and conversion to CO_{2eq} values



- Integration of measured values in CO₂ modeling
- Digital-twin for energy-based control & scheduling of production



Implementation: Battery Gluing Process Emission Evaluation - Shed Arrangement & Setup



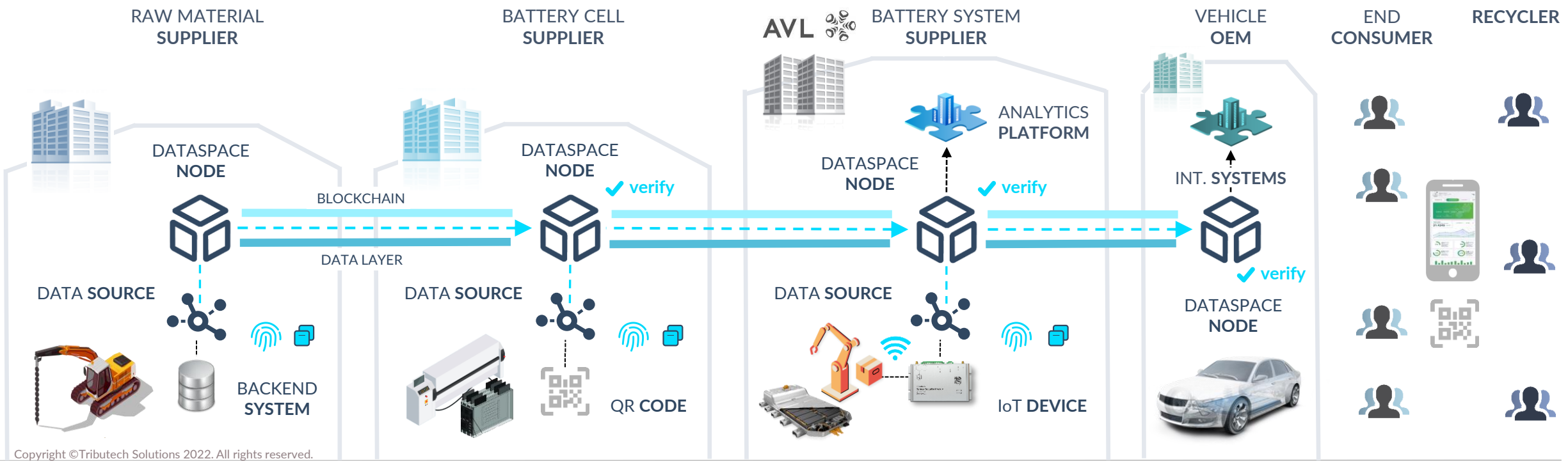
THC ... Total Hydrocarbons, SPN10 ... Solid Particle Number >10nm, TPN ... Total Particle Number >10nm

Implementation: Digital Battery Passport of the future



BATTERY PASSPORT APP

DIGITAL BATTERY PASSPORT



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Implementation: Digital Battery Passport of the future

Product Type Management

Product Unit & Passport Registration

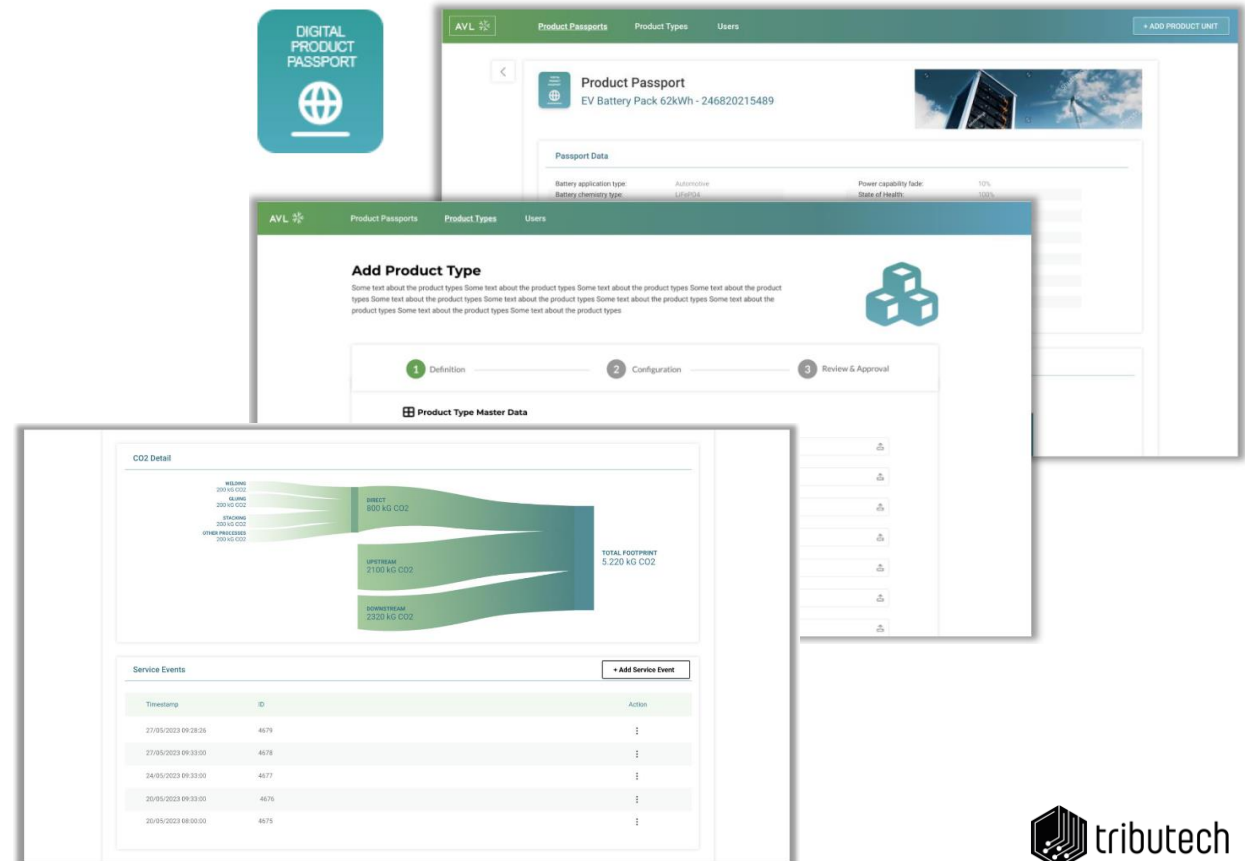
Compliance and Notarization

Product Carbon Footprint Tracking

- Categories based on scope
- Footprint on different levels

Integrate new parameters

- Sustainability
- Circularity



The image displays three overlapping screenshots of the AVL Digital Product Passport software interface. The top screenshot shows a 'Product Passport' page for an 'EV Battery Pack 62kWh - 246820215489', with fields for 'Passport Data' including 'Battery application type', 'Battery chemistry type', 'Autonomous', 'Power capability factor', and 'State of Health'. The middle screenshot shows the 'Add Product Type' workflow, with steps for 'Definition', 'Configuration', and 'Review & Approval', and a 'Product Type Master Data' table. The bottom screenshot shows a 'CO2 Detail' chart and a 'Service Events' table.

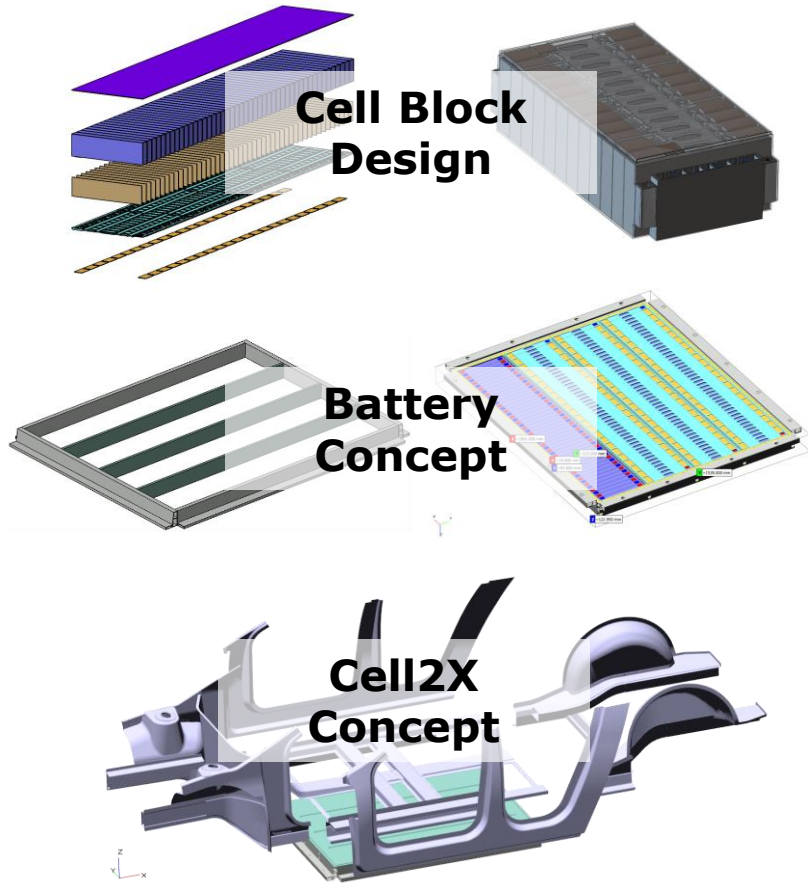
CO2 Detail

Category	Value (kg CO2)
WISDOM	200 kg CO2
ASSEMBLY	400 kg CO2
PACKAGING	200 kg CO2
OTHER PROCESSES	200 kg CO2
DIRECT	800 kg CO2
UPSTREAM	2100 kg CO2
DOWNSTREAM	2320 kg CO2
TOTAL FOOTPRINT	5.220 kg CO2

Service Events

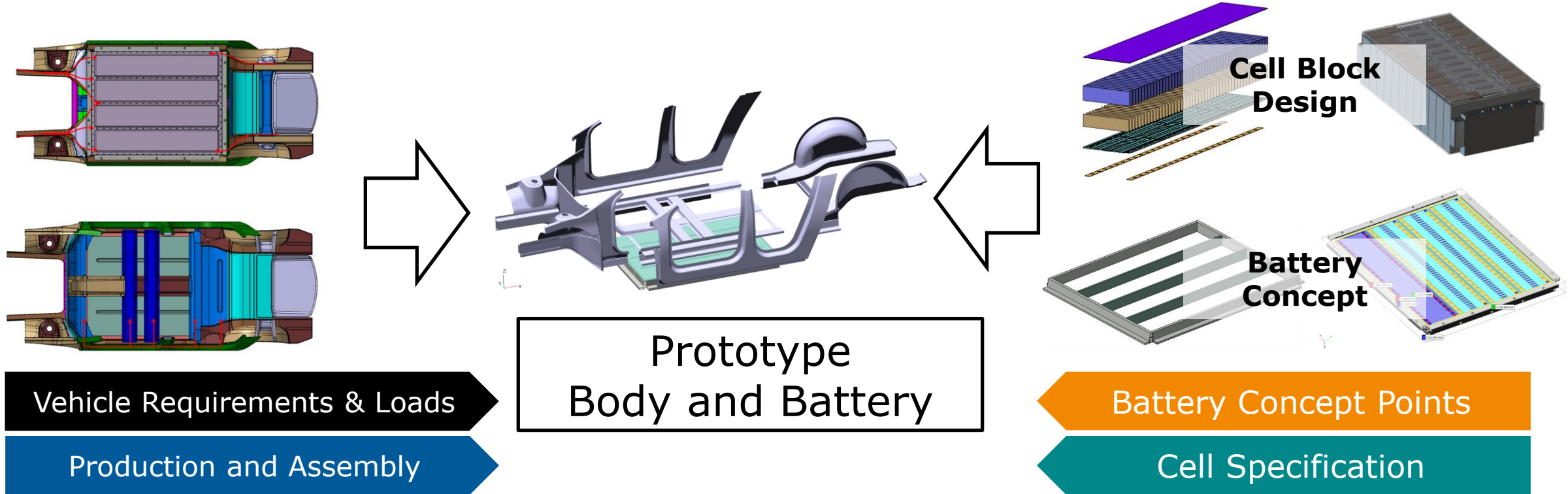
Timestamp	ID	Action
27/05/2023 09:28:26	4679	⋮
27/05/2023 09:33:00	4678	⋮
24/05/2023 09:33:00	4677	⋮
20/05/2023 09:33:00	4676	⋮
20/05/2023 08:00:00	4675	⋮

Development of future BEV Battery



- **Cell**
 - AVL cell design optimized for fast charging
- **No Propagation**
 - Design for safety concept **“Fail Inside”**
 - Integrated safety concept starting from cell to pack housing
- **Simplified EE architecture**
- **BMS**
 - Wireless BMS
- **2 phase cooling system**
- **Housing design Cell2Pack**

Cell2X Approach



Engineering of ...

... cell becomes part of vehicle

... vehicle becomes part of cell

Key Takeaways



Early development phase defines lifecycle carbon footprint



CO₂e to be considered in development process & design guidelines



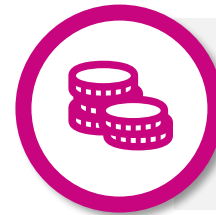
CO₂e lever in supply chain is larger than at the OEM



Optimize information flow to enable refurbishment and recycling



A balanced product needs to add CO₂e in the DfX evaluation



Sustainable products require reversible production processes

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