Green Manufacturing of Batteries in EU

Dr. Ing. Rahul Gopalakrishnan, CEO - Avesta

AVESTA

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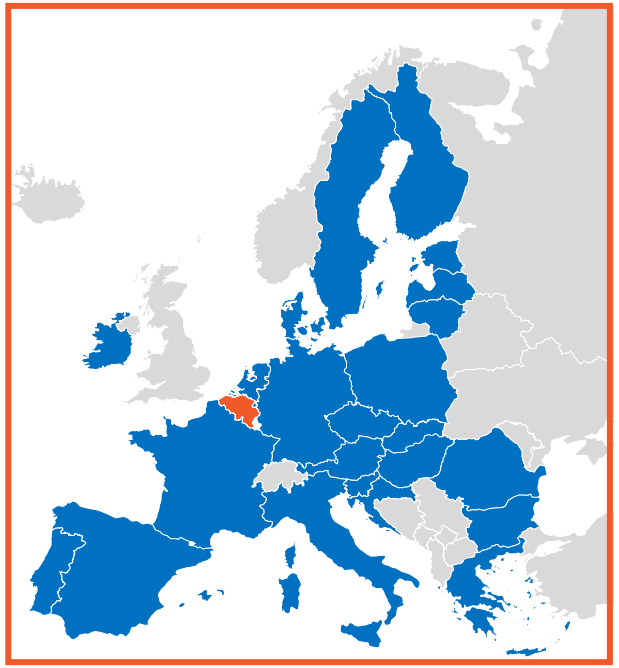
Company

01a

Vision

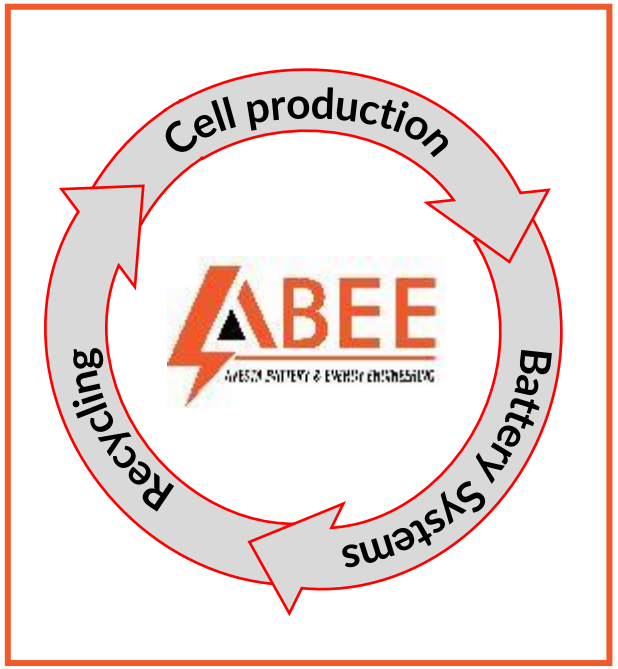


Made in EU

ABEE has a vision of making EU a battery industry hub through sustainable and low CO_2 battery production.

Affordable electrification

Lower the cost of electrification through technology development for volume mobility applications.



Circular approach

From cell production to their integration and recycling, ABEE follows a circular economy philosophy.

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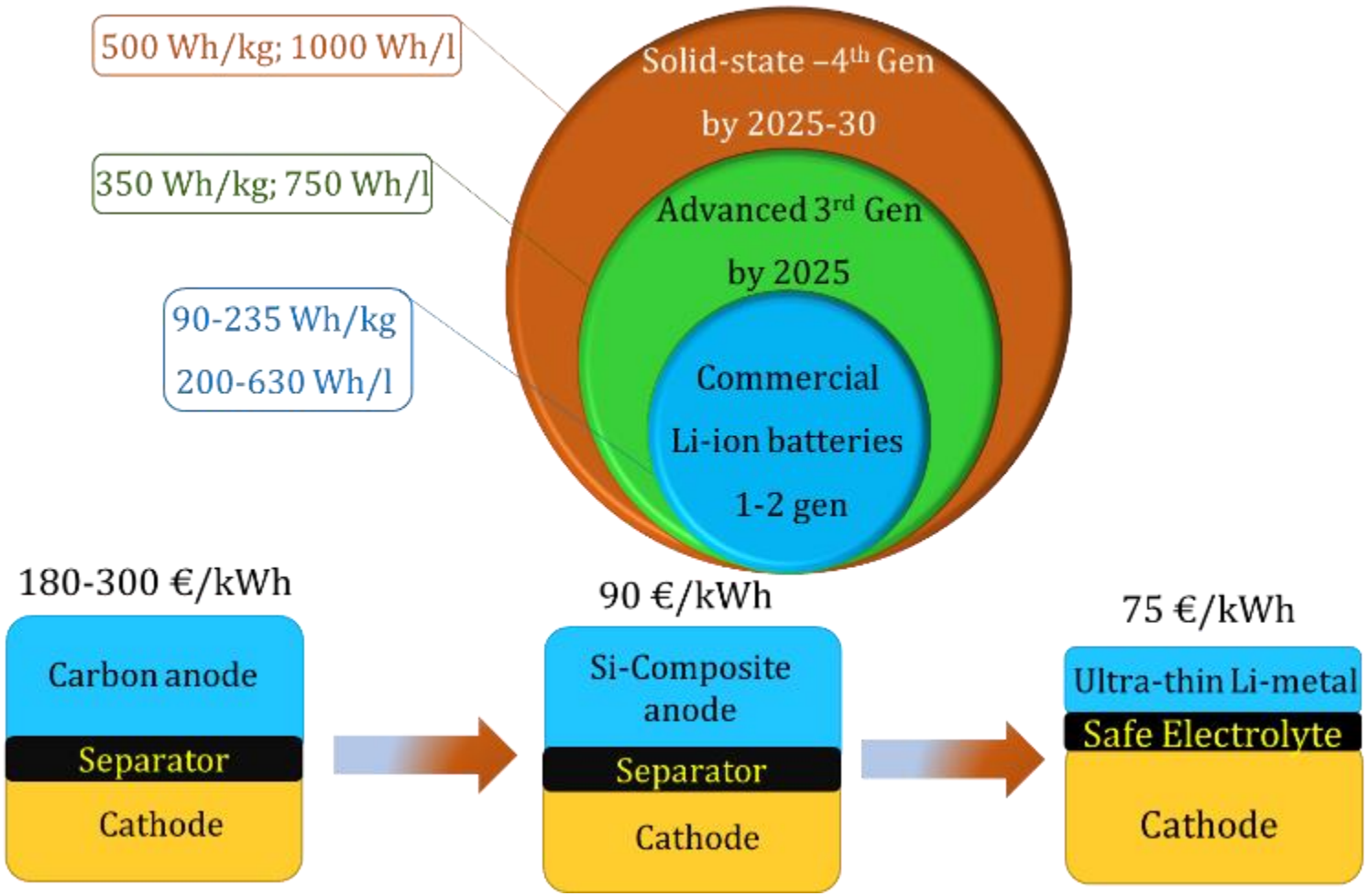
01b

Generation of LIBs



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01c ABEE HQ / R&D center

- Founded in **2019**.
- Located in **Ninove, Belgium** with an area of 9000 m^2.
- Cell fabrication, battery systems and recycling **prototyping lines**, including those for large pouch and prismatic cells.
- State of the art chemical and analytical laboratories, testing facilities, 250m^2 dry room with **-60 °C** dew point.
- Total employees: 60
- R&D center to house **150 employes** by 2025.

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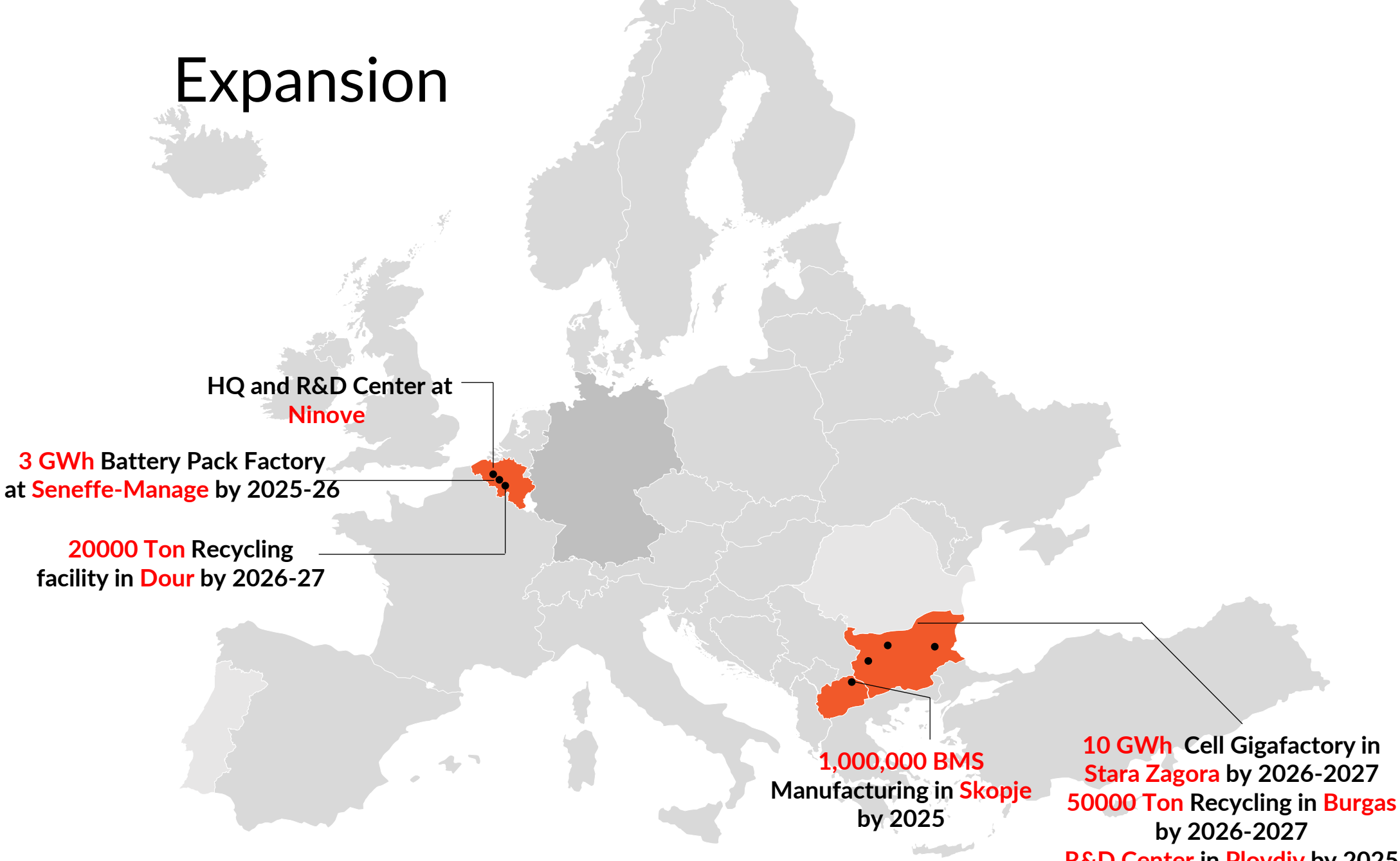
01f

Expansion



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02

Infrastructure

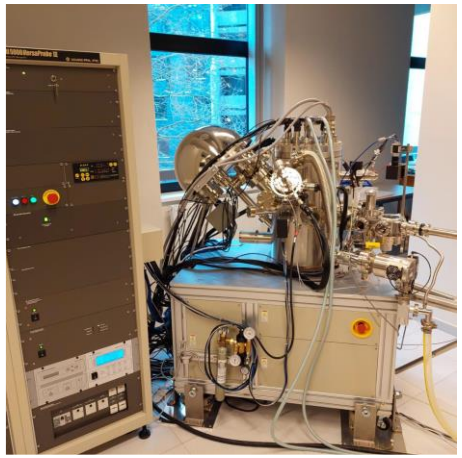
02a

Cell Maufacturing and Upscaling

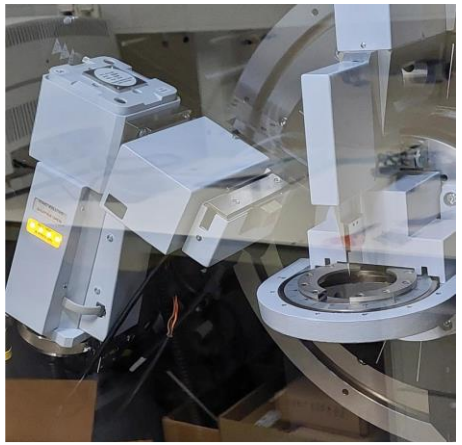
LiM Coating

Dry room (-60 dew point)

Cell assembly



Insitu XPS



Insitu XRD

Insitu AFM

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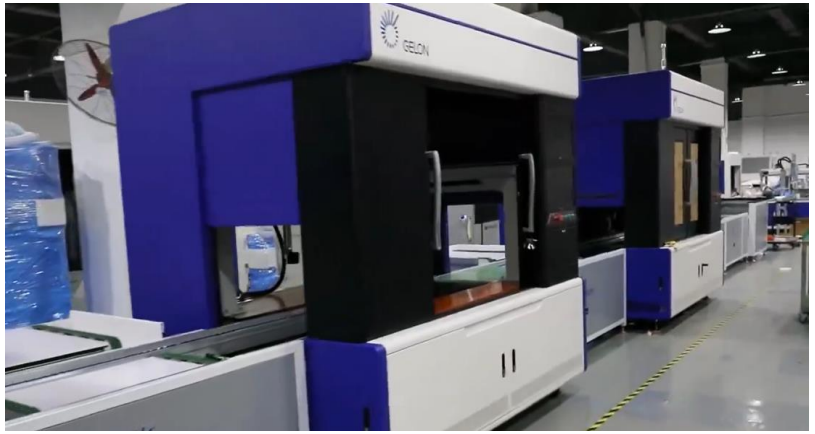
02b Commercial suppliers of Battery systems

- Incentive to bring in-house designed battery technology
- Modular battery system design platform for automotive and stationary applications
- BMS manufacturing
- Integration of innovative light weight material
- Capacity: 0,8 GWh/year (6,8 GWh by 2026) and 10000 BMS/year



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03

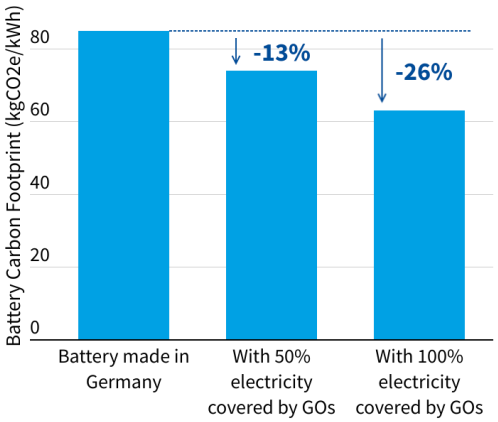
Green Manufacturing

03a Green Manufacturing - definition

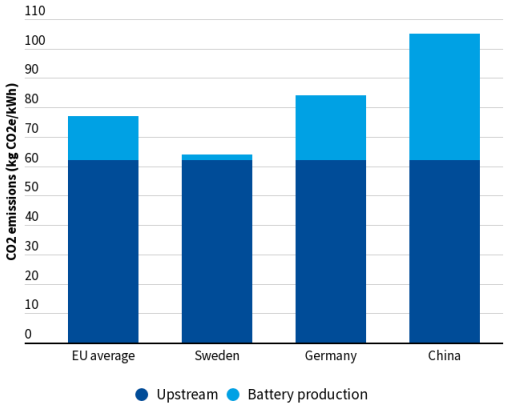
Keywords:

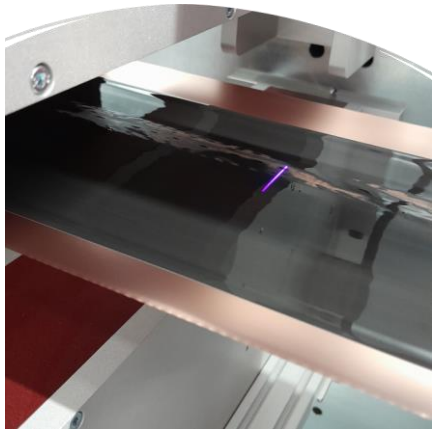
- Cradle to grave
- Full value chain sustainability
- Accountability and reporting
- Low CO_2 footprint

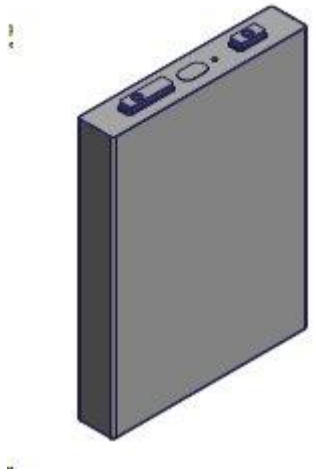
Guarantees of Origin artificially reduce battery carbon footprint



Carbon emissions from battery production at different locations







Source: T&E and Avesta

03b The need for Green Manufacturing

Environmental Sustainability

Resource Extraction Impact: Minimizing deforestation, water scarcity, and soil degradation from lithium, cobalt, and nickel mining.

Carbon Footprint Reduction: Reducing greenhouse gas emissions from energy-intensive manufacturing processes.

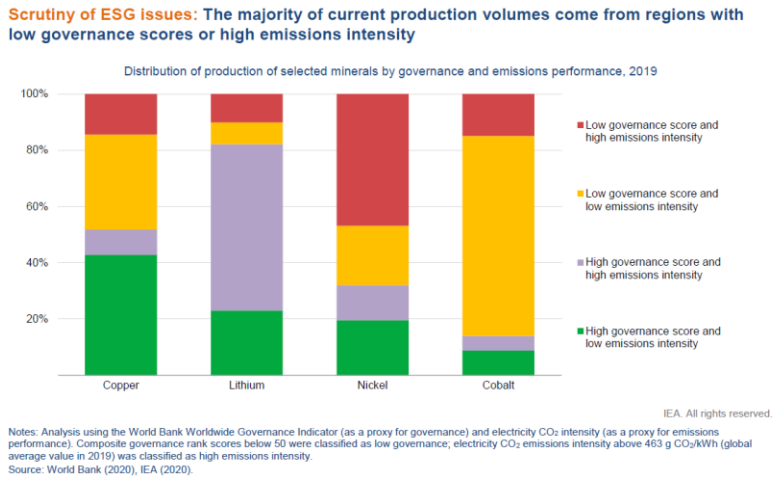
Waste and Pollution Control: Managing toxic chemicals and heavy metals to prevent land and water contamination.

Resource Efficiency and Circular Economy

Material Scarcity and Recycling Needs: Addressing the depletion of finite resources by promoting recycling and material recovery.

Design for Longevity and Recyclability: Creating modular and easily recyclable batteries to support a circular economy.

Conserving Critical Minerals: Reducing dependency on virgin materials through closed-loop recycling systems.



Source World Bank and IEA -2020

03c The need for Green Manufacturing

Market Demand and Corporate Responsibility

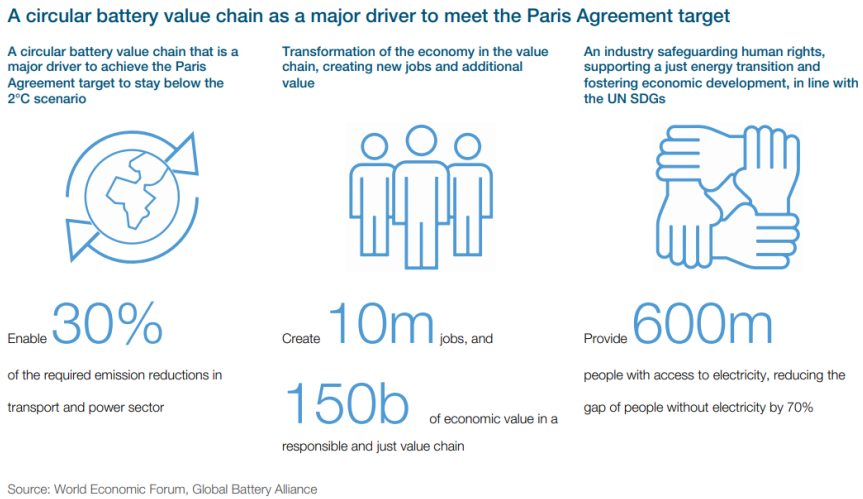
Eco-Conscious Consumer Base: Meeting the growing demand for sustainable products among environmentally aware consumers.

Corporate Social Responsibility (CSR): Enhancing brand image and accountability by adopting green manufacturing practices.

Innovation and Economic Growth

Advancements in Green Technology: Development of solid-state, biodegradable, and alternative battery chemistries that are safer and more sustainable.

Economic and Job Opportunities: Growth in the green battery sector, fostering new jobs and investment in sustainable tech and recycling infrastructure.



03d The need for Green Manufacturing

Regulatory Compliance and Policy Alignment

Government Regulations: Adhering to guidelines like the EU Battery Directive, which mandates sustainable production, recycling, and ethical sourcing.

Net-Zero and Climate Goals: Aligning with global carbon-neutral commitments and reducing the industry's environmental footprint.

International co-ordination on sustainable and responsible extraction already exists

Selected initiatives categorised by activity area

Name	Climate	Sustain-ability	Responsible sourcing	Rights of workers	Fairness and inclusivity	Governance	Security of supply
World Bank Climate Smart Mining Initiative	●	●				●	●
European Battery Alliance							●
European Raw Materials Alliance							●
Extractive Industries Transparency Initiative						●	
Global Battery Alliance	●	●	●				
Energy Resource Governance Initiative		●	●	●		●	
Fair Cobalt Alliance				●	●		
International Council on Mining & Metals	●	●	●	●	●	●	
Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development		●	●	●	●	●	
Initiative for Responsible Mining Assurance	●	●	●	●	●	●	
Towards Sustainable Mining	●	●	●	●	●		
OECD Responsible Business Conduct			●	●	●	●	
Responsible Minerals Initiative			●	●			
Responsible Minerals Foundation	●	●	●	●	●	●	
Women's Rights and Mining			●		●		

Note: Primary activity type: ● = Technical assistance. ● = Industry standardisation. ● = Investment/funding. ● = Research and analysis.

		Metals in scope	Coverage	Content*	Governance
IRMA	Initiative for Responsible Mining Assurance	All	Mining	ESG	Multi-stakeholder
	Towards Sustainable Mining	All	Mining	E & S	Multi-stakeholder
ICMM	International Council on Metals & Mining	All	Mining	ESG	Industry
	Environmental, Social & Governance (ESG) Standard for Mineral Supply Chains	All	Smelter and refiner	ESG	Third-party auditors
	Global Responsible Sourcing Due Diligence Standard for Mineral Supply Chains	All	Smelter and refiner	OECD Due Diligence risks	Third-party auditors
asi	Aluminium Stewardship Initiative	Aluminium	Value chain	ESG	Multi-stakeholder
CRAF	Cobalt Industry Responsible Assessment Framework	Cobalt	Smelter and Refiner	E & S	Industry
RCI	Cobalt Refiner Supply Chain Due Diligence Standard	Cobalt	Smelter and refiner	OECD Due diligence risks	Third-party auditors
THE COPPER MARK	The Copper Mark	Copper	Value chain	ESG	Multi-stakeholder
JDDS	Joint Due Diligence Standard for Copper, Lead, Nickel and Zinc	Copper, Zinc, Nickel, Lead	Smelter and refiner	OECD Due diligence risks	Multi-stakeholder
NZMM	*Nickel, Zinc and Molybdenum Mark***	*Zinc, Nickel, Molybdenum*	*Value chain*	*ESG*	*TBD*
CERA	*Certification of raw materials***	*All*	*Value chain*	*ESG*	*TBD*

** There is not consistent information on the differing comprehensiveness of schemes. The IGF has made a quantitative comparison of selected schemes, available here: bit.ly/3E7xByo*

*** Not yet launched*

Source IIEA- The Role of Critical Minerals in Clean Energy Transitions- March 2022

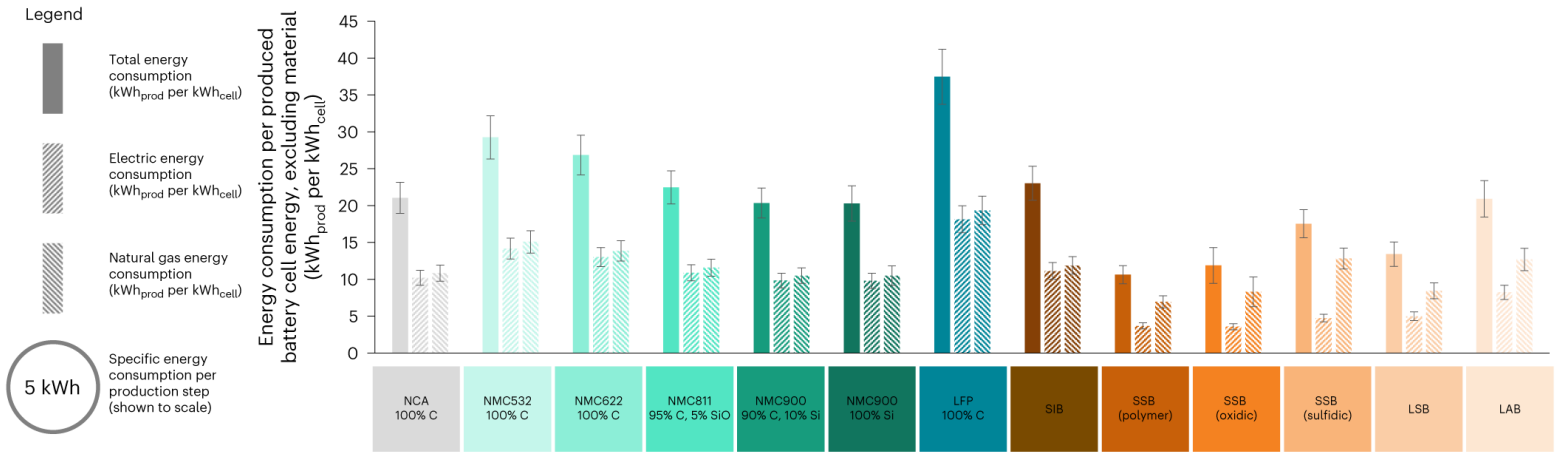
03e

Implementation scenarios

Transition to Renewable Energy Sources for Manufacturing Facilities (600GWh planned by 2030)

Implementation: Conduct an energy audit, set a target for renewable energy use, and establish partnerships with green energy suppliers. This could include installing solar panels at manufacturing plants or purchasing renewable energy credits.

Impact: Reduces the carbon footprint of production processes and aligns with net-zero emissions targets.



20- 40X energy consumption in battery manufacturing

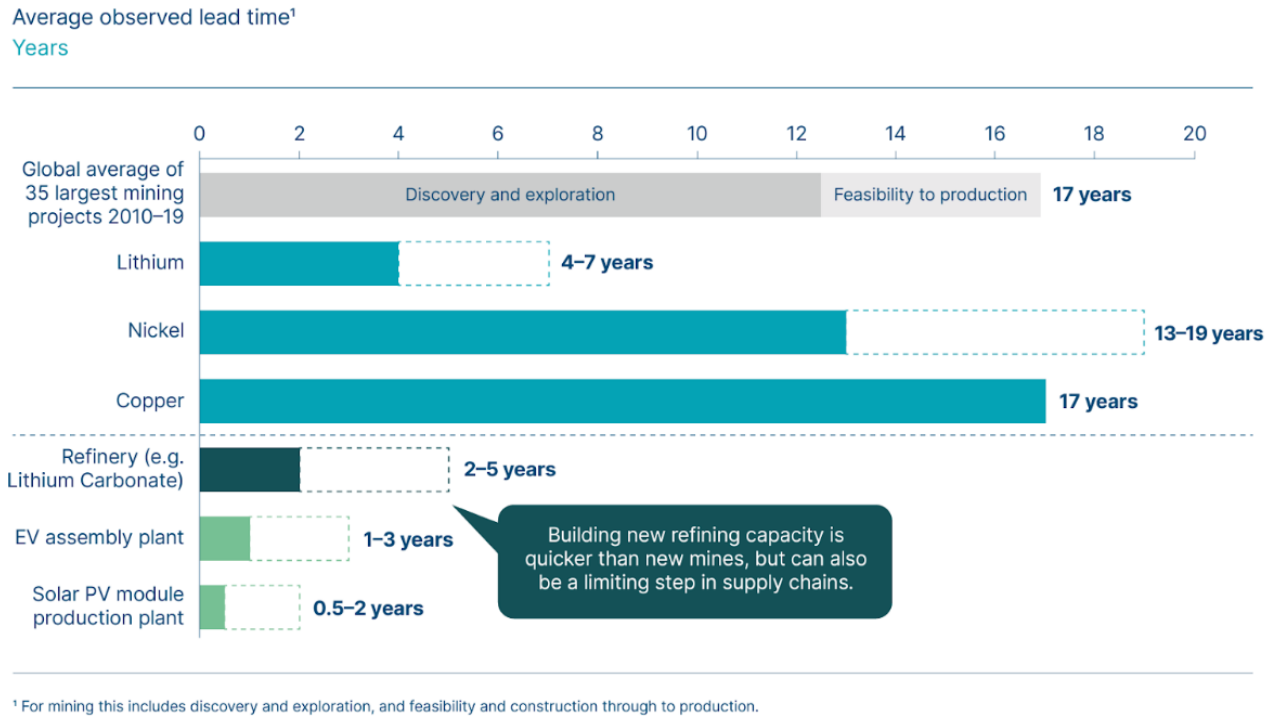
Source : Degen, F. et al. Energy consumption of current and future production of lithium-ion and post lithium-ion battery cells. Nat Energy 8, 1284–1295 (2023)

03f Implementation scenarios

Adoption of Closed-Loop Recycling – Design for recycling

Implementation: Invest in advanced recycling technologies, such as hydrometallurgical or direct recycling, that enable efficient recovery of critical materials without extensive energy consumption.

Impact: Conserves finite resources, reduces dependency on mining, and minimizes waste, moving closer to a circular economy in battery production.



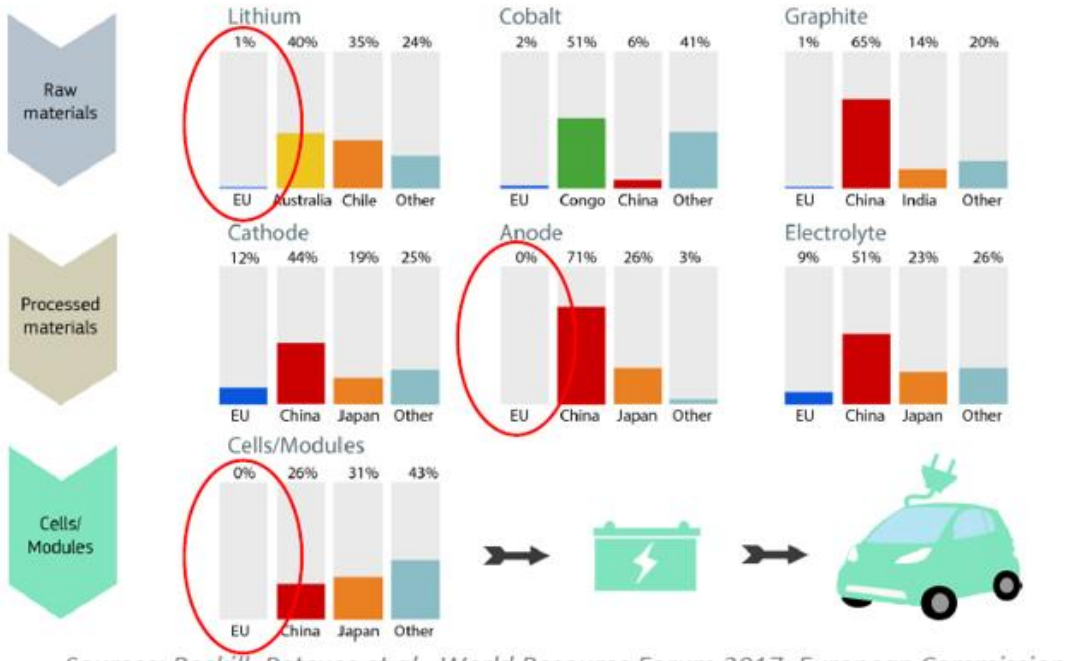
Source : IEA (2023)

03g Implementation scenarios

Sustainable sourcing and eco-friendly chemicals

Implementation: Robust and transparent supply chain and shift to green chemistries

Impact: Supply chain dependability, reduction of pollution, health risk and regulatory adherence



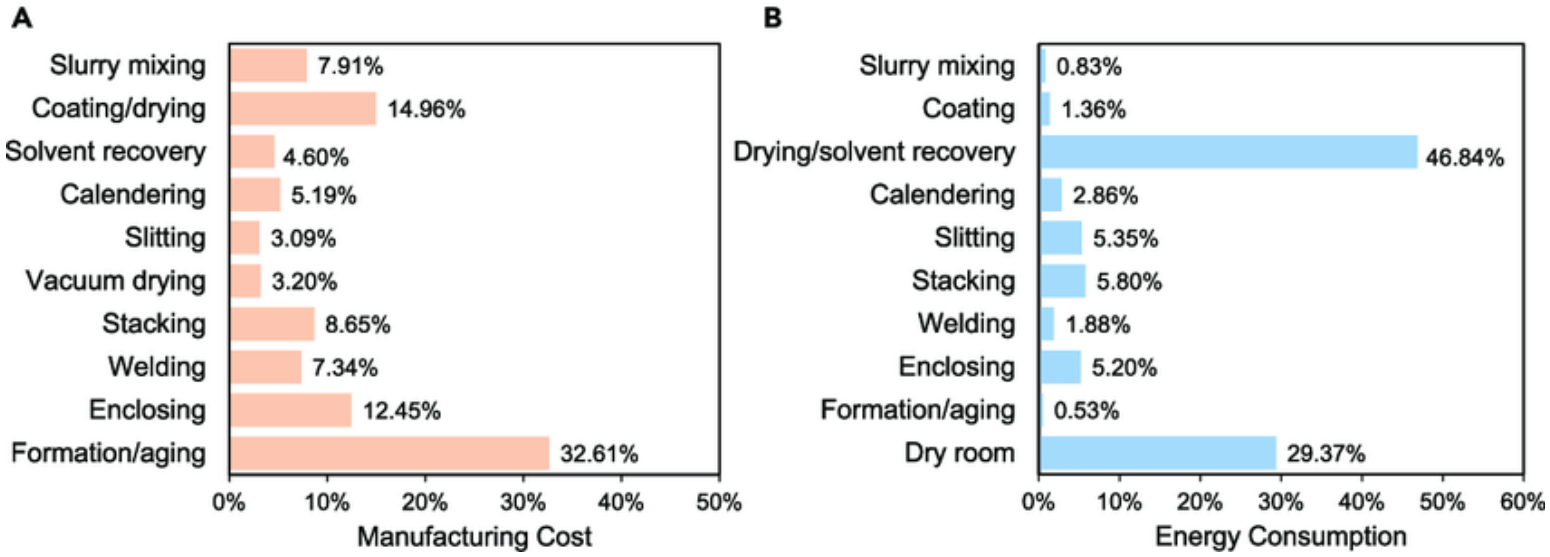
Sources: Roskill, Peteves et al., World Resource Forum 2017, European Commission

03h Implementation scenarios

Modular battery design and energy efficient manufacturing techniques/equipment

Implementation: Evaluate and implement Design for recycling in battery manufacturing and switch to energy efficient process/equipment

Impact: Reduces waste, lowers complexity in recycling, lowers energy consumption and operating costs



Liu, Yangtao et al., Current and Future Lithium-Ion Battery Manufacturing. iScience. 24. 102332

Conclusion

Summary:

- Green manufacturing of batteries is critical to supporting sustainable energy goals while minimizing environmental impact.
- Preserving/efficient utilisation of resources
- Reduction in cost of production
- Fostering innovation

Future Action:

- Encouragement for continued research push towards implementation
- Incentivising companies to adopt green manufacturing

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CONTACT

contact@abeegroup.com
www.abeegroup.com