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From Circular Economy to Export Economy – Europe's Battery Recycling Dead End

Created for:

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EUROPE'S RECYCLING DEAD END.

Do we really need **battery recycling in Europe**?

What is **already working well** – and where are the **current bottlenecks**?

Why is battery recycling **so difficult to implement** for us Europeans?

Is it **just about recycling itself**, or do we need to **think bigger**?

What role does **EU regulation** play?

And **how do we get out** of this dead end?



1

NECESSITY
FOR BATTERY
RECYCLING IN
EUROPE

2

STATUS QUO
RECYCLING
LANDSCAPE
IN EUROPE

3

FINDING THE
RIGHT
RECYCLING
PROCESS

4

QUO VADIS
BLACK MASS?

5

EU-VISION &
REGULATORY
VS. REALITY

6

CALL FOR
ACTION

A functioning battery recycling system is not a “nice-to-have” – it’s a necessity. And the time to build such an ecosystem is running out.

A recycling ecosystem is essential...



Enormous volumes of production scrap, repair cases, and end-of-life batteries

**~2.5 M
tons¹⁾**

per year in 2040



Significant material value

**~10-15
B EUR²⁾**

contained metal value



Criticality and availability of contained raw materials

Up to 90%

Dependency on China
for certain raw materials



Environmental concerns

100 kg CO₂
per kWh battery in
production



Regulatory requirements and obligations for battery recycling

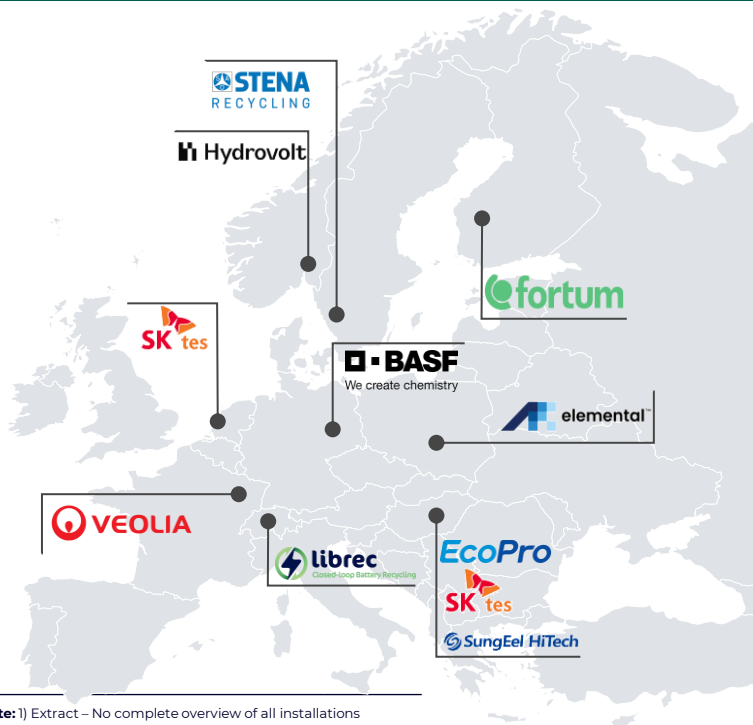
16%
recycled content
requirement for cobalt in
new batteries from 2031
onward

...and it must be established soon – volumes are rising rapidly!

Note: 1) Assuming an annual return flow of 500 GWh; (2) based on a 65% NMC / 35% LFP mix and current raw-material prices.

The first steps in battery recycling – disassembly, shredding, and sorting – are already mastered in Europe at a high level and with sufficient capacity.

Overview battery shredding units in Europe¹⁾



Note: 1) Extract – No complete overview of all installations

>50 existing disassembly and shredding units across Europe with a total annual capacity exceeding **300 kt/a**.

A plant size in the range of **5–10 kt per facility** increases flexibility and minimizes investment risk.

High-tech plant engineering in Europe provides **best-in-class solutions** for shredding, automation, and separation efficiency.

European black mass is in **high international demand** due to its superior quality and purity.

Pyrometallurgical processes (e.g., Umicore, Nickelhütte Aue, ...) serve as **additional flexible options**, also applicable to **alternative chemistries**.

However, when it comes to refining black mass, we still have some catching up to do. Existing plants struggle with process stability, flexibility, and utilization rates.

Technology & knowhow are generally available

Europe has a **strong chemical industry** and numerous companies with the **fundamental know-how and flow sheets** for refining processes.

Moreover, **the first plants for hydrometallurgical black mass processing** have already been **constructed and commissioned**¹⁾.

Company	Country	Capacity	Status
Fortum	Finland	5 000 t/a	Operating
Accurec	Germany	4 000 t/a	Operating
Mercedes-Benz	Germany	1 500 t/a	Operating
BASF	Germany	100 t/a	Prototype
Veolia ²⁾	France	4 000 t/a	Operating

Note: 1) only extract – no full list of all installations. Startups like Tozero or Cylib are also building up capacities. 2) Ni- & Co recovery

BUT: Scaling & cost competitiveness are lacking!

The core challenge remains the **global cost pressure**, driven in part by the **underutilization of existing assets in China and Korea**.

For such chemical plants, **economies of scale** are crucial — **pilot and small-scale facilities will not be cost-competitive**.



Scaling dilemma: When is the right time to scale up, and to what extent? The trade-off between **underutilization risk** and **lack of scale effects** remains critical.



Public acceptance and NIMBY dynamics for large chemical plants in Europe (e.g., BASF in Finland, Sungeel in Thuringia) further **increase investment uncertainty**.



CAPEX (safety requirements, construction labor costs, permitting) and **OPEX** (energy, personnel, SG&A, waste disposal) are **up to 100% higher in Europe** compared to China.

In addition, Europe lacks an offtake market, raising the question of the “right” flow sheet.

	Intermediates	Intermed.	Commod.	Commodities	Downstream Integr.
Flow Sheet/ Output	Mixed Hydroxide Precipitate (MHP)				
Pros					
					
Cons					
					
Offtaker					

In addition, Europe lacks an offtake market, raising the question of the “right” flow sheet.

	Intermediates	Intermed.	Commod.	Commodities	Downstream Integr.
Flow Sheet/ Output	Mixed Hydroxide Precipitate (MHP)				
Pros 	• Standard material in industry • Simple production				
Cons 	• Requires further processing • Lower value density				
Offtaker	Refineries Trader				

In addition, Europe lacks an offtake market, raising the question of the “right” flow sheet.

	Intermediates	Intermed.	Commod.	Commodities	Downstream Integr.
Flow Sheet/ Output	Mixed Metal Sulfate (MMS)				
Pros	• Simplified process vs. individual sulfates • Direct use in pCAM production				
Cons	• Mostly liquid (logistics challenge!) • Limited offtake options				
Offtaker	pCAM producers Refineries				

In addition, Europe lacks an offtake market, raising the question of the “right” flow sheet.

	Intermediates	Intermed.	Commod.	Commodities	Downstream Integr.
Flow Sheet/ Output	Metals & other metal salts				
Pros	• Good transport and storage stability • Flexible downstream usability				
Cons	• No direct (p)CAM integration possible • Process complexity				
Offtaker	Refineries Trader				

In addition, Europe lacks an offtake market, raising the question of the “right” flow sheet.

	Intermediates	Intermed.	Commod.	Commodities	Downstream Integr.
Flow Sheet/ Output	Metal sulfates				
Pros	• Market standard in pCAM production • Direct use possible				
Cons	• Separation processes required • Quality assurance is complex				
Offtaker	pCAM producers Trader				

In addition, Europe lacks an offtake market, raising the question of the “right” flow sheet.

	Intermediates	Intermed.	Commod.	Commodities	Downstream Integr.
Flow Sheet/ Output					pCAM
Pros					• Highest value creation • Process synergies (no individual separation steps)
Cons					• Technologically demanding • High qualification and certification effort
Offtaker					CAM producers

In addition, Europe lacks an offtake market, raising the question of the “right” flow sheet.

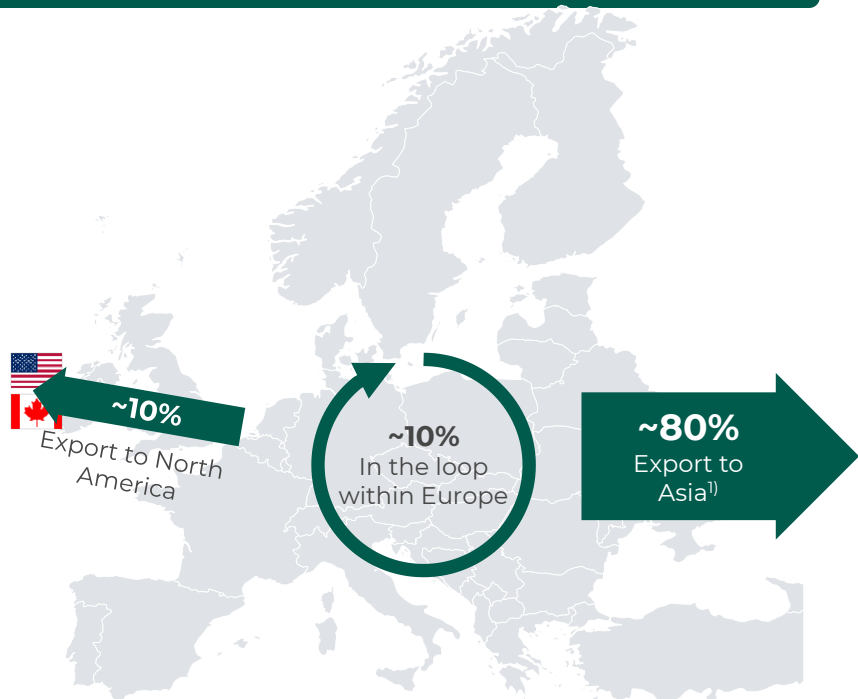
	Intermediates	Intermed.	Commod.	Commodities	Downstream Integr.
Flow Sheet/ Output	pCAM				
Pros +	- Standard material in industry - Simple production	- Simplified process vs. individual sulfates - Direct use in pCAM production	- Good transport and storage stability - Flexible downstream usability	- Market standard in pCAM production - Direct use possible	- Highest value creation - Process synergies (no individual separation steps)
Cons -	- Requires further processing - Lower value density	- Mostly liquid (logistics challenge!) - Limited offtake options	- No direct (p)CAM integration possible - Process complexity	- Separation processes required - Quality assurance is complex	- Technologically demanding - High qualification and certification effort
Offtaker	Refineries Trader	pCAM producers Refineries	Refineries Trader	pCAM producers Trader	CAM producers

Selecting the **right flow sheet and integration level** is **not trivial** and depends on a **variety of parameters**. Currently, the **absence of a pCAM (or more generally, offtake) landscape in Europe** represents a **major bottleneck**.

For **other chemistries (e.g., LFP)**, this is **even more pronounced** – and increasingly **challenged by the lower material value** of LFP.

A large share of European black mass is exported to Asia, though new EU regulations aim to restrict such exports.

Massive outflow of black mass from Europe



Pull factors Asia

- Severely underutilized refining capacities, especially in China and Korea (utilization ~20–30%).
- Active efforts to import black mass (e.g., China: as of 01.08.2025, black mass is no longer classified as waste).
- Intense competition for limited black mass volumes – in 2023, approx. 10 kt of black mass were imported into China from Korea.



Countermeasures EU

- Harmonized classification of black mass as “hazardous waste” across all EU member states (previously decided nationally).
- As a result, exports to non-OECD countries (e.g., China) are now prohibited, while exports to OECD countries are subject to authorization (PIC³) and strict documentation requirements.

Note: 1) Depending on the source, utilization rates range from 60–90%; 2) OECD = Organization for economic co-operation and development; 3) PIC = Prior informed consent – procedure under EU Waste Shipment Regulation (EC No. 1013/2006).

Between ambition and reality: the EU demands higher recycled content – yet Europe's access to recycle remains uncertain.

EU Vision: Recycling as a core element of our batteries

VS.

Reality: Availability & re-integration of recycle

- Harmonized definition of black mass
- **Environmental, sustainability, and efficiency requirements** for battery recycling processes (e.g., CO₂ footprint)
- **Mandatory recycled content quotas** in new batteries (EU Battery Regulation – (EU) 2023/1542)

Metal	2031	2036
Co	16%	26%
Ni	6%	15%
Li	6%	12%

- **Reporting obligations** on transparency, traceability, and compliance (e.g., Battery Passport)

- In **theory, sufficient lithium** feedstock is available – even considering typical recovery rates.
- **However:** Access to **exported black mass** remains a **major risk factor**.
- **Governance tools** (e.g., Battery Passport) are **highly complex and bureaucratic**, acting as cost drivers.
- **Recycling outside the EU** is **formally permitted** for meeting quota obligations – but only under “equivalent conditions.”
- Still: **Where is the value creation for Europe?**

We need more industrial realism and commitment from all stakeholders – not just regulatory romanticism without bite.

How are the “gatekeepers” for recycling feedstock – OEMs and cell manufacturers – positioning themselves?

- No real incentive for localization.
- In the current crisis: **100% focus on cost efficiency** – Asian alternatives remain cheaper.
- **Negative experiences with newcomers** lead to a **preference for “proven players”** – avoiding industrialization risks, quality issues, and the “valley of tears”.
- All **regulatory requirements** can currently be met with the **dominant setup** (shredding in Europe – refining in Asia) OEMs largely depend on Asian cell manufacturers, who have built their own recycling networks in Eastern Europe (Sungeel, Posco, EcoPro, Huayou) – with pre-treatment in Europe and refining in Asia.
- **Introducing alternative material suppliers** often means **higher costs and additional qualification** efforts – a risk OEMs are reluctant to take in the current environment.



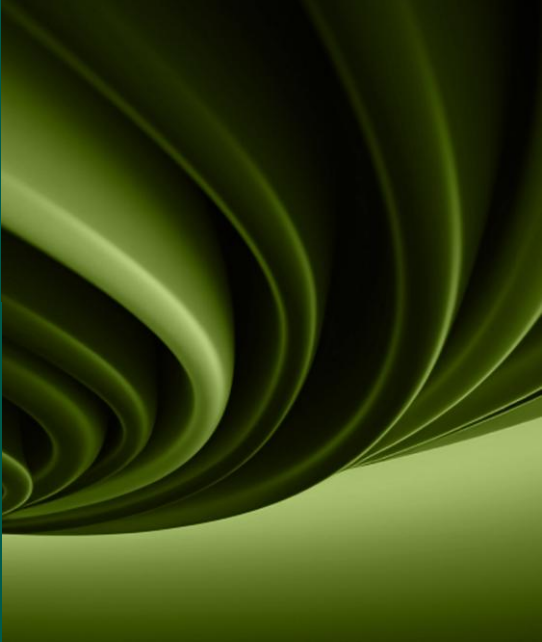
As long as Europe lacks a **cost-efficient, integrated recycling ecosystem** with **committed downstream offtakers** and **political backing**, our role in battery recycling will remain limited to **“waste pre-treatment with export permit”** – not a true closed loop.



Thank you for your attention –
We look forward to the discussion!



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An abstract graphic on the right side of the slide, featuring flowing, wavy lines in shades of green and yellow, creating a sense of movement and energy.

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