



Setting up a battery recycling value chain for the European electric vehicle market

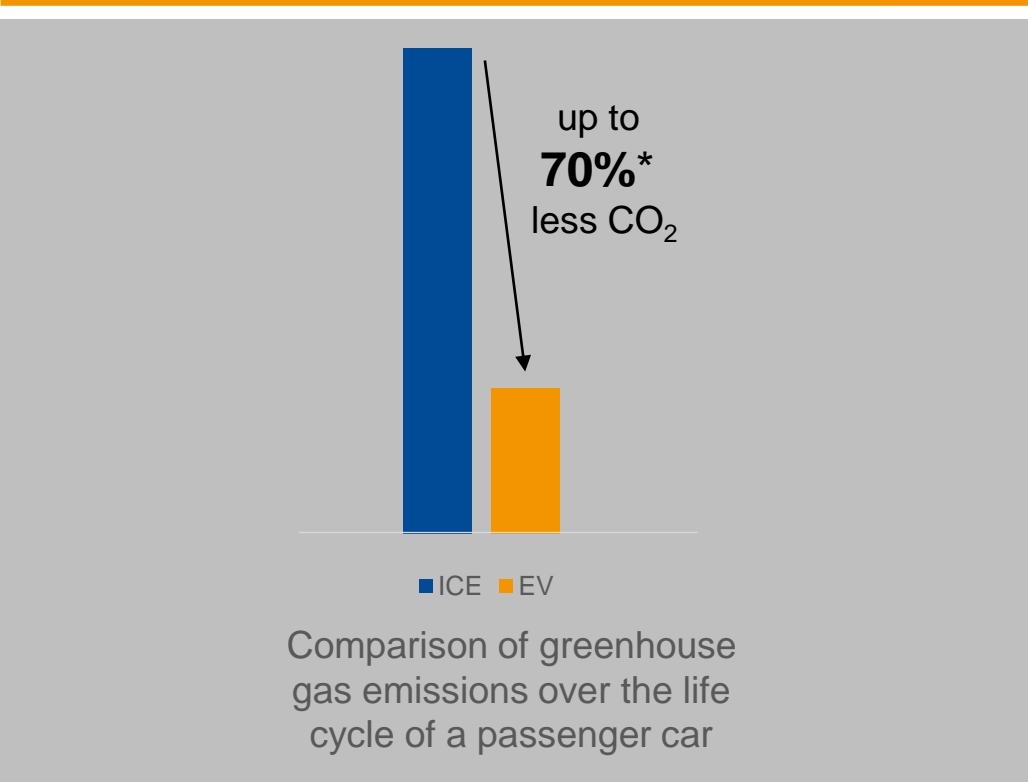
Hungarian Battery Day 2024

Dennis Haardt

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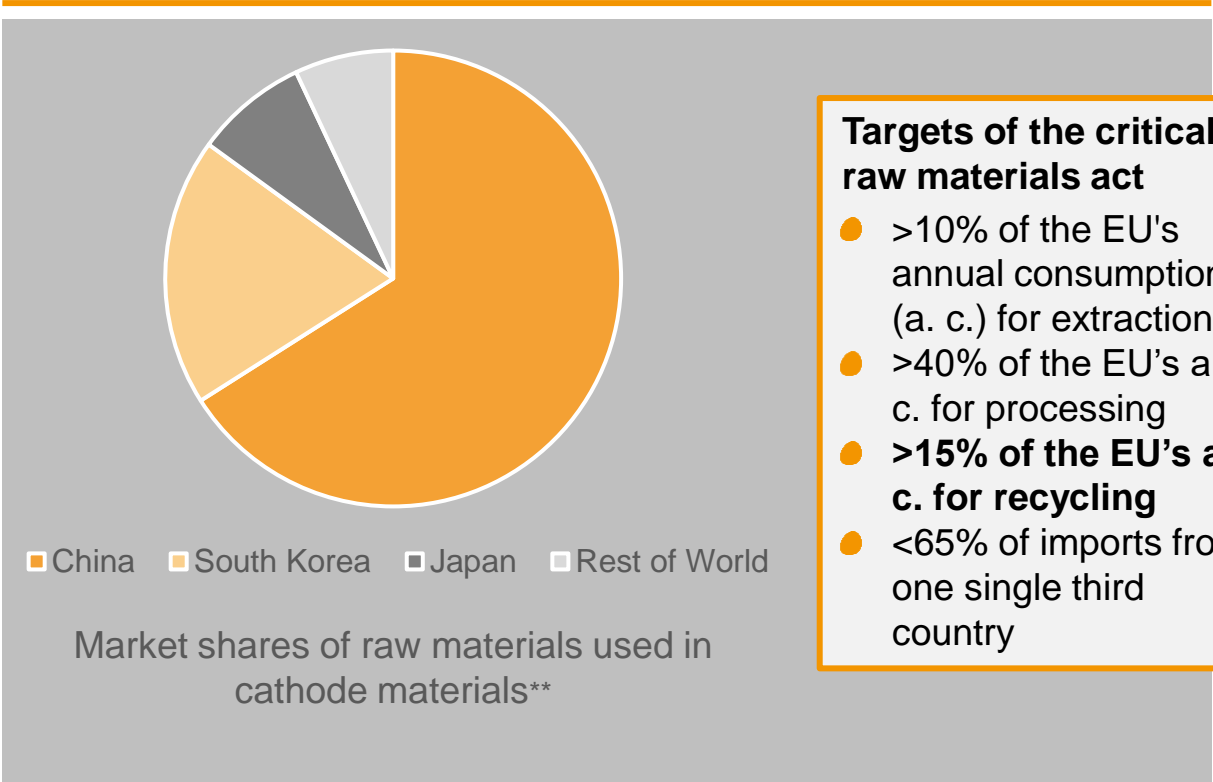
As the global shift towards electromobility gains momentum, an independent supply of raw materials becomes crucial

Electromobility holds immense potential in shaping a more sustainable future



* Whitepaper by international council on clean transportation: A global comparison of the life-cycle greenhouse gas emissions of combustion engine and electric passenger cars, 2021, depending on the distance traveled and the share of renewable energy in the electricity

Important components of battery materials are not easily available in the EU and mostly sourced from third countries



Targets of the critical raw materials act

- >10% of the EU's annual consumption (a. c.) for extraction
- >40% of the EU's a. c. for processing
- >15% of the EU's a. c. for recycling
- <65% of imports from one single third country

**Fraunhofer ISI, Market share active materials 2022



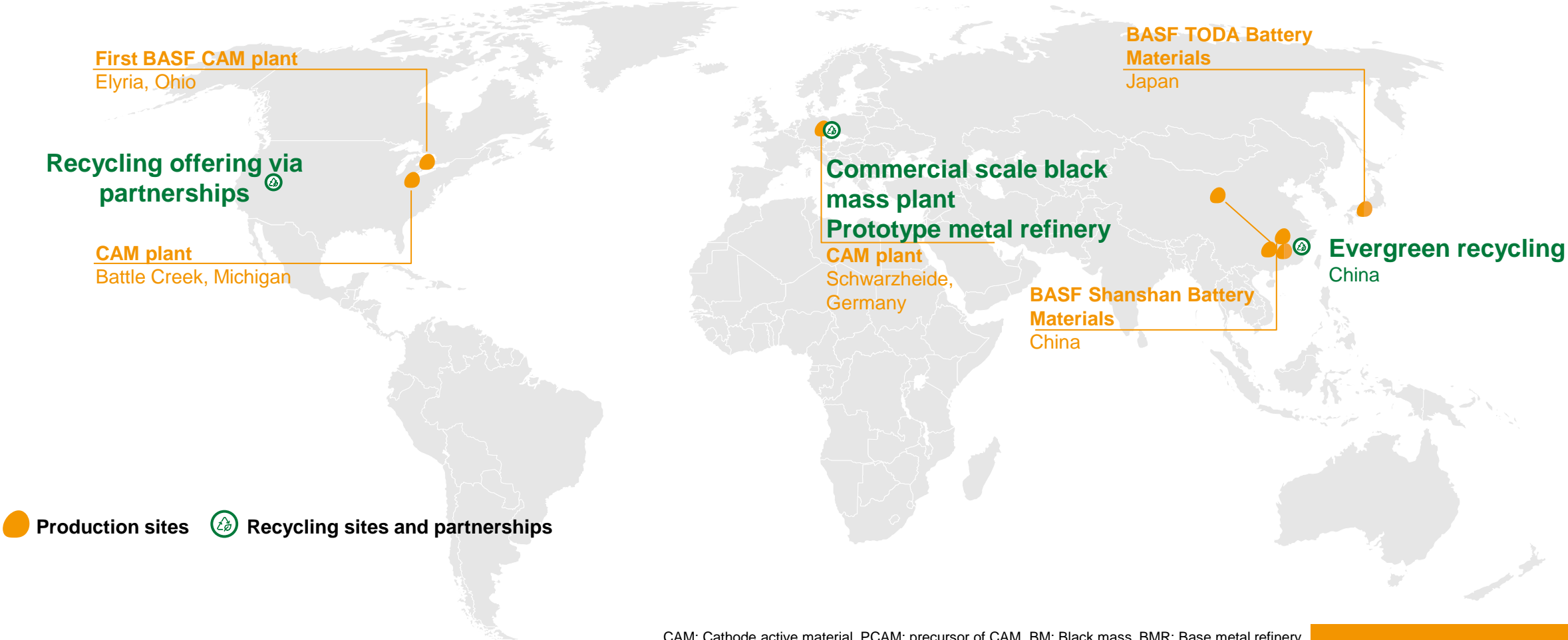
Battery Recycling

enables the shift towards electromobility in the most sustainable way



Our circular approach allows us to feed the **valuable metals** obtained via Battery Recycling **back into the production** of new batteries

BASF serves his customers with battery materials and recycling in all major regions



● Production sites ♻️ Recycling sites and partnerships

CAM: Cathode active material, PCAM: precursor of CAM, BM: Black mass, BMR: Base metal refinery
 Map for indicative purposes, not adjusted for completeness or accuracy



We are proud of our brand-new assets for battery recycling in Schwarzheide!



Black mass production facility



Prototype metal refinery

The prototyping plant is the basis for an optimized large-scale black mass refinery



Key information

- Covers the **whole hydrometallurgical process** and enables **scale-up**
- Facilitates **optimal recovery rates of valuable materials**

With the prototyping plant we gain valuable experience for scaling up to commercial scale

Validate process

Validate and further improve BASF's hydrometallurgical refining process

Optimize input feed

Optimize blend recipes for feeding a commercial scale black mass BMR

Contractor selection

Expertise and connections established with multiple technology and engineering contractors

Optimize equipment

Gain operational experience as basis for equipment optimization

Benefits of prototyping plant

*Base Metal Refinery

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BASF's industry-leading EHSQ standards at the black mass production facility in Schwarzheide



Key information

- Ready for start up **end of 2024**
- **Dry shredding**
- **Annual processing** capacity of **15,000 tons** of EV batteries and production scrap
- **Flexible process** allows for variations in feed composition

To make battery recycling truly sustainable, protecting the environment and well-being of our employees is a key priority

Environmental Protection

Systematic off-gas treatment ensuring no release of toxic particles into the atmosphere

Health

Introduction of contamination and non-contamination areas to minimize exposure to operators

Process Safety

Sophisticated explosion protection concepts

Quality

On-site technology competence center to ensure production quality and process improvements

Examples of EHSQ measures

We provide a full battery recycling package to our customers

Battery recycling platform



Collection network for Europe



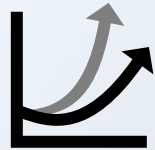
Special transport packaging



Black Mass production and refining



A number of significant market uncertainties are hindering investments in Europe



**Slower market
ramp-up of EVs in
EU**

Also resulting in less
cell production



**Attractive incentive
schemes in other
parts of the world**

Competitive
disadvantage for
investments in
Europe

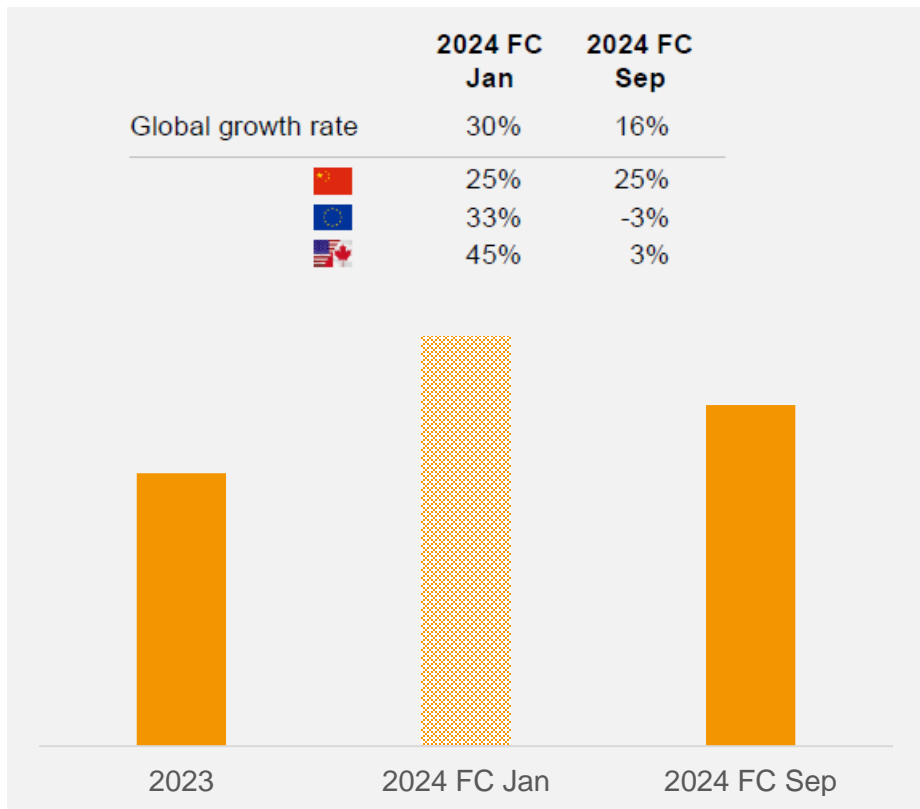


**Unclear regulatory
situation**

e.g. regarding export
of recycling
intermediates like
black mass

The xEV momentum has slowed down significantly in 2024, especially outside of China

2024 xEV growth rate¹ has halved with latest FC driven by reduced demand...



...and OEMs, cell and CAM producers have announced delays to their capital commitments in the Western hemisphere



- Delayed electrification goals by multiple years
- Falling sales and intensifying price war for EVs



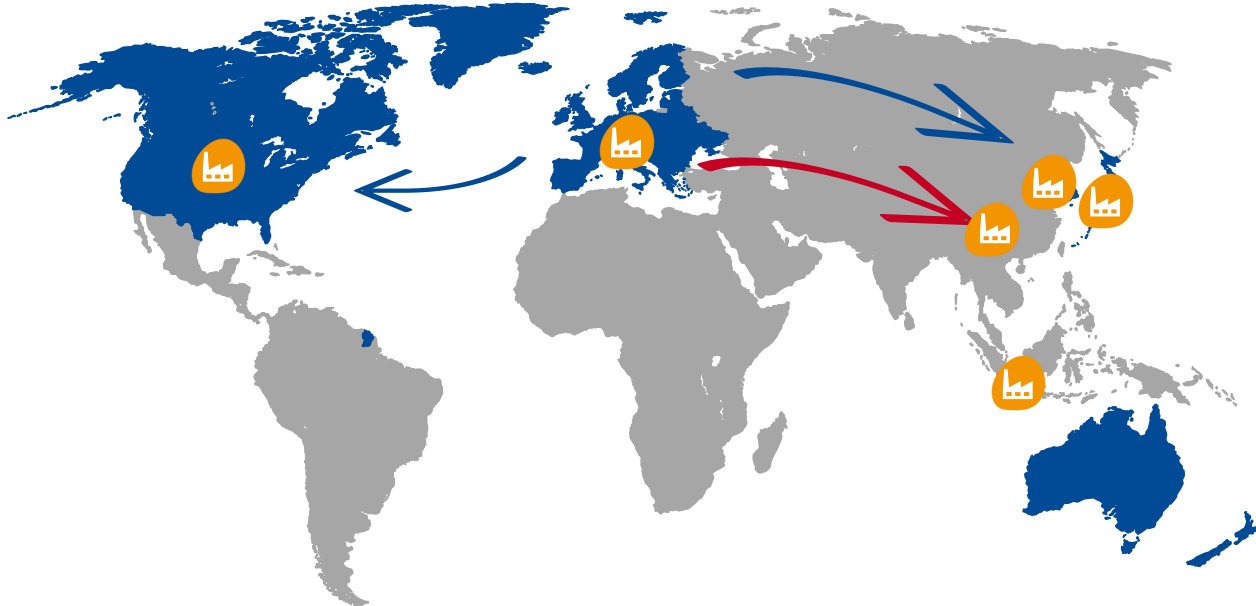
- Reassessed location strategy due to highly volatile market and uncertainty
- Paused work on factories in Europe due to slowing demand



- Reassessed growth projections in response to slowdown
- Abandoned European CAM plant
- Postponed investment in North America

1 – S&P Global Mobility forecast September 2024

Export regulation are a decisive factor for building up a battery recycling industry in Europe



- OECD Country
- Non-OECD Country
- ➔ Export restricted

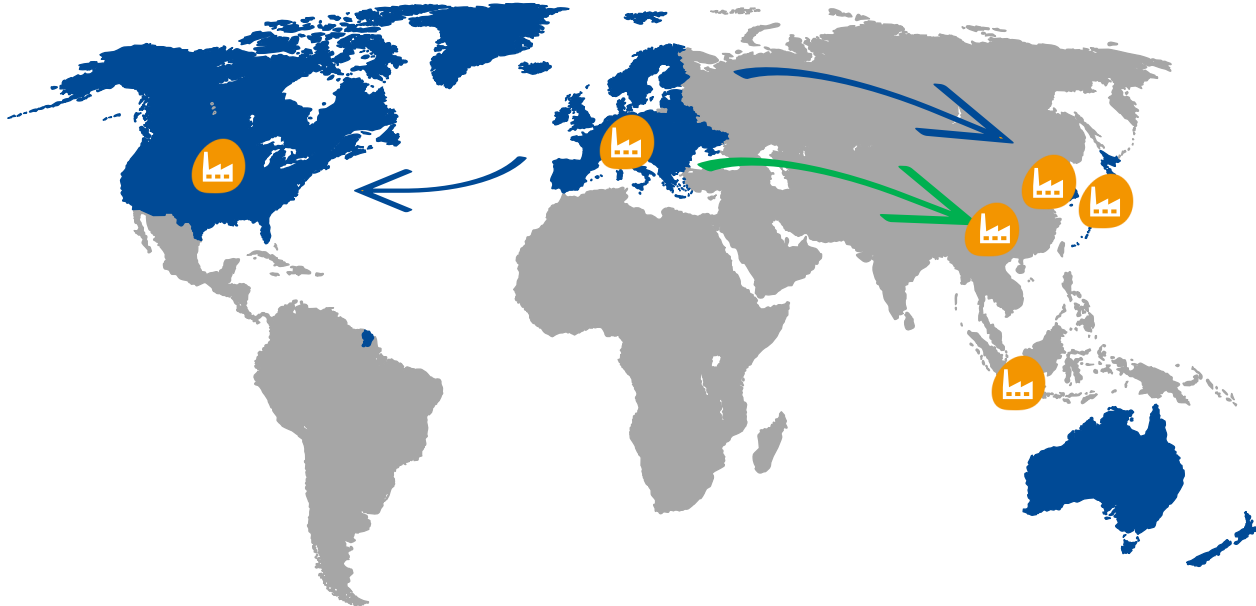


Delegated regulation on recycling efficiency
Feb 2025

The classification of black mass as hazardous waste must be **clear and consistently enforced across Europe fast and uniformly**



Clear end of waste definition for battery recycling required to reduce uncertainty and enable investments

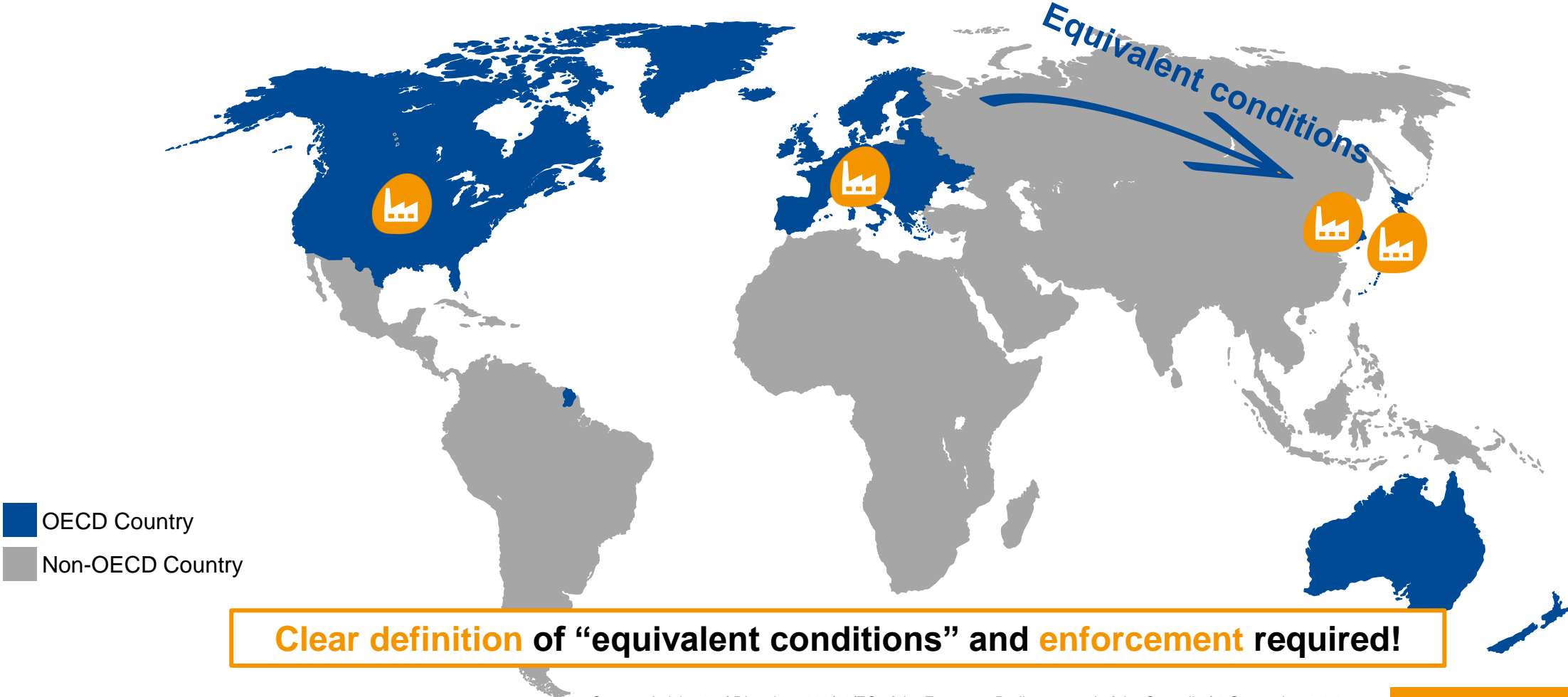


- OECD Country
- Non-OECD Country
- Export as product



Black mass classification as hazardous waste is only effective when black mass cannot be turned into a product with low effort

Recycling in countries outside EU is only allowed under “equivalent conditions”



Clear definition of “equivalent conditions” and enforcement required!

Source: Article 15 of Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC

BASF committed to build a sustainable european battery recycling value chain

KEY Requirements

Classification of black mass as **hazardous waste** must be **clear and consistently enforced** across Europe

Clear end of waste definition for battery recycling. Also **recycling intermediates** beyond black mass must be hazardous waste

Waste tourism must be prohibited

Clear definition of **“equivalent conditions”** and enforcement



Let's power a sustainable future for e-mobility together!



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