



CELLCYCLE

PART OF THE **SER** GROUP

The Challenges of Battery Recycling in the UK and how Innovation can Help Create a Sustainable Future

About Us

The SER Group was founded with the aim to create a sustainable future through IT, WEEE and battery recycling. As of today, the SER Group has established itself as one of the leading recycling companies in the UK.

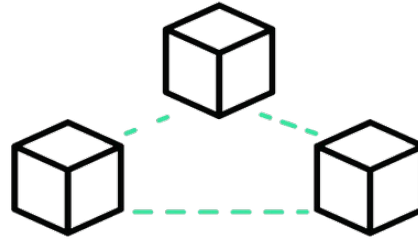
In response to the rapidly growing demand for battery recycling within the UK SER launched its own dedicated battery division Cellcycle.



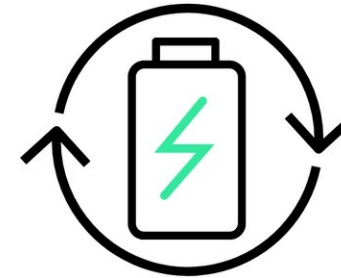
Our Services



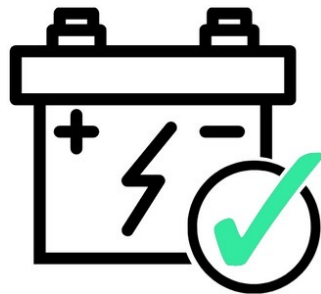
Compliant Logistics



Asset Management



Battery Recycling

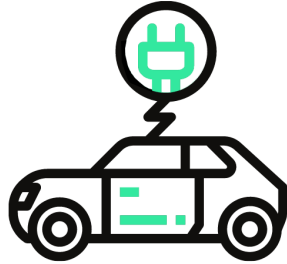


Battery Reuse

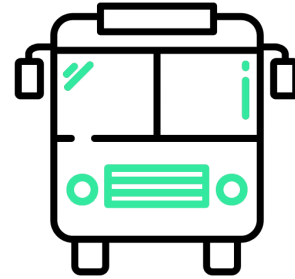


Consultancy

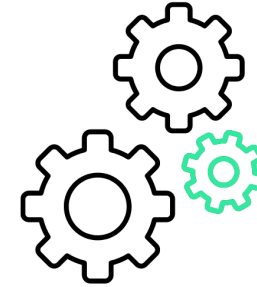
Across a Range of Industries



Automotive Industry



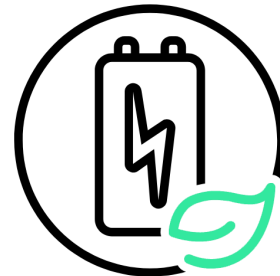
Transport Sector



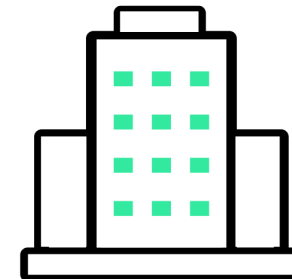
Manufacturing



Healthcare & Medical



Renewable Energy



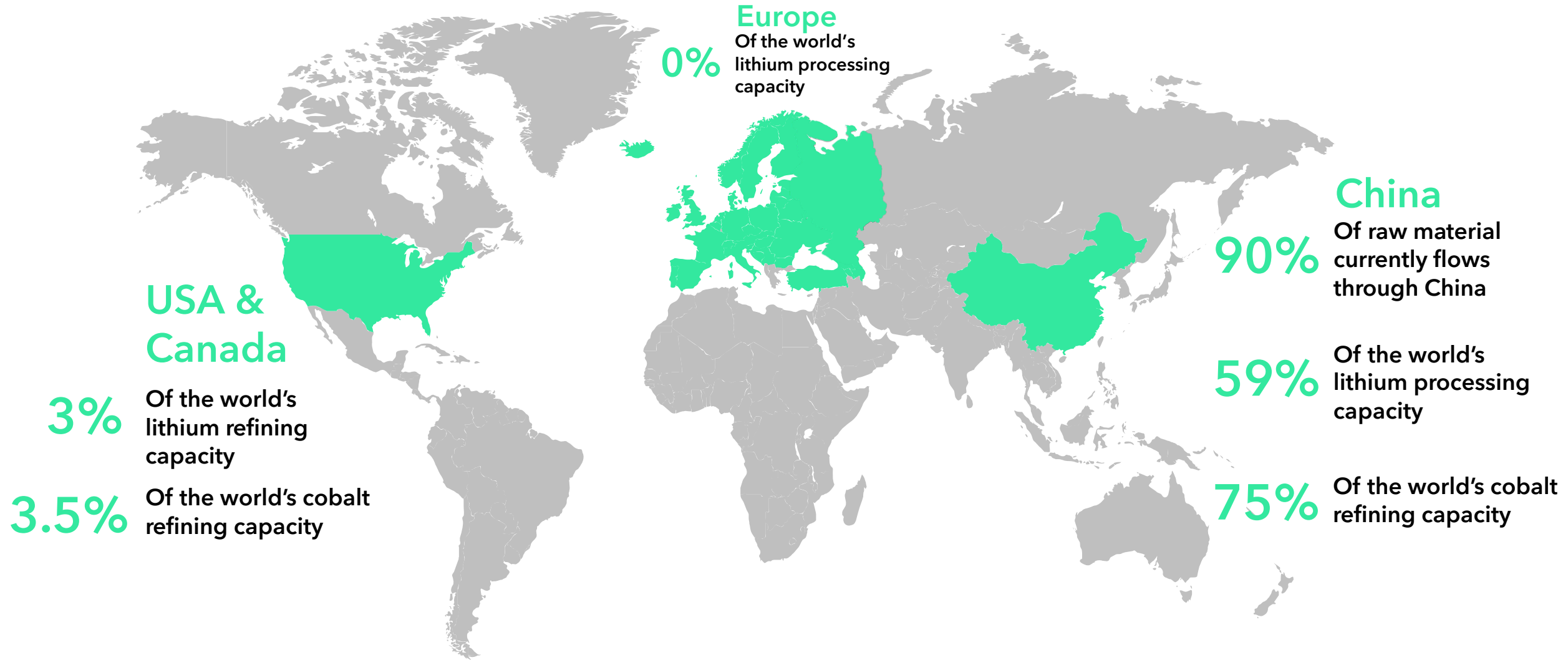
Commercial Sector

The Current Challenges Faced in the UK

- UK behind Europe, US and Far East in battery recycling innovation
- Logistics
- classifications, ADR and requirements
- Barriers of being sustainable
- The solutions
- Innovation
- Collaboration



Global li-ion recycling at a glance



3% Of the world's lithium refining capacity

3.5% Of the world's cobalt refining capacity

USA & Canada

0% Of the world's lithium processing capacity

Europe

90% Of raw material currently flows through China

China

59% Of the world's lithium processing capacity

75% Of the world's cobalt refining capacity

What is logistics for recycling purposes?

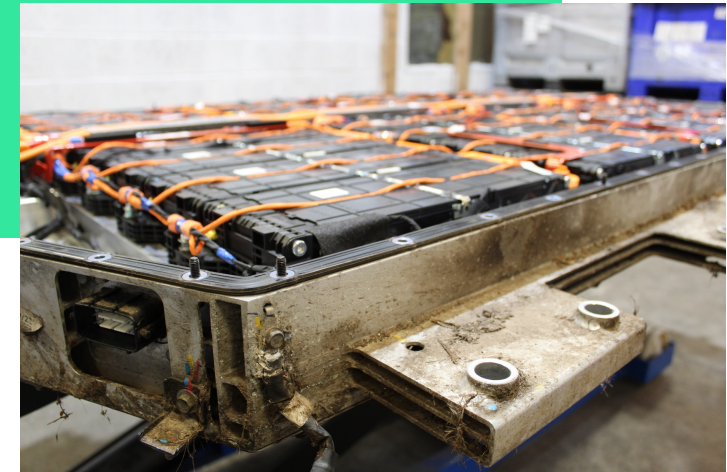
When a lithium battery whether portable (<4Kgs) or industrial/automotive (application) is considered unfit for original purpose, damaged or is discarded. (However, could be considered for reuse or repurposing), the consignment of a battery to batteries becomes waste and falls under the Battery Waste Regulations (WB&A Regulations 2009).

Waste lithium batteries potentially falls under the ADR (Accord relative au transport international des marchandises Dangereuses par Route) Dangerous Goods, depending upon weight shipped and status.



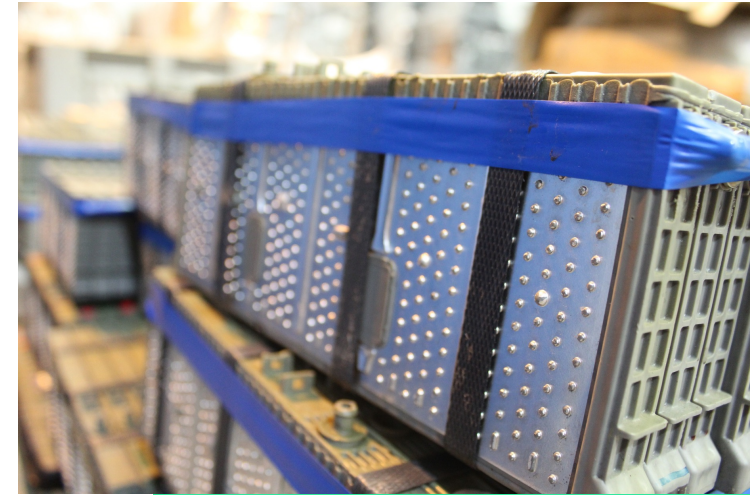
What is considered safe or unsafe to transport?

- A safe to transport battery is a unit that conforms to tests 38.3, is free from damage, and generally in an operable state but maybe no longer fit for its originally designed purpose.
- Unsafe no longer conform to tests 38.3, or is a prototype before manual testing criteria is complete, it should be undamaged, leaking or venting. (Generally BMS failure or other)
- Critical does not conform to tests 38.3, expanded (blown), Mechanically or thermally damaged, leaking or venting



Oddities around the ADR and Battery Regulations

- When considering if an ADR driver is required. 333Kg rule
- ADR boxes have different requirements depending on manufacture, chemistry vs kWh
- Under or over 30 Kg rule
- Determining what is safe or unsafe.
- Which packaging to use (400Kg max on some)
- Hazardous waste or green waste
- Exclusion of NiMH from the ADR regulations



Battery Classification for ADR

Chemistry
Identification

Li-ion

Technical Assessment for Compliant Transportation

- Battery conforms to 38.3 criteria
- Do defects from mechanical or thermal damage

GREEN

- Identified as being defective for safety reasons
- No longer conforms to 38.3 criteria
- No leaking or venting
- No mechanical or thermal damage to cells

AMBER

- No longer conforms to 38.3 criteria
- Classed as defective from mechanical or thermal damage to cells

RED

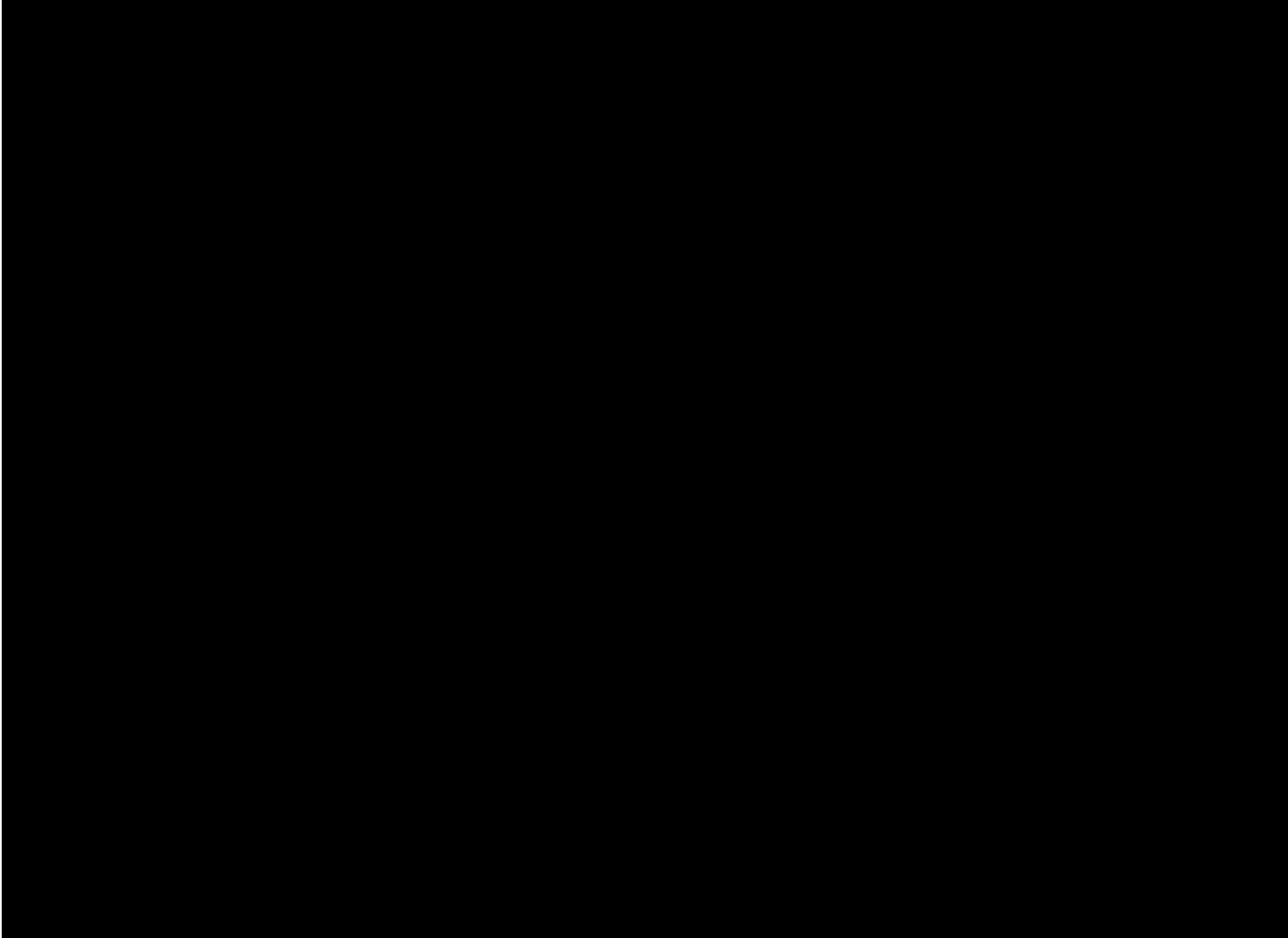
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UK Compliance, legislation and regulation

- All UK battery recyclers must be approved by a regulative authority (EA, SEPA, NIEA...)
- ABTO, ABE, Environmental Permit and other accreditation
- ADR compliant processes for li-ion batteries
- Basel Convention compliance for import & export
- European Waste Codes
- Due diligence, Transparency & Competency

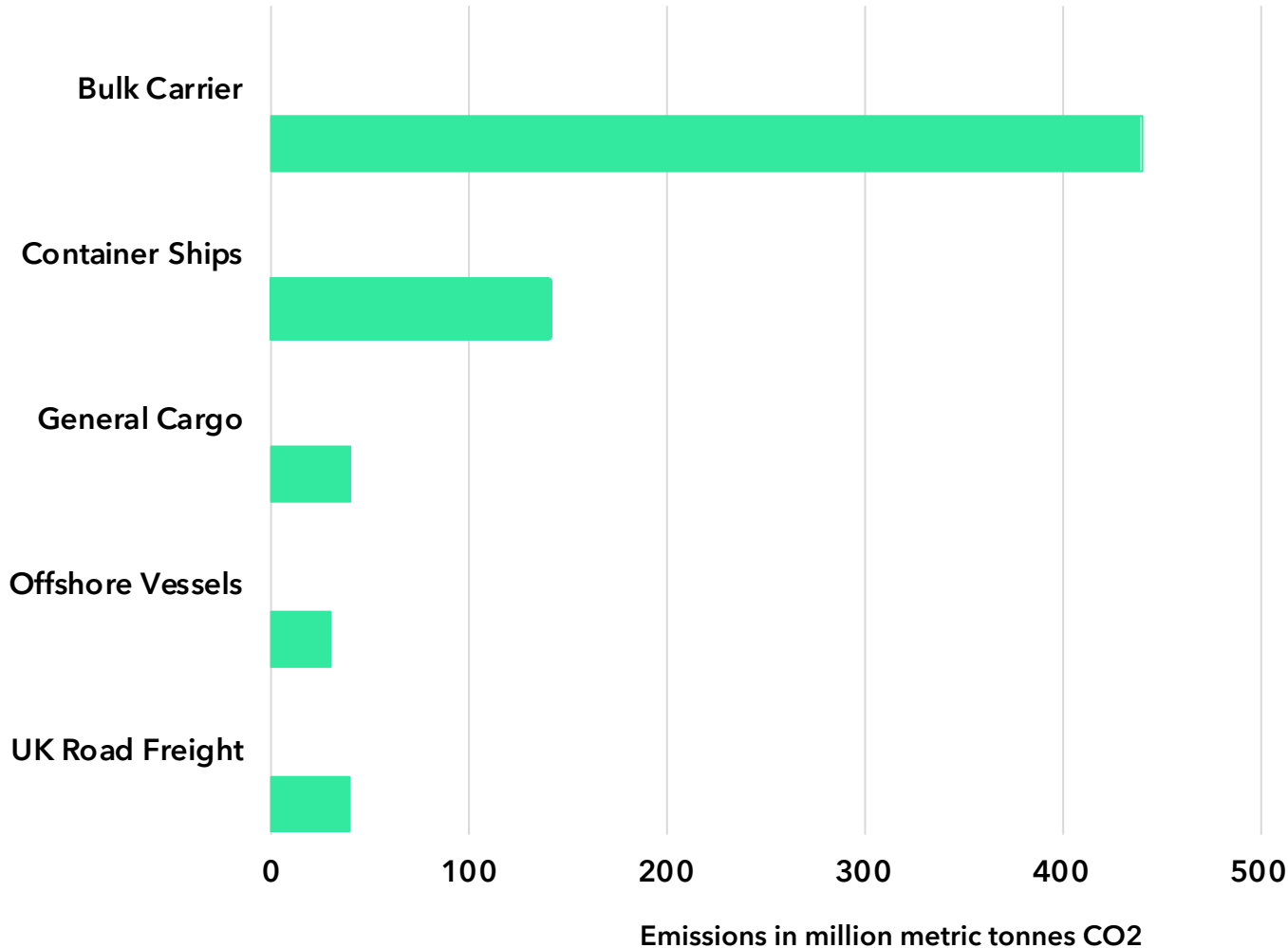


UK experience with Lithium battery recycling

- Europe and wider areas of the globe class li-ion batteries as hazardous waste but the UK classes it as Green Waste
- Currently in the UK there's no refining capability
- The UK's battery recyclers currently only provide: Specialist handling, logistics, dismantling, packaging and storage with a minority of recyclers having shredding capability to produce blackmass
- Currently however, all UK li-ion battery recyclers have to export their material to refiners across the globe



CO₂ emissions in worldwide shipping



650 million metric tonnes of CO₂ emissions

This statistic shows the CO₂ emissions in worldwide shipping according to 2020 estimates, by ship type. Bulk carriers emitted on average 440 million metric tons CO₂, while container ships emitted 140 million metric tons CO₂ per year, General Cargo 40 million and Offshore vessels 30 million.

The total amount produced by heavy goods & light duty vehicles in the UK is 39.6 million metric tonnes.

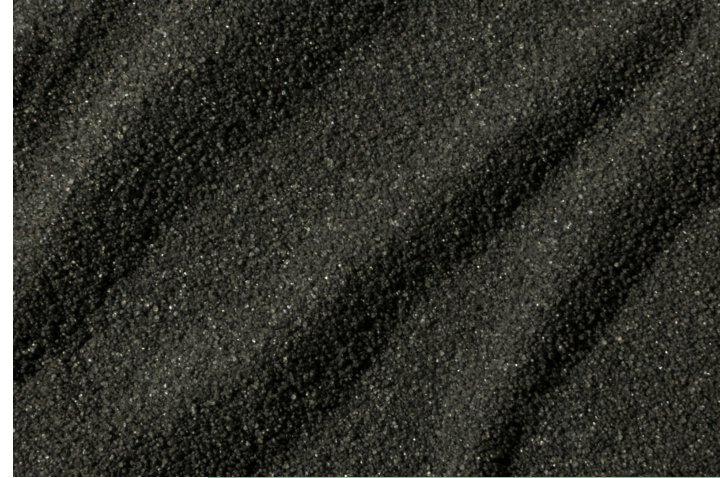
Producing a Black Mass for Battery Recycling

- Black mass is produced through multiple shredding of battery material
- Just like li-ion batteries, blackmass is currently regarded by some as green waste, but should it be?
- Some of Europe and wider consider it hazardous
- In the UK recyclers can only shred li-ion batteries down to a blackmass and so this material must be exported to refiners outside of the country



The benefits of black mass in recycling li-ion batteries

- Not shipping live battery
- Low fire risk
- Allows extraction of critical minerals
- Easier to export under current legislation
- Increase potential yield of critical minerals
- Reduce the overall mass of battery material
- Easier to treat through current refining processes



Problems arising from the Creation & Treatment of Blackmass

- The recycling of battery materials doesn't just give rise to fire risks from thermal runaway, but also potential hazards from chemical constituents of the batteries.
- The removal of fluorine is crucial when reducing the risks and material costs when refining battery material.
- Both Nickel and Cobalt are carcinogenic and as such require specialist handling to limit occupational exposure.
- Acetylene Black is also considered carcinogenic
- Primary control measures must be implemented at design and engineering stage not just for PPE but how the material is to be processed
- The battery recycle industry must focus on the risks associated with the treatment of black mass and battery material and put the necessary processes in place to ensure a safe and sustainable future for EOL li-ion batteries.



What if?

- We don't need to take batteries down to a black mass
- We could reduce the risks and hazards of recycling battery material
- You could develop new techniques not currently used by industry leaders whilst still producing battery grade critical minerals
- Utilise a new recycling process more sustainable than the current industry standard
- The batteries can be recycled using completely natural, biological and reusable resources
- It is scalable and adoptable



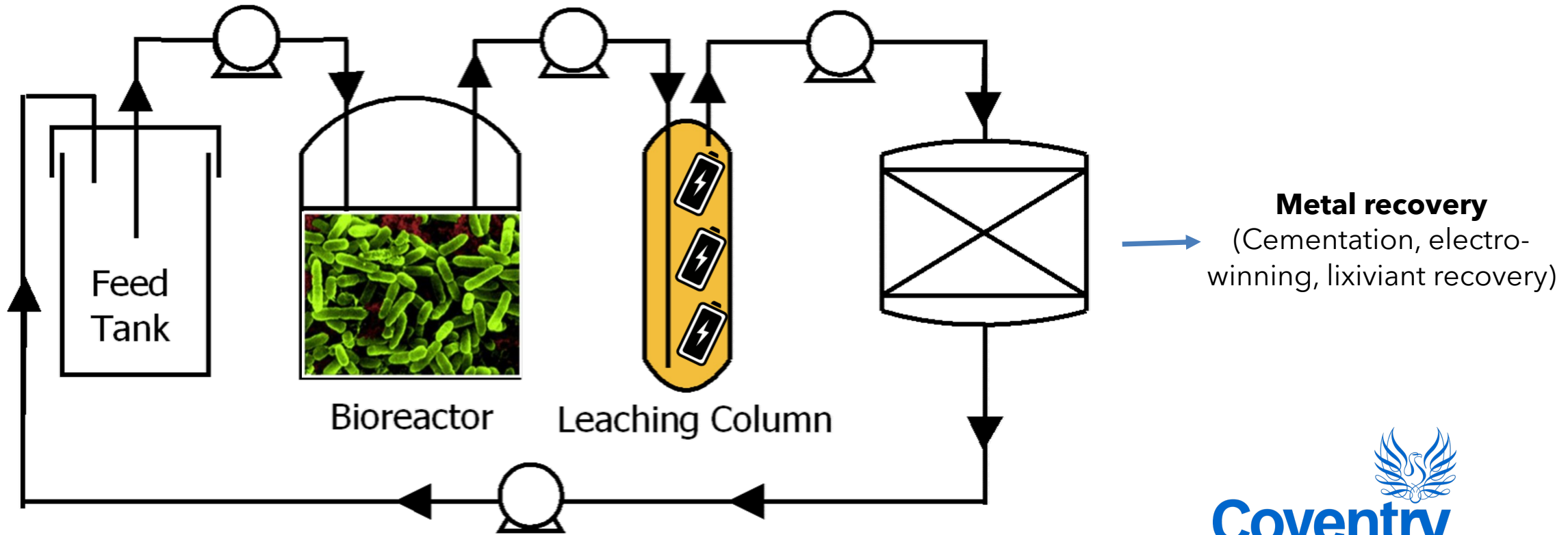
How we're making this possible

The use of naturally occurring microorganisms, harmless to both humans and the environment,

Conversion of insoluble solid metal into water-soluble metal to recover metals including copper, zinc, lead, arsenic, antimony, uranium, nickel, molybdenum, gold, silver and cobalt...



A Sustainable Closed-loop System



Thank You!

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