

# **Battery recycling:**

**Research presentation** 









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# **D-Carbonize & its CO<sub>2</sub> management software**





# 2 360 000 tCO2e under management in the Carbon Cockpit



tCO2e under management - 2021



Hypotheses: 1 hectare = 10 tCO2e offset in 1 year 1 hectar = 1 000 trees 1 tree = 10 kgCO2e/year



# Martin Kahl – Our expert partner

Martin Kahl is an independent writer, researcher, and consultant specialising in automotive and future mobility.

Martin has over 20 years' experience in supply chain research, automaker profiling, consulting, journalism, editing, publishing, conference hosting and moderating.

Learn more about Martin's research and editorial consulting services for automotive and mobility stakeholders at <a href="https://kovetic.com">https://kovetic.com</a>

Martin also hosts <u>Ride: The Urban Mobility Podcast</u> which looks at all aspects of the business of getting around.





# **Public launch of report at Umicore recycling facility**





30 000 words 30 interviews 37 organisations contacted

Format: Electronic, available online





Vice Prime Minister of Belgium and Federal Minister of Mobility and Transport, Georges Gilkinet.



# **Study scope**

### Lithium-ion battery (LIB) value chain and study scope



Scope of the study

# Battery recycling -Introduction



# **Context and key numbers**

Today 2030 X14 23 16.5 m 12% ww fleet Electric vehicles worldwide (ww) ~10 years = ~80% capacity ~450 kg Incl. lithium = 8kg Mining Recycling 1 t of lithium = 55 t 2 273 000 750 t 250 t of used batteries of brine of ore litres water -3 8ookgCO2

30/05/2023



At least 384 new graphite, lithium, nickel, and cobalt mines will need to be built over the next decade to meet demand for electric vehicles and energy storage batteries by 2035

Benchmark Mineral Intelligence





# **Opening thoughts about the current recycling sector** In a nutshell

- Worldwide recycling capacities need to grow by x25 by 2030 (World Economic Forum & Global Battery Alliance)
- European recycling capacities need to grow by x20 (~600 kt) by 2030
- 2 recycling facilities in BE: Umicore (7 kt) & ABEE (R&D)
- Recycling feedstock currently relies on production scrap (30% → <5%), some used and damaged batteries</li>



### **From Umicore**



# Main challenges summarised by 'CARS'





# **CARS: Inside a battery**





SABIC prototype EV battery pack tray



### **CARS: Inside a battery** Pack weight Pack capacity Weight per Model (kWh) kWh (kg) (kg) 6.7 **Chevrolet Bolt** 435 65 kWh VW ID.4: 82kWh – 493 kg Ford F-150 726 131 kWh 5.5 Lightning 6.2 214 kWh Hummer 1329 Pack removal Hyundai lonig 5 72.6 kWh 6.2 450 64kWh Kia Niro 457 7.1 Enclosure = typically 60 – 160kg Renault Zoe 326 55kWh 5.9 Pack Tesla Model 3 481 75 kWh 6.4 12 modules VW e-up! 248 36.8kWh 6.7 VW ID.4 82kWh 6.0 493 Module 288 cells Source: VW media Cell

30/05/2023

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# **CARS: Inside a battery**

Importance of cathode chemistry

Anode Graphite



# Cathode

*Lithium* + nickel / managnese / cobalt / phosphate

- o Common to chemistries
- o **1 kg/kWh**
- Hard to recycle
- Not commercially viable
- Reducing agent in its high temperature process

- **NMC**: lithium-nickel-<u>manganese</u>-cobalt-oxide, (50% ww)
- NCA: lithium-nickel-cobalt-<u>aluminium</u>-oxide, (Tesla)
- LFP: lithium-iron-phosphate (low value minerals) (rising star, shorter range)
- Future = Solid-state batteries >2030



# **CARS: Different chemistries, same sourcing challenge**

Minerals from an average 60 kWh battery (excl. LFP)



■ Graphite ■ Aluminum ■ Nickel ■ Copper ■ Steel ■ Lithium ■ Manganese ■ Cobalt ■ Iron 30/05/2023



# **CARS: Material sourcing for LIB**

### Dependence on mineral sourcing – Geopolitical risks



Good to know: in 2021, global prod. of lithium = 0.5% total reserves

### Sources of battery raw materials





# **CARS: Material sourcing for LIB**

Strategic importance to keep valuable materials and energy storage capacity in EU



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### Sources of battery raw materials







Yann Vincent, Chief Executive, Automotive Cells Company (ACC)



# **CARS: Material sourcing for LIB**

### Dependence on China for graphite production for LIB



### Level of control by CN



~70%



Up to 100%









# **CARS: Material sourcing for LIB**

### Alternatives are coming...



Synthetic graphite



Anode-free batteries (\$50/kWh at scale)



Lignode (from trees)





### Existing regulation is unsuitable for new industries such as LIB recycling

Europe's most recent regulation covering batteries dates from 2006, and doesn't cover LIB.



Under current European legislation, the first producer remains responsible for the battery throughout its life.

Until the liability issue is addressed, automakers will be reluctant to allow their batteries to go into second life.

Liability



### Existing regulation is unsuitable for new industries such as LIB recycling

Europe's most recent regulation covering batteries dates from 2006, and doesn't cover LIB.





Liability Permit



### Factors to consider when choosing a recycling facility location

- Permit obtention
- Favourable energy costs and availability of low carbon energy
- Land availability
- Good logistics
- Availability of well-developed infrastructure
- A highly qualified workforce
- Subsidies and incentives



### Existing regulation is unsuitable for new industries such as LIB recycling

Europe's most recent regulation covering batteries dates from 2006, and doesn't cover LIB.



Liability



Permit



Transport

"Our troubles start when things are labelled as waste. **Society and industry are changing, but regulation is not keeping up.** We very strongly advocate for a review of regulation to be suitable for a circular economy model. What is waste? Frankly speaking, a battery pack, even no longer usable, is not waste."

Kurt Vandeputte, Sr Vice President Battery Recycling Solutions, Umicore



Coming regulations expected to provide clarity...but still only reached proposal stage

Coming regulation includes:



Carbon footprint declaration: From 1 July 2024, batteries must "comply with maximum lifecycle carbon footprint requirements"

- Major role for carbon calculation tools.



Battery passport: An electronic exchange system for battery information, to be in place by 1 January 2026. Expected to be a QR-code/RFID-based system with Blockchain that shows the history of the battery, from raw materials, manufacturing, and ownership, to repairs and modifications.



Specific targets for **battery collection**, and for the use of **minimum levels of recovered materials**: cobalt (16%), lead (85%), lithium (6%) and nickel (6%) in new batteries

# CARS: Moving batteries can quickly become a challenge

Regional and national administrative tasks are hampering the development of this industry





"Rules vary in Belgium between Flanders, Wallonia, and Brussels, which makes it very difficult to operate"

Kristof Bogaert, advisor at Denuo, BE waste and recycling association

# **Closing thoughts**



# **Battery recycling closing thoughts**





Recycling will complement, not replace mining (≤10%)



# **THANK YOU**



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