



## Overview of the new regulatory requirements concerning the recycling of Li-ion batteries

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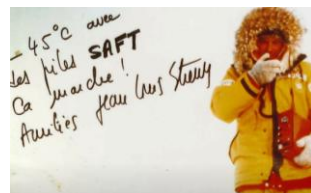
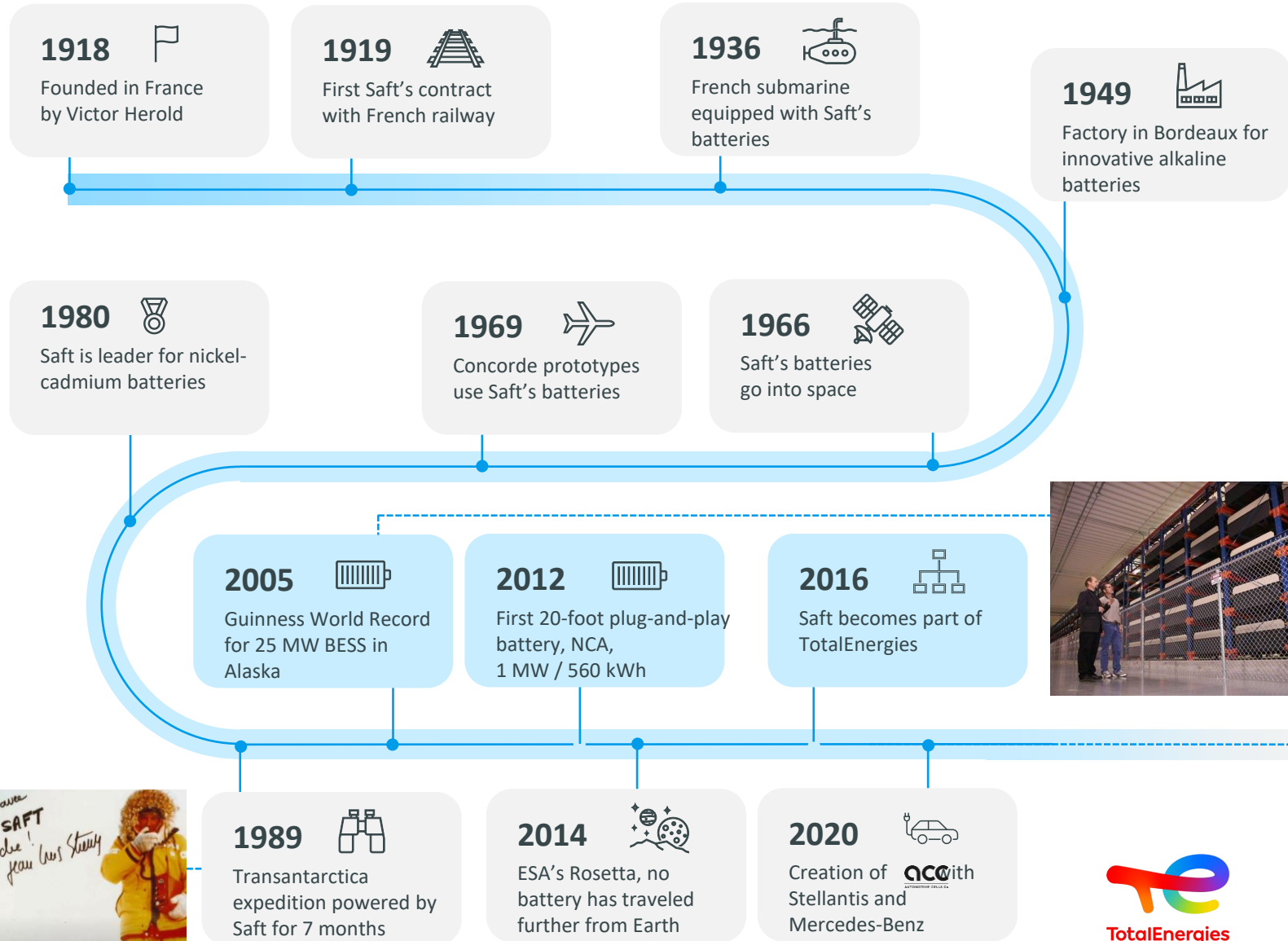


**TotalEnergies**

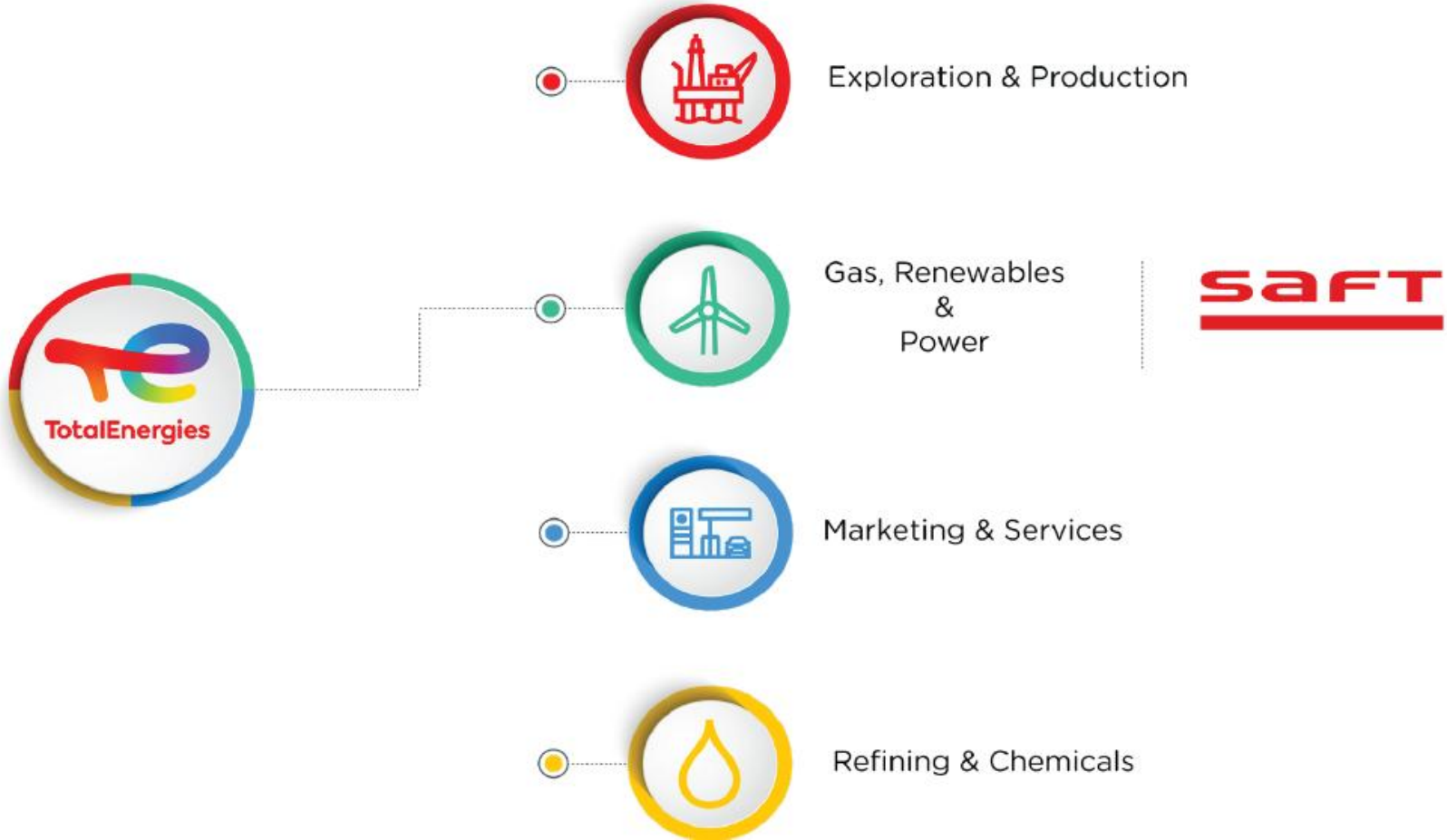
# Saft, we energize the world since 1918



- 19 countries**  
**16 industrial sites**
- 4 500 employees**  
**55 nationalities**
- 4 divisions**
  - Aerospace, Defense & Performance
  - Connected Smart Energy
  - Energy Storage Systems
  - Industry, Mobility & Infrastructure
- € 111 M in R&D in 2024**  
**42 patents in 2023**
- € 1,3 B in revenues**  
**+15% vs 2023**
- Battery Leader**
  - 50% of the world's high-speed trains
  - 75% of international metros
  - Supplier to 5 Formula One teams
  - Two-thirds of the global aircraft fleet
  - Over 300 satellites with our batteries



# Saft, a wholly-owned subsidiary of TotalEnergies since 2016





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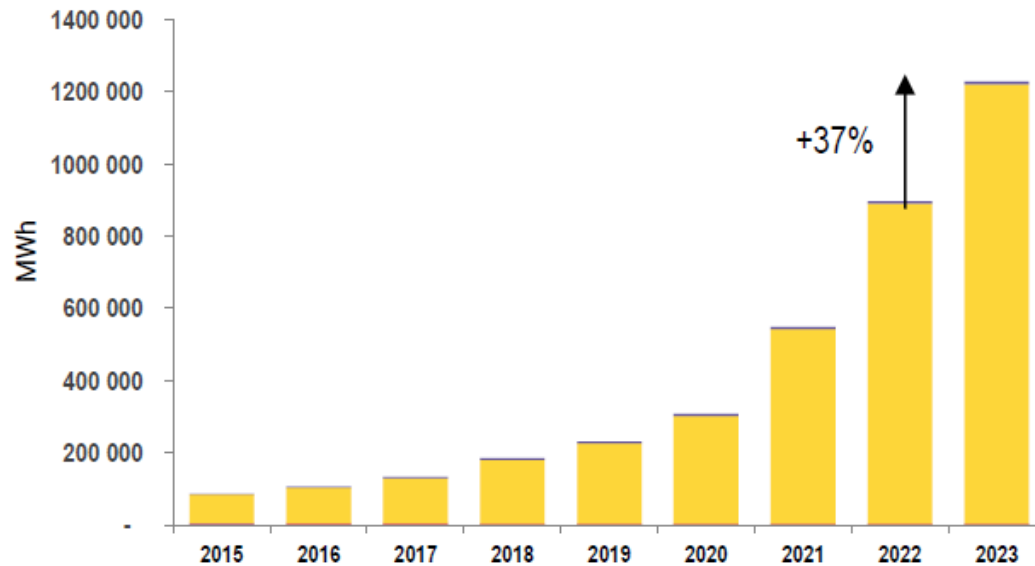
01.

Quick overview of the  
Li-ion battery market

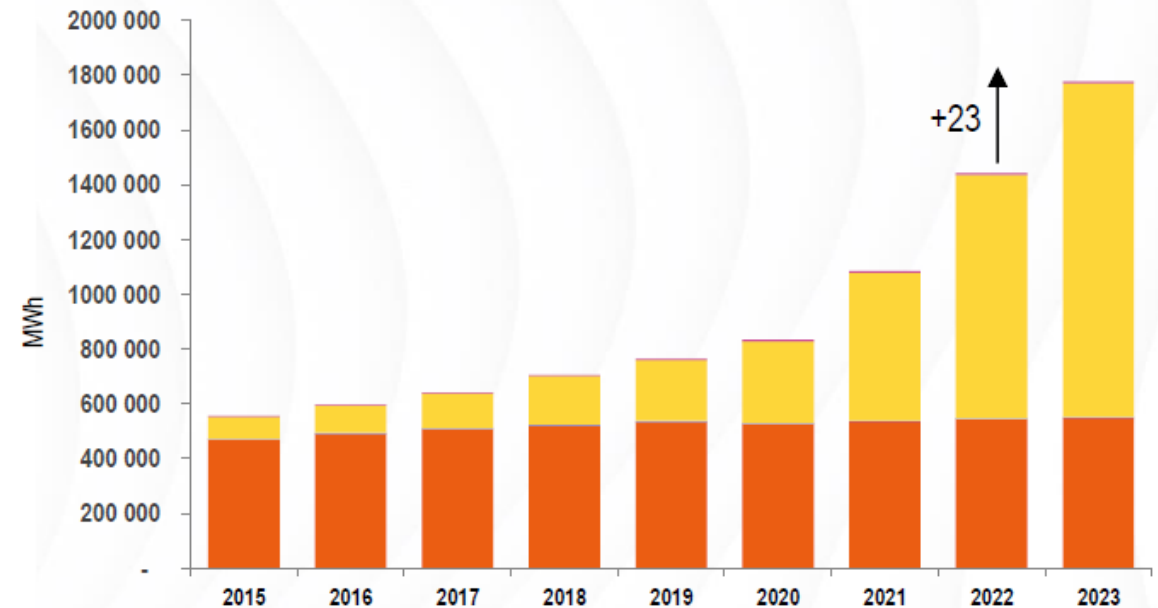
# Worldwide battery market (in MWh)

Within the global battery market, the Lithium-Ion battery segment represents the highest growth & the major investment part, while Lead Acid batteries still represents >30% of the market

Worldwide battery market by Chemistry, 2015-2023, MWh



Worldwide battery market by Chemistry, 2015-2023, MWh



Others (Flow battery, NAS, ...) Li-ion NiMH NiCD Others (Flow battery, NAS, ...) Li-ion NiMH NiCD Lead Acid

Source: Avicenne Energy 2024

# Lithium-ion : from portable batteries in 1990-2000 to many **saft** EV, LMT & industrial batteries today



Portable batteries

EV, LMT and industrial batteries

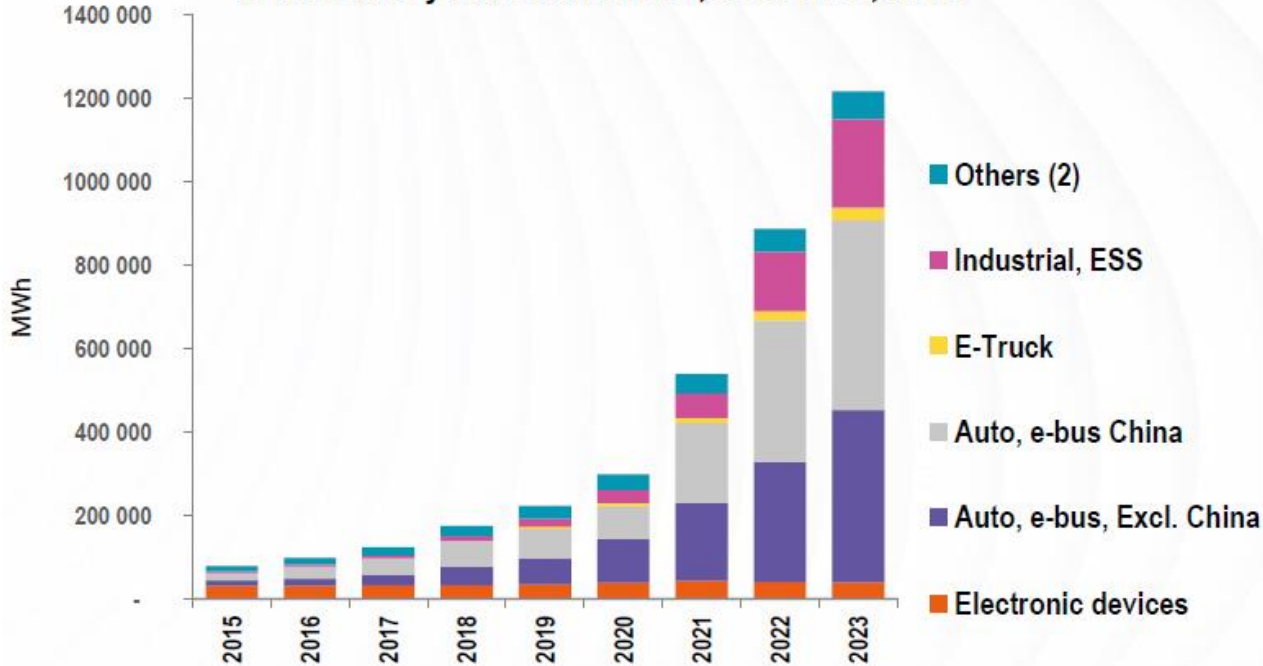
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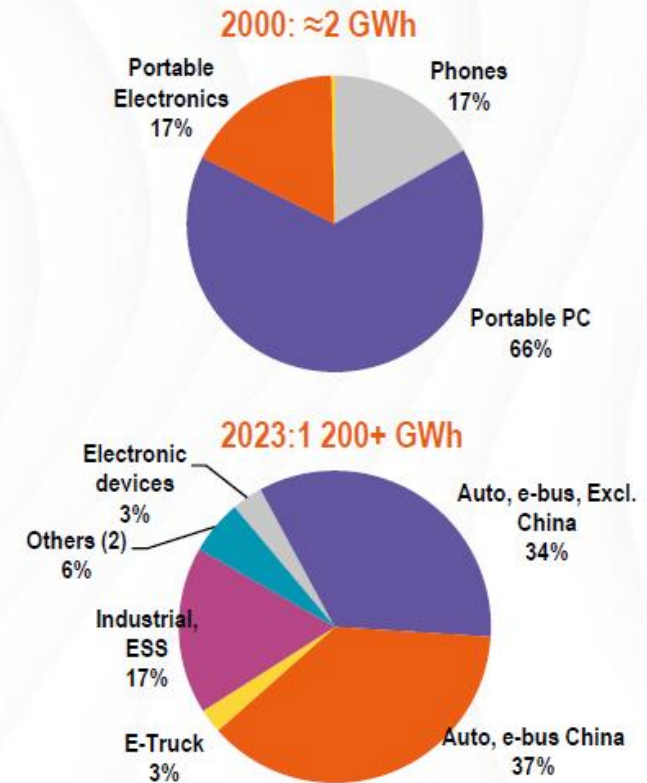
# Worldwide Li-ion battery market by applications

**In 2023, EV, e-buses & e-trucks account for 75% of the li-ion battery market with a total LIB market of 1 200 000+ MWh**

*Li-ion Battery sales worldwide, 2000-2023, MWh*



CAGR 15-23: 37% per year in volume



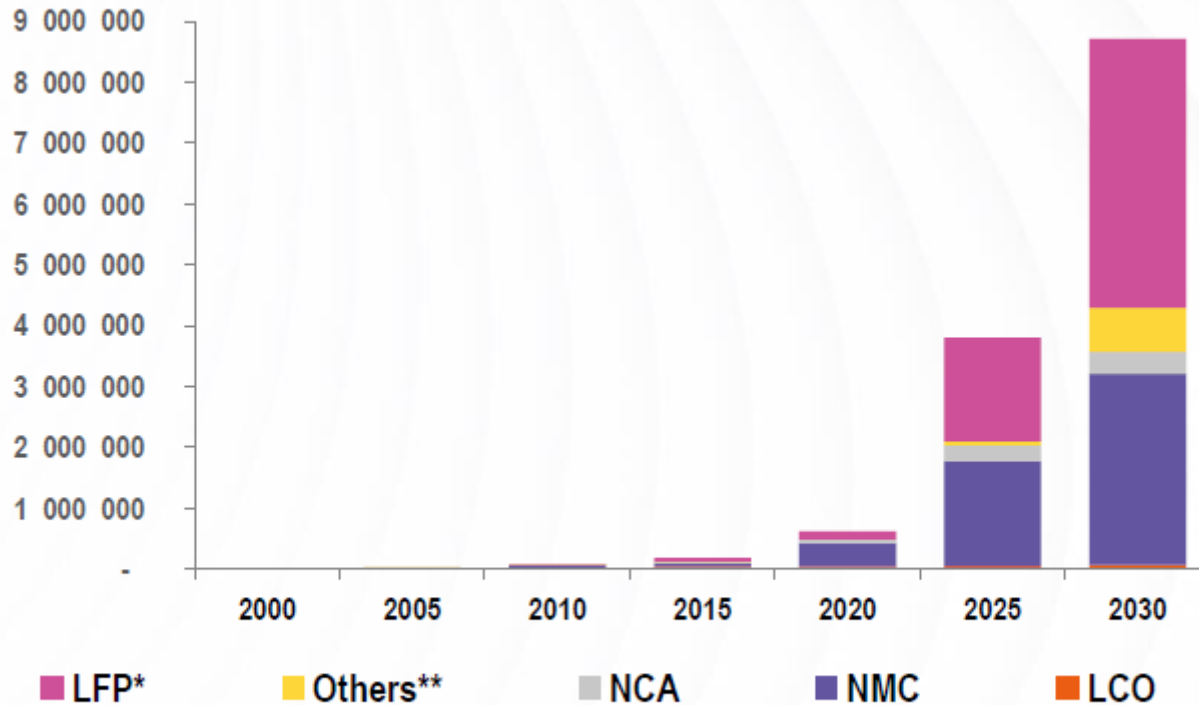
(1) Pack level

(2) Others: medical devices, power tools, gardening tools, e-bikes...

# Main positive active materials



**Cathode active materials by chemistry in Tons, 2000-2030**

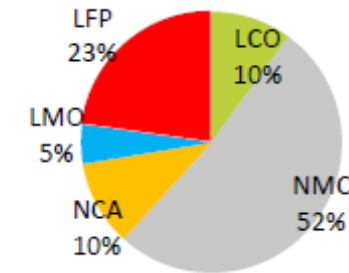


\*: LFP: LFP+LFMP, NMC: Low-mid and High NMC, Lithium Rich High Mn

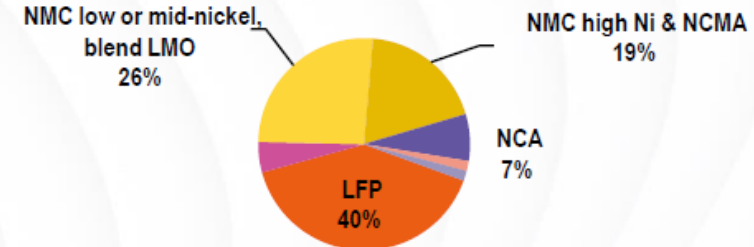
\*\*: Others: Na-ion, Zinc...

**Source: Avicenne Energy 2024**

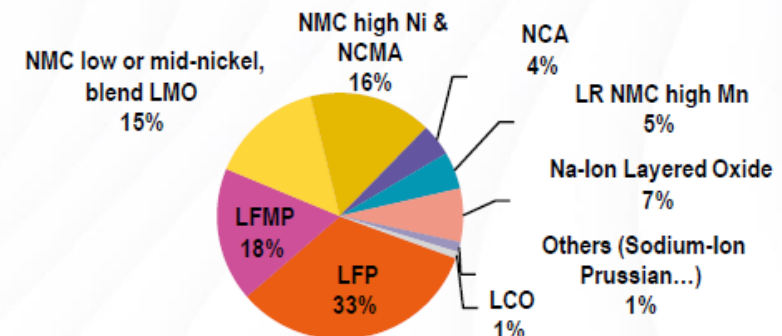
**Cathode active materials in 2020  
450 000 Tons**



**Cathode Active Materials in 2025: 3,800+ kTons**



**Cathode Active Materials in 2030: 8,700+ kTons**

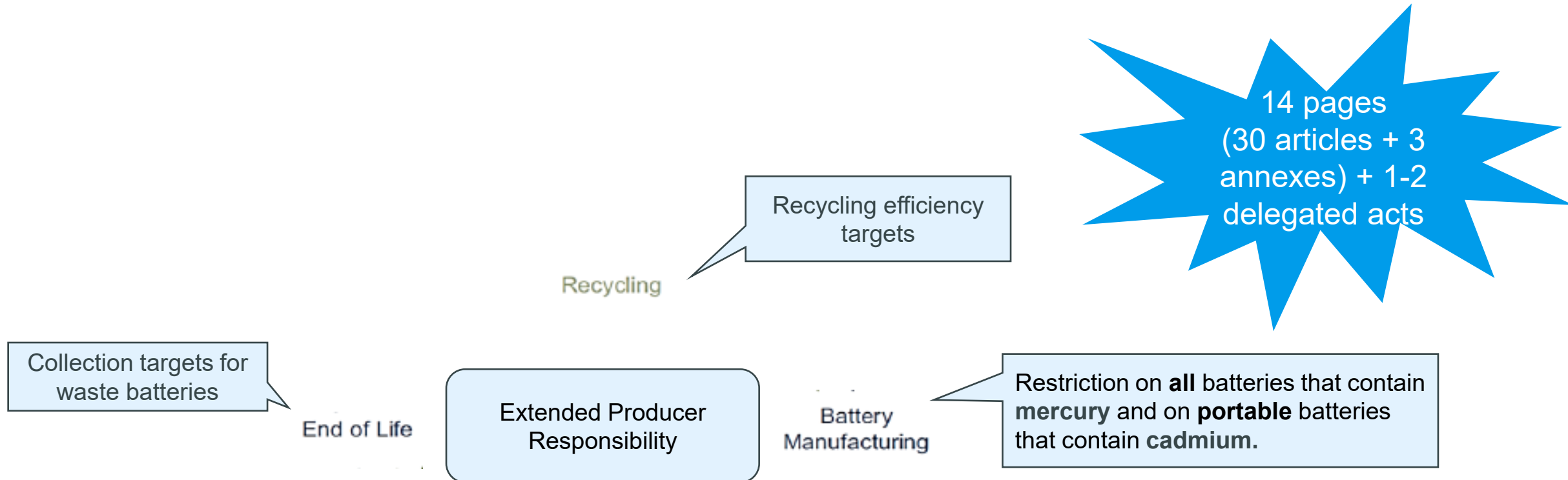


# 02.

From the battery  
directive to the new EU  
battery regulation

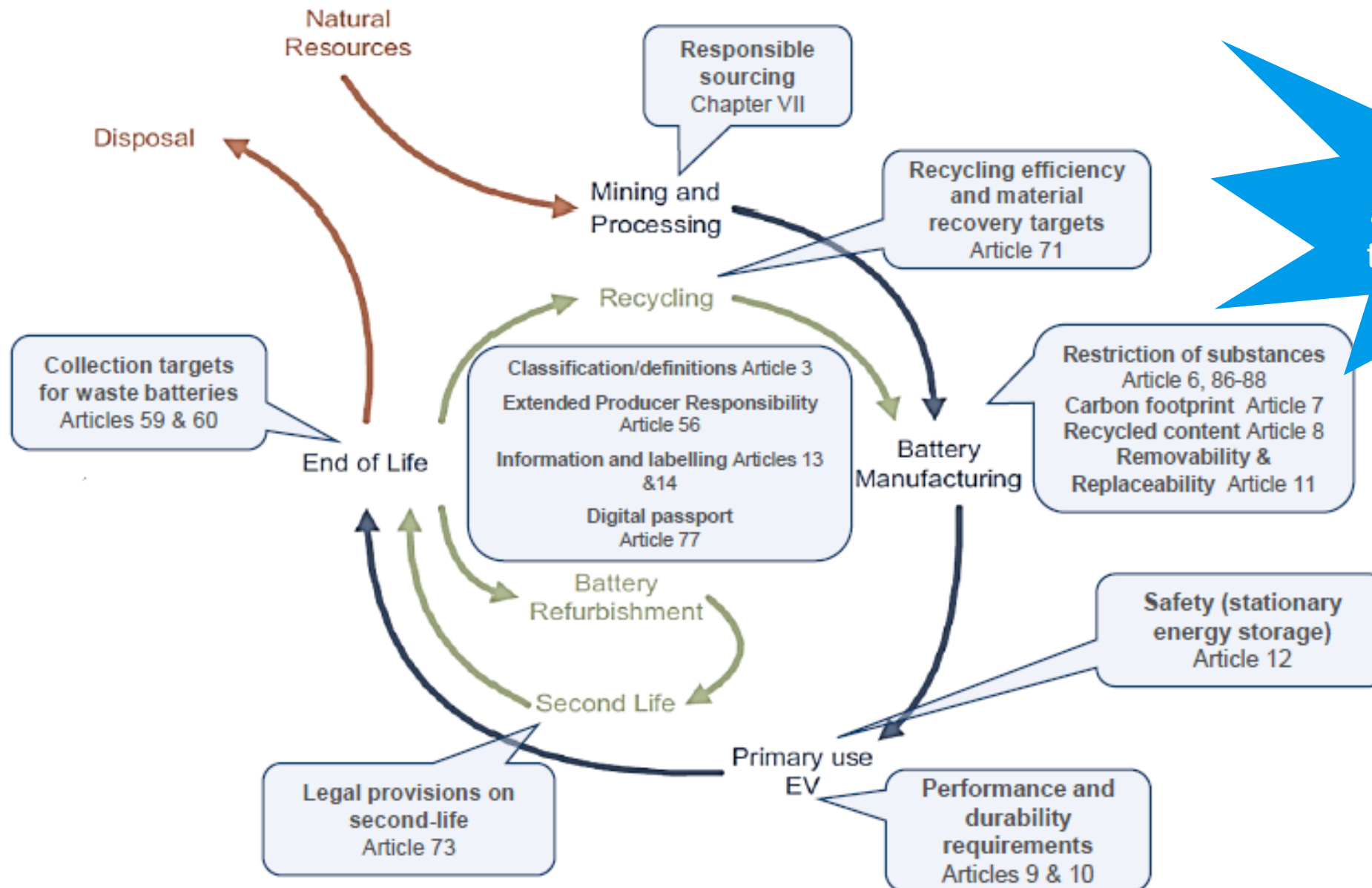
# EU Battery Directive 2006/66/EC

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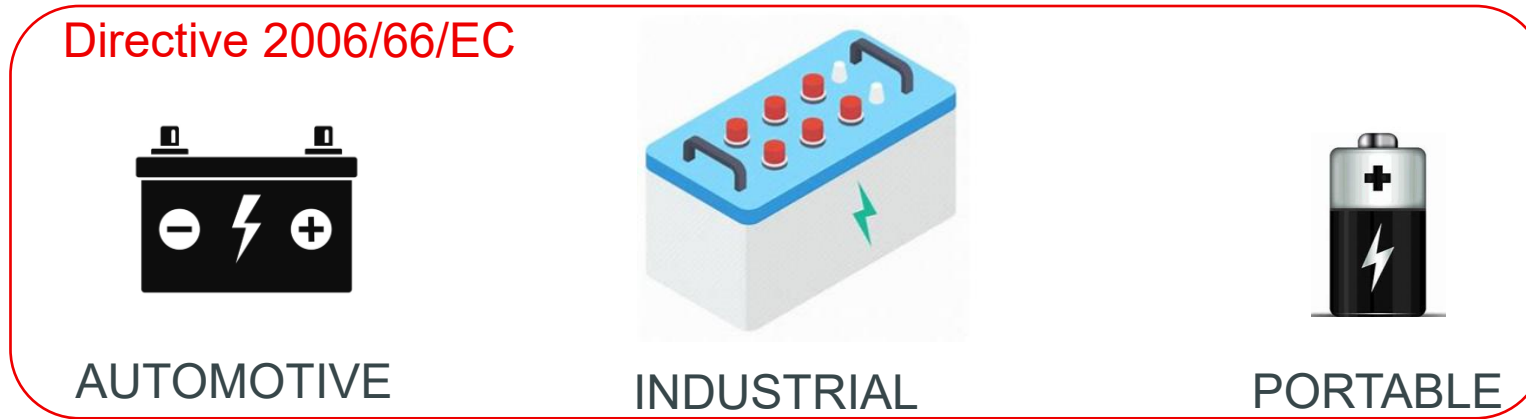
# New Battery Regulation (EU) 2023/1542

**saft**



117 pages  
(96 articles + 14 annexes) + more than 30 delegated acts

# Five battery categories instead of three

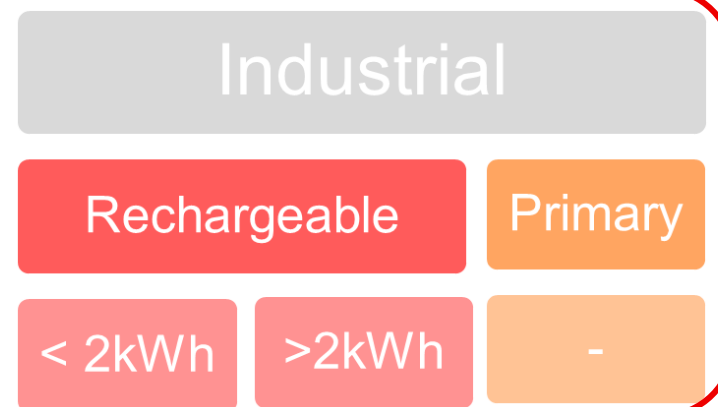


## Regulation (EU) 2023/1542



Obligations vary quite significantly across the five categories

For the **applicability of the safety and sustainability requirements**, further distinction is made for industrial batteries.



# Summary of the main requirements

## DESIGN REQUIREMENTS

- Restrictions of substances
- Carbon footprint
- Recycled content
- Performance and durability
- Removability and replaceability
- Safety (only for SBESS)

## END OF LIFE & RECYCLING

- EPR obligations for producers/PROs
- Collection of waste portable/LMT batteries
- Recycling efficiency targets
- Material recovery targets
- Shipment of waste batteries outside the EU
- Reporting obligations

## INFORMATION & TRACEABILITY

- Labelling and CE marking
- Information via QR code
- Digital Battery Passport

## DUE DILIGENCE

- Due diligence policy
- Management system
- Risk management plan
- Third-party verification
- Disclosure of information

# Recycling targets : Art 71 and Annex XII

## RECYCLING EFFICIENCIES BY 2025 AND 2030 (by average weight)

- 75 % for lead-acid batteries; & 80% in 2030
- 65% for lithium-based batteries; & 70% in 2030
- 80% for nickel-cadmium batteries
- 50% for other waste batteries

## MATERIAL RECOVERY TARGETS BY 2027 AND 2031

- 90 % for cobalt; & 95% in 2031
- 90 % for copper; & 95% in 2031
- 90 % for lead; & 95% in 2031
- 50 % for lithium; & 80% in 2031
- 90 % for nickel, & 95% in 2031

**By 18 February 2025**

Rules on calculation and verification



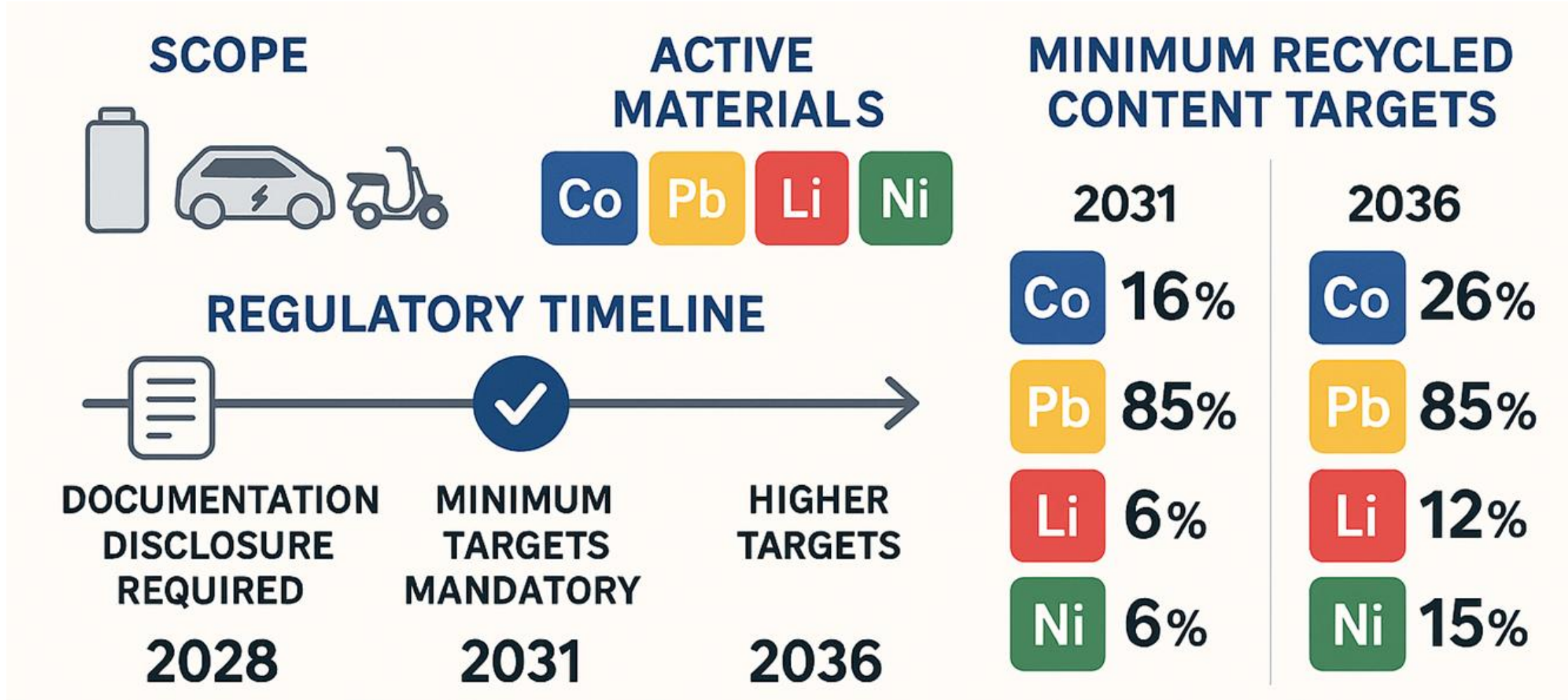
**By 18 August 2026**

Commission to review all targets for recycling efficiencies and material recovery

**No fixed deadline:**

The Commission can add other batteries chemistries and materials to the targets

# Article 8 : Recycled content

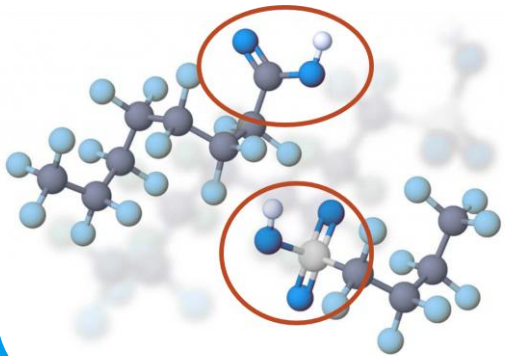


Batteries that have been subject to preparation for re-use, repurposing or remanufacturing are out of scope for art 8

# PFAS (Per- and poly-fluoroalkyl substances) restriction proposal in Europe

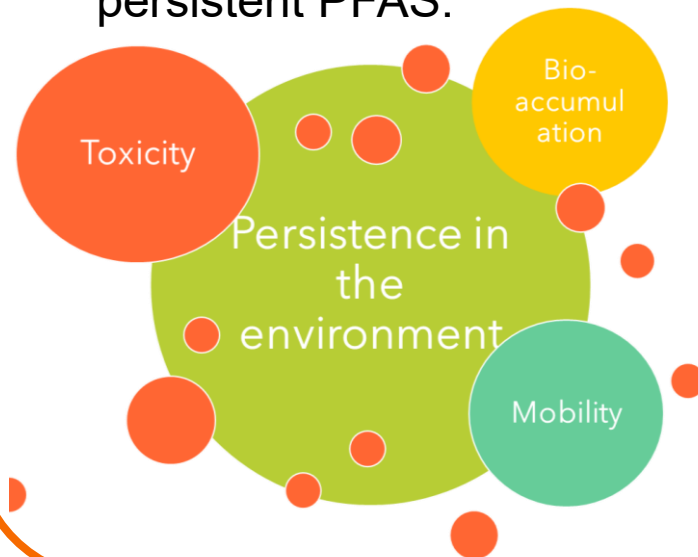
## Definition:

at least one – CF<sub>2</sub>– or one – CF<sub>3</sub> group, without any H/Cl/Br/I attached to it.



## Forever chemicals:

- Persistence due to the **strength of the carbon-fluorine bond**.
- PFAS are either persistent themselves or degrade to other persistent PFAS.



## PFAS restriction proposal in EU :



- Proposed in Feb 2023
- 5600 comments received during ECHA Public Consultation
- Comments assessed by ECHA expert committees
- Potential time-limited derogations



### Ban on manufacture, use and placing on the market

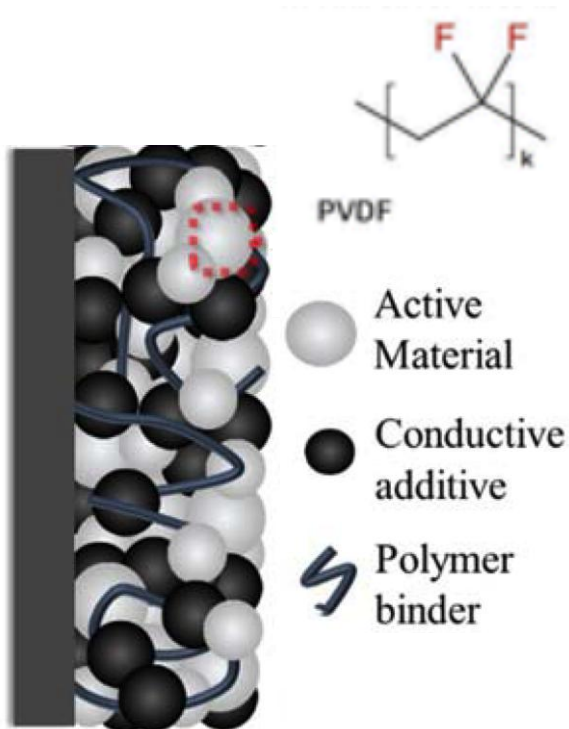


- As substances on their own
  - As a constituent
  - A mixture
  - An article
- }  $\geq 25$  ppb for any PFASs  
}  $\geq 250$  ppb for sum of PFASs  
}  $\geq 50$  ppm \* for PFASs

\* If total fluorine exceeds 50 mg F/kg the manufacturer, importer or downstream user shall upon request provide to the enforcement authorities a proof for the fluorine measured as content of either PFASs or non-PFASs.

# Fate of PVDF during Li-ion battery recycling ?

- PVDF: Binder of positive electrodes in Li-ion batteries



## Lithium-ion battery recycling: a source of per- and polyfluoroalkyl substances (PFAS) to the environment?

*Environ. Sci.: Processes Impacts*, 2023, **25**, 1015-1030

Conclusion : Currently the most common LIB recycling process involves **pyrometallurgy**, which operates at **high temperatures (up to 1600 °C)**, sufficient for **PFAS mineralization**. However, **hydrometallurgy**, an increasingly popular alternative recycling approach, operates under milder temperatures (<600 °C), **which could favor incomplete degradation and/or formation and release of persistent fluorinated substances.**



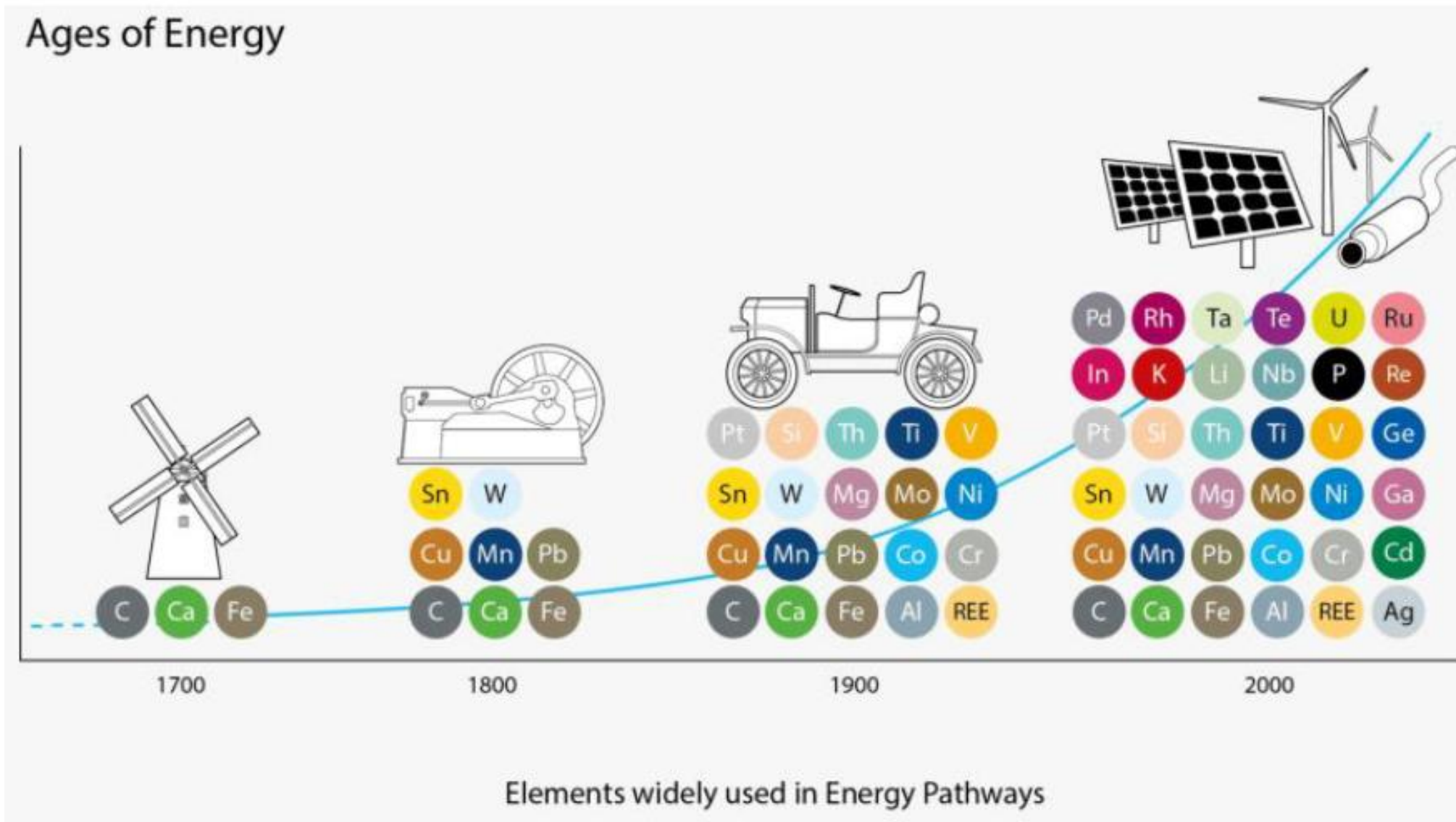
CRITICAL  
RAW  
MATERIALS  
ACT

#CRMAct #RawMaterial

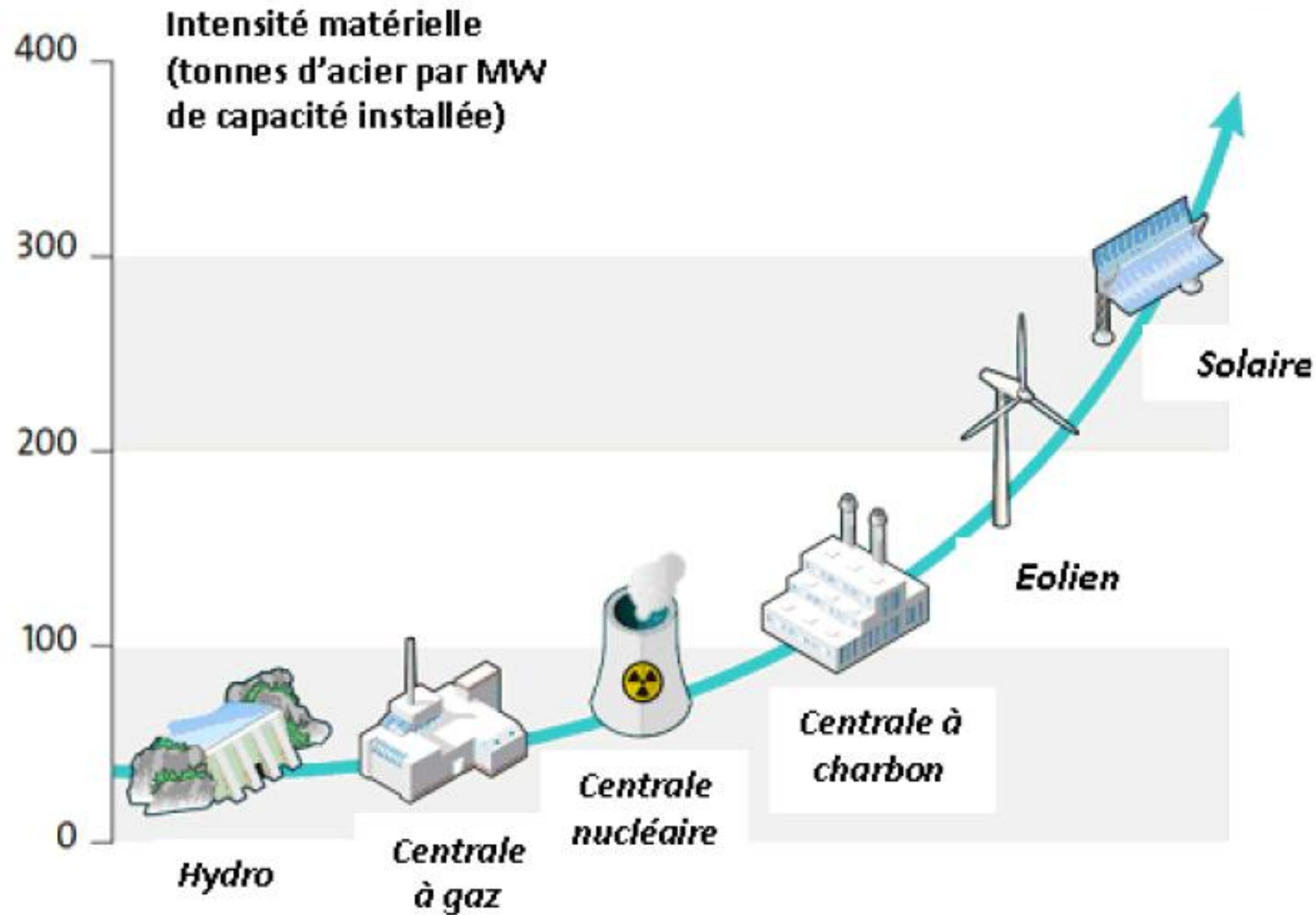
# 03.

## Critical / Strategic Raw Materials

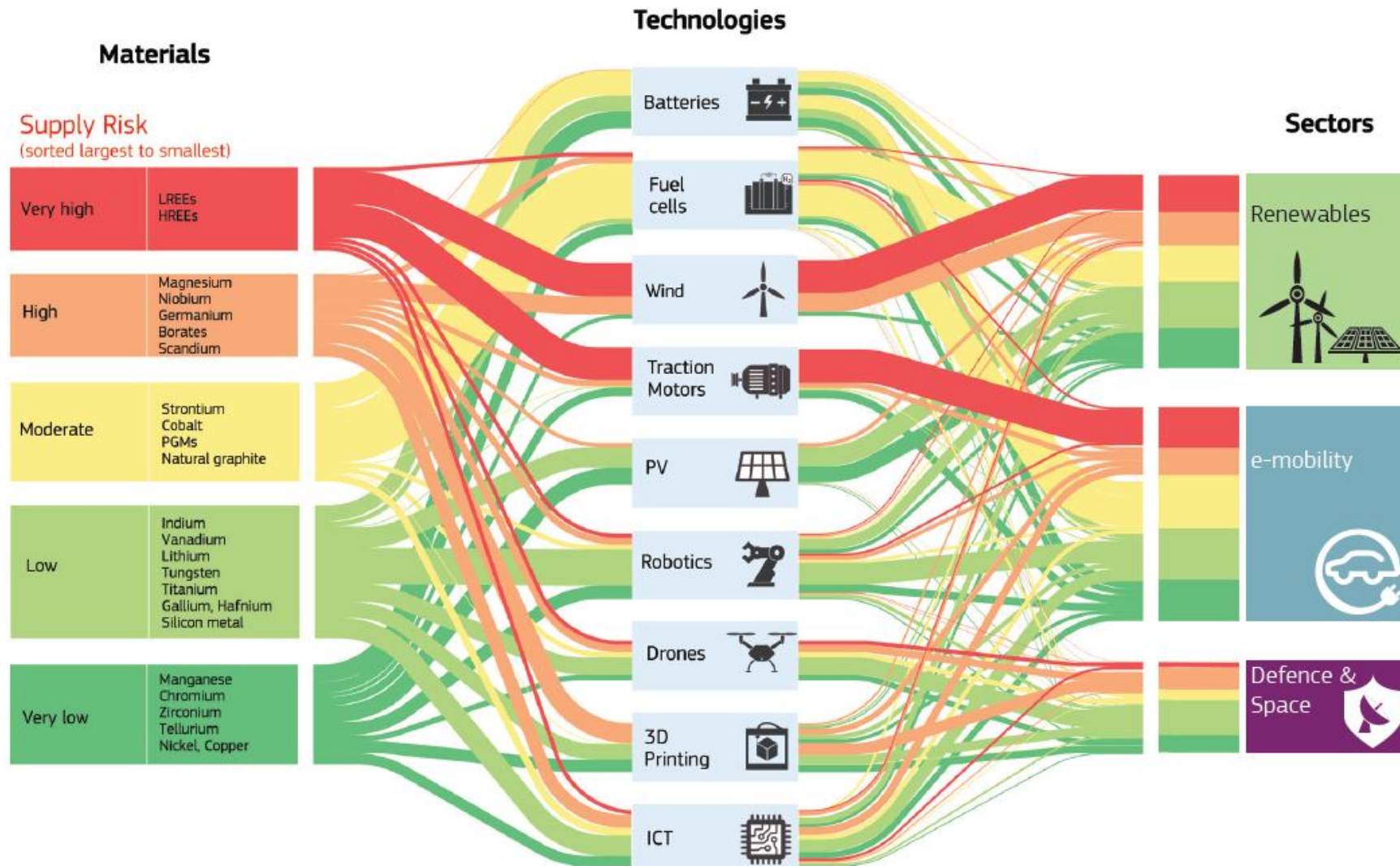
# More elements are used



# More quantities are used



# Competition between uses and sectors



# 2024: EU Critical Raw Material Act

## CRITICAL RAW MATERIALS

Critical Raw Materials are at the beginning of many industrial supply chains and their global demand is increasing:

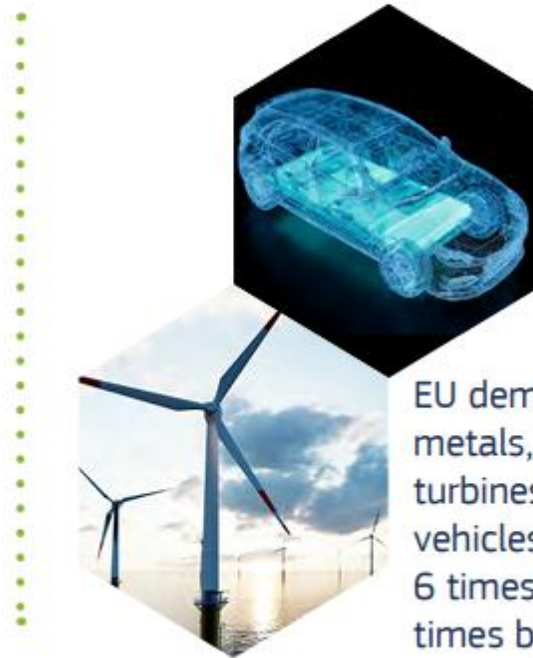


**Rare earths are key components of permanent magnets** used in wind turbines motors

**Lithium, cobalt and nickel** are used in battery manufacturing

**Silicon** is used for semi-conductors

The demand of critical raw materials will increase in the next years:



EU demand for lithium batteries powering our electric vehicles and energy storage set to increase 12 times by 2030 (21 times by 2050)

EU demand for rare earth metals, used in wind turbines and electric vehicles set to rise 5 to 6 times by 2030 (6 to 7 times by 2050)

# 2030 targets for Strategic Raw Materials

## SETTING PRIORITIES

### List of **Critical Raw Materials**

- It identifies raw materials which are important for the whole European economy and face a high risk of supply disruption

### List of **Strategic Raw Materials**

- It identifies a list of raw materials characterised by high strategic importance and projected global supply/demand imbalances

## SETTING 2030 BENCHMARKS FOR STRATEGIC RAW MATERIALS



### EU EXTRACTION

At least **10%** of the EU's annual consumption for extraction



### EU PROCESSING

At least **40%** of the EU's annual consumption for processing



### EU RECYCLING

At least **15%** of the EU's annual consumption for recycling



### EXTERNAL SOURCES

Not more than **65%** of the EU's annual consumption of **each strategic raw material at any relevant stage of processing** from a single third country



# Critical Raw Materials – Strategic Materials



## EU Critical Raw Materials Act

Critical Raw Materials Marked with Color

★ Strategic Raw Material

- Transition metals
- Alkali metals
- Nonmetal
- Metals
- Metalloid
- Actinide
- Halogens
- Lanthanide
- Noble gas
- Alkaline earth metals



The 2024 CRMA identifies **34 CRMs for the EU** (marked with color) , of which **17 are identified as Strategic Raw Materials \*** because they are considered as the most crucial for the green & digital transition, as well as for defence & aerospace.



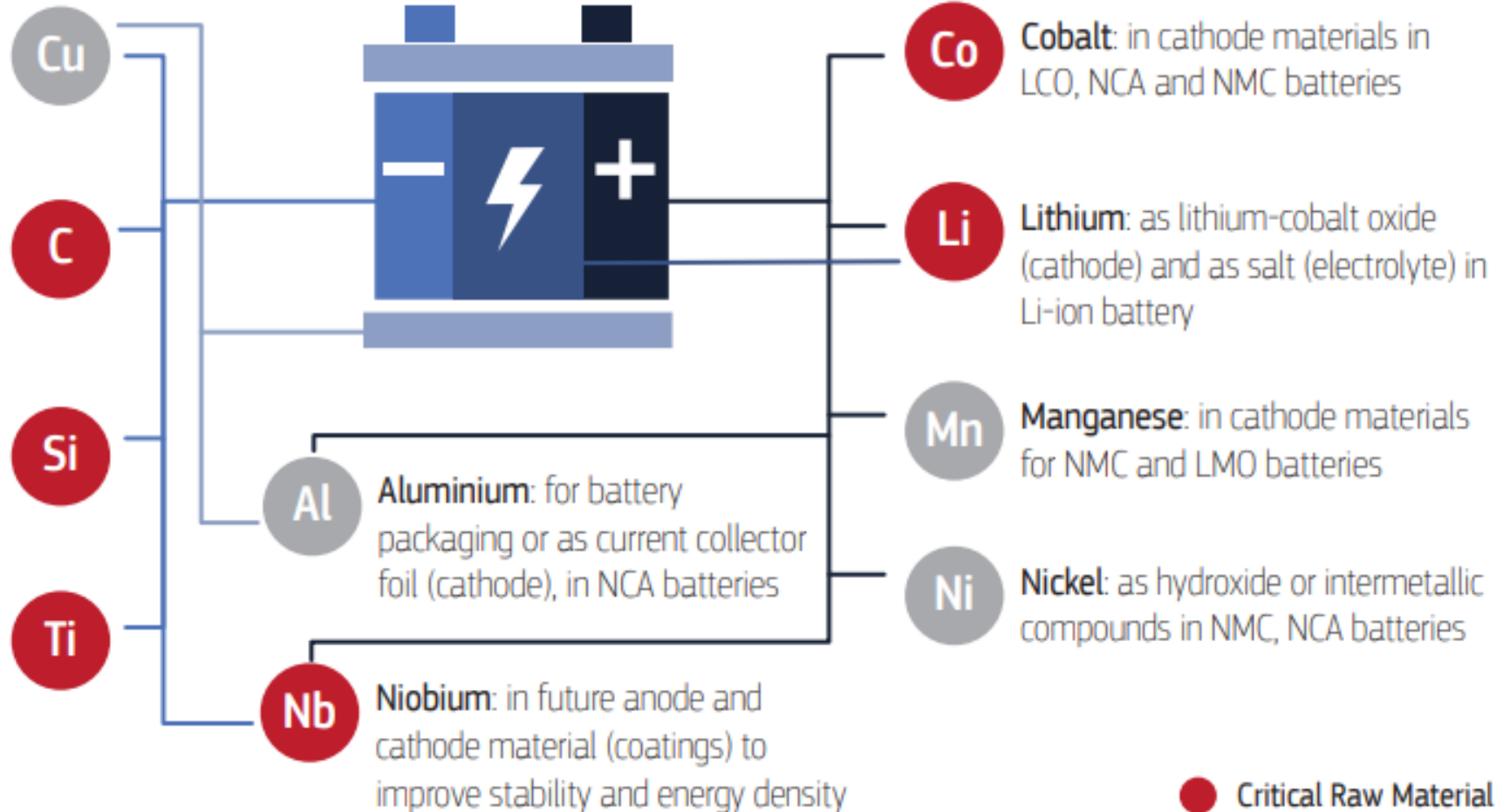
# Main materials used in batteries

**Copper:** as current collector foil at anode side, in wires and other conductive parts

**Graphite:** natural or synthetic high-grade purity in anode electrode in all Li-ion battery types

**Silicon:** in (future) anodes to enhance energy density

**Titanium:** in future anode materials and coatings, in LTO, for battery packaging



- Battery technologies are relying on an increasing number of different materials, with increasing quantities : **recycling facilities will have to be flexible to different material flows**
- Some of them are identified as Critical Raw Materials and Strategic Raw Materials with complex value chains
- The new EU Battery regulation has a strong focus on sustainability and full life cycle approach
- **Recycling and recycled content** are a part of the solution but in a developing sector like batteries, virgin materials will still be required !