CRITICAL ELEMENTS AND THE TRANSITION TO ELECTRIC MOBILITY

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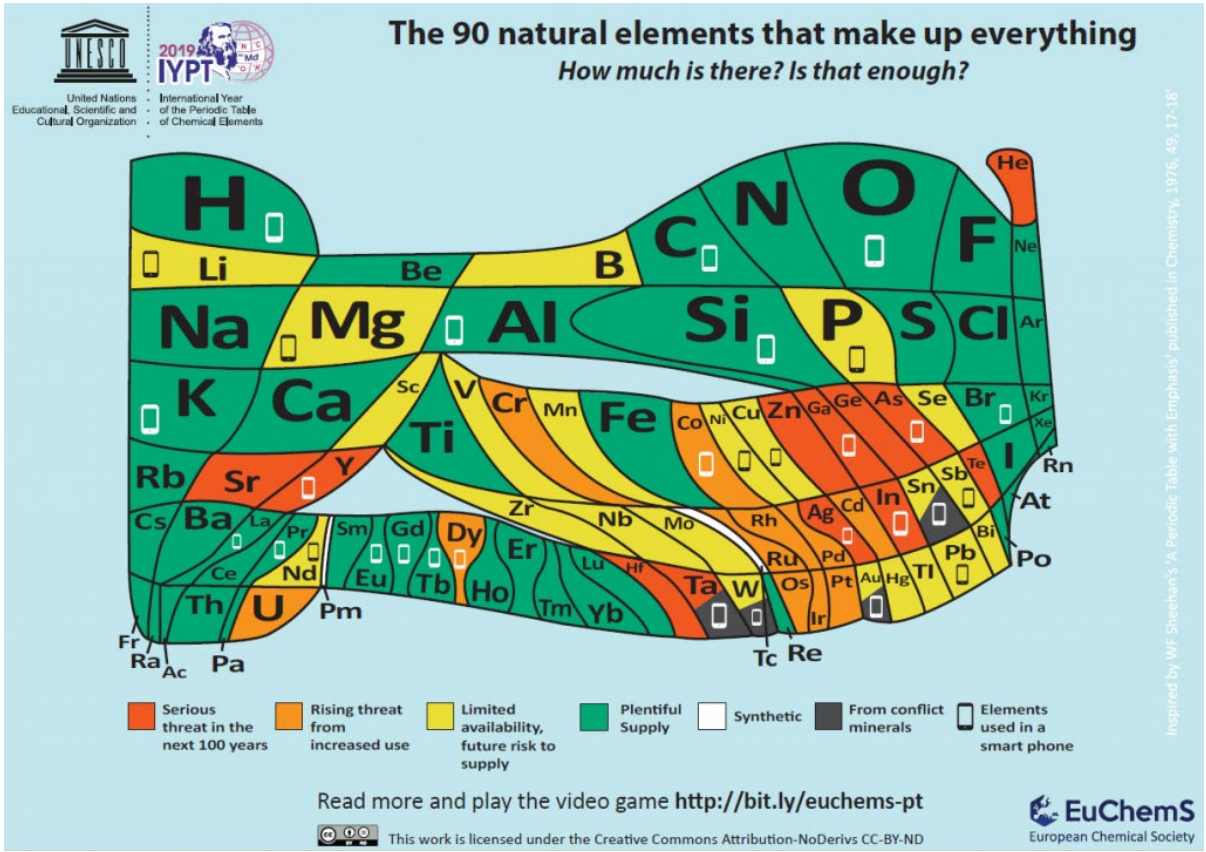
The Value is on Circularity
Recycling-Reusing-Reinvesting on Critical Raw Materials
European Parliament, November 5th, 2020

CRITICAL ELEMENTS: THE EUCHEMS PERIODIC TABLE



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European Chemical Society

Available in
35 languages!

www.euchems.eu/euchems-periodic-table/

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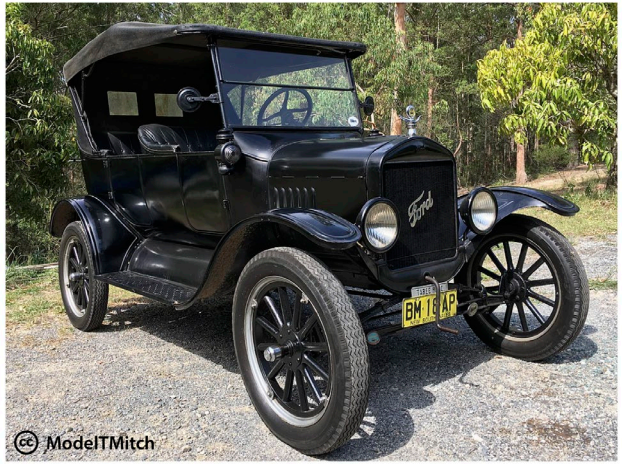
THE EPIC BATTLE of CAR TECHNOLOGIES OF THE EARLY 20TH CENTURY

Electric, 1906

Steam, 1908

Int. Comb. Engine (ICE) 1926



The electric vehicle (EV) virtually disappeared for almost a century

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Then the key enabling technology was invented

The Nobel Prize in Chemistry 2019

Ill. Niklas Elmehed. © Nobel Media.

John B. Goodenough

Prize share: 1/3

Ill. Niklas Elmehed. © Nobel Media.

M. Stanley Whittingham

Prize share: 1/3

Ill. Niklas Elmehed. © Nobel Media.

Akira Yoshino

Prize share: 1/3

"For the development of Lithium Ion Batteries"

(LIB's)

LIBs made possible to make cars with comparable **SIZE**, **WEIGHT** and **PERFORMANCE** of ICE

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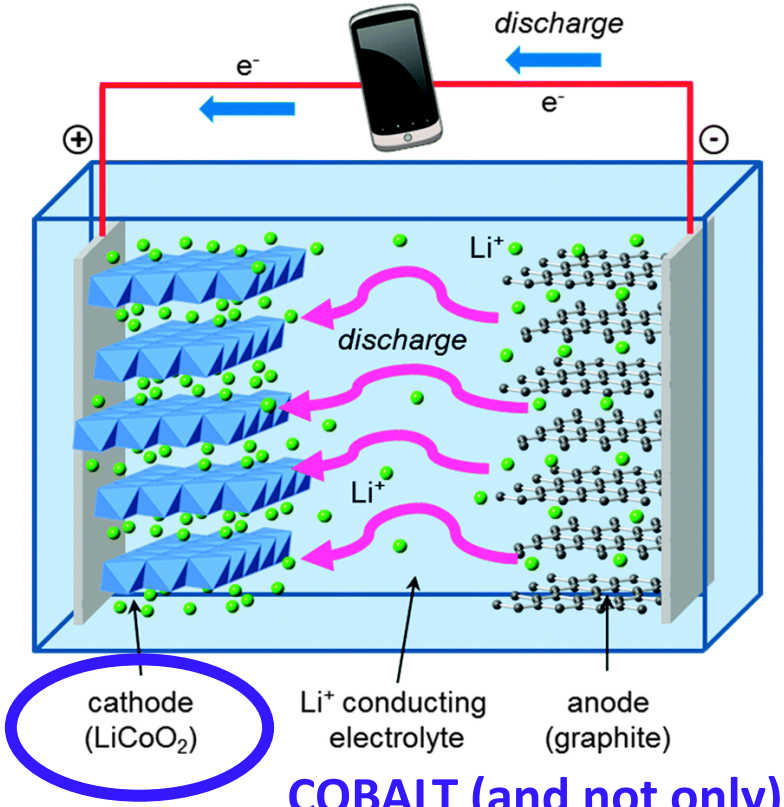
WHY LITHIUM ?



The LIGHTEST and SMALLEST metal with one of the highest electrochemical potentials

High energy density

High charging speed

Long duration

PERFECT FOR BATTERIES

COBALT (and not only)!

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HOW DOES THE BATTERY LOOK LIKE? MY CAR

24 MODULES WITH 8 CELLS: **296 CELLS**

Battery Capacity: 40 kWh

Battery Weight: 208 kg

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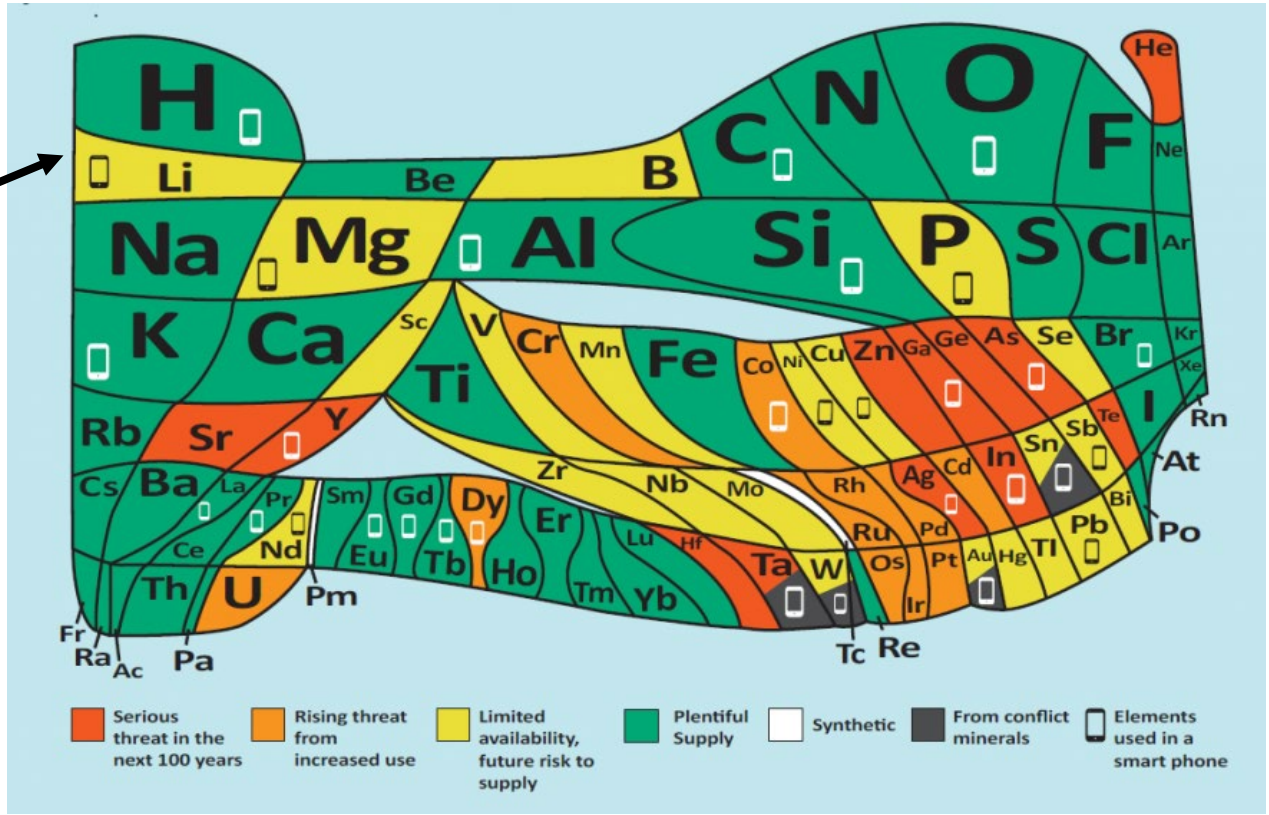
ESTIMATED MATERIAL CONTENT OF MY BATTERY

- 10 kg Li (cathode, electrolyte)
- 25 kg Ni (cathode)
- 8 kg Mn (cathode)
- 9 kg Co (cathode)
- 48 kg Graphite (anode)

~ 100 kg

LITHIUM



3 2 1

Li

Lithium

6.941

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LITHIUM

Major producers: Australia, Chile, Argentina

RESERVES : 17.0 Mton; RESOURCES > 80 Mton

The world's largest resource
Salar de Uyuni, Bolivia - 10,000 km^2
(comparison: Greater London is 1580 km^2)

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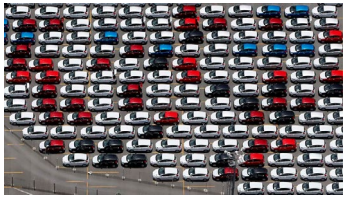
CAR SALES VS. LITHIUM EXTRACTED



2019

CAR SALES WORLDWIDE

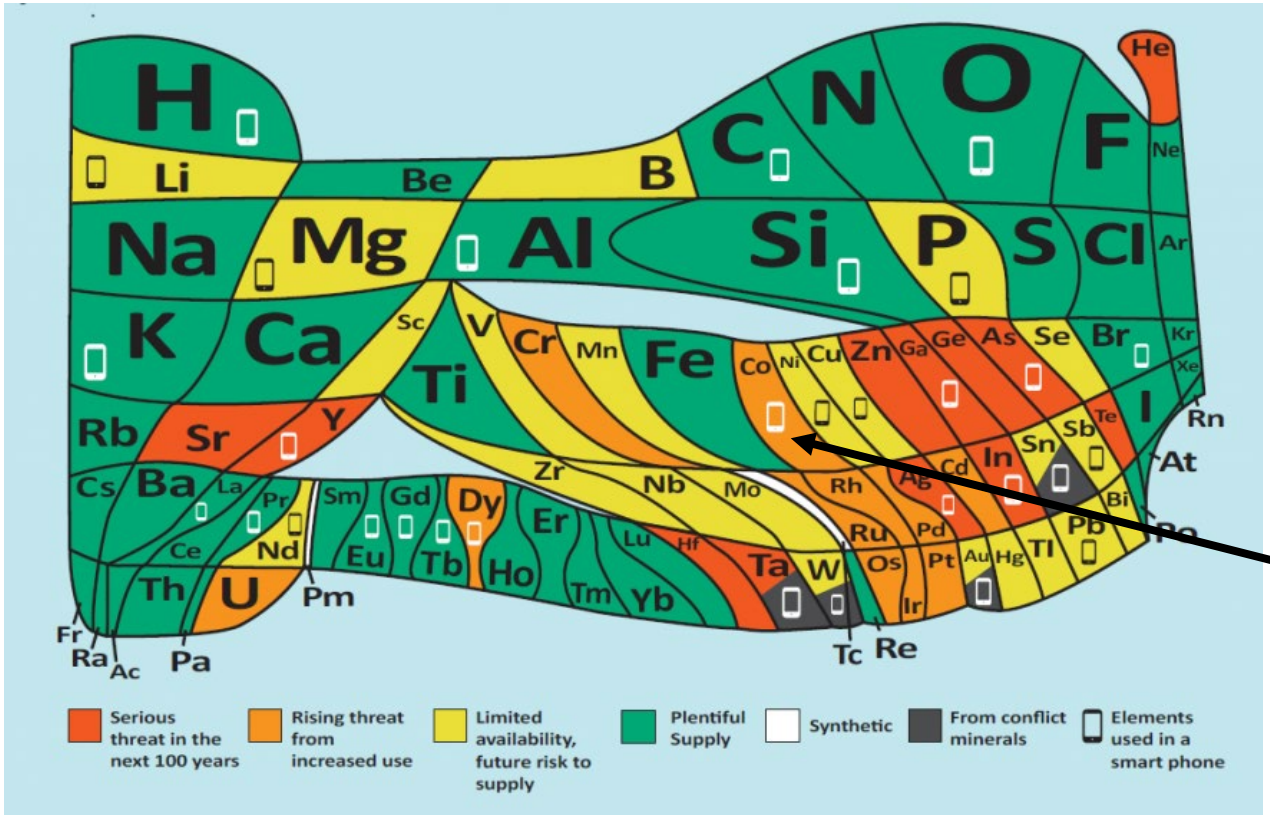
75 MILLIONS

LITHIUM MINED

77 kton

CURRENT LITHIUM PRODUCTION CAN SUPPORT ABOUT 10% OF GLOBAL ANNUAL CAR SALES

COBALT



27 $3d^7 4s^2$

Co

Cobalt

58.933

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THE COBALT PROBLEM

>60% supply based in one country, D.R. Congo, where labor exploitation may occur in small mines

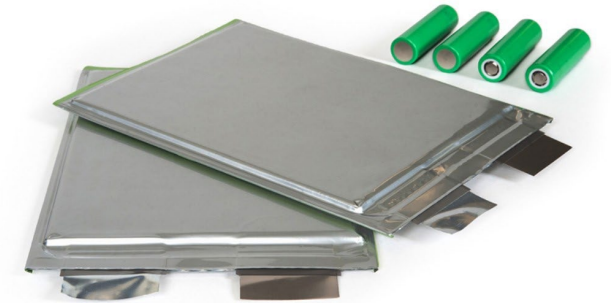
100% refining in China

Cobalt being reduced in LIBs cathodes typically replaced by Nickel

RECYCLING ISSUES OF LIB'S

- **SEVERAL METHODS are implemented** (hydrometallurgical, pyrometallurgical, "direct recycling") each of them with pros and cons

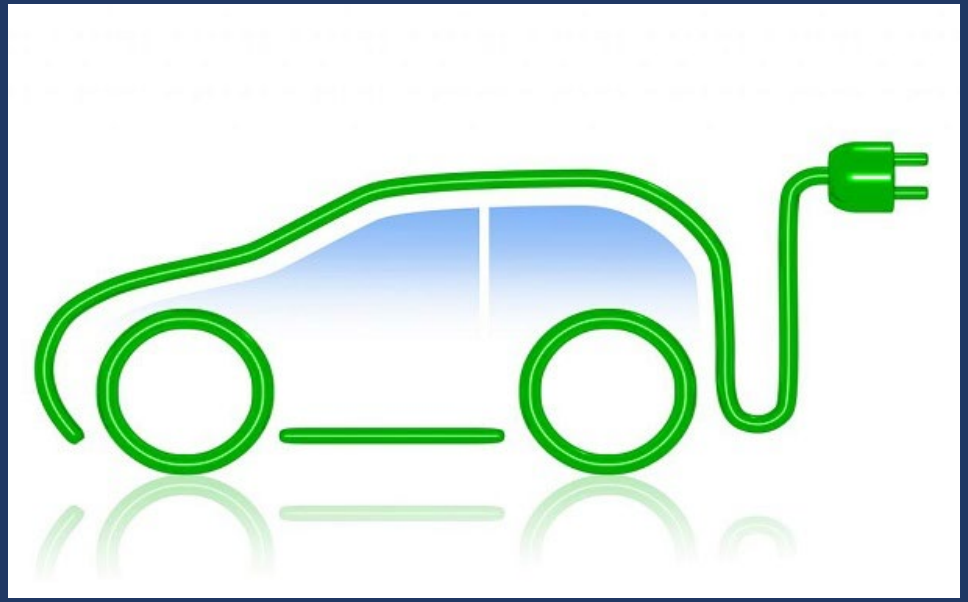
- LIBs occur in **different forms and size**, with different materials inside



- LIBs are **designed for performance and duration**, not recycling

- **Only some parts** of them are economically attractive (Co but not Li)

WHY MUST WE ELECTRIFY TRANSPORTATION?



A CLOSED SYSTEM POWERED BY RENEWABLES

An EV does NOT exchange
any matter

IT ONLY NEEDS ELECTRICITY,
WHICH CAN BE 100% RENEWABLE

YOU CAN CHOOSE
YOUR SUPPLIER

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MY OLD DIESEL CAR: AN OPEN SYSTEM

14 YEARS 200 000 Km

Diesel fuel burnt
11.1 ton
(7 times its weight)

CO_2 emitted
33.5 ton
(21 times its weight)

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An EV is 3-4 times more efficient than I.C.E. car

FULLY CHARGED BATTERY

40 kWh

Energy equivalent of

4 LITERS OF PETROL

Driving range : 280 km

EV: the "70 km/l" car ALREADY EXISTS

WHAT ABOUT ELECTRICITY CONSUMPTION?*

In Europe: **292 million cars**

Average mileage: **12000 km/y**

If electric they'd consume: **630 TWh/y**

EU, 2018

896 TWh from RENEWABLES

(32% of total production)

* Data from EUROSTAT

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WARNING: EV IS ONLY PART OF THE SOLUTION

PUBLIC TRANSPORT

RAILWAYS

CAR SHARING

AUTONOMOUS DRIVE

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WORK FOR legislatorS

- A **regulatory framing on the supply** of Li, Co and other critical elements to prevent environmental degradation and human exploitation

- Strict rules on **second-life use and end-of-life** recycling of EV LIBs

- Support the growth of a **EU-based battery industry**

- **Redirect subsidies** away from fossil fuels to renewable energies

- Promote the **development of public transportation and bike** use in urban areas

THE BIG EUROPEAN PARADOX

We enjoy the best quality of life on Earth
BUT our enviable prosperity is based on
energy and mineral resources coming FROM OTHER CONTINENTS

IT IS OUR UTMOST INTEREST

1- A peaceful world where fair trade of critical materials is implemented

2- A knowledge-based society that makes circular economy a reality

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THANK YOU FOR YOUR ATTENTION

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