

# Materie prime critiche nell'economia decarbonizzata: possibili soluzioni

## Critical raw materials in green economy: possible solutions

**Bruno Cova**  
Advisory Services &  
Studies Director  
CESI SpA

Rome - June 16, 2023



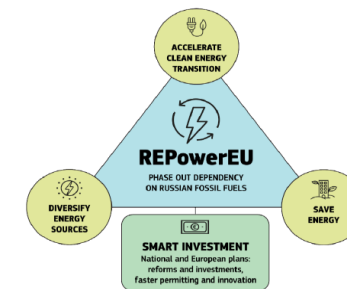
# EU: between challenging goals and harsh reality

Despite the ambitious **decarbonization targets**...



14 July 2021

2030 Targets	Fit x 55	REPowerEU
GHG reduction vs 1990	55%	
%RES on energy consumption	40%	45%



18 May 2022

...the EU economy is **still largely based on fossil fuels**, the largest share of them are imported

EU\* imports **56%** of its energy, which makes it the largest net energy importer among G20 members

- **96%** of crude oil imported
- **83%** of NG imported

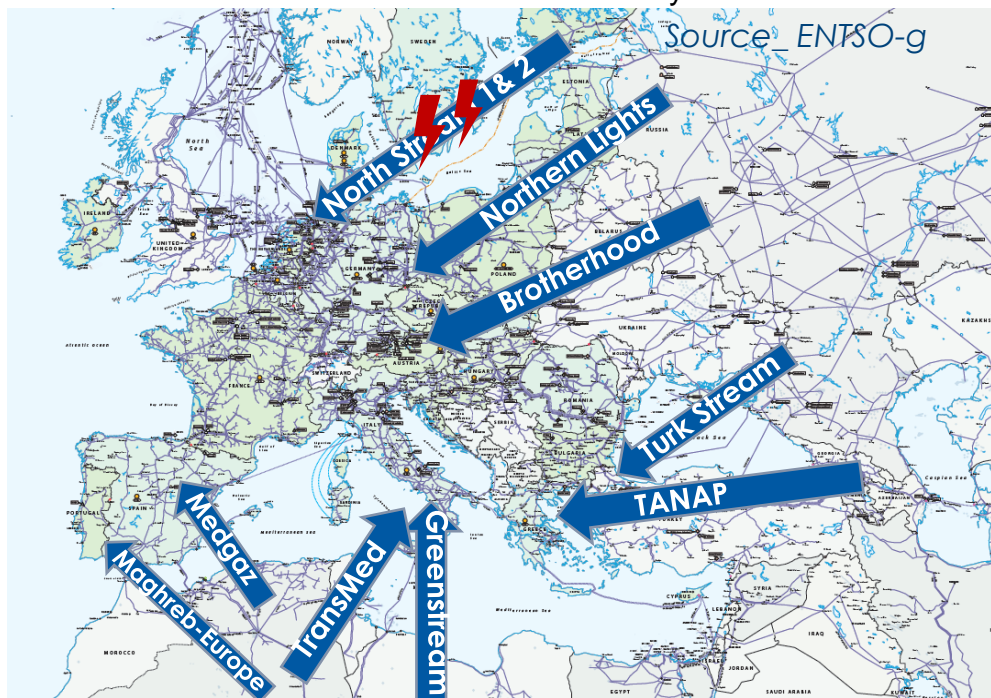
✓ in 17 Member States the dependency on NG imports exceeds 90%

EU energy bill in 2022: **€ 834 billion**

Italy

- **93%** of crude oil imported\*
- **95%** of NG imported\*\*

IT energy bill in 2022: **€ 140 billion**



The heavy dependence on imported fossil resources makes Europe **highly vulnerable to possible external shocks**

# The energy transition implies a **geopolitical shift for energy sources**

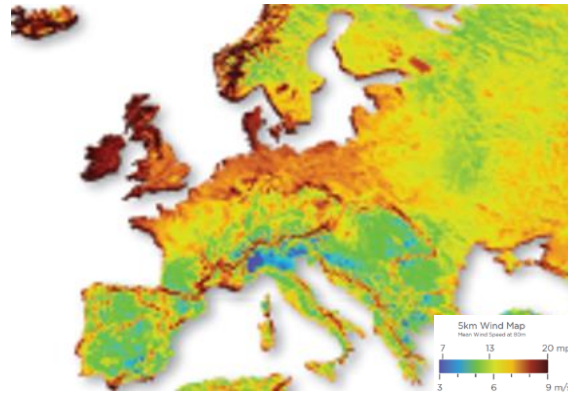
From imported Oil and Gas...

...to **exploitation of local RES**

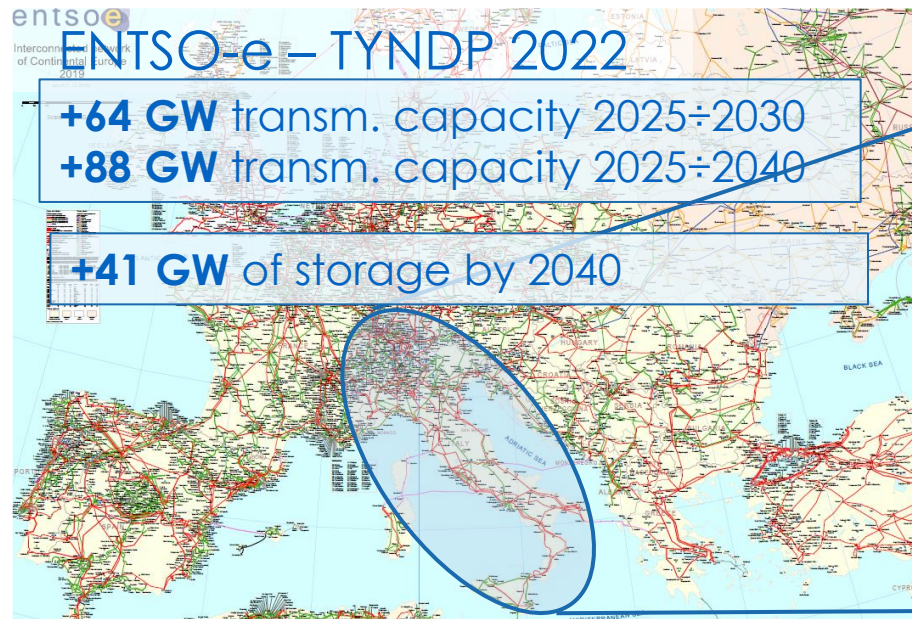
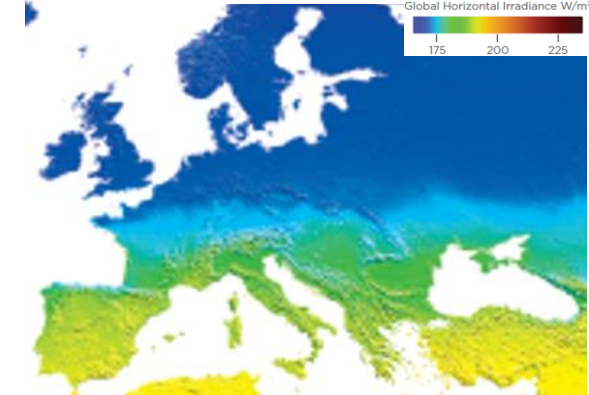


consequent growing effort  
in transmission capacity

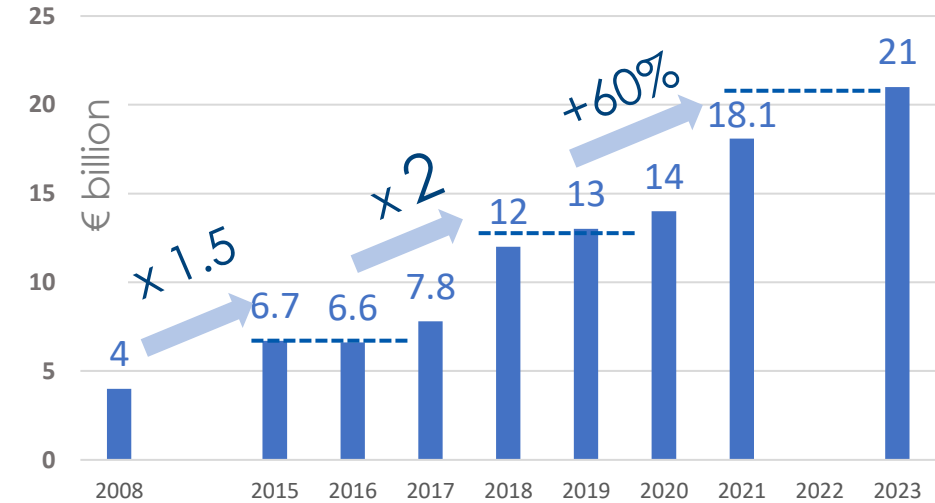
### Wind producibility



### Solar producibility



### 10-year National Development Plan

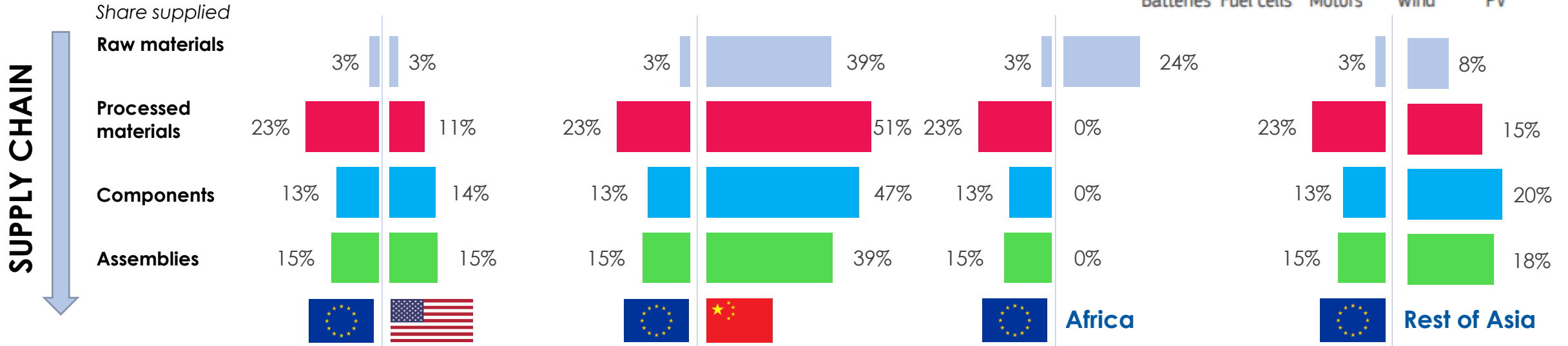


Infrastructural effort largely based on **critical raw materials**, notably **copper** and **bauxite**

# The energy transition implies a **geopolitical shift for energy technologies**

## European Commission Report *Critical Raw Materials for Strategic Technologies and Sectors in the EU*

Key suppliers for strategic energy technologies – A comparison with EU



Material	Supply risk	Largest supplier to EU	
		Country	Share of EU demand supplied
LREEs	Very High	China	99%
HREEs	Very High	China	98%
Magnesium	High	China	93%
Niobium	High	Brazil	85%
Borates	High	Turkey	98%



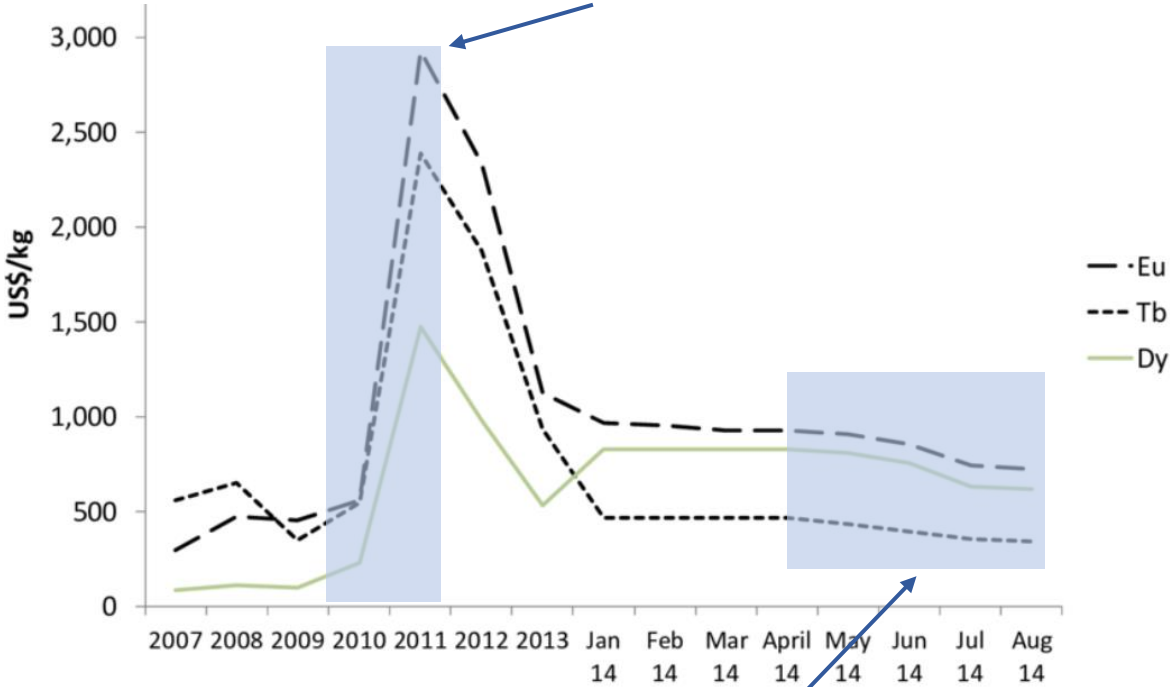
# Supply chain of Critical Raw Materials –First critical event dates back to 2011

Restrictions on REE export imposed by **China** following a dispute with Japan

Ineffective reactions of **EU and USA** with claim at WTO

Reaction from **Japan**:

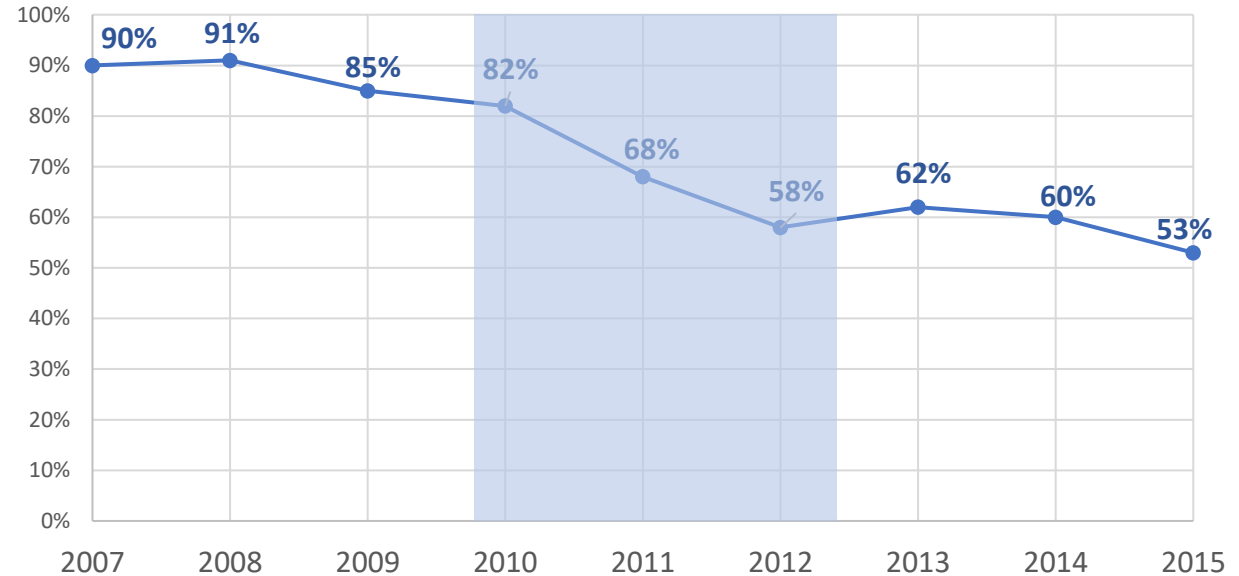
- ✓ Higher stocks of REE
- ✓ Diversification of import



Source: ResearchGate

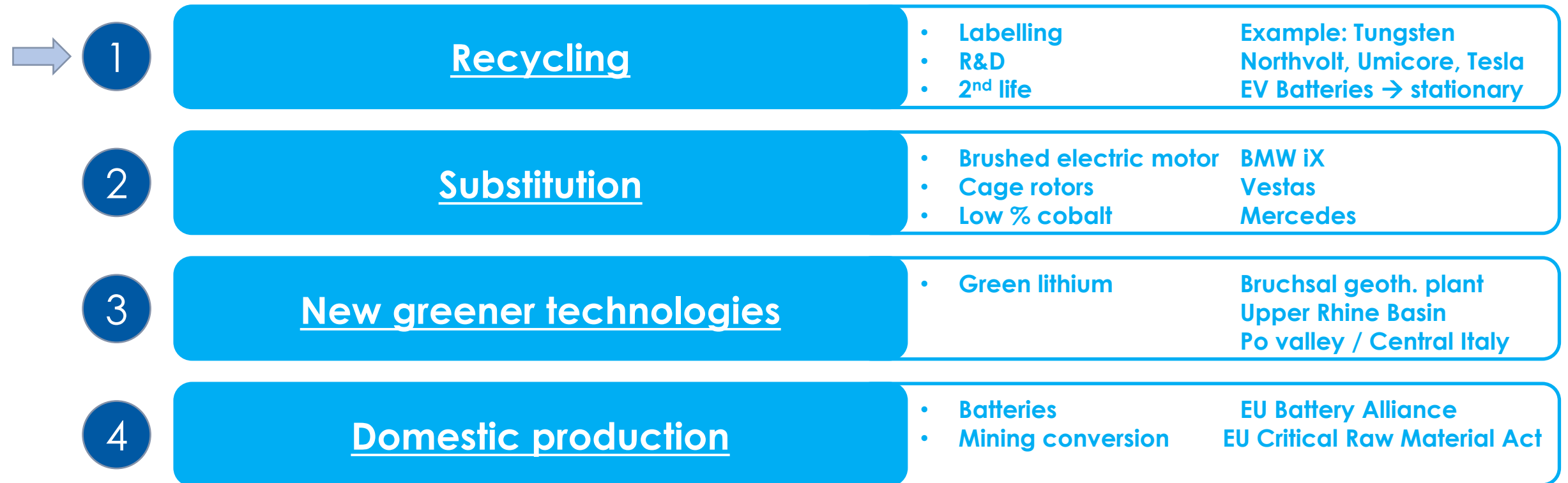
REE prices kept low by **China** to discourage competitors enter in the REE supply chain

Japan: REE import from China



# Measures to mitigate risks

The decarbonization pathway will help in reducing the fuel dependency, while ensuring a security of supply provided that a series of measures are undertaken



# Complexity of recycling materials adopted in green technologies

## E-vehicles and utility scale batteries

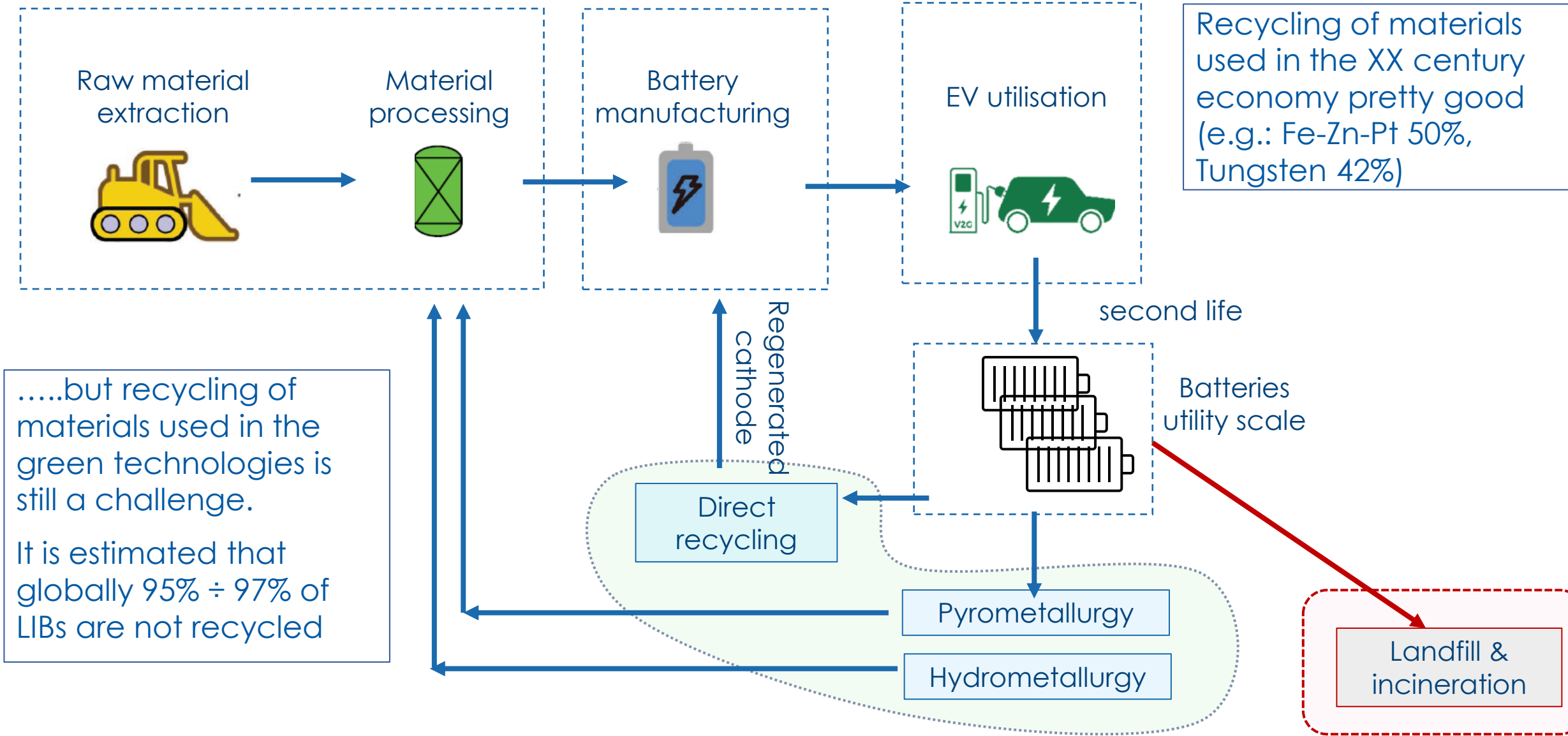
Most common technology **Lithium-Ion Battery (LIB)**

Several solutions with different materials adopted

	Cathode	Anode	Specific energy at cell level	Cycles
			[Wh/kg]	[nb cycles]
<b>NMC</b>	Lithium nickel manganese cobalt oxide	graphite	140-200	2000+
<b>NCA</b>	Lithium nickel cobalt aluminum oxide	graphite	<b>200-250</b>	2000+
<b>LMO</b>	Lithium manganese oxide	graphite	100-140	1000-2000
<b>LFP</b>	Lithium iron phosphate	graphite	90-140	3000+
<b>LFP-LTO</b>	Lithium iron phosphate	Lithium titanate	≤ 80	<b>5000+</b>

Cathode is the most critical component  
Several different critical materials contained → need for different processes for their recycling

# Life cycle of batteries in a circular economy





# Comparison of different LIB recycling methods

## Current **challenges** in recycling processes:

- ✓ variability of input chemistries
- ✓ presence of impurities
- ✓ the safe handling of LIBs components due to electrolyte or Li atoms exposure
- ✓ scalability
- ✓ standardisation
- ✓ simplification of treatment steps
- ✓ new market developments...

Need for flexible processes to quickly adapt to various and evolving technologies

## Comparison of different LiB recycling methods

Best Worst

	Technology readiness	Complexity	Quality of recovered material	Quantity of recovered material	Waste generation	Energy usage	Capital cost	Production cost	Presorting of batteries required
Pyrometallurgy	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hydrometallurgy	.....	.....	.....	.....	.....	.....	.....	.....	.....
Direct recycling	.....	.....	.....	.....	.....	.....	.....	.....	.....

## Materials recovered

	Cobalt recovered	Nickel recovered	Copper recovered	Manganese recovered	Aluminium recovered	Lithium recovered
Pyrometallurgy	.....	.....	.....	.....	No	.....
Hydrometallurgy	.....	.....	.....	.....	.....	.....
Direct recycling	.....	.....	.....	.....	.....	.....

Source: <https://doi.org/10.1038/s41586-019-1682-5>

# How to foster recycling in Circular Economy

**Recycling** is key to offset vulnerabilities arising from critical materials adopted in green technologies...

Measures:

✓ Labelling: complex mix of materials contained in batteries and other green technologies

- QR codes
- RFID tags
- Standardisation of formats
- Clear classification of inner hazardous components

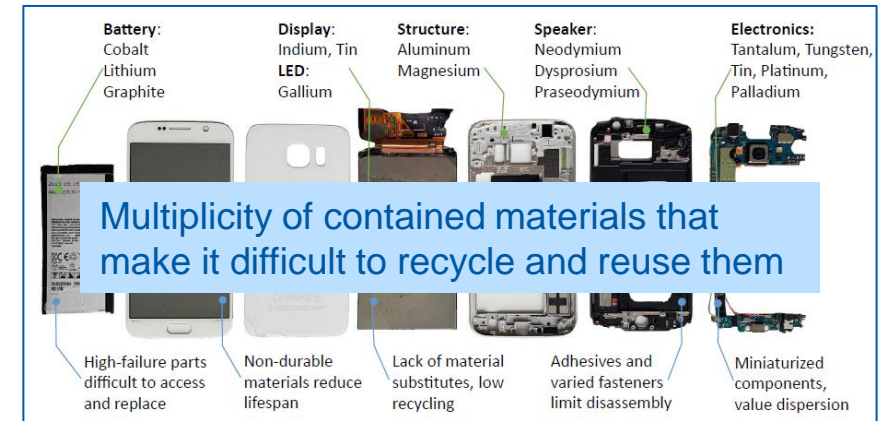
✓ Design of components: reversible assembly

✓ R&D of recycling process aimed at reducing:

- GHG emissions compared with primary production
- Energy consumption

✓ Political driver: see the “**European Green Deal’s Circular Economy Action Plan**”

...but without forgetting all possible solutions to ensure energy independency (**substitution**, **domestic production** and **green technologies** for extracting and processing raw materials)



Source: One Earth Perspective

# Measures to mitigate risks

The decarbonization pathway will help in reducing the fuel dependency, while ensuring a security of supply provided that a series of measures are undertaken

1	<u>Recycling</u>	<ul style="list-style-type: none"><li>• Labelling</li><li>• R&amp;D</li><li>• 2<sup>nd</sup> life</li></ul>	Example: Tungsten Northvolt, Umicore, Tesla EV Batteries → stationary
2	<u>Substitution</u>	<ul style="list-style-type: none"><li>• Brushed electric motor</li><li>• Cage rotors</li><li>• Low % cobalt</li></ul>	BMW iX Vestas Mercedes
3	<u>New greener technologies</u>	<ul style="list-style-type: none"><li>• Green lithium</li></ul>	Bruchsal geoth. plant Upper Rhine Basin Po valley / Central Italy
→ 4	<u>Domestic production</u>	<ul style="list-style-type: none"><li>• Batteries</li><li>• Mining conversion</li></ul>	EU Battery Alliance EU Critical Raw Material Act

# The political driver

Proposal of a new regulation establishing a framework for “**ensuring a secure and sustainable supply of critical raw materials**” – March 2023

Updated list of:

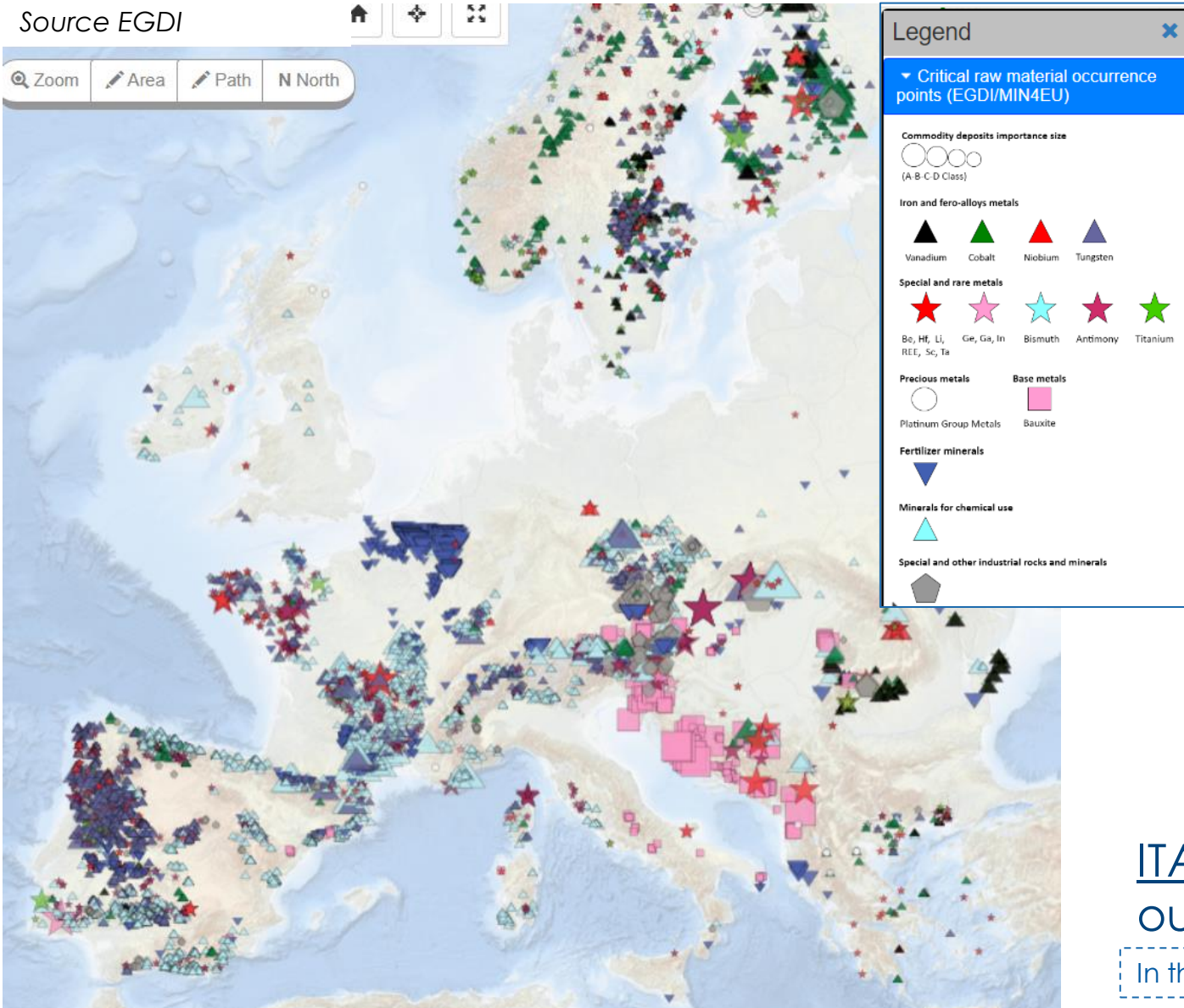
- ✓ Strategic raw materials: **16**
- ✓ Critical raw materials: **34**

2030 targets for domestic capacities along the strategic raw material supply chain:

- ✓ At least **10%** of the EU's annual consumption for **extraction**,
- ✓ At least **40%** of the EU's annual consumption for **processing**,
- ✓ At least **15%** of the EU's annual consumption for **recycling**,
- ✓ **Not more than 65%** of the Union's annual consumption of each strategic raw material at any relevant stage of processing from **a single third country**



# Europe has a fair amount of CRM potential



SWEDEN: announced the discovery of the greatest rare earth deposit in Europe



NORWAY: launched an ESIA for mining of minerals from the bottom of the sea

ITALY: the underground contains at least **15** out of 34 CRM

In the XVIII century the largest European Cobalt was in Piedmont

# The obstacles: the social acceptance of mining activities

## ITALY:

08-APR-2022  
da pag. 1-3 / foglio 1 / 2

Il Sole **24 ORE**  
Dir. Resp.: Fabio Tamburini  
Tiratura: 81177 Diffusione: 137712 Lettori: 756000 (0004135)

**Energia.** In arrivo 42 bocciature di diritti di ricerca su 45 nuovi impianti  
Le applicazioni delle regole Pitesai colpiscono anche i 108 siti già in funzione

**Produzione nazionale.** Delle 123 concessioni minerarie, di cui 108 relative al gas, oltre il 70% con le nuove norme ricade in aree definite «non idonee»

## SWEDEN:

*Analisi* | **Materie prime**

Terre rare trovate in Svezia, perché l'entusiasmo rischia di essere prematuro

Stoccolma esulta per la nuova scoperta, ma perché porti frutti serviranno esplorazioni, verifiche e autorizzazioni

Awareness of the EUROPEAN COMMISSION who in the CRM regulation recognizes the need for...

Continued efforts are needed to address concerns related to **public awareness and acceptance.** Efficient and comprehensive public consultation processes and transparent and constant communication with those concerned, including with Indigenous Peoples and with the public at large when applicable, can contribute to addressing these challenges.

EC COM(2023) 165 final

# Good news: Political driver and growing Awareness on external vulnerabilities...



EUROPEAN CRITICAL RAW MATERIALS ACT

March 2023

The EU is aiming to ensure a secure and sustainable supply of critical raw materials for Europe's industry.

**la Repubblica**  
Quotidiano - Dir. Resp.: Maurizio Molinari  
Tiratura: 151071 Diffusione: 131007 Lettori: 1487000 (0004135)

*Il ministro Urso: apriamo la ricerca mineraria*

04135 04135

## Dal litio al cobalto, il tesoro che l'Italia ha dimenticato

**Il Sole 24 ORE**  
ECONOMIA

In evidenza In edicola Fiume di denaro: inchieste Podcast Lab24: i visual

Servizio | Industria estrattiva

## L'auto elettrica fa rinascere le miniere piemontesi

di Davide Madeddu  
18 agosto 2021

24+ **Abbonati**

**Il Sole 24 ORE**  
Dir. Resp.: Fabio Tamburini  
Tiratura: 94517 - Diffusione: 149810 - Lettori: 785000: da enti certificatori o autocertificati

06-MAG-2021  
da pag. 1-24  
foglio 1 / 2  
Superficie 34 %

**AGENZIA INTERNAZIONALE DELL'ENERGIA**  
«Fate scorte di litio e rame»  
Sissi Bellomo — a pag. 24

**Green&Blue**  
Dir. Resp.: Fabio Bogo  
Tiratura: N.D. Diffusione: N.D. Lettori: 3889000 (0004135)

**DATA STAMPA**  
www.datastampa.it

07-OTT-2021  
da pag. 29 / foglio 1

## Che vita sarebbe senza il neodimio?

**LE FIGARO**  
Dir. Resp.: Alexis Brézet  
Tiratura: 0 - Diffusione: 315159 - Lettori: 1972000: da enti certificatori o autocertificati

## La pénurie de minerais stratégiques menace

ARMELLE BOHINEUST @armellella Agir vite et ensemble

06-MAG-2021  
da pag. 26  
foglio 1  
Superficie 12 %

## L'Aie: obiettivi sul clima a rischio senza litio e rame, servono scorte strategiche

Giorno - Carlino - Nazione Economia Energia  
Dir. Resp.: Agnese Pini  
Tiratura, diffusione e lettori non disponibili (0004135)

Uno studio del Cnr definisce le aree con potenziali giacimenti  
Due le zone principali con flussi geotermici e termali  
di Alessandro Farruggia

**Il Sole 24 ORE**  
Quotidiano - Dir. Resp.: Fabio Tamburini  
Tiratura: 71008 Diffusione: 132572 Lettori: 715000 (0004135)

**DATA STAMPA**  
www.datastampa.it

## Miniere, tra Piemonte e Lazio parte la caccia a litio e cobalto

## La domanda di minerali per la transizione verde è pronta ad esplodere: e l'offerta?

di Marcello Minenna  
5 febbraio 2023

**Il Sole 24 ORE**  
COMMENTI

## La Svezia annuncia la scoperta del più grande giacimento di terre rare in Europa

di Beda Romano  
12 gennaio 2023

**Il Sole 24 ORE**  
MONDO

Further reading on: CESI Energy Journal, issue: May 2022 ([www.cesi.it/energy-journal](http://www.cesi.it/energy-journal))

