UP CATALYST

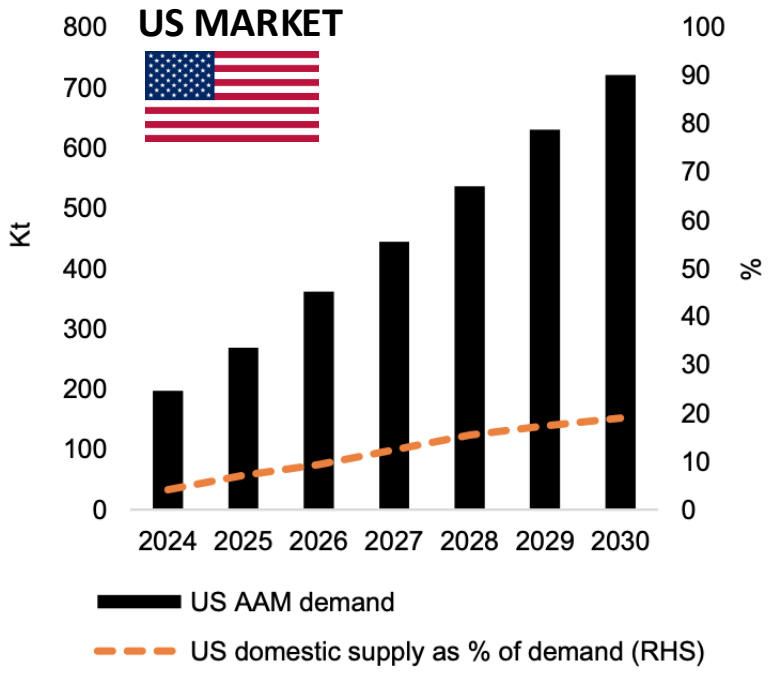
Turning CO_2 into Critical Materials:

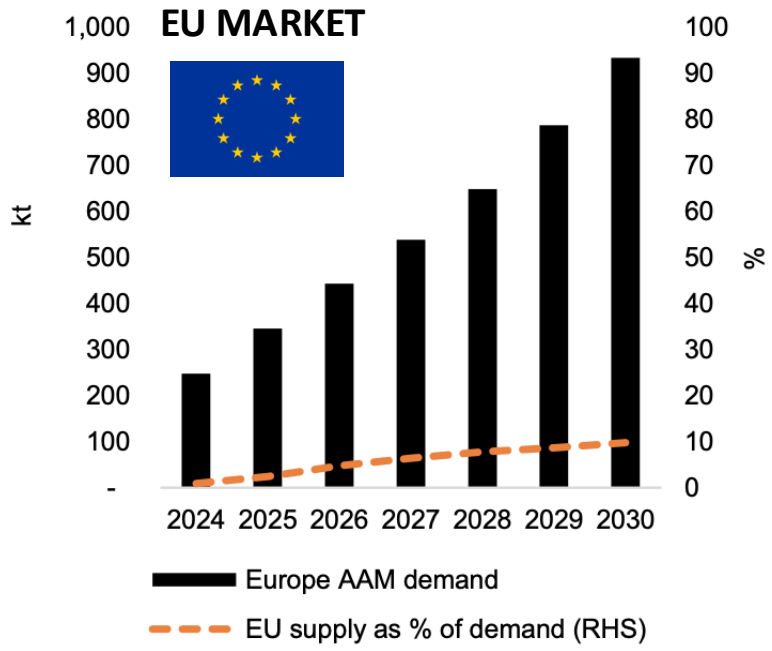
Local, Green Carbon for Tomorrow's Supply Chains

Dr. Apostolos Segkos, Head of Development

Global Problem

Every EV requires Graphite – local demand vs local supply



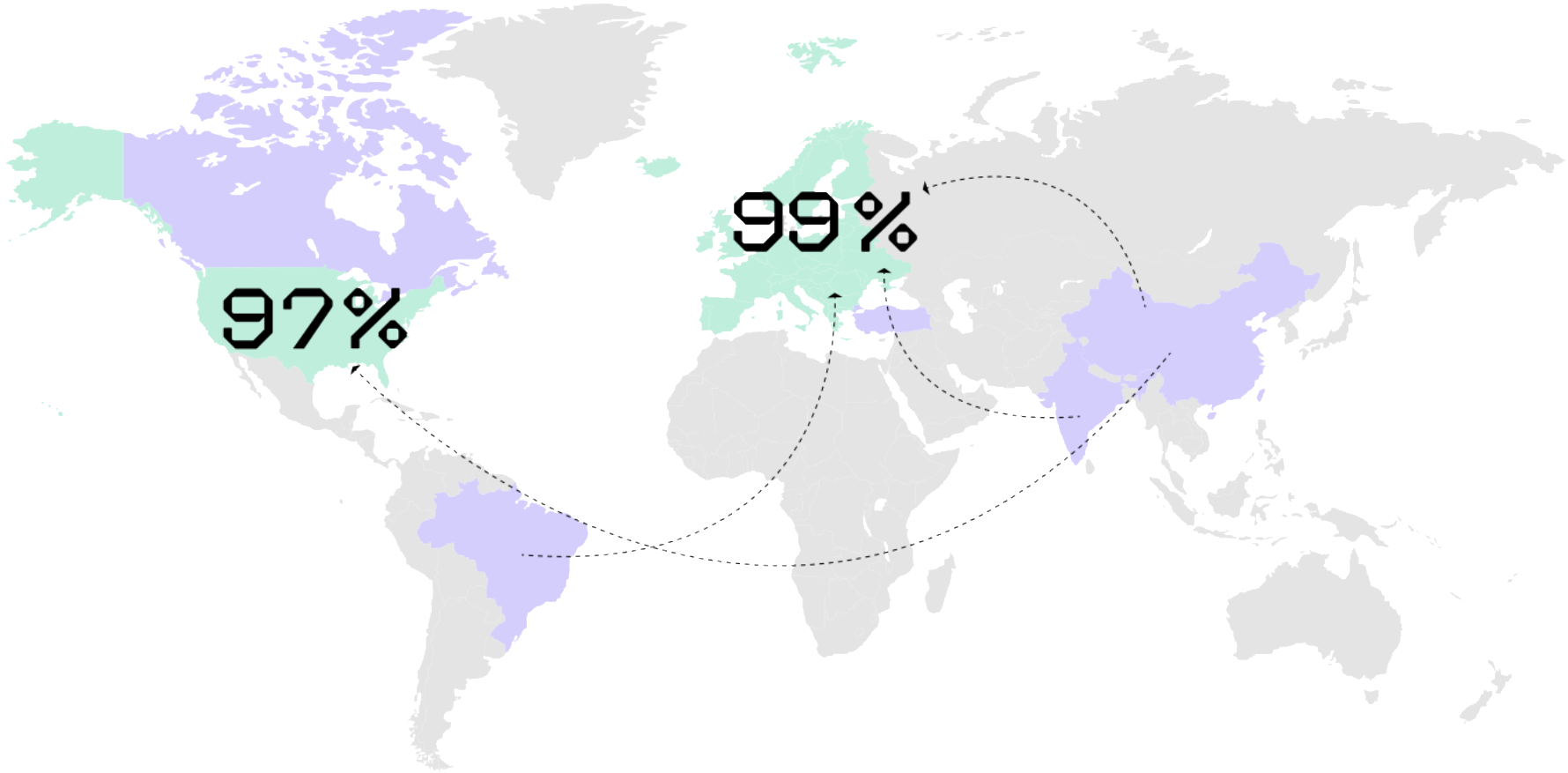


Source: Benchmark Minerals

TOTAL DEMAND OF DOMESTIC MARKETS ONLY MET BY 10-20% OF DOMESTIC SUPPLY

CHALLENGE #1: SUPPLY CHAIN SECURITY

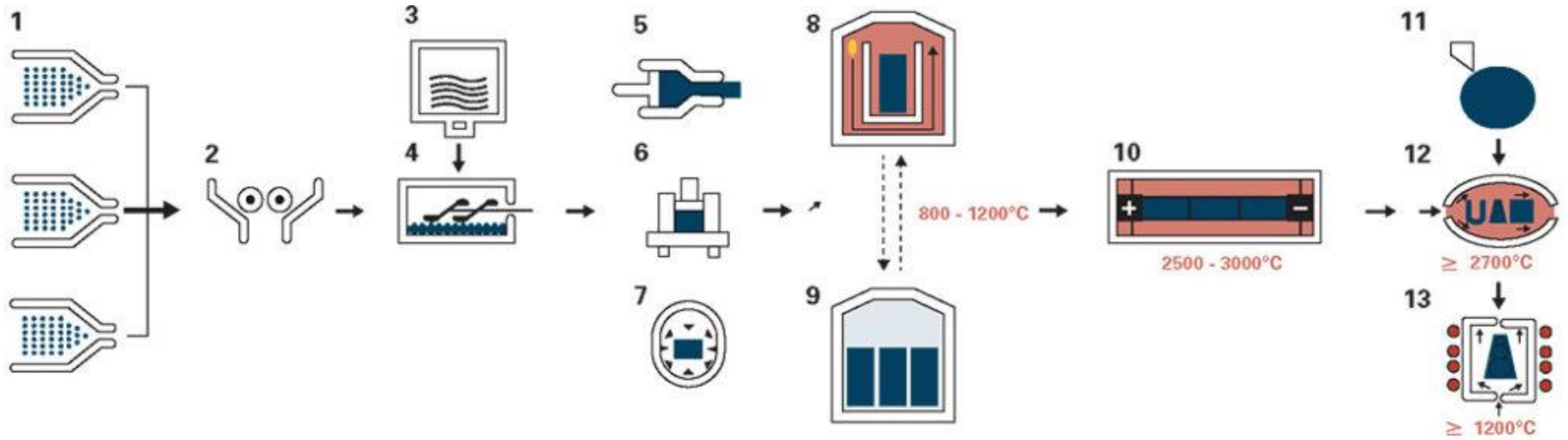
The EU does not produce graphite



- The EU, the US, Japan and Korea have declared graphite as a critical raw material.
- China curbed graphite exports from 1st of December 2023.
- 77% of the global graphite need comes from China.

CHALLENGE #2: CARBON EMISSIONS

Synthetic Graphite

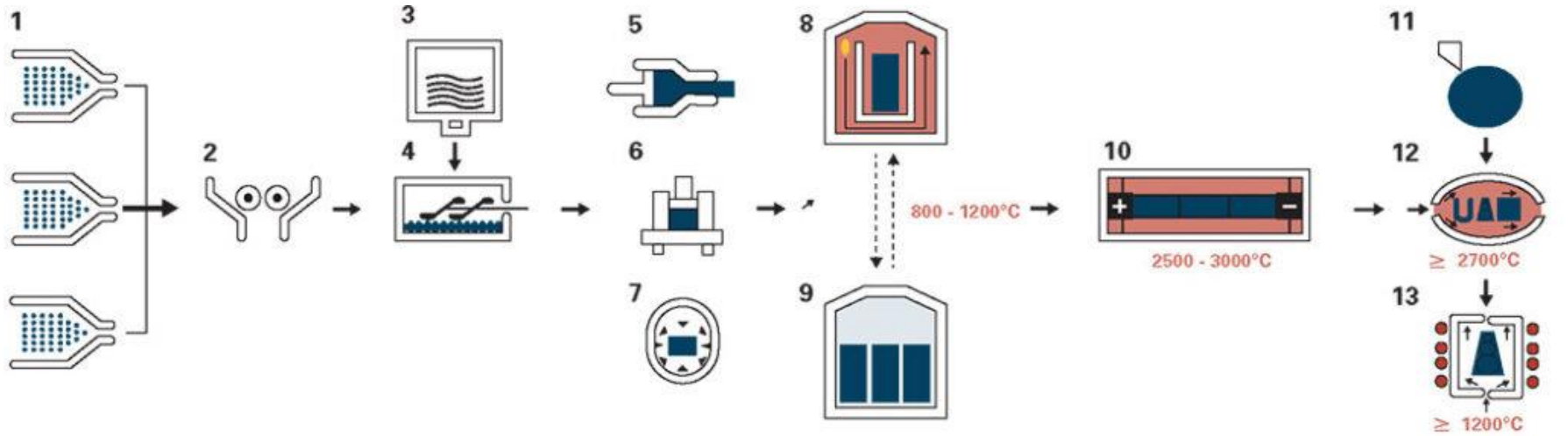


1 Coke , graphite
2 Grinding
3 Coal tar pitch
4 Mixing
5 Extruding
6 Vibro molding
7 Isostatic pressing
8 Carbonizing
9 Pitch impregnation
10 Graphitizing
11 Machining
12 Purifying
13 SiC coating

source:
SGL Carbon GmbH

CHALLENGE #2: CARBON EMISSIONS

Synthetic Graphite



1 Coke , graphite
2 Grinding
3 Coal tar pitch

4 Mixing
5 Extruding
6 Vibro molding

7 Isostatic pressing
8 Carbonizing
9 Pitch impregnation

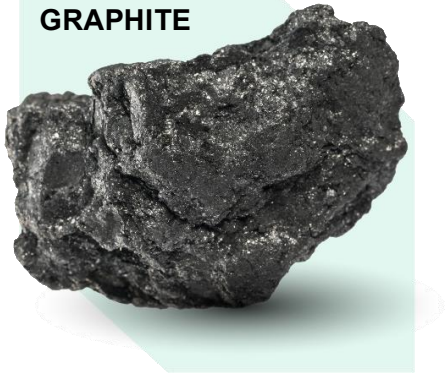
10 Graphitizing
11 Machining
12 Purifying
13 SiC coating

source:
SGL Carbon GmbH

CHALLENGE #2: CARBON EMISSIONS

Conventional Graphite and Nanotube production methods emit large amounts of CO_2

GRAPHITE



20 kg of CO_2

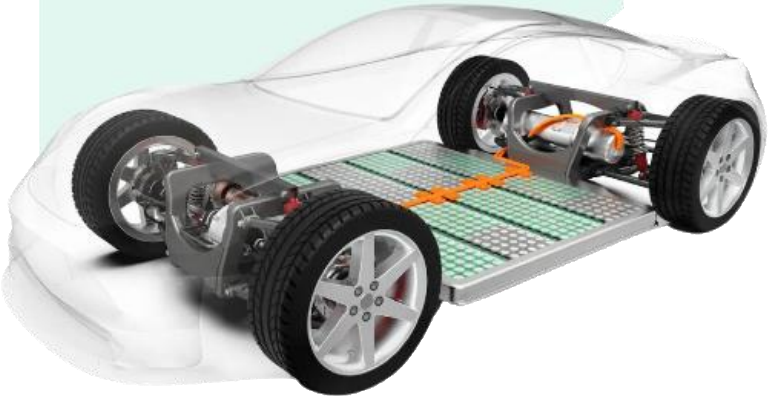
CONVENTIONAL

MWCNTs

170 kg of CO_2

CONVENTIONAL

60 million tons of annual CO_2 emissions by 2030



UP Catalyst: Turning CO_2 into Critical Materials

Split CO_2 molecule into oxygen and carbon

$$CO_2 \longrightarrow C + O_2$$

At the lowest temperatures

UP	**700°C** 18-24 hours	VS	**OTHERS**	**2800°C** Several weeks

But what about cost?

The “green premium” cannot win

700°C
18-24 hours

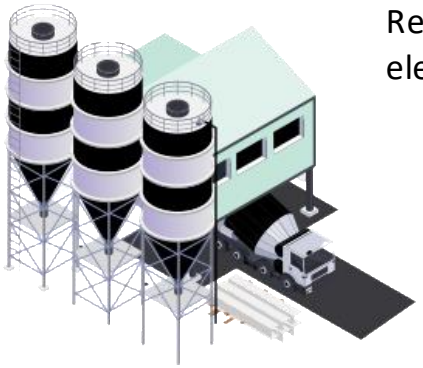
VS

OTHERS

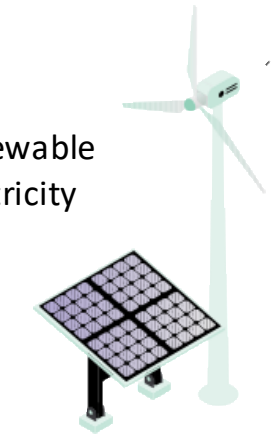
2800°C
Several weeks

Low Energy → **Lowest Cost**

Local, Green Carbon for Tomorrow's Supply Chains

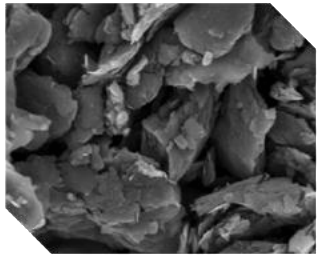


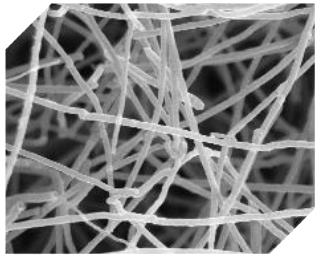
CO_2 emission from hard-to-abate industries



Renewable electricity

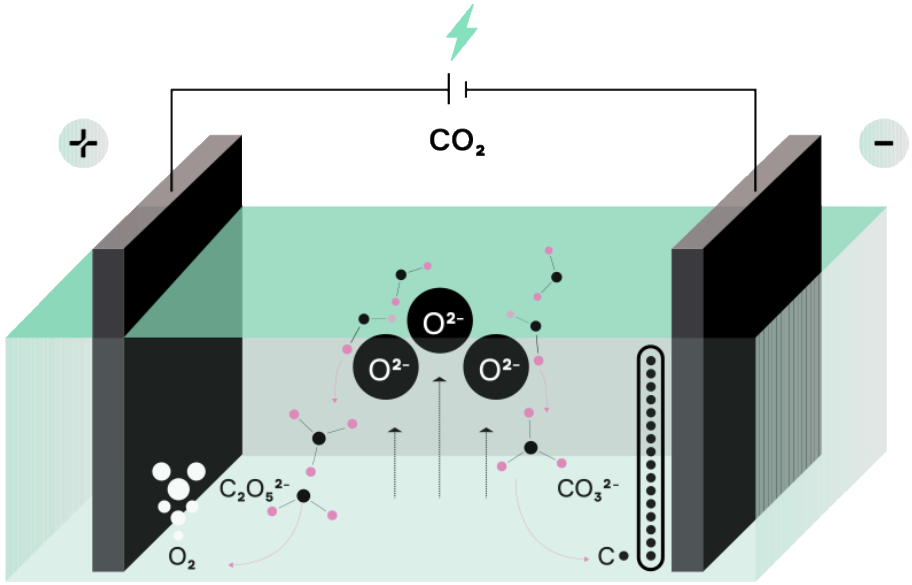
Sustainable Graphite





Sustainable MWCNTs

SCALABLE TECHNOLOGY



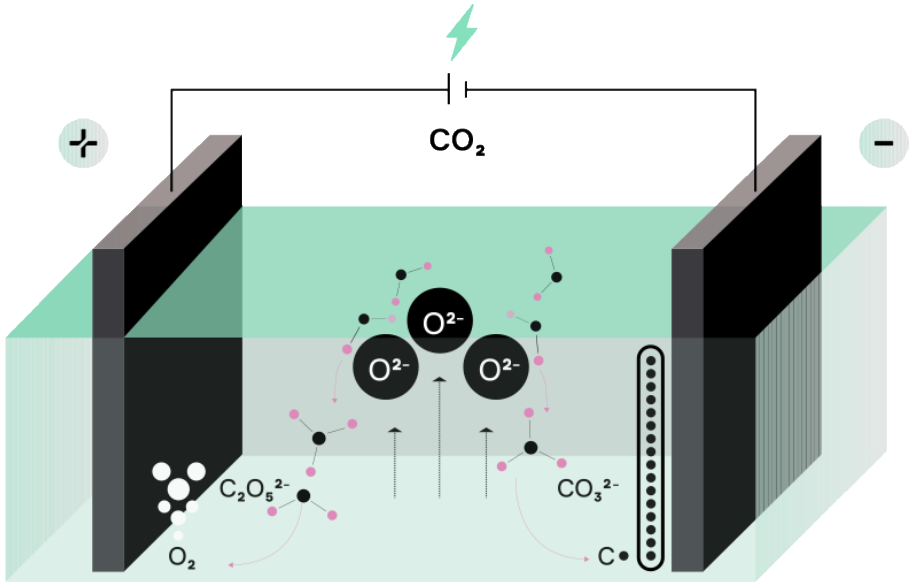
O_2 evolution CO_2 absorption C deposition

Known technology and already applied in

- Aluminium
- Magnesium

Scalable reactor design

SCALABLE TECHNOLOGY



O_2 evolution CO_2 absorption C deposition

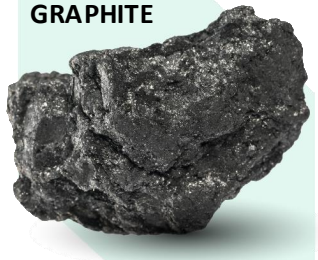
Molten salt electrolysis:
Known and already applied in

- Aluminium
- Magnesium

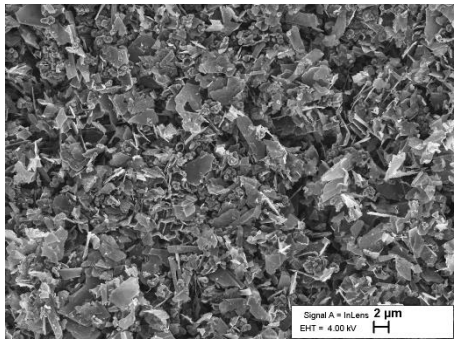
Deployable Pilot Reactor

OUR IMPACT: Localized supply chain of sustainable raw materials

GRAPHITE

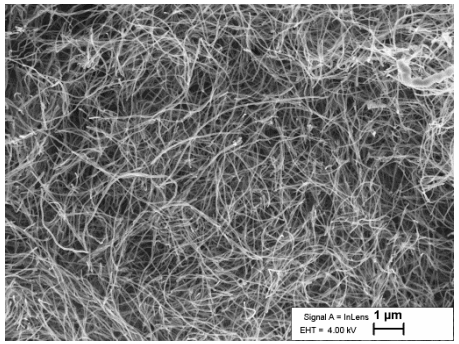


	CO_2 EMISSIONS PER TON OF MATERIAL	FEEDSTOCK
Benchmark, synthetic	20 tons	Fossil
UP CATALYST	0.07 ton	CO_2



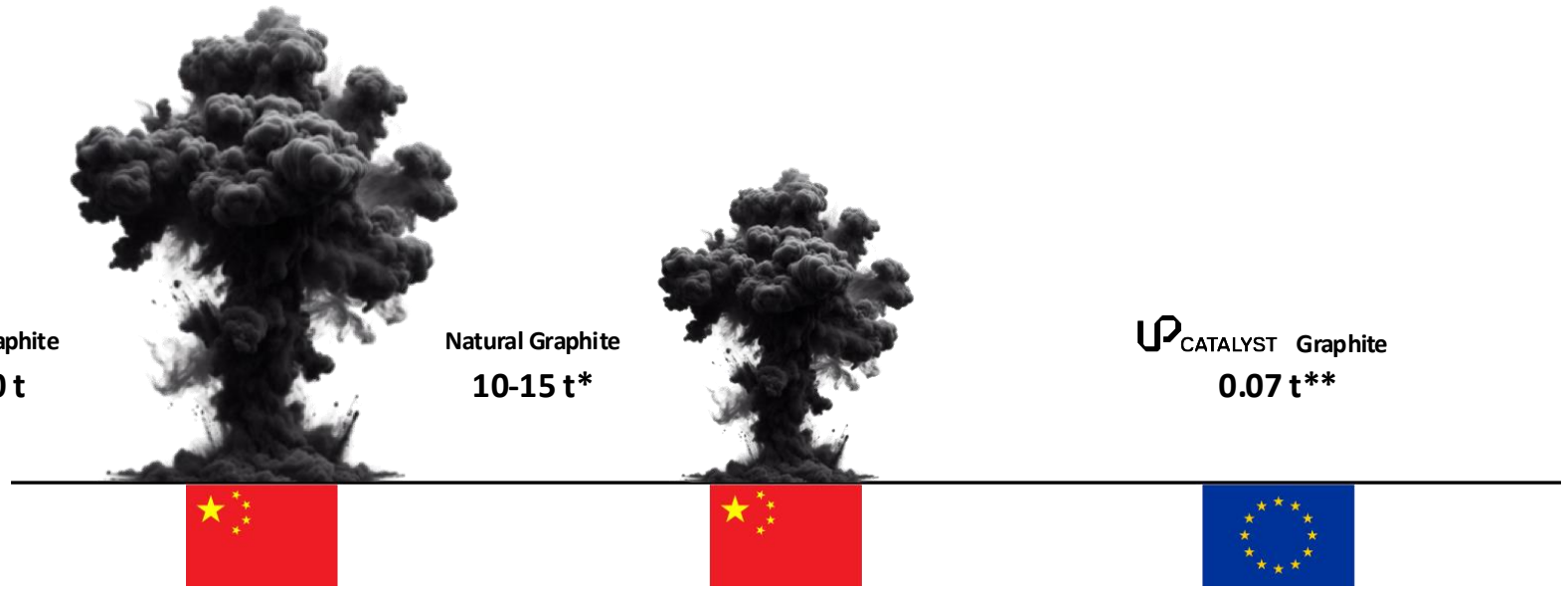
MWCNTs

Benchmark, CVD method	170 tons	Fossil
UP CATALYST	0.7 ton	CO_2



EMISSION AVOIDANCE THROUGH CO2 UTILISATION

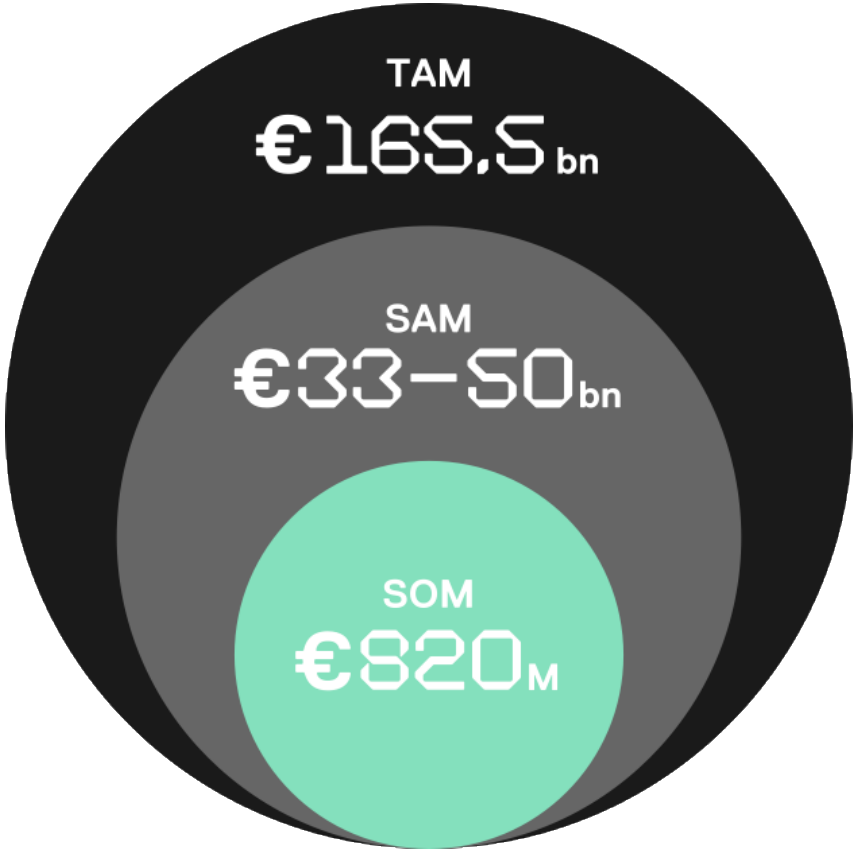
Tons of CO_2 per ton of material produced

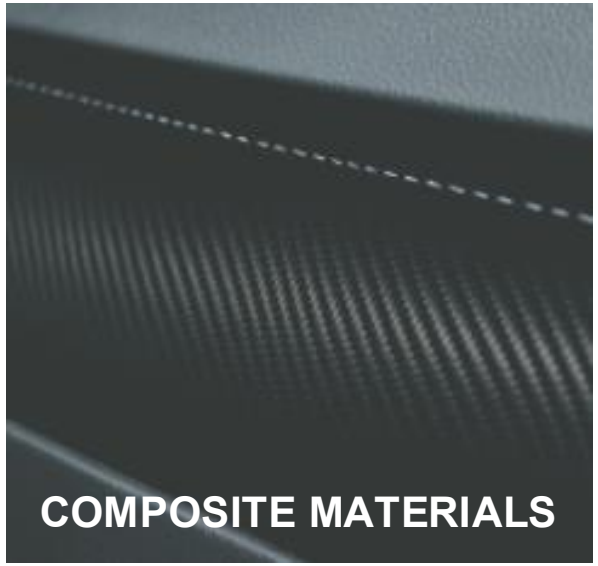


*Carrère, et. al, (2024). https://doi.org/10.1016/j.est.2024.112356
**LCA validated by Research Institutes of Sweden (RISE) and Bureau Veritas (2024)

OUTLOOK: MARKET OPPORTUNITY

Market opportunity is larger than for battery applications alone





CO2GRAPHITE

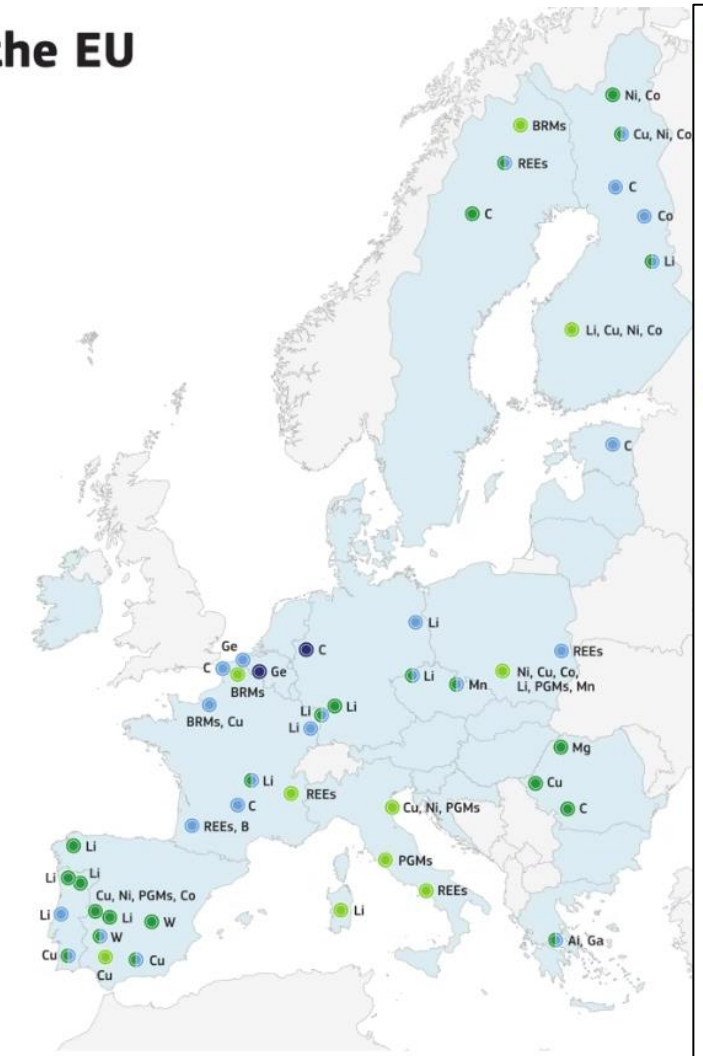
Strategic Projects for the EU

MAP LEGEND

Extraction · Processing · Recycling · Substitution

Al	Aluminium
B	Boron
BRMs	Battery Raw Materials [1]
Co	Cobalt
Cu	Copper
Ga	Gallium
Ge	Germanium
C	Graphite
Li	Lithium
Mg	Magnesium
Mn	Manganese
Ni	Nickel
PGMs	Platinum Group Metals
REEs	Rare Earth Elements
W	Tungsten

[1] Battery Raw Materials refer to lithium, cobalt, nickel, manganese and graphite



Disclaimer: The location of projects is based on a regional scale and doesn't reflect their exact geographical locations

Description of project

CO2GRAPHITE project is a processing project located in Estonia. It aims to build a large-scale facility to produce battery-grade graphite based on the synthesis of carbon materials from carbon dioxide (CO2). This technology is the result of R&D efforts started over 10 years ago in the University of Tartu (Estonia).

Benefit for the EU

CO2GRAPHITE project would make a meaningful contribution to the security of the EU's supply, contributing to the achievement of the 2030 benchmarks. The use of carbon-negative technology allows the project promoter to capture and convert industrial CO2 emissions into battery-grade graphite. This project involves partnerships with various entities across the EU, as well as suppliers and off takers.

Project Name:
CO2GRAPHITE

Project Type:
Processing

Strategic Raw Material:
Graphite

Project Promoter:
UP Catalyst OÜ

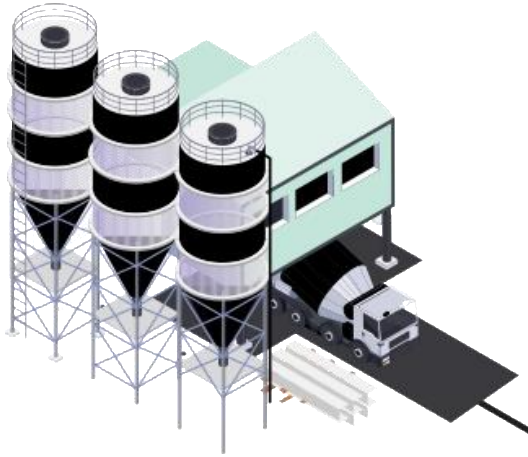
Project Country:
Estonia

Estimated Starting Date of Production:
2025

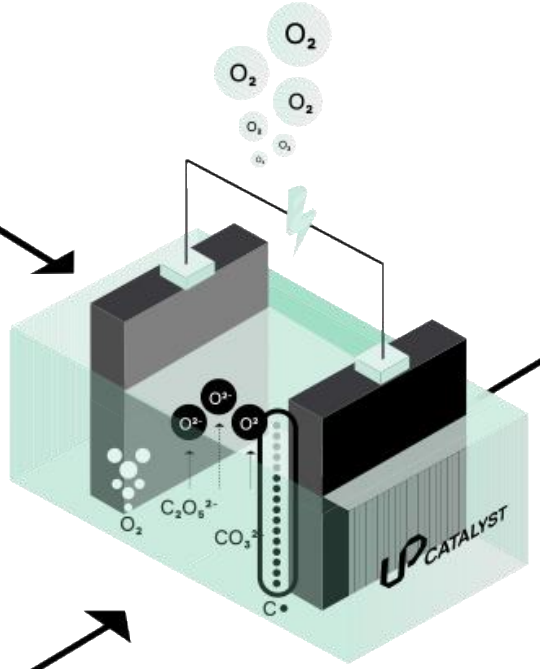
UNFC Classification:
E2 // F2.1 // G3

PRODUCTION REQUIREMENTS

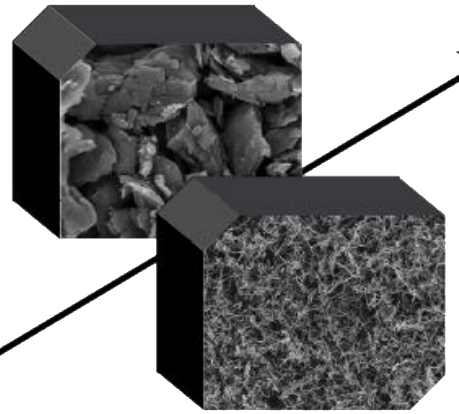
1. Captured CO_2 emissions



2. Renewable Energy & Grid Connection



3. Land



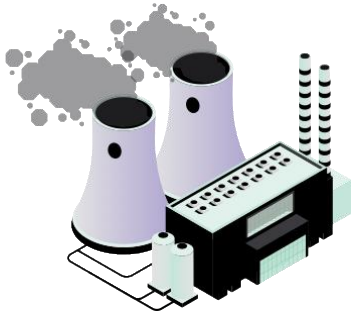
4. Financial Incentives/ Ecosystem

Output:
30 000 ton of graphite/yr
500 tons of CNTs/yr

~450 000 new EVs/yr

Input:
CO2: 110 000t/yr
Energy: 600GWh
Power: 80MW

SCALING CCU PROJECT IN ESTONIA

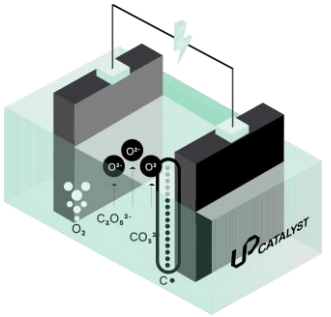


CAPTURED CO_2

- ✗ **Small volumes (<6000t /yr)**
- ✗ **> 100 000 tons/year**
- ✗ National Strategy to support CCUS

ELECTRICITY & GRID/ LAND

- ✓ **Energy: 600GWh** (11% of total electricity consumption in Estonia in 2024) - doable by 2030
- ✗ Cheap electricity
- ✗ Cross-border PPA (Estlink cable)
- ✗ Power: 80MW (fastest – Narva)



FINANCIAL INCENTIVES & POLICIES

- ✓ Small Grants (EIS: R&D for employees, RUP applied research)
- ✓ Large Scale Investment Aid (**Low support rate**)
- ✗ Mid-scale grants (gap between small and large)
- ✗ Support to attract EU funds (Horizon, IF)
- ✗ Ecosystem (hydrogen, Power2X, CCUS)
- ? CISAF
- ?

ALTERNATIVES?

Country	Price
Finland	Available CO_2, cheap and clean electricity, strong and reliable grid, R&D grants, tax credits, low-interest loans that can be converted into grant, investment aid, facilitated access to EU funding instruments, private and public investor interest
Canada	National CCUS Strategy, National Critical Materials Strategy, available CO_2, cheap and clean electricity, R&D Funds, tax Credits, CAPEX funding programms
South Korea	Cheap CO_2, strong position in critical raw materials, batteries and advanced industries, world-class construction expertise, strategic access to the broader Asian market

Leading the world to renewable carbon