

Synthetic Graphite Anode Materials

An EU supply perspective

SGL Carbon in a nutshell

Data and facts 2021

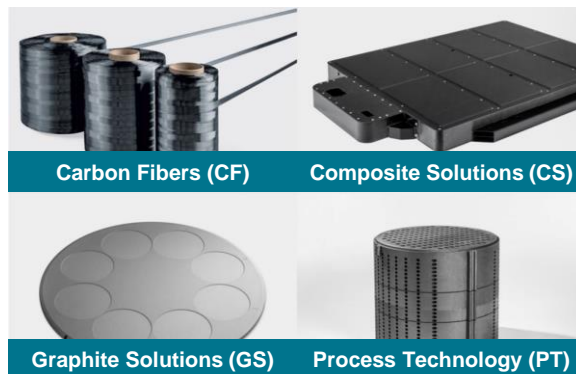
Anchor investors*

- SKion GmbH 27.46%
- BMW AG 18.44%
- Volkswagen AG 7.41%

Global presence with 31 sites

Business Unit structure

GS business line Battery Solutions



GS Battery Solutions

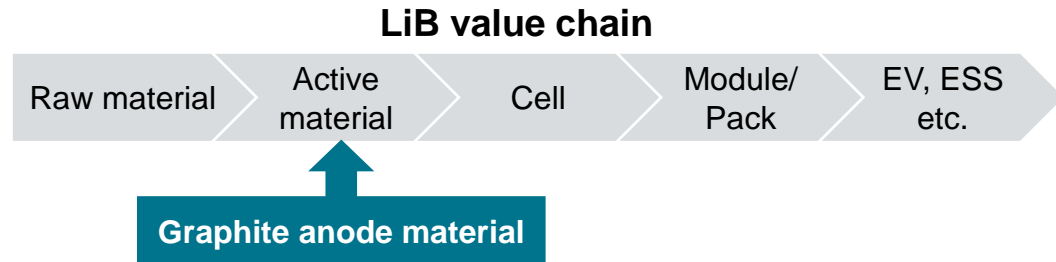
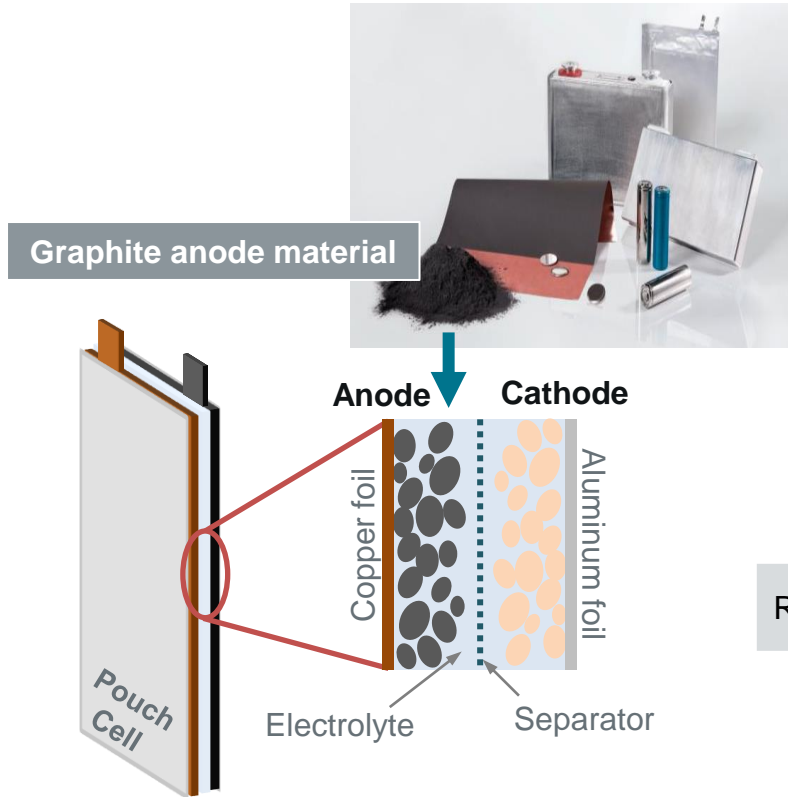
- 2 decades mass production of synthetic graphite anode material precursor
- Production sites in Europe and USA
- R&D and application lab in Germany
- Forward integration to finished anode material under IPCEI

* according to §§33 ff WpHG

Lithium-Ion Battery (LiB) is a hi-tec system: each cell component is unique and leads to very specific cell characteristics

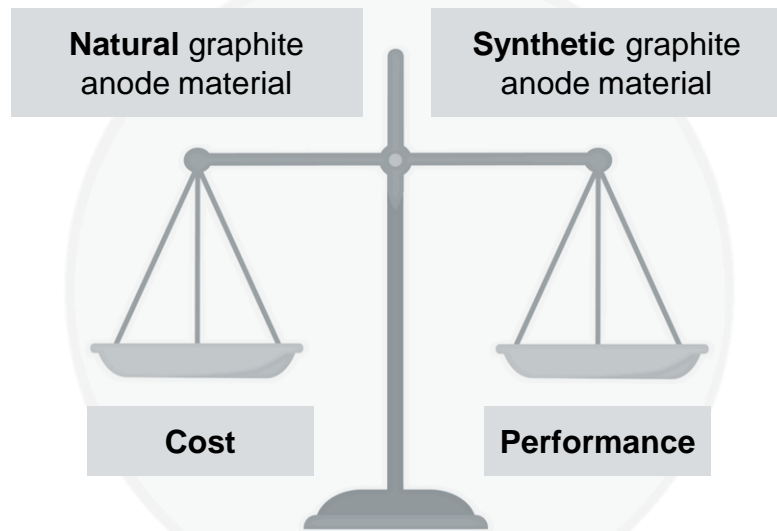
Active anode material availability is key

- Each component essential & cell specific
- Key components anode, cathode, electrolyte and separator used in defined ratio and with unique specification
- Replacement of components requires extensive cell tests and means system redevelopment
- De-facto not replaceable due to qualification cascade: 3 months for first tests, >1 year for system re-qualification



LiB anode materials: graphite is the best available technology solution. Synthetic & natural graphite deliver all needed cost/performance ratios

Material profile comparison ¹

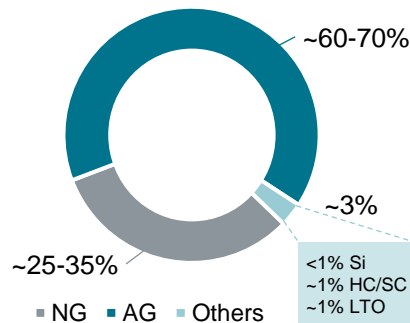


Global demand 2030: ~2 - 3 million tons ³

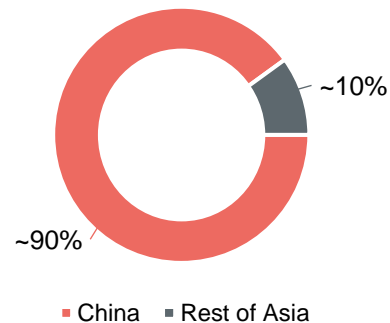
Graphite represents >90% of anode market

- Both types are **complimentary** as these are **not replaceable** against each other
- Very **unique specifications**
- Other carbon types such as hardcarbons are technically inferior to graphite and unsuitable to replace graphite

Anode material market ²



GAM production region ²



Synthetic graphite anode materials can be faster scaled up at flexible locations and provide the potential of a fully sustainable value chain

Synthetic graphite anode material

- Petrochem side-stream, (renewable/recyclate materials)
- European raw material base instantly available
- Industrial process, ESHA rules according to location
- Specific production assets for LiB anode quality
- Flexible location
- Leadtime for capacities 1.5 – 3a

Carbon raw material



Synthesis & heat process



Finishing



Industrial process

Yield: 70 – 90%

Natural graphite anode material

- Mineral with fossil origin
- Marginal availability from European mines yet
- Mining process followed by refining as industrial process
- Exploitation of mine mainly dedicated to natural graphite
- Mining bound to countries of mine
- Leadtime 8 - 10a incl. exploration of mine

Mineral



Separation/Purification



Finishing



Mining

Industrial process

Yield: 5 - 15%

E-mobility requirements will be a game changer. A sustainable and competitive EU LIB value chain will be essential for public credibility

LIB technology: The legacy



- Driven by consumer electronics performance demands
- Asian consumer electronics industry → Asian value chain
- Sustainability not in focus
- Niche compared to future demand, build over 20 years

LIB technology: Now and the future



- Driven by e-mobility and renewable energy storage
- Key agenda is decarbonization/sustainability
- Demand will be ca. 10x vs. today
- EU value chains have to be established in this decade

Electromobility in the EU aims to improve the climate while maintaining our ethical values and wealth – this is not compatible with today's LIB value chain legacy from consumer electronics.

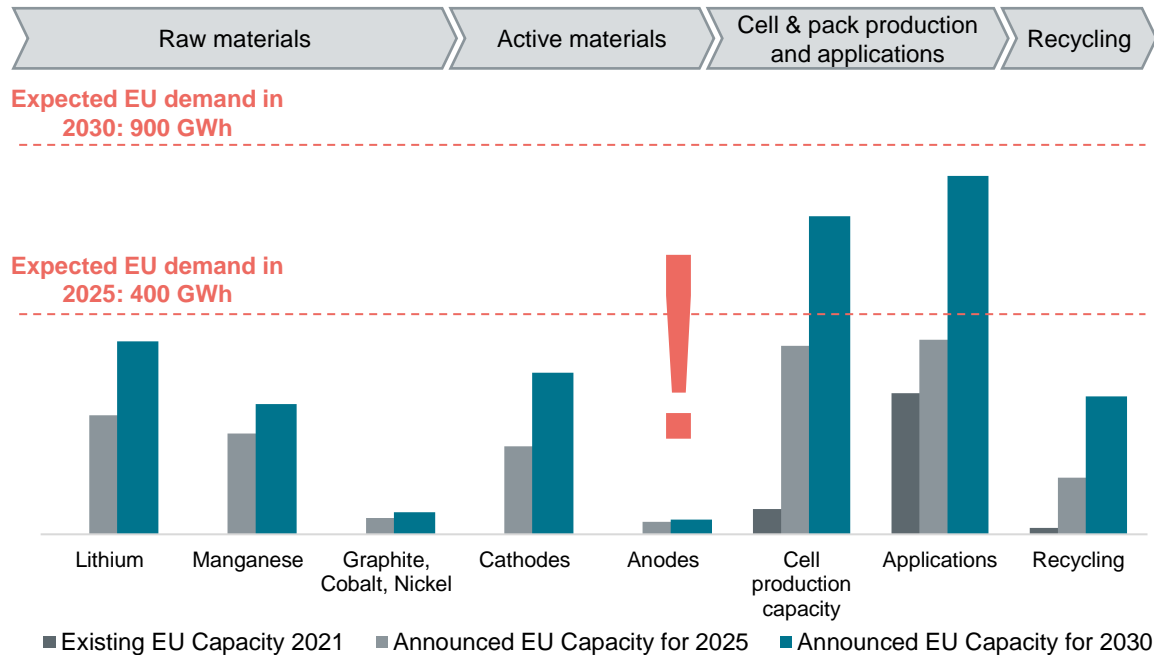
Sustainability

Competitiveness

EU employment

Current availability of anode material from EU production is marginal, however, significant potential to build high coverage from EU sites

Predicted share of EU supply vs. expected EU demand ¹



Risk of building a facade

- EU demand for LiB active material is **not covered** by published projects
- **>80%** of anode material from **China**
- **High dependency** on imports leads to vulnerable situation in EU
- Supply interruption will mean **stop of production** at EU cell producers

Material supply is the “light switch” for EU LiB makers

1) Illustration based on European Battery Alliance, Innovation Norway and Eyde Cluster: The Nordic Battery Scene, part 2, National governments

Relying on anode material supply from Asian sources bears the risk of a “ground stop” for EU LiB cell & EU EV production

China risks are real – EU to establish a level playing field & to remove the dependency

Political risk

- Current 5-year plan **limits capacity expansion** in energy & raw material intensive sectors in China
- Policy to higher **local value-add & domestic priority**
- **Export control** for graphite anode materials (synthetic & natural): Authority approval necessary for each export

Logistics & commercial risks

- **Production & powerplant cutoffs** for emission control have long tradition (e.g., Beijing Olympics 2008 ... 2022)
- **Long distance transport** suffering from Transport / container shortages and added **carbon footprint**
- **Unpredictable lead-times** and **unsustainable prices**

Different values

- **Non-market** economy
- Control of EU standards in **ESHA/ESG limited**
- **Government control** for investments outside China, and **technology access restrictions**

Such risks are proven realities

- **Russia/Ukraine impact** on supply of oil, gas,...
- **Semiconductor**/chip crisis
- **Corona** shortages (e.g., masks)
- **Rare Earth** minerals
- **Magnesium** (impact on Aluminum production)

SGL offers the base to establish an independent, competitive and sustainable European supply for synthetic graphite anode materials

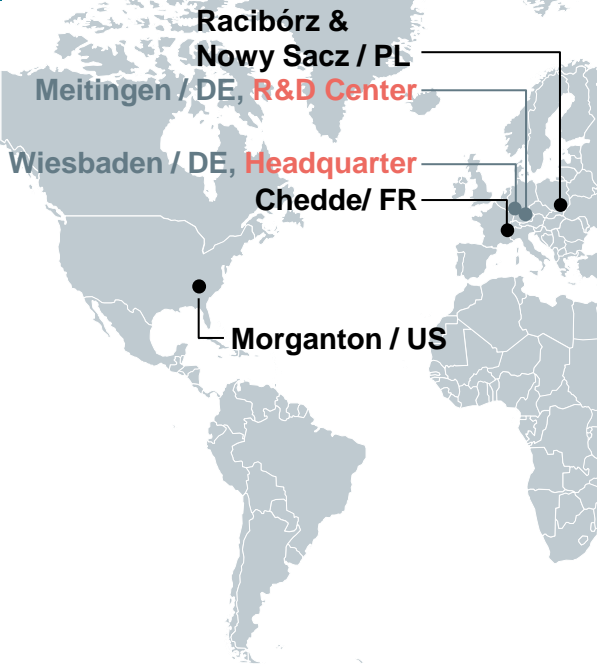
Established production sites with space for expansion



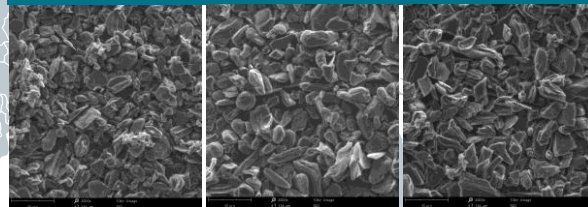
Material & application development labs and knowhow



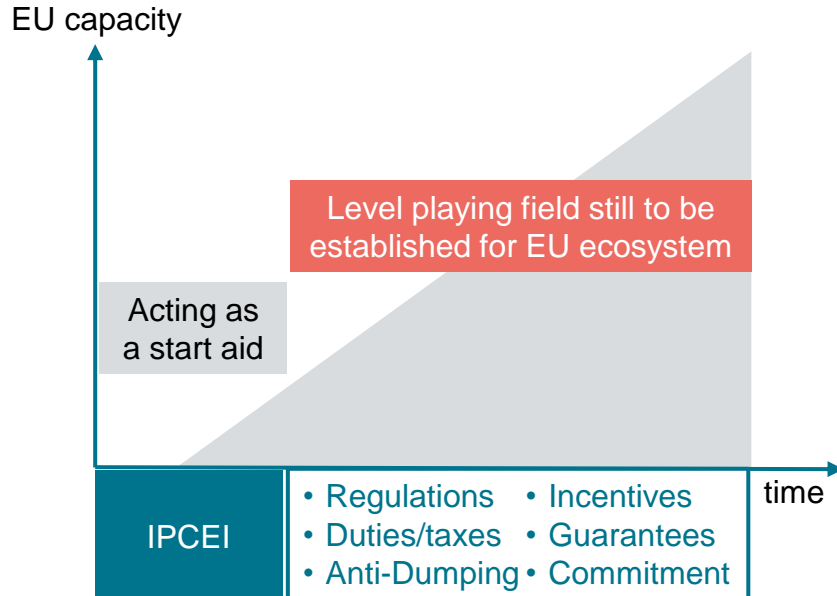
Sustainability in focus



Product & process expertise



Synthetic graphite anode material capacities can be scaled within 2-3 years lead-time. Downstream & governmental commitments essential



Measure 1: Strategic cooperation

- **Integrated cooperation** between OEM, cell producers and material suppliers
- Binding **commitments** from cell makers and/or OEM to material manufacturers

Measure 2: Governmental frame

- **Regulations** which create a level playing field
- **Incentive measures** for EV sales must support EU cell and material production
- Foster investments via risk mitigation, e.g., like **state guarantees**

Because carbon matters

Solutions for a European battery ecosystem

