



The Critical Materials Company

Investor Day 2015
AMG Graphite Presentation

June 25, 2015

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Overview



AMG Critical Materials

- Vanadium
- Superalloys
- Titanium Alloys & Coatings
- Aluminum Alloys
- Tantalum & Niobium
- Antimony
- **Graphite**
- Silicon

AMG Engineering

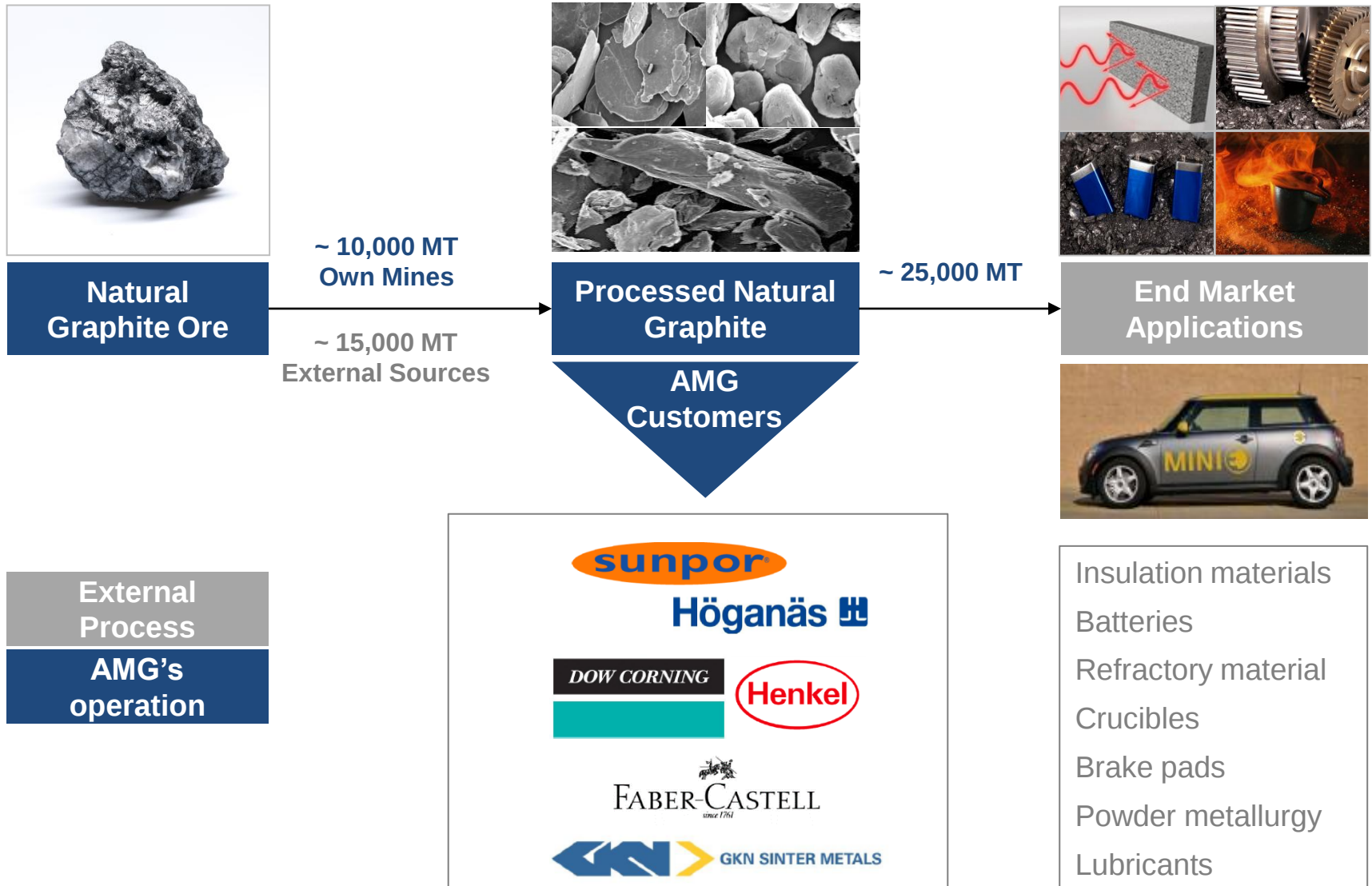
- Engineering
- Heat Treatment Services



Overview

- AMG Graphite is a world-leading processor of customized high-purity natural graphite with integrated mining operations to secure raw material supply
 - Processing facilities in Germany, Czech Republic, Sri Lanka and China
 - Mines in Germany, Sri Lanka, and Zimbabwe
 - Mozambique mine development project
 - 150 grades of natural graphite and 25 grades of dispersions
 - \$67m revenue in 2014
 - 467 employees
- Global market for natural graphite is approx. 1.2m MT, thereof **80-85k MT are high-end grades.**
- AMG's high-end grade production is ~20k MT, representing ~ **25% of the global high-end market**
- Alterna Capital acquired a 40% equity interest in AMG Graphite in 2015 by way of a capital increase

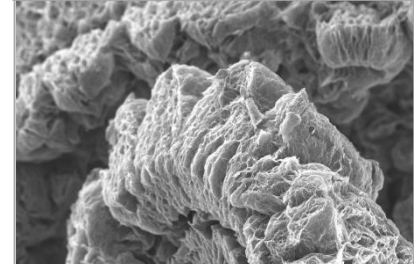
Value Chain



Strategy

AMG Graphite provides high quality natural graphite solutions through an integrated sustainable value chain serving the global market

- Partner with customers in the development of innovative graphite-based applications
 - Up to > 99.99 % Carbon
 - Flakes to Powders
 - Dispersions and Expandable Graphite
- Solidify our position as world market leader in natural graphite solutions
 - Combination of own mines and flexible market sources
 - Increase own mine capacities to 2/3 of required strategic raw material by 2020
- Grow the existing product portfolio
- Develop new products and applications in the high-end graphite markets for CO2 emission reduction, population growth and energy efficiency



Growth Opportunities

Organic Growth

Heat Insulation

Lubricants
Dispersions
Expandables

Future Markets & Applications

Battery Anode
Material

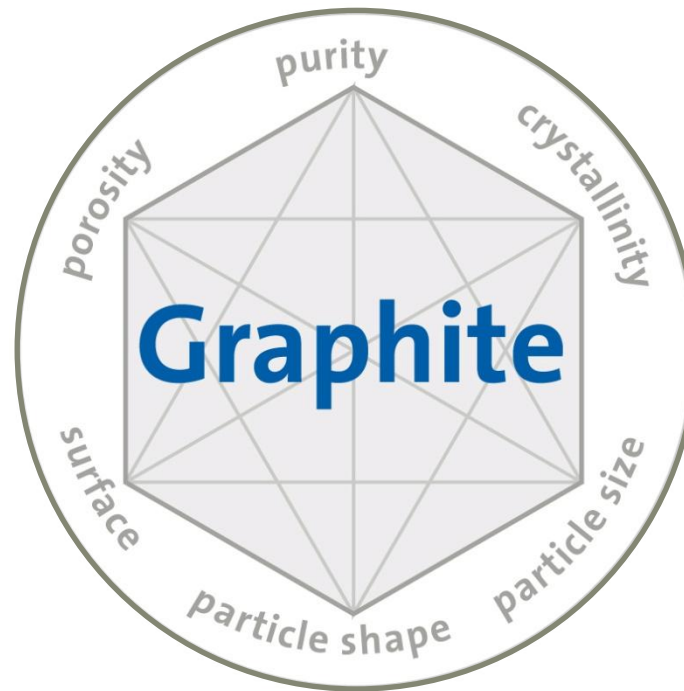
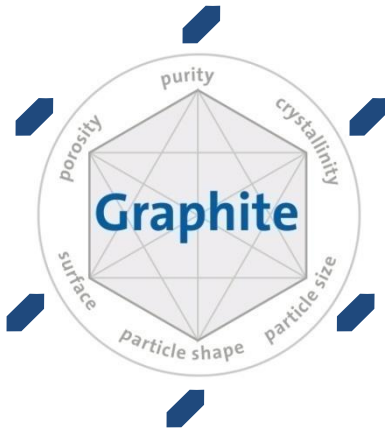
Graphene

Nuclear Waste
Disposal
Solutions

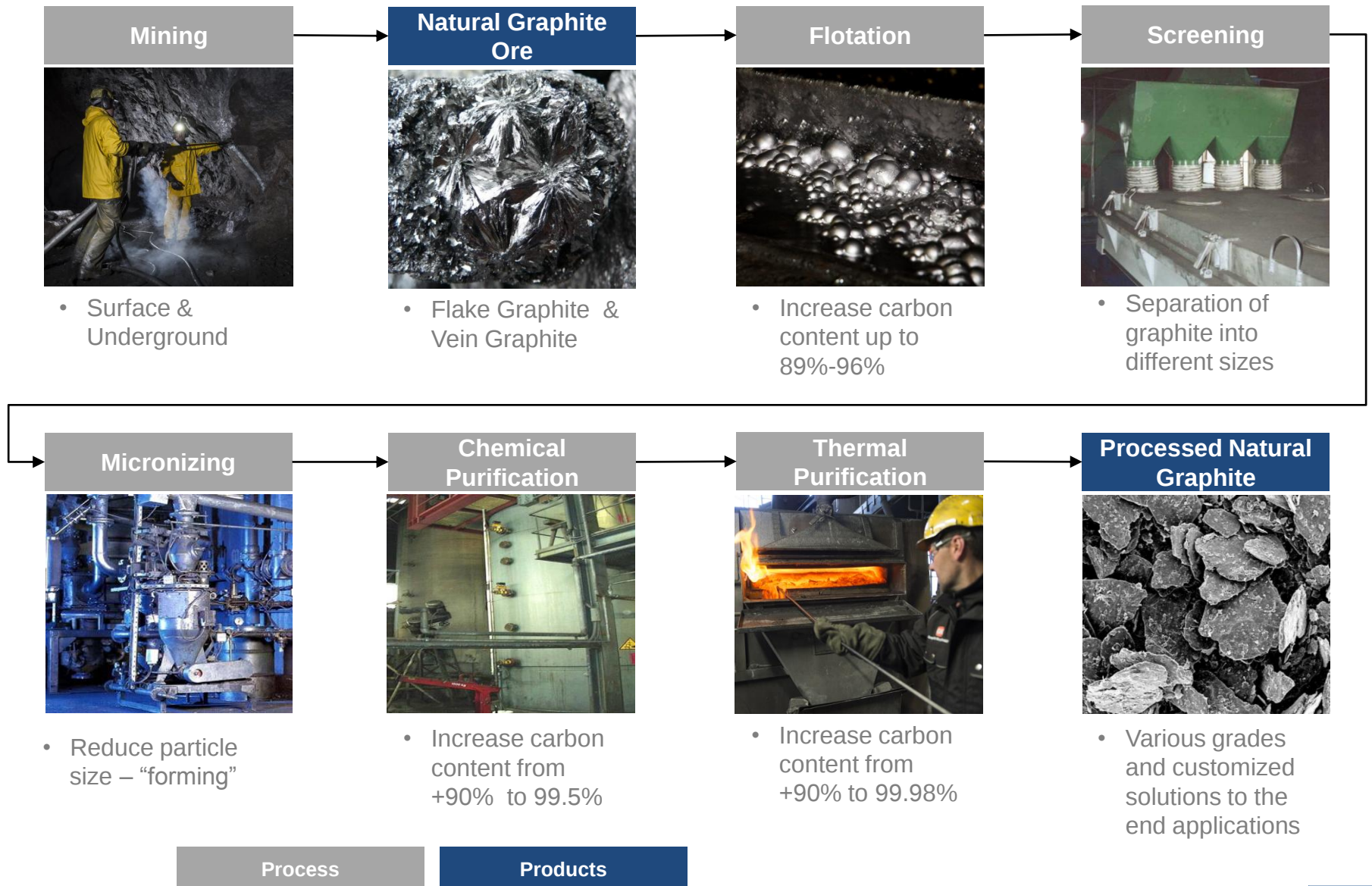
Operations



Graphite Parameters



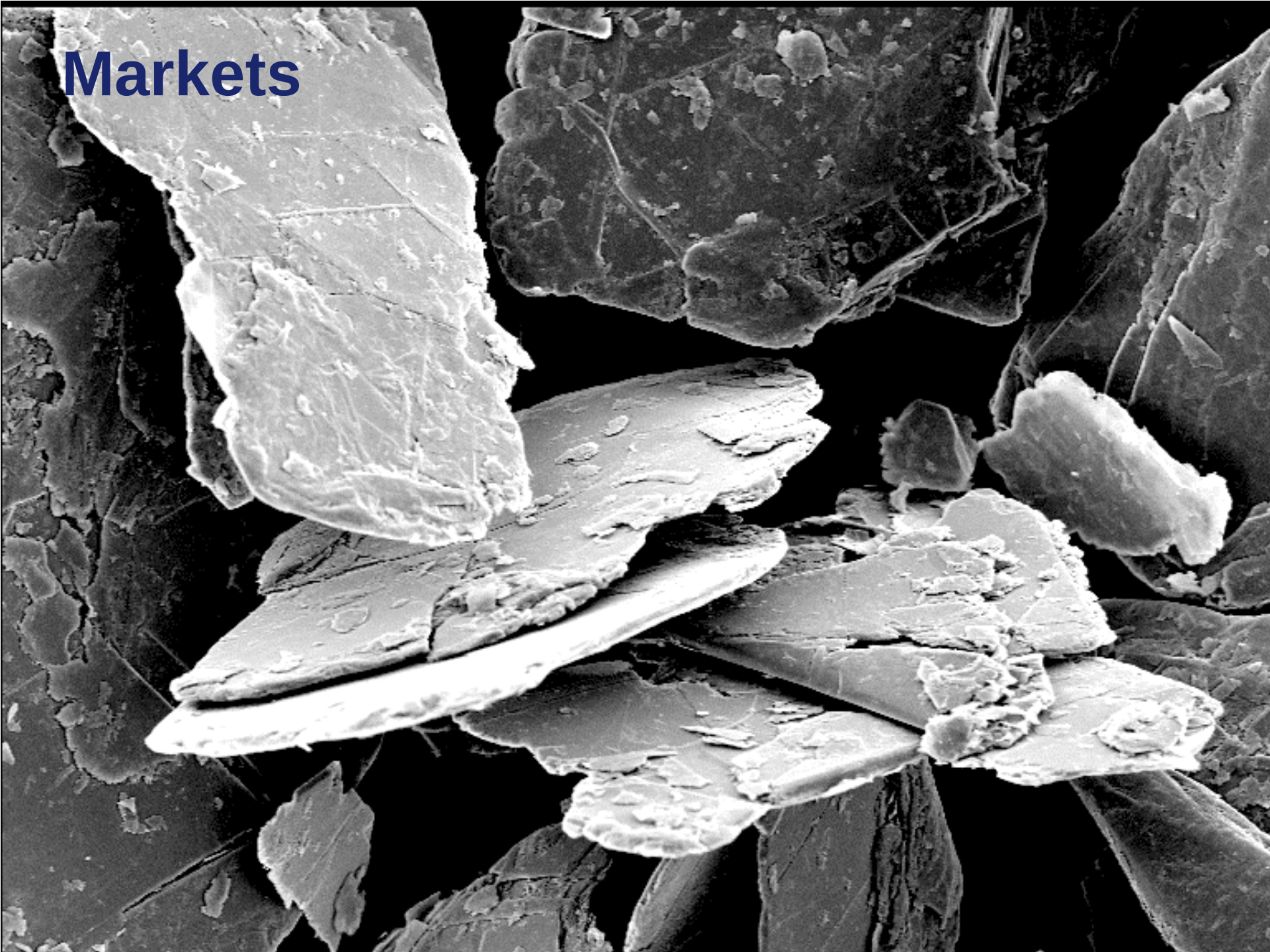
Operations – Flow Sheet



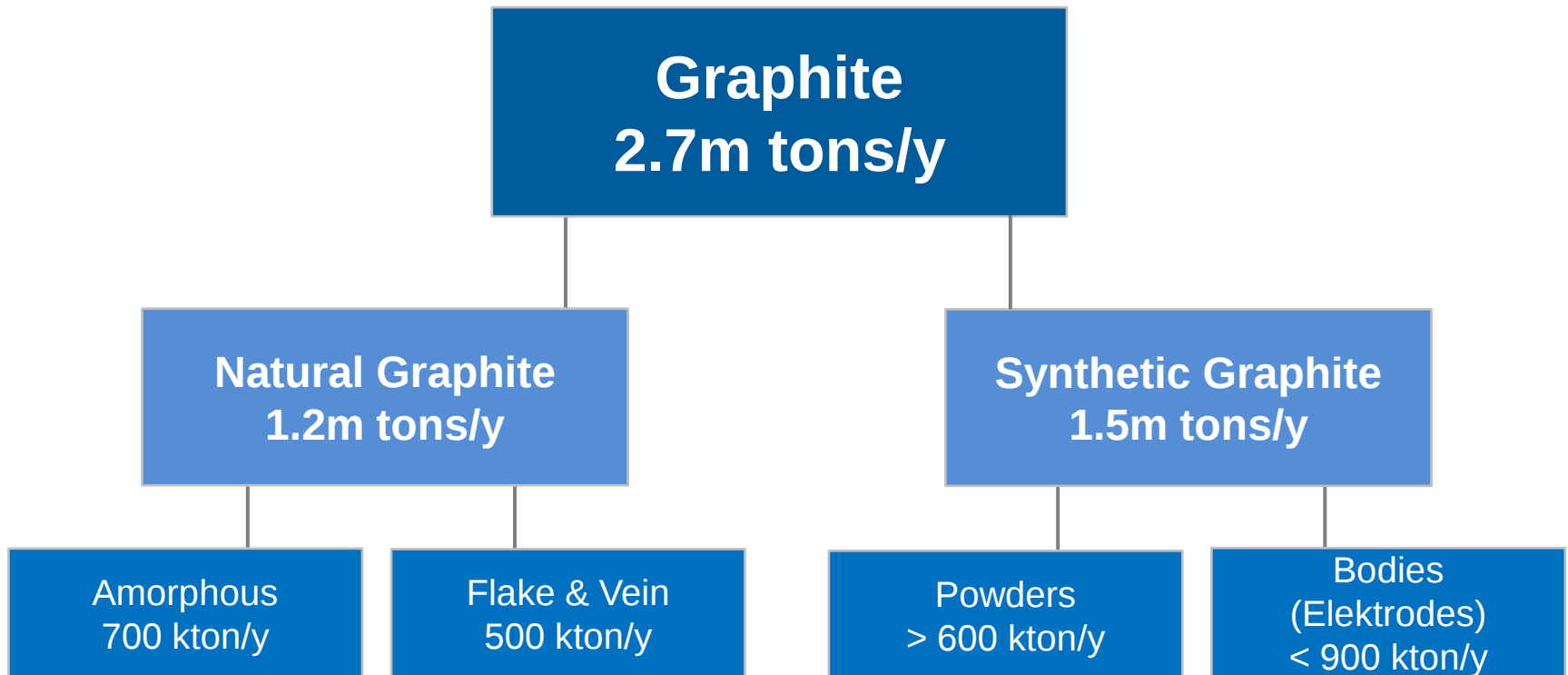
Operations – Locations



Markets



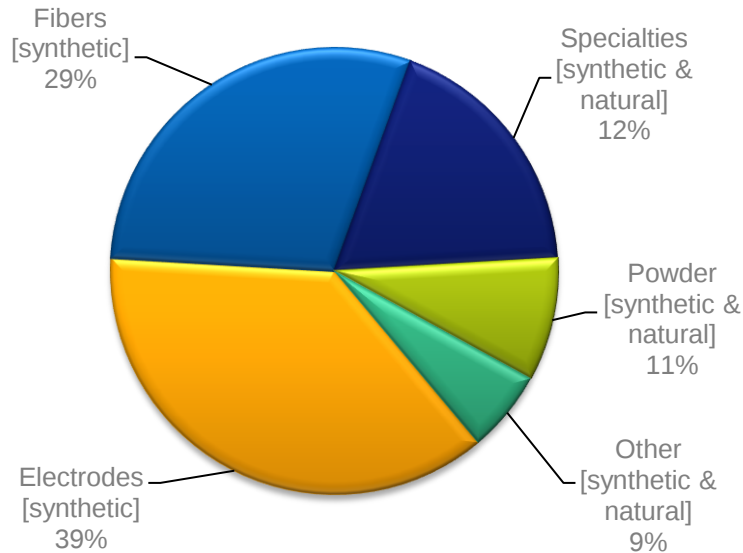
Market – End Markets



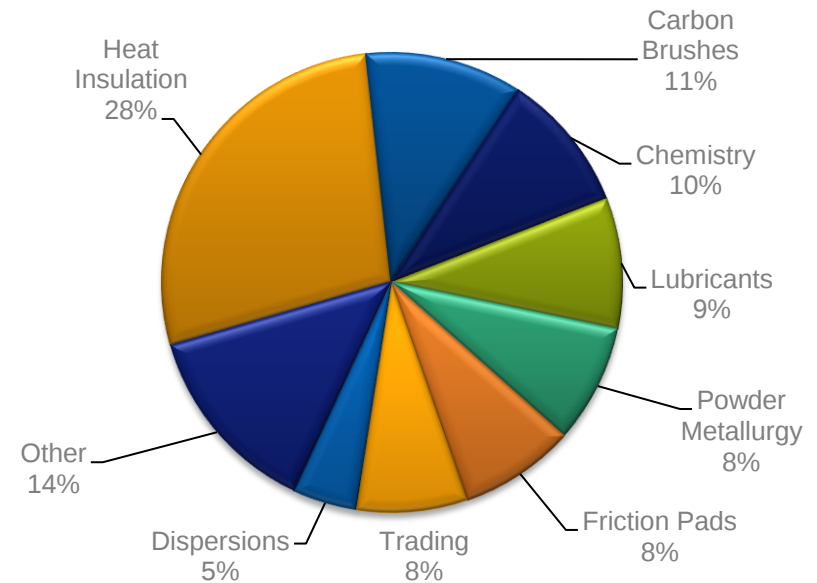
- Of the 1.2m metric tons per annum of natural graphite sold globally, 80-85k metric tons are high-end grades
- AMG's high-end grade production is ~20k metric tons, representing ~ 25% of the global high-end grade natural graphite products
- China is the dominating producer and consumer

Market – End Markets

Global Graphite Market



AMG Market by End Use



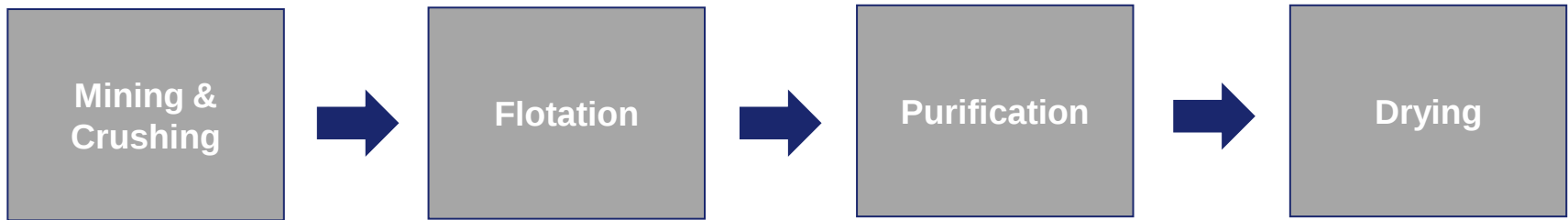
➤ The global graphite market is ~\$14B

- Natural graphite is 9% of the graphite market with \$1.3B, or 1.2m MT
- Synthetic graphite is 91% of the graphite market with \$12.3B, or 1.5 MT

Energy Consumption: Natural vs. Synthetic Graphite

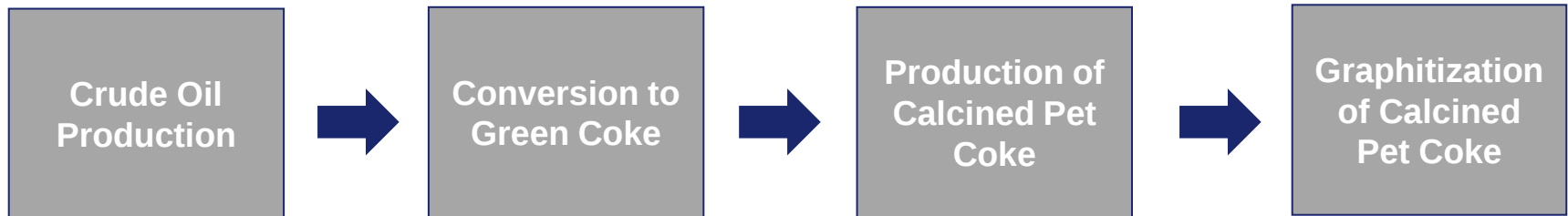
To produce 1 ton of synthetic graphite with similar carbon content and particle size approx. 200% more energy is needed

Natural Graphite Summary Flow Sheet



Total energy required to produce 1 ton of natural graphite (approx. 99.5% carbon) is 2,500 kWh/MT

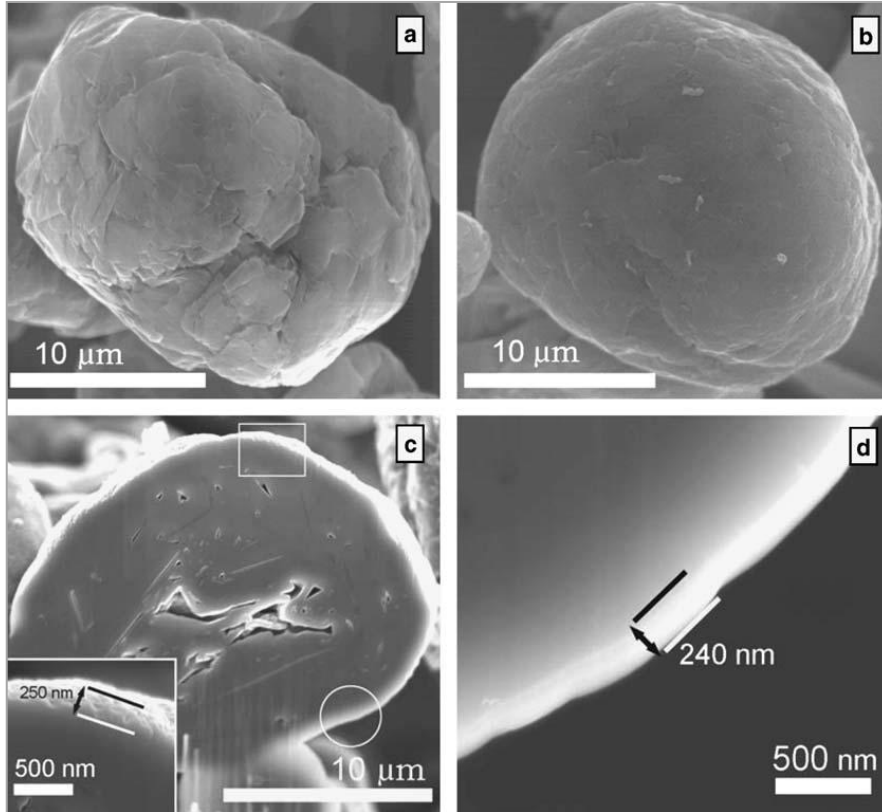
Synthetic Graphite Summary Flow Sheet



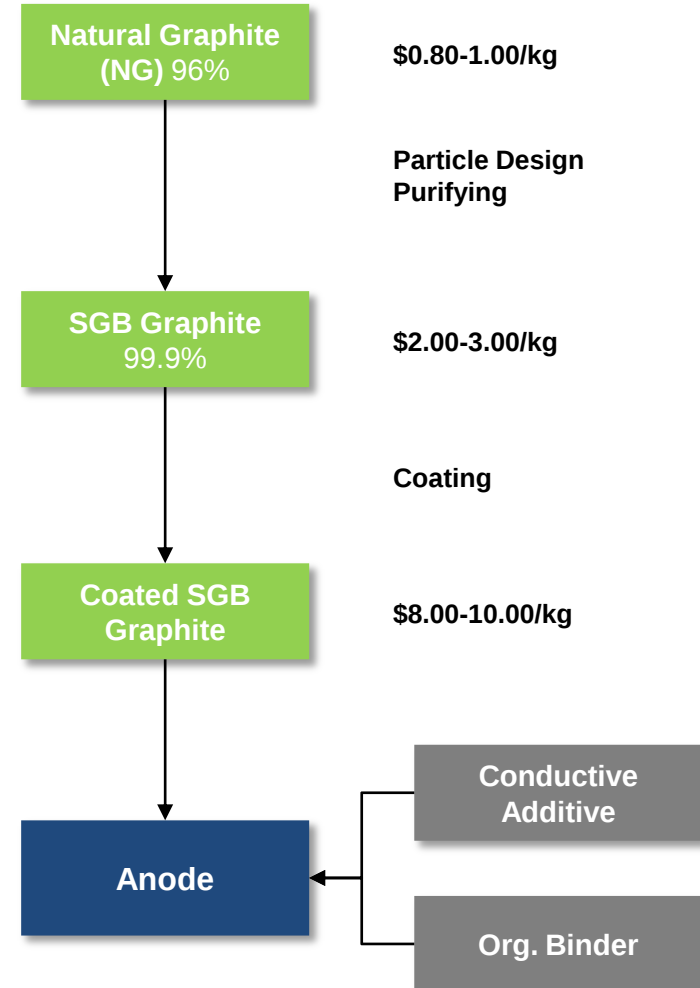
Total energy required to produce 1 ton of synthetic graphite (approx. 99.5% carbon) is 7,500 kWh/MT

Future Markets – Battery Anode Materials

Production process for anode material

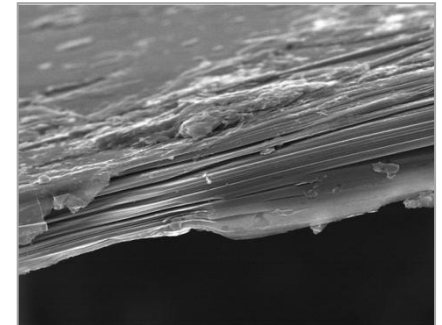
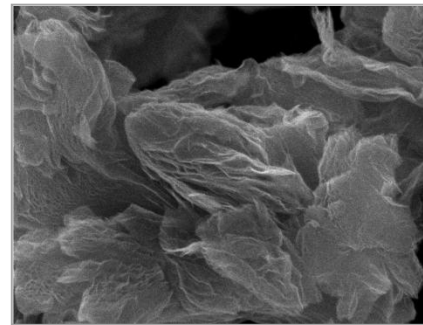
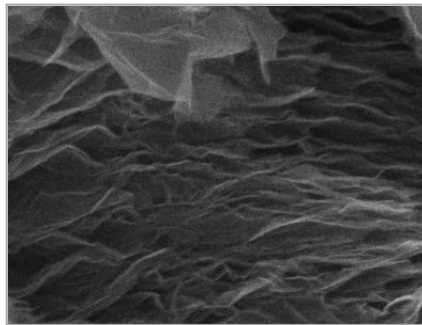
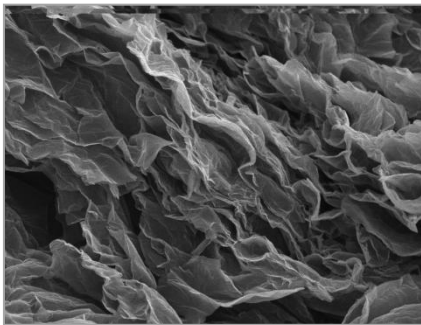


- a. Potato Shape SGB
- b. Carbon Coated SGB
- c. Cross section of a coated SGB
- d. Magnification of c



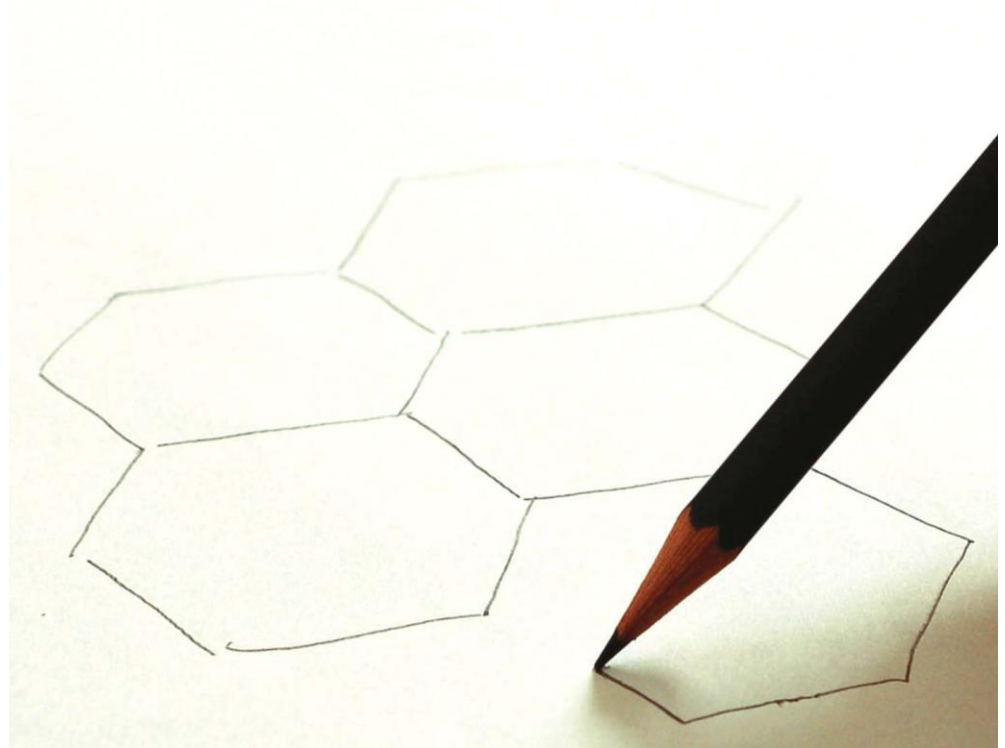
Future Markets – Graphene

- Graphite flake consists of thousands of graphene layers
 - 3 million sheets of graphene are < 1 mm thick
 - 200x stronger than steel
 - Impermeable to gases and extremely high surface area
 - Most stretchable crystal and is stronger than diamond
 - Better conductivity than silver (both heat and electricity)
- AMG Graphite's Sri Lankan Graphite is an excellent precursor material for Graphene
- AMG Graphite is producing multilayer Graphene (graphite oxide route, lab scale)
 - Sales & marketing agreement with Haydale for plasma functionalized Graphene

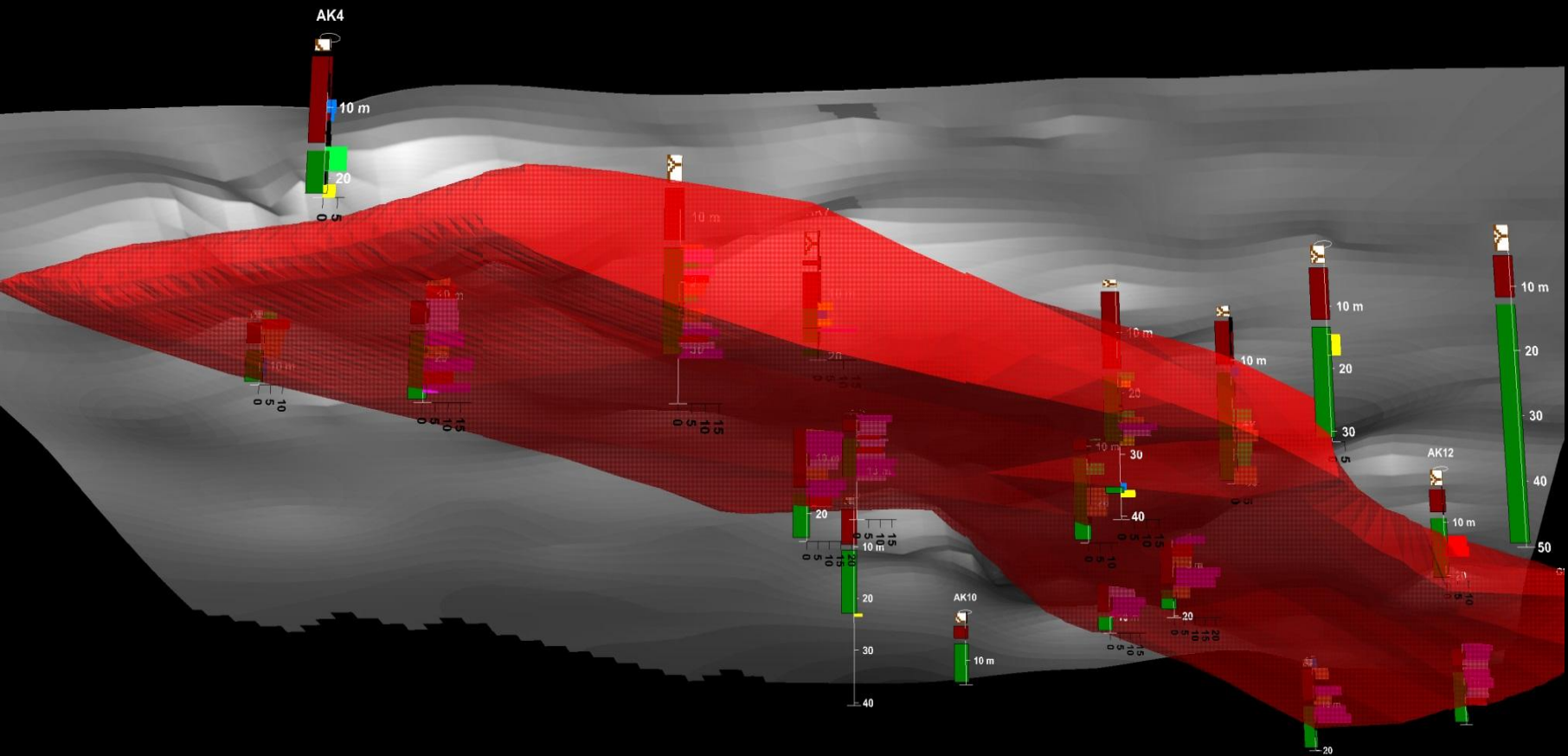


Applications for Multi-Layer Graphene

- **Barrier textiles,
Absorber, Membranes**
- **Filled polymers/composites**
- **Energy storage**
 - Li-Ion batteries
 - Other batteries
 - Super Caps
- **Inks, anti corrosion coatings,
heat / electricity conductive
coatings**

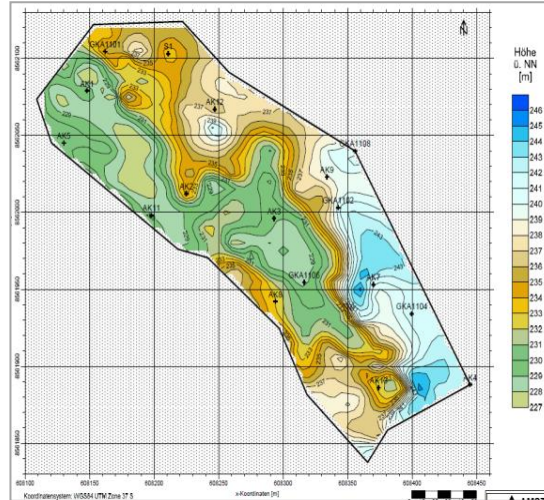


Securing Raw Material



Ancuabe West
View of orebody from below,
looking West

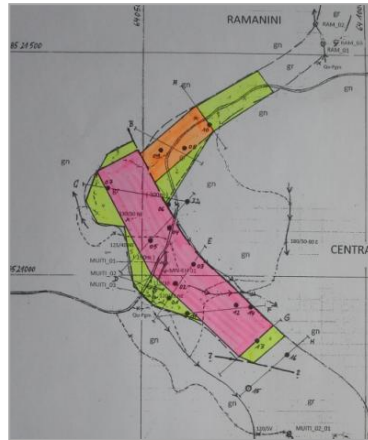
The ANCUABE project



Project Ancuabe (Brownfield Site)

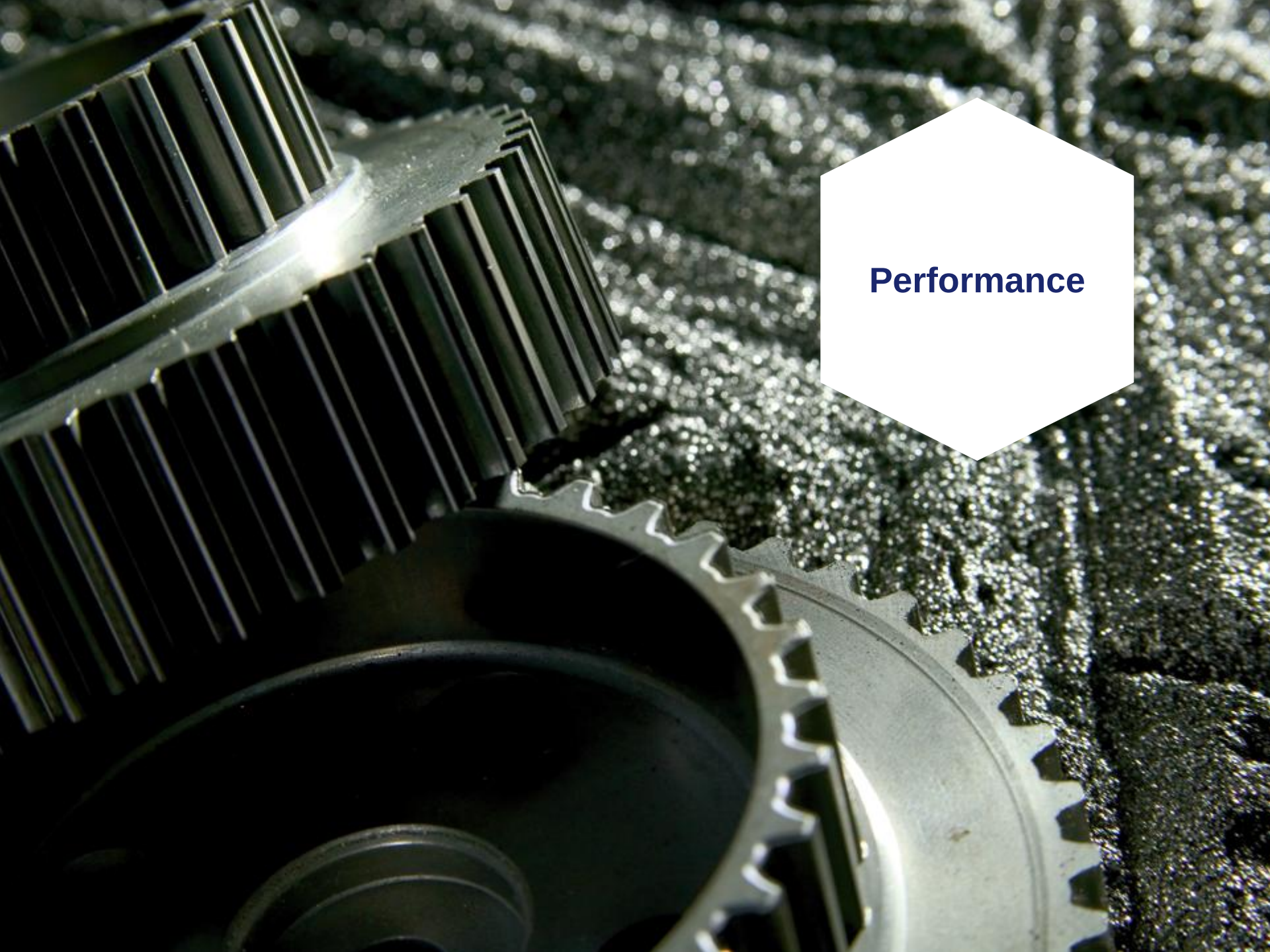
- Original plant build in 1992; production stopped in 1998
- Projected production of 6,000 metric tons per year (expandable to 9,000 metric tons per year)
- Investment of approx. \$10 Million
- Operations to commence in Q2 2016
- Workforce of approx. 120 employees
- Social projects initiated and ongoing e.g. School & Kindergarten, Agriculture & Herbal Medicine Center
- Vocational technical training center for welders and electricians planned
- Secured and in final contracting stage for project financing with banks

The NIPACUE project



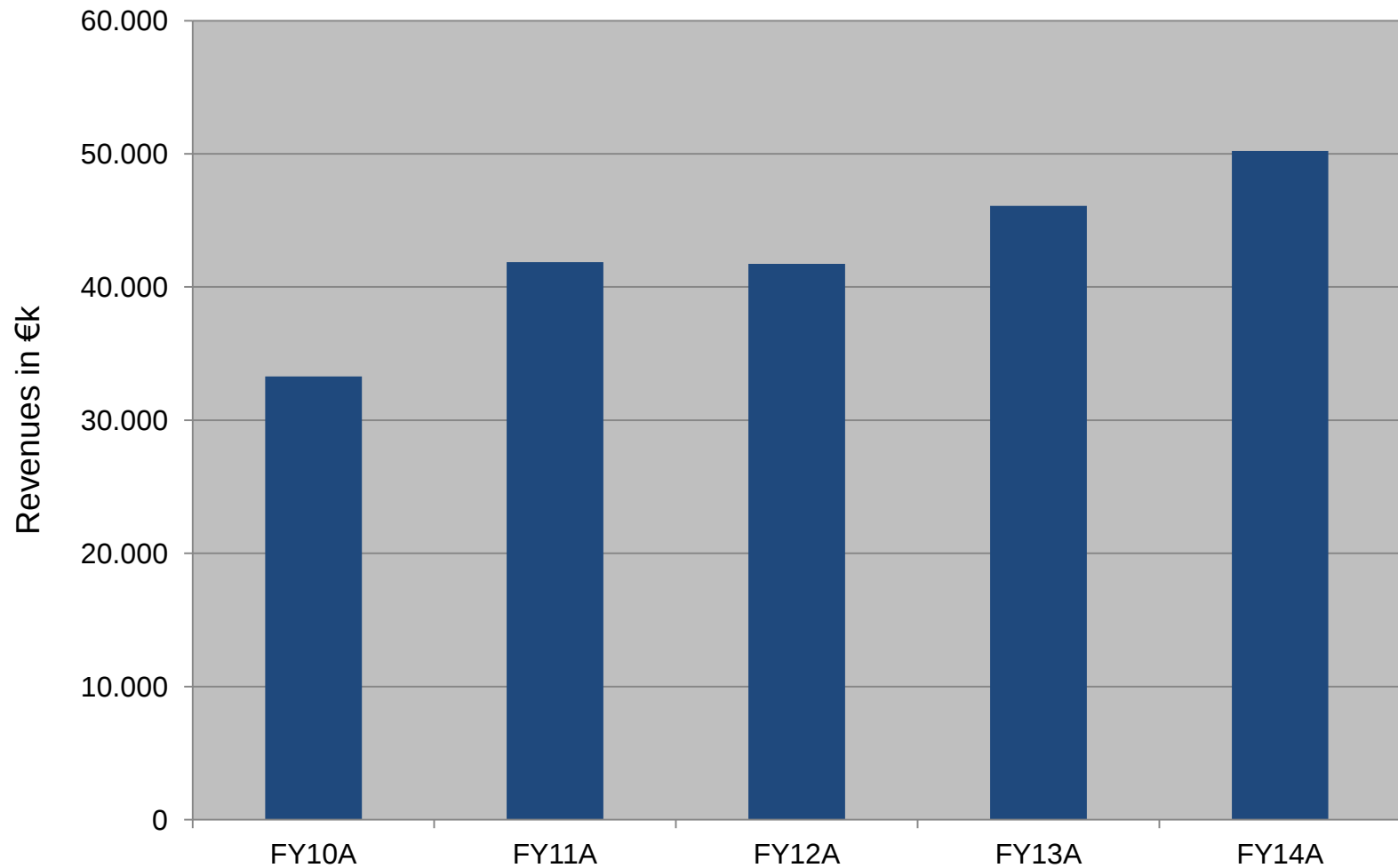
Project Nipacue (Greenfield Site)

- Status: Exploration and Pre-Feasibility
- Graphite deposit (JORC): > 900,000 metric tons
- Potential commencement of operations from 2020 onwards
- Following completion of the ANCUABE project, focus will be on the evaluation and further development of the feasibility study of project NIPACUE.



Performance

Performance – AMG Graphite 2010 - 2014



Value Creation

➤ Organic Growth

- Strong growth through 2020 with existing product portfolio
- Increase market share and product offerings
 - Heat insulation
 - Lubricants and dispersions

➤ 2015 Operational Objectives

- \$10m investment in the Ancuabe mine in Mozambique
- Develop graphite products & technologies for e-mobility
- AMG Graphite & Haydale Graphene product testing at customers laboratories



Al

C

Mo

Ti

Sb

Ni



Cr

Nb

Ta

V

Si