



TALGA RESOURCES

Advanced Graphite and Graphene for
High Performance Batteries

Mark Thompson
Managing Director

Goldman Sachs Battery Day
27 March 2018



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Talga Resources

Vertically integrated advanced
material technology company
focusing on graphite and
graphene products

CORPORATE SNAPSHOT

FINANCIAL INFORMATION

Share price (ASX code TLG) (21-March-18)	A\$0.77
52 week low / high	A\$0.365 / A\$0.92
Shares outstanding ^{1,2}	202.95m
Market Capitalisation	A\$156.3m
Cash (31-Dec-17)	A\$14.0m
Debt (31-Dec-17)	Nil
Enterprise value	A\$142.3m

Source: IRESS, company filings. As at 21 March 2018.

¹ Excludes 44.8m listed options (TLGOA) with exercise price A\$0.45 and expiring 31 Dec 2018

² Excludes 33.0m unlisted options (mostly employees and directors) with exercise price range up to A\$1.02 and expiry date range 4 Oct 2018 to 17 Dec 2020

SHARE PRICE PERFORMANCE

Share price (A\$) 12 months

Volume (m)



MAJOR SHAREHOLDERS

Smedvig – <i>Scandinavian based family office</i>	12.6%
Mark Thompson – <i>Managing Director</i>	7.1%
J P Morgan Nominees (Australia)	4.2%
HSBC Custody Nominees (Australia)	3.9%
Pelmer Securities	3.8%
Citicorp Nominees	3.6%
Kamberg Investments	3.1%

▶ VERTICALLY INTEGRATED ADVANCED MATERIAL SUPPLY CHAIN

European operations and business units

- ▶ **Talga Mining Sweden**
100%-owned high grade graphite deposits – Largest resources in Europe

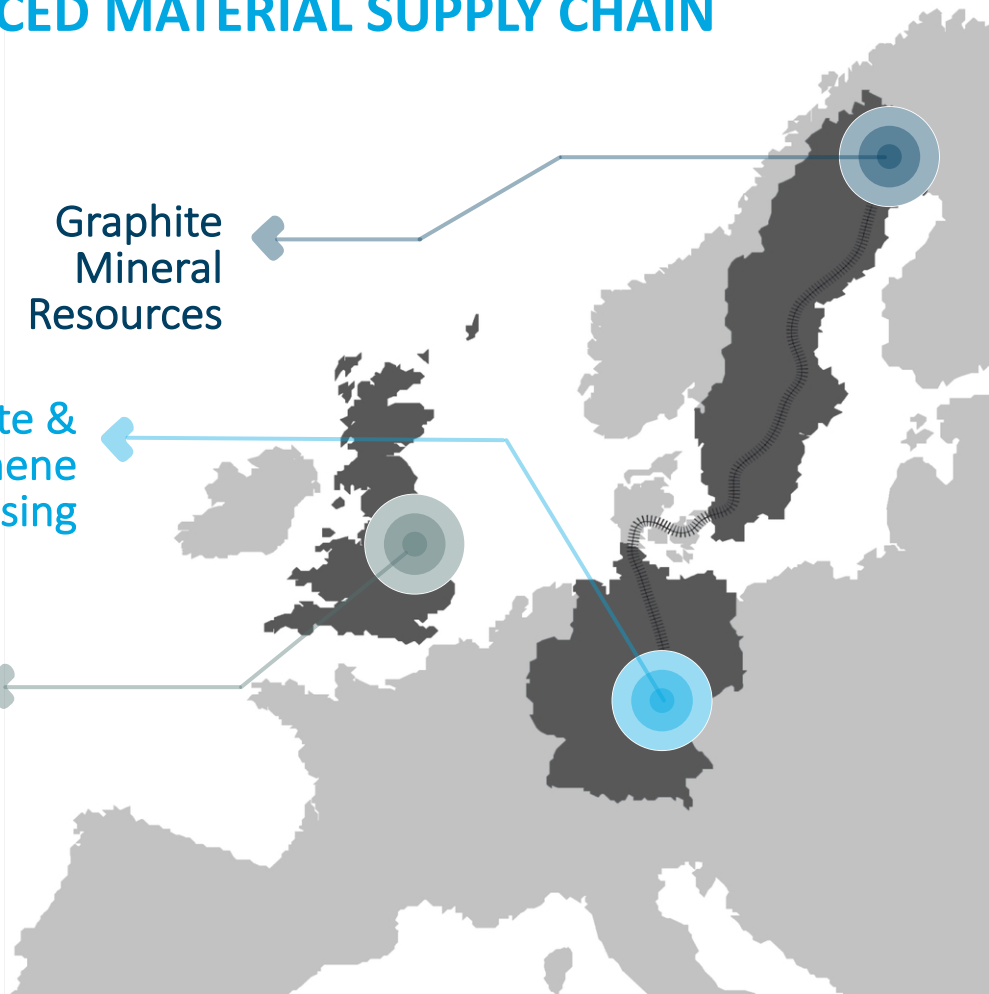
- ▶ **Talga Advanced Materials Germany**
100%-owned test process facility located in Rudolstadt, Germany

- ▶ **Talga Technologies UK**
Product development and marketing team located in Cambridge, UK

Graphite
Mineral
Resources

Graphite &
Graphene
Processing

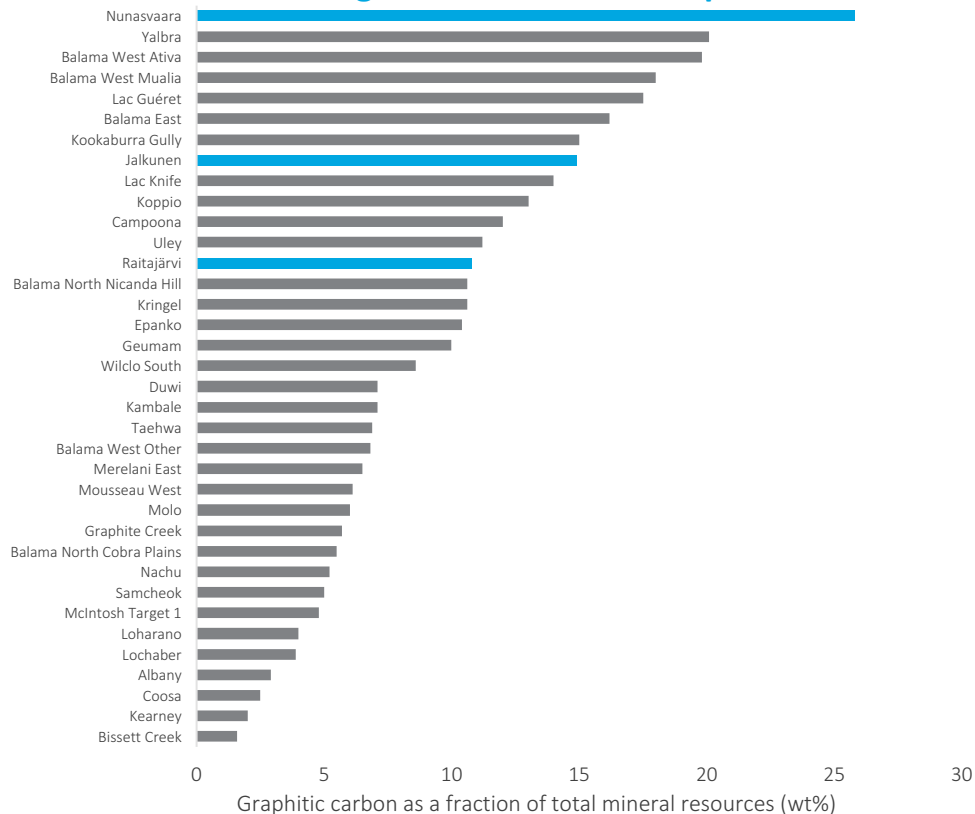
Product
Development
and Marketing



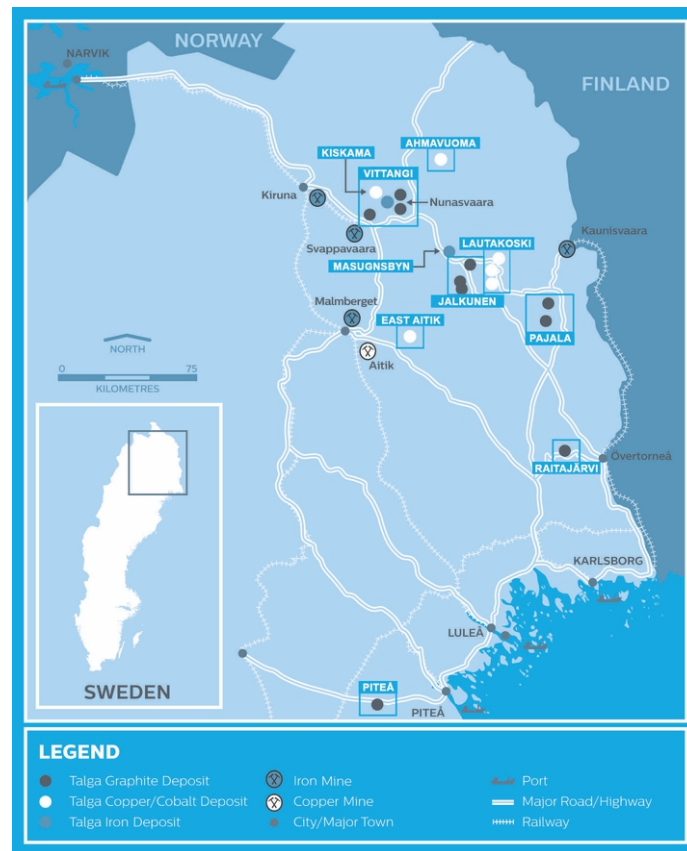
GLOBAL LEADER IN RESOURCE GRADE

Multiple high grade graphite JORC resources and largest in Europe

Average Grade of In-situ Graphite



Source: <http://www.techmetalsresearch.com/metrics-indices/tmr-advanced-graphite-projects-index/> September 2015.



▶ LOW IMPACT BULK GRAPHENE PROCESS TECHNOLOGY

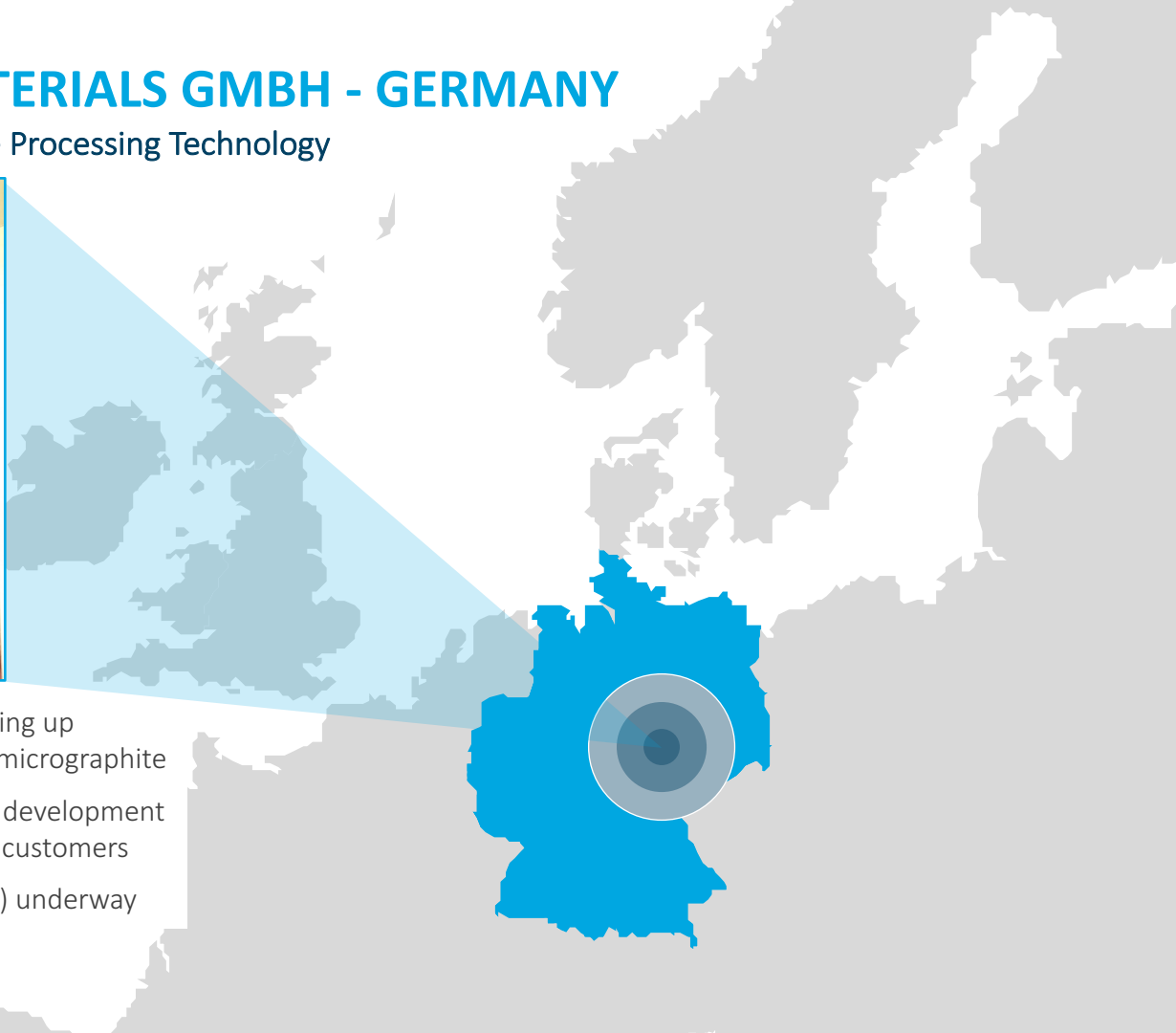


► TALGA ADVANCED MATERIALS GMBH - GERMANY

Scaling Up Proprietary Bulk Graphene Processing Technology

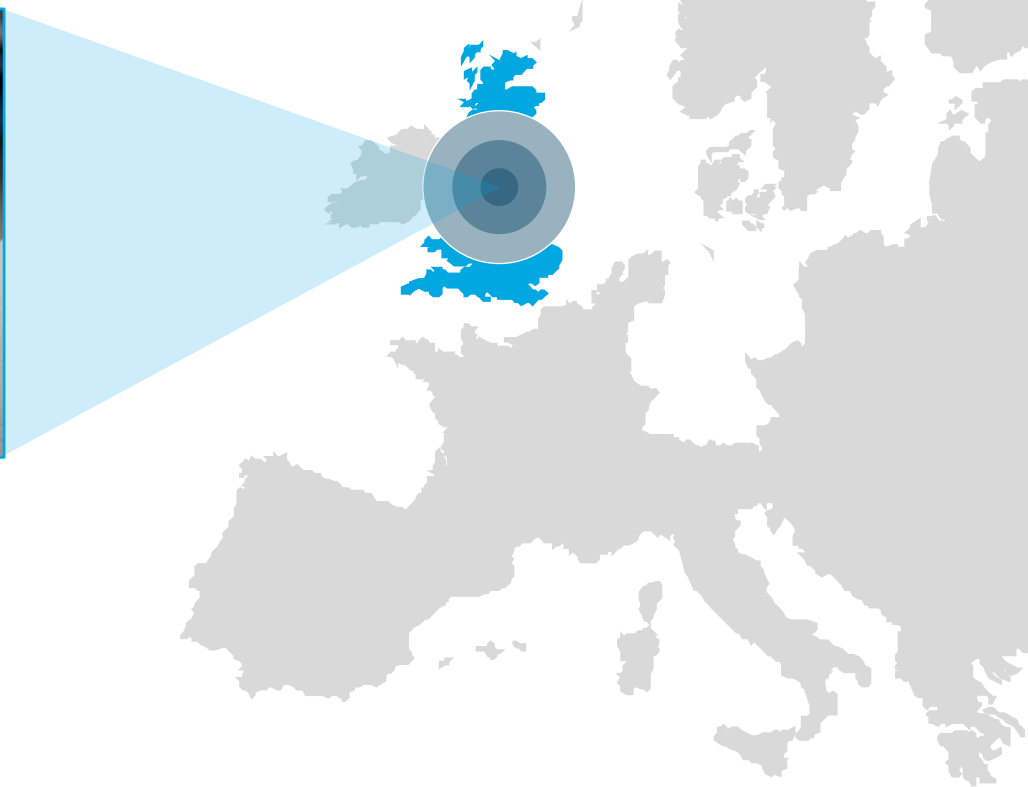
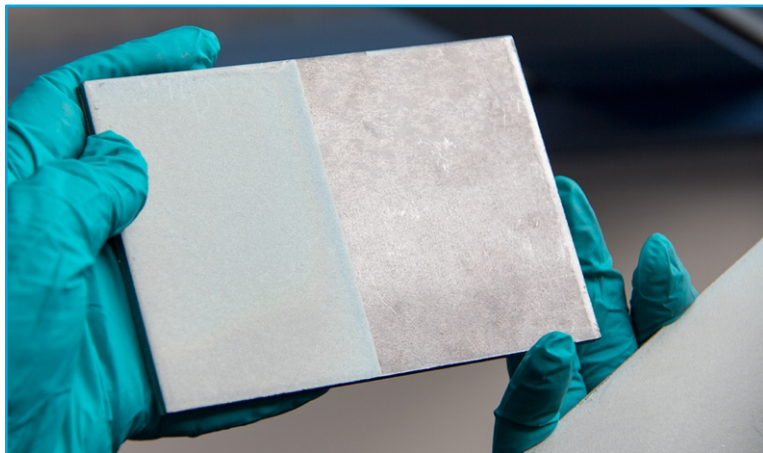


- 100% owned proprietary test facility scaling up process for production of graphene and micrographite
- Output of testwork available for product development collaborations with industrial partners & customers
- Commissioning of next scale up (phase 3) underway



TALGA TECHNOLOGIES LTD - UK

Product Development with R&D Partnerships and Formal Industry Agreements



Some current collaborations include:

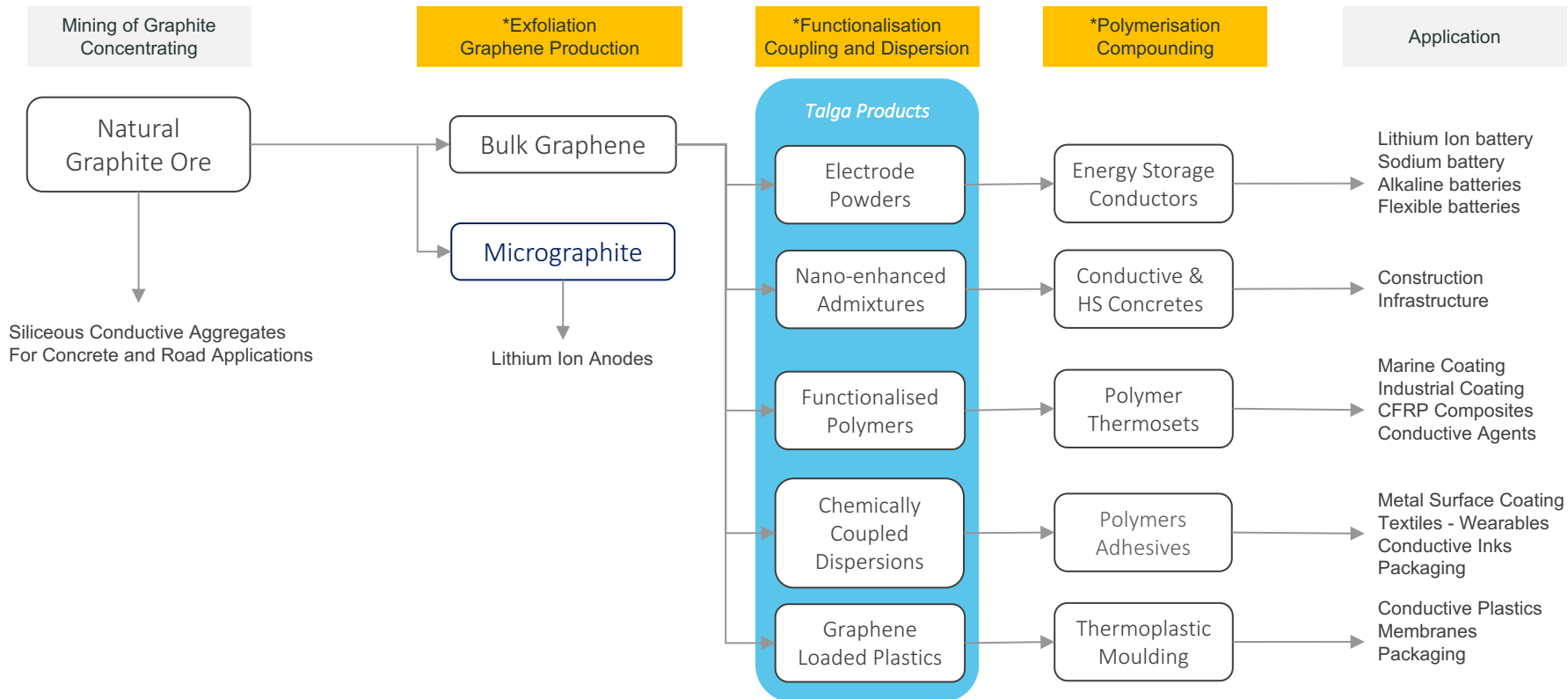


▶ PROVEN INTEGRATED SUPPLY CHAIN



TALGA TECHNOLOGIES - FORWARDLY INTEGRATING GRAPHENE

Using Functionalisation and Polymerisation/Compounding techniques to enter current markets



*Note: Functionalisation is the adding of chemical bonds to the graphene to enable it to impart its performance characteristics into the bulk material it is blended. It is a value-adding process required for integration into products.

▶ OUR PRODUCTS

We make added value and enhanced Products used across four key sectors, with batteries being one in energy.



BUILDING MATERIALS

- ▶ Combined graphite and graphene mixtures for high strength building materials
- ▶ Conductive screeds for de-icing systems
- ▶ Conductive flooring, wall panel systems combined with heating or cooling systems



ENERGY

- ▶ Micro-graphite for current lithium-ion high power batteries
- ▶ Next generation anodes with higher energy performance
- ▶ Conductive additives for lithium-ion batteries and flexible, printable batteries for 'Internet of Things' and 'Wearable' devices



COATINGS

- ▶ Eco-friendly chrome-free based pre-treatment coatings
- ▶ Pre-fabrication and post fabrication anti-corrosion coatings
- ▶ Marine anti-fouling coating systems



COMPOSITES & RESINS

- ▶ High strength carbon fibre resins
- ▶ Engineered plastics and polymer composites
- ▶ Lightning strike protection and EM shielding
- ▶ Thermal sink polymer resins
- ▶ Conducting inks and pastes

► TECHNICAL MANAGEMENT – ENERGY PRODUCTS

Talga staff in-house expertise of leading battery developments



Sai Shivarreddy Ph.D.
Manager - Product Development

Heads up Talga's development of advanced carbon products for energy storage. 7 years industrial experience focusing on early stage commercialisation of novel materials and energy technologies.

- Previous positions include leading graphene research and commercialisation efforts at Tata Group in collaboration with the Cambridge Graphene Centre.
- Founder of multiple energy harvesting and storage technologies.



Claudio Capiglia Ph.D.
Director of Battery Technologies

Over 20 years experience in the battery industry in Japan. Exclusive know-how of the research, development and industrialisation of advanced materials and electrodes for Li-ion battery manufacturing.

- Previous Professor and head of Battery Group/ Italian Institute Technology
- Cofounder and Director of the original Li-ion cell manufacturers in Europe
- Former Senior Scientist for solid state battery technologies for Hybrid Electric Vehicles (HEVs) at Toyota.



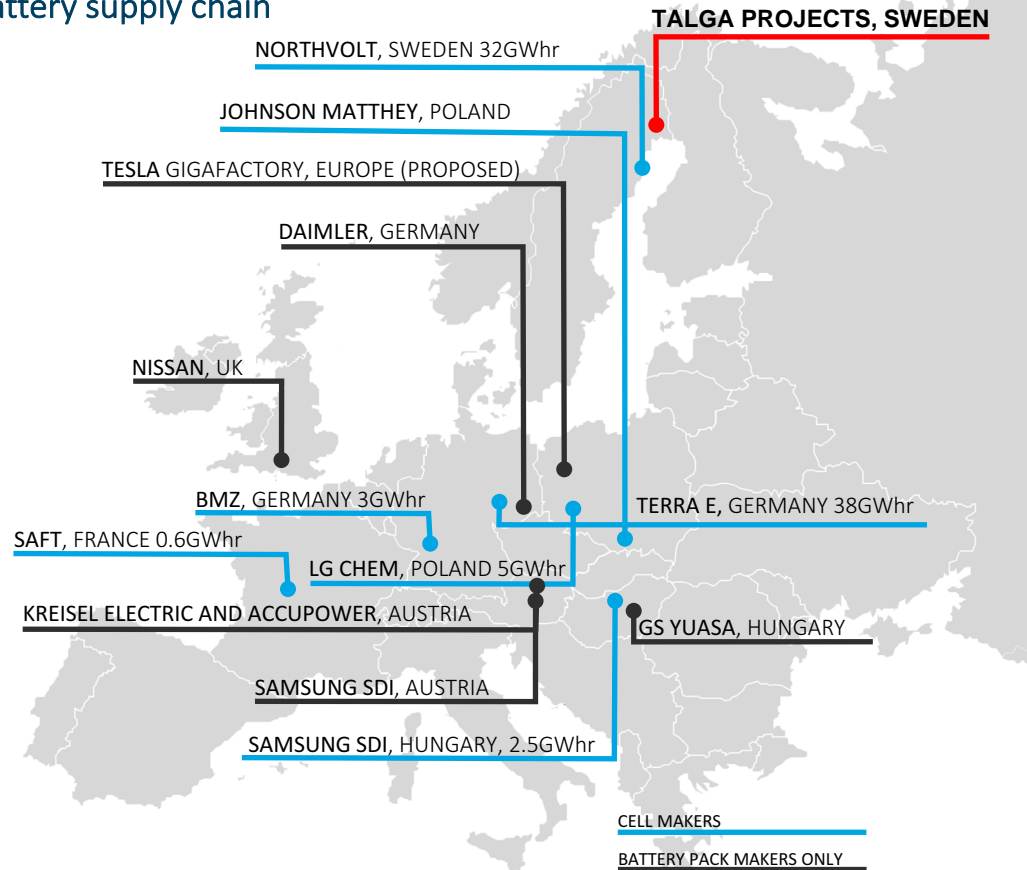
UNIQUELY PLACED

For the fast growing
Li-ion battery supply chain

▶ EUROPEAN BATTERY GIGAFACTORIES

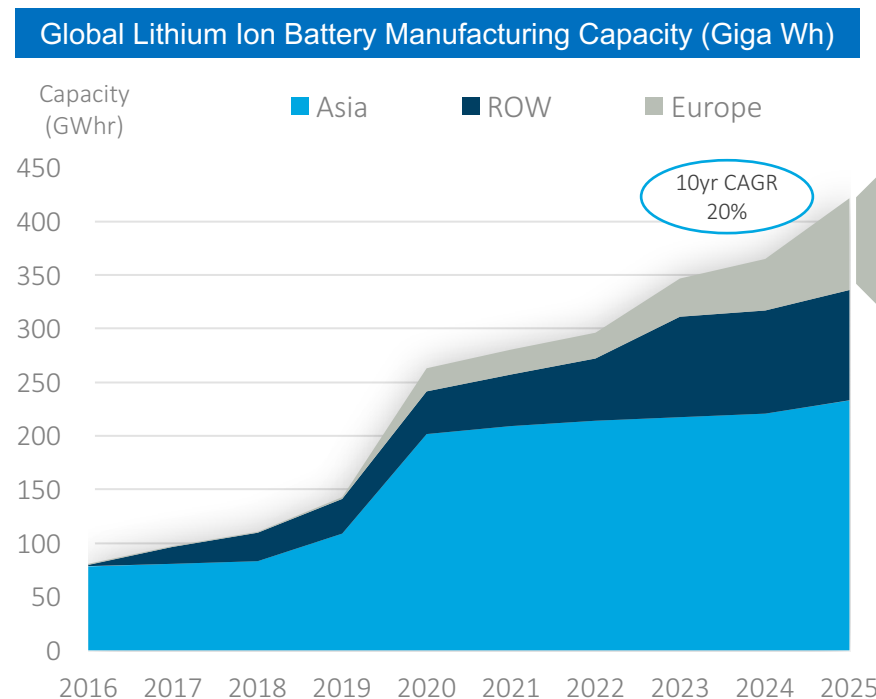
Location advantage to supply fast growing Li-ion battery supply chain

- ▶ **Multiple** Li-ion “Gigafactories” underway or planned in EU
- ▶ **Majority** of raw materials are currently imported into Europe from Africa (cobalt and graphite) or China (graphite)
- ▶ **Talga’s** graphite and cobalt-related deposits in Sweden represent an important potential non-Africa, non-China supply
- ▶ **Rocketing growth** in EV’s underwritten by many EU governments
- ▶ **Direct rail-links** to multiple ‘Gigafactories’ creates different supply-demand dynamic to standard China supply story



▶ EUROPE GIGAFACTORY STARTUPS

Global Li-ion cell production set to more than double by 2020, with Europe near quadrupling from 2020-25



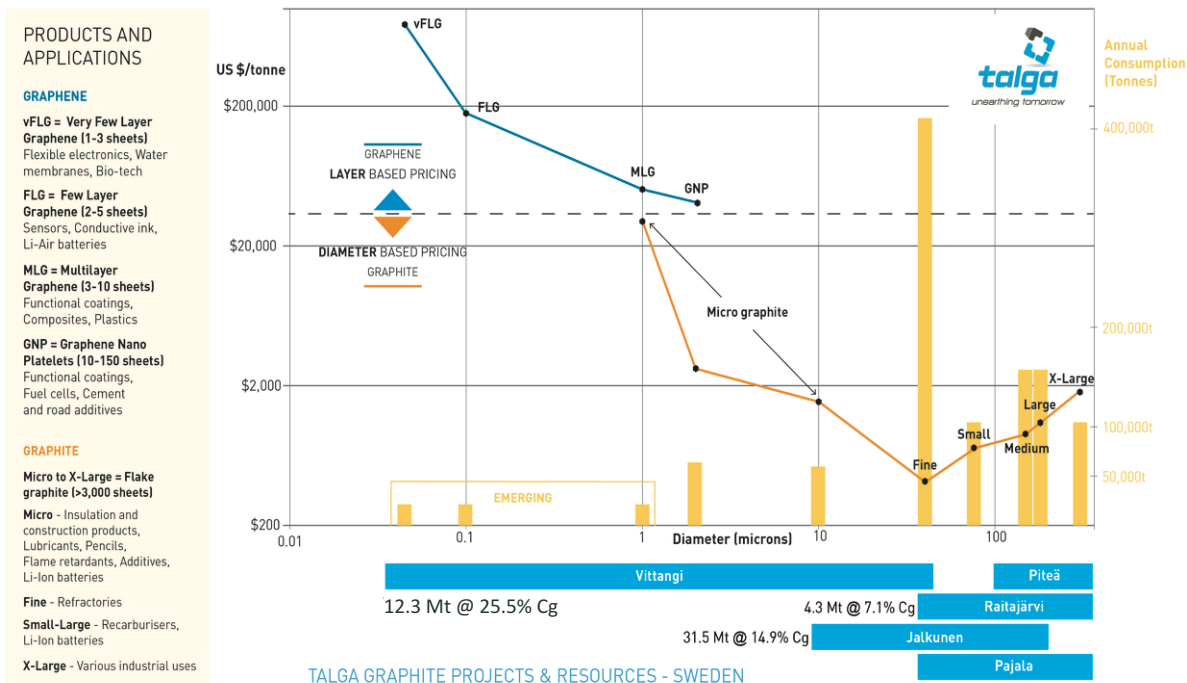
Country	Company/JV	Installed Capacity GWhr	
		2020	2025
Germany	Terra E Consortium	1.0	34.0
Sweden	Northvolt	8.0	32.0
Poland	LG Chem	5.0	5.0
Germany	LeClanche	3.4	3.4
Germany	BMZ/Bosch	0.0	3.0
Hungary	Samsung	2.5	2.5
UK	WMG/Coventry	1.0	1.0
France	Saft	0.6	0.6
TOTAL		21.5	81.5

Note: Daimler and VW have not declared if making cells in Europe

Source: Bloomberg, Benchmark*2023, Avicenne, UBS

▶ GRAPHITE PRICING

Batteries are a disruptive driver demand to natural graphite, which historically consumed only <5% for anodes.



- ▶ Graphite products are diverse and supply chain is fragmented across hundreds of suppliers & re-processors (purifiers, shapers and coaters)
- ▶ Pricing is opaque and under private contracts
- ▶ Smaller sizes take more milling energy so attain higher prices
- ▶ *Benchmark Minerals* now quote battery base 99.95%C <10 micron spheronised uncoated at US\$3,800 tonne

References: Reports of Benchmark Minerals, Industrial Minerals, Fullerox, Roskill, Prographit, internal reports and personal communications



LITHIUM-ION PERFORMANCE

Graphite and graphene
materials for current
and next-gen batteries

▶ LITHIUM-ION BATTERIES

Created in 1970's and first commercialised in 1980's, Lithium-ion still has impediments to mass take up in demanding applications like transport

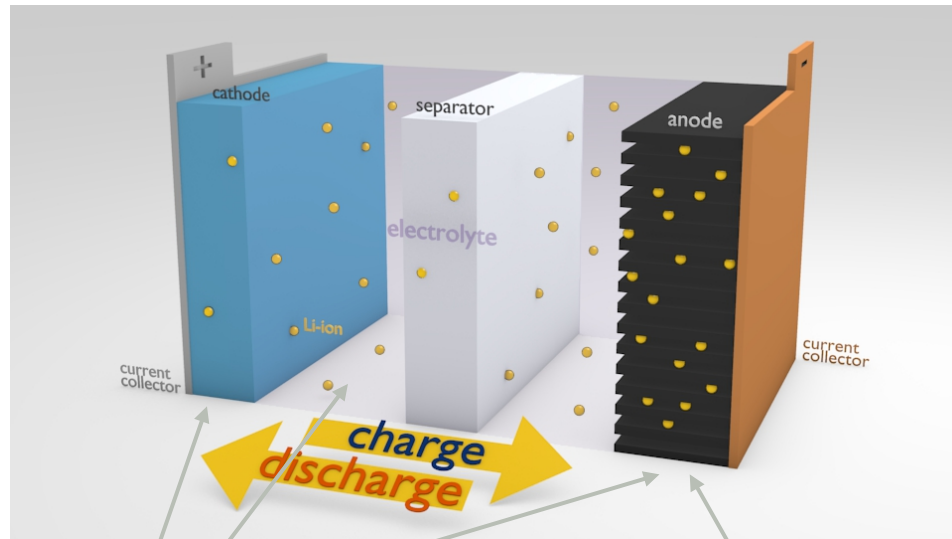


- ▶ Weak – limited capacity which limits range of mobility
- ▶ Slow to charge (safely)
- ▶ Expensive – economically on per unit basis and environmentally in production of materials.
- ▶ Flammable
- ▶ Heavy when include thermal and impact safety management structures (~70% of battery pack weight)
- ▶ Poor recyclability

► SOLUTIONS THROUGH BETTER MATERIALS

Automotive sector pushing hard for next gen battery materials to increase safety/performance and lower cost

CURRENT LI-ION CELL COMPONENTS



Where **graphene** can be used

Where **graphite** is used

TRENDING LI-ION TECHNOLOGIES

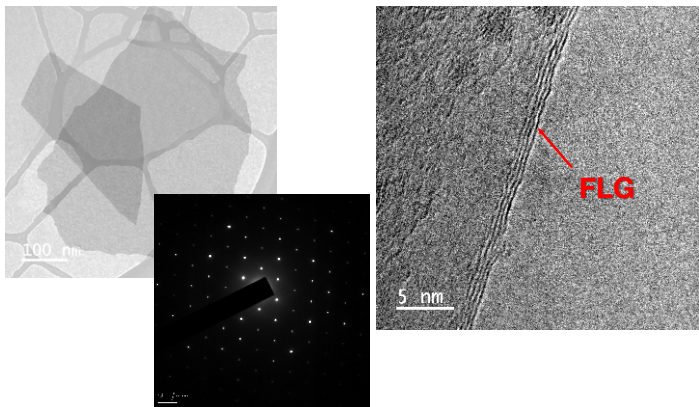
- **Silicon** additives and solid silicon electrodes (potential 3,579mAh/g)
- **All-solid state** with no electrolyte or liquid (potential low cost and safe)
- Next generation under advanced R&D:
 - Li-sulfur** (very high energy and eco friendly)
 - Li-air** (petrol power potential)
 - Sodium-ion** (abundant and low cost)
- **Graphene** tends to be used in more next gen batteries than graphite due to higher conductivity, surface area and physio-chemical potential, and can be used across more parts of battery than just anode.

► SILICON ELECTRODES ENABLED BY GRAPHENE

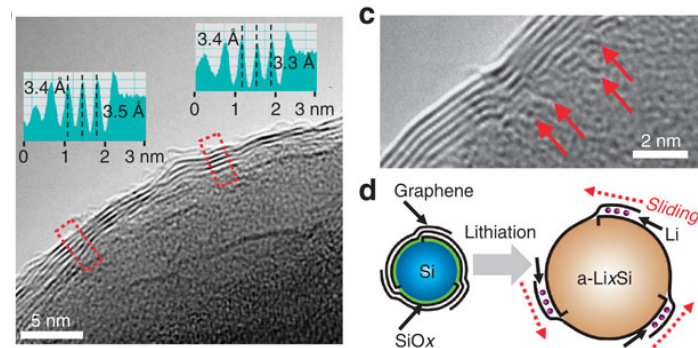
Talga is developing materials for current additive silicon and next gen solid silicon electrodes

- Industry needs higher capacity batteries (longer range) but not bigger/heavier. Addition of silicon up to 30% will double reversible capacity to $>750 \text{ mAh/g}$ = $>50\%$ \$\$ vs Standard Graphite
- Many new battery technologies require graphene more than graphite e.g. **Samsung** silicon battery¹
- **Goldman Sachs** estimate an Rmb6.3bn (US\$0.9bn) addressable market by 2025 for graphene in batteries²

TALGA GRAPHENE



SAMSUNG GRAPHENE COATED SILICON

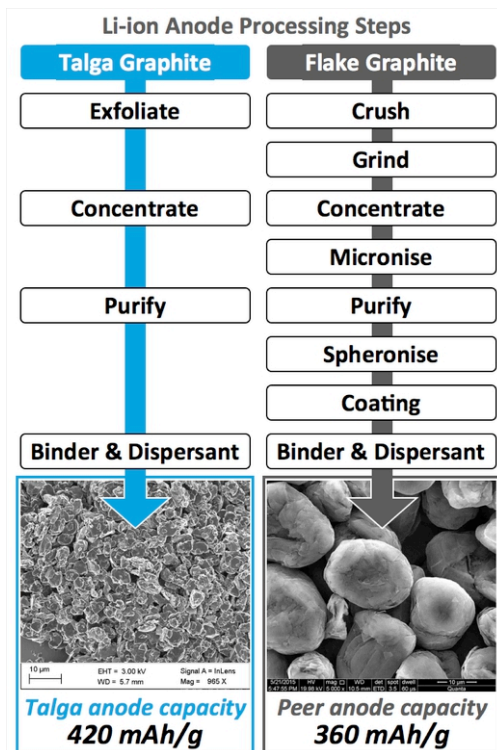


¹ Source "Graphene balls for lithium rechargeable batteries with fast charging and high volumetric energy densities", Nature Communications 8:1561. Samsung

² Source "Chinas Battery Challenge; A New Solution", Goldman Sachs Feb 2017

TALGA MATERIAL ADVANTAGE

Talga's patent pending technology liberates graphite as well as graphene from raw ore, enabling use in Li-ion anodes with less processing steps than peers



- ▶ Talga anode graphite has **natural unique morphology** and **unmilled small size**, with graphene-like structures increasing Lithiation sites
- ▶ Tests at WMG confirm Talga anode capacity of **420 mAh/g** vs pure graphite limit **372 mAh/g** and average ASX graphite co's **360 mAh/g**
- ▶ **Excellent stability**: 99.9% coulombic efficiency and >99.5% reversible capacity over 1,200 hours cycling
- ▶ **Cost effective** process but needs optimising to improve surface area/first charge to **commercial levels**, then watch this space!

higher performance with less
manufacturing steps = lower eco-impact



TALGA PARTNERS THROUGH 'FARADAY CHALLENGE'

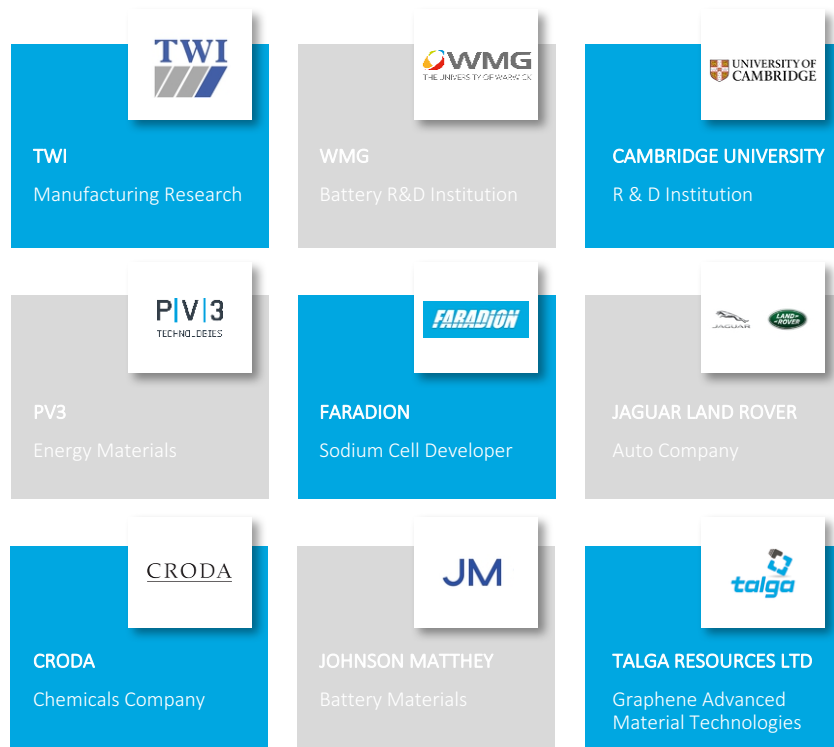
UK Government funding through Innovate UK's £246 million 'Faraday' initiative to create new battery technologies and local supply chains



Department for
Business, Energy
& Industrial Strategy

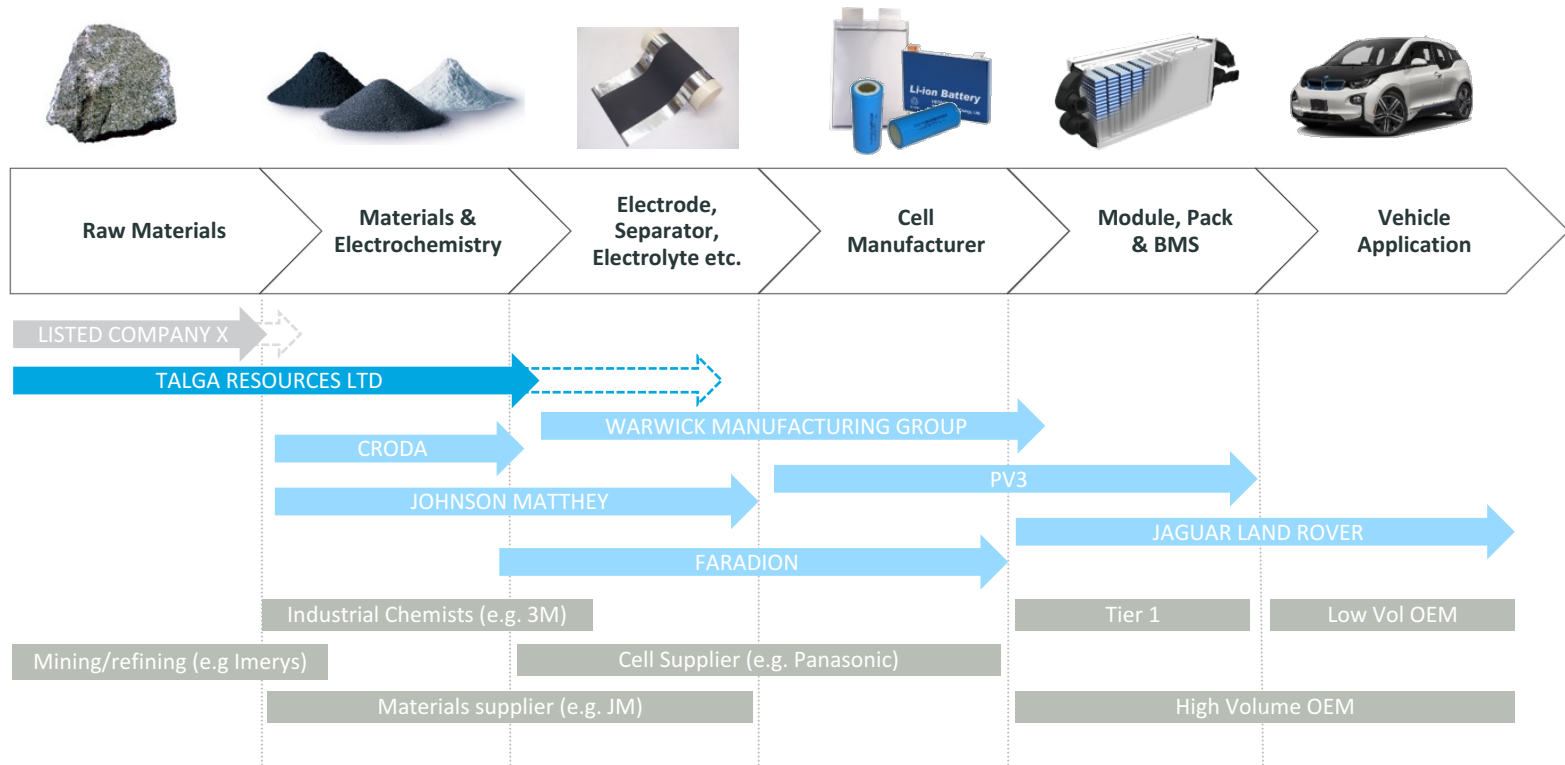
Innovate UK

- Talga wins 70% rebate against eligible costs (~A\$1.5m budget) over 1-2 year period for 3 programs:
 - **Scale up** of Li-ion electrode materials; higher performance current
 - **Graphene-silicon** and alloy anodes (Safevolt);
 - **Sodium-ion** batteries for automotive power applications.
- Binding collaboration agreements signed with partners including *Jaguar-Land Rover, Johnson Matthey, Croda, Faradion, PV3, Cambridge University and Warwick Manufacturing Group.*

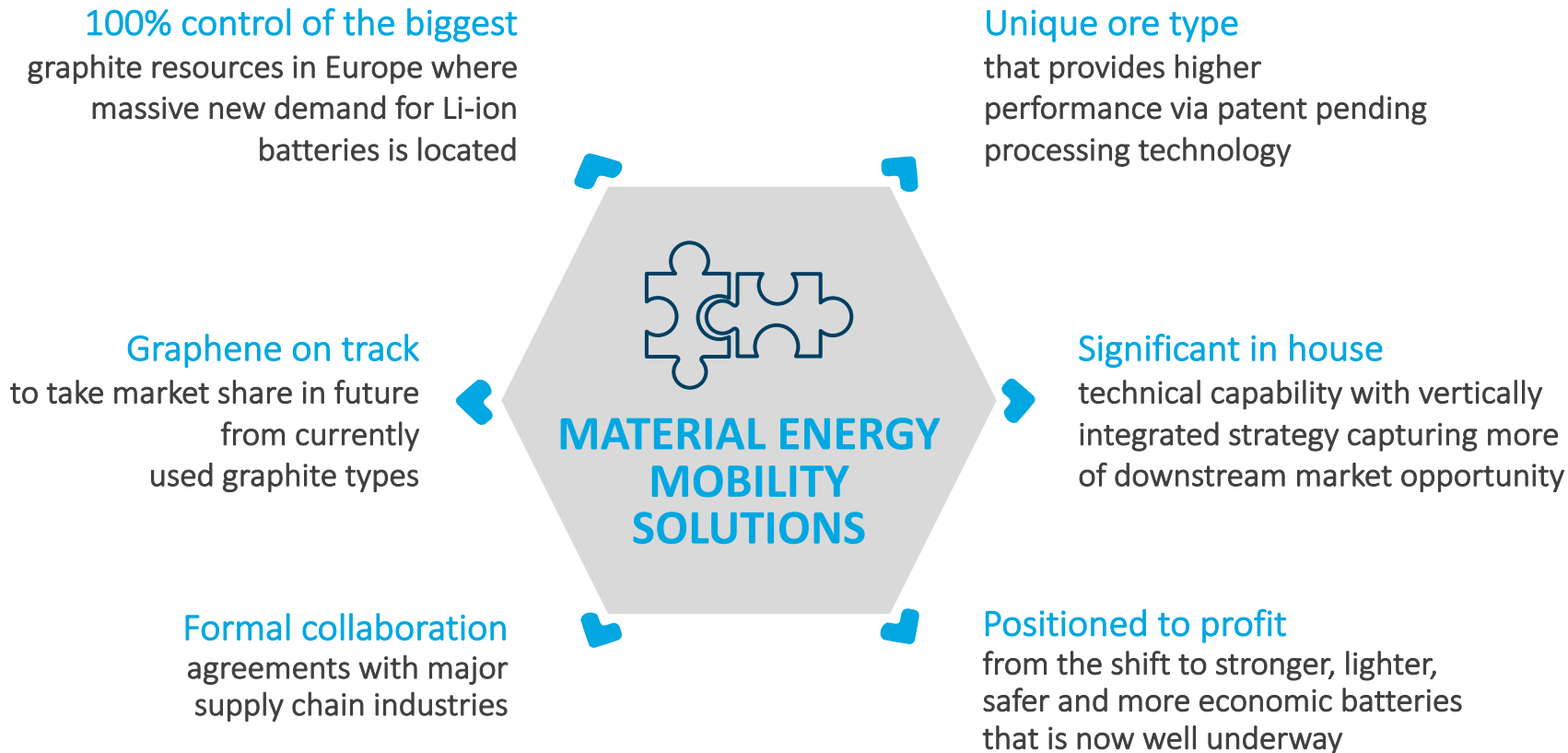


▶ DEVELOPING SIGNIFICANT PART OF SUPPLY CHAIN

Talga integrated supply and product technology captures more of supply chain



► WHY TALGA?



COMPANY DIRECTORY

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Talga Advanced Materials GmbH | Rudolstadt, Germany

Prof.-Hermann-Klare-Str. 25, 07407 Rudolstadt, Germany



APPENDIX AND STATEMENTS

Competent Person's Statements

The information in this document that relates to exploration results is based on information compiled by Amanda Scott, a Competent Person who is a Member of the Australian Institute of Mining and Metallurgy (Membership No.990895). Amanda Scott is a full-time employee of Scott Geological AB. Amanda Scott has sufficient experience, which is relevant to the style of mineralisation and types of deposits under consideration and to the activity which has been undertaken to qualify as a Competent Person as defined in the 2012 edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code). Amanda Scott consents to the inclusion in the report of the matters based on her information in the form and context in which it appears.

The information in this report that relates to Graphite Resource Estimation for the Vittangi Project is based on information compiled by Oliver Mapeto and reviewed by Albert Thamm. Both Mr Mapeto and Mr Thamm are consultants to the Company. Mr Mapeto is a Member of both the Australian Institute of Mining and Metallurgy (Membership No.306582) and Australian Institute of Geoscientists (Member No 5057) and MR Thamm (Member No 203217) is a Fellow Member of the AusIMM.

Both Mr Mapeto and Mr Thamm have sufficient experience relevant to the styles of mineralisation and types of deposits which are covered in this document and to the activity which both are undertaking to qualify as a Competent Person as defined in the 2012 edition of the "Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves" ("JORC Code"). Mr Mapeto and Mr Thamm consent to the inclusion in this report of the Matters based on this information in the form and context in which it appears.

The information in this report that relates to Exploration Targets is based on information compiled and reviewed by Mr Simon Coxhell, a consultant to the Company and a member of the Australian Institute of Mining and Metallurgy and Mr Mark Thompson, who is an employee of the Company and a member of the Australian Institute of Geoscientists. Mr Thompson and Mr Coxhell have sufficient experience which is relevant to the activity which is being undertaken to qualify as a "Competent Person" as defined in the 2012 Edition of the "Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves" ("JORC Code"). Mr Thompson and Mr Coxhell consent to the inclusion in the report of the matters based on this information in the form and context in which it appears.

The information in this report that relates to Iron Ore Resource Estimation and Graphite Resource Estimation for the Jalkunen and Raitajärvi Projects is based on information compiled and reviewed by Mr Simon Coxhell. Mr Coxhell is a consultant to the Company and a member of the Australian Institute of Mining and Metallurgy. Mr Coxhell has sufficient experience relevant to the styles of mineralisation and types of deposits which are covered in this document and to the activity which he is undertaking to qualify as a Competent Person as defined in the 2012 edition of the "Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves" ("JORC Code"). Mr Coxhell consents to the inclusion in this report of the Matters based on this information in the form and context in which it appears.

Cautionary Statement

Any data on the scoping study referred to in this report is based on low level technical and economic assessments, and is insufficient to support estimation and economic assessments, and is insufficient to support estimation of Ore Reserves or to provide assurance of an economic development case at this stage, or to provide certainty that the conclusion of the scoping study will be realised. The Company confirms that all material assumptions and technical parameters underpinning the scoping study results and projections in this release continue to apply and have not materially changed. The use of the word "ore" in the context of this report does not support the definition of 'Ore Reserves' as defined by the 2012 Edition of the 'Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves'. The word 'ore' is used in this report to give an indication of quality and quantity of mineralised material that would be fed to the processing plant and is not to assumed that 'ore' will provide assurance of an economic development case at this stage, or to provide certainty that the conclusion of the scoping study will be realised.

▶ GRAHITE JORC RESOURCES AND EXPLORATION TARGETS

Nunasvaara JORC (2012) Mineral Resource (17% Cg cut-off)

JORC 2012 Classification	Tonnes	Graphite (%Cg)
Indicated	10,700,000	25.7
Inferred	1,600,000	23.9
Total	12,300,000	25.5

Jalkunen JORC (2012) Mineral Resource (5% Cg cut-off)

JORC 2012 Classification	Tonnes	Graphite (%Cg)
Inferred	31,500,000	14.9

Raitajärvi JORC (2004) Mineral Resource¹ (5% Cg cut-off)

JORC 2004 Classification	Tonnes	Graphite (%Cg)
Indicated	3,400,000	7.3
Inferred	900,000	6.4
Total	4,300,000	7.1

Talga Graphite Exploration Targets ² 0-100m Depth

Project	Exploration Target	Tonnes (0-100m Vertical Depth)		Graphite (% Cg)	
		Min.	Max.	Min.	Max.
Vittangi	Nunasvaara	62,400,000	93,600,000	20	30
	Kotajärvi	16,640,000	30,160,000	20	25
	Maltosrova	20,800,000	52,000,000	20	25
Jalkunen	Tiankijokki	2,600,000	5,200,000	15	25
	Nybrännan	5,200,000	10,400,000	20	30
	Suinavaara	2,600,000	5,720,000	15	25
	Lautakoski	26,000,000	52,000,000	15	25
	Subtotal	136,240,000	249,080,000	19	27
Rounded Total		136,000,000	250,000,000	18	25

1 Note: This information was prepared and first disclosed under the JORC code 2004. It has not been updated since to comply with the JORC code 2012 on the basis that the information has not materially changed since it was last reported. The Company is not aware of any new information or data that materially affects the information included in the previous announcement and that all of the previous assumptions and technical parameters underpinning the estimates in the previous announcement have not materially changed.

2 Note: The Exploration Target is based on a number of assumptions and limitations with the potential grade and quantity being conceptual in nature. There has been insufficient exploration to estimate a Mineral Resource Estimate in accordance with the JORC Code and it is uncertain if future exploration will result in the estimation of a Mineral Resource.