



Swedish Graphite Anode Project

Developing European graphite anode for lithium-ion batteries

Dr Sai Shivareddy

Benchmark Mineral Intelligence
London, 24 June, 2019



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► TALGA – SPECIALTY CARBONS FOR A CLEANER WORLD

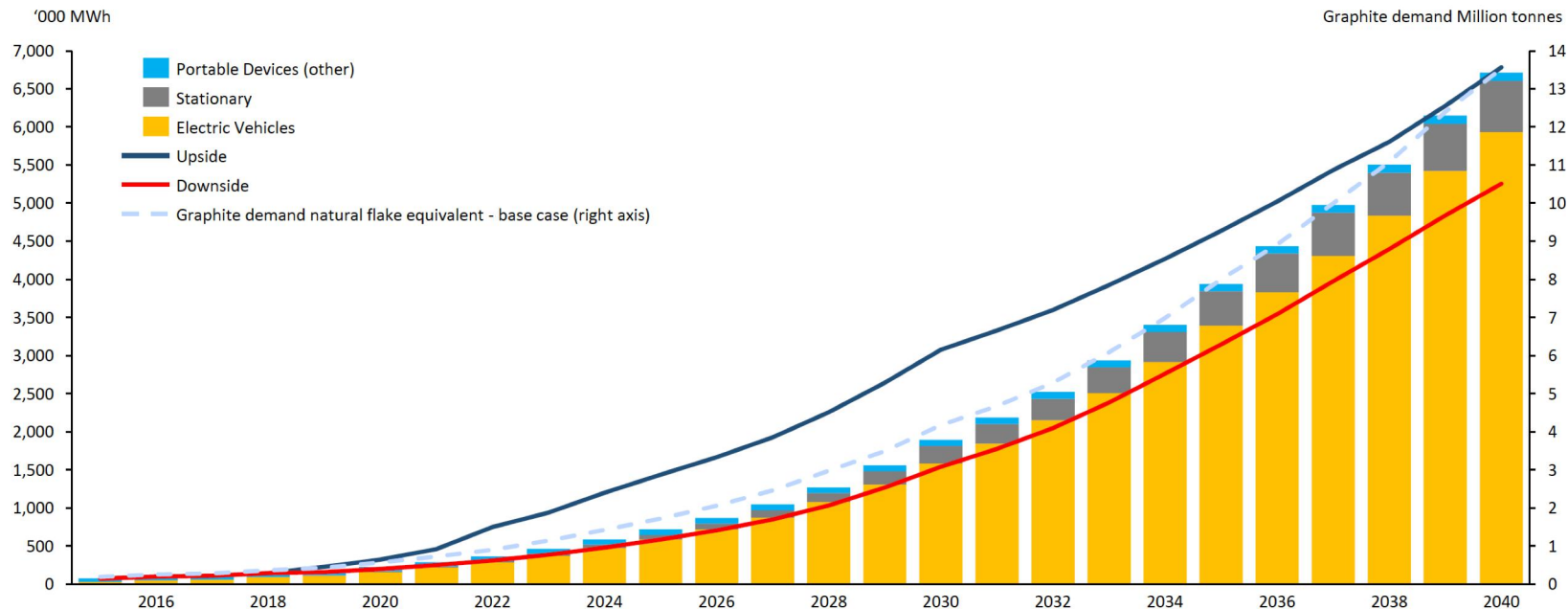
The right assets at the right time and place

- Developing Europe's first and **largest Li-ion battery anode supply** in Sweden
- Utilising **wholly owned technology**, world-class **graphite** deposits and **clean low- cost power** to responsibly extract highest margins
- Stage 1 anode production includes **downstream refining** and **high value fully-coated anode** production planned commence 2020
- **Pipeline** of high performance graphite and graphene products for **clean-energy applications** in batteries, coatings, concrete and more



► “RIGHT TIME”- HIGH GROWTH MARKET

Graphite demand for li-ion battery anodes to exceed 2 million tonnes by 2028 and 13 million tonnes by 2040

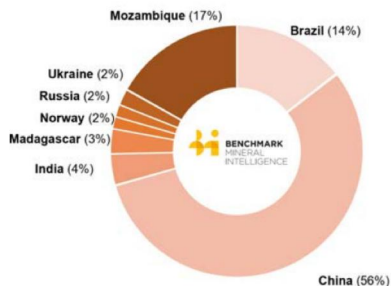


Note this is in addition to existing graphite markets in electrodes, refractories, industrial uses etc

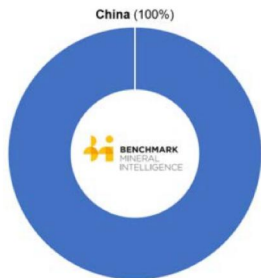
► “RIGHT PLACE” – EUROPE

Europe currently produces <4% global mined graphite, yet will require over 348,000tpa anode graphite by 2028

Graphite Mining



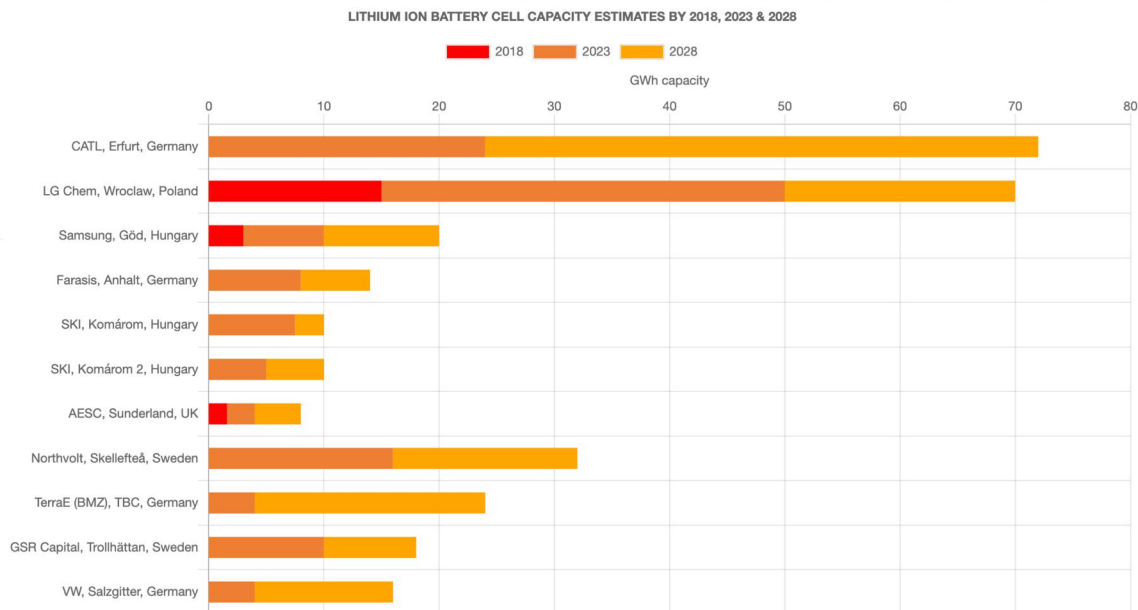
Graphite Refining



Regions: Europe

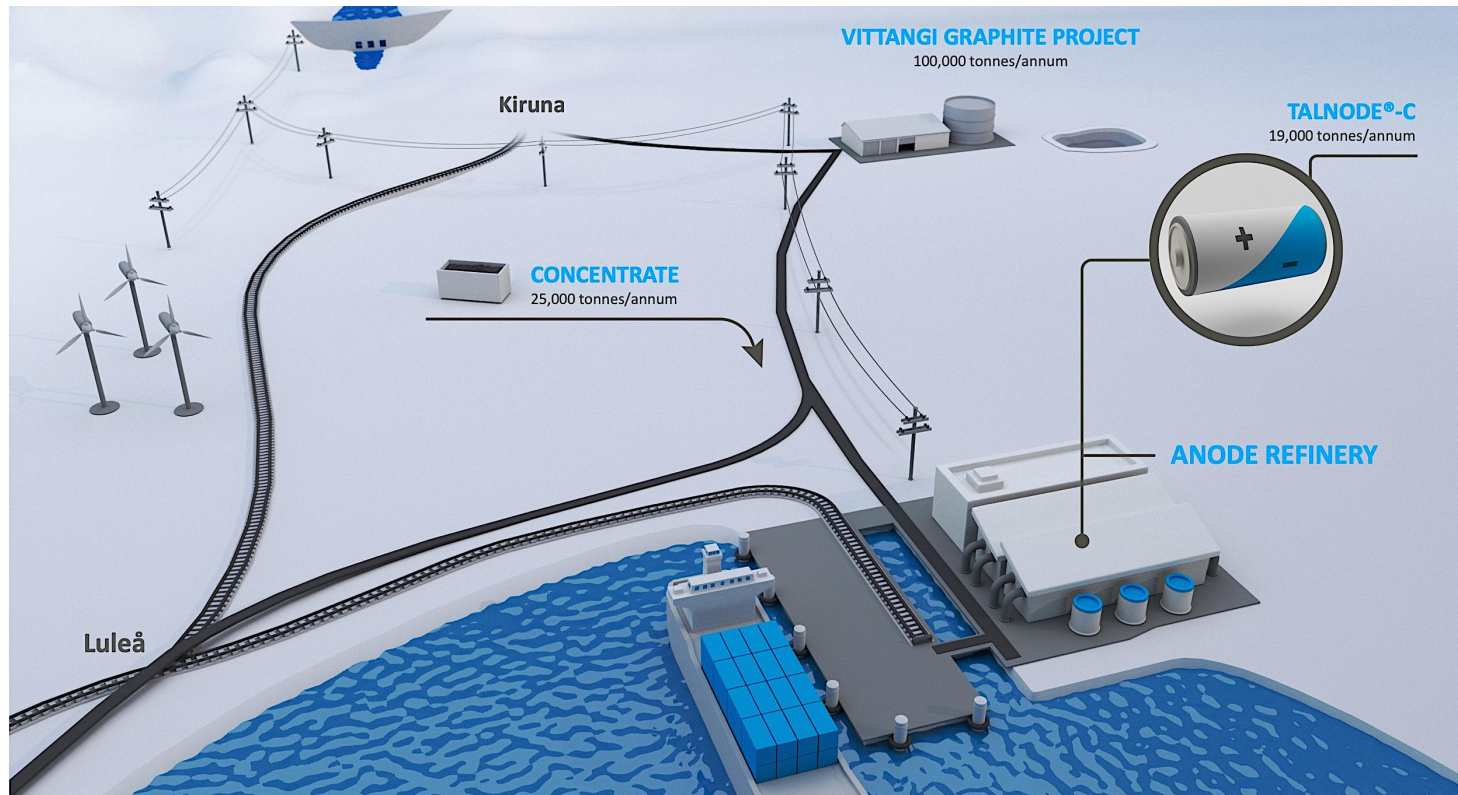
Megafactories: 11

Total Capacity Pipeline by 2028: 294.0 GWh



► THE SWEDEN SOLUTION – VITTANGI PROJECT ANODE PRODUCTION

Integrated open-cut graphite mine, concentrator and refinery producing sustainable li-ion battery graphite anode



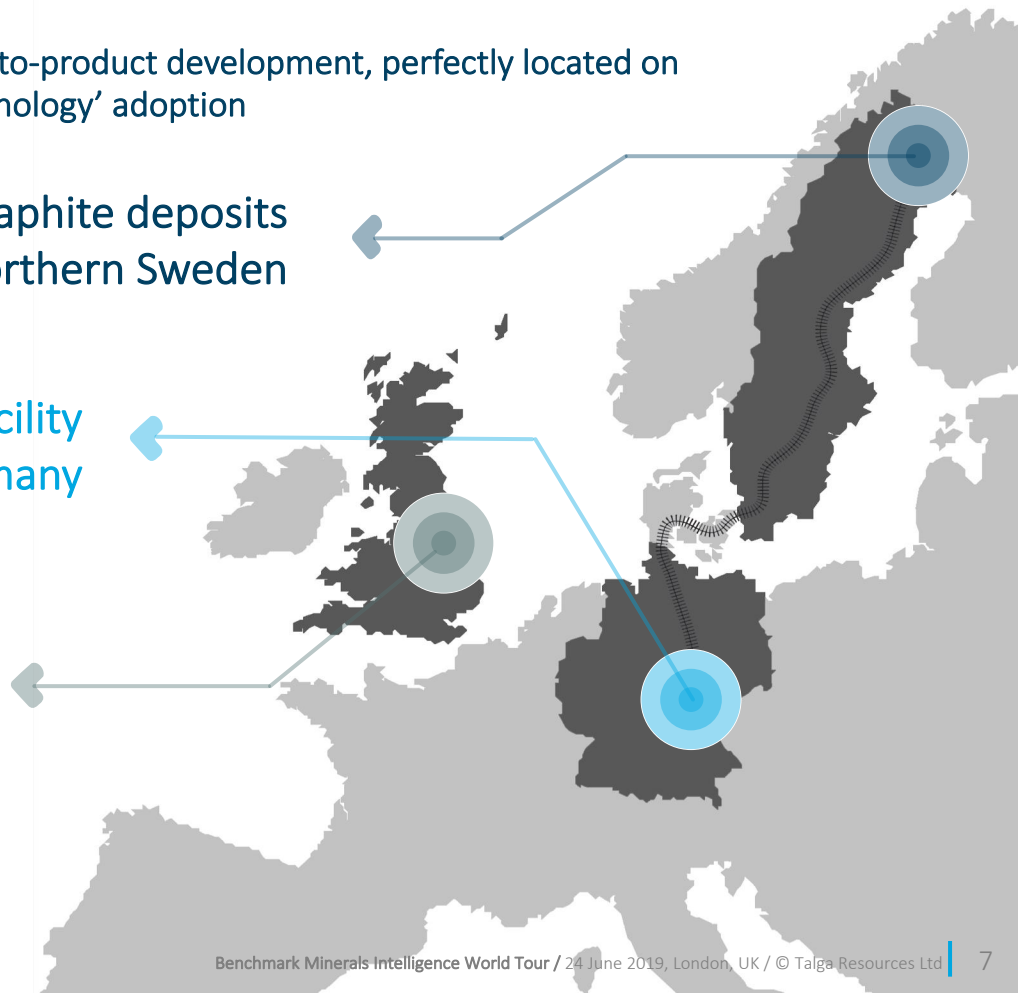
TALGA EUROPEAN OPERATIONS

Vertically integrated company with control of mine-to-product development, perfectly located on doorstep of countries undergoing rapid 'green-technology' adoption

100%-owned graphite deposits
northern Sweden

100%-owned pilot test process facility
Thuringia region, Germany

In-house science and technology teams
in Maxwell Centre & Graphene Centres
Cambridge Uni, UK



► A NEW EUROPEAN SOURCE OF LI-ION BATTERY ANODE MATERIAL

Long life mine supply supporting a robust, high margin project in a tier 1 jurisdiction

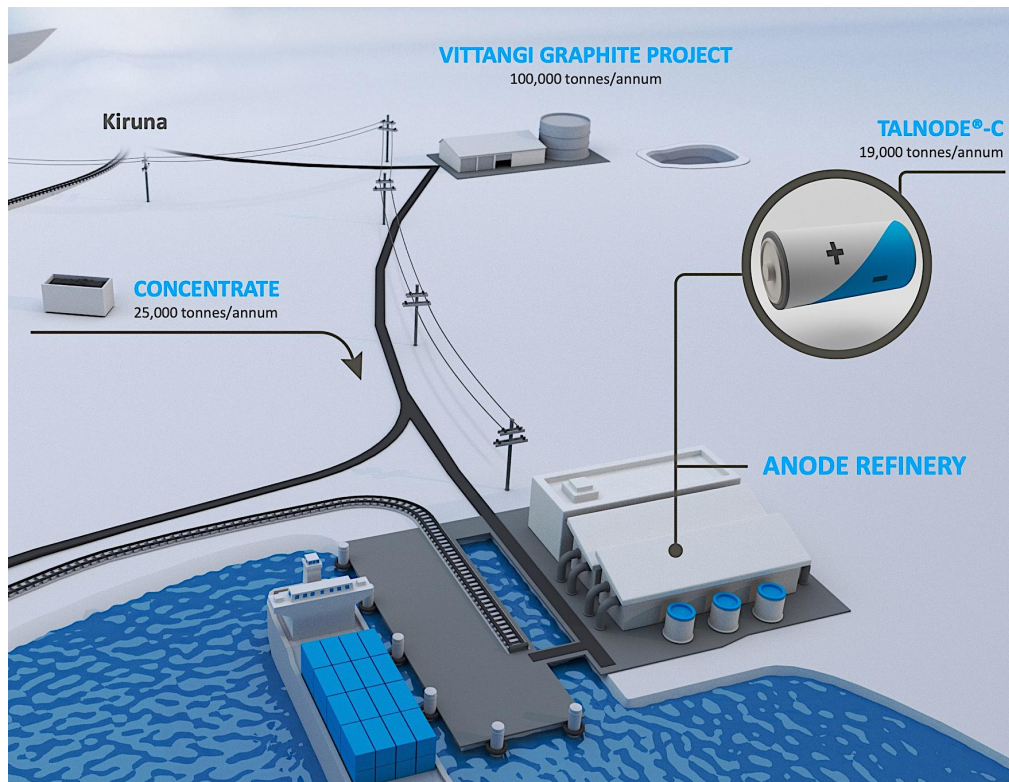
- Conventional open-pit **100,000tpa** mining operation with on-site concentrator at *Vittangi* and anode refinery at port of *Luleå*
- Toll primary milling in **Stage 1 (2020)** to reduce costs and scale up product supply and first anode refinery module, before steady state production in **Stage 2 (2021)**
- Northern Sweden low cost and low CO₂ sustainable power (over 18 TW/year **Hydro** & 12 TW/year **Wind**) and **quality existing infrastructure**
- Close to emerging European battery factories in Sweden, Poland, Hungary and Germany
- Funding initiatives with customers and potential **strategic partners** to take the Project into production - **Definitive Feasibility Study (DFS)** aiming for completion by 2020



► PFS HIGHLIGHTS - HIGH MARGIN OPERATION

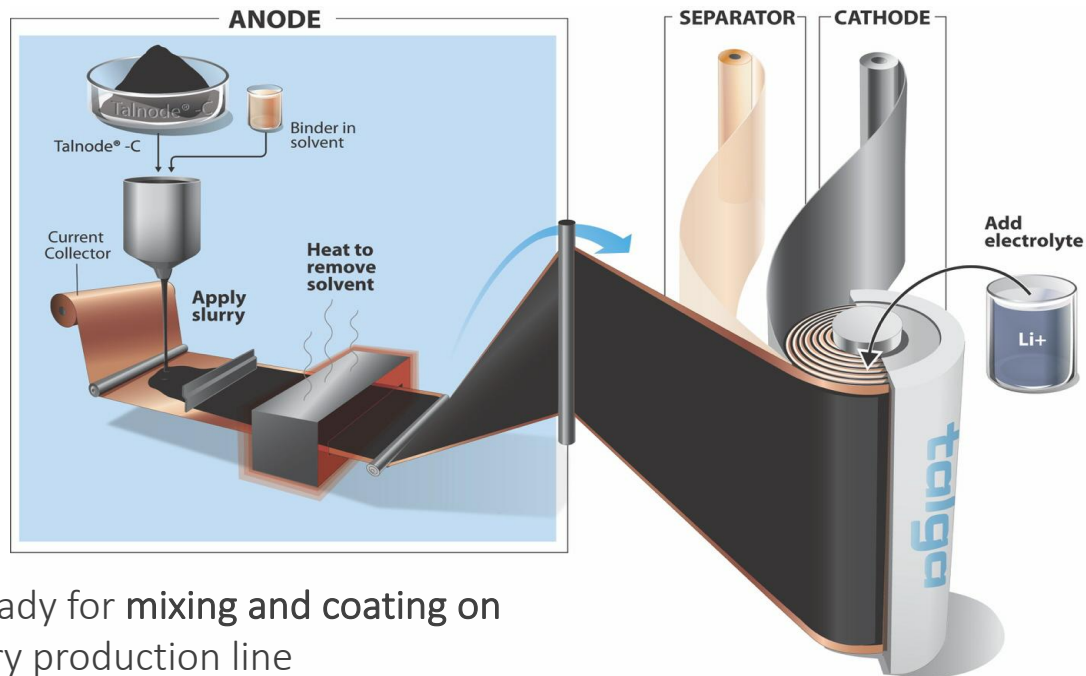
Pre-Feasibility Study (May 2019) demonstrates technically & financially robust long-life operation

Metric	PFS
Talnodel [®] -C production	19,000tpa
Ore mining rate	100,000tpa
Life of Mine (LOM)	22 years
Pre-tax NPV ₈ (real)	US\$1,056m
Pre-tax IRR	55%
Capex Stage 1	US\$27m
Capex Stage 2	US\$147m
Payback	1.5 years
Talnodel [®] -C price	US\$11,250/t
Production Cash cost	US\$1,852/t
Revenue (LOM)	US\$4,148m
EBITDA (LOM)	US\$3,254m



▶ PRODUCTION OF ACTIVE ANODE MATERIAL FOR LI-ION BATTERIES

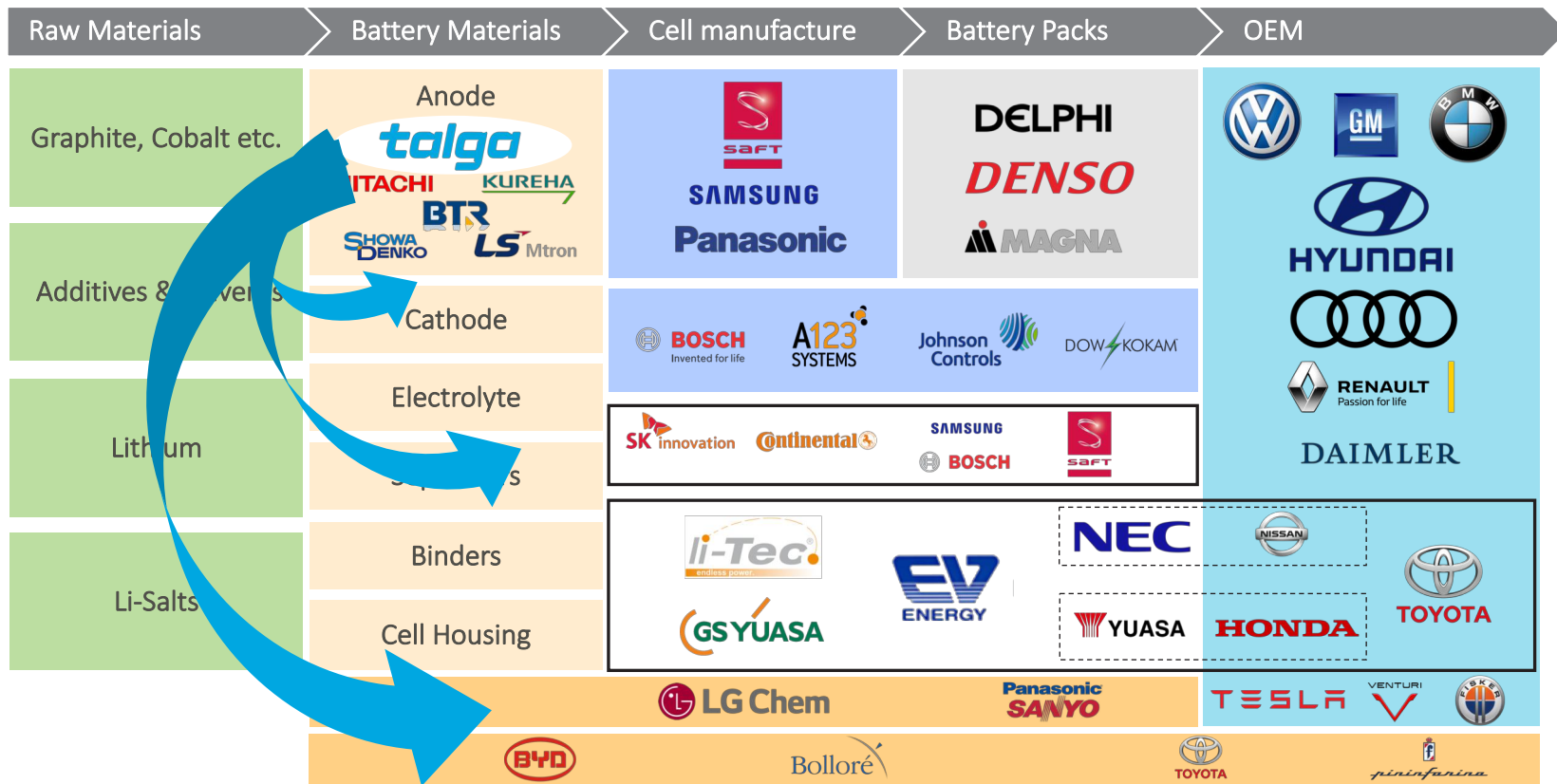
Talnode-C product sold directly to customers for final manufacture of coated current collector



- ▶ A fully coated anode powder ready for mixing and coating on current collector in Li-ion battery production line

▶ OUR CUSTOMERS ARE CELL MAKERS & ANODE SPECIFYING OEM'S

Value-added anode product and technology positions Talga deeper in supply chain



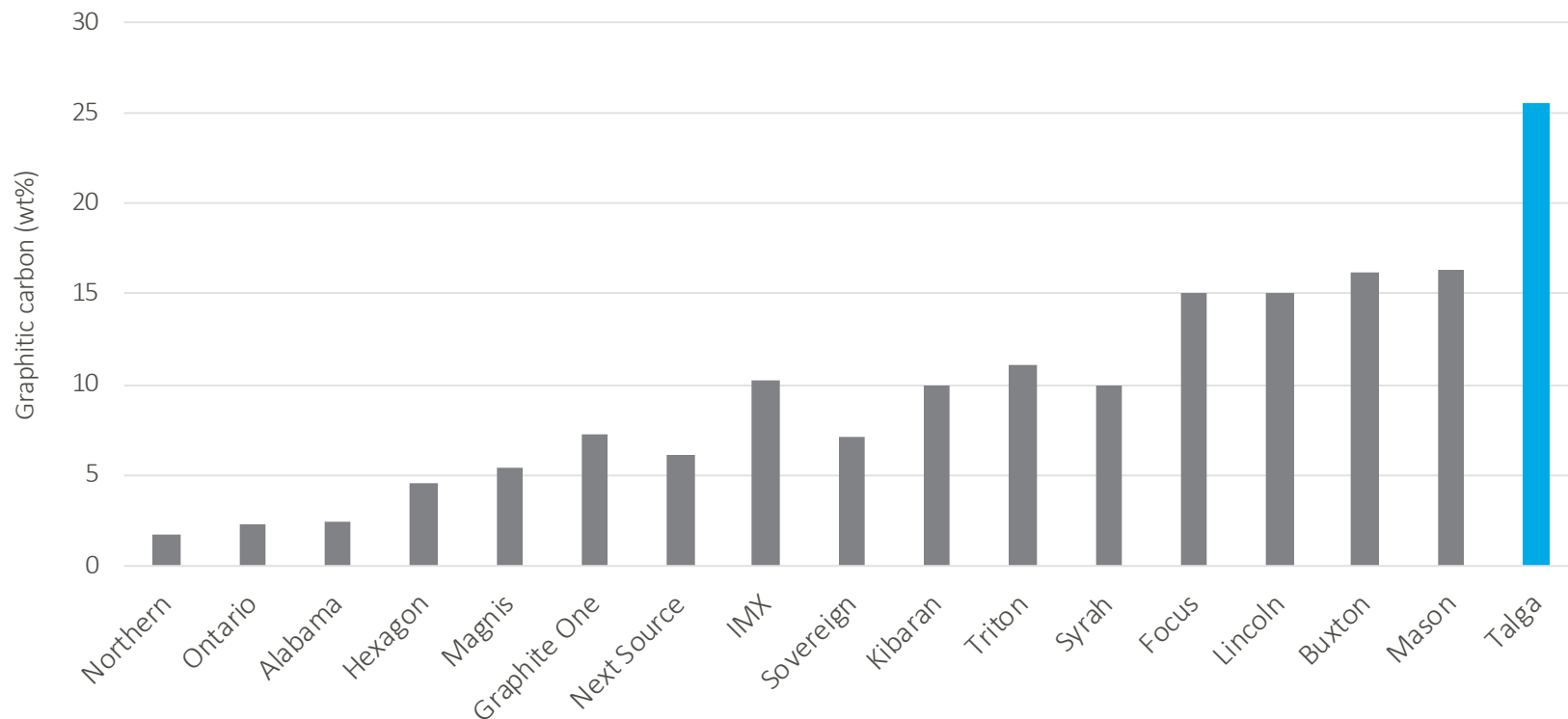
▶ STAGED DEVELOPMENT UNDERWAY

High value, low volume operation lowers environmental footprint



- ▶ Talga has operated successfully with all stakeholders in Sweden since 2012 including trial open cut mining of Nunasvaara South in 2016 (pictured above) after which successful rehabilitation was completed and mining bonds returned
- ▶ Further work on revegetation that specifically support reindeer herding is planned. **Permitting for Stage 1 & 2 both well underway**

TALGA ADVANTAGES - GRAPHITE RESOURCE GRADE



▶ VITTANGI CLEAR GROWTH POTENTIAL

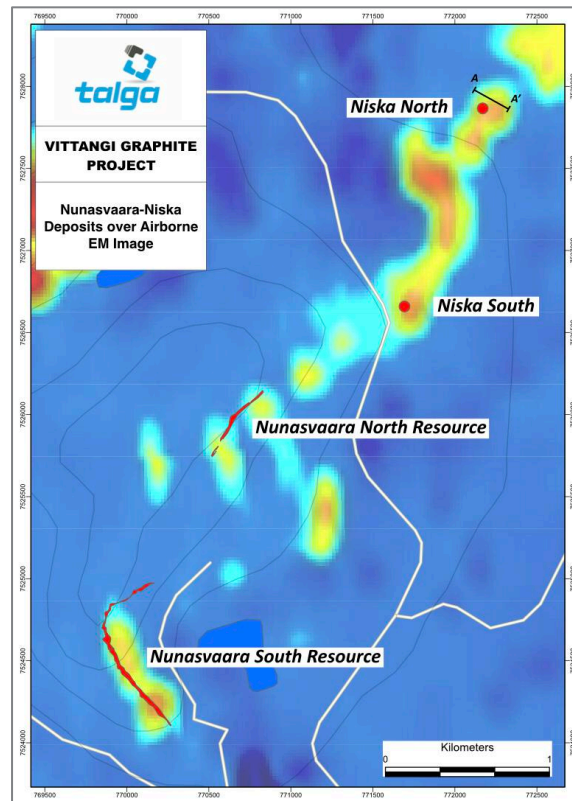
Kilometres of graphite zones being defined along strike from Nunasvaara resource and in nearby Talga projects

- ▶ Vittangi PFS based solely on Ore Reserve of 1.9Mt @ 23.5% TGC as part of global Indicated MRE of 10.7Mt @ 25.7% Cg (Golders, UK)
- ▶ High growth potential with new discovery along strike to north at Niska (ASX:TLG 5 Jun 2019) drilling includes 136m @ 26% graphite

Nunasvaara S.	Nunasvaara N.	Niska Discovery
Average 20m wide	Average 20m wide	Average 50m+ wide
Resource grade 24.8%Cg	Resource grade 29.2%Cg	Drill grades ~26%Cg

Mineralisation from surface

- ▶ Maiden resource for Niska to be estimated following remaining drill results being received Jun-July 2019
- ▶ Continued growth in scale suggest a new and globally significant graphite province is present, with potential for a long term technology mineral industry to be established in north Sweden



Talnode® Development

A new class of high-performance, low-cost graphitic carbon anode products



Pouch cell prototype developed with Talnode® product

► EXPERIENCED BATTERY TEAM



► **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
Co-founder and Director of the original Li-ion cell manufacturer in Europe
Former Senior Scientist for solid state battery technologies for HEVs at Toyota



► **Stephen Hutchins Ph.D.**
Director of Sales

Physicist with over 20 years of building new materials technology and engineering businesses and helping customers meet their objectives.

Previous Commercial Director, CTO and COO at Keronite Group
Former Head of Sales and Project Management at Lotus Engineering
Fellow of the Institute of Materials, Minerals and Mining



► **Sai Shivareddy Ph.D.**
Manager – Energy Storage

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 position 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



► **Fengming Liu Ph.D.**
Senior Scientist – Batteries

Over 11 years industry experience. Focus on programs for silicon and new generation battery anodes under 'Safevolt' a Talga led project granted financial assistance under the UK Government's Faraday Battery Challenge.

Co-founder and former Senior Scientist for silicon anode specialist Nexeon
Responsible for 10 Li-ion battery anode patents to date

▶ BATTERY PRODUCTS

Talga battery technologies developed in-house and with quality commercial partners, including funding assistance from Innovate UK's Faraday Challenge programs



High Performance

Engineered graphite anode for stable lifetime and 20% higher capacity: Talnode®-C

Fast Charge

Formulated graphite anode for ultra-fast charge (0-100% in 3 minutes): Talnode®-X

Silicon Anode

Graphene Silicon anode for higher energy density (50% higher than standard): Talnode®-Si

Conductive Agent (under development)

Functionalised graphene (Talphone®) additive for Li-ion battery cathodes

Selection of Current Commercial & Development Partners



Department for
Business, Energy
& Industrial Strategy

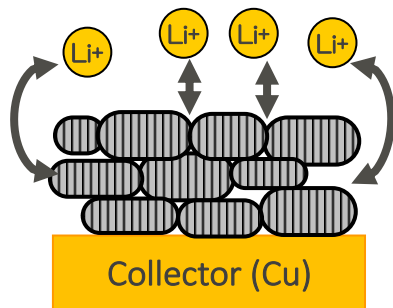
Innovate UK



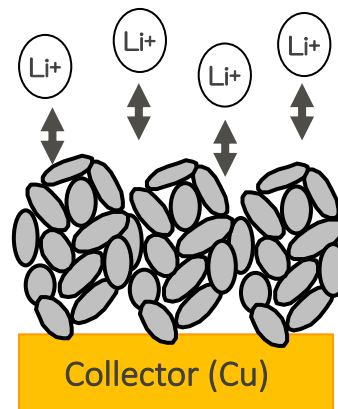
UNIVERSITY OF
CAMBRIDGE

➤ APPROACH FOR OPTIMAL GRAPHITE ANODE PARTICLE DESIGN

Design criteria being *carbon source, particle size, shape, surface functional groups, coating and orientation*



- Anisotropic particle orientation in **conventional flake**
- High resistance to diffusion

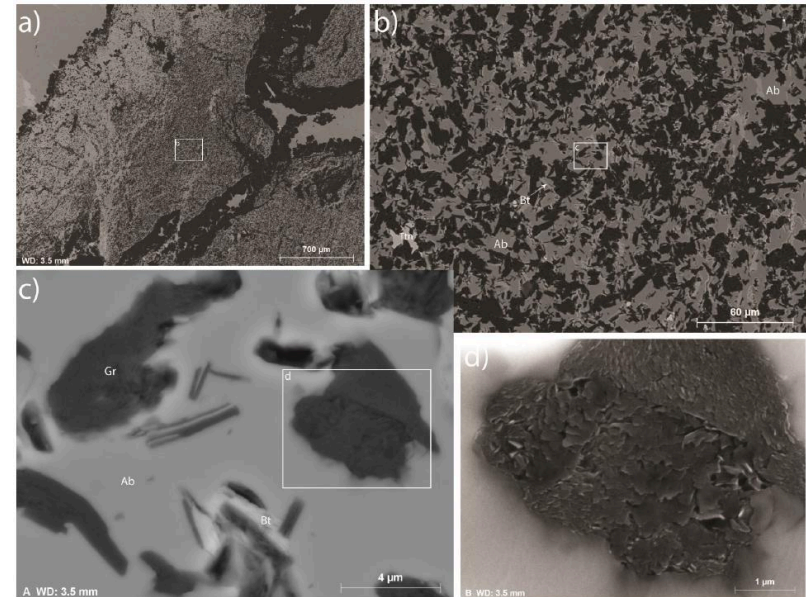


- Right Crystallite and particle size
- Better Li⁺ absorption
- Porosity in particle and porosity in electrode
- Electrode swell and Li⁺ resistance reduced

▶ TALGA ADVANTAGE - UNIQUE ORE

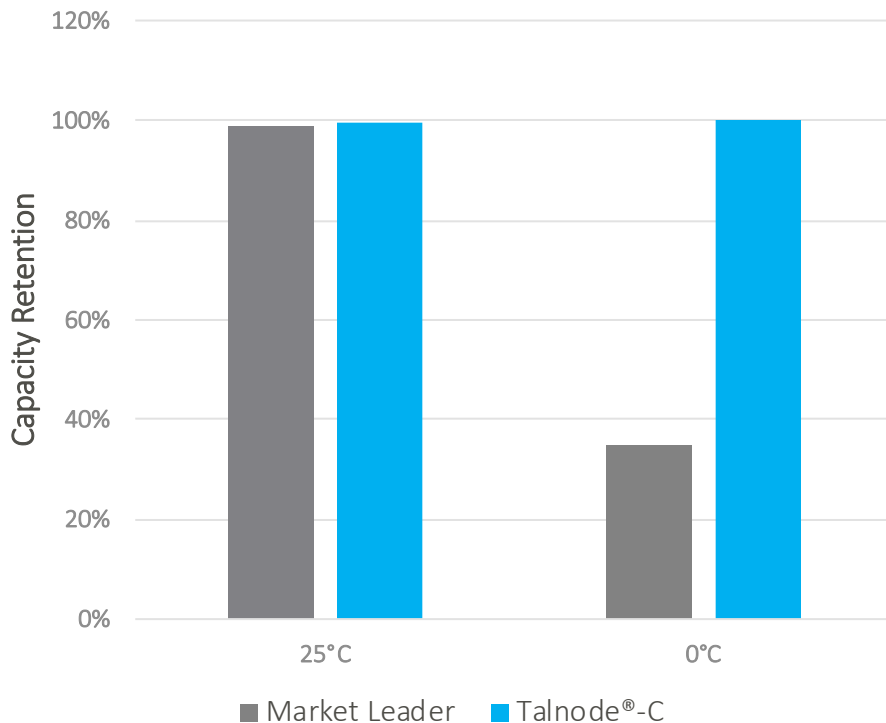
Uniquely formed highly crystalline flake graphite naturally sized for anode particles

- ▶ Vittangi graphite formed from a 2 billion year deposit of microbes naturally crystallised at low temperature, high pressure and ultra-fine size
- ▶ High crystallinity, grade, consistency and conductivity makes ore amenable to both electro-chemical exfoliation and ultra-fine grinding methods
- ▶ Excellent liberation and size distribution for Li-ion battery applications at high process yields (>85%) versus industry standard (<50%)
- ▶ Other natural advantages are enhanced by Talga processing and particle engineering



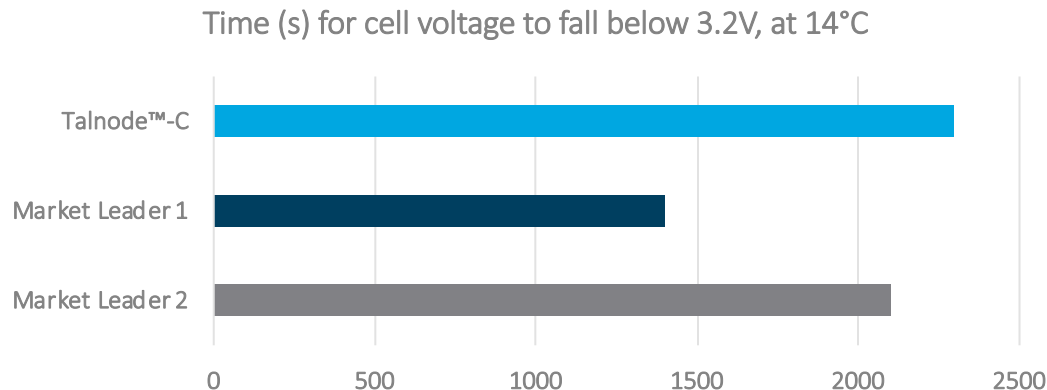
▶ OUTSTANDING FREEZING TEMPERATURE PERFORMANCE

Retention of 100% capacity and 100% cycle efficiency at freezing temperature (0°C)

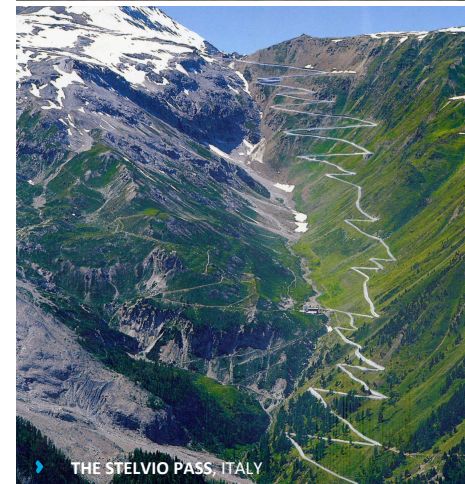


▶ ENDURANCE UNDER HIGH POWER AND FAST CHARGE

High efficiency in real-world endurance test at low temperature

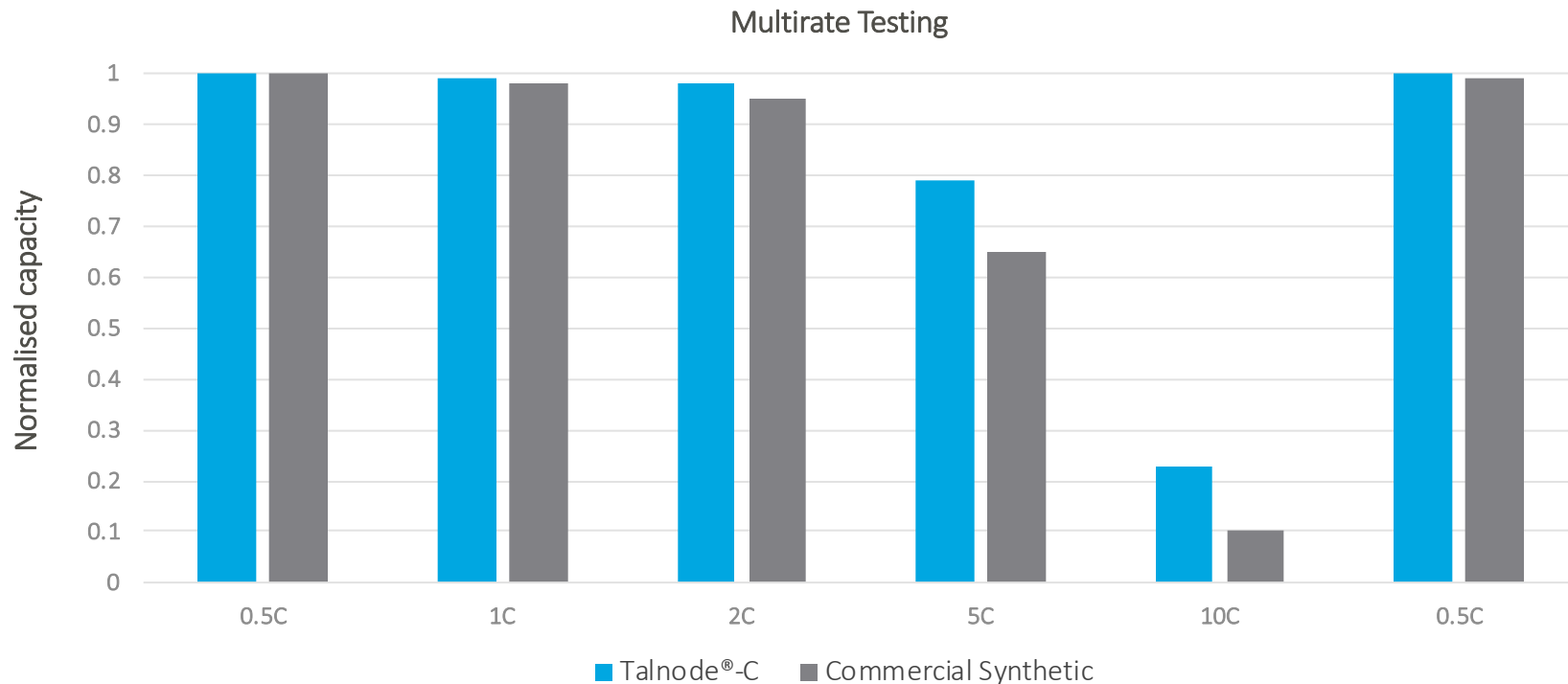


- ▶ The 'Stelvio' test simulating driving up a mountain at high speed
- ▶ Measures the ability of the cell to collect the regenerative current with high efficiency after high-power discharge



▶ TALNODE®-C OUTPERFORMS SYNTHETIC GRAPHITE

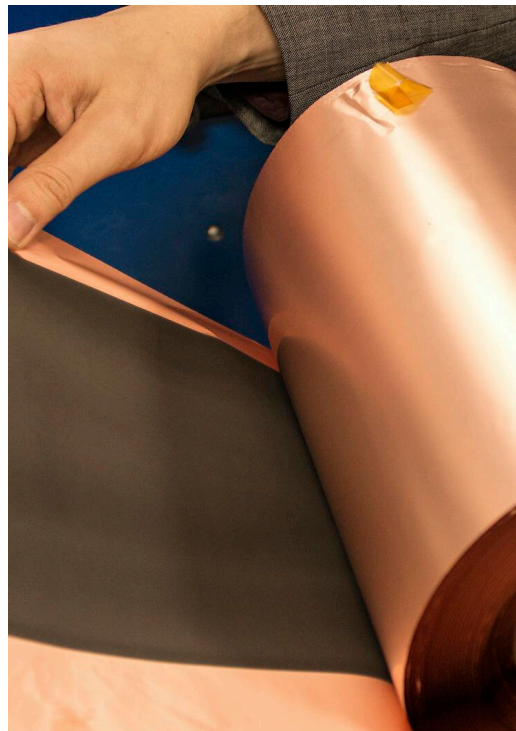
Shows higher capacity at all C rates tested and this is retained even after trials at 10C



► TECHNOLOGY SUMMARY

Talga is planning to mass produce anode materials for current gen Li-ion batteries

- Talga has developed high performance graphitic battery materials enabled by its unique:
 - *ore type*
 - *processing technology*
 - *in-house material engineering technology*
- Tests with Talnode® show low internal cell resistance, leading to:
 - *Class-leading performance at low temperature with no evidence of Li plating on the anode*
 - *Reversible charge transfer at high rates (up to 5C)*
 - *Potential for less cell heating (easier thermal management)*
- Talnode® material may be used directly in Li-ion and alkaline battery electrodes, or as a raw material for further enhancements/modifications



CORPORATE OVERVIEW

DIRECTORS



▶ **Terry Stinson**
Non-Executive Chairman



▶ **Mark Thompson**
Managing Director



▶ **Grant Mooney**
Non-Executive Director



▶ **Steve Lowe**
Non-Executive Director

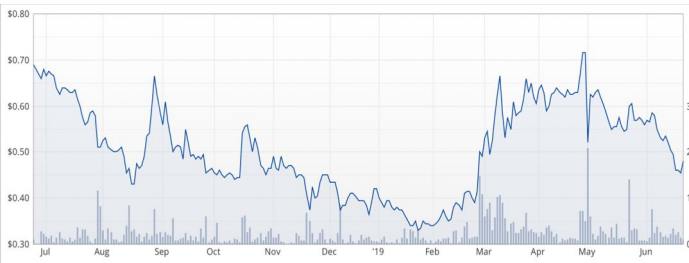


▶ **Ola Rinnan**
Non-Executive Director

SHARE PRICE PERFORMANCE

Share price (A\$) 12 months

Volume (m)



MAJOR SHAREHOLDERS (16 MAY 2019)

Smedvig – <i>Scandinavian based family office</i>	11.7%
Mark Thompson – <i>Managing Director</i>	6.5%
HSBC Custody Nominees (Australia)	4.8%
J P Morgan Nominees (Australia)	4.6%
Pelmer Securities	4.2%
Citicorp Nominees	3.5%
Top 20	52.5%

FINANCIAL INFORMATION (ASX:TLG)

Shareholders	~4,900
Share price	A\$0.48
52 week low / high	A\$0.325 / A\$0.73
Shares outstanding ¹	218.8m
Market Capitalisation	A\$105.0m
Cash (31-Mar-2019)	~A\$10.9m
Debt (31-Mar-2019)	Nil
Enterprise value	A\$94.1

Source: IRESS, company filings. As at 24 June 2019 unless stated otherwise.

¹ Excludes 15.4m unlisted options (mostly employees and directors) with exercise price range up to A\$1.02 and expiry date range 7 July 2019 to 10 Feb 2022.

Primary listing on the Australian Securities Exchange (ASX:TLG) with trading in Frankfurt (TGX) and USA (TLGRF)

► WHY TALGA?

Investment Case Summary

- ***Right place and right time:*** booming EU battery supply chain growth
- ***Advantages over peers and incumbents:*** higher grade resources and anode processing yields provide lower processing costs and more sustainable low-CO₂ production in first class jurisdiction Sweden
- ***Value-added products:*** advanced product pricing power and higher margins, plus added value from in-house battery science team and wholly owned technologies
- ***Huge growth pipeline:*** massive high grade resources still open in all directions and deep pipeline of high value next-generation battery anode products
- ***Value re-rating ahead:*** Current partnerships with quality technology partners to be augmented with end users, strategic partners and project developers to re-rate Talga towards values in PFS. New exploration and technology results imminent.



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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.

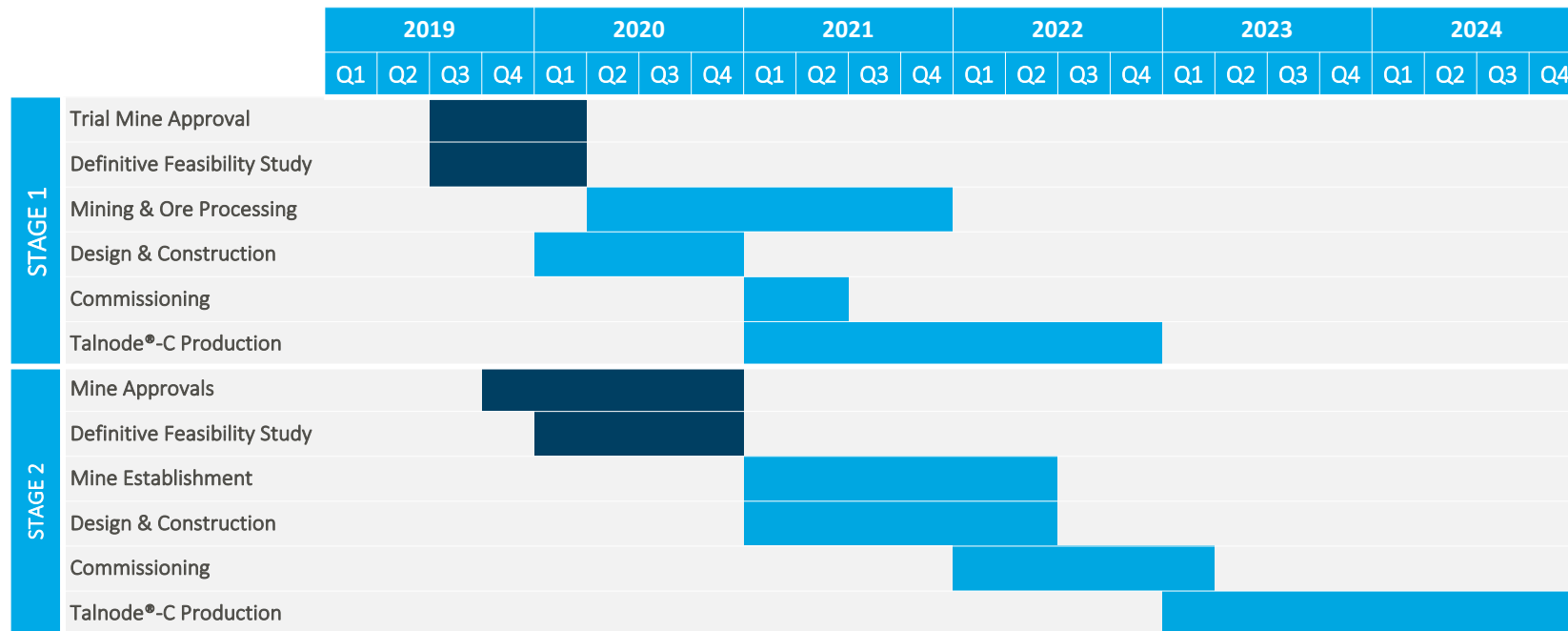
The information in this report that relates to Graphite Resource Estimation for the Vittangi Project is based on information compiled by Oliver Mapeto and reviewed by Albert Thamm. Both Mr Mapeto and Mr Thamm are consultants to the Company. Mr Mapeto is a Member of both the Australian Institute of Mining 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 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.

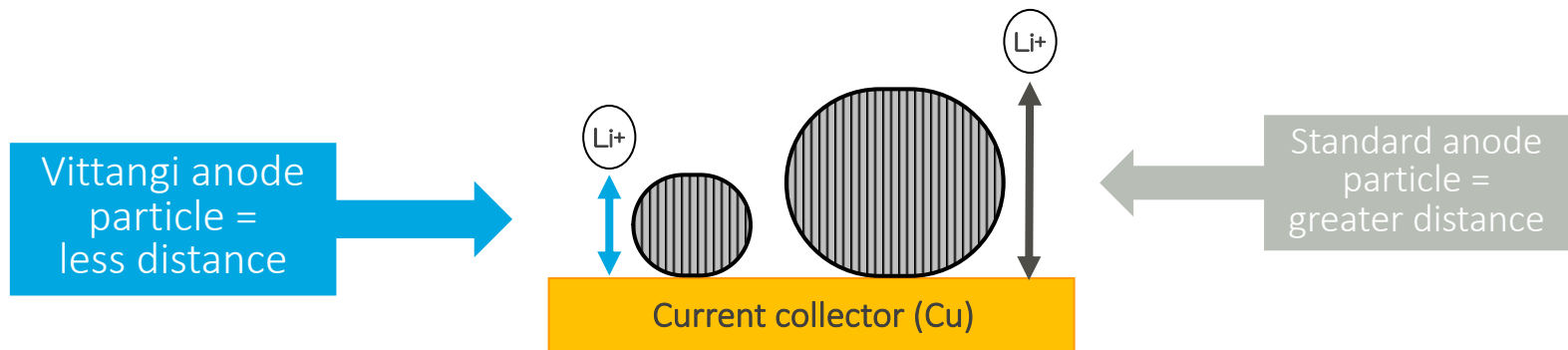
The information in this announcement that relates to Reserve Estimation is based on and fairly represents information that has been compiled by John Walker. Mr Walker is a Principal Mining Engineer with Golder Associates Ltd. who act as consultants to the Company. Mr Walker is a Professional Member of the Institute of Materials, Minerals and Mining (Membership No.451845) a Fellow of the Institute of Quarrying (Membership No.22637) and a Fellow Member of the Geological Society (Membership No.1021044). He has been involved in the mining industry for 30 years acting in various roles including production, project development and consulting. Mr Walker has sufficient experience relevant to the styles of mineralisation and types of deposits which are covered in this announcement and to the activity 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 Walker consents to the inclusion in this announcement of the matters based on this information in the form and context in which it appears.

► DEFINITIVE FEASIBILITY STUDY UNDERWAY



▶ SMALLER IS BETTER

Market trend is to faster charge and more power for many battery applications. Anodes with smaller graphite particle size such as Vittangi's offers the kinetics to address the market.



- ▶ Small graphite particles provide lower charge transfer resistance, making batteries with faster charge/more power
- ▶ Smaller particles also can be engineered to particular orientations helpful for high charge rates
- ▶ Smaller graphite particles provide a larger surface area for better electrolyte wetting, higher charge rates, less dendrites ('shorts') and low temperature performance. However, can cause high first cycle losses, so balance is needed for the application (e.g., graphite anode for electronics/phones is different to Auto EV or power tools).

► GRAPHITE INVENTORY

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

Nunasvaara JORC (2012) Ore Reserve (12% Cg cut-off)

JORC 2012 Classification	Tonnes	Graphite (%Cg)
Proven	0	0
Probable	1,935,000	23.53
Total	1,935,000	23.53

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 2014 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