



# Talga Resources

Super Anodes: new generation graphite  
for improved Li-ion batteries

Benchmark Minerals Graphite + Anodes 2018  
Newport Beach, CA. USA  
Oct 23, 2018



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# Talga Resources

Vertically integrated  
graphite and graphene  
products company



## ► WHAT WE DO

Advanced material technology company developing and commercialising the worlds highest grade graphite mineral resource to produce value added graphene and battery products

- Significant in house capability to develop and commercialise value added products in collaboration with industry majors
- - Product development; Chemists, Physics and Material Science
  - Process development; Engineers Chemists
  - Mineral resource development; Earth scientists
- Development phase: trial mining completed, process test facility in Germany scaled up, pre-feasibility for all permitting well underway
- Formal agreements executed with substantial commercialisation partners



Selection of staff at Talga Technologies Ltd, Cambridge UK



# ▶ CORPORATE SNAPSHOT

## FINANCIAL INFORMATION

Shareholders	~3,700
Share price (ASX code TLG) (18-Oct-2018)	A\$0.56
52 week low / high	A\$0.42 / A\$0.92
Shares outstanding <sup>1,2</sup>	217.4m
<b>Market Capitalisation</b>	<b>A\$121.7m</b>
Cash (30-Sep-2018)	~A\$16.6m
Debt (30-Sep-2018)	Nil
<b>Enterprise value</b>	<b>A\$105.1m</b>

Source: IRESS, company filings. As at 18 Oct 2018.

<sup>1</sup> Excludes 43.8m listed options (TLGOA) with exercise price A\$0.45 and expiring 31 Dec 2018

<sup>2</sup> Excludes 26.7m unlisted options (mostly employees and directors) with exercise price range up to A\$1.02 and expiry date range 31 Dec 2018 to 17 Dec 2020

## SHARE PRICE PERFORMANCE

Share price (A\$) 5 years

Volume (m)



## MAJOR SHAREHOLDERS

Smedvig – <i>Scandinavian based family office</i>	11.7%
Mark Thompson – <i>Managing Director</i>	6.6%
J P Morgan Nominees (Australia)	6.5%
HSBC Custody Nominees (Australia)	5.5%
Pelmer Securities	4.2%
Citicorp Nominees	3.4%
<b>Top 20</b>	<b>54.4%</b>

## ▶ OUR OPERATIONS

Headquartered in Australia (listed on ASX) with major operations and business units in Europe

- ▶ **Talga Graphene AB/Talga Battery Metals AB**  
Sweden. 100%-owned Graphite, Cobalt and Copper/Gold deposits

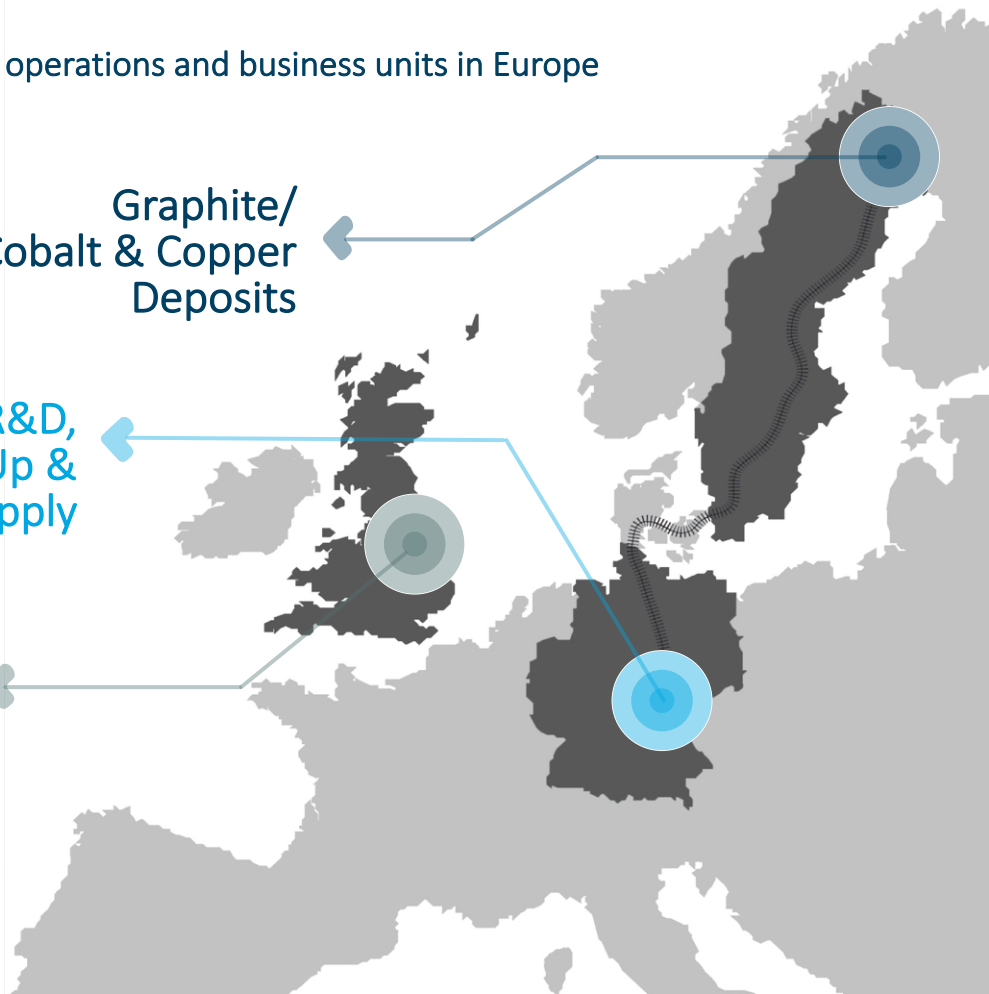
- ▶ **Talga Advanced Materials GmbH**  
Germany 100%-owned process test facility located in Rudolstadt

- ▶ **Talga Technologies Limited**  
UK. In-house product R&D team located in Cambridge

Graphite/  
Cobalt & Copper  
Deposits

Process R&D,  
Scale Up &  
Sample Supply

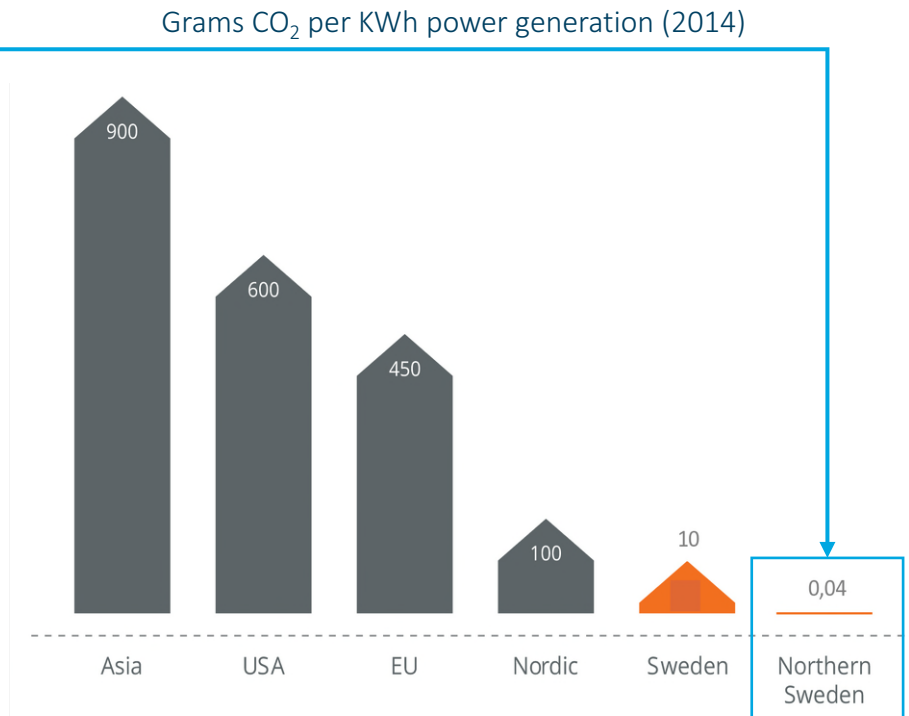
Product  
Development  
& Marketing



## ► NORTH SWEDEN ADVANTAGES

New source of long term mineral supply chain to Europe and Asia

- **Low cost** and **low CO<sub>2</sub>** sustainable power (over 18 TW/year **Hydro** & 12 TW/year **Wind**)
- **Quality existing infrastructure** roads and railway with links to ports and smelters
- **Close to emerging European battery factories** in Sweden, Poland, Hungary, Germany et al
- **Quality long term operating and investment** jurisdiction with 22% corp tax rate, 0.2% mineral tax rate

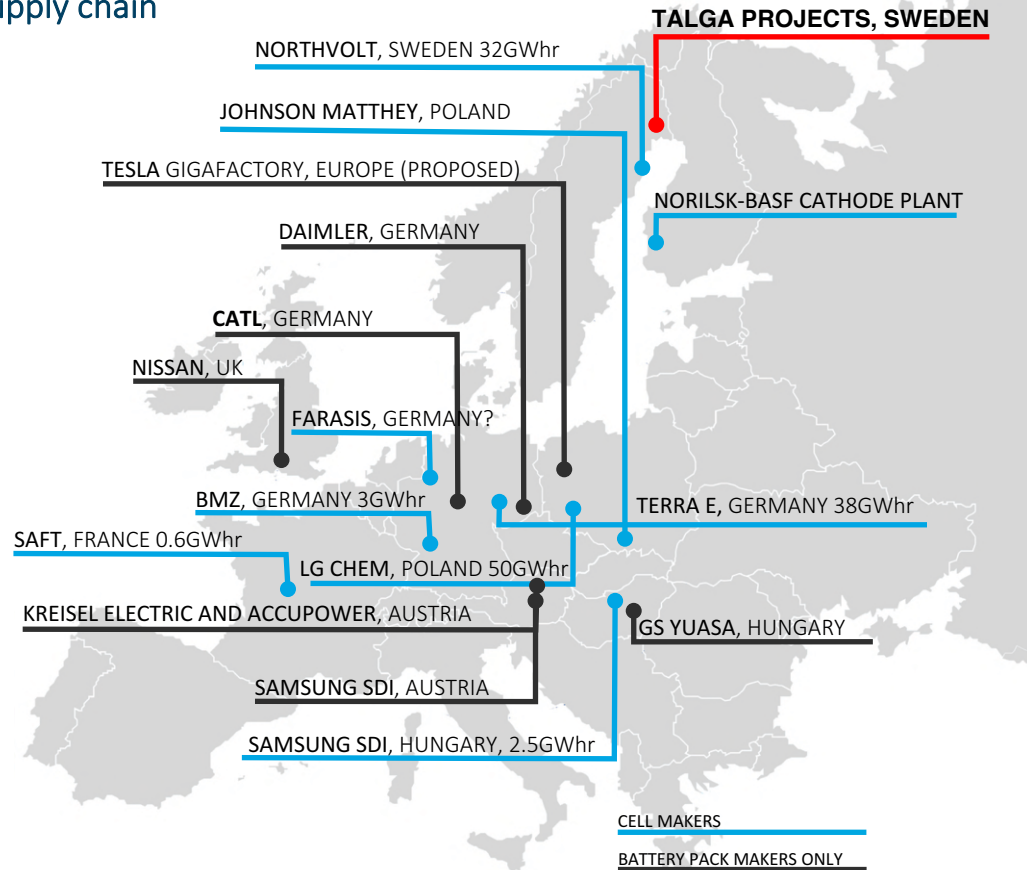


Data and Graphic Courtesy of “Invest in Norrbotten!”

# ▶ EUROPEAN BATTERY MEGAFACTORIES

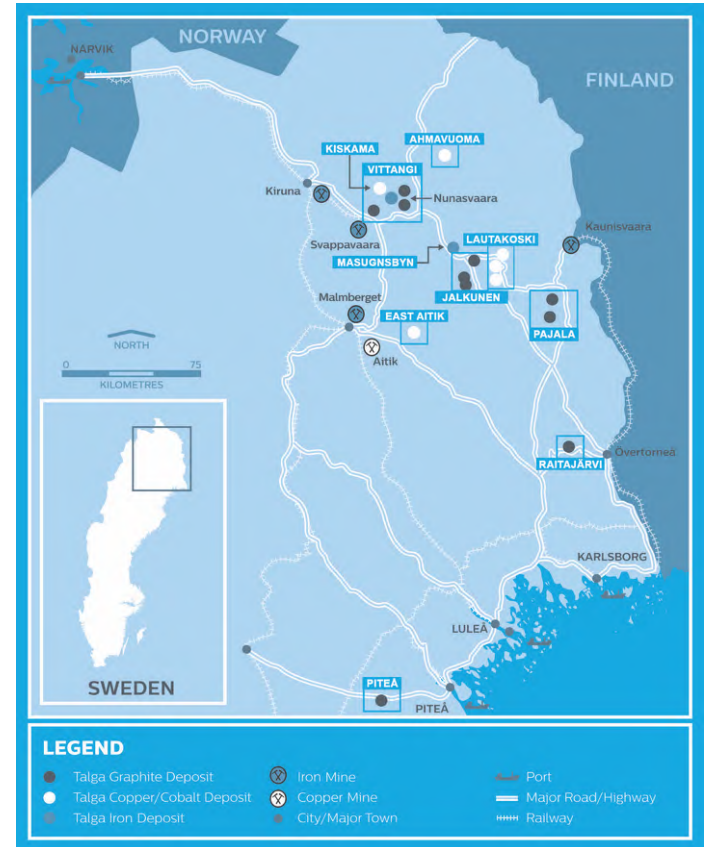
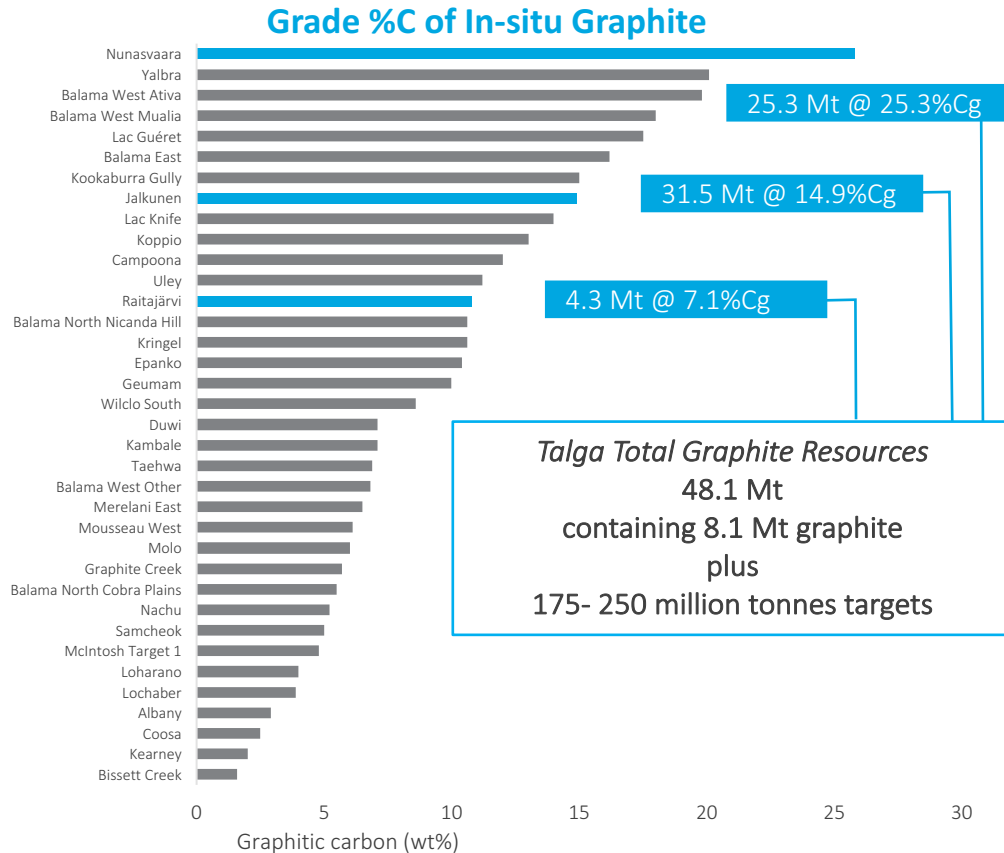
Location advantage to supply local Li-ion battery supply chain

- ▶ **Multiple** Li-ion battery “megafactories” being built or planned in EU
- ▶ **Major** car markets turning to EVs
- ▶ **Majority** of raw materials are currently imported into Europe from Africa (cobalt and graphite) or China (graphite)
- ▶ **Talga’s** anode and cobalt-related deposits in Sweden represent a strategic supply, on direct rail links
- ▶ **Rocketing growth** underwritten by many EU governments legislating against ICE cars





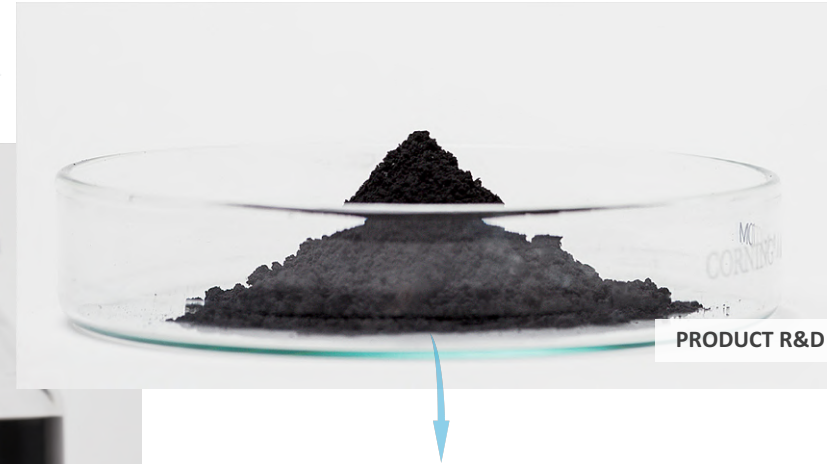
# ▶ GLOBAL LEADER IN GRAPHITE RESOURCE GRADE



## ▶ SUMMARY OVERVIEW OF OPERATIONS



# ▶ VERTICALLY INTEGRATED GRAPHITIC PRODUCT SUPPLY CHAIN

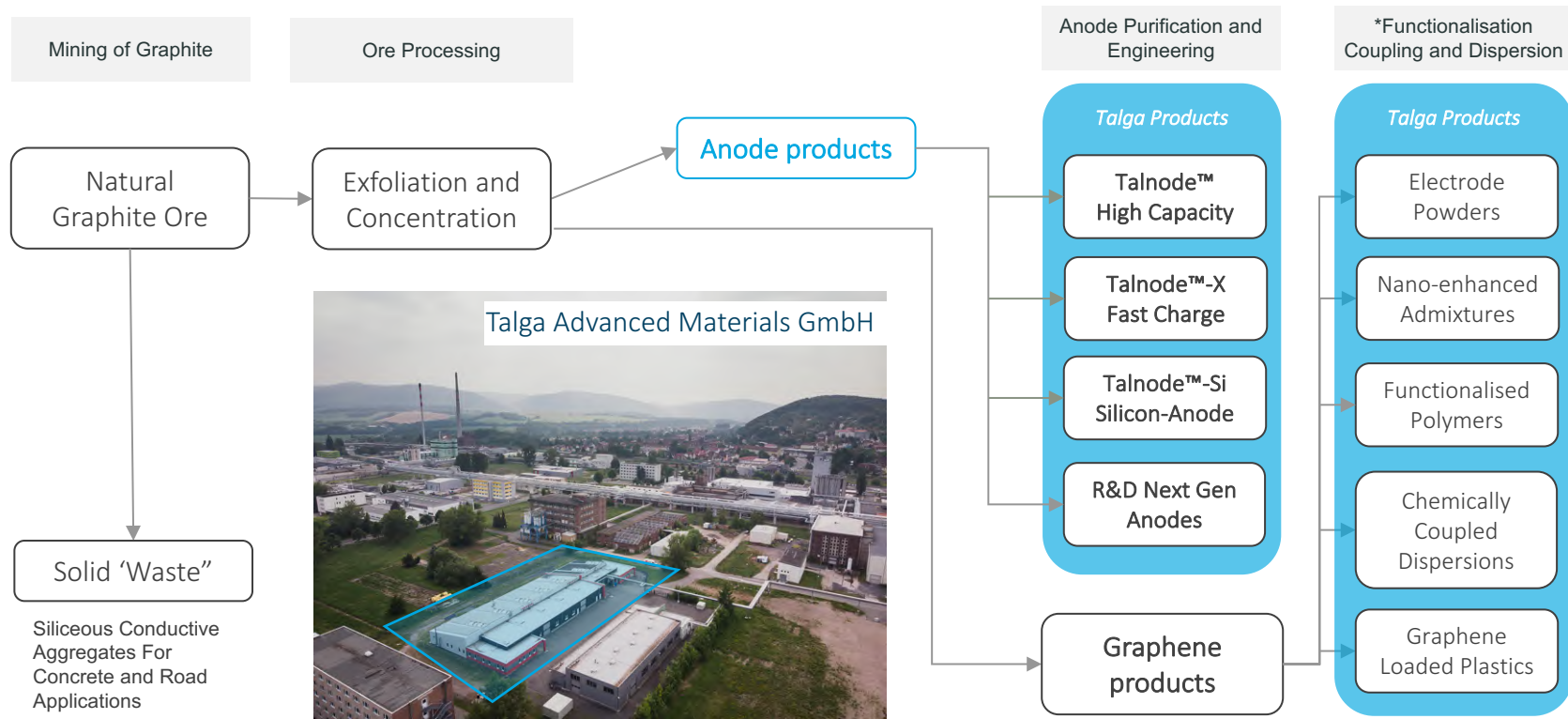


Some current collaborations include:



# ▶ ONE ORE – MANY PRODUCTS

Vittangi graphite ore yields both graphite and graphene for value-adding into products.

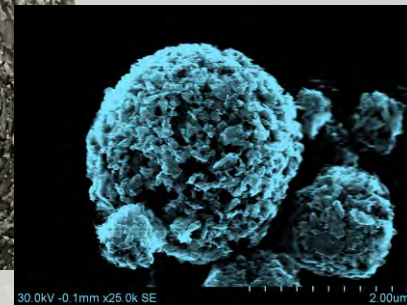


\*Note: Functionalisation is the adding of chemical bonds to the graphene to enable it to impart its performance characteristics into the bulk material it is blended. It is a value-adding process required for integration into products.



# LI-ION BATTERY PRODUCTS

Talga anode developments and  
results to date





## ► ENERGY STORAGE TEAM

In-house expertise of leading battery developments



**Sai Shivareddy 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.



**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.

- Previous positions include co-founder and Senior Scientists for UK-based silicon anode specialist Nexeon Ltd.
- Responsible for 10 Li-ion battery anode patents to date.



**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.

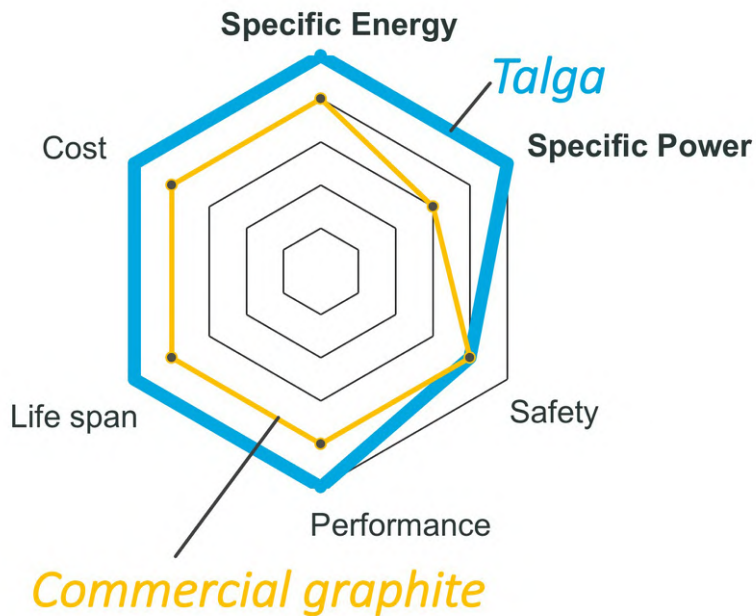
- Previous Professor and head of Battery Group/ Italian Institute Technology
- Cofounder and Director of the original Li-ion cell manufacturers in Europe
- Former Senior Scientist for solid state battery technologies for Hybrid Electric Vehicles (HEVs) at Toyota.

**Da Wang Ph.D.**  
Research Scientist – Batteries

**Lina Zhou Ph.D.**  
Research Scientist - Batteries

## ▶ ANODE PRODUCTS

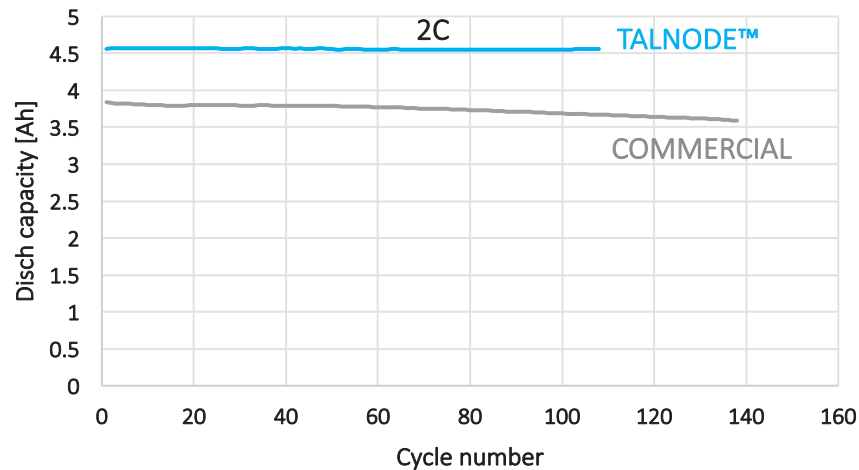
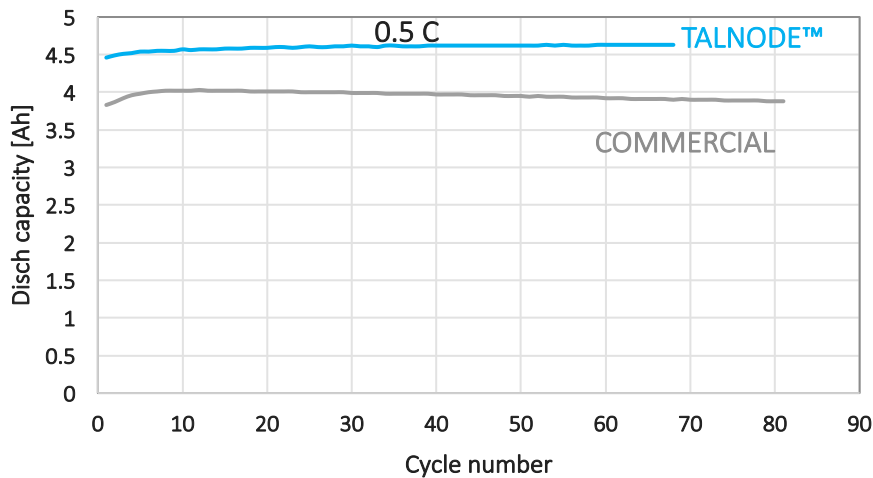
Talga is developing a range of high value Li-ion battery anode products under the Talnode™ trademark



- ▶ Improved charging and discharging rates
- ▶ Improved power and energy performance
- ▶ Less swelling
- ▶ Longer lifespan through great stability
- ▶ Lower cost of anode electrode manufacturing

## ▶ TALNODE™ - FOR POWER

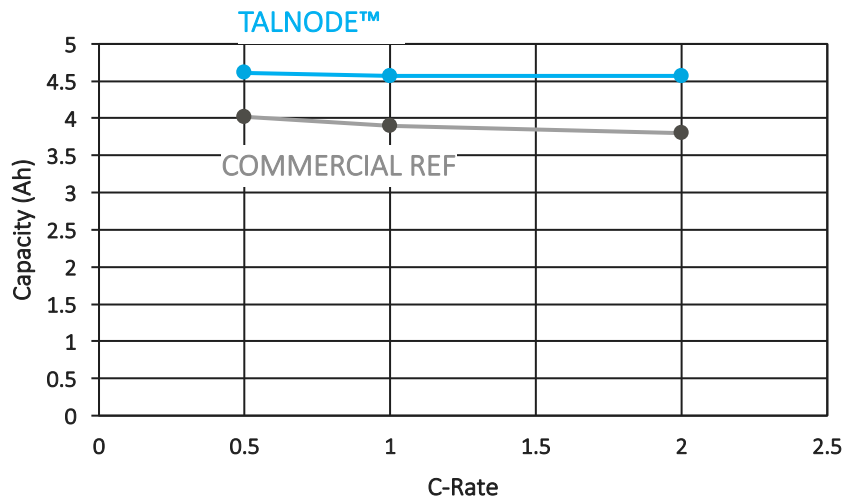
Talnode™ in 4.5Ah pouch cells show more power and energy in initial tests



- ▶ 100% Talga Graphite as Active Material in 4.5Ah NMC pouch cells
- ▶ High capacity retention at high power (same capacity of 4.5Ah at 0.5C and 2C)
- ▶ >90% first cycle efficiency
- ▶ Benchmarked with current market leading graphite product at leading independent EU facility

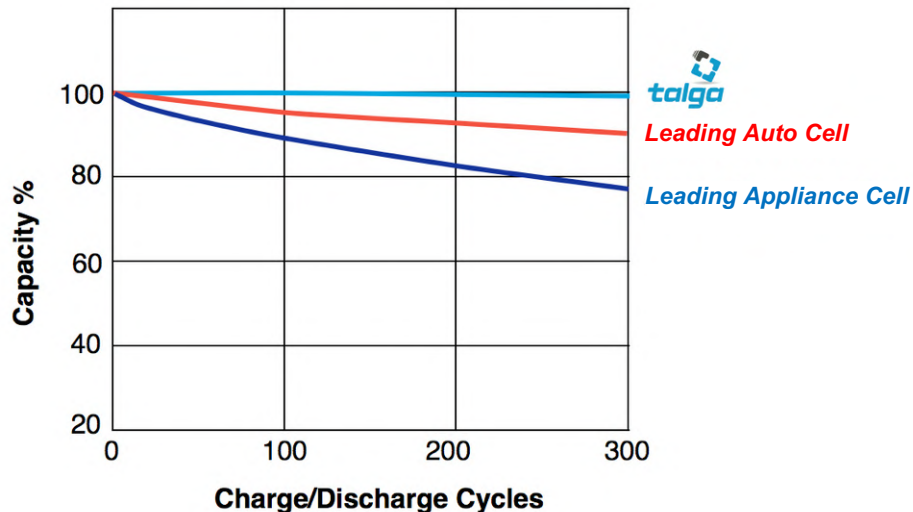
# TALNODE™ FOR STABILITY AT HIGH CHARGE RATES

Very high stability compared to leading brand cells



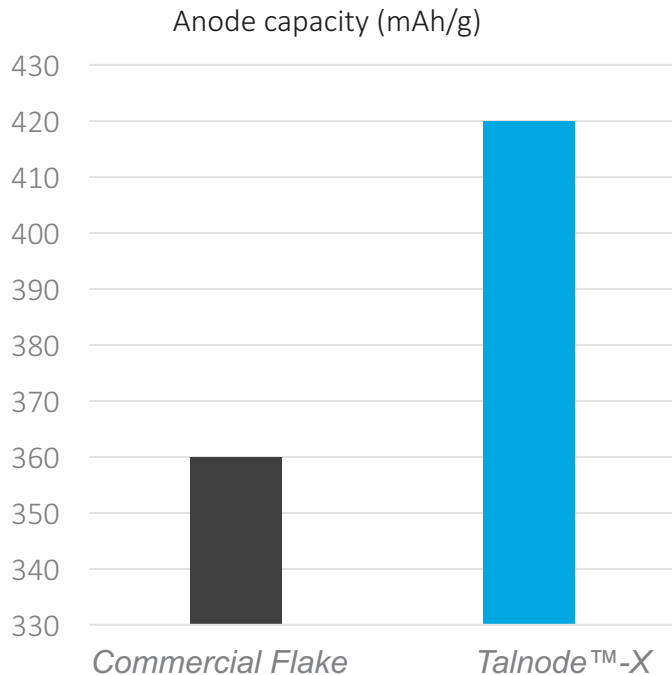
- ▶ ~20% power above commercial reference
- ▶ Very high stability up to 300 cycles (cycle testing ongoing)

## BATTERY CYCLE LIFE CHARACTERISTICS (@25°C)



## ▶ TALNODE™ - FOR HIGH CAPACITY

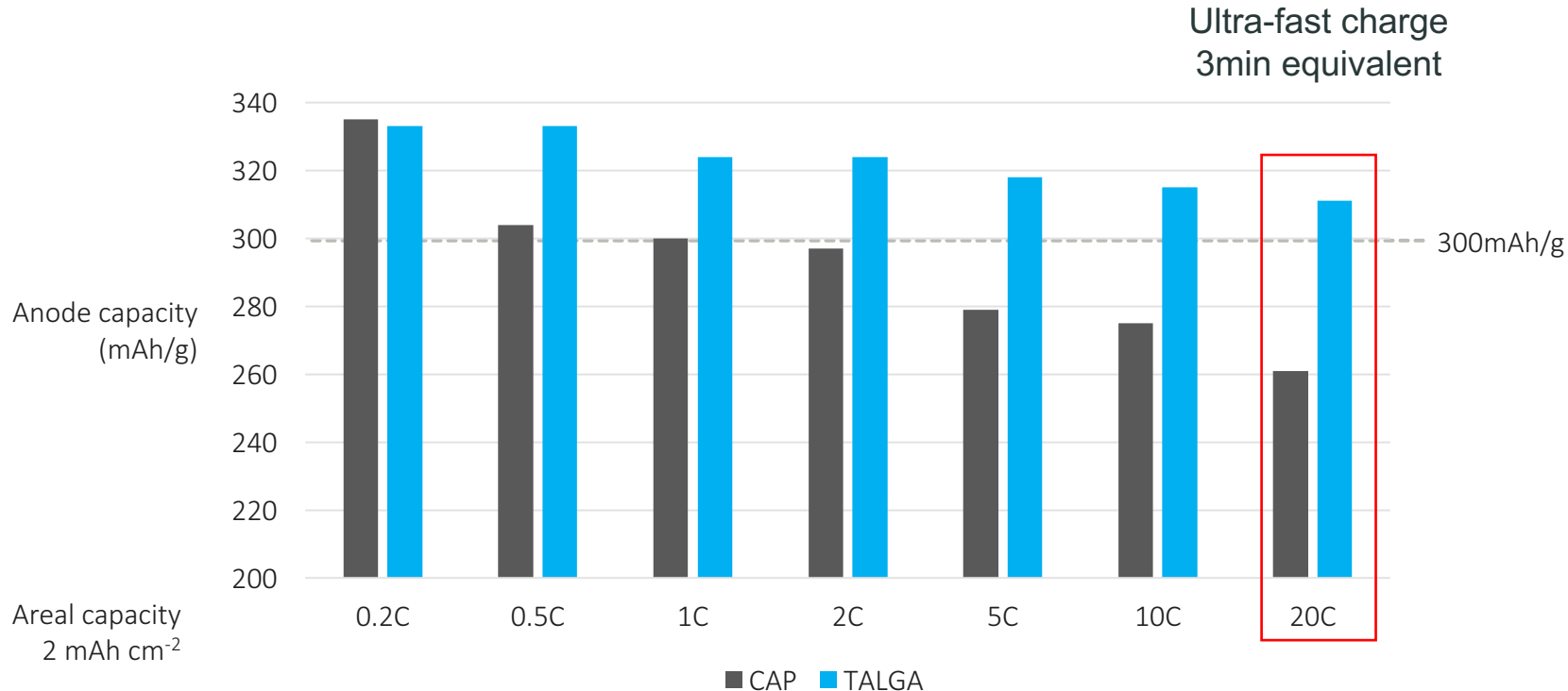
Engineered graphite product achieves >372 mAh/g without silicon



- ▶ Talnode™-X has unique morphology
- ▶ Increases Li accessible sites for intercalation
- ▶ Higher than graphite capacity
- ▶ Cost effective process
- ▶ Very stable anode electrodes



## TALNODE™ - FOR FAST CHARGE



Extreme high charge rate (up to 20C or 3min) at higher capacity for Talnode™-X (right) compared with Leading Commercial Anode Product (CAP)(left). In tests a range of coin cells were fabricated using Talga's graphite anode and tested to a common protocol with the commercial reference prepared at the same time and under the same conditions.

## ▶ 100% OWNED ORE PROCESS TECHNOLOGY



# TALGA 'FARADAY CHALLENGE' PARTNERS

UK Government funding £246 million 'Faraday' initiative to create new battery tech and local supply chains

Innovate UK



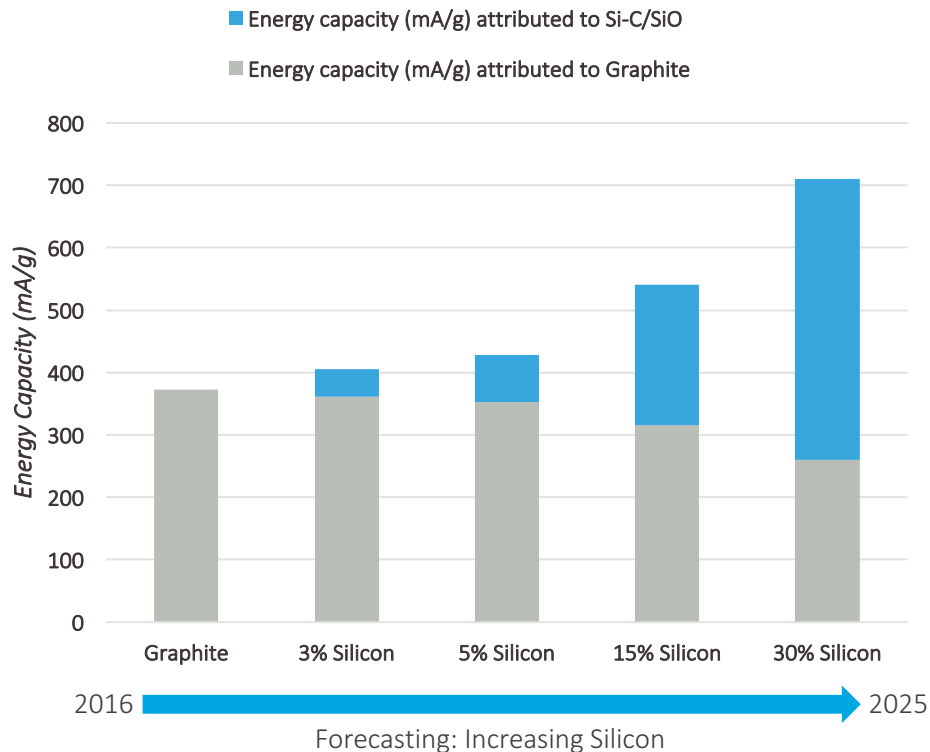
Department for  
Business, Energy  
& Industrial Strategy

- Talga wins 70% rebate against eligible costs (~A\$1.5m budget) over 1-2 year period for 3 programs:
  - '*Scale up*' higher performance Li-ion electrode materials
  - '*Safevolt*' higher energy anodes with new graphene-silicon and alloy materials
  - '*Sodium*' sodium-ion battery technology for 12v replacement automotive applications.
- Binding collaboration agreements signed with partners including Jaguar-Land Rover, Johnson Matthey, Croda, Faradion, PV3, Cambridge University and Warwick Manufacturing Group.



## ► HIGH SILICON ANODES

Fast growing demand for Lithium ion batteries with higher energy density = longer life/range



- Growth in silicon loading driven by demand for higher energy density, particularly China NEV credits and national energy plans\*



- A silicon anode can provide ~10 times the gravimetric energy of the standard graphite anode in a Li-ion battery.
- Companies developing or planning silicon anodes include Volkswagen, BTR, Samsung, Hitachi\*\* *however*, silicon experiences drastic volume change during charging, causing short battery life/failure.

\* China Industrial Association of Power Sources

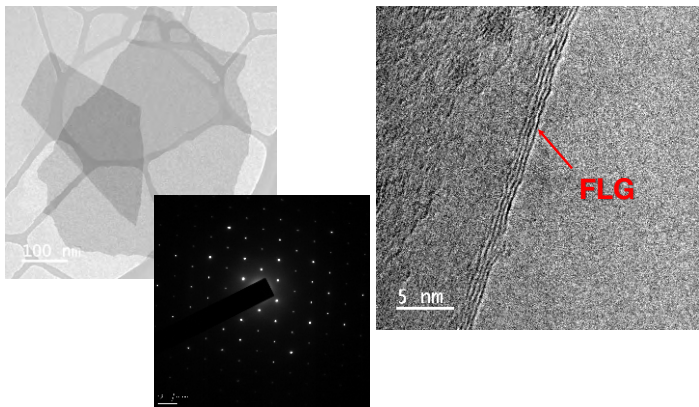
\*\* See ASX:TLG 24 October, 2018

## ► HIGHER SILICON ENABLED BY GRAPHENE

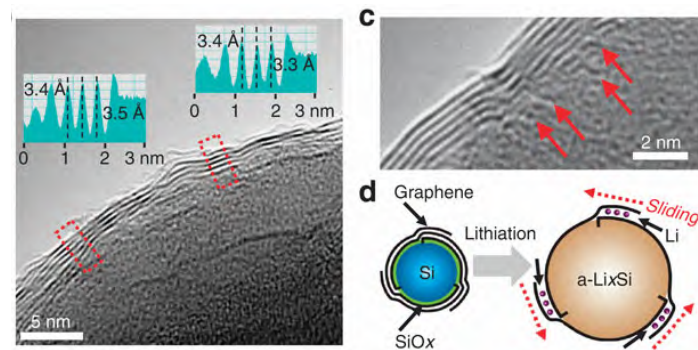
The solution to effectively higher silicon loadings may be graphene

- In some commercial Li-ion batteries (for example: BTR, Panasonic, Hitachi, Maxell among others), small amounts of silicon are already added to the carbon anode to enhance cell energy, but higher levels are hindered.
- Samsung has patented and is marketing a solution with graphene shells around silicon<sup>1</sup>
- Goldman Sachs estimate an Rmb6.3bn (US\$0.9bn) addressable market by 2025 for graphene in batteries<sup>2</sup>

### TALGA GRAPHENE



### SAMSUNG GRAPHENE COATED SILICON



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

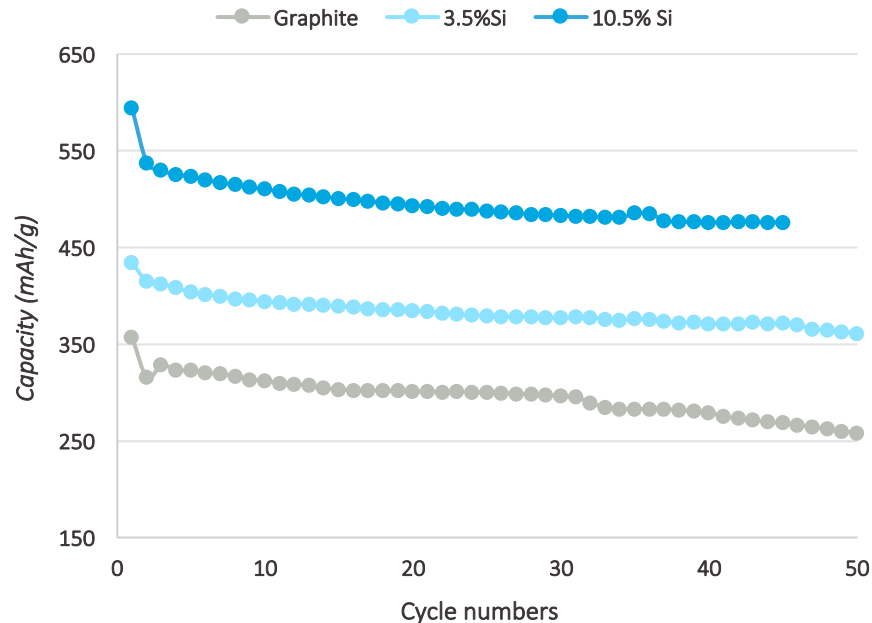
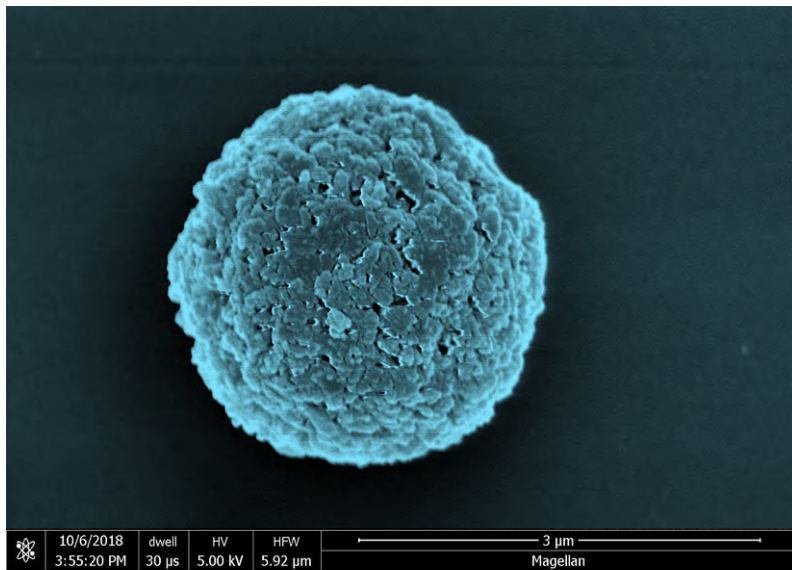
<sup>2</sup> Source "Chinas Battery Challenge; A New Solution", Goldman Sachs Feb 2017



## TALNODE™ SILICON

Under Faraday 'Safevolt' project Talga is developing high capacity silicon anode using Talphene® graphene

- ▶ ~50% higher reversible capacity compared to commercial graphite\*
- ▶ Coloumbic efficiency of 99.3% – 99.8%
- ▶ 95% reversible capacity (after 45 cycles - cycling tests ongoing)



\* See ASX:TLG 24 October, 2018

## ► CONCLUSIONS AND NEXT STEPS

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

- Test results show potential for Talga to produce high performance battery materials enabled by its unique;
  - ore type
  - processing technology
  - anode material technology
- Deep in house capability and technology sets Talga apart and enables potential to enter higher value chain.
- Battery anode products are complementary to, and can be produced alongside, graphene products.
- Recent meetings in Asia confirm outlook for demand of Talga target anode products:  
1 - high capacity 2 - fast-charge and 3 - silicon anodes.
- Options for production of large scale batches of commercial samples/prototypes in 2019 using currently mined material being reviewed.
- Talga energy storage team relocated to Maxwell Centre of Cambridge University, UK. Further product development and testing underway at leading independent facilities in Europe and Asia. Preparation and despatch of samples underway.
- Battery market development and studies underway to potentially incorporate battery anode production into the current Vittangi project pre-feasibility studies now due in Q1 2019.

## CONTACT US

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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 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.

# ▶ 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

## 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 Resource<sup>1</sup> (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 <sup>2</sup> 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.