ASX: TLG

# TALGA RESOURCES

A Path to Industrial Scale Graphene Supply and Commercialisation

Graphene Malaysia 2017

10 July 2017 | Kuala Lumpur





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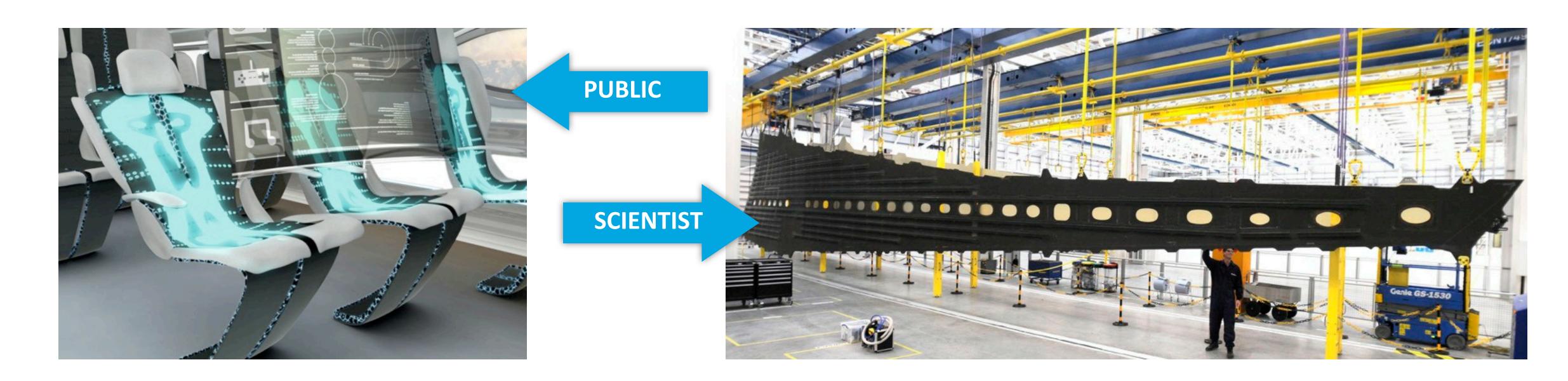
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#### INTRODUCTION



# "Planes will be made from the wonder material graphene in 10 years" Richard Branson

- Graphene is rarely, by itself, a product per se
- Technical community knows this, but some of public (including stakeholders) are still confused
- There is no 'killer app' for graphene so far, nor does there need to be one
- Talga's industrial scale graphene manufacture is all about creating *additives* that enhance existing materials



#### TALGA OPPORTUNITY



Technology minerals company commercialising the worlds highest grade natural graphite project to mass produce graphene and related products



- Own 100% of a unique and large graphite source in tier 1 mining and technology materials destination Sweden
- ▶ Mining doesn't require drilling or blasting of ore 100% owned processing technology
- Not constrained to one market big value proposition to remove a supply and pricing bottleneck across multiple large markets
- Business model revolves around making real world products perform better and with new functionality today
- End users currently validating the products and strategy to deliver business case
- Talga's markets totally different to flake graphite players with exception of batteries
- ▶ Talga is doing it now, not just talking about it

#### **CORPORATE SNAPSHOT**



#### FINANCIAL INFORMATION

Share price (ASX code TLG) (07-July-17)	A\$0.63
52 week low / high	A\$0.24/ A\$0.92
Shares outstanding <sup>1,2</sup>	202.4m
Market Capitalisation	A\$127.5m
Cash (30-Jun-17)	A\$16.3m
Debt (30-Jun-17)	Nil
Enterprise value	A\$111.2m

Source: IRESS, company filings. As at 07 July 2017.

1 Excludes 44.9m listed options (TLGOA) with exercise price A\$0.45 and expiring 31 Dec 2018

2 Excludes 30.7m unlisted options (mostly employees and directors) with exercise price range A\$0.35-A\$1.00 and expiry date range 4 Oct 2018 to 17 Dec 2020

#### **SHARE PRICE PERFORMANCE**

Share price (A\$) 12 months

Volume (m)

50.90

50.80

50.70

50.60

50.50

50.40

50.30

50.20

#### **MAJOR SHAREHOLDERS**

Smedvig - Scandinavian based family office	12.6%
Mark Thompson - Managing Director	7.0%
Pelmer Securities	3.8%
HSBC Custody Nominees (Australia)	3.6%
Citicorp Nominees	3.3%
Kamberg Investments	3.1%
Yandal - investment entity associated with Mark Creasy	3.0%

#### **BOARD AND MANAGEMENT**

# Substantial commercialisation experience with some of Australia's best known innovation and development projects



**Terry Stinson Non-Executive Chairman** 

Former President & CEO of Synerject LLC, and Vice President Manufacturing of Fortune 500 company, Outboard Marine

Current Managing Director and CEO of Orbital Corp (ASX: OEC)



**Mark Thompson Managing Director** 

Founder and former Director of Catalyst Metals (ASX: CYL), Current Non-Executive Director of POZ Minerals (ASX: POZ)

Member of Australian Institute of Geoscientists and the Society of Economic Geologists



**Grant Mooney Non-Executive Director** 

Current Director of Carnegie Energy (ASX: CCE), Barra Resources (ASX: BAR) and POZ Minerals (ASX: POZ)

Wealth of senior management experience in resources and technology markets



**Steve Lowe** 

**Non-Executive Director** 

Current business manager for Creasy Group and Non-Executive Director of Coziron Resources (ASX: CZR)

Former Chairman and Non-Executive Director of Sirius Resources (formerly ASX: SIR)



Managed the manufacturing division of the outboard marine propulsion products for a privately held US\$1bn multinational.



Oversaw the evolution of Carnegie Wave Energy from 2008 as it developed innovative renewable energy solutions in Australia.



Oversaw the company during the discovery and development of one of the largest Cu/Ni discoveries in Australia in the last 30 years.



Managed the company from 2000 to 2002 including the introduction of several new sales products.



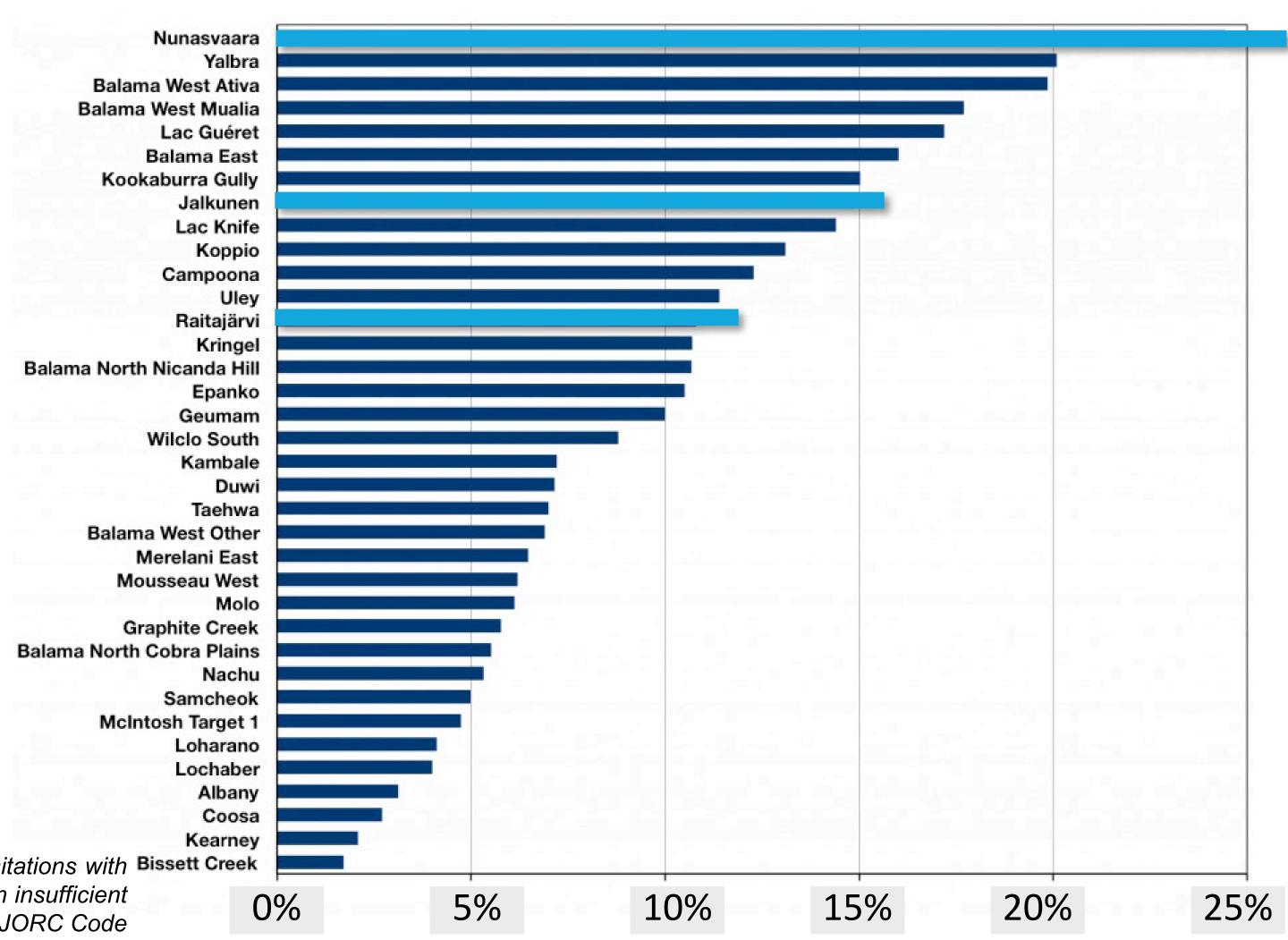
Has led Orbital since 2008 and successfully secured a breakthrough deal with Insitu Inc. (Boeing) for the supply of global unmanned aerial vehicle propulsion systems worth up to A\$120m over a 3 year period.

#### **TALGA OWNS 3 OF THE WORLD'S TOP 10 GRAPHITE RESOURCES\***

Talga has pipeline of high grade graphite deposits where nature has paid for the crystallising of the carbon

- Largest graphite resources in Europe
- Lower eco-footprint than standard deposits and close to exisiting infrastructure in safe Tier 1 investment destination - Sweden
- Focus is on margins and massive natural or technical advantage, not resource tonnes for tonnes sake

Average Grade of Graphite Resource (graphitic carbon C%)



Note: The Exploration Target is based on a number of assumptions and limitations with Bissett Creek 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.

#### WHAT IS GRAPHENE?



Graphene is an extraordinary material whose commercialisation pathway has been constrained only by volume and cost of production, not applications.



- Graphene is the thinnest substance ever made atomic layers of crystalline carbon which constitute graphite
- When small particles of graphene are used as an additive (mixed into a material) it can impart superior strength, lightness, conductivity or enhance functionality
- But technical specification is less relevant than how it works in a product
- Once standards or performance demonstrated, industry wants production volume reality, repeatability and a sustainable long term source with a 'clean' supply chain

#### **TALGA OPERATIONS**



#### Vertically integrated operations provide economic advantages

#### 1. Upstream

#### Source

- ▶ 100%-owned graphite project near Kiruna in Northern Sweden
- World's highest grade graphite resource (JORC/NI43-101)
- Unique ore able to be used directly as anode in electrochemical exfoliation process

#### 2. Midstream

#### **Processing**

- 100%-owned test facility in Rudolstadt, Germany
- Expanding proprietary scalable process
- Current ore treatment capacity of ~30tpa

#### 3. Downstream

#### **Product Development**

- Product development team based in Cambridge
- In-house technology and skills to create 'value-add' products
- Accelerates commercialisation process

# 11 UPSTREAM SOURCE: UNIQUE GRAPHITE ORES



#### 100%-owned upstream asset which is the world's highest grade JORC/NI43-101

graphite mineral resource

- Talga flagship Vittangi graphite project located 20km east of LKAB's iron ore mine and railhead at Svappavaara, Sweden
- World's highest grade JORC/NI43-101 compliant graphite resource, Nunasvaara
- ▶ Wide, uniform mineralisation starts at surface can support >20 year mine life and more for industrial scale production

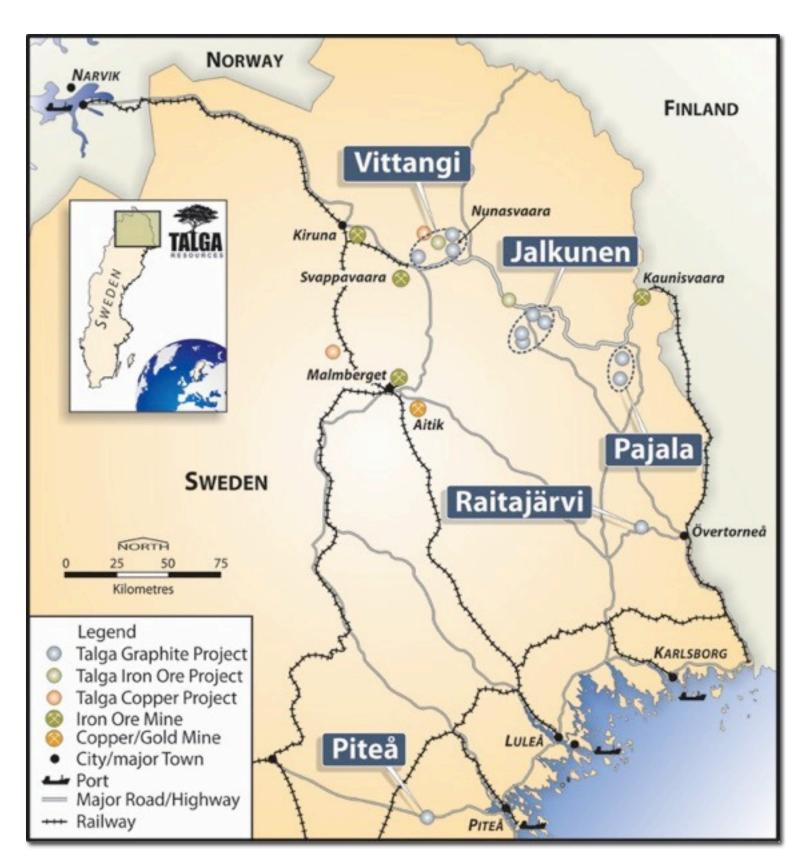
#### JORC compliant Mineral Resources

Project	Tonnes	Graphite Grade
Vittangi	9,800,000	25.3 %Cg
Jalkunen	31,500,000	14.9 %Cg
Raitajärvi	4,300,000	7.1 %Cg

#### JORC compliant Exploration Targets

0-100m Depth	Tonnes	Graphite (%Cg)
Total	136-250,000,000	18-25

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.



#### Operational progress



#### **GEOLOGY ADVANTAGE**

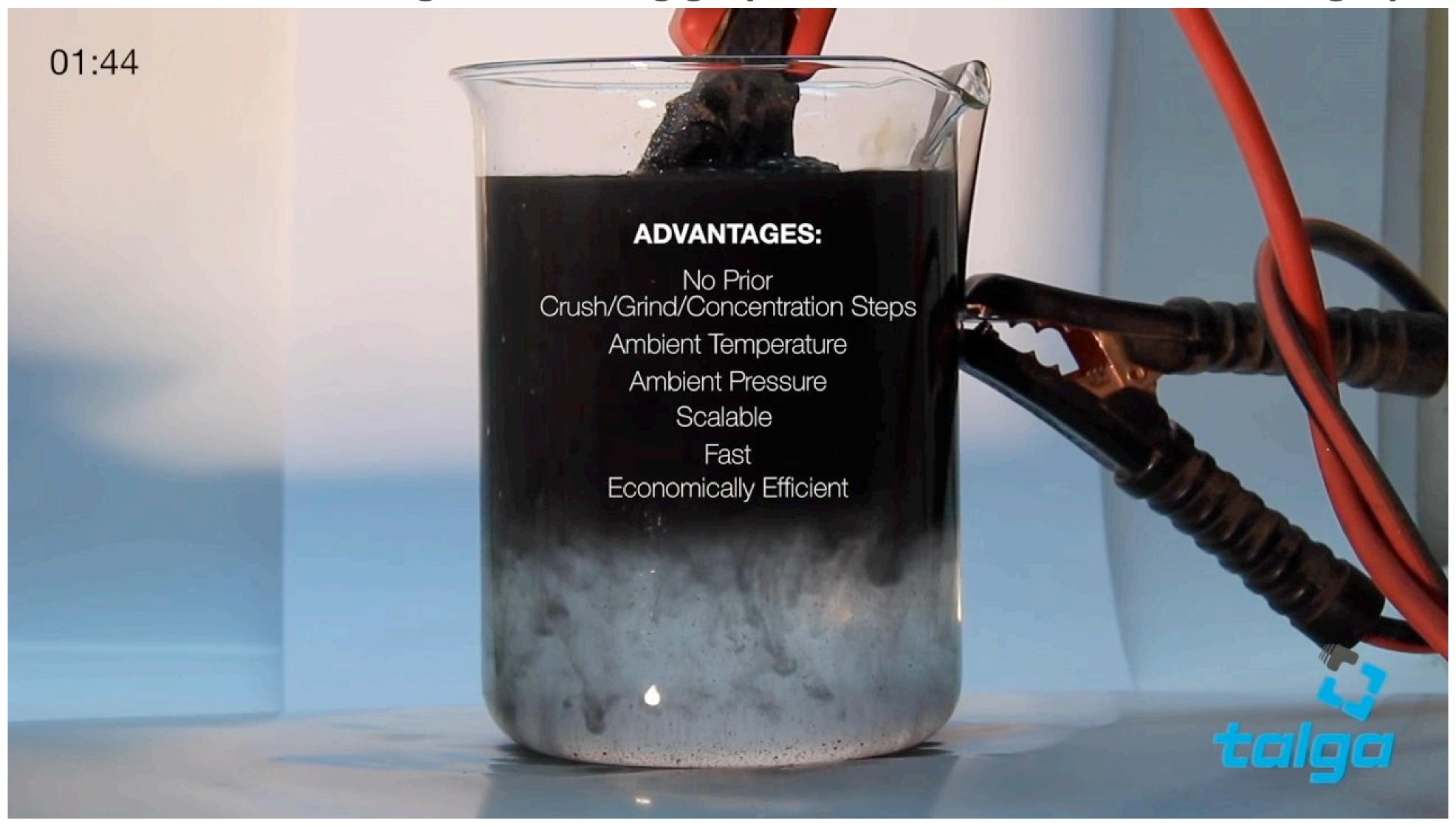


Ore blocks are conductive enough to use as electrodes without processing



# 2 MIDSTREAM: GEOLOGY MEETS TECHNOLOGY

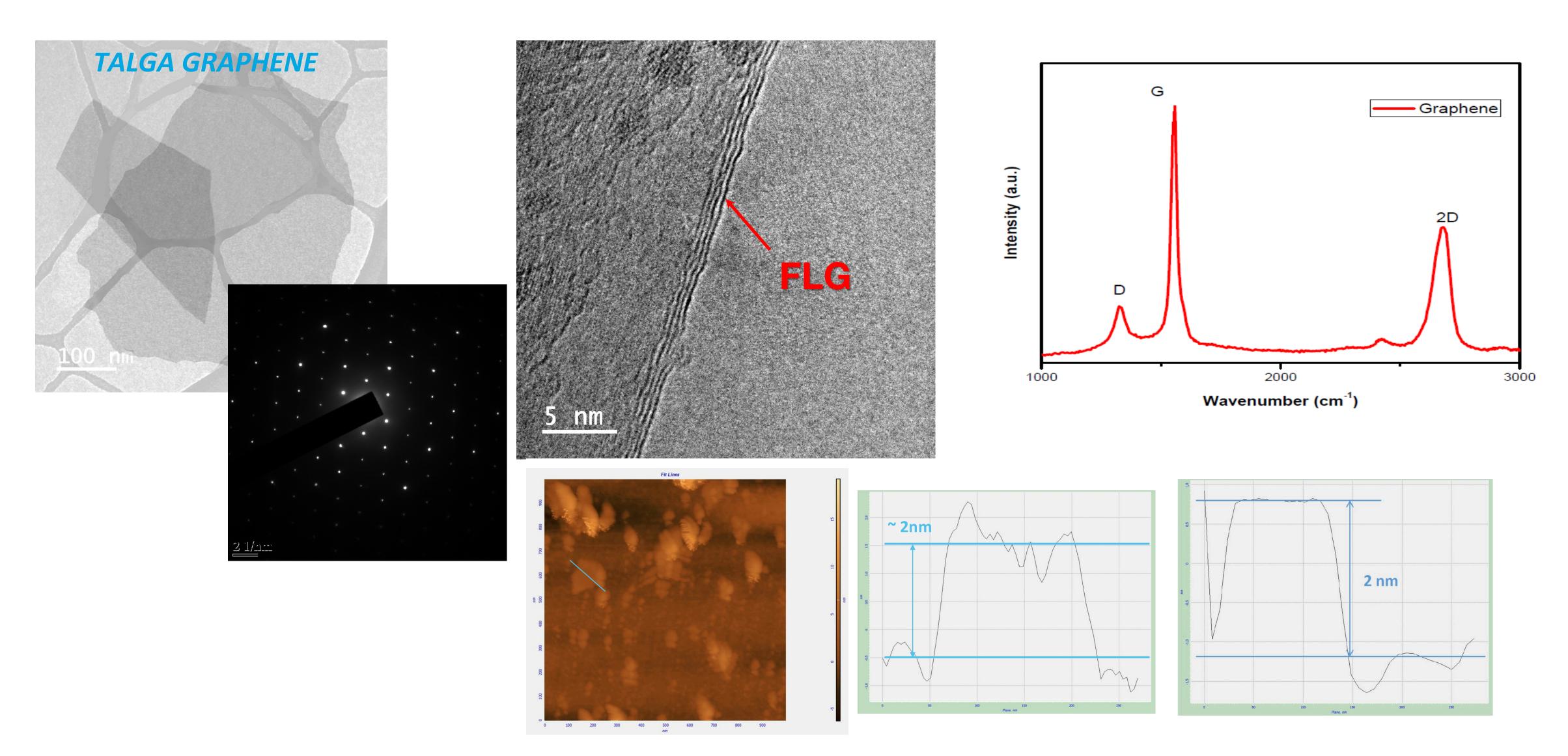
Concept demonstration of Talga exfoliating graphene direct from its Swedish graphite ore



#### QUALITY GRAPHENE FOR BULK VOLUME MARKETS



#### Multi-academic partners and institutions confirm high quality FLG for bulk volume additives



#### TALGA OPERATIONS SUMMARRY ON VIDEO





# **B** DOWNSTREAM: PRODUCT DEVELOPMENT



# Talga has in-house 'value added' product development capabilities – starts with internal prototype testing followed by external validation with end users

#### **Product Development**

- Talga's UK team, based in Cambridge, focuses on developing value-added graphene and micrographite products for key enduser markets
- Products developed by Talga are important to unlock value-add margins (as distinct from 'raw' graphite and graphene revenue)
- ▶ Talphene<sup>TM</sup>, is the brand of Talga graphene enhanced products



#### **Partners**

- Talga's product development team collaborates with industry leading partners to accelerate the commercialisation of its graphene and micrographite products
- Resources are shared and various intellectual property agreements are in place to ensure commercial protection of Talga's developments





















#### MARKET OPPORTUNITY FOR GRAPHENE



In addition to raw materials, Talga is focused on the manufacture and commercialisation of targeted products across 4 key industry sectors









#### **Construction additives**

#### **Advantages**

Improves strength, durability and impermeability

Imparts electric and thermally conductive properties

Reduces concrete used and decreases industry CO2 emissions

Enables underground power transmission cables, underfloor heating, road and bridge snow melting and de-icing

Immediate market opportunity
US\$17bn specialty concrete

# **Energy storage** (batteries)

#### **Advantages**

Enables higher performance and lower cost Li-ion, flow and alkaline batteries.

Flexible, printable batteries for 'Internet of Things' and 'Wearable' devices

Lower toxic footprint by enabling water-based battery chemistry

Lower cost fuel cells

#### Immediate market opportunity

US\$24bn battery market

# Talphene<sup>™</sup> enhanced coatings

#### **Advantages**

Eco-friendly alternative to toxic chromium based coatings

Lower cost and superior performance with reduction in zinc, copper, phosphate, zirconia

Corrosion protection increased by up to 74% for mild steel

Eco-friendly marine anti-fouling

#### **Immediate market opportunity**

US\$22bn corrosion protection sector within global US\$120bn

# Carbon fibre composites/resins

#### **Advantages**

Stronger and lighter epoxy resin systems for carbon fibre and polymer composites

Enables lightning strike protection and EM shielding in carbon fibre planes and EV's

Replaces copper heating elements/wires to reduce weight of EV's

#### **Immediate market opportunity**

US\$18bn composites sector

#### STRATEGY IN ACTION: ROADMAP FOR COATING PRODUCTS

Talga's most advanced product development highlights the Company's ability to execute on its strategy of targeting large end users and securing commercialisation agreements

Academic **Validation** 

**Prototype** Developed

IP **Protection** 

Peer Review **Industry Partner** / Validate Price

**Product** Development















Validation of technology in R&D program at **Indian Institute** of Technology in Bombay

> Complete (July 2016)

#### **PROTOTYPE**

Few layered graphene used to develop coatings formulation that marries with end user chemistry

> Complete (Aug 2016)

#### **TALPHENE**<sup>TM</sup>

Formulation IP protected with patent pending. Trademarks for marketing

> Complete (Aug 2016)

#### FlatChem

Peer review study of Talga's anti-corrosion coating published in FlatChem journal

> Complete (Sep 2016)

#### Chemetall expect more •

Joint dev & commercialisation agreement with leading German coatings subsidiary of BASF

> Complete (Mar 2017)

#### **CURRENT WORK PROGRAM**

Preparation of functionalised formulations for incorporation with Chemetall products and testing for commercialisation

> **Underway** (May 2017)

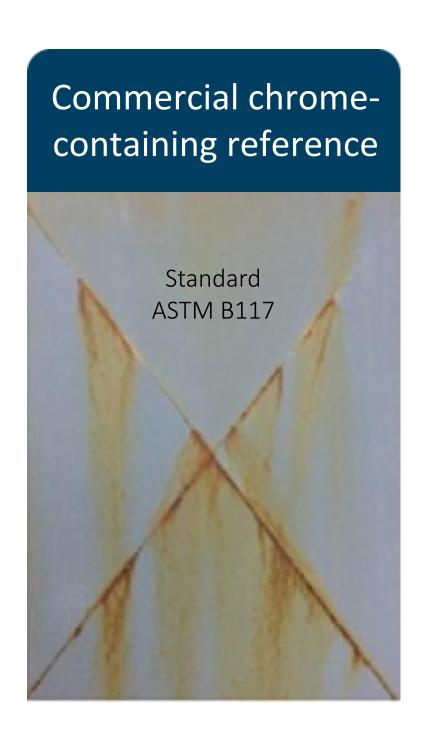
#### **COATING PRODUCT - ANTI CORROSION**

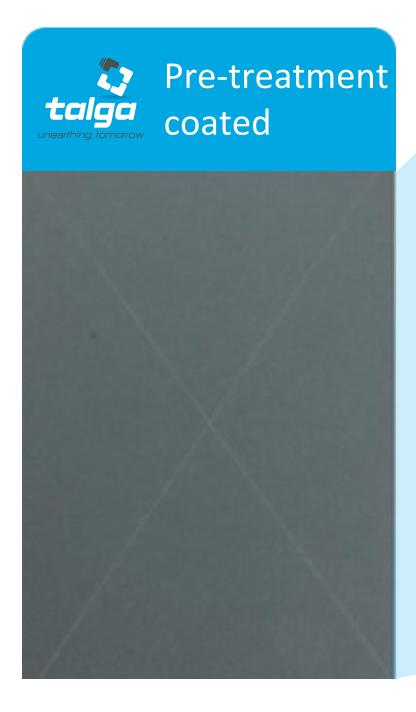


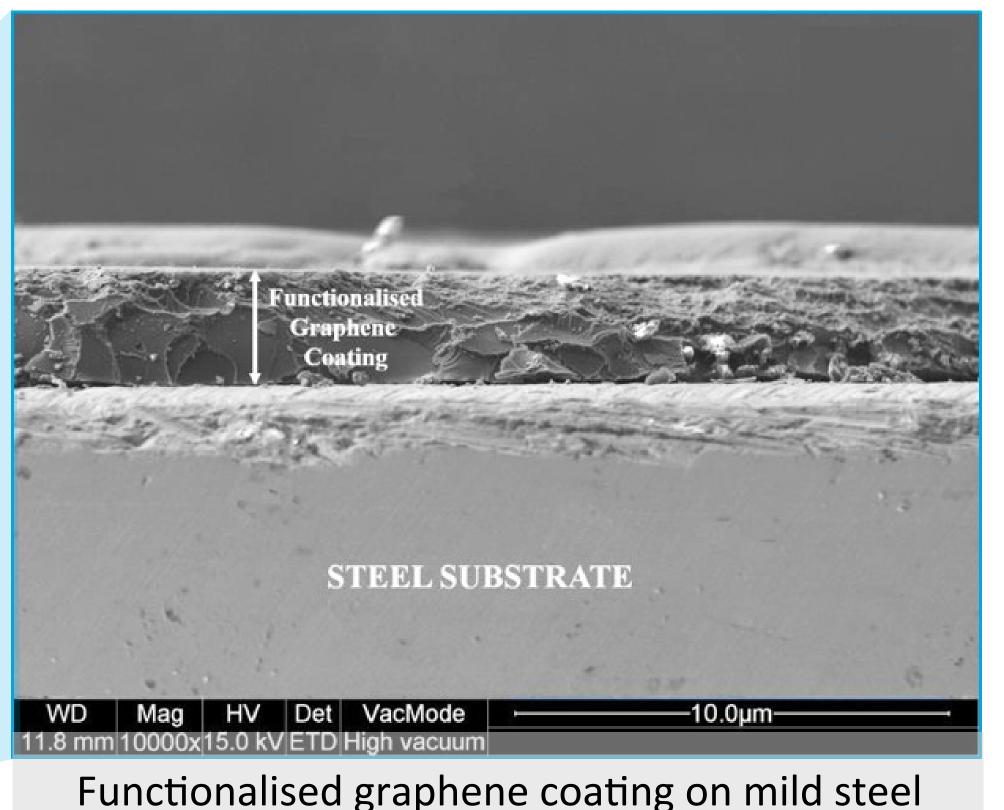
In ASTM-standard salt exposure tests Talga graphene formulation improves performance over chrome-containing reference



After 1,500hrs accelerated corrosion (salt spray)





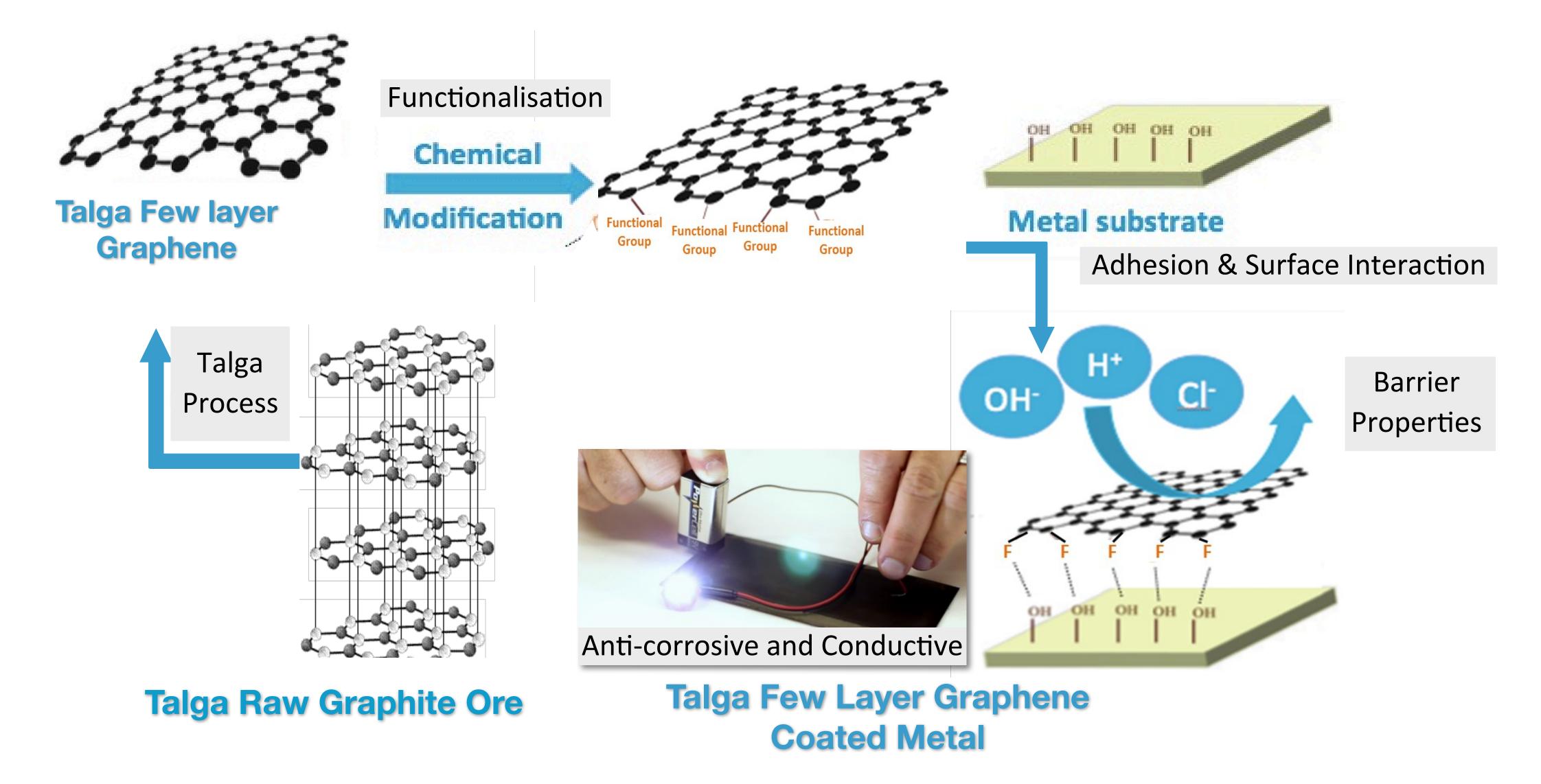


Functionalised graphene coating on mild steel

#### **COATING PRODUCTS - TALGA TECHNOLOGY**



#### In ASTM-standard salt exposure tests Talga graphene formulation



#### **COATINGS PRODUCT DEAL - CHEMETALL**



Talga is advancing higher performance coatings with graphene as eco-friendly alternative to chromium, zinc and copper for giant global coatings market

- Joint Development Agreement ("JDA") with Chemetall, a global business unit of **BASF** Coatings Division, to co-develop and commercialise grapheneenhanced coatings
- Aim for eco-friendly, high performance, corrosion resistant surface treatments (estimated addressable market size c. USD\$10.4B)

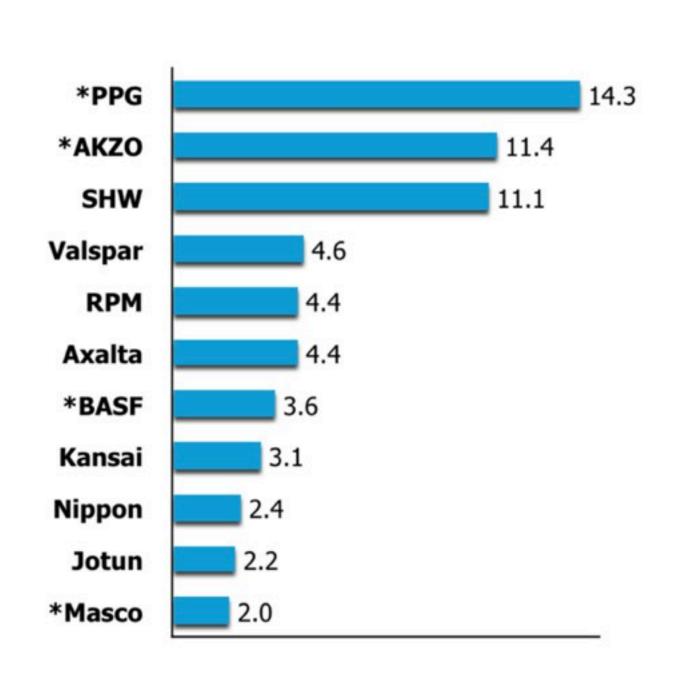


Disclosable terms to the Agreement:

- 2 year product development phase
- •5 year exclusive graphene supply arrangement

Paints and Coatings Market Leaders US\$/annum.

#### Global Leaders by Sales (\$Billion)



Source: Jan 2016 Valspar Investor Presentation & Company reports. \* Excludes non-coating sales

#### ENERGY PRODUCTS – LITHIUM ION BATTERIES



Talga is positioning to supply higher performance/lower cost conductive additives and materials for Li-ion, flow and alkaline batteries with more eco-friendly manufacturing

#### ROLL-TO-ROLL MANUFACTURE OF LI-ION BATTERY ELECTRODES





#### **Global market**

Li-ion market growing rapidly with government legislation and consumer trend to eco-friendly power and transport

#### Talga micrographite

and GNP's in Li-ion batteries requires less harmful processing steps

#### Targeting improved

Li-ion with less toxic eco-impacts by enabling water-based chemistry and lower manufacturing inputs

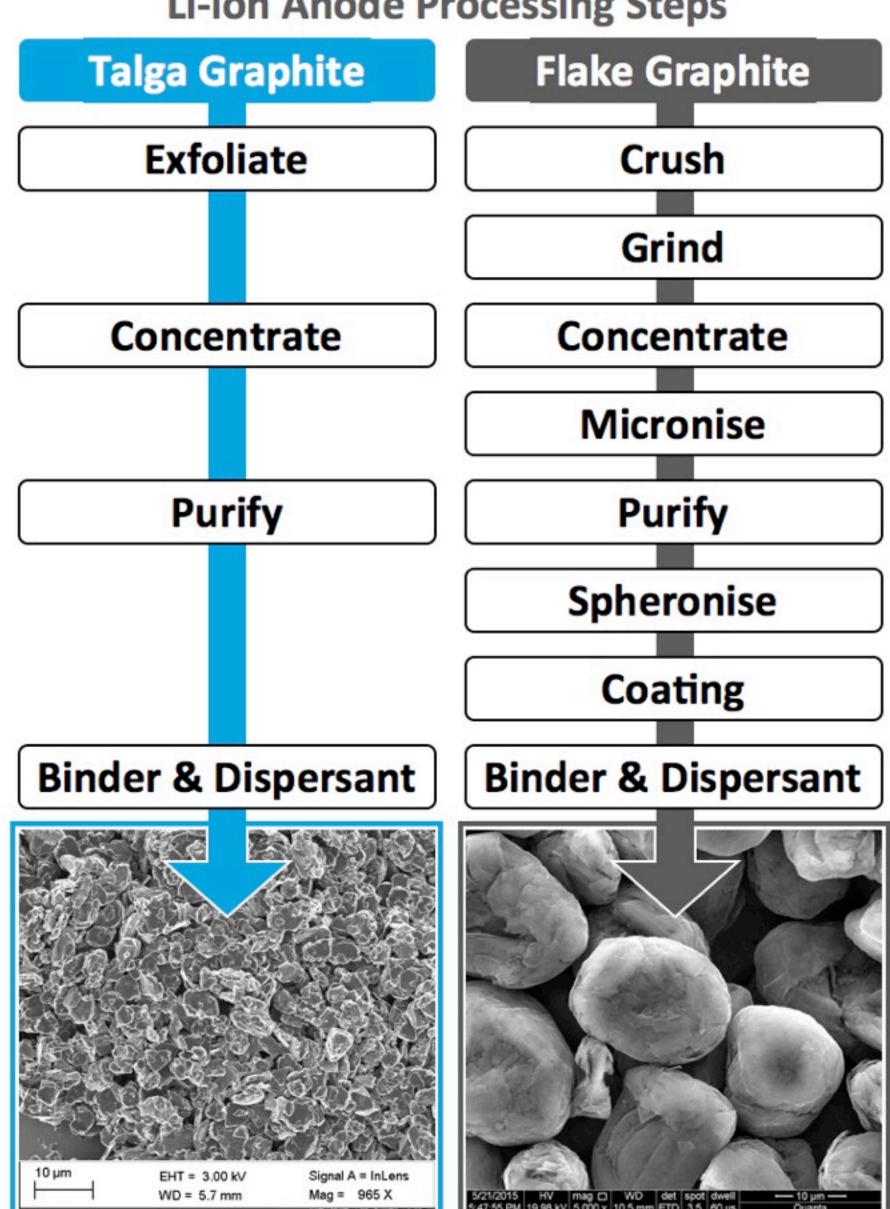
#### **Industrial style**

Li-ion 'pouch' cell testwork and commercial-style roll to roll anode formulations underway

#### **Test programs**

for new-gen Li-ion batteries to be pursued

#### **Li-ion Anode Processing Steps**



Talga anode capacity

420 mAh/g

Peer anode capacity

360 mAh/g

#### PROCESS ADVANTAGE - BATTERIES

Talga's patent pending technology liberates conductive material from raw graphite ore, skipping processing steps required by peers

higher performance with less manufacturing steps = lower eco-impact



**Unmilled** Talga graphite shows promising results of 420mAh/g, higher capacity than graphite theoretical limit 372mAh/g

**Excellent stability** with 99.9% coulombic efficiency and low capacity loss (reversible capacity >99.5%)

Graphene is more conductive than graphite, enabling faster charging and longer life cycle, and will play a large role in batteries going forward.

Goldman Sachs estimate an Rmb6.3bn (US\$0.9bn) addressable market by 2025 for graphene in batteries



### **ENERGY PRODUCTS —** PRINTED BATTERIES

Talga is co-developing supply of graphene conductive inks for electrodes in the world's thinnest, flexible printed batteries

ZINERGY PROTOTYPE **ULTRA-THIN FLEXIBLE BATTERY** 

Joint development agreement with Zinergy

The market for flexible, light weight, and often disposable but eco-friendly batteries is growing rapidly

Flexible form and ultra-low weight, smart packaging, portable electronics, wearables and sensors

The global thin film electronics market estimated to be USD\$29.3 billion

Thermal concrete in underground power line application

#### **CONSTRUCTION PRODUCTS - CONCRETE**

Talga's successful trial of thermally conductive concrete shows promise with a fast growing and potentially bulk volume market



**Graphene** added to concrete enables electrical or thermal conductivity



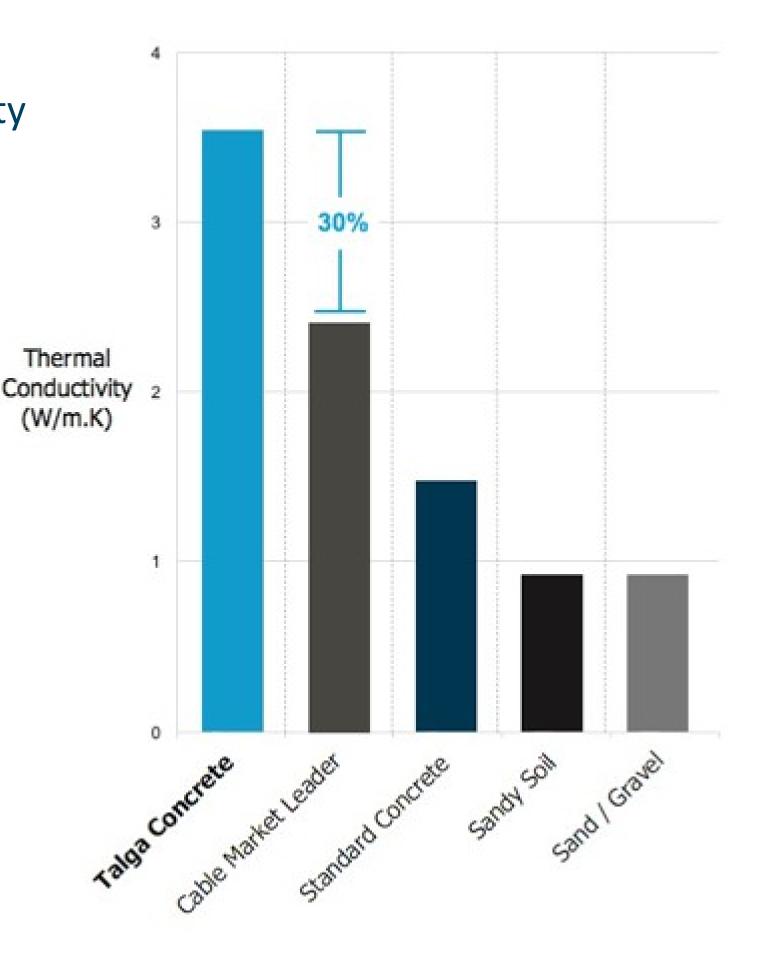
**Applications**: powerline heat dissipation, underfloor heating, ice-free road-bridge-tarmac areas



German government plans upgrades to >7,500 kilometres of high voltage electric power lines



**30%** more thermal conductivity than market leader



# High strength concrete bridge, Sweden

# Concrete graphene mix

#### **CONSTRUCTION PRODUCTS - CONCRETE**

#### High strength concrete



Graphene added to concrete improves strength



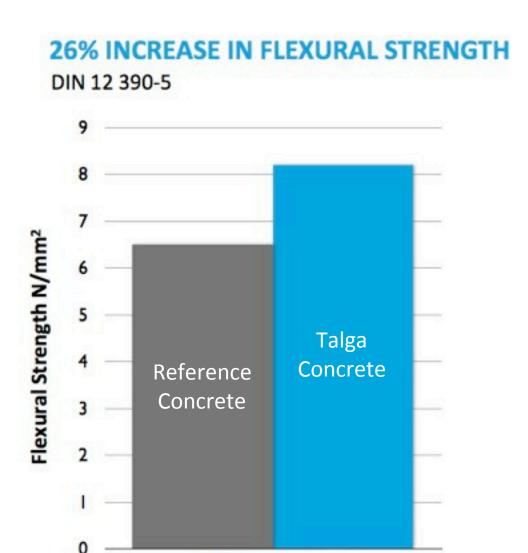
**Applications** include high rise buildings, road and rail infrastructure



**Urbanisation** and requirements for lower volume/lower emissions is driving demand



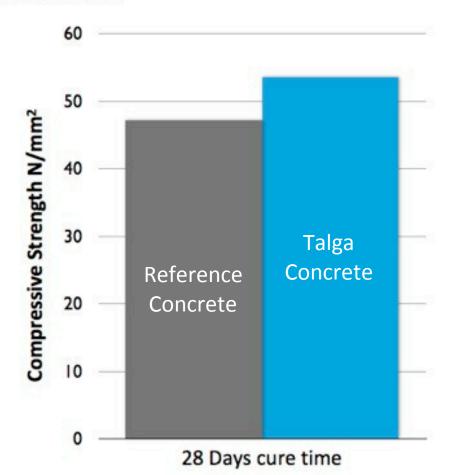
Strengthens concrete at **low loadings** so can be lower cost in some applications



#### 14% INCREASE IN COMPRESSIVE STRENGTH

28 Days cure time

DIN 12 390-3



#### **COMPOSITES PRODUCTS**



#### Stronger epoxy resins for carbon fibre composites also marine paint coatings



- Graphene additives are demonstrated to make epoxy resin systems stronger, lighter or more functional (conductive)
- Epoxy resins is used to make carbon fibre composites, a lightweight material widely used in aerospace, automotive and wind turbine sectors
- Current market looking for less weight (for less fuel use in planes)
   plus conductivity (for lightning protection, de-icing or EM shielding)
- Anti-fouling marine coatings market is looking for new epoxy based paint coatings amid growing environmental legislation against currently used toxic metals and chemicals
- Emerging markets in textiles, plastic and fibres for 'wearable' technologies & 3-D printing
- Talga prototype tests are underway

#### STRONGER, LIGHTER, FURTHER



Talga's opportunity to deploy graphene in EV's is larger than just batteries Lighter vehicles have increased range, a key point of both efficiency and marketing/sales



#### **SUMMARY - TALGA OPPORTUNITY**



#### Technology minerals company commercialising mass produced graphene and products

#### Potential best-margin,

large-volume supplier of graphene and Substantial commercialisation experience

#### Rapidly transitioning

towards monetisation, maiden revenues in 2017

World's highest grade

graphite resource

**SCALE GRAPHENE PARTNER** 

In-house product development collaborating with industry majors

Uniquely placed

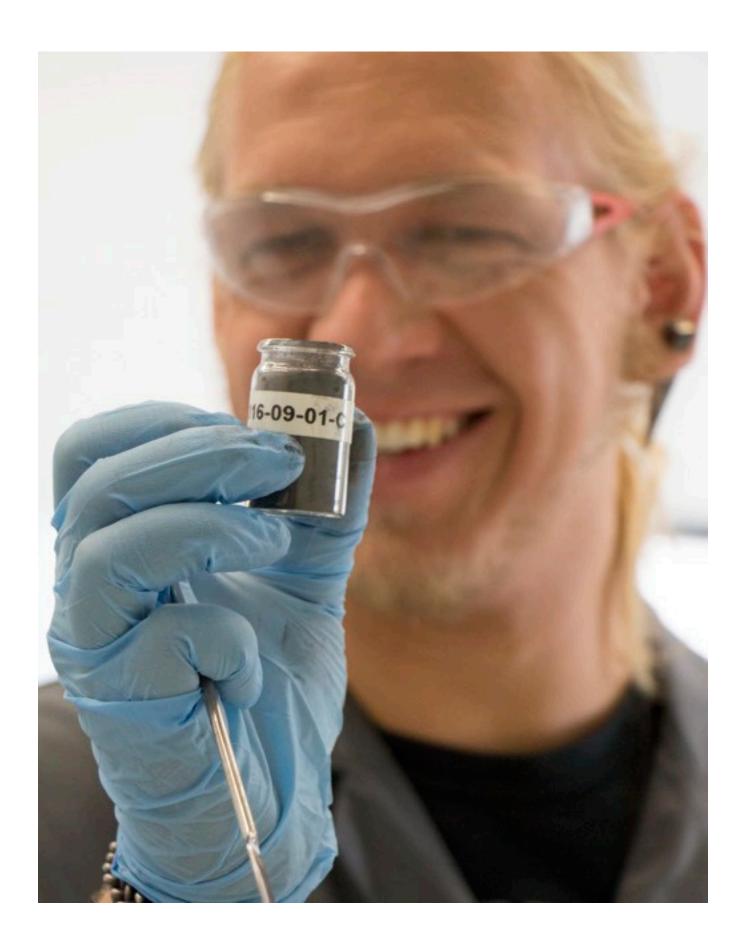
to own graphene supply chain

Formal agreements

with well-capitalised commercialisation partners

# COMPANY DIRECTORY

Talga Resources Ltd has subsidiaries in UK, Sweden and Germany



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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 Jalkuen 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 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	<i>25.5</i>

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 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 <sup>2</sup> 0-100m Depth

Project	Exploration Target	Tonnes (0-100m Vertical Depth)			cg)
		Min.	Max.	Min.	Max.
	Nunasvaara	62,400,000	93,600,000	20	30
Vittangi	Kotajärvi	16,640,000	30,160,000	20	25
	Maltosrova	20,800,000	52,000,000	20	25
	Tiankijokki	2,600,000	5,200,000	15	25
	Nybrännan	5,200,000	10,400,000	20	30
Jalkunen	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

<sup>1</sup> 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.

<sup>2</sup> 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.