

**Talga Resources Ltd**  
**ASX:TLG**  
**Presentation**

**Innovative process for large scale production of high  
quality graphene**

*DECHEMA Gesellschaft für Chemische  
Technik und Biotechnologie e.V.*

*Frankfurt Feb 2016*

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- ▶ World's **highest grade graphite** resource<sup>#</sup> - 100% owned
- ▶ World first **processing technology**
- ▶ Commercial **scalability** not achievable by other methods or deposits
- ▶ **High quality low risk** jurisdiction - Sweden
- ▶ 100% owned **Pilot test plant** scaling up - Germany
- ▶ Entering sample supply phase in **customer development** on path to full scale production in Sweden



Talga's graphite ore is highly conductive in an unprocessed state, as demonstrated by powering an LED through the graphite ore with an AA battery.



# High Grade Graphite Pipeline

**100%** ownership of **five** graphite projects in **Sweden** containing multiple deposits offering the **full range** of market size specifications. Three JORC resource<sup>1</sup> projects in the development pipeline.



## Vittangi

JORC Resource Total **7.6Mt @ 24.4% Cg**

## Raitajärvi

JORC Resource Total **4.3Mt @ 7.1% Cg**  
(87% coarse flake size)

## Jalkunen

JORC Resource Total **31.5Mt @ 14.9% Cg**

## Pajala

Drilled flake sizes **<75µm to >400µm**

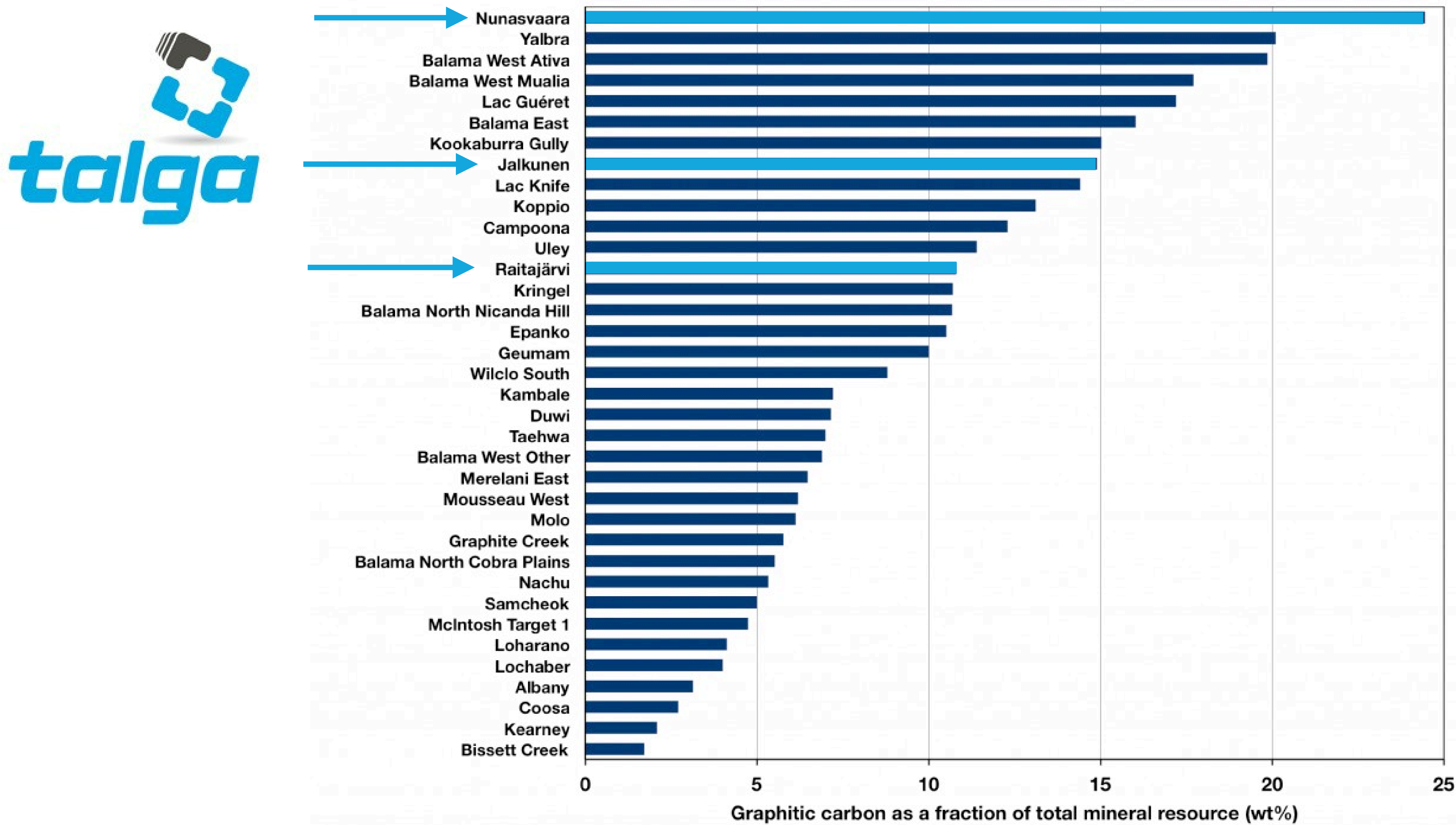
## Piteå

Drilled flake sizes **80% >300µm**

\*See Scoping Study released to ASX 9 October 2014.

# Peer Comparison: Leading Resources for Grade

Average Grade of In-situ Graphite







# Advantages of Sweden

- ▶ Established quality **infrastructure**
- ▶ **Low cost** power supply with **high renewable** energy content:
  - Hydro **67 TWh**
  - Wind **12 TWh**
  - Solar **79 MWh**
- ▶ **Low CO<sub>2</sub>** emission person/year:
  - Sweden **5.1t**
  - EU **7.9t**
  - USA **19.1t**
- ▶ **Low risk investment jurisdiction** consistently in top 10 Fraser Institute
- ▶ Rail and road **connection** to EU markets
- ▶ Mineral Production tax **0.2%**  
Corporate tax rate **22%**

*Hydroelectric power source in north Sweden*





# Talga Europe Operations



## Research, Development and Analytics

- ▶ JV Uni of Dresden/Max Planck
- ▶ Friedrich-Schiller-University Jena

## Local Industry/Potential End users

- ▶ Use research as interface



## German Operations

- Talga Advanced Materials GmbH*
- ▶ Rudolstadt Pilot test facility

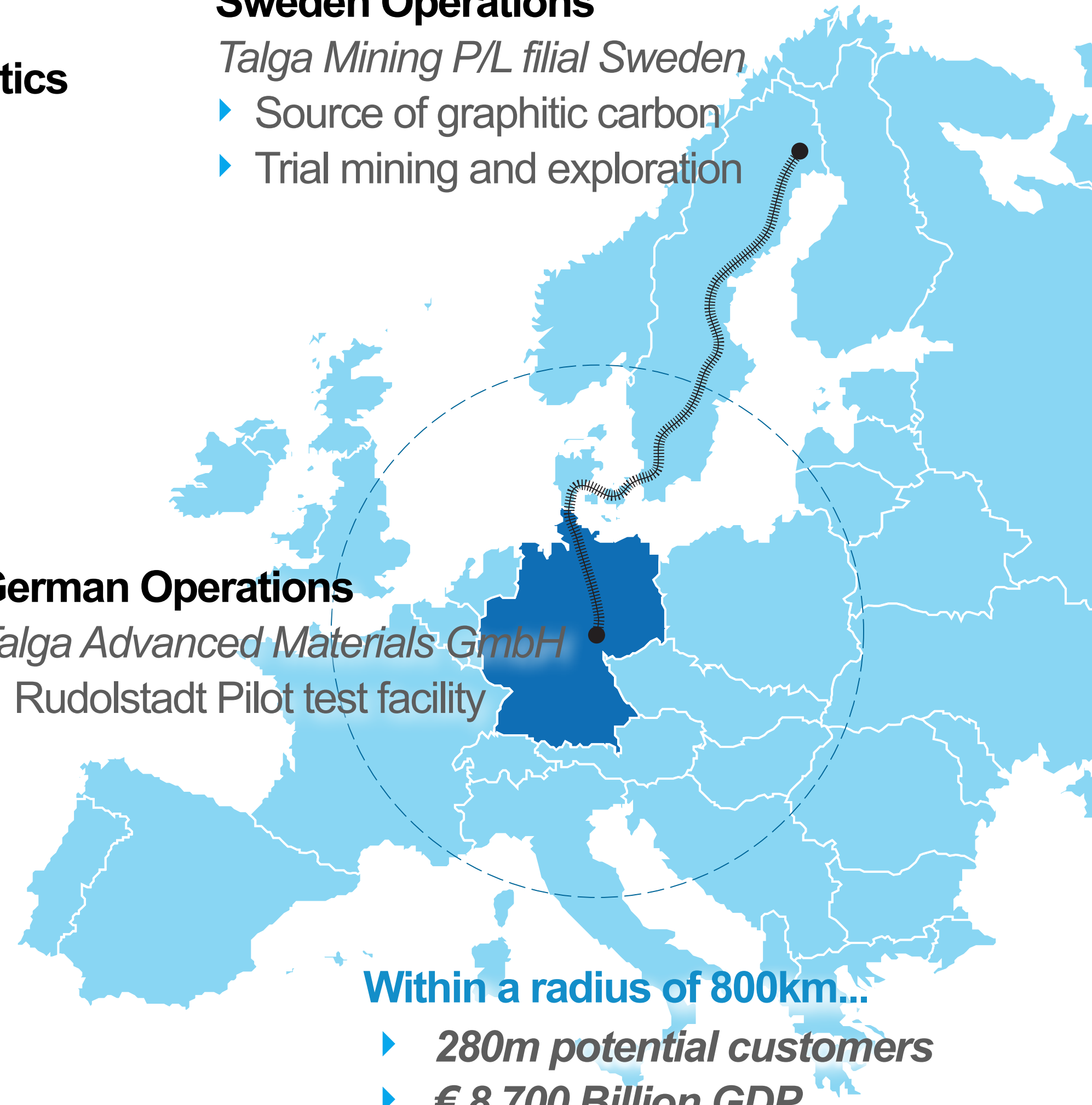
## Consultants

- ▶ General Research GmbH
- ▶ Conduit to research, industry, local finance

## Sweden Operations

*Talga Mining P/L filial Sweden*

- ▶ Source of graphitic carbon
- ▶ Trial mining and exploration

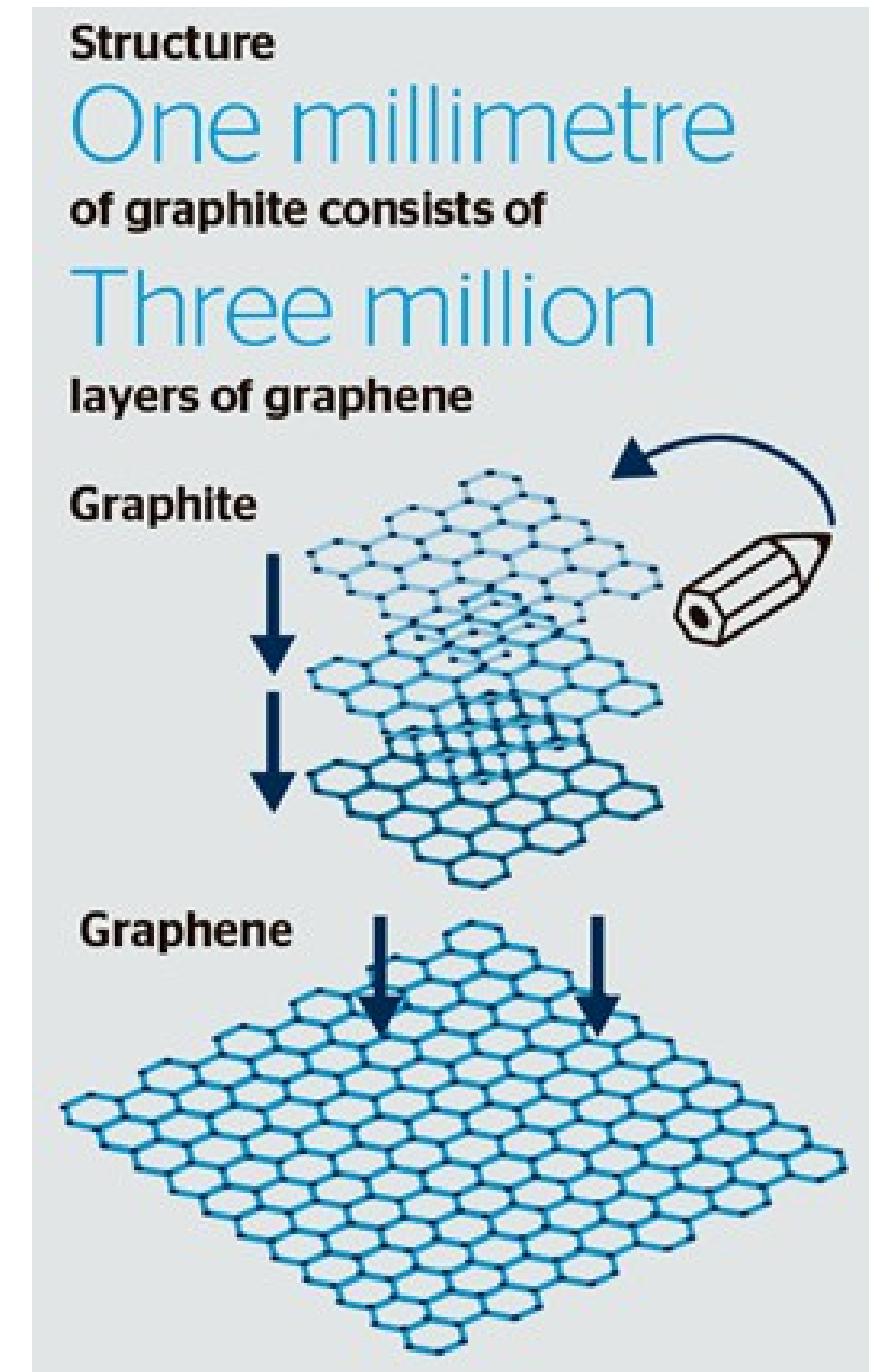


**Within a radius of 800km...**

- ▶ 280m potential customers
- ▶ € 8,700 Billion GDP

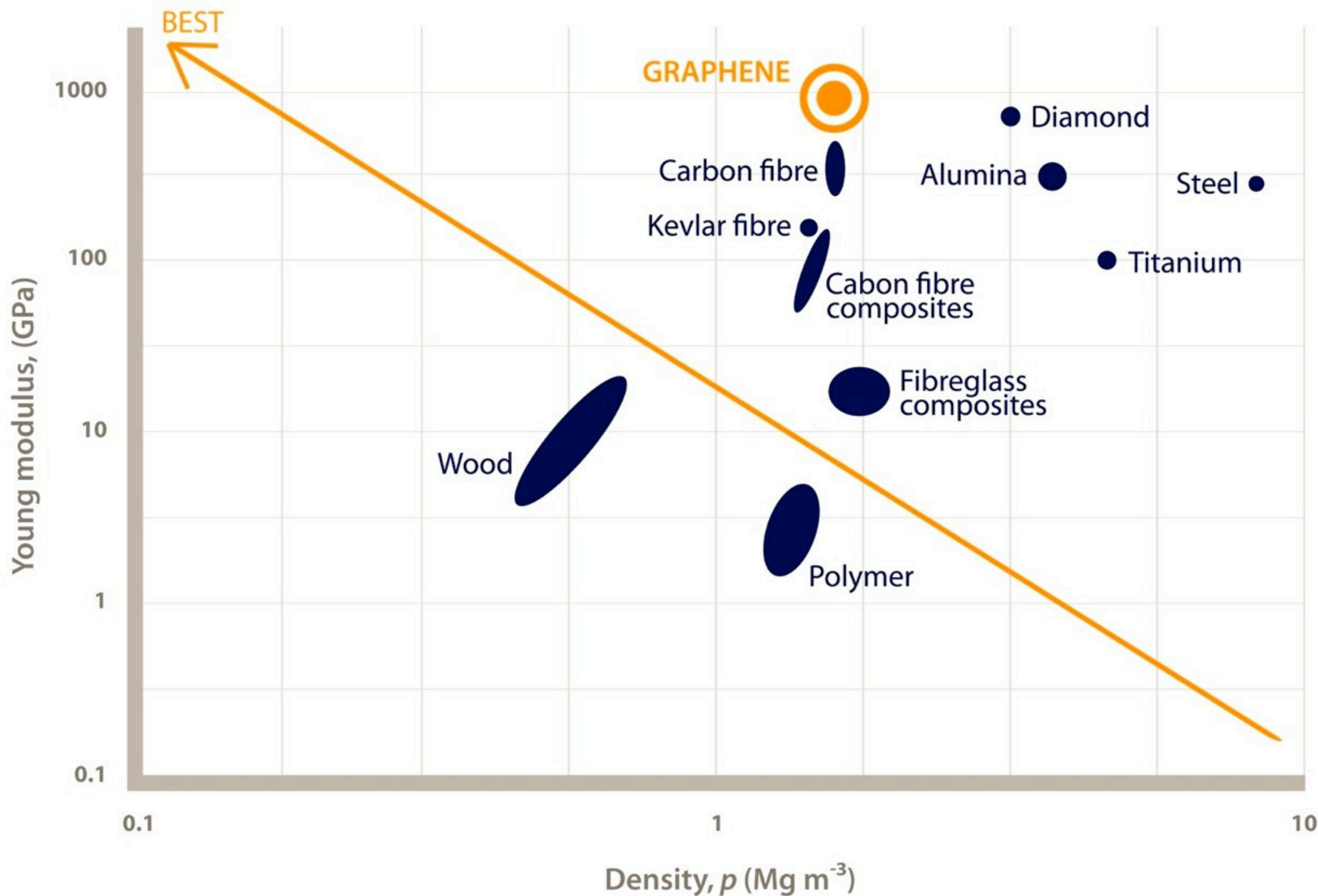
# Graphite vs Graphene?

- ▶ **Graphite** (as a natural mineral) is crystalline carbon, arranged in stacked layers.
- ▶ **1mm** of graphite contains **~3 million** layers one atom thin layers, called **graphene**.
- ▶ **Graphene** was produced for the first time 10 years ago and it is the thinnest, strongest and most impermeable and conductive known material.
- ▶ Natural graphite therefore is **already made** of graphene, but to separate graphite to graphene is very **expensive** and **hard to scale** up.





# Graphene: Light and Strong

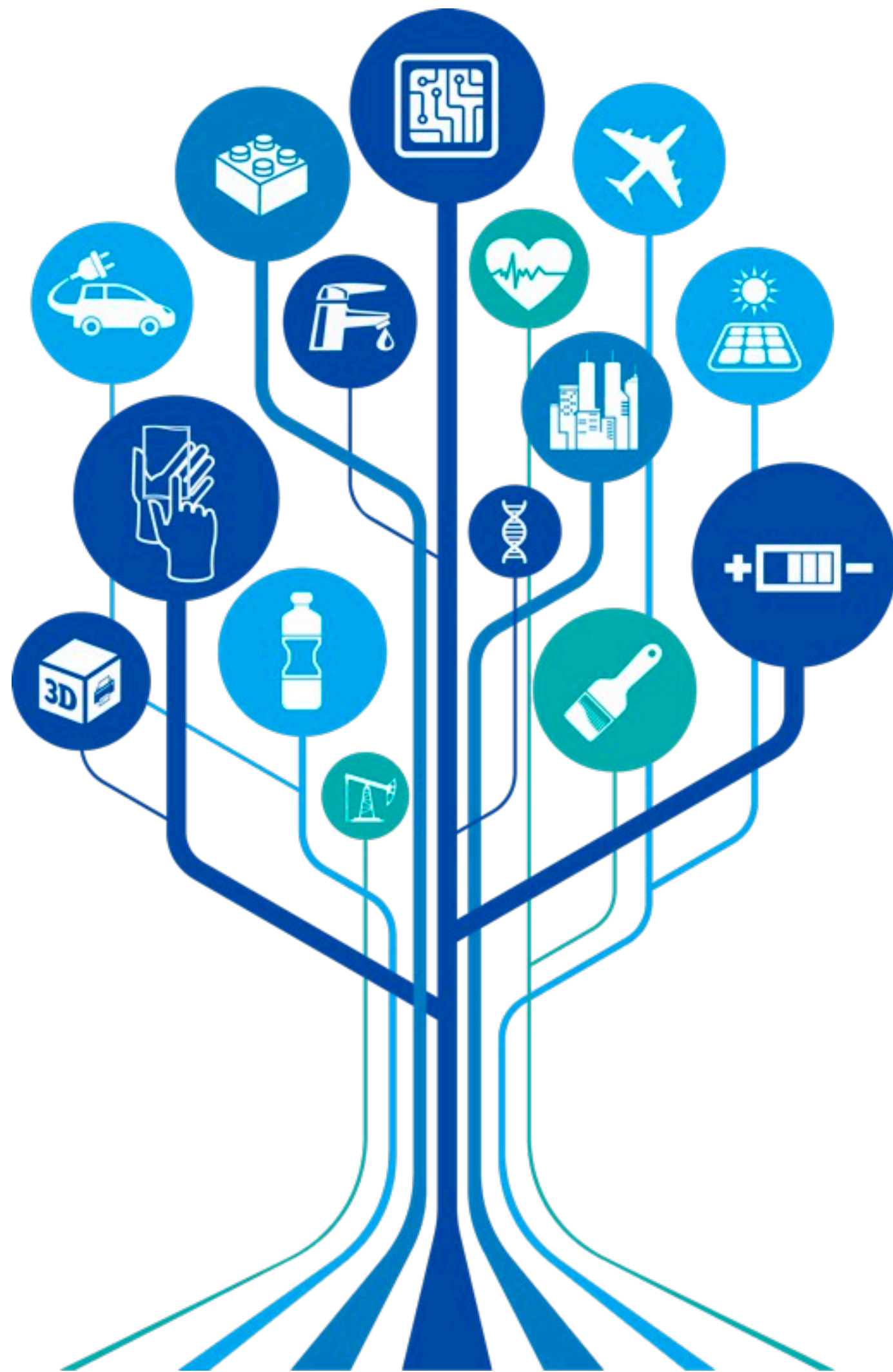


What matters for transport is stiffness per unit weight, or specific modulus :





# Graphene - Large Volume Additive Potential



Graphene's combination of best-in-class strength, electrical and thermal conductivity, impermeability, flexibility and other properties make it an exciting new additive for a wide range of industrial applications.

Among the largest existing applications by volume, graphene can be used as an additive to increase performance:

- ▶ **Paint and Coatings:** current 40 million tonne annum market forecast to reach 52 million tonnes (2017) worth \$186 billion<sup>a</sup>.
- ▶ **Cement and Concrete:** current additives market worth \$13.6B and projected to rise to \$21.2 billion in 2017.
- ▶ Also printed circuits/conductive inks, polymers for water membranes and food packaging



# Disruptive potential in anti-corrosion applications

Annual cost of corrosion worldwide estimated to be **US\$2.2 trillion**, or ~3% of global GDP\*. **Graphene** incorporated in coating systems provides an environmental friendly solution towards protection against corrosion. This may be attributed to graphene's:

- ▶ **High surface area**  
Reduces liquid permeation by increasing tortuous path effect.
- ▶ **Impermeability**  
Barrier to water, oxygen and other corrosive materials such as chloride, sulphates, etc.
- ▶ **High conductivity**  
Provides alternative path for electrons to travel, other than the metal substrate, thereby retarding the overall corrosion process.



***“The use of graphene for anticorrosive applications provides an eco-friendly and industrially scalable replacement to chromium (VI) based coatings.”***



# Graphite: do you know the cost?

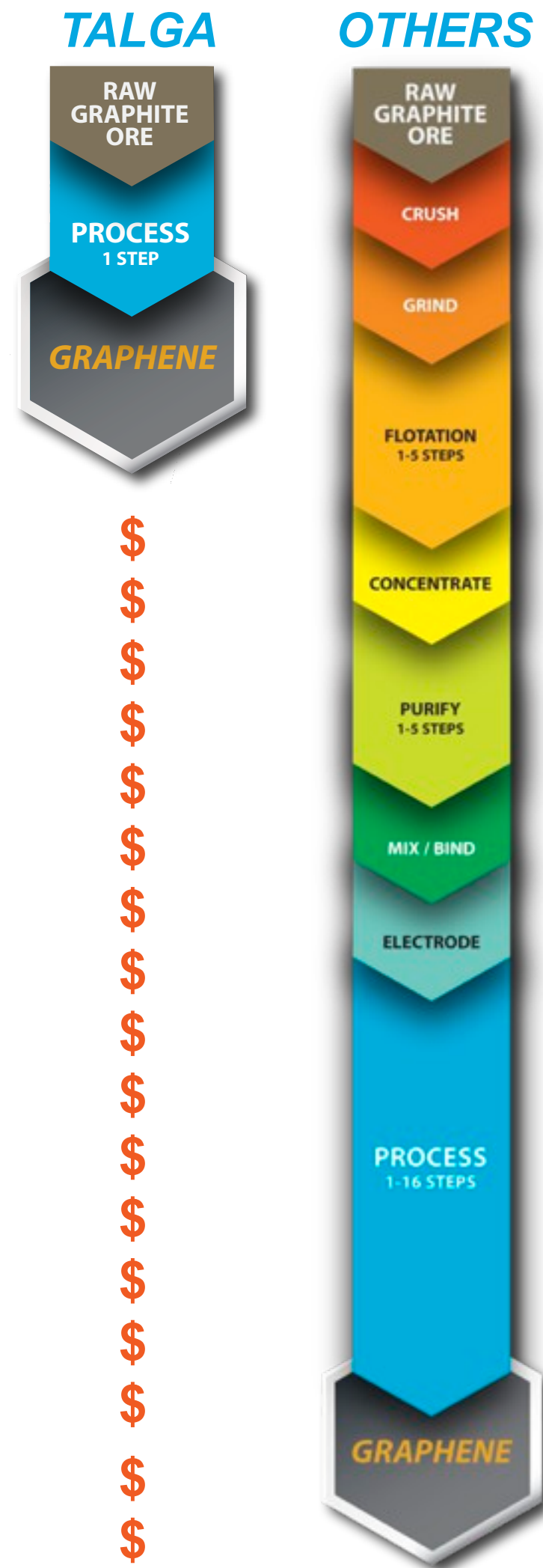
- ▶ Usually graphite ores require drill/blast mining, crushing, milling, flotation and purification stages to produce a graphite concentrate, **prior** to the start of making graphene.
- ▶ Each stage induces an environmental footprint from the energy, dust, chemicals and waste.
- ▶ The graphite is then blended from different sources and may contain impurities that differ.
- ▶ Cleaner and lower risk supply chains from consistent/homogenous sources are required.
- ▶ The **ideal** is a method that does not require so many steps and has a smaller energy, social, environmental and economic cost. Synthetic or expanded graphite is very expensive.



*Typical Graphite flake production facilities in northern China*



# Talga natural advantage



- ▶ Talga's patent pending technology uses **unprocessed raw graphite ore** directly as an **electrode** in an **electrochemical cell**.
- ▶ **The process drives molecules between the layers of graphite to liberate pristine graphene in a single stage.**
- ▶ Benefits are:
  - Industrial **Scalable**
  - **Economically** revolutionary
  - **Flexible** to produce range of products for broadest market
  - More environmentally sustainable
- ▶ Can incorporate **in-situ** functionalisation and product dispersion.



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The black particles are graphene and graphite exfoliating from the unprocessed raw ore

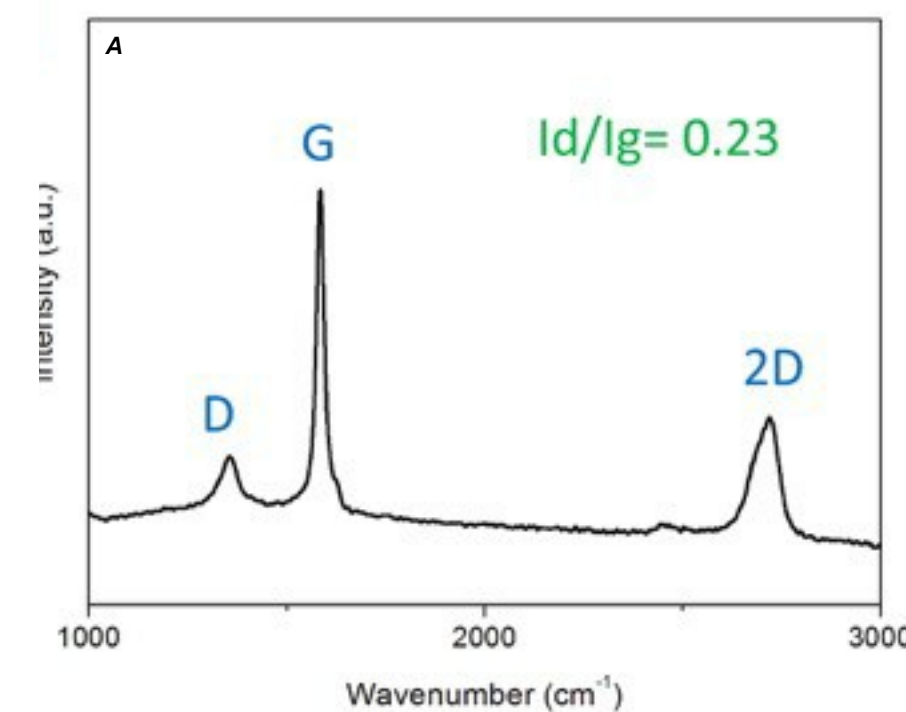




# Graphene from Talga Ore

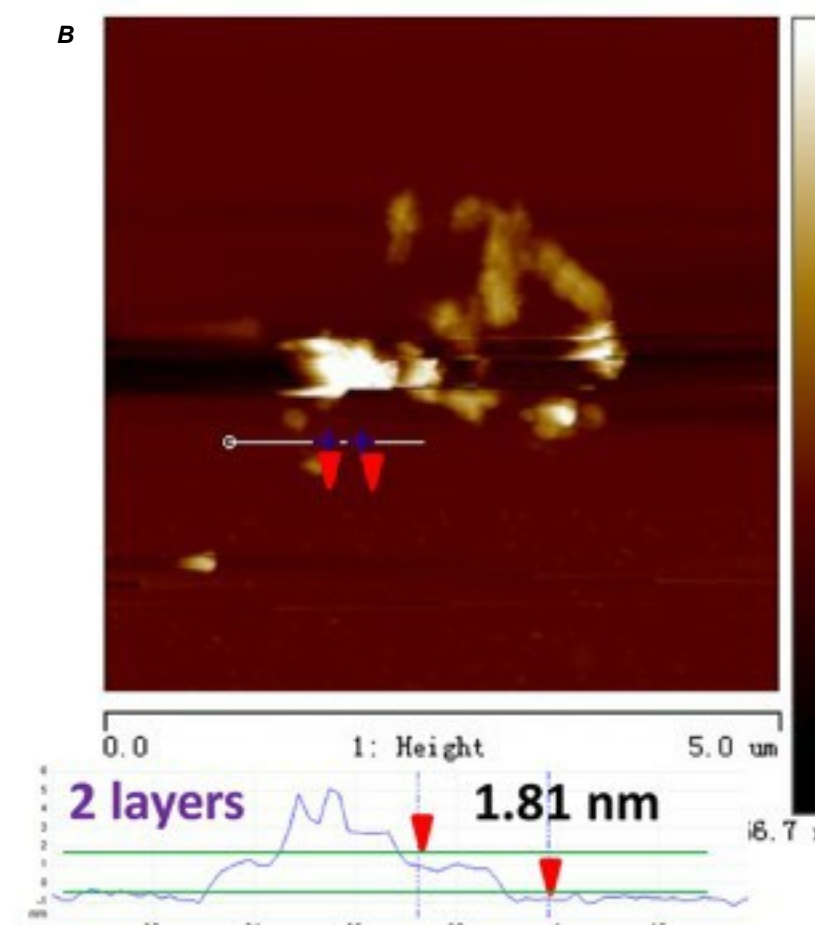
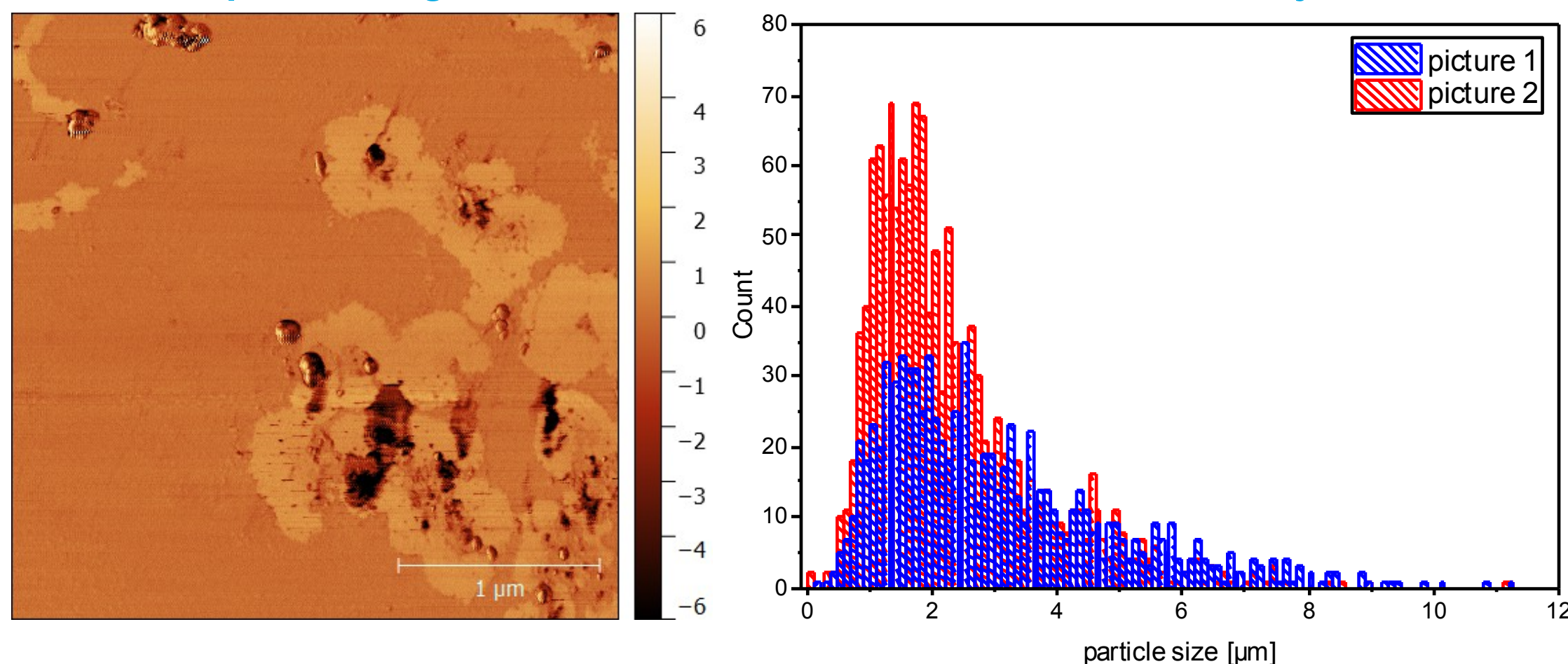
- ▶ Vittangi raw ore exfoliates directly to micro-sized graphite and graphene without crushing, grinding, milling or micronisation.
- ▶ Various studies confirm Talga's low defect graphene.
- ▶ Avoids 'Hummers' style oxidation and retains good size range for additive applications.
- ▶ Flexible process can be **optimised** for different layers/purity spec output to suit range of current and future applications.

A) Raman Spectra B) Atomic Force Microscope image  
C) Graphene powder D) Graphene dispersion



TLG Graphene Image

SEM Size Study

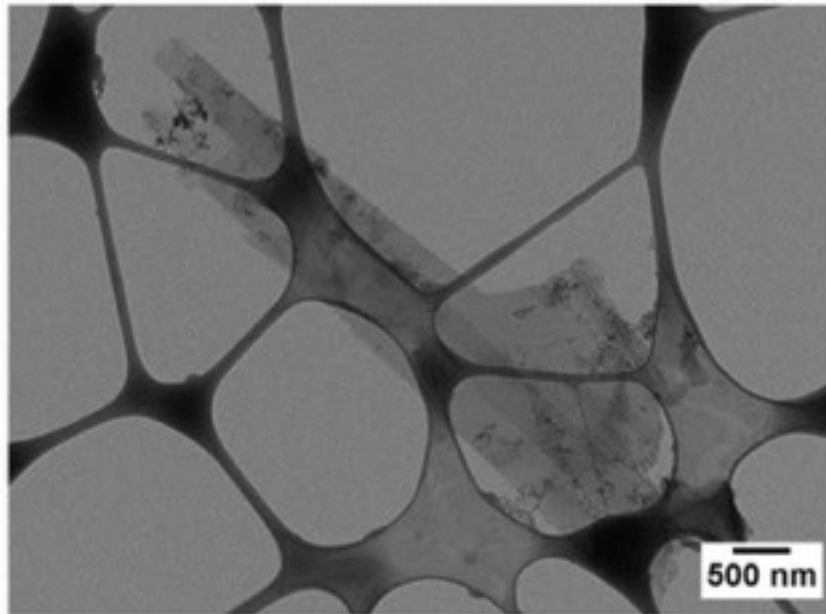
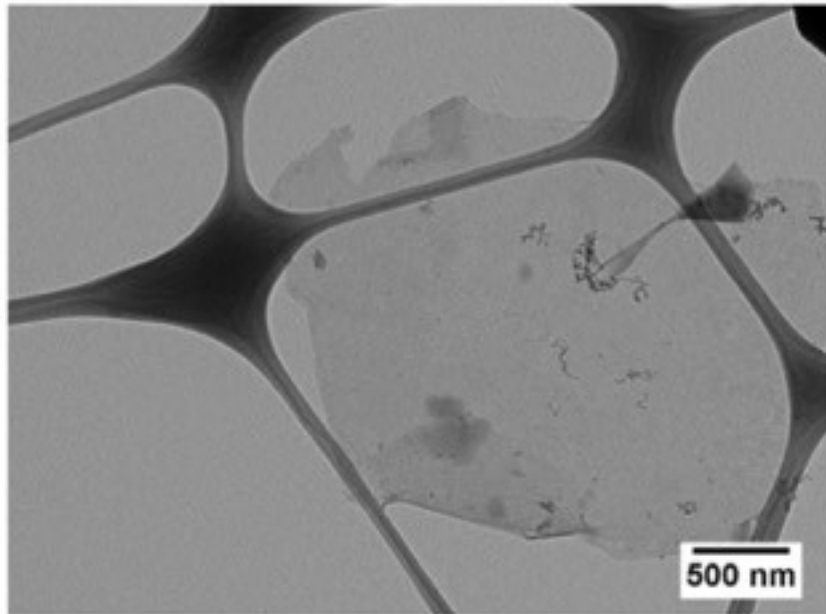
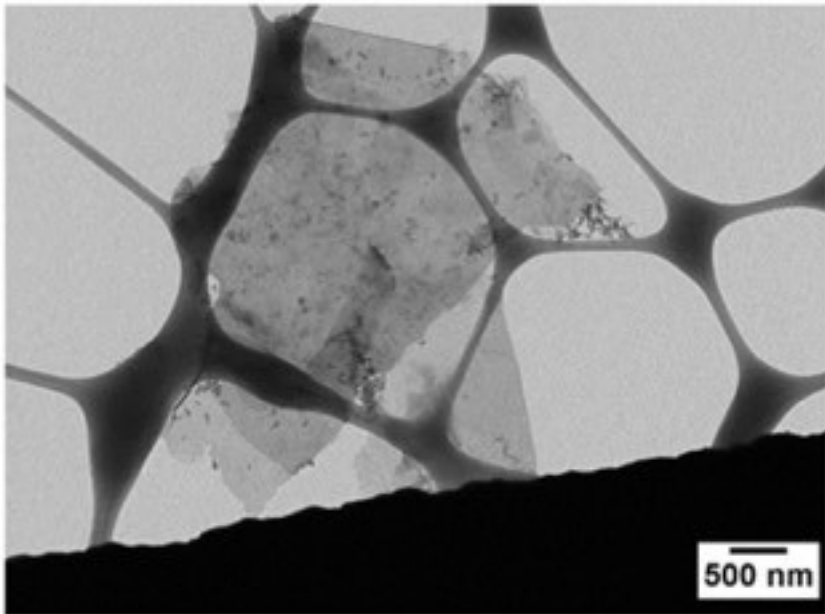
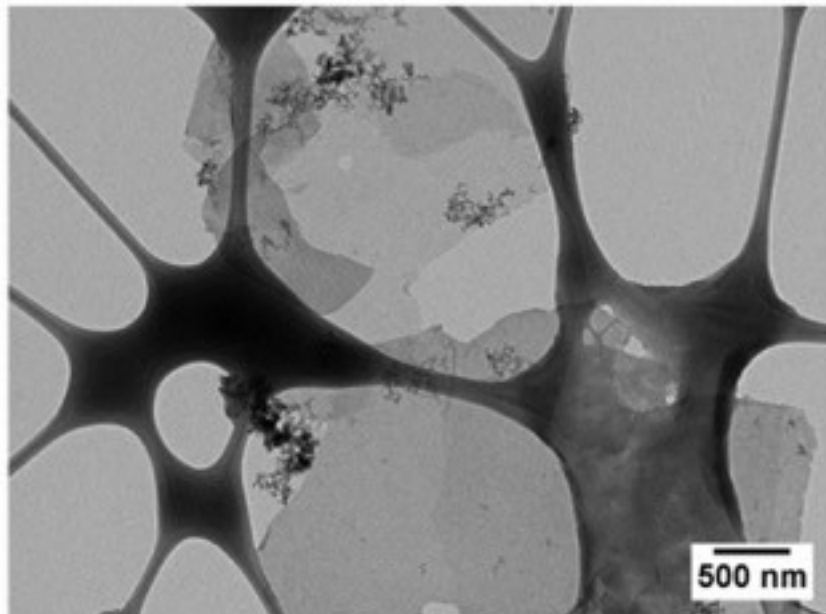
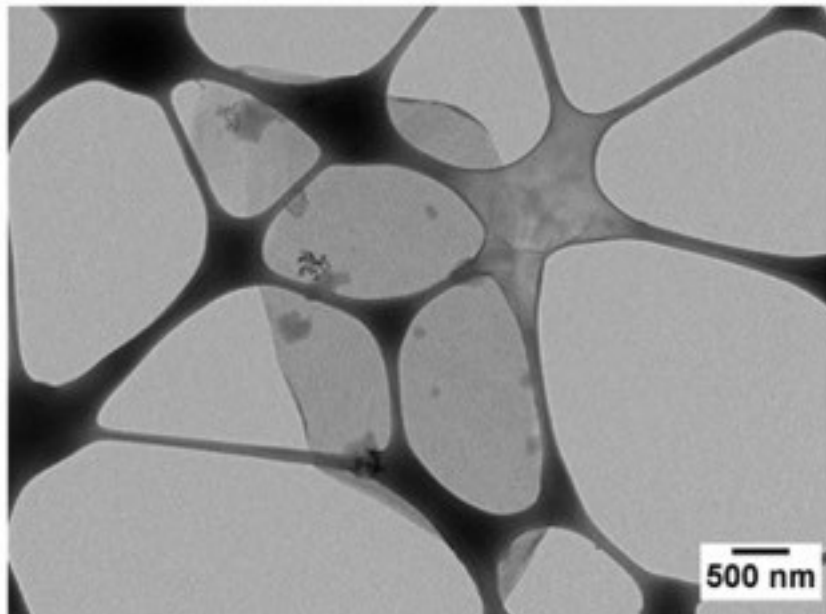
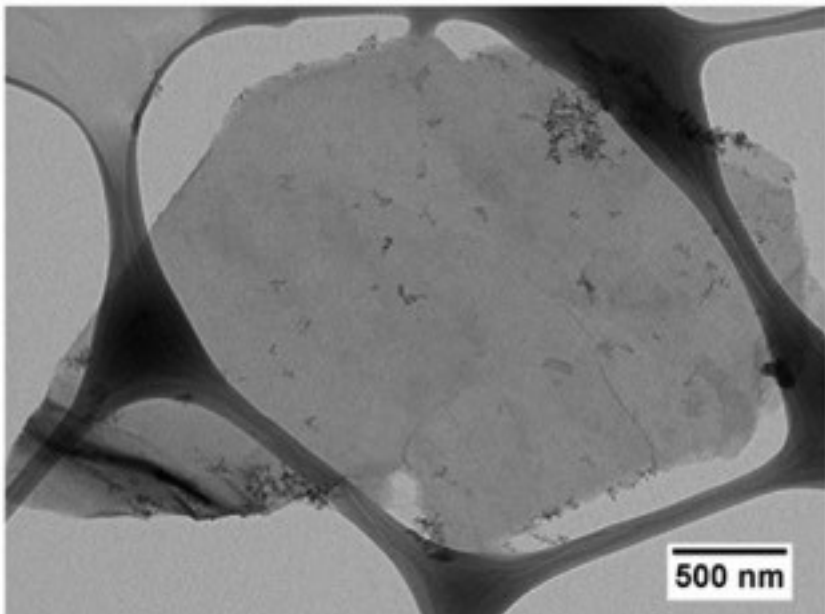
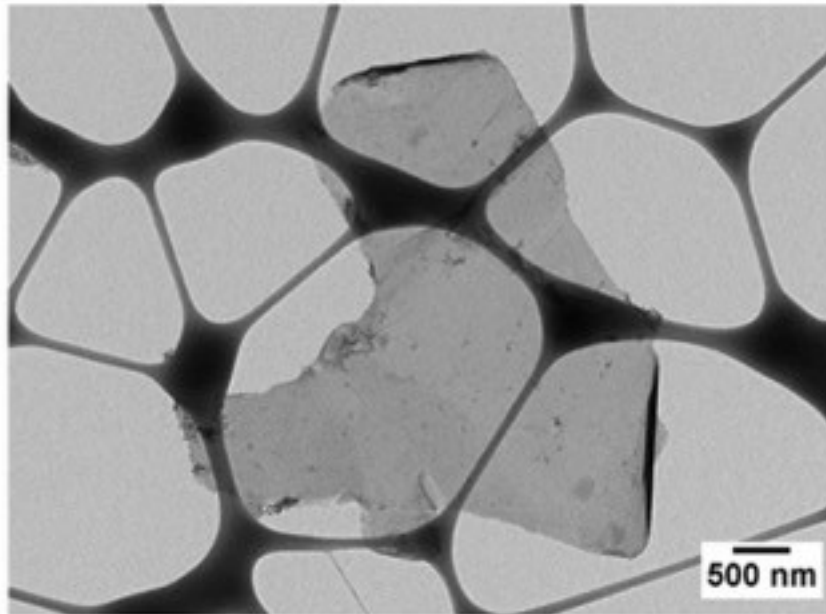
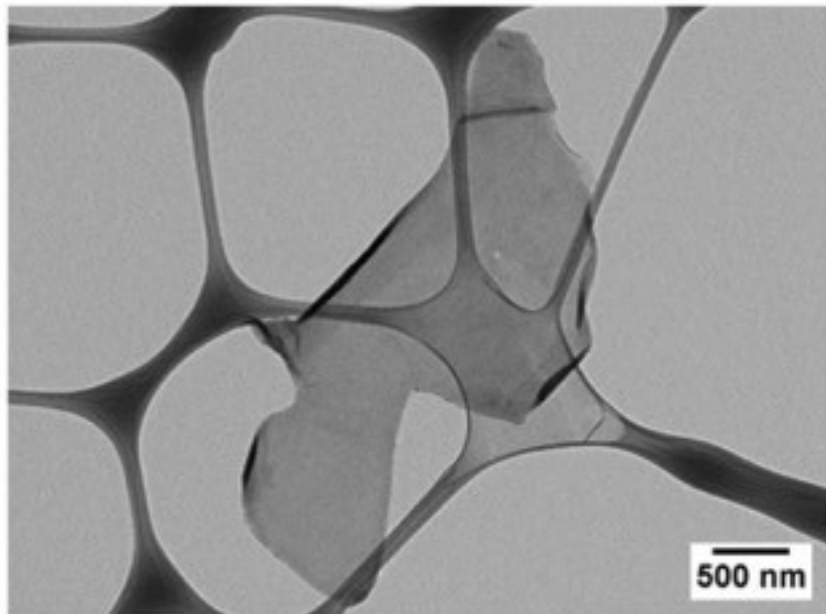
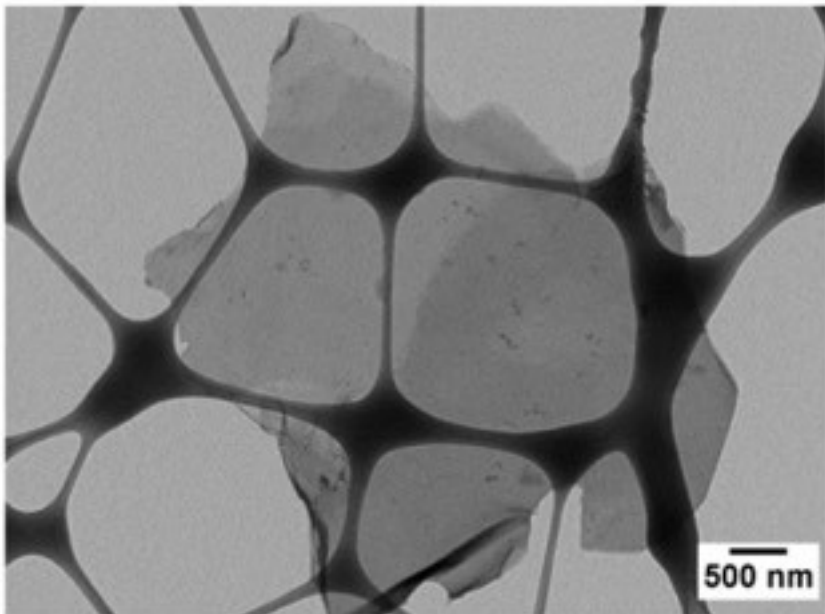




# Recent Graphene from Process



TEM ML-C-01-g I





# Talga Simplifies Processing Steps vs Others



## GRAPHITE PRODUCTION

## GRAPHENE PRODUCTION

### Liberation

### Concentration

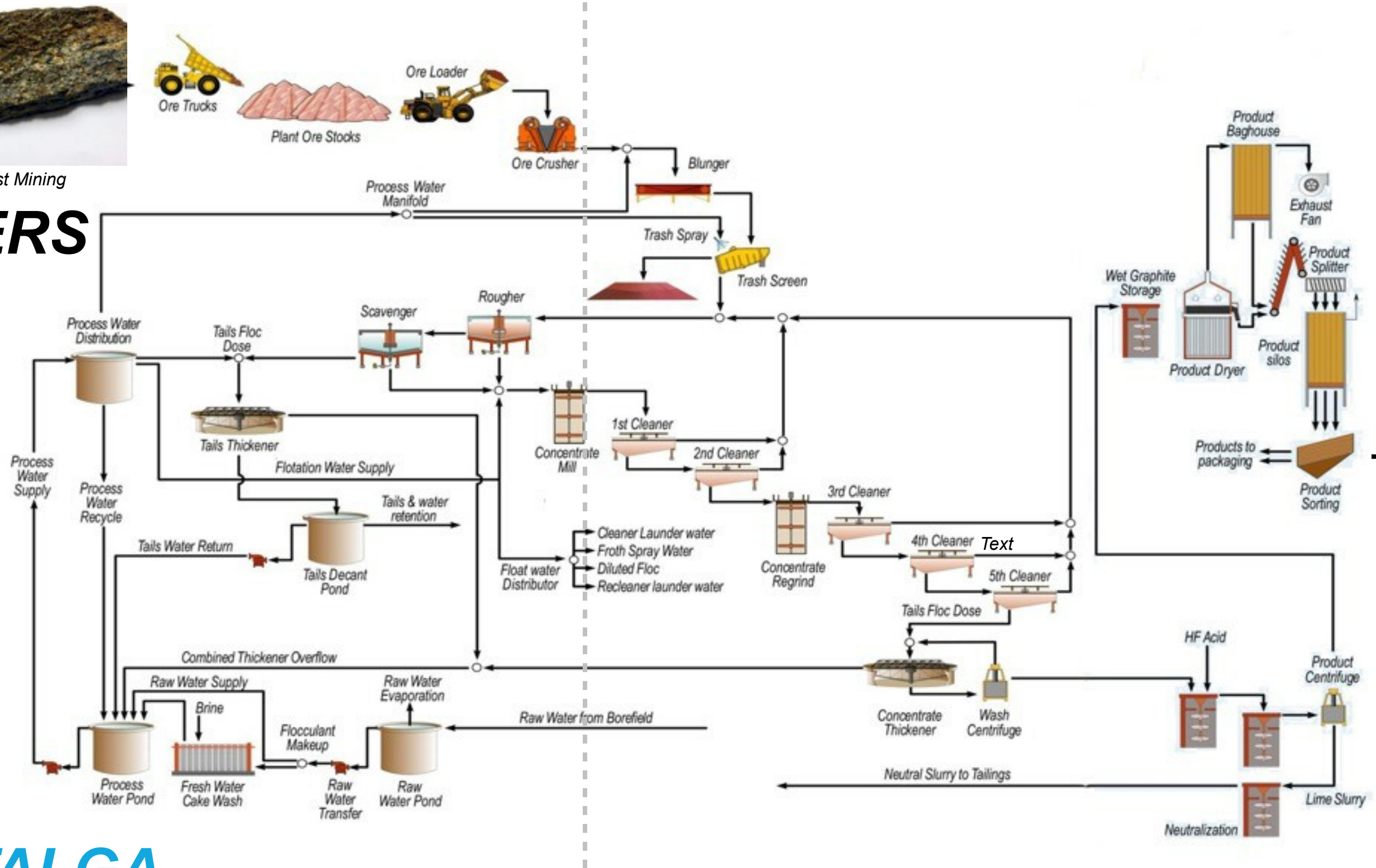
### Liberation

### Concentration



Drill and Blast Mining

OTHERS



Stylised Graphene and Mico-Graphite Liberation and Concentration Plant



Product Packaging

TALGA



Block Extraction Mining/Shaping



Block Transport to Mill



# Successful Trial Mine

- ▶ 2015 trial mining confirms amenability of ore to be shaped and extracted to suit electrochemical conversion process to graphene.
- ▶ Further ore extraction permitted to 2018 before full scale permitting.



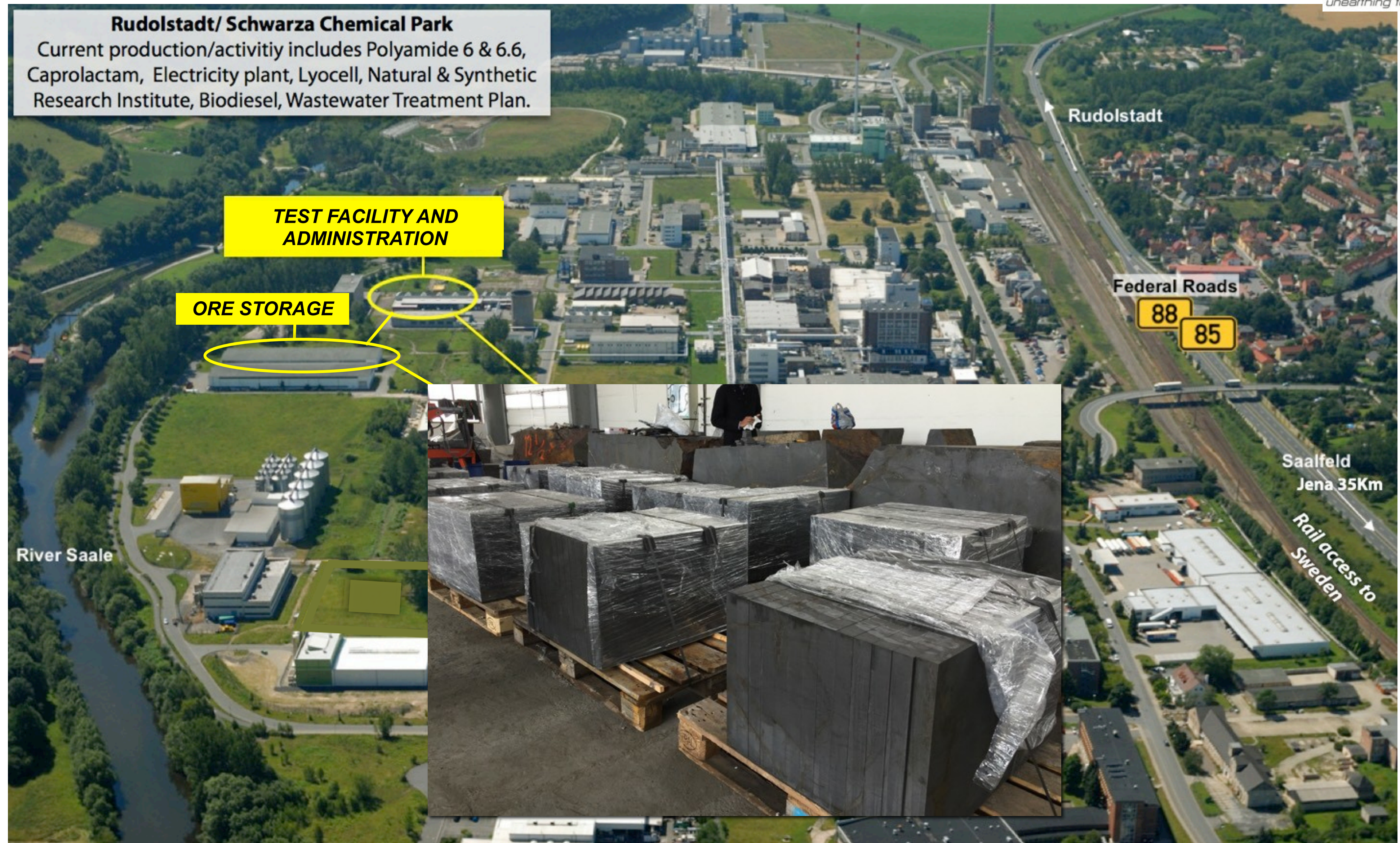


# Trial Mine (Video)





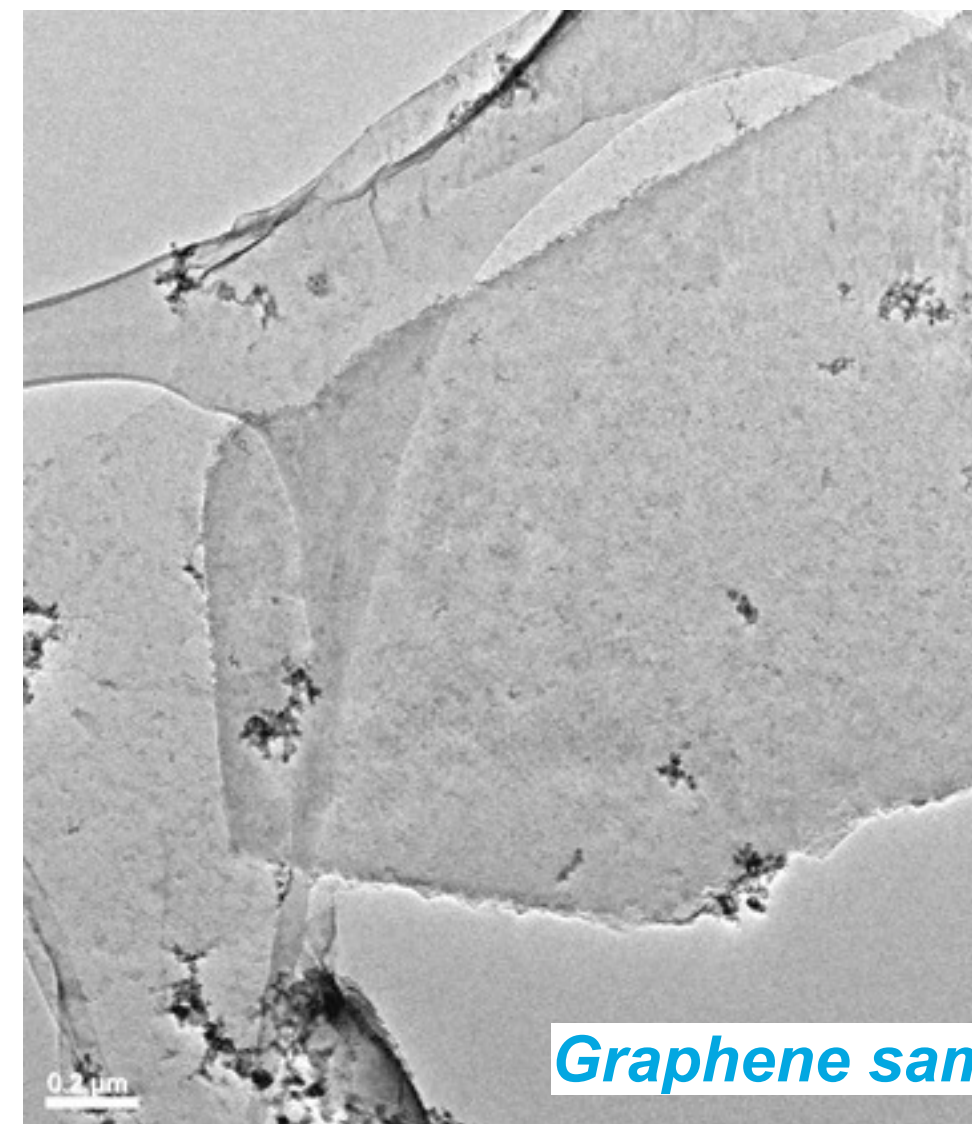
# Pilot Test Facility- Rudolstadt, Germany.





# Development Status

- ▶ **2015** trial mining **complete** - further campaigns up to 2018 permitted
- ▶ **Pilot test-work underway** in Talga's facility in **Germany** (team assembled)
- ▶ **3 phases** to upscaling process - first phase (10kg feed/cell) **underway**, second phase (multiple 50kg feed/cell) delivered.
- ▶ Focus now on commercial relationships to place upcoming graphene and graphite production - samples being delivered to end users now
- ▶ Future full scale processing planned to shift from Germany to **Sweden** once statutory permitting completed - process commenced.



Graphene samples from Rudolstadt





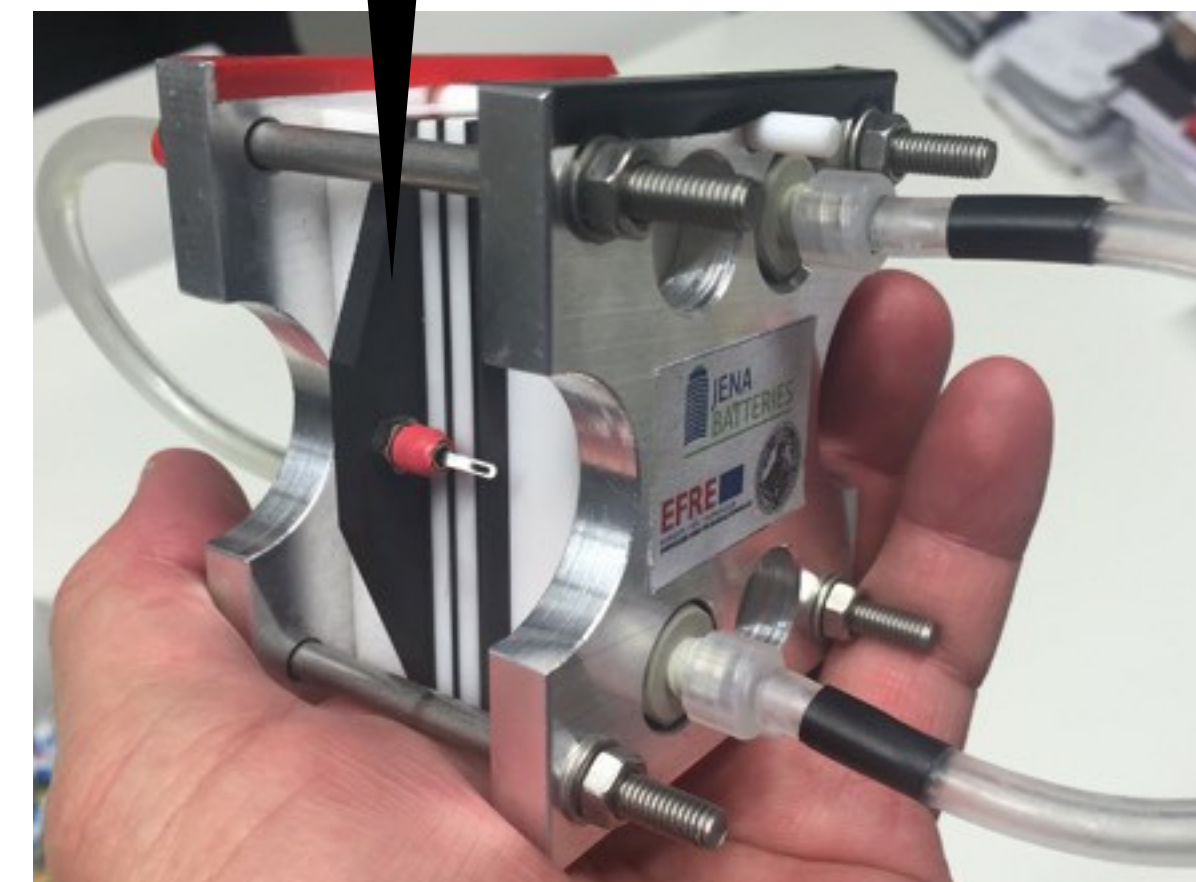
# Graphite - current energy storage market

- ▶ Talga produces graphite in the **same process** as the graphene
- ▶ Graphite is a significant component of many types of Li-ion battery, flow battery and fuel cells.
- ▶ Commonly there is 10x more graphite than lithium in a Li-ion battery.
- ▶ Global Li-ion demand worth over US\$50b with battery materials alone worth over US\$10b, up from US\$375m in 2011.
- ▶ Advantage of Talga is less energy (no grinding, micronising and other steps) to produce ultrafine graphite for Li-ion anodes.
- ▶ Talga product may also suit membranes, plates and current collectors of flow batteries and fuel cells.



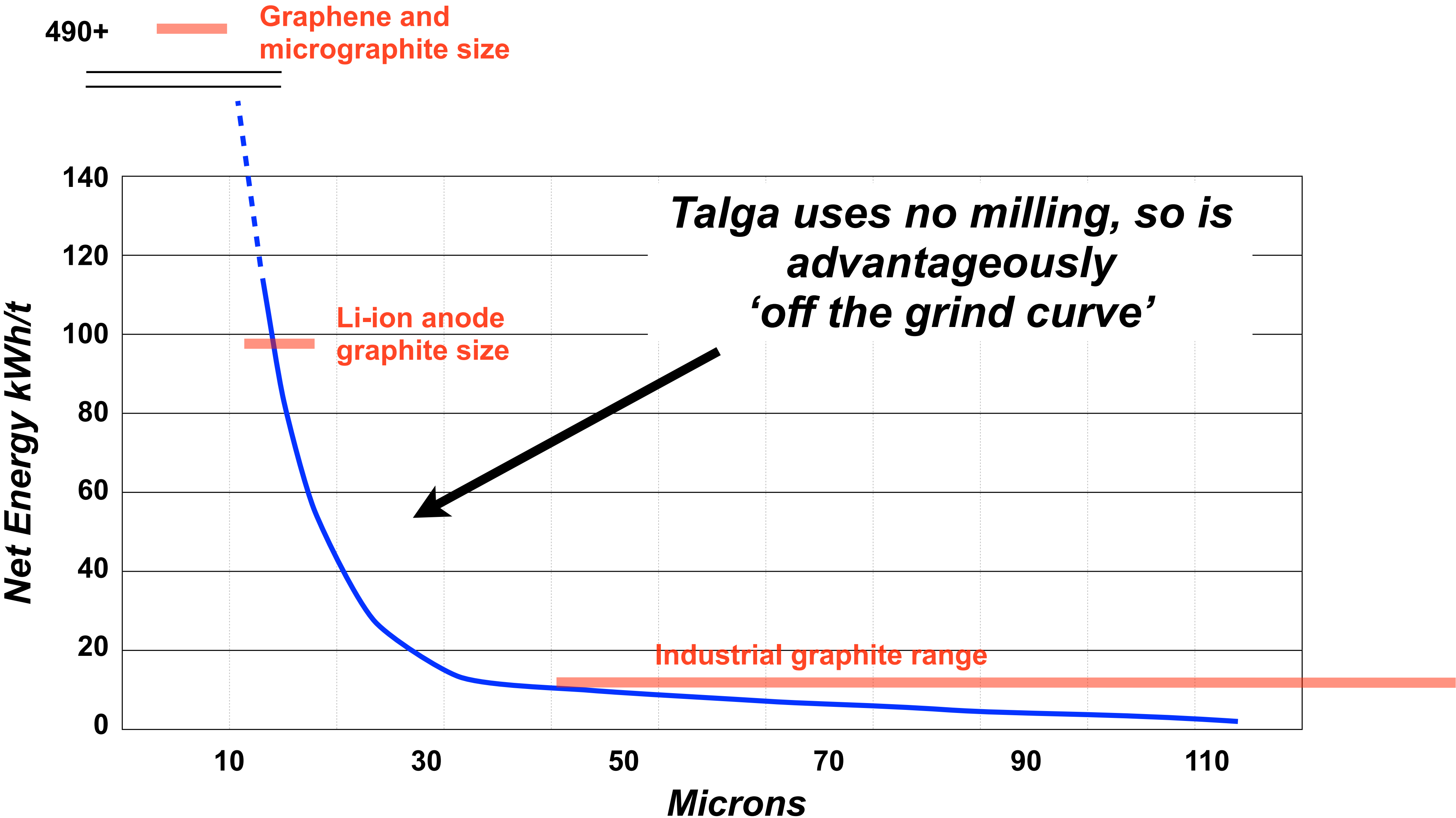
Graphite in Li-ion battery

Graphite in flow battery





# Grinding costs energy (\$)

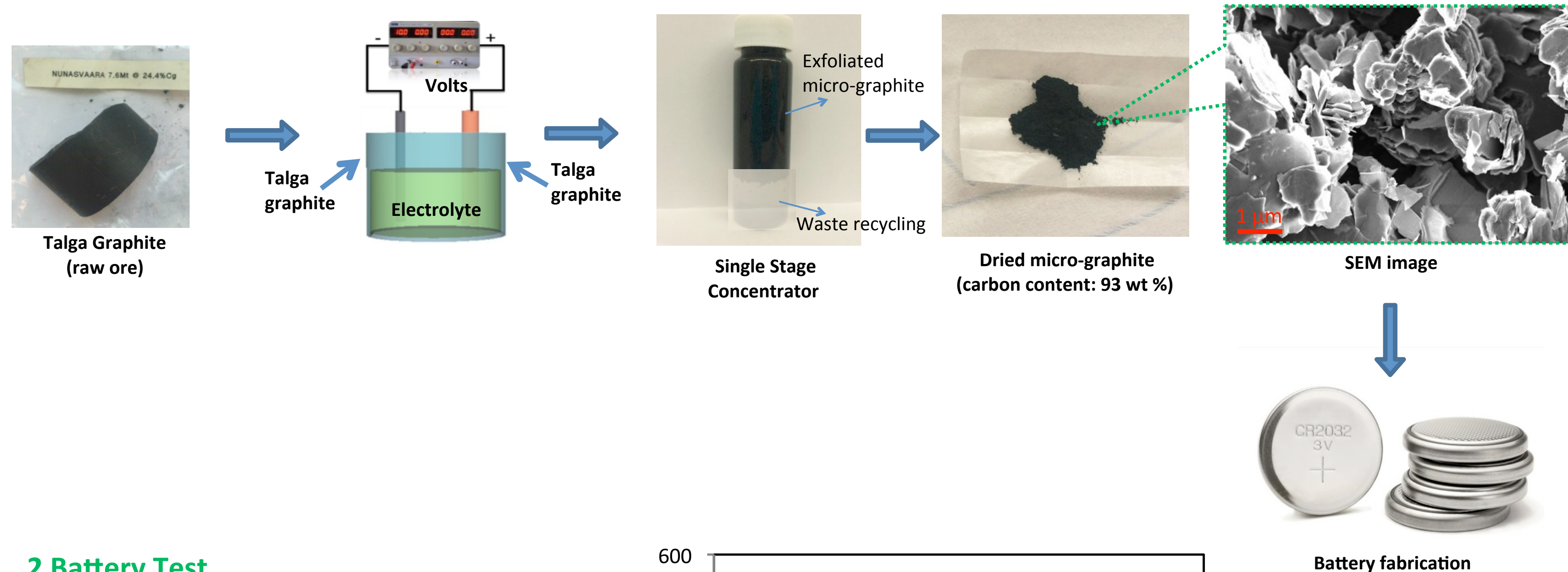


Ball mill grind to 80% passing size (microns). 9mm ball media. West Australian mine data.



# Exfoliated graphite direct in Li-ion battery anodes

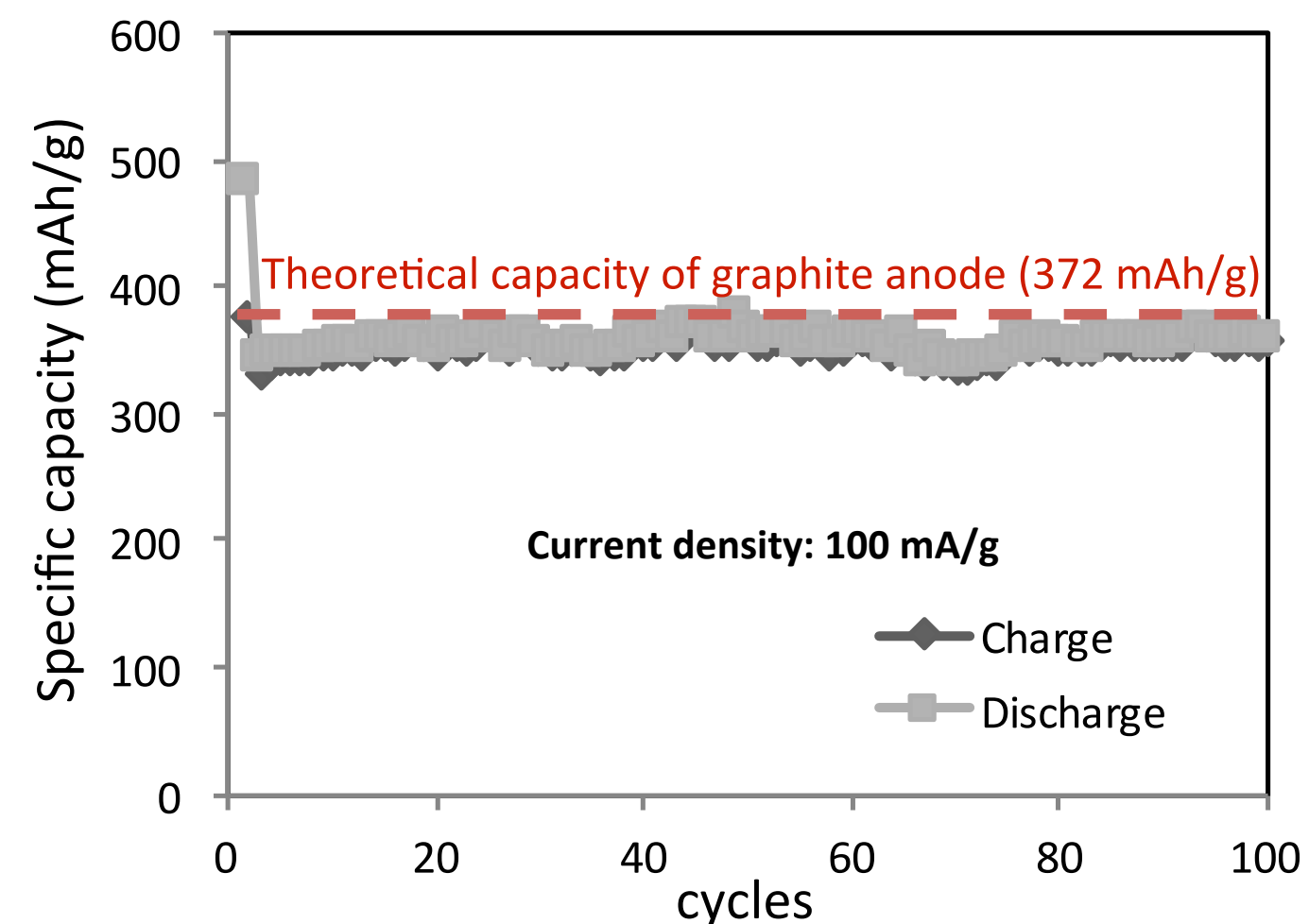
## 1 Exfoliation Process



## 2 Battery Test

### Condition

- LAND CT2001A battery system
- Active material: Talga Micro-graphite
- Preparation: binder, dispersant.  
Note: no prior spheroiding or coating
- Voltage: 0.01-3 V vs Li/Li<sup>+</sup>

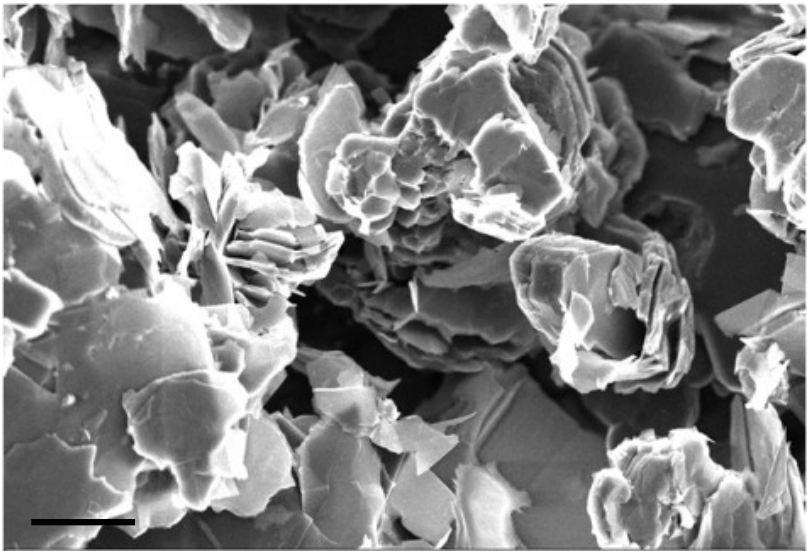



Average capacity  
~ 360 mAh/g

(the capacity of  
commercial graphite is  
~340 mAh/g)



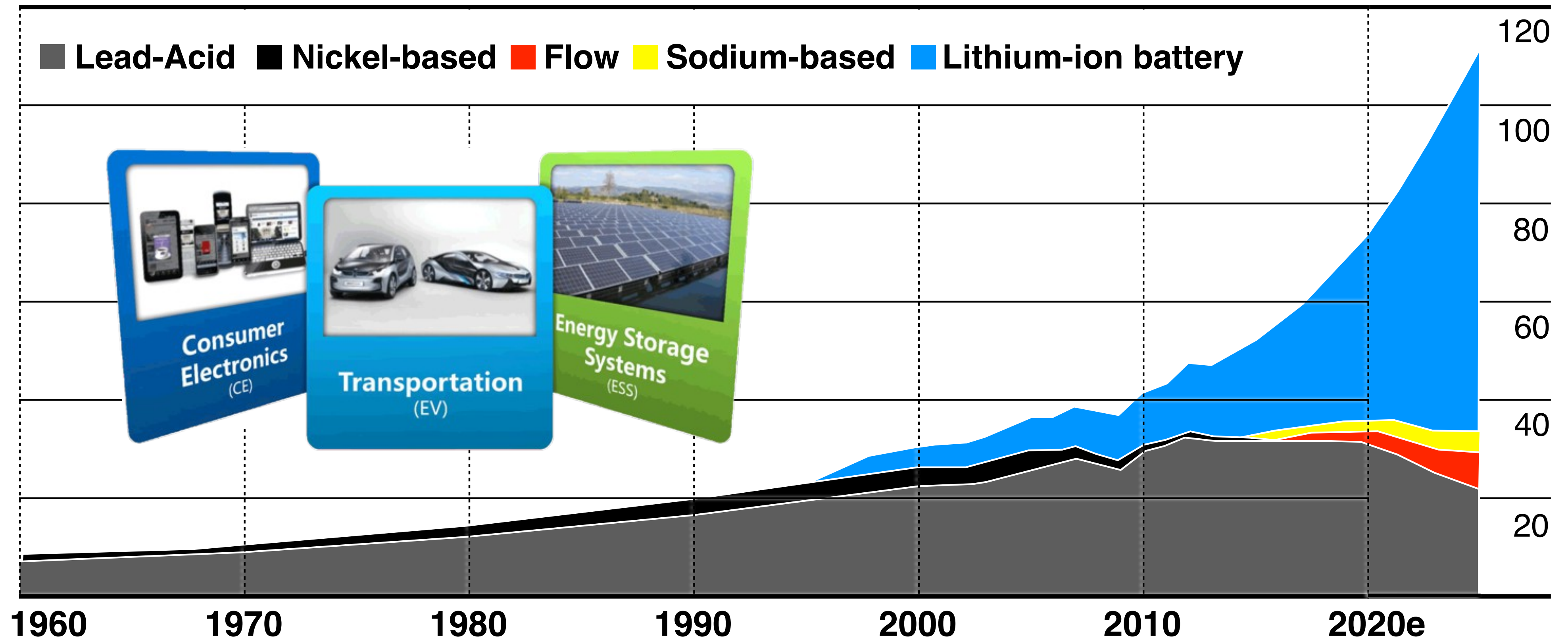
# Lowering steps - improving economics

Talga Graphite	Spheronised Graphite
Talga Processing Steps	Peer Processing Steps
Exfoliate	Crush
↓	Grind Stages
Concentrator single stage	Flotation stages
↓	Micronisation
	Purification (chemical/thermal)
	Shaping (spheronisation)
	Coating
Mix binder and dispersant	Mix binder and dispersant
	
<i>Battery average capacity ~360 mAh/g</i>	<i>Battery average capacity ~360 mAh/g</i>



# Rare commodity - a growing demand

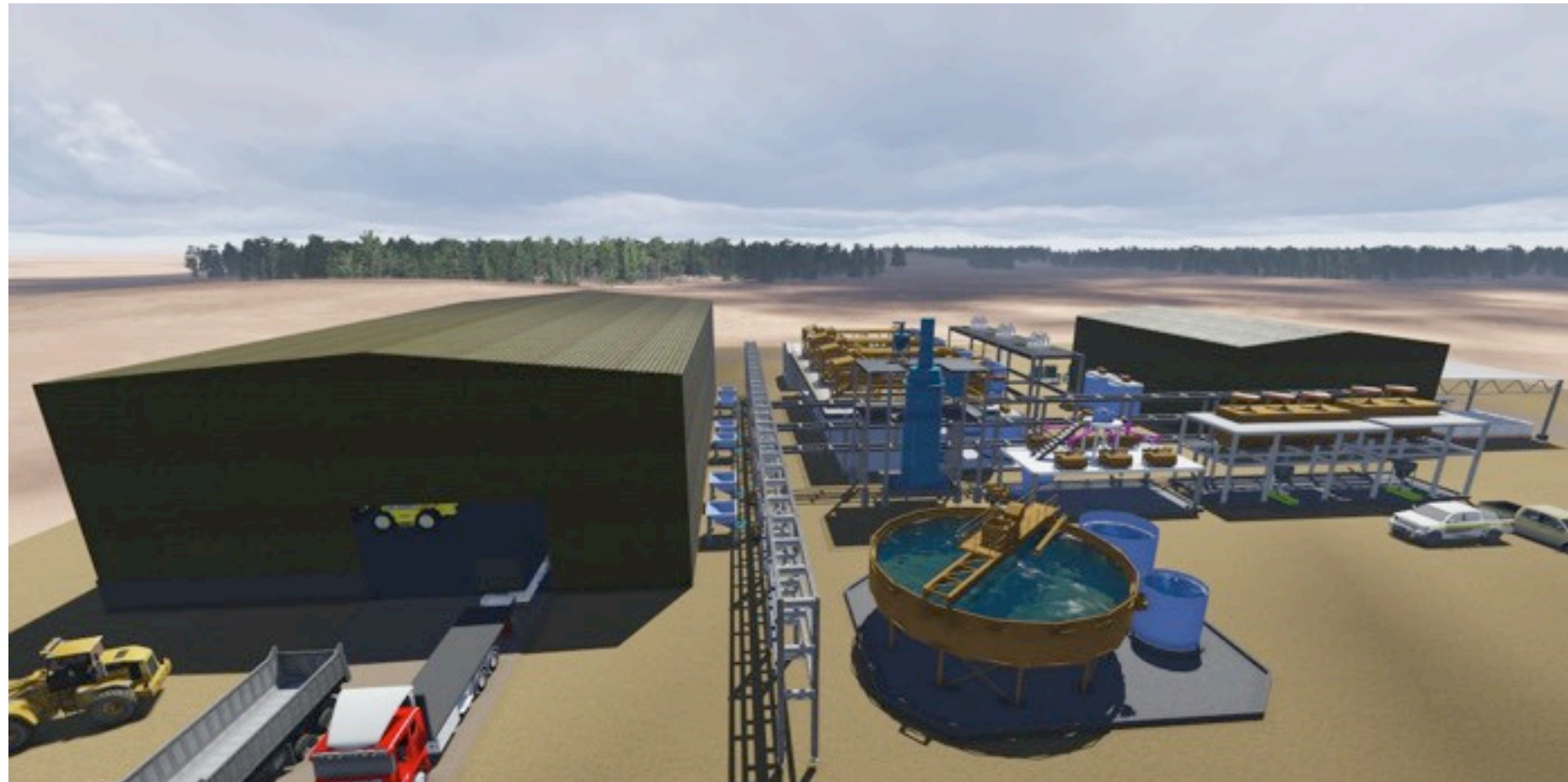
## Global rechargeable battery market (\$USb)



SOURCE: BERNSTEIN



# Full Scale Production - Economic Model<sup>a</sup>



Items		Base Case
Plant throughput	(tpa)	250,000
Diluted Feed Grade	(%)	23.6*
Graphite production	(tpa)	~46,000
Graphene production	(tpa)	~1,000
Life of Mine Strip Ratio	W:O	4:1
Graphite price assumption	(USD\$/t)	480
Graphene price assumption	(USD\$/t)	55,000
Capital cost	(AUD\$m)	29.3
Mine Life	(years)	19.7
Discount Rate	(%)	12
Pre Tax Net Present Value (NPV)**	(AUD\$m)	~490
Payback from construction start	(years)	1.4

\*Feed grade after mining dilution factors. \*\* Pre-tax and other impositions but including state and private royalties.

- ▶ Following successful scale up of process development at Rudolstadt, full scale development planned in Sweden.
- ▶ Process of 250,000 tonnes per annum to produce approximately 40,000t graphite, 6,000t micrographite and 1,000t graphene per annum over 20 years.
- ▶ Capital cost A\$29.3m as no crushing/grinding circuit and ancillaries.
- ▶ Net present value (at 12% discount rate) estimated ~A\$490m
- ▶ Does not require graphene to be financially robust
- ▶ Big leverage in value-adding to graphite and micrographite streams compared to conservative assumptions.

<sup>a</sup> For details see Scoping Study released to ASX 9 October 2014. No material parameters have changed since that date.





## Tata Steel (UK)

- ▶ Collaboration agreement to co-develop graphene products using Talga materials
- ▶ Tata Group comprises over 100 companies with multinational operations and >580,000 staff
- ▶ Talga graphene to be used in anti-corrosion and high performance coatings. Paint and coatings market > 40 Mt annum.



## Haydale Graphene Industries PLC

- ▶ UK based nanomaterials company with value add functionalisation process but no source of graphene. Specialise in graphene enriched polymers for composites and plastics.

## EU Graphene Flagship - Associate Member

- ▶ Fast track access to huge network of commercial and technology partners
- ▶ Invited alongside **Bosch** and **Lego**.





# Financial and Corporate Summary

## Capitalisation Summary 26 February 2016 (AUD\$)

Shares on issue (TLG Ordinary)	146.3M
Unlisted Options <sup>1</sup>	21.3M
Market Capitalisation (undiluted @ \$0.30)	\$44M

## Board

Managing Director - Mark Thompson

Chairman - Keith Coughlan

Non-Executive - Grant Mooney

Non-Executive - Stephen Lowe

Cash (end of Dec 2015) ~\$5 million. Nil Debt.

## Top 5 Shareholders

Lateral Minerals P/L (M.D. Mark Thompson)	10.3%
Gregorach P/L and related entities	5.0%
Yandal Investments P/L	3.8%
HSBC Custody Nominees Australia Ltd	4.6%
UBS Nominees P/L	3.3%

## ASX: TLG 12 month Share Price



<sup>1</sup> Various expiry and strike prices with majority expiring December 2016 at 50-60c



## *Goals and news flow:*

- ▶ Increase **scale** at pilot test plant
- ▶ Increase **sample supply** volume to industry
- ▶ Increase **industrial partners & end users**
- ▶ Trial in **products**
- ▶ Add value to all parts of ore
- ▶ ***Drive Talga value towards scoping study results as above confirms assumptions***





# Appendices- Graphite Resources and Targets

**Nunasvaara JORC (2004) Mineral Resource<sup>1</sup> (10% Cg cut-off)**

JORC 2004 Classification	Tonnes	Graphite (%Cg)
Indicated	5,600,000	24.6
Inferred	2,000,000	24.0
<b>Total</b>	<b>7,600,000</b>	<b>24.4</b>

**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
<b>Total</b>	<b>4,300,000</b>	<b>7.1</b>

**Talga Graphite Exploration Targets <sup>2</sup>**

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
<b>Rounded Total</b>		<b>136,000,000</b>	<b>250,000,000</b>	<b>18</b>	<b>25</b>

*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.*



# Appendices - References

## References

#) see <http://www.techmetalsresearch.com/metrics-indices/tmr-advanced-graphite-projects-index/>

\* see Industrial Minerals Natural Graphite report 2012, unpublished reports for Talga, and Scoping Study released to ASX 9 October 2014.

NB) any data not specifically referenced is based on personal communications with industry participants where appropriate and/or unpublished technical research.

## Cautionary Statement

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 be 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.

## Competent Person's Statement

The information in this report that relates to Exploration Results and 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 Resource Estimation 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.