

## **Talga graphene boosts thermal-conductive concrete for large infrastructure projects**

### **Talga Resources Ltd**

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### **Corporate Information**

ASX Codes **TLG, TLGOA**

Shares on issue **181.9m**

Options (listed) **44.9m**

Options (unlisted) **28.7m**

### **Company Directors**

**Terry Stinson**

Non-Executive Chairman

**Mark Thompson**

Managing Director

**Grant Mooney**

Non-Executive Director

**Stephen Lowe**

Non-Executive Director

- Independent testing program shows significant increases in concrete thermal conductivity using a blend of Talga graphene and primary ore:
  - 30% improvement over market leading thermal concrete product
  - excellent free flowing properties
- Prototype results support Talga's commercialisation strategy in the building and construction sector
- Partnering discussions underway with global manufacturers in concrete additives market (current size c.USD\$17 billion/year<sup>1</sup>)
- Presents opportunity for 100% ore utilisation at Talga's operation in Northern Sweden

Australian technology minerals company, Talga Resources Ltd ("**Talga**" or "**the Company**") (ASX: TLG), has achieved outstanding results, verified by an independent test laboratory, on graphene enhanced prototype concrete samples.

As announced in July 2016, in addition to raw graphite and graphene materials, Talga is developing 'fit for purpose' products within four prime industry sectors (coatings, composites, building products/construction, and energy storage). Conductive concrete falls within the building products/construction sector.

Thermally conductive concrete is a growing market which has potential to be an early adopter of graphene enhanced products. Applications include thermal transfer materials for underground power transmission cables, domestic heating, road and bridge snow melting and tarmac de-icing.

### **Test Results**

Talga graphene enhanced concrete samples were recently tested at the commercial concrete/cement laboratory Betotech Baustofflabor GmbH ("**Betotech**") in Erfurt, Germany. A range of prototype formulations were prepared using a blend of primary ore and graphene from Talga's 100% owned Vittangi project combined with industry standard cements and aggregates (see Figure 1).

Thermal conductivity results of the Talga concrete ranged up to 3.5 watts per metre kelvin (W/m.k), which is a significant, circa 30% improvement over a current market leading product (see Figure 2). Further, the thermal conductivity improvement is achieved with extremely low loadings of graphene, blended with a larger amount of crushed primary Vittangi ore that is naturally highly conductive.

Talga's prototype products also demonstrated excellent free-flow properties, a vital attribute for commercial applications (lubrication "slump" test results of 650mm compared to 460mm in market leading products) and ability to reduce expensive flow agents by 50%. Further testing to quantify strength and other performance related attributes is continuing.



In parallel with development and testing, Talga has initiated commercial discussions with global leaders in the concrete industry. Industry is seeking partners that have supply and technical capabilities to deliver thermal conductivity improvements across concrete based products in the global energy infrastructure and the civil, building and construction sectors.

**Talga Managing Director Mark Thompson** commented:

*“We are delighted with the test results of our first graphene enhanced concrete prototypes. They demonstrate significantly improved ability to transfer heat energy, opening a range of existing large-scale construction and infrastructure markets for Talga’s graphene and graphite products. Our European location is situated on the doorstep of these markets and major infrastructure projects, such as Germany’s ‘Suedlink’, where thousands of kilometres of underground power cables may require high thermally conductive concrete materials.*

*It is important to note that the most successful concrete prototype incorporates both primary graphite ore and graphene, making it feasible to target 100% resource utilisation from our flagship Vittangi graphite project. I am confident that, if successful, this could create a new environmental processing benchmark for the graphite ore processing industry and significantly further improve the economics and development footprint of our operations in Sweden.”*

### Next Steps

The thermal conductivity results set the stage for Talga to advance its various discussions with international players in the building and construction sector. Talga will continue to progress its product and commercialisation strategy in this sector using prototype test results as the catalyst to initiate joint development programs with global suppliers in the industry, similar to the agreement recently announced with Chemetall, part of BASF.

A range of in-house concrete formulations were prepared and tested against multiple performance criteria, which included, but was not limited to, thermal conductivity and flow properties. Results for other concrete performance attributes are being finalised to provide test data on material strength, electrical conductivity and rheology.

### Concrete Tests

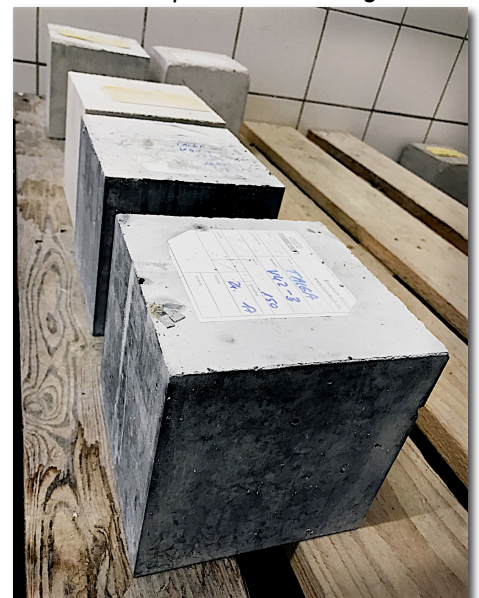
The tests were conducted at Betotech, an ISO9000 certified independent laboratory in Erfurt, Germany in accordance with German Institute for Standardization (DIN) standards on preparation and curing (DIN206-1, DIN12 390-1, DIN12-390-2) and thermal conductivity (measured by ISOMET 2104).

The thermal conductivity results for 150 x 150mm concrete cube samples through 28-day cure time trial are summarised and compared to the same published for a market leading product and standard construction backfill materials<sup>2</sup> (see Figure 2).

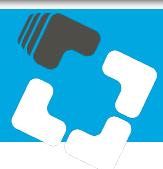
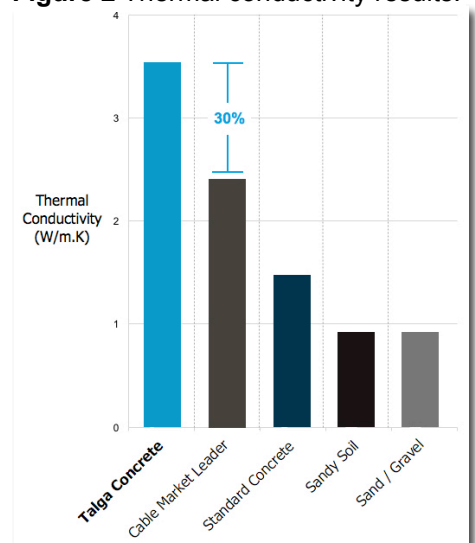
### Thermally Conductive Concrete

Concrete is a widely used material with many engineering advantages in construction applications, but it is normally a poor conductor of heat. In recent years there has been a growing demand for high thermal-conducting concrete to effectively transfer heat in large volume industrial applications including bedding and backfilling material around underground high voltage power cables, geothermal power installations and

**Figure 1** Talga 150 x 150mm cube concrete samples await testing.



**Figure 2** Thermal conductivity results.



storage containers for certain contaminated materials. Other emerging applications include domestic geothermal and underfloor heating, road and bridge snow melting and tarmac de-icing.

In underground power cable installations thermally-conductive concrete offers:

- Reduced power transmission losses by dissipating heat away to surrounding soil or materials;
- Increased power capacity, particularly vital in the distribution of wind or solar energy;
- Reduced concrete volume required overall, saving costs;
- Improved durability of plastic insulation around cables;
- Reduced magnetic field effects; and
- Reduced 'hot-spots' and increased quality of power transmission.

### Market for Specialty Concrete

The global concrete/cement additives market<sup>1</sup> is worth over USD \$17 billion/year to service the total concrete and cement market worth over USD\$450 billion/year. This includes specialty concrete sectors and niches such as the fast growing conductive and thermal concrete market.

Key industry leaders with specialty conductive concrete/cement products include companies like Heidelberg Cement Group, Italcementi and Sankosha Corporation, amongst others.

Talga's initial target market for thermally conductive concrete is the European infrastructure sector, particularly high voltage underground power cable projects. The German Government has approved the installation of 1,000 kilometres of underground high voltage power cables to expand the country's power grid ("Suedlink"). The grid expansion is a pillar in Germany's shift to renewable energy, and is designed to carry green energy from wind farms in northern coastal areas to the industrial south where several nuclear power and fossil fuel plants are being switched off. The high-voltage cabling is required to be installed underground to appease residents along the route and speed up construction<sup>3</sup>.

Further, the German Federal Ministry for Economic Affairs and Energy reports that more than 7,500 kilometres of high voltage electric power lines will need to be upgraded or replaced in the next few years in Germany alone<sup>4</sup>. A significant amount of these will be installed underground (an increasing trend in Europe and the world generally) potentially further increasing the demand for thermally conductive concrete.

**See Glossary below for explanation of technical terms.**

For further information visit [www.talgaresources.com](http://www.talgaresources.com) or contact:

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**Figure 3** Thermal conductive concrete in power cable application.



## References

1. World Cement & Concrete Additives Market, 2016, Freedonia Report 3358.
2. Textbook of Engineering Thermodynamics, R.K. Rajput, Laxmi Publications, 2010.
3. “Germany-to-build-11-billion-power-link-as-cost-estimate-doubles” Bloomberg article 9 June 2016
4. German Federal Ministry for Economic Affairs and Energy; Grids and Grid Expansion. See [www.bmwi.de](http://www.bmwi.de)

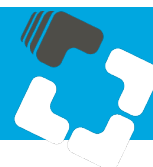
### About Talga

Talga Resources Ltd (ASX: TLG) is a technology minerals company enabling stronger, lighter and faster products for the coatings, battery, construction and carbon composites markets using graphene and graphite. Talga has significant advantages owing to 100% owned unique high grade conductive deposits in Sweden, a pilot test facility in Germany and in-house graphene product technology. Testing of Talga materials and products is underway with a range of corporations including industrial conglomerates Tata and BASF subsidiary Chemetall, UK listed Haydale and German based Jena Batteries.

## TECHNICAL GLOSSARY

The following is a summary of technical terms:

<b>Backfill Material</b>	Materials used to fill an open void once the structure has been installed.
<b>Bedding Material</b>	Material placed over a sub-base to hold and support a layer above, ensuring the layers above or surface is level and even.
<b>Betotech</b>	Betotech Baustofflabor GmbH, an independent ISO certified cement and concrete testing group.
<b>Cement</b>	A powdery substance made by calcining lime and clay, mixed with water to form mortar or mixed with sand, gravel, and water to make concrete.
<b>Concrete</b>	A building material made from a mixture of broken stone or gravel, sand, cement, and water, which can be spread or poured into moulds and forms a stone-like mass on hardening.
<b>DIN Standards</b>	Deutsches Institut für Normung e.V. (German Institute for Standardisation) develops standards for rationalisation, quality assurance, environmental protection, safety and communication in industry, technology, science, and government, as well as the public domain. DIN standards provide companies a basis for quality, safety and minimum functionality expectations.
<b>Energy Infrastructure</b>	The basic physical and organisational structures and facilities needed for the operation of energy supply.
<b>Electrical Strength</b>	The maximum voltage sustainable by an insulating material, after which it loses its insulating properties.
<b>Footprint</b>	The impact on the environment by human activity in terms of pollution, damage to ecosystems, and the depletion of natural resources.
<b>Formulations</b>	A material or mixture prepared according to a formula.
<b>Graphene</b>	A single atom thick layer of crystalline carbon, with properties of strength, conductivity and transparency that stem from its unique 2D structure.



<b>Graphite</b>	An allotrope of carbon in which carbon has $sp^2$ hybridisation. Can be found as a natural mineral or can be synthesised using great pressure and temperature. Natural graphite consists of many stacked layers of Graphene, approximately 3 million layers of Graphene per millimetre of Graphite.
<b>Geothermal Power</b>	A renewable energy source produced from utilising temperature gradients in the ground versus the surface.
<b>High Voltage Power Cable</b>	Cables intended for electrical power transmission with rated nominal voltages between 35kV - 220kV.
<b>ISO9000</b>	International standards for quality assurance set by the International Standards Organisation. It includes some 20 elements of quality process performance, and is a prerequisite for delivering predictable, quality products to customers.
<b>Isomet 2104</b>	A multifunctional instrument (Applied Precision Ltd) for measuring thermal conductivity, thermal diffusivity, and volume heat capacity.
<b>Magnetic Field Effects</b>	The effects of the lines of force that exist around an energised electrical conductor, magnet, or inductor on objects near current-carrying conductors.
<b>Power Capacity</b>	In terms of generation, the capacity of a power plant is the maximum power that installation is capable of producing.
<b>Suedlink</b>	A planned high-capacity North to South power line in Germany. This is a part of a larger power grid upgrade initiated by the German Government with the purpose of guaranteeing current, and future, safe and competitive national power supplies.
<b>Thermal Conductivity</b>	A measure of heat flow through a specific material independent of its thickness, the greater the value the lesser the resistance. Can be expressed as ( $\lambda$ ) or (W/m.K)
<b>Ultra-High Voltage Power</b>	Electrical power with voltages in excess of 800 kilovolts (kV).
<b>(W/m.K)</b>	Watts per metre-Kelvin, a measure of Thermal Conductivity

