

Global breakthrough as Talga's graphene-infused concrete conducts electricity

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Corporate Information

ASX Codes **TLG, TLGOA**

Shares on issue **204.2m**

Options (listed) **44.0m**

Options (unlisted) **32.6m**

Company Directors

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Australian advanced materials technology company Talga Resources Ltd ("Talga" or "the Company") (ASX:TLG), has achieved high levels of electrical conductivity in concrete by using an additive developed from the Company's graphene-graphite research and development laboratory in the UK.

The breakthrough offers substantial potential in existing and emerging industrial applications, particularly as concrete is the world's largest construction material by volume.

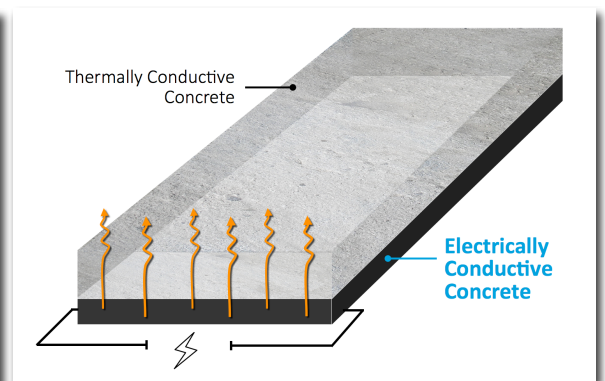
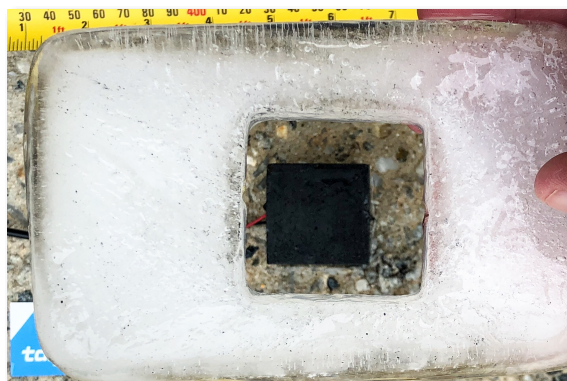
Summary highlights are as follows:

- **Initial tests show Talga's graphene-enhanced concrete is highly electrically conductive - attaining 0.05 ohm.cm volume resistivity**
- **Adds potential 'heating element' function and more to US\$450 billion annual concrete market – world's largest volume construction material (>5 billion tonnes/annum)**
- **Current applications include: underfloor heating (replacing plumbed hot water based installations), anti-static flooring, EMI shielding, strain sensors and grounding/lightning protection**
- **Emerging application in solid-state heated roads for environmentally friendly way of clearing ice and snow from key transport routes and airports when compared to use of ploughs, corrosive salt, de-icing chemicals and wastewater treatment of runoff**
- **Future potential includes role in dynamic and wireless charging of electric vehicles while driving**
- **Follows Talga's value-add product development strategy and creates new opportunities with global partners in energy & construction infrastructure**

Figure 1

(L) Talga concrete sample after melting 5cm depth of ice from 9v power.

(R) Conceptual underfloor heating/road application.



Talga Managing Director, Mr Mark Thompson:

“The initial test results show that Talga’s graphene-enhanced concrete achieves such high electrical conductivity that it can act like the heating element of an electric stove (Fig 1). This type of concrete has some exciting and large volume applications, and in some cases can combine with our thermally conductive concrete (ASX:TLG 10th April 2017)¹.

“Furthermore the conductivity is achieved with a very low loading of our graphene, but a larger amount of ore processing by-products, providing maximum potential for the most cost effective, scalable and eco-friendly development options.

“Talga’s successful tests follow work published by Exeter University² showing 146% improvement in concrete strength using graphene. They estimated that a 50% reduction of cement used for the same strength concrete would result in a 446kg/tonne reduction in carbon emissions by the cement industry, currently the third-largest industrial energy consumer and second largest industrial CO₂ emitter in the world³.

“Talga is encouraged by these first tests and will move to take the prototype results to potential development partners in the world’s largest construction industry material.”

TESTS

The concrete samples were manufactured at Talga’s 100%-owned German process test facility and the Betotech (Heidelberg Cement Q&C) laboratory in Germany using industry standard cement with additions of Talga’s pristine graphene, graphite and silica-rich by-product of ore processing. The optimised formulation targeted high electrical percolation at low material concentrations and with potentially lower cost factors.

The samples were tested in-house, by a European industrial partner and further measurements were undertaken by Professor Ian Kinloch’s group at the University of Manchester (“UoM”). In the UoM study, the conductivity of samples was measured using electrical impedance spectroscopy in both through-plane and in-plane directions over a range of frequencies. For reference, a standard mortar (without Talga additives or aggregates) was used. A summary of results is shown below in Table 1 and Figure 2.

Figure 2 Summary UoM test data showing electrical conductivity of Talga concrete sample (blue) compared to reference mortar (grey) and stability of Talga material at a large range of frequencies.

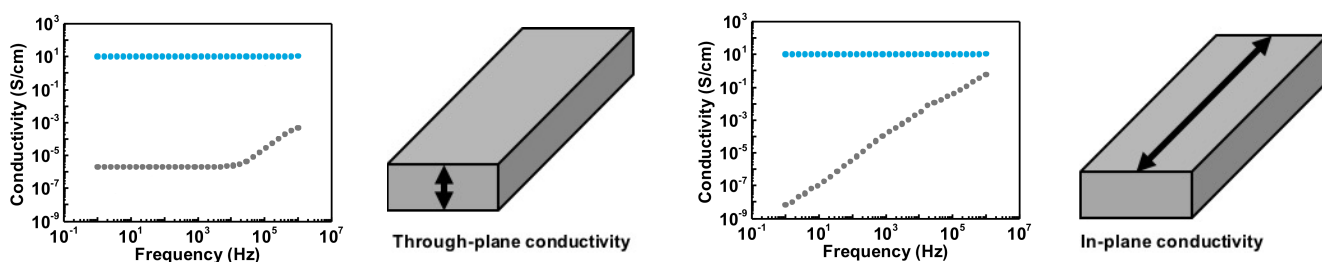


Table 1 Highlights of UoM test data in volume conductivity and resistance results.

Specimen	Conductivity (Siemen/cm)	Resistivity (Ohm.cm)
Talga Concrete	20	0.05
Standard Mortar	0.000001	1000000

In summary the UoM tests recorded the Talga graphene enhanced concrete (see Fig 3) had high electrical conductivity (low resistivity) to 0.05 ohm-cm (Ohm is the measure of a material's resistance to conduct electricity, the lower the better).

This rating compares to a general resistivity level of around 1,000,000 ohm-cm for the reference mortar at a similar dryness (the background level of moisture can affect electrical conductivity, so samples are measured at the same dryness).

The results have also shown the silica-rich by-product of ore processing is remarkably conductive in itself, tough and highly suitable for use in construction materials. Trial concrete products developed by Talga are targeting the innovative use of this material, thereby increasing potential economic benefits and sustainability of the future Swedish operation.

APPLICATIONS

As concrete is effectively an insulator (does not conduct electricity) in a dry state, adding the function of high electrical conductivity has been a goal of material scientists for a long time.

Attempts typically relied on the addition of high loadings of magnetite (iron), steel fibres, synthetic and natural carbons (including graphite) but did not achieve high levels of performance. In addition the required (high) loadings of active materials tended to cause negative effects on cost, strength, corrosion and abrasion resistance, maintenance costs and weight.

The electrically conductive 'graphene concrete' has applications in current markets such as underfloor heating, where it can provide a long-term, low-maintenance alternative to plumbed hot water installations (see Figure 4). Other current applications include the provision of anti-static flooring and EMI shielding (radio frequency interference) in buildings, and cost effective grounding and lightning strike protection for a range of infrastructure from bridges to wind turbines.

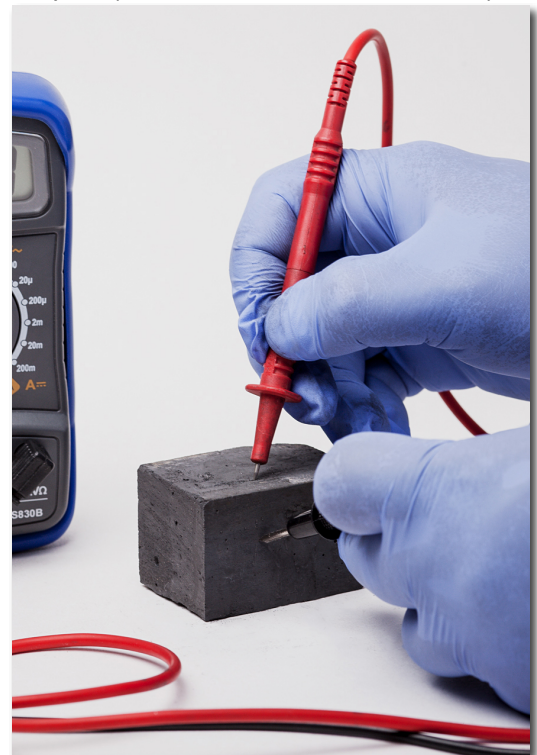
Additionally, as a 'solid state heater' the technology may enable more rapid, and environmentally friendly ways of clearing ice and snow from key transport routes and airports compared to the cost of ploughs, salt, de-icing chemicals and wastewater treatment of chemical runoff.

Figure 4 Traditional plumbed underfloor heating - can be replaced by long life solid state conductive concrete.



Photo: Hanson Australia

Fig 3 Talga graphene enhanced concrete sample. (Note this is not the test method).

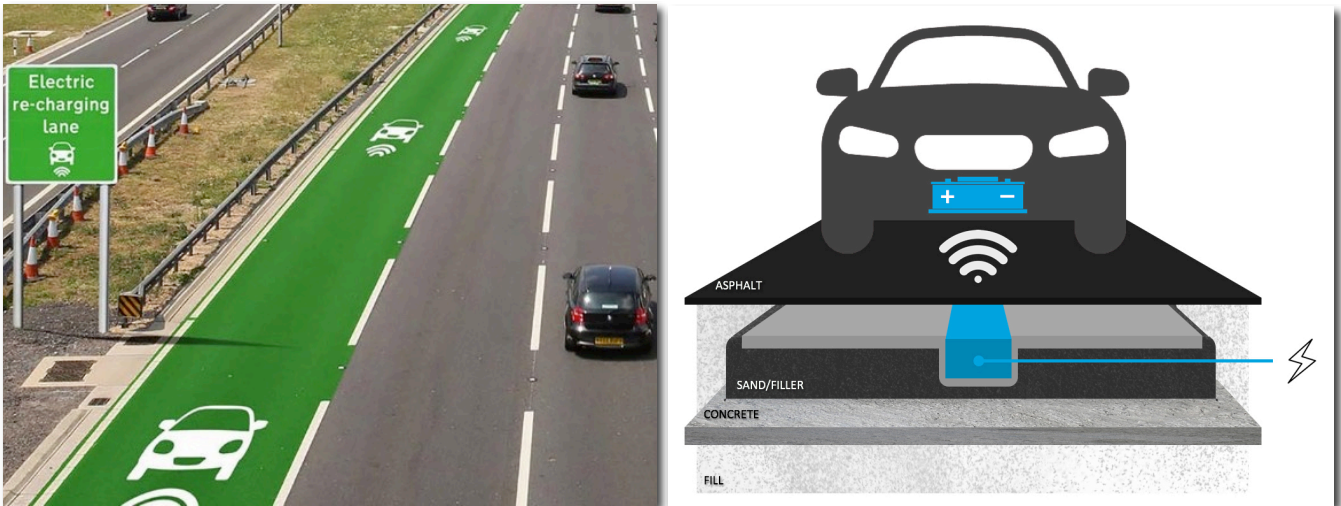


The replacement of widely used salt; as a material cost, its transport and distribution, and its corrosive effect on road/bridge infrastructure and vehicles would be an emergent but high potential application for heatable concrete.

In future, Talga will investigate the potential of the electrically conductive concrete for a cost effective role in enabling inductive (wireless) charging technologies for electric vehicles under dynamic (driving) as well as stationary (parking) conditions^{4,5} through the increased range of heating, sensing and other conductive concrete functions (See Figure 5).



Figure 5 Idealised concept of inductive (wireless) charging technologies for electric vehicles.



MARKETS AND NEXT STEPS

Talga's commercialisation strategy is focused on targeted value-added graphene and graphite products covering the energy, coatings, composites and construction sectors.

Initial partner work and customer testing is already underway on:

- Lithium-ion batteries and a range of energy storage technologies
- Metal pre-treatment, marine epoxy and other coatings;
- Cement/concrete additives: and
- Epoxy resins for carbon fibre (composites).

These applications and products have been developed over the past two years with global scale industrial and R&D partners, using high grade graphite ore liberated in successful trial mining from Talga's wholly-owned deposits in north Sweden.

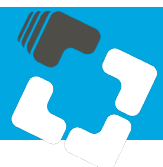
The global concrete market exceeds 5 billion tonnes/year⁶ and is worth over USD\$450 billion/year⁷. Specialty concretes are a subset of this and while having no formal volume that may be attributed to a new product, Talga considers the market for conductive concrete is significant.

The Company currently has an MoU with the world's second largest concrete manufacturer, Heidelberg Cement, focussed on thermally conductive concrete, but is free to explore other market opportunities. Talga is currently recruiting a European based commercial team, that will include construction sector and concrete market experience, to use these test results in commercialisation discussions with a range of industrial partners.

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REFERENCES

1. [http://www.talgaresources.com/irm/PDF/1995_0/TalgaGrapheneBoostsConcreteThermal Conductivity 2017](http://www.talgaresources.com/irm/PDF/1995_0/TalgaGrapheneBoostsConcreteThermalConductivity2017)
2. "Ultra high Performance Nano engineered Graphene – Concrete Composites for Multifunctional Applications", D. Dimov et al, Advanced Functional Materials, 2018.
3. Cement Sustainability Initiative, World Business Council for Sustainable Development, 2018.
4. Location Planning for Dynamic Wireless Charging Systems for Electric Airport Passenger Buses, Helber et al "Energies", 2018.
5. Inductive Charging Through Concrete Roads, Beelden et al "European Road Infrastructure Congress", 2016.
6. Cement Market Forecast 2018-2023, IMARC Report 4715138, 2018
7. World Cement & Concrete Additives Market, Freedonia Report 3358, 2016.

No New Information

To the extent that announcement contains references to prior exploration results, these have been cross referenced to previous market announcements made by the Company. These had been disclosed to JORC 2012 standard. Unless explicitly stated, no new information is contained. The Company confirms that it is not aware of any new information or data that materially affects the information included in the relevant market announcements that assumptions and technical parameters underpinning the relevant market announcement continue to apply and have not materially changed.

Forward-Looking Statements

This ASX release has been prepared by Talga Resources Limited. This document contains background information about Talga Resources Limited and its related entities current at the date of this announcement. This is in summary form and does not purport to be all inclusive or complete. Recipients should conduct their own investigations and perform their own analysis in order to satisfy themselves as to the accuracy and completeness of the information, statements and opinions contained in this announcement. This announcement is for information purposes only. Neither this document nor the information contained in it constitutes an offer, invitation, solicitation or recommendation in relation to the purchase or sale of shares in any jurisdiction. This announcement may not be distributed in any jurisdiction except in accordance with the legal requirements applicable in such jurisdiction. Recipients should inform themselves of the restrictions that apply in their own jurisdiction. A failure to do so may result in a violation of securities laws in such jurisdiction. This document does not constitute investment advice and has been prepared without taking into account the recipient's investment objectives, financial circumstances or particular needs and the opinions and recommendations in this representation are not intended to represent recommendations of particular investments to particular investments to particular persons.

About Talga

Talga Resources Ltd ("Talga") (ASX: TLG) is an advanced material technology company enabling stronger, lighter and more functional graphene and graphite enhanced products for the multi-billion dollar global coatings, battery, construction and carbon composites markets. Talga has significant advantages owing to 100% owned unique high grade conductive graphite deposits in Sweden, a test processing facility in Germany and in-house product development and technology. Joint development and commercial agreements are underway with a range of international corporations.



TECHNICAL GLOSSARY

Betotech	Betotech Baustofflabor GmbH, an independent ISO certified cement and concrete testing group.
Cathodic protection	Technique used to control corrosion and increase the service life of reinforced concrete structure.
Cement	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.
Compressive strength	Ability of concrete to resist deformation under tension/stretching force.
Concrete	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.
DIN standards	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.
Electrical impedance spectroscopy	Measure of a material's electrical properties as a function of frequency.
Electrical resistivity	Measure of material's ability to obstruct flow of electricity. Can be expressed in (Ohms.m) or (Ohms.cm).
Electrical strength	The maximum voltage sustainable by an insulating material, after which it loses its insulating properties.
Electromagnetic shielding	Practice of surrounding electronics and cables with conductive materials to guard against interferences from incoming or outgoing electromagnetic frequencies (EMF).
Energy infrastructure	The basic physical and organisational structures and facilities needed for the operation of energy supply.
Formulations	A material or mixture prepared according to a formula.
Graphene	A single atom thick layer of crystalline carbon, with properties of strength, conductivity and transparency that stem from its unique 2D structure.
Graphite	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.
Grounding	Safety measure used to prevent accidental contact with electrical hazards.
Heating element	A device that converts electric current passing through it into heat energy.
Inductive Charging	Inductive charging (also known as wireless charging) uses an electromagnetic field to transfer energy between two objects through electromagnetic induction.
Magnetic field effects	The effects of the lines of force that exist around an energised electrical conductor, magnet, or inductor on objects near current-carrying conductors.
Ohm.cm	Ohm centimeter, a measure of Electrical resistivity.
Plasticiser	Material added to concrete to improve flexibility and reduce brittleness.
Power capacity	In terms of generation, the capacity of a power plant is the maximum power that installation is capable of producing.
S/cm	Siemens per cm, a measure of electrical conductivity.
Thermal conductivity	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 (λ) or (W/m.K).

