

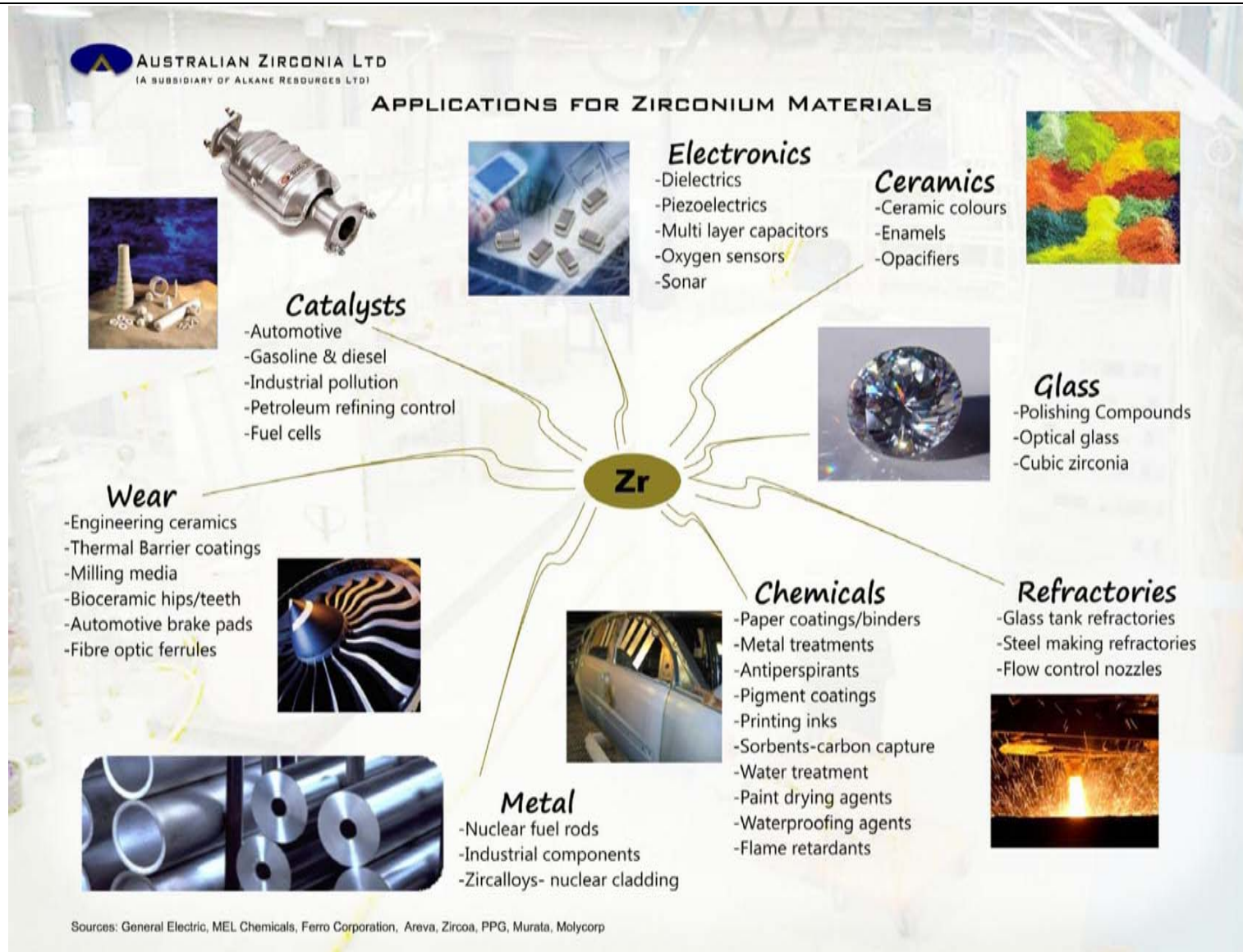
## **Products of the Dubbo Zirconia Project**

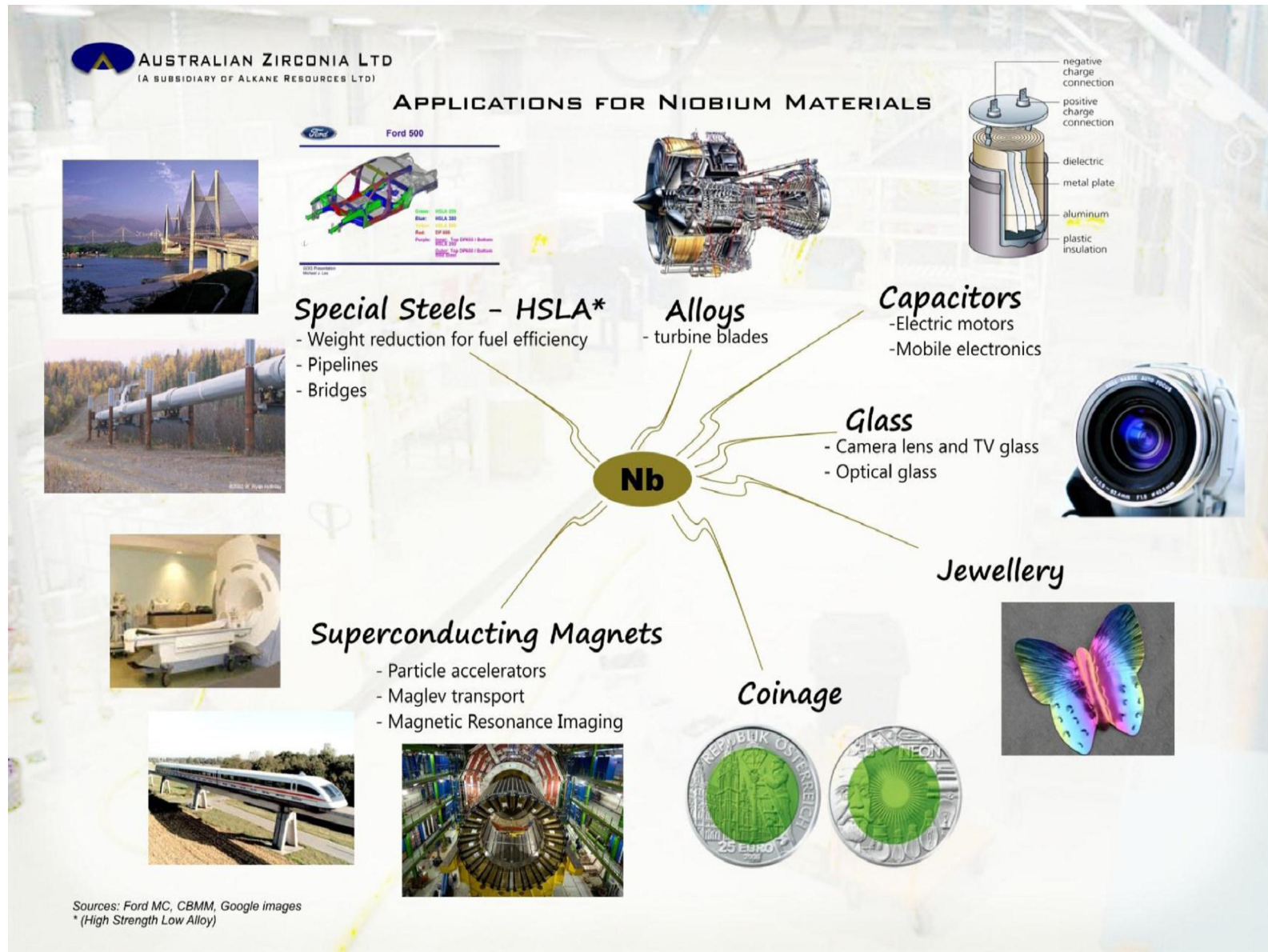
The production of a range of rare metal and rare earth products has been confirmed through the operation of a demonstration pilot plant established at the ANSTO Minerals facility at Lucas Heights. These final products include a range of zirconia products, ferro-niobium and other heavy and light rare earth oxides. There is considerable international market demand for rare metal chemicals, e.g. from zirconium, niobium, hafnium and tantalum, that can be used in the ceramic, catalyst, electronics, magnetic, and specialty glasses and alloys industries. Rare earth elements are also in demand because of their use in clean technologies, computing, automotive, entertainment, medical and military industries.

**Plates 1, 2 and 3** provide illustrations of the applications of zirconium, niobium and REE's.

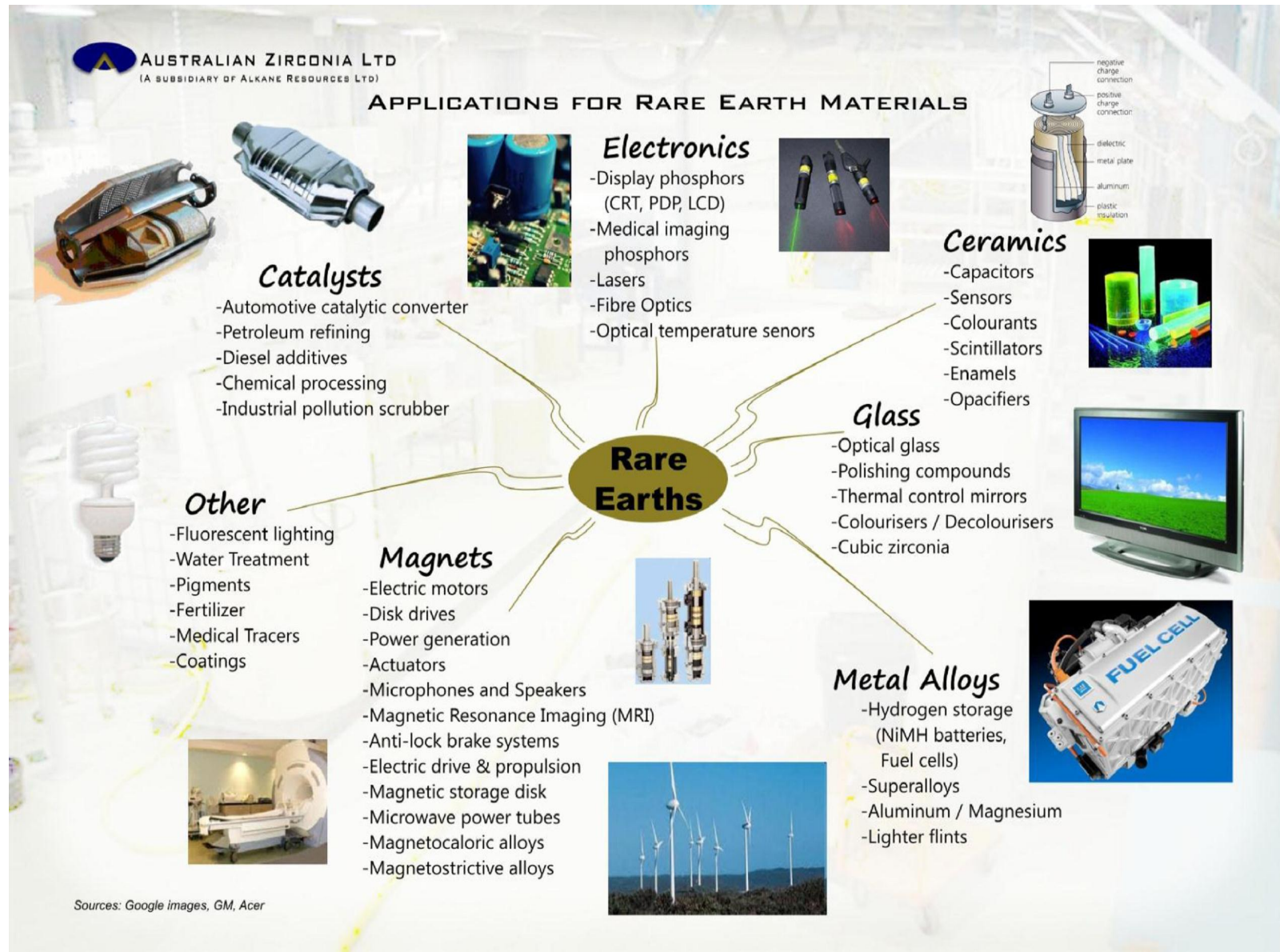
In many cases, there is no alternative to rare earths in manufacturing some products. More specifically the rare earth metals may be considered amongst a range of 'new age metals' that are becoming increasingly valuable for their applications in new technological developments.

Some of the possible uses for these products have environmental benefits. Several of the metalliferous products of the DZP would be used as substitutes for more traditionally used, but more harmful, products, while some products would be used as components of modern technologies that deliver specific environmental benefits. **Table 1** provides an overview of the products of the Proposal and their potential environmental benefits.









**Table 1**  
**Products and Uses**

Product	Use	Replaces	Environmental Benefit
Compounds of Zirconium	Drying agent in paints	Lead, traditionally used as the drying agent.	Zirconium-based paints remove the need to use lead-based paints in houses, schools, and buildings. Lead is toxic to humans and to the environment.
	Oxygen sensors and catalytic converters in cars		Zirconium has long been a key element in the oxygen sensors which measure the fuel-to-air ratio of car exhausts. These sensors allow the car's emissions management system to regulate the ratio in order to minimise needless greenhouse gas emissions.
	Catalytic converters in cars		Zirconia has been used to increase the efficiency of catalytic converters in cars <sup>1</sup> which change harmful compounds in car exhausts into harmless materials.
Niobium	Lightweight vehicle chassis	Heavier metals, like steel, that increase the chassis weight	Niobium is a lightweight metal used mainly in alloys and super alloys. Niobium alloys in vehicle chassis lighten the weight of the chassis, and overall weight of the car, by up to 10%, reducing the petrol required to power the car.
Hafnium	Control rods in nuclear reactors		Hafnium enables the production of control rods used in nuclear reactors. According to the US Nuclear Energy Institute, the use of nuclear power around the world reduced CO <sub>2</sub> emissions by more than 2 billion metric tons in 2005 by replacing the use of fossil fuels used to generate electricity. <sup>2</sup>
Tantalum	Capacitors for electronic goods	Non-tantalum capacitors	Tantalum capacitors, though relatively expensive, are highly sought after in a range of electronic goods such as mobile phones. Solid-bodied tantalum capacitors can run for decades enabling the continued use of relevant electronic devices rather than replacing the devices due to capacitor failure.
Rare earths – Yttrium	Corrosion-resistant coatings for cars	Lead-based coatings	Yttrium has been used in the development of cationic electro-deposition coatings to prevent corrosion of cars. Yttrium is much less toxic to humans and to the environment than lead-based products, and is a more effective anti-corrosion tool, with only half the yttrium by weight required to protect car bodies from corrosion when compared to lead. <sup>3</sup>
Rare earths – Europium	LED lights	Traditional incandescent lights	Europium can be used in white light emitting diodes (LEDs) <sup>4</sup> , the next big thing in sustainable lighting technologies. LEDs are much more energy efficient than traditional lighting systems.
Rare earths	Wind turbine magnets		Rare earths enable the production of wind turbines, a clean energy source. Australia has a renewable energy target of 20% by 2020, making the production of clean energy sources essential to achieving this goal. <sup>5</sup>
Rare earths - lanthanum	Hybrid car components	Traditional car components	Rare earths are used in a variety of hybrid car components <sup>6</sup> . Their light weight reduces the overall weight of the car parts.
Rare earths	Hybrid car batteries	Traditional lead-acid car batteries	Hybrid car batteries made from rare earths are up to twice as power efficient as traditional lead-acid batteries. <sup>7</sup>
Rare earths	Compact fluorescent light globes	Traditional incandescent bulbs	Compact fluorescent bulbs can produce the same amount of light as traditional incandescent bulbs but greatly reduce electricity consumption <sup>8</sup> .
<p>Note 1 <a href="http://media.rsc.org/Zinc%20and%20zirconia/Zirconia.pdf">http://media.rsc.org/Zinc%20and%20zirconia/Zirconia.pdf</a>.</p> <p>Note 2 <a href="http://www.nei.org/keyissues/protectingtheenvironment/quantifyingnuclearenergysenvironmentalbenefits">http://www.nei.org/keyissues/protectingtheenvironment/quantifyingnuclearenergysenvironmentalbenefits</a>.</p> <p>Note 3 <a href="http://www.epa.gov/greenchemistry/pubs/pgcc/winners/dgca01.html">http://www.epa.gov/greenchemistry/pubs/pgcc/winners/dgca01.html</a>.</p> <p>Note 4 <a href="http://www.popularmechanics.com/technology/engineering/news/important-rare-earth-elements#slide-2">http://www.popularmechanics.com/technology/engineering/news/important-rare-earth-elements#slide-2</a>.</p> <p>Note 5 <a href="http://www.environment.nsw.gov.au/resources/climatechange/10923windfacts.pdf">http://www.environment.nsw.gov.au/resources/climatechange/10923windfacts.pdf</a>.</p> <p>Note 6 <a href="http://www.popularmechanics.com/technology/engineering/news/important-rare-earth-elements#slide-1">http://www.popularmechanics.com/technology/engineering/news/important-rare-earth-elements#slide-1</a>.</p> <p>Note 7 <a href="http://www.popularmechanics.com/technology/engineering/news/important-rare-earth-elements#slide-1">http://www.popularmechanics.com/technology/engineering/news/important-rare-earth-elements#slide-1</a>.</p> <p>Note 8 <a href="http://energy.gov/sites/prod/files/piprod/documents/US-EU_WORKSHOP_on_RARE_EARTHS_Program.pdf">http://energy.gov/sites/prod/files/piprod/documents/US-EU_WORKSHOP_on_RARE_EARTHS_Program.pdf</a>.</p>			