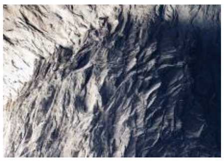
Edison Explains

Electric vehicles and rare earths

What does the electric vehicle revolution mean for rare earth elements?



Why do electric vehicles need rare earth elements?

Around 73% of rare earth elements are used in mature industries, including glass, ceramics and metallurgy. The remaining 27% are used in the production of neomagnets, which are essential components in electric vehicles (EVs).

Using the force produced when two magnets with opposing poles repel each other, electric motors use permanent magnets and coils that have been magnetised by electricity to propel an axle. The force (torque) of the spinning axle is used to power the wheels of an electric car.

Induction-based electrical motors, which do not use permanent magnets, can also power EVs. However, they are an unpopular solution compared to their magnetic cousins. Tesla, one of the only holdouts in induction motors, has used a magnetic engine in its new Model 3.

Which rare earth elements are used in EVs?

A magnet's strength is commonly measured by its coercive force and flux density.

Of the four main types of magnets, those made from the rare earth neodymium rate highest in coercivity, while retaining a similar flux density to their less powerful peers. This combination makes them perfect for high-powered EVs.

The drawback of simple neodymium magnets is a low operating temperature. This means they lose their magnetism at temperatures of around 60–80°C, like those found in an electric engine.

To mitigate this issue, the rare earth element dysprosium, or more rarely terbium, can be added, increasing operating temperatures to above 160°C.

Dysprosium, along with the rare earth element praseodymium, can also increase a magnet's coercivity, when alloyed with neodymium.

For this reason, neomagnets for EVs tend to be composed of around 24% neodymium, 7.5% dysprosium and 6% praseodymium.

Edison Insight

'The mid-term growth potential of EVs and neomagnets could drive demand for rare earth elements to levels never seen before. Obtaining secure and sustainable production outside China must be front and centre in the thoughts of end-users.'
Dr Ryan D Long, Edison mining analyst

Which companies are expanding into EV rare earths?

The greatest density of rare earth projects is in Australia. Australian explorer Northern Minerals is set to open its pilot plant at the Browns Range, in its quest to become the largest producer of dysprosium outside China.

Elsewhere in Australia, Alkane Resources, under its fully owned subsidiary Australian Strategic Materials, has completed its feasibility study at Dubbo, in New South Wales. There is also action in Northern Australia, where Arafura Resources owns and operates the Nolans rare earth project on a large praseodymium deposit.

The Yangibana Rare Earth Project, operated by Hastings Technology Metals, has integrated nine mining licences in the Gascoyne region of Western Australia.

Outside of Australia, Peak Resources owns the Ngualla Tanzania rare earth project, which expects to make 90% of its revenue from neodymium and praseodymium. And Rare Element Resources continues to operate the Bear Lodge Project, in Wyoming.

How quickly will the market for EV rare earth elements grow?

The International Energy Agency (IEA) forecasts the EV fleet will grow from 3.1m in 2017 to 125m in 2030.

Given a fully electric vehicle requires between 1kg to 2kg of neomagnets, with 0.42kg for hybrid variants, the market is set to expand massively over the next decade.

Dysprosium demand for EVs in 2017 was around 180–360 tons (t).

If the IEA's forecast holds true, demand for dysprosium in EVs would reach 6,000–13,000t by 2030, while neodymium would go from 582–1,162t in 2017, to 20,000–40,000t by 2030. Praseodymium would grow from 150–300t in 2017 to 5,000–10,000t by 2030.

That said, the amount of rare earth elements required per EV is unlikely to remain stable, and will probably drop as the technology improves.

29/01/19

Even so, a maturing EV industry represents an incredible growth in rare earth demand. Given China's diminishing exports of rare earths, this demand may be difficult to meet over the medium term.

Why does China's diminishing stake in rare earth export threaten the market?

China has dominated the supply chain for rare earths over the last 25 years, growing its market share from 54% in 1994 to highs of 97% in 2006.

The virtual monopoly on supply led to price volatility in 2010, when China put export quotas on rare earths, driving the price upwards. The 2010 quotas led to a decline in global total rare earth oxide production of 30% in a single year.

The quotas ceased in 2016, after the WTO ruled them to be unjustified, but China plans to continue its policy of reducing rare earth exports. This is part of its push towards environmental sustainability, high-tech markets and a consumer driven economy.

What are EV rare earth prices?

The 2010 quotas artificially increased prices, with neodymium reaching peaks of $270/kg, dysprosium $1,600/kg and praseodymium $225/kg.

Following the 2010 production shortage, prices declined between 2011 and 2015 to $48/kg for neodymium, $278/kg for dysprosium and $75/kg for praseodymium.

Since then the price of dysprosium and neodymium has declined to $172/kg and $62/kg, respectively.

Those weak price points have made investors wary of engaging in equity investment within the rare earth sector, with the entire prospect considered to be high-risk, low-reward.

The growth of EVs, alongside the decline in Chinese production, will likely see prices increase over the medium term, making proactive investment into new projects more likely.