New Power

Draft CfD allocation pot wins little praise from renewables organisations

The Department of Energy and Climate Change (Decc) expects the budget for its first first Contracts for Difference (CfD) allocation round to be £205 million, according to a draft budget published at the end of July. The department said the CfD announcement "will provide long-term clarity and reduce risk for investors".

So-called "established technologies" – onshore wind (>5MW), solar PV (>5MW), energy from waste with CHP, hydro (5-50MW), landfill gas and sewage gas – will compete for contracts worth £50 million.

Less-established technologies - offshore wind, wave, tidal stream, advanced conversion technologies, anaerobic digestion, dedicated biomass with CHP, geothermal, Scottish islands onshore wind – will bid for contracts worth £155 million.

The allocations are spread across delivery years starting in 2016/17 and reaching ahead to 2020/21 (they are not separate and additional in each year). That spread means that developers can bid for support from this year's budget for projects being commissioned any time between now and the end of the decade.

The CfD allocation comes in addition to Renewables Obligation funding at this stage, giving many developers the option of choosing between the two support schemes. The RO closes to new projects in 2017.

There are no caps on technologies in either pot in the CfD budget. There is a minimum level of commitment for just one technology basket – wave and tidal stream, where Decc wants to see a minimum 70MW capacity come forward. Decc has reserved part of the overall CfD budget to bring forward 100MW of

State Aid clearance (mostly) granted

Two of the key measures in the government's Electricity Market Reform package have passed EU State Aid tests. The Capacity Mechanism and FIT Contracts for Difference were both given the green light by the European Commission, which noted that in both cases in the long run overseas generators would be able to compete for contracts on the same terms as domestic bidders.

The Commission also approved Final Investment Decision (FID) - enabling contracts signed by the Department of Energy and Climate Change (Decc) with five offshore wind farms - Walney, Dudgeon, Hornsea, Burbo Bank and Beatrice.

Decc is still awaiting clearance for three biomass FID-enabling projects - two conversions and one dedicated combined heat and power plant. Also awaiting clearance is plans for greater support for onshore wind in Scottish islands.

Decc will seek separate State Aid clearance for bespoke CfDs planned to support carbon capture and storage projects.

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Metal supply: is it a risk for energy?

Behind the steel and concrete, even the most familiar energy technologies rely on exotic metals to deliver high performance. Those metals can be hard to extract, globally concentrated and in growing demand by competing industries. Are they a risk factor? Janet Wood investigates

Most types of electricity generation look fairly familiar: turbines, whether they are impelled by wind, water. steam or gas, have been around for centuries and most other equipment is working on basic design principles almost as old. And from a distance the technologies can look simple: generally iron and steel in concrete foundations.

But that familiarity is misleading: the technology inside is complex and more and more dependent on a suite of metals that sound far more exotic.

The names are unfamiliar, but the needs are growing. In a "State of the planet" blog for the Earth Institute, that organisation's Peter Kelemen gave the example of a metal called neodymium, required for the permanent motors used in wind turbines. He said, "Every MW of electricity needs 200kg of neodymium.... If wind is going to play a major part in replacing fossil fuels, we will need to increase our supply of neodymium."

In 2012 an MIT study projected that neodymium demand could grow by as much as 700% over the next 25 years; demand for dysprosium, also needed for wind turbines, could increase by 2,600%.

Neodymium and dysprosium are both members of a group of metals known as "rare earths". Another is praseodymium, which is a component of metal alloys. This group of metals has come under scrutiny because China is almost the only supplier: 97% of the rare earths used worldwide come from China's mines in Inner Mongolia. Fears have been raised that China may reserve its supply to itself, and indeed in March this year a World Trade Organisation (WTO) panel argued that Chinese export restrictions on the metals breached WTO rules and obligations. The Chinese pricing strategy is also obscure.

Limited access to key metals is not confined to rare earths, or to China. Brazil accounts for 92% of extraction of niobium – not a "rare earth" metal but one with important uses in magnets. South Africa and Kazakhstan extract 62% of chromium and cobalt production is dominated by the Democratic Republic of Congo.

That sounds risky. But once again it is easy to be misled. Despite the name, the 17 "rare earths" are not, in practice, at all rare.

Don't be misled

Catherine Joce, manager for circular economy and materials security at the Knowledge Transfer Network, explains that the problem with rare earths is not finding resources. Some are more common than metals that sound more familiar and, for example, the Minor Metals Trade Association notes that a mineral called Monazite "contains all of the rare earth elements, often in concentrations of up to 50%. Monazite can be found in river sand in countries such as India, Brazil and South Africa". The problem, Joce says, is extracting and processing the rare earths.

"You find all 17 rare earths in varying percentages and you need a market for all of them."

The rare earths are "very particular in how they are found," said Joce, "they are very chemically similar and so very difficult to separate. You find all 17 rare earths in varying percentages and you need a market for all of them. Finding a deposit that has the right balance [to reflect the market for each metal] is hard and we don't have the processing capacity to do that complicated separation".

That would mean that once you have found a deposit that marches your market, a developer would end up transporting ores in some form to a processing facility – multiplying the energy demand and environmental impact of what is already a very damaging activity.

As for possible processing sites in existence now, Joce lists just a couple outside China. She says the US had that capability and is bringing it back on line, while Sweden has both deposits and capability.

In fact, rare earths are just one example of "strategic metals" where supply is restricted in some way and future uses are likely to grow fast enough to test the

Key question for wind turbine end-of-life

There is both a big potential cost or potential opportunity around recycling the magnets from wind turbines at the end of their lives, says Catherine Joce, manager for circular economy and materials security at the Knowledge Transfer Network.

The magnets in today's wind turbines do contain large amounts of useful metals. She says they will not be re-used in their current form: "the technology is changing so fast that in ten or 20 years" they will be obsolete, she says, as new bigger turbines are employed.

"It's not just a few kilogrammes," she said, as is clear from Peter Kelman's assessment that put the neodymium requirement for each megawatt at 200kg. "At the moment we have made more progress in recycling small magnets [for example as part of disc drives] than large ones," she said.

It's not clear who will have ownership of thousands of tonnes of wind turbine magnets as wind farms are "replanted". Developing a process and building a facility to recycle them is a big risk, but it could have a large return.

market. That may not apply just to obscure metals: for some relatively familiar metals demand may outstrip supply too.

This issue is on politicians' watch lists. A 2010 report from the Select Committee on Energy and Climate Change 2010, said "In our view strategically important metals comprise the rare earth elements, the platinum group elements and other main group elements of importance to the UK."

Research Councils UK (RCUK) said in evidence to the Committee that "The technology required to deliver the government's plans to build a "green manufacturing" sector e.g. solar cells, depends on the availability of some strategically important metals. A stable supply of metals will be important in the transition to a low carbon economy."

The committee named other "strategically important" metals, as well as all the rare earths and all of another distinct group of elements, the platinum group. The EU, meanwhile, had already added the rare earths and platinum group to 12 others in an existing list of critical materials. In June this year it boosted that list to 20 items (see table). Some – like coking coal - are not chemical elements. Some – like silicon – are clearly not included for their rarity. What is going on?

This issue is really about commodity supply, and that is the reason why it's too simplistic to say that China has a stranglehold on the supply of one element or another.

These are commodity items where supply and demand are dynamic. Supply of one element can be challenged because more is needed – as in the ramp-up of wind power – or because the source has been disrupted, whether that is because of technical or political problems or exhaustion of a source. But there is much more at play. The market factors are complex and interdependent. For example, the German demand for PV-related critical metals and silicon largely collapsed along with the industry, when it was faced with cheaper Chinese imports. And as Catherine Joce points out, "lots of the time it is price volatility that matters rather than [simply high prices]. You can't plan for price fluctuations].

In evidence for the Select Committee report Anthony Lipmann, managing director of Lipmann Walton & Co Ltd and former chairman of the MMTA, said that there was no shortage of strategic metals because "in practice, you just dig deeper". But digging deeper, finding new resources, or processing new supplies is costly

. The Select Committee noted that "higher energy costs are a particularly significant factor in the exploitation of lower grade minerals to extract a metal and thus in their financial viability. The corollary is that the supply of metal is vulnerable to increases in energy costs."

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Speaking about this issue in 2010, David Sandalow, assistant secretary for policy and international affairs at the US Department of Energy, said the answer was a global supply chain with diverse sources.

He said: "The first strategy is to globalise supply chains for strategic materials. Second, we must develop substitutes. Third, we must promote recycling, re-use and more efficient use of strategic materials". The market is dynamic and responds in all these ways – and it must continue to respond: we are not evolving towards a stable market but learning to stay balanced in one that is constantly shifting.

Examples are easy to find. Bill Radvak of American Vanadium Corp, writing in Energymag in 2012, noted that for vanadium “world consumption has grown at approximately 6.4% while in China alone the growth has been about 20.5%.per year” He said global vanadium consumption was expected to double by 2020, for use in specialist steel alloys, and he said that “As recently as 2005, a simple change in building codes turned China from the world’s largest vanadium exporter to a net importer, causing a 450% increase in vanadium prices in less than a year.”

His company, founded in 2006, was a response to this market “pull” and is working on permits for a the first US mine, the Gibellini Project. He said it would produce “approximately 25% of US needs and 4-5% of the world’s current vanadium supply”.

The Select Committee report said mining firms were “looking favourably at Britain as a project destination with deposits of strategic metals leading a small mining revival following the launch of the country’s first new metal mine in 45 years”.

The UK has deposits of metals such as tin - used in mobile phones, and tungsten - used to make drilling tools - as well as antimony and tellurium.

But bringing a new mine on line is a slow and costly process – and one that has its own risks. Speaking at an Institute of Metal, Minerals and Mining conference three years ago Gerry Clarke discussed the evolution of the lithium industry – a metal with fast growing demand for batteries, and hence electric vehicles, but also used more and more widely in solar PV, as well as nuclear power and high efficiency glass.

Clarke said forecasts of prospective automotive demand-growth had been “disproportionate to established lithium markets, exacerbated by ill-informed opinion concerning lithium reserves and resources,” and the result had been “wide- ranging commentary as to whether or not there is sufficient lithium available in the Earth’s crust”.

He said that market fever after decades of “unexciting lithium market dynamics with just a few producers fuelled scepticism and created the conditions that have led to a gold-style “rush” by the industry”. He said there were 82 new projects in the pipeline that far exceeded likely demand - those in Argentina, Australia, Bolivia, Canada, China, Finland, Serbia and the USA had announced cumulative target tonnages of 228,000t per year to meet a demand gap of 100,000t in 2020, and that was without taking into account likely growth in supplies from recycling. “Pain looks an inevitability for many,” he said.

Sandalow’s call to develop replacements has also found fertile ground. For example, a $3 billion, three-year programme started at the US’s Ames Laboratory in 2012 aims to develop a new class of permanent magnets based on cerium, for use in electric vehicles and renewable generation. Cerium is four times more abundant and significantly less expensive than the neodymium currently used. As always, there is a caveat: a successful programme could reduce demand for neodymium, but a fast global expansion of those technologies will call on both.

Meanwhile, rising demand in a related, or entirely different sector can raise prices and disrupt supply, and each other sector is also looking at finding new sources or finding substitutes just as much as the energy industry. The biggest use of rare earths is not renewable energy, for example, despite its growth, but as catalysts in te chemicals industry.

Recycle and recover

In a society moving towards a “circular economy” where waste is a new resource one obvious factor ought to be recycling – and indeed as well as being mentioned by the US’s Sandalow this option was

UKERC

A new report by the UK Energy Research Centre ‘Materials Availability for Low Carbon Technologies’ indicates that options for material substitution are limited but recommends that the UK continues to pursue technology substitutes to better protect the industry against price volatility. For example, while some thin film photovoltaics rely on critical metals, other thin film technologies, such as amorphous silicon, do not. In addition, more must be done to encourage recycling of metals from end-of-life products by offering sufficient price incentives and better regulation.

Creating secondary sources will help relieve supply pressures, but it is also vital to the growth of the low-carbon economy that we further develop primary sources of metal minerals. To facilitate this, the research recommends greater support for R&D support for substitute materials and technologies; strategic stockpiling of selected materials; and international diplomacy, financial support and bilateral agreements with foreign exporters. This will require greater collaboration between industry and government.

See www.ukerc.ac.uk

highlighted by the Select Committee.

Its report said, "We are pleased that the metal recycling industry in the UK is recycling 90%, by weight, of collected waste and that substantial quantities of platinum, rhodium, palladium, gold and silver are being recovered, mainly from recovered waste electrical and electronic equipment. However, it is of great concern to us that some strategic metals, which are often in products in small quantities, are likely to be lost in the 10% not being recycled."

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It is a strategy that is hard to realise, says Joce. As with extracting the metals from fresh deposits, processing is generally a complex and energy intensive business, even for relatively small-scale items.

She gives the example of mobile phones: they contain up to 40 elements and it is easier – and more cost effective - to extract and recycle the plastic and gold contained in them than to go on to remove small amounts of the other elements, even if they are those that have key uses in many industries. Making further recycling economic requires a complex facility on a massive scale and Europe relies on just one, a facility working on a "phenomenal scale" in Belgium, Joce says.

Another important use for rare earths and other "exotic" metals in the energy industry is in producing highly-specified alloys with the characteristics required for extreme environments, such as gas turbine blades heat-proof to thousands of degrees or nuclear power pipework, or corrosion-resistant steels like used in oil and gas, or renewables, offshore.

Those alloys require only trace amounts of critical metals, so the issue for these alloys is seldom one of availability or price. The question is around the circular economy. It is entirely uneconomic to remove those traces from steel. Instead, the steel is simply re-used as lower grade steel.

So are rare earths a risk factor for the energy industry? They are: but like other commodities, they are a risk factor that can be managed, with constant vigilance.

They are unlikely to be showstoppers but they could affect projects long term. As Catherine Joce says, "None of these things are rare. They may just not be available".

Metals considered "critical" or "strategic" in the UK or EU

Metal	Symbol	Uses	Rarity
Rare Earths			
Cerium	Ce	Catalytic converters	EU14 list, SelCom 'strategically important'
Dysprosium	Dy	Magnets, wind power	EU14 list, SelCom 'strategically important'
Erbium	Er	Fibre optics	EU14 list, SelCom 'strategically important'
Europium	Eu	CFLs, lasers	EU14 list, SelCom 'strategically important'
Gadolinium	Gd	Nuclear	EU14 list, SelCom 'strategically important'
Holmium	Ho	Few, but high potential for magnets	EU14 list, SelCom 'strategically important'
Lanthanum	La	Batteries, hydrogen storage potential	EU14 list, SelCom 'strategically important'
Lutetium	Lu		EU14 list, SelCom 'strategically important'
Neodymium	Nd	Magnets, lasers	EU14 list, SelCom 'strategically important'
Praseodymium	Pr	Alloys, CFL	EU14 list, SelCom 'strategically important'
Promethium	Pm		EU14 list, SelCom 'strategically important'
Samarium	Sm	Magnets, IR-absorbing glass	EU14 list, SelCom 'strategically important'
Scandium	Sc		EU14 list, SelCom 'strategically important'

Terbium	Tb	Fuel cells, semiconductors, PV	EU14 list, SelCom 'strategically important'
Thulium	Tm	Refrigeration	EU14 list, SelCom 'strategically important'
Ytterbium	Yb		EU14 list, SelCom 'strategically important'
Yttrium	Y	Superconductors	EU14 list, SelCom 'strategically important'
Metal	Symbol	Used in	Rarity
Antimony	Sb	Batteries	EU14 list, SelCom 'strategically important'
Beryllium	Be	PV	EU20 list, SelCom 'strategically important'
Cadmium	Cd	Thin film PV	
Chromium	Cr	Batteries, many structures	SelCom 'strategically important'
Cobalt	Co	Batteries	EU14 list, SelCom 'strategically important'
Gallium	Ga	PV, LEDs	EU14 list, SelCom 'strategically important'
Germanium	Ge	Fibre optics, PV	EU14 list. SelCom 'strategically important'
Gold	Au		SelCom 'strategically important'
Hafnium	Hf	Semiconductors, gas turbine blades, alloys	SelCom 'strategically important'
Indium	In	PV, LEDs	EU14 list,SelCom 'strategically important'
Lithium	Li	Nuclear, batteries, concentrating solar power, storage	SelCom 'strategically important'
Magnesium	Mg	Storage	EU14 list, SelCom 'strategically important'
Molybdenum	Mo	PV, superconductors	
Nickel	Ni	Batteries, alloys, magnets	SelCom 'strategically important'
Niobium	Nb	Alloys, magnets	EU14 list, SelCom 'strategically important'
Rhenium	Re	Turbine blades, superconductors	SelCom 'strategically important'
Selenium	Se	PV, batteries	
Silver	Ag	Electrical/electronics	
Tantalum	Ta	Gas turbine blades	Rising threat but moved out of EU list due to better supply, SelCom 'strategically important'
Tellurium	Te	Thin film PV	Serious threat
Titanium	Ti		SelCom 'strategically important'
Tungsten	W		EU14 list,
Vanadium	Va	Batteries, alloys	SelCom 'strategically important'
Zinc	Zn		
Platinum group			
Iridium	Ir	Alloys	EU14 list, SelCom 'strategically important'
Osmium	Os	Catalysis	EU14 list, SelCom 'strategically important'
Palladium		Catalysis	EU14 list, SelCom 'strategically important'
Platinum	Pt		EU14 list, SelCom 'strategically important'
Rhodium			EU14 list, SelCom 'strategically important'
Ruthenium	Ru		EU14 list, SelCom 'strategically important'