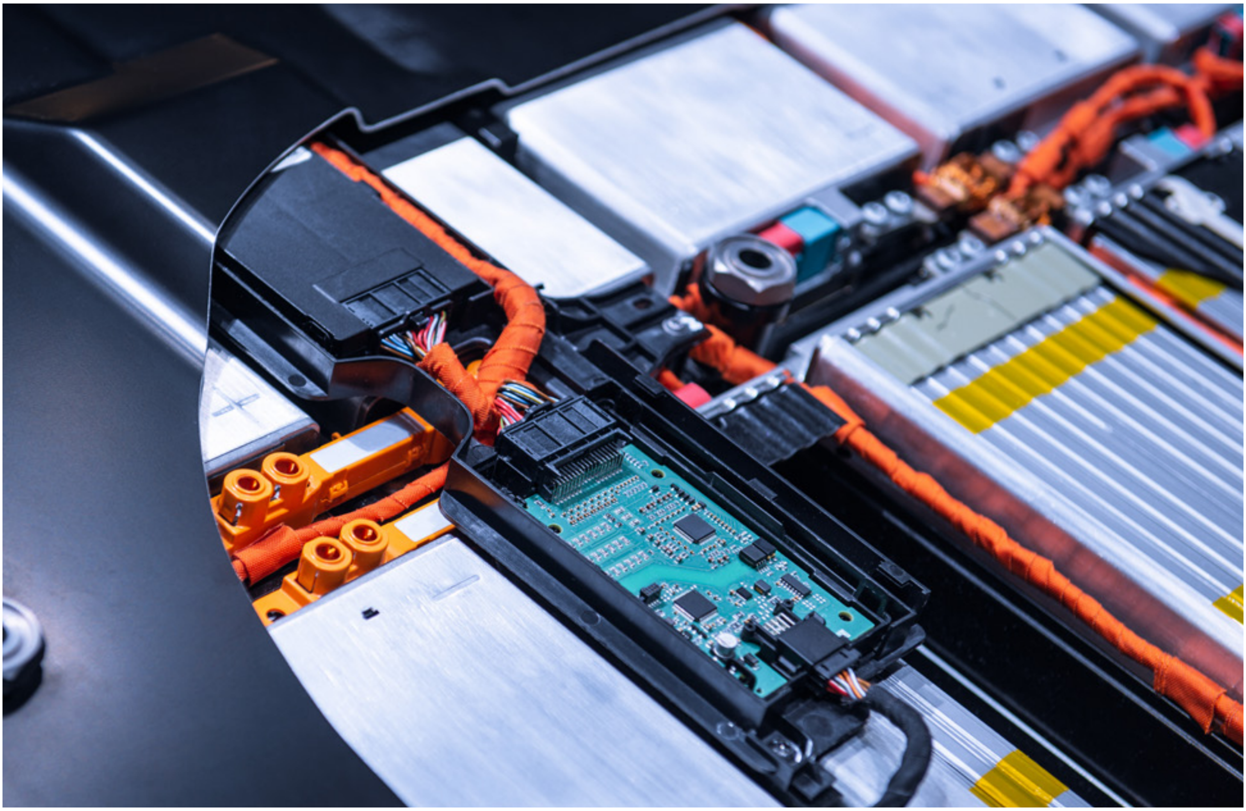
Critical point

Securing the raw materials needed for the UK's green transition

green alliance…



Critical point: securing the raw materials needed for the UK's green transition
By Susan Evans, Heather Plumpton and Libby Peake

Acknowledgements
Many thanks to John Barrett and the team at the Centre for Research into Energy Demand Solutions (CREDS), for generously sharing their modelling data with us ahead of the publication of their report, *The role of energy demand reduction in achieving net-zero in the UK*, enabling us to develop our lower energy demand scenario.

We would like to thank the Circular Economy Task Force members for their support throughout this project, including their feedback on the analysis and its implications.

This report is produced by Green Alliance as part of a work programme for the Circular Economy Task Force, a policy focused business forum to promote ambitious ideas on the better management of resources.

The analysis and recommendations in this report are solely those of Green Alliance and do not necessarily reflect the views of the Circular Economy Task Force members.

Circular Economy Task Force:

With support from:

Green Alliance
40 Broadway
London SW1H 0BU

020 7233 7433
ga@green-alliance.org.uk

www.green-alliance.org.uk
@GreenAllianceUK

The Green Alliance Trust
Registered charity no 1045395
Company limited by guarantee
(England and Wales) no 3037633

The Green Alliance Trust
Registered charity no. 1045395
Company limited by guarantee
(England and Wales) no. 3037633
Registered at the above address

Published by Green Alliance
ISBN 978-1-912393-66-4
November 2021

Designed by Howdy

Summary

Technologies central to a low carbon economy, like electric vehicle batteries, wind turbines and solar panels, are made using resources such as lithium and rare earth elements, which are examples of critical raw materials. Although economically and strategically important, there are known risks to their supply.

As the prime minister set out in his 2020 *Ten point plan for a green industrial revolution*, the UK wants to lead the world in low carbon technologies, with the potential to create a quarter of a million green jobs in regions across the UK.[1] However, supply chain risks around critical raw materials, and related reputational risks, threaten this ambition and the transition to net zero more generally.

First, the mining, processing and refining of these materials can cause considerable environmental and social harm, running counter to goals on climate change, biodiversity and human rights. Second, geopolitical tensions are rising as countries all over the world are securing supplies for their own use in green, digital and military technologies, with China controlling over 60 per cent of the supply of some resources.

UK demand for certain critical raw materials is set to soar as a result of the move to a net zero carbon economy. Under its current transition strategy, it is likely to use up double its fair global share of known reserves of some critical raw materials by 2035, and this could increase to as much as five times its fair share by 2050. We have assessed 'fair share' based on the amount of known reserves available, divided per head of population. Such rapid increases in demand for relatively scarce resources, in a world of intensifying supply chain risks, suggest that low carbon sectors in the UK could face significant supply chain vulnerabilities. And, by using more than its fair share, the UK could hinder the wider global transition to net zero, as well as drive growth in damaging extractive industries, exporting pollution impacts to low income, resource rich countries.

However, there are lower risk options. Our analysis shows that the amount of critical raw materials required could be sharply reduced by cutting energy demand and improving resource efficiency. Through economy-wide measures such as improving freight efficiency and insulating homes, and by increasing car sharing, public transport and active travel, the UK could halve its total use of some critical resources by 2030, compared to the current trajectory. This would cut immediate supply risks, but even so, by 2050 the UK could still be using up to three times its fair share of reserves of some critical raw materials.

By also scaling up recovery and reprocessing, through circular economy approaches, an increasing share of remaining demand could be met with secondary materials, resulting in less environmental damage. This would allow the UK to retain and maximise the value of critical raw materials, build more resilient supply chains and create good jobs across the country, contributing to both the levelling up and green recovery agendas. Recent Green Alliance analysis suggests there could be 450,000 jobs by 2035 in an expanded circular economy, including in the regions of the UK that most need them.[2]

We conclude that the UK should adopt a strategy to ensure long term supplies of critical raw materials that prioritises both energy demand reduction and circular economy approaches. Under this strategy, primary extraction would be the higher risk, last resort option to meet industry's requirements. The government has announced its intention to publish a critical minerals strategy in 2022, with oversight from an expert committee. We propose the following guiding principles for this new strategy:

1.
Set an ambitious environmental mandate for the new critical minerals strategy and expert committee.

They should:

- align with UK environmental targets, including the net zero target and the new resource and nature targets set under the new Environment Act;
- minimise negative environmental and social impacts globally, with extractive activities curtailed and managed responsibly;
- ensure the committee is independent and representative of industry, academia and non-governmental organisations (NGOs);
- be transparent, including about the committee's mandate and work programme;
- catalyse the resumption of work on a National Materials Datahub to underpin strong decision making on critical raw materials management.

2.
Harness the potential of energy demand reduction.

The government should:

- seek advice from the Climate Change Committee on critical raw material supply risks to the net zero transition plan, and on the options to reduce those risks through energy demand reduction;
- adopt 'no regrets' measures immediately to cut demand for critical raw materials, ie accelerate the introduction of energy efficiency measures across transport, buildings and other sectors, and support design innovations that reduce the need for critical raw materials in low carbon technologies.

3.
Build a circular economy for critical raw materials

The government should:

- seize short term opportunities to introduce effective extended producer responsibility rules for batteries, as well as waste electrical and electronic equipment (including solar panels);
- strengthen standards for the end of life treatment and recycled content of low carbon technologies and infrastructure, including through the public procurement process;
- establish comprehensive circular economy policy frameworks for electric vehicle batteries and other important technologies, such as rare earth magnets, to spur investment in reprocessing;
- use the UK Infrastructure Bank to invest in infrastructure for the circular economy, including recovery, reprocessing and reuse facilities for critical raw materials and the technologies which require them, and in adequate storage facilities to retain value.

By taking these actions the UK would demonstrate global leadership in steering a fair transition to a decarbonised economy, minimising environmental damage, while at the same time supporting growth in the essential industries of the future.

Critical raw materials are essential for a low carbon economy

"As countries across the world decarbonise and build their low carbon industries, global demand for critical raw materials is rising."

Critical raw materials are economically and strategically important, often with specific functionality that makes them hard to replace, but there are supply risks.[3] Some are needed for the transition to a net zero carbon economy, for the manufacture of technologies such as wind turbines, solar panels and electric vehicle batteries. The same materials are also essential in other sectors, including consumer electronics and defence.[4]

Motors used in wind turbines and electric cars require the rare earth elements neodymium, dysprosium and praseodymium for their permanent magnets. The predominant type of solar panel on the market is made using silver.[5] Batteries for electric vehicles and energy storage can use a range of technologies, but most common is lithium-ion, requiring both lithium and cobalt.[6]

As countries across the world decarbonise and build their low carbon industries, global demand for critical raw materials is rising. The prime minister's *Ten point plan for a green industrial revolution* aims to put the UK "at the forefront of global markets for clean technology".[7] This includes the wind turbines and electric vehicle batteries, essential for low carbon transport and energy, which need to be rolled out fast. The government has committed to quadrupling UK offshore wind capacity and replacing sales of new petrol and diesel cars with electric vehicles during the 2020s. Investing in these rapidly scaling industries will position UK companies to export clean technologies and services around the world.

Supply chain risks

Sourcing the critical raw materials necessary for this industrial revolution comes with risks. Mining and processing can have significant environmental and social impacts. In addition to the greenhouse gas emissions from production, mining results in biodiversity loss from land use change, as well as water and air pollution.[8,9] Some processes also exacerbate water scarcity. Brine-based lithium extraction in South America requires 500,000 gallons of water per tonne of lithium, in a region already suffering water stress.[10] And, as known and accessible reserves become increasingly scarce and the quality of mined material declines, the environmental impacts of mining increases.[11]

Deep sea mining for critical raw materials will expand these impacts to the delicate ecosystem of the seabed.[12] Companies involved in supply chains are being cautious, including the electric vehicle battery manufacturers Samsung SDI and Volvo Group, who are already asking for a moratorium on deep sea mining until the full environmental impacts are understood.[13]

Social impacts of mining can include corruption, high injury rates and human rights abuses. Up to 30 per cent of cobalt mining in the Democratic Republic of Congo is carried out in small scale operations, which are known to use child and forced labour in some cases.[14]

"In 2020, China dominated both production and geological reserves of rare earth elements."

Furthermore, some critical raw materials are geographically concentrated, creating geopolitical risks. In 2020, China dominated both production and geological reserves of rare earth elements, holding 60 per cent of global mine production and 40 per cent of reserves.[15] China also controls a disproportionate share of some other critical raw materials. The majority of cobalt reserves are found in the Democratic Republic of Congo, where China controls over 40 per cent of production and has recently taken steps to extend its influence.[16] China contains 49 per cent of lithium reserves, but production is more widespread, led by Australia and the 'lithium triangle' of Chile, Bolivia and Argentina.[17]

The limited potential for UK primary supplies of critical raw materials

The UK currently does not produce any lithium, cobalt, silver or rare earth elements.[18] Companies such as British Lithium are exploring the potential to mine from geothermal waters in south west England.[19] There is also the possibility of undiscovered cobalt resources in the Lake District, North Pennines, Cheshire and North Wales, but no systematic assessment has been conducted.[20]

If the UK wants to develop domestic primary supplies, much more investment will be needed in processing facilities and skills.[21] And many of the potential sites are in treasured landscapes, increasing the likelihood of strong and protracted public battles over mining and extraction proposals.

Resource security concerns

Securing access to materials is a matter of increasing concern for countries, with governments diversifying their sources and shoring up their stocks, even at the expense of other countries' supplies, which raises questions of equity. But, when it comes to climate change, the world will succeed or fail collectively.

As the UK seeks to build its green industrial base and lead in the global race to net zero, it is important to ask now whether the current plans are enough to put the country on track for a transition which is secure, green and fair.

We address this question by estimating the UK's future needs for critical raw materials to underpin the decarbonisation of the economy over the next few decades. Focusing on those needed for electric vehicles, wind and solar power, we explore how quickly the UK is likely to draw down its fair share of global reserves. We compare a scenario approximating the UK's current demand trajectory, which depends heavily on the rapid adoption of green technologies in power generation, transport and industry, against a scenario in which cross-cutting measures to lower energy demand help to reduce reliance on critical raw materials.

Emerging concern

Critical raw materials in consumer electronics and data centres

Critical raw materials are used in many technologies essential to modern life, including consumer electronics and data centres. These technologies use a wide range, including copper, gallium, germanium, gold, indium, rare earths and tantalum. The volume of electronics produced every year means that small changes in material content have big implications for resource demand, and supply chains cannot always adapt fast enough to keep up with the market.

For example, digitalisation produces vast amounts of data that need to be stored and processed. Global demand for data storage by 2025 could require 120 times the current EU demand of the rare earth neodymium. This could create supply problems for wind turbines and electric vehicles, which both use rare earth elements in permanent magnets. To avoid this competition for materials, other data centre technologies could be used, but these use other, more expensive, critical raw materials, such as platinum.[22] Managing these conflicts requires systematic and strategic oversight.

The UK is on track to use more than its fair share of critical raw materials

"Not only are supplies finite, every increase in production makes global climate and biodiversity goals harder to achieve."

Supply risks tend to be discussed in terms of demand versus annual supply. For example, the Natural History Museum has said that, to replace all of today's cars with electric vehicles, the UK would need twice the annual global production of cobalt.[23] The typical response to projected under supply is to increase extraction but, not only are supplies finite, every increase in production makes global climate and biodiversity goals harder to achieve. Reducing demand for virgin materials is the only certain way to ensure that supply chains are both resilient and sustainable.

In this analysis, we focus on three technologies vital to the net zero transition: wind turbines, solar panels and electric vehicles. The critical raw materials they require include rare earth elements, cobalt, lithium and silver. Instead of looking at annual supply and demand, as is usually the case, we have compared total projected UK cumulative demand, against the country's 'fair share' (based on population) of total known reserves.

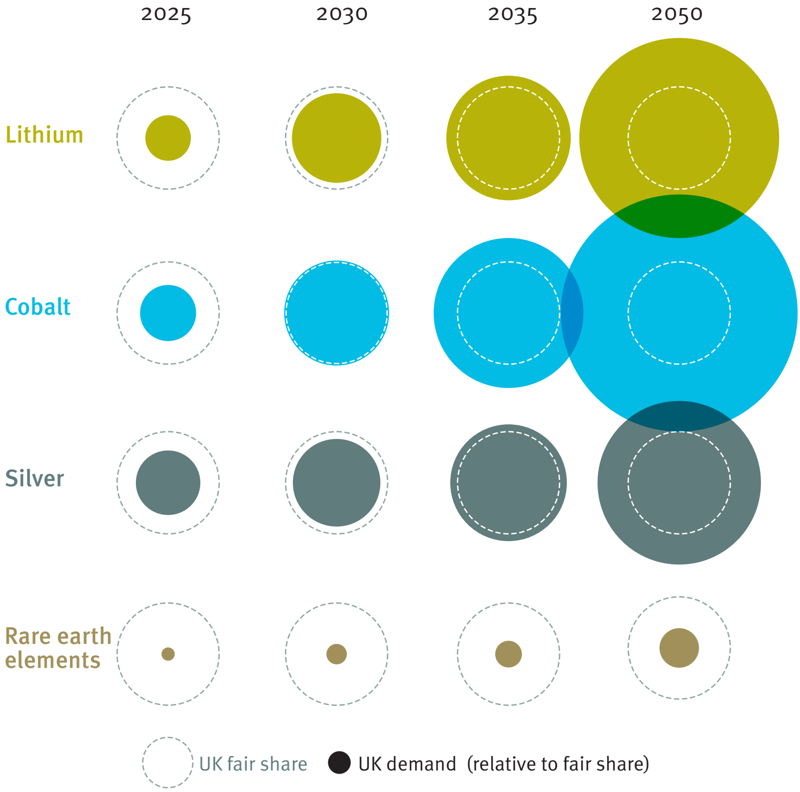
Demand is particularly high for the lithium and cobalt used in electric vehicle batteries. Between now and 2035, the UK could have used up 240,000 tonnes of lithium and 90,000 tonnes of cobalt. By 2050, the UK's cumulative demand for lithium could more than double to 550,000 tonnes.[24]

When other uses are taken into account, the UK is on track to use more than its global fair share of these critical raw materials by 2035, with the situation worsening by 2050.

The picture is particularly stark for the materials needed for electric vehicle batteries. The UK will use one and a half times its fair share of lithium by 2035, rising to over four times by 2050. For cobalt, it will use twice its fair share by 2035 and over five times by 2050. The projection is also risky for solar PV panels, which use silver to conduct electricity. The UK will use up 1.3 times its fair share of silver by 2035, and over two and a half times by 2050.

"The UK must take a strategic, sustainable approach to the critical raw material challenge as a matter of urgency."

UK is set to far exceed its fair share of some critical raw materials by 2050



This level of resource use sets up unnecessary risks for the future growth and long term viability of the UK's low carbon industries. As we illustrate, they would face significant supply risks by 2035 and certainly by 2050. Even for rare earths, where UK use is likely to remain below its fair share, reserves are subject to high geopolitical risks, as production is dominated by China. Those countries able to control critical raw material supplies will be able to dominate the market in high value-added production, benefiting from the associated high quality jobs and export revenue.

If the UK wishes not only to secure its future material supplies but also establish leadership in high value-added low carbon technologies and products, it must take a strategic, sustainable approach to the critical raw material challenge as a matter of urgency.

By using more than its fair share of reserves to meet domestic consumption by 2035, the UK could also hinder the low carbon transition of other countries. Driving growth in extractive industries would also mean that lower income, resource rich countries disproportionately suffer the pollution and human rights impacts of the UK's clean growth. This is contradictory to the aim of a clean, green transition and is clearly unjust.

How the UK can maintain supplies of critical raw materials

"If the UK adopted strategies to reduce energy demand it could reduce energy consumption by 41 per cent by 2050, relative to 2020 levels."

Cutting energy use

Demand for technologies needed for decarbonisation will vary, depending on how much energy is used. Analysis by academics at the Centre for Research into Energy Demand Solutions (CREDS) shows that, if the UK adopted strategies to reduce energy demand across the whole economy using existing technologies combined with moderate behaviour change, it could reduce energy consumption by 41 per cent by 2050, relative to 2020 levels. This would make it cheaper to reach net zero carbon, with lower investment required in the power system, lower operating costs and, therefore, the possibility of lower household bills. This strategy would require more rapid roll-out of heat pumps and energy efficiency retrofits of existing building stock, and further investment in active travel, public transport and healthier diets (see page 13).[25]

By cutting energy use across buildings, transport, industry and food, cumulative demand for lithium and cobalt could be reduced by 55 per cent in 2030, compared to a high energy demand scenario, significantly reducing immediate supply chain risks.

Our two energy use scenarios: low versus high demand

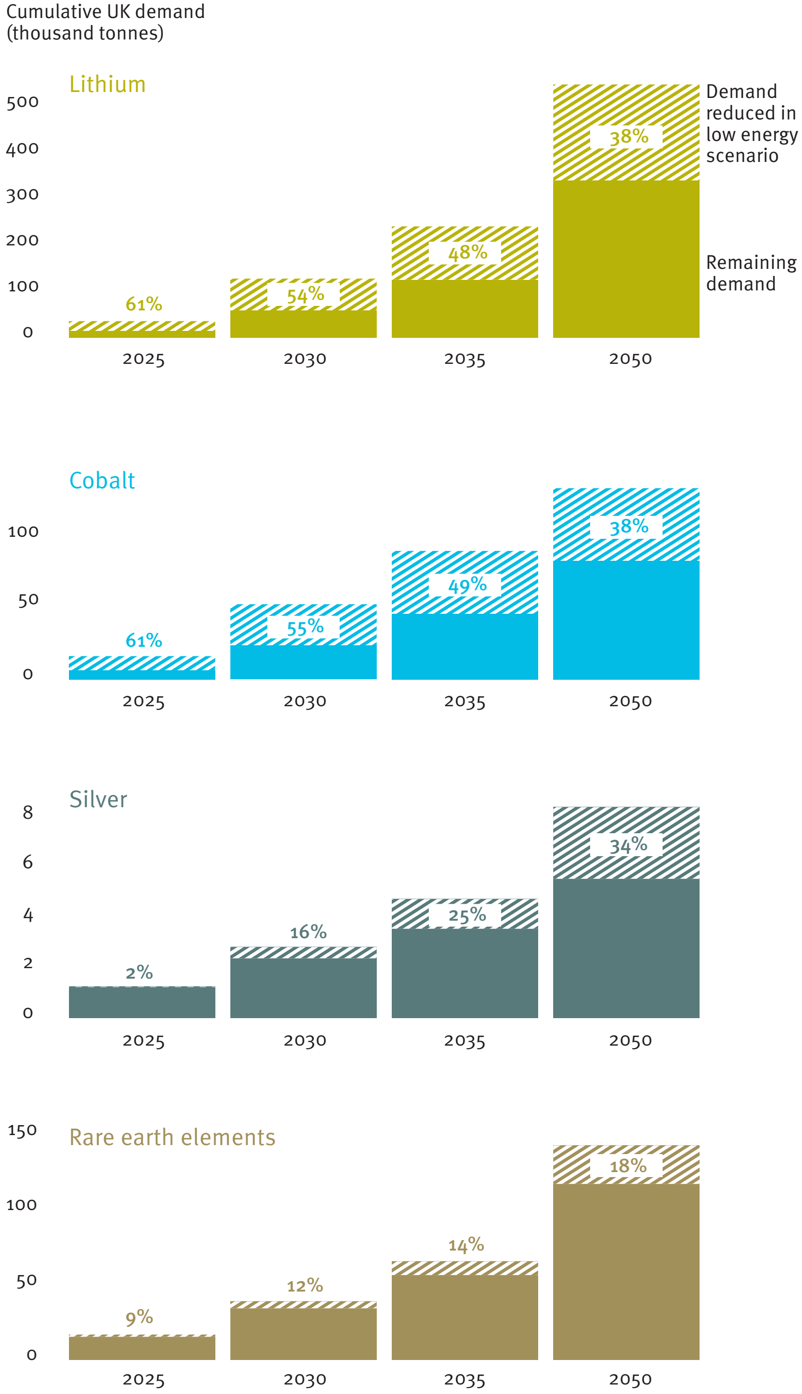
We have compared two future scenarios for energy use: high and low energy demand. In both, the UK achieves its aim of net zero carbon emissions by 2050 and meets other government climate targets, including 40GW offshore wind and the phase out of new petrol and diesel car sales by 2030. The assumptions behind each are, as follows:

High energy demand In this scenario, there is fast uptake of electric vehicles and ambitious roll-out of renewable energy capacity. Our vehicle projections are based on the Climate Change Committee's 'balanced net zero pathway'.[26] The power capacity projections are based on National Grid's Future Energy Scenarios 2021 'consumer transformation pathway', which relies on electrification and demand side flexibility.[27]

Low energy demand In this scenario, energy demand is minimised and resource efficiency is improved. It is based on the 'shift' pathway, outlined by CREDS, which models the most that could be achieved with an "ambitious programme of interventions across the whole economy", assuming "existing technologies and current social and political framings". This includes: a significant increase in the use of public transport and active travel, with car ownership reduced substantially, fewer calories consumed and the adoption of healthier diets, reductions in food waste, rapid roll-out of heat pumps and building energy efficiency retrofits, repurposing of office spaces for housing, smart heating systems, the most efficient technologies adopted for household appliances, with gas ovens and hobs phased out, and reduced new build construction.[28]

For more information about the modelling and methodology underlying these two scenarios, go to: www.green-alliance.org.uk/resources/Critical_point_methodology.pdf

Cutting energy use could reduce demand for critical raw materials.



“Many critical raw materials are wasted when the products they are used in reach the end of their lives.”

Building a circular economy for critical raw materials

Even if demand for critical raw materials is reduced by cutting energy use, the UK is still likely to exceed its fair share of lithium, cobalt and silver before reaching the net zero carbon target in 2050. To stay within its fair share of reserves in the longer term and avoid supply chain risks, the UK should maximise the use of secondary resources.

Many critical raw materials are wasted when the products they are used in reach the end of their lives. If they are simply discarded, valuable, strategic resources are lost forever from the UK economy.

In 2019, the UK fleet of electric cars and vans contained over 1,400 tonnes of lithium and 800 tonnes of cobalt. These volumes are worth £26.3 million and £31.5 million respectively (at October 2021 prices).[29,30] If recovered and recycled, that volume of lithium and cobalt would be enough to make 220,000 battery electric cars, which is ten per cent of projected new sales in 2035, under our low energy demand scenario.

Volumes of critical raw materials available for recycling will increase substantially as the green economy grows. Today, in Scotland, fewer than 50 onshore wind turbines are decommissioned each year but, by 2050, this figure will be 5,500, generating up to 1.4 million tonnes of waste materials.[31] Keeping these valuable resources in the economy, through reuse and recycling, would make a significant contribution to meeting future demand. Use of secondary materials also helps to reduce the greenhouse gas emissions generated when making new products. Using recycled content instead of virgin material to build a wind turbine is estimated to save 35 per cent of manufacturing emissions.[32]

However, recycling rates for critical raw materials are incredibly low. UK and EU data is lacking but, globally, it is thought that only one per cent of lithium and rare earth elements are recycled, while the EU recycling rate for cobalt was estimated to be 35 per cent in 2015-17.[33,34]

If the UK were to reduce energy demand and adopt ambitious recycling rates for these valuable resources, reaching 70 per cent for lithium, 80 per cent for rare earths and 90 per cent for cobalt, in 2050 it could meet nearly all critical material needs from wind, solar and electric vehicle technologies with secondary materials derived from those sectors. In this scenario, recycled material could meet 80 per cent of remaining demand for rare earths, 88 per cent for lithium and 100 per cent for cobalt.[35]

Building a circular economy for critical raw materials would keep them within the UK, reducing geopolitical supply chain risks and, if there are resource constraints globally, it would assist in creating an attractive operating environment for UK manufacturing businesses. Additional need for recovery and reprocessing would also create new jobs.

“In the EU, rapid action is already being taken to build a circular economy for critical raw materials to secure supplies.”

The UK has made a start, funding projects like the RECOVAS partnership in Coventry which will create 550 new jobs in electric vehicle battery recovery and recycling.[36] But there is much more potential like this which could be tapped across the UK, including in the higher value parts of the supply chain for low carbon technologies.

We have previously shown that, if the government adopted a more ambitious approach to the circular economy in general, it could generate 450,000 jobs by 2035 in the regions of the UK that need them the most.[37] These jobs could include skilled manual work in repairing and remanufacturing goods, as well as in procurement management and administration.[38] Securing these jobs relies on the UK actively competing with other countries for first mover advantage.

In the EU, rapid action is already being taken to build a circular economy for critical raw materials to secure supplies for member states. In 2020, it launched an Action Plan on Critical Raw Materials and created the European Raw Materials Alliance of governments, industry, academia and NGOs. The plan commits to mapping secondary supplies of critical raw materials and identifying sites for recycling by 2022.[39] This strategy is going to provide more certainty than currently exists in the UK for businesses looking to invest in recycling and low carbon technology projects.

The proposed EU Sustainable Battery Regulations would also create strong legal requirements for the circularity of critical raw materials.[40] The benefits to EU economies, in battery production and recycling alone, is estimated to be as high as a million new jobs and €200 billion in new business.[41]

Emerging concern

Critical raw materials in electrolysers for green hydrogen and batteries

Our analysis takes into account that improvements in design mean technologies are likely to use less critical raw materials in future. However, we have not factored in the potential for designing out critical raw materials completely or switching between different critical raw materials. There is active research ongoing into this, in particular the development of alternative battery chemistries, which may alleviate projected supply chain issues in future.[42] But, without strategic oversight of changing requirements, conflicts could still arise and expose supply chain vulnerabilities.

For example, a range of electrolyser technologies exist for green hydrogen production, requiring different combinations of critical raw materials, including iridium, platinum, nickel and cobalt. Some designs do not need iridium, platinum or cobalt, but they still need nickel.[43]

As UK production of green hydrogen ramps up to meet the target of 5GW of low carbon hydrogen supply by 2030, impacts on nickel demand are likely to rise.[44] But nickel is also used in wind turbines and batteries, including those favoured by Tesla, which sells the world's most popular electric vehicle.

As battery storage capacity expands to manage a more flexible electricity grid, demand for nickel, lithium and cobalt will further increase, which is an emerging concern for supply chains.

An opportunity for the UK

“The countries which move first to make their industries circular and resilient will be in the strongest position, exporting the relevant know how and technologies.”

Responsible stewardship of critical raw materials, including policies that ensure energy demand is well managed and more valuable materials are retained in use, would help the UK to achieve the promised green industrial revolution and reach a net zero carbon economy, without jeopardising future growth of green technologies in the UK or abroad. It would maximise the value of critical raw materials to the economy and create new jobs in recovery and reprocessing. In doing so, the UK would gain early mover advantage in circular economy approaches, which could translate into new export opportunities. And, importantly, it would minimise supply chain risks for industry, reduce environmental damage and ease geopolitical tensions around trade.

The UK has shown exemplary global leadership on climate governance through its early adoption of legally binding climate targets and the net zero carbon by 2050 goal for the economy. In the year it holds the global UN climate summit presidency (COP26), sustainable management of critical raw materials is another opportunity to lead by example.

In future, what we now refer to as ‘low carbon industries’ will simply be ‘all industries’, as decarbonisation progresses. The countries which move first to make their industries circular and resilient will be in the strongest position, exporting the relevant know how and technologies to others and reaping the subsequent economic and reputational benefits.

A strategic, sustainable approach

As the UK seeks to develop a thriving green economy at home, while striking new trade deals and building its own geopolitical strategy post-Brexit, better resource management will be integral to success. The recent *Net zero strategy* sets out plans to publish a critical minerals strategy in 2022, with oversight from an expert committee on critical minerals.[45] This, along with the proposed establishment of a Critical Minerals Intelligence Centre to analyse resource stocks and flows, is a crucial first step in achieving resource security and hopefully heralds the resumption of work on the long promised National Materials Datahub, currently on hold.

However, the aims set out for the critical minerals strategy are unambitious in relation to reducing supply chain risks and meeting demand in a way that has the least environmental impact. Better stewardship of critical raw materials, through demand management and an established circular economy, should be central to the UK strategy to address these points. Diversifying raw material sources is likely to be a necessary component, but should be viewed as the less desirable, higher risk option.

We propose the following guiding principles for the new strategy:

1.
Set an ambitious environmental mandate for the new critical minerals strategy and expert committee.

The aims of the new strategy and expert committee should align with all the UK's environmental goals, including targets for net zero emissions by 2050, and those set in the Environment Act and the 25 year environment plan; for instance, protecting 30 per cent of land by 2030, and preventing water and air pollution.

The committee should have a clear mandate to reduce risks in supply chains, including the environmental and social impacts of extraction, and to meet demand with the least environmental impact. Under this mandate there is a need for energy demand management and circular economy approaches to be at the heart of the strategy, while extraction should be minimised and managed responsibly.

The expert committee on critical minerals should be independent and include stakeholders from across industry, academia and NGOs, to ensure that economic, social and environmental factors are considered, including sourcing of materials, their applications and end of life treatment. Committee outputs should be public, including its mandate, work programme and strategy.

To provide the detailed data needed to support strong decision making and identification of circular economy opportunities, the Critical Minerals Intelligence Centre should contribute to the development of a broader National Materials Datahub, which is currently delayed.

The strategy should be updated every five years, in line with the latest technological and policy developments.

2.
Harness the potential of energy demand reduction

There is no mention, in the aims of the critical minerals strategy, of the need to manage energy demand to reduce supply chain risks. The Climate Change Committee should be tasked with providing independent advice on the risks that critical raw materials pose to the government's chosen approach to decarbonisation, and the options to reduce those risks, such as energy demand reduction and new technology. This advice should inform the critical minerals strategy, to be published in 2022. Following publication of the strategy, the Climate Change Committee should provide ongoing, in-depth analysis of low carbon pathways and critical raw material risks at the sector level, to inform sector specific plans for the next iteration of the strategy.

The government should take immediate steps to reduce energy demand, thereby cutting critical raw material demand, through energy efficiency measures across transport, buildings and other sectors. This should include increasing investment in public transport and active travel, and increasing the efficiency of freight to reduce miles travelled by heavy goods vehicles. For energy efficiency in buildings, more investment and incentives are needed. For instance refurbishment should be encouraged by the removal of VAT on renovations, bringing it in line with zero VAT rate new build.[46] These policy options are 'no regrets' as they support the transition to net zero and lead to significant health and social benefits, as well as reducing the demand for critical raw materials.

The government should support research and innovation to increase the resource efficiency of low carbon technologies, and identify sustainable alternatives which rely less on critical raw materials.

3.
Build a circular economy for critical raw materials

The aims of the proposed critical minerals strategy are so far weak on the need to develop a circular economy to keep strategic materials in use at their highest value. There is huge potential for secondary supply of critical raw materials to meet future demand, and this should be a core aim of the long term strategy. The UK's intention to support international standards on the circular economy is welcome, but it can and should do much more to encourage circular approaches by UK industry.

Short term opportunities, such as those presented by the forthcoming extended producer responsibility rules for waste electrical and electronic equipment (including solar panels) and batteries, should be taken by the government to ensure producers have the incentive to make equipment more easily recyclable and reusable, and to help make recycling more economically viable. Strong standards, as part of public procurement processes, should be put in place for end of life treatment and use of recycled materials for low carbon technologies, like wind turbines.

In the medium term, the government should establish comprehensive circular economy policy frameworks for electric vehicle batteries and other important technologies, such as rare earth magnets. The suite of measures in the EU's proposed sustainable batteries regulations currently sets the benchmark for best practice and is already spurring investment in battery reprocessing within the EU. The Department for Environment, Food and Rural Affairs' (Defra's) *Waste prevention plan* and the new Environment Act provide a basis for relevant measures, such as ecodesign requirements and better systems for tracking material content in products, which should be used to increase the recovery and reprocessing of critical resources. Measures should be developed in close collaboration with UK manufacturers and waste management firms, to standardise good design and level the playing field.

Building a circular economy also requires investment in the necessary additional infrastructure across the country, which will create new jobs and contribute to the government's levelling up agenda. First, investment is needed in developing technologies and scaling up recovery, recycling, reprocessing and reuse facilities for critical raw materials and the low carbon technologies which require them. It should be a priority for the UK Infrastructure Bank to derisk these markets and demonstrate viable revenue streams for future private sector investment.[47] Second, the expansion of local infrastructure will be necessary to store and transport recovered technologies and resources, including the large number of wind turbines due to be decommissioned. This will keep critical materials and circular economy jobs in the UK.[48]

Endnotes

1 UK Government, 2020, *The ten point plan for a green industrial revolution*

2 Green Alliance, 2021, *Levelling up through circular economy jobs*

3 Eunomia report for the Department for Environment, Food and Rural Affairs (Defra), 2020, *Review of the future resource risk faced by the UK economy*

4 European Commission, 2020, *Critical raw materials for strategic technologies and sectors in the EU - a foresight study*

5 Eunomia report for Defra, 2020, op cit

6 European Commission, 2016, *Assessment of potential bottlenecks along the materials supply chain for the future deployment of low-carbon energy and transport technologies in the EU*

7 UK Government, 2020, op cit

8 M Azadi, SA Northey, S H Ali, et al. 2020, 'Transparency on greenhouse gas emissions from mining to enable climate change mitigation'. *Nature Geoscience*

9 International Energy Agency, 2021, *The role of critical minerals in clean energy transitions*

10 *WIRED UK*, 5 August 2018, 'The spiralling environmental cost of our lithium battery addiction'

11 International Energy Agency, 2021, op cit

12 *TIME*, 7 September 2021, 'Seabed mining may solve our energy crisis. But at what cost?'

13 WWF, 31 March 2021, 'Brands back call for moratorium on deep seabed mining'

14 International Institute for Environment and Development, 29 September 2021, 'Mining cobalt better'

15 United States Geological Survey, 2021, *Commodity statistics and information*

16 Mining.com, 17 September 2021, 'What China's increasing control over cobalt resources in the DRC means for the West'

17 United States Geological Survey, 2021, *Commodity statistics and information*

18 British Geological Survey, 2020, *Directory of mines and quarries*

19 British Lithium website, britishlithium.co.uk

20 British Geological Survey, 2020, *Raw materials for a low carbon future*

21 University of Birmingham, 2021, *Securing technology-critical metals for Britain*

22 European Commission, 2020, op cit

23 Natural History Museum, 3 June 2019, letter to UK statutory Committee on Climate Change, 'Reaching net zero emissions in the UK by 2050'

24 Projections are calculated for 2025, 2030, 2035 and 2050. Projections are included for 2050 to give an indication of the total critical raw material demand needed to reach net zero carbon emissions, but these are speculative as technology change and critical raw material content are hard to predict so far into the future.

25 Centre for Research into Energy Demand Solutions (CREDS), 2021, *The role of energy demand reduction in achieving net-zero in the UK*

26 Climate Change Committee, 2020, *The sixth carbon budget, the UK's path to net zero*

27 National Grid, 2021, *Future energy scenarios*

28 CREDS, 2021, *The role of energy demand reduction in achieving net-zero in the UK*, Chapter 3, 'Our approach'

[29] Trading Economics, 20 October 2021, ‘Lithium’

[30] London Metal Exchange, 19 October 2021, ‘Cobalt’

[31] Zero Waste Scotland, 2021, *The future of onshore wind decommissioning in Scotland*

[32] Ibid

[33] Eunomia report for the Department for Environment, Food and Rural Affairs, 2020, op cit

[34] Green Alliance, 2018, *Completing the circle: creating effective UK markets for recovered resources*

[35] Ambitious recycling rates based on: J Busch et al, 2014, *Managing critical materials with a technology-specific stocks and flows model*

[36] UK Battery Industrialisation Centre, 17 November 2019, ‘UKBIC collaborates to create first end-of-life supply chain for EV batteries’

[37] Green Alliance, 2021, *Levelling up through circular economy jobs*

[38] Ibid

[39] European Commission, 3 September 2020, ‘Commission announces actions to make Europe’s raw materials supply more secure and sustainable’

[40] European Commissions, 10 December 2020, ‘Green deal: sustainable batteries for a circular and climate neutral economy’

[41] InnoEnergy, 19 May 2020, ‘The European Battery Alliance to support EU’s post coronavirus recovery’

[42] Bloomberg Green, 30 September 2021, ‘Iron battery breakthrough could eat lithium’s lunch’

[43] International Renewable Energy Agency, 2020, *Green hydrogen cost reduction: scaling up electrolysers to meet the 1.5C climate goal*

[44] UK Government, 2021, *UK hydrogen strategy*

[45] UK Government, 2021, *Net zero strategy*

[46] Green Alliance, 2021, *Net zero policy tracker, September 2021*

[47] Green Alliance, 2021, *Levelling up through circular economy jobs*

[48] Zero Waste Scotland, 2021, op cit

Green Alliance
40 Broadway
London SW1H 0BU

020 7233 7433
ga@green-alliance.org.uk

www.green-alliance.org.uk
@GreenAllianceUK

The Green Alliance Trust
Registered charity no. 1045395
Company limited by guarantee
(England and Wales) no. 3037633
Registered at the above address