
Just Transitions within Sectors
and Industries Globally

Rare Earth Elements, Global Inequalities and the 'Just Transition'

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About Just Transitions within Sectors and Industries Globally

The programme examines how just transitions whilst tackling climate change and biodiversity is key to supporting inclusive economies and societies in the future. Through the programme, the Academy awarded funding to nine research projects exploring the actions required in sectors and industries globally across supply and value chains, with a focus on key economic emitters or areas of society that will help reduce and/or eliminate greenhouse gas emissions. The programme was funded by the UK's Department for Business, Energy and Industrial Strategy.

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Executive summary

This report details preliminary findings from the project 'Rare Earths in the Just Transition: Connecting Global Inequalities in REEs Commodity Chains', which was funded by the British Academy's Just Transitions within Sectors and Industries Globally scheme.

Although Rare Earth Elements (REEs) are neither a sector nor an industry in a conventional sense, they are vital resources for several industries and a range of sectors vital to a technology-led transition to carbon-zero. They are important in the development of permanent magnets, for example, which have transformed the efficiency of new-generation wind turbines and electric vehicles.

Energy transition has become a key strategy for international governments as they address climate change and demand for these minerals looks set to increase. However, REEs are associated with multiple challenges. The geological formation of REEs means that they are very difficult minerals to mine. Deposits of REEs are widely distributed throughout the earth's crust, but they cannot be mined in the same way as more well-known minerals, such as gold, or copper. The challenge of mining REEs has led to many countries relying on the import of products that incorporate REEs rather than developing their own primary sources of the minerals. In the UK, for example, there is a high reliance on REEs and other critical mineral products in a number of important sectors. This has been most obvious in the automotive industry where major car production lines have been affected throughout 2021 and 2022 because of supply chain issues. China is the leading global supplier of REEs products. This situation emerged over the last 20 years, when a significant divergence between the importance China attached to increasing mining and production capacity for REEs and that of almost all other governments became apparent. State support for China's REEs industry has led to its dominance, at a time when western governments have made limited investments in alternative sources of supply. The dangers of this are seen in the lack of supply chain diversity at the lower levels. This is compounded by the fact that REEs are difficult to recycle and there are presently insufficient means by which a circular economy for REEs can have a significant impact on reducing the vulnerabilities of the primary supply chain.

We aim to encourage broader but connected discussions about these materials and the realities of REEs sourcing, in this case in the borderlands of Myanmar. We do this against a background in which demand for REEs is predicted to increase according to every scenario focused on technology-led energy adaptation. The increased demand that is anticipated reflects that the advantages REEs provide are real and important for a technology-driven response to the climate crisis in both the short and medium term. These minerals support many of the key technologies of modern life, especially in economically powerful middle- and high-income countries. The desire at least to maintain living standards and hopefully to improve them, despite if not because of the transition, makes the continued development of a wide range of REEs-reliant technologies politically important for leading industrial and democratic economies.

In our report we are sensitive to the complexity of issues that use of REEs creates, and we are keen to avoid simplistic responses. These important minerals have the potential to support inclusive development and mitigate global inequalities in cross-cutting ways. Wind turbines incorporating REEs may provide greater supplies of carbon-neutral energy in Myanmar as elsewhere, for example.

Through our case study in Myanmar we hold up a mirror to the concept of Just Transition as it is currently used in the global north. We show in this report how the northeast borderlands of Myanmar have emerged as a Just Transition 'Sacrifice Zone' in recent years. We make preliminary recommendations about where pressure points to improve this situation may be discernible. As this is currently a conflict zone, and the military coup in Myanmar in February 2021 has further entrenched and extended violence in this region, there are no quick solutions and no easy answers. However, we identify a range of issues that have been somewhat overlooked in discussions of REEs extraction in Myanmar to date.

In relation to the technical aspects of mining, we conclude that there is a great deal that can be done to support local communities, environmental activists, CSOs, community youth leaders and others. There are some excellent environmental groups, such as the Kachin Development Networking Group (KDNG), who work tirelessly both to improve local knowledge about conservation and environmental impacts of conflict and development and seek to inform international and national actors about local issues. Yet there is very little knowledge about REEs beyond the issue of extraction: even miners have little or no insight into the uses of REEs and its downstream markets. One local miner told us: "I did ask some of the Chinese what the minerals were used for and they told me that because they were minerals they could be used in lots of things, including aeroplanes, or even bullets or bombs – everything!" For local people to consider a range of outcomes that might be appropriate for them, including the development of better managed mine sites under the supervision of local actors with significant technical and local knowledge, knowledge inequalities about REEs need to be addressed. We believe that there is potentially scope for technical expertise to be supported and developed among local groups, even in the present situation.

Significant research into REEs extraction has taken place in the last decade, especially in China. It may be possible even in a context where the wider political environment is not favourable to political settlement that knowledge for improving mining processes and supporting environmental recovery plans can reach local communities, mine workers and supervisors. International calls to stop the mining are likely to have limited impact; calls for the boycott of companies who use REEs sourced in Myanmar will also be ineffective because such sourcing is almost impossible to trace in the supply chain. However, if it may be possible to make small on-the-ground changes to improve the situation and prevent the mine landscape from being irrecoverably damaged, that will be an important short-term contribution with medium to long-term implications that can be built upon in the future. It is also in the interests of many of the companies and their local mediators to bring about such improvements.

Our report considers the development of pro-environmental policy to regulate REEs extraction and production from a Chinese perspective. This is helpful because it limits the degree to which we see these issues entirely through the lens of conflictual geo-politics. Recognising some of the internal imperatives for limiting REEs extraction may raise some optimism that Chinese companies, and state actors with interests in limiting environmental damage in a neighbouring and yet unstable borderland region, may be able to bring some influence to bear to support better environmental management, even of unregulated mines in the border region, in line with China's national policy on REEs mining mitigation.

In addition to our detailed critical overview of the origins, implications, and consequences of REEs extraction in Myanmar in the context of its relations with China, we also use our case study to hold a critical mirror to the literature that has emerged relating to the Just Transition. We argue that the underlying framework

that helps to bring the many discordant voices around this concept together is the imperative for decolonising notions of the Just Transition. This is particularly pertinent in a context such as the Myanmar borderlands.

Finally, we recognise that the lack of public knowledge about REEs and related minerals and materials in end user communities and in the countries that have high technology industries that utilise REEs extensively is also part of the problem. Despite being so important in dealing with the climate crisis, REEs remain unfamiliar, as do the manifold challenges – and opportunities – their use entails. We consider the importance of developing teaching and learning around REEs within an Education for Sustainable Development (ESD) framework as a way of mitigating this problem. Supporting young people to develop their thought leadership in managing the most complex problems that their generation will inherit in informed and technically resilient ways is an important concern for all of us.

Research objectives

To date, information about REEs extraction in Myanmar has been driven by journalistic reporting. Much of this has been courageous, well researched and vitally important for drawing attention to the issue of REEs mining, especially as a contributory factor in ongoing conflicts.¹ However, we use the opportunity provided by this report to flesh out a broader narrative. Solutions-focused interventions that aim to help rescue this region from its status as a Sacrifice Zone are needed, which in turn requires that different parts of the global supply chain understand and accept the ethical and political web of interests in which they play a part. While our findings are preliminary, we aim to begin filling in some critical information gaps to support informed and nuanced interventions.

We also believe that Education for Sustainable Development (ESD) is an important corollary to other policies for energy transition. Developing greater understanding of the global inequalities that must be managed fairly for a planetary Just Transition to take place is a priority for governments that rely on public consent. Improving the extent of public knowledge about these issues to encourage informed debate is an important part of the wide picture of how we tackle climate change. REEs cannot be put into the 'too difficult' box because of perceptions of technological complexity, or the challenges of the geo-political context. We take the view that the sooner young people become better informed about the costs and benefits of different technological responses to climate change, the sooner they will quite naturally emerge as thought leaders in R&D and other areas relating to REEs, including the circular economy and accountability for the use of key materials in product design from source to user. We need to make REEs a more mainstream part of conversations about the energy transition and, in turn, less subject to dramatic nationalist geo-political distortions.

Research challenges

Our project attempts to integrate three areas that are each very challenging to research on their own terms:

1. The opaque and disaggregated global commodity chains of REEs
2. The reasons why the northern borderlands of Myanmar have become a Just Transition 'Sacrifice Zone' as China's control of production and mid-stream markets for REEs and related products has become dominant
3. The local governance issues and societal consequences of mining REEs in the borderlands of the Kachin region in Myanmar

Clearly, a short project has limited capacity to change the way that we understand such complex, sensitive, and hard-to-delineate issues. However, by integrating these issues, we hope to clarify some of the local realities of REEs mining that are presently only vaguely understood by downstream producers and consumers, while also taking the issue of Myanmar away from its traditional circles of interest by presenting it to

¹ <https://www.frontiermyanmar.net/en/weapons-power-and-money-how-rare-earth-mining-in-kachin-enriches-a-tatmadaw-ally/>

new audiences.

The region where the mines proliferate is at the best of times difficult to access, being controlled by multiple armed groups of various sizes, capacities, and capabilities. These include areas controlled by posts of the Myanmar army and by relatively large ethnic armed organisations, as well as pocket-sized domains controlled by multiple small militias. These latter groups may assert power over a single mountain pass, a particular border gate or portion of a transportation route, or small area of opium cultivation. The region is, of course, also squeezed between two heavily militarised and securitised states that flex their power in line with interests that may be defined in very distant places to those of the borderlands themselves.

At the time of writing, it is also a time of additional and somewhat unprecedented challenges for conducting any field research in this area. Of these current challenges, the ongoing Covid 19 pandemic has been hugely significant for disrupting borderland life. The licit and illicit cross-border traffic that is so much a part of regular life in this region became subject to border closures and the expulsion of migrant workers, producing a dramatic, sudden impact. The livelihoods of people who were already facing challenges because of long-term conflict, including the displacement to camps of more than 100,000 internally displaced people during the past decade, were made significantly more difficult. This also impacted the extent to which our research teams could operate over spaces as this situation developed a new phase with the arrival of new Covid 19 variants in the border region.

In addition, our research took place less than a year from the start of the latest military coup in Myanmar in February 2021. This has triggered one of the largest movements of civil disobedience and armed resistance seen in the country in modern times. In this situation, it may seem reckless even to undertake research in this setting. However, these issues do not go away for local people simply because international actors cannot gain access. It is the ongoing and even heightened urgency of such enquiries that motivated our local research team to undertake this challenging work, being also best placed to minimise and understand the risks. This was only achievable because of the long-term nature of our collaborations and engagement and diligent attention to minimising potential harms.

Critically, however, these kinds of emergencies are the very things that shape and influence the scale and nature of REEs extraction: the volatility of border openings and closures reveals the everyday scale of flows of goods and people as the gates are navigated; the capacities of armed organisations and militia groups to assert control over mining sites and transportation routes becomes clearer; the lack of oversight of the trade becomes hyper-attenuated during times of escalating violence and is therefore made more obvious. It is no coincidence that reports during the first months following the coup, before the Omicron variant of Covid 19 emerged, stated that a sharp spike in REEs extraction and illicit smuggling into China was being seen on the ground in areas that were directly or indirectly under the control of the Myanmar military². If we wish to address the supply chain fragilities that impact global demands for REEs, the toxic trio of Covid 19, a military coup, and nationwide collapse of civic administration, is an impact on that chain that needs to be better understood. These are challenges for our research, but they are also real-world issues that are important for understanding REEs exports from Myanmar.

2 <https://www.bangkokpost.com/world/2112407/illegal-rare-earth-mining-surges-in-myanmar>; <https://www.aninews.in/news/world/asia/myanmar-illegal-rare-earth-mining-in-kachin-state-on-chinas-border-rises-since-coup20210429024238/>

Assessing the significance of Myanmar's REEs exports for global supplies

But how important to the global supply of REEs is the output from Myanmar? This is a very difficult question to answer with precision, despite being usually the first question that is asked. Myanmar was mostly absent from global statistics for REEs ore production until customs data from China began to give a more nuanced picture of China's REEs interests. With increasing environmental restrictions and limits on internal ore extraction over the past decade, China became not just the world's dominant exporter but also the world's leading importer of REEs to make up the deficit in its own domestic industrial requirements. Concerns within China about the environmental impact of REEs mining was a significant contributory factor in this shift. We discuss this in more detail in our full report.

The customs data does, however, give some indication of the significance of Myanmar's contribution to global REEs supplies. Using this data, Reuters stated that in 2020, Myanmar provided 71% of China's imports of rare earths mixture with carbonates, 94% of its rare earth compounds, and 90% of its main rare earth oxides³. This was a scale of production and export that elevated Myanmar to the top ranks of REEs producers globally. This is also supported by US Geological Survey statistics, which ranked Myanmar (Burma) 3rd largest producer globally, with output almost equivalent to second-ranked US in 2019, and with almost double the production of 4th ranked Australia in 2020.⁴ According to these statistics alone, current production from the Myanmar borderlands makes it a globally significant contributor to global REEs supply chains.

However, as is explained in our full report, these figures do not give a complete picture. The cross-border trade in REEs between the borderlands of northern Myanmar and China can also be circular. Answers to the question of how ores originating in Myanmar become regularised within official statistical chains inside China remain unclear. Ultimately, the best calculation for quantities exported to China from Myanmar would be derived from a crow's nest vantage point above the border gates at Chipwe and Ruili, with a head count of lorries laden with sacks of dust recorded over time. Local people do this unconscious count every day. They see a steady flow of such lorries, and their perceptions and quiet observations of the scale of the trade and its variations over time can be informative. In previous years, local people also witnessed vast numbers of trucks laden with timber that had been illegally logged, with border crossing points being carefully choreographed by a host of actors, official and non-official and on both sides of the border, to facilitate the flow. As with the illicit trade in jadeite, and in people, trafficked commodities only remain illicit until they enter a space of regulation and oversight, usually through being granted documents that inscribe their legibility. Instantly, a jadeite stone or a bag of rare earths dust becomes an official statistic when it is inscribed in an official ledger, no matter its source. This renders the origin opaque when there is no compulsion to record it, and may even be disincentivised.

The local actors involved in this flow from illicit to licit are invisible from higher level, data-driven and statistical vantage points. The actors on the ground are multiple and speak to a variety of agendas and interests. While it is tempting to categorise everything that emanates from the Chinese side of the border as being 'Chinese', it obscures the human scale of REEs chains across this border. Access to these difficult-to-access regions must be enabled through brokerage with political and

3 <https://www.reuters.com/article/us-myanmar-politics-china-metals-explain-idUSKBN2AA12U>
4 <https://www.usgs.gov/centers/national-minerals-information-center/mineral-commodity-summaries>

military elites with cross-border connections. Many of the minority nationalities in Yunnan have genealogical counterparts in Myanmar. 'The Chinese' in this sense may also identify as from the ethnic minzu on the Yunnan side, be that Jingpo, or Lisu, or Zaiwa, or any other communities, and they may be important brokers. Mining companies, however, often build on the expertise of actors from distant parts of the China, where technological expertise in REEs extraction has been honed over several decades. These actors may have little knowledge of the Myanmar borderlands. Even understanding what 'China' is in this context, therefore, is not always clear.

Similarly, the military actors in this border region need to be disentangled and distinguished from each other, as there are many, quite distinct actors. For those uncomfortable with the idea that the state is not always the agent of good governance, the northeast borderlands can be a challenging environment to conceptualise. Some military actors, like the Kachin Independence Army (KIA) and the New Democratic Army-Kachin (NDA-K) can make legitimate claims to being engaged in political struggles for the greater autonomy of communities in their respective regions over many years. At least in their origination, they were mobilised and popularly supported as legitimate groups of armed resistance with political goals. However, protracted conflict has also led to different agendas. Since the NDA-K became a Border Guard Force (BGF) in 2009, those political origins seem for many to have become distorted by the business opportunities that acting as proxies for the interests of the Myanmar army in the areas under their control can provide. When we refer to the impact of REEs mining and how it can be better managed, therefore, we must take account that one of the principal armed actors in this setting that benefits from the illicit extraction of resources is the Myanmar military and its array of barely concealed business interests. Suggestions that regulatory oversight at a national level is the main medium to address the realities of this situation assumes that it is mainly the petty interests and greed of smaller non-state armed groups that need to be controlled. This is an oversimplification of a much more complex picture of brokerage, facilitation, and exploitation.

Our principal aim, therefore, is to bring together in a preliminary way the interconnected issues of global energy transition, international geo-politics focused upon China's regional and global role in REEs, and the experiences of conflict-affected rural regions in one of Asia's most hard-to-reach hinterlands. As Wang and Lo have recently argued, there is a need to examine through real-world examples how competing ideas about the move to carbon zero globally manifests as lived experiences of the 'just transition' in diverse settings.⁵

Key questions

A key component of our work is to understand the lived experience of people working in and living around the mines. Not only is this a highly sensitive subject within an active conflict zone, but at the time of our project there had been a new Covid 19 spike. The emergence of the Omicron coronavirus variant in the Chinese border town of Ruili meant that access to the mining areas close to this border town was severely constrained. Although the border crossing points were starting to open for general trade and traffic, the previous weeks had seen many migrant workers forced away from the mining area either to temporary holding camps outside the area, or to their homes; in the case of people previously internally displaced due to conflict, they returned to the various IDP camps that dot this region. The team therefore had access to people directly involved in the mines but within relatively lower risk environments

5 Wang, Xinxin & Lo, Kevin (2021). *Just transition: A conceptual review. Energy research & social science*, 82, p.102291.

around the capital Myitkyina, as well as in towns and villages that were not closed off, because of the emerging Covid 19 situation. Most of our research participants were Kachin identifying individuals and all research was undertaken entirely in local languages.

Our approach was also informed by work that the team had conducted previously on jadeite mining “Sustainable Lives in Scarred Landscapes: Heritage, Environment, and Violence in the China-Myanmar Jade Trade” (Ref: SDP2\100109).⁶ Approximately 120 Life Stories were collected during that project, including jade miners, small-stone traders who had been active from the 1970s-1980s in Myanmar, shopkeepers, market traders in Yunnan, and agricultural workers in Myanmar. People from a wide range of ethnic, religious, and political identities involved in jadeite mining, processing, and trading were interviewed. Life Story research is a particular focus in our research methodology. One of the intentions in this project was to explore the boundaries and possibilities of similar qualitative research relating to REEs. Again, the short time frame of the project meant that this work could only be preliminary, but we raised questions such as: What can be learned from earlier experiences of the impact of regulatory mechanisms to bring mining of different resources under control? What may be different in REEs-related mining solutions? What impact is mining of this kind likely to have on peace settlements in this conflict-afflicted region?

Another key question, as with our previous project relating to jadeite, was to understand cross-border connections with China. The emergence of China’s environment protection policies was significant in the dynamics that pushed mining into the grey zone of the Kachin-Yunnan borderlands. While the higher-level geo-politics of this issue have been discussed relatively extensively, the impact on the ground for local communities in the Myanmar borderlands has been poorly understood, primarily because of lack of access to the sites where we work. Our research, therefore, focuses in these initial stages less on the quantitative assessment of output and cross-border trade, than the qualitative experience of companies inserting themselves into this environment. Again, this is preliminary work and further development and analysis will take place in coming months and years.

We also hoped to understand in more detail the frictions and discontinuities in the concept of the Just Transition, in line with the British Academy’s intentions in this call. In what ways do the current energy transition and its proponents connect their arguments with the social and political dimensions of the just transition at different scales? Does it matter to us that local communities in REEs producing regions are multiply disadvantaged while ‘our’ needs and desire for green technologies are progressed as a higher priority? Holding Just Transition discourse up to this mirror reveals some of the conceptual, political, and economic assumptions that actors in the global north make about a technology-driven response to climate change, and the different perspectives from communities in the global south. However, it also forces us to rethink the commonalities between communities in Just Transition ‘Sacrifice Zones’ in the global south and north. A planetary level just transition needs to address supply chain issues at every level so that source communities are full beneficiaries of its outcomes wherever they may reside. Justice has spatial, ideological, and cultural dimensions.⁷ It cannot be defined solely through the lens of climate justice, or the justice frameworks singularly identified as relating to energy, environment, or human rights, none of which encompass the global nature of the REEs commodity chain. Neither in the context we outline in Myanmar can it be understood as a problem that can be easily translated through a framework of labour

6 <https://www.thebritishacademy.ac.uk/projects/sustainable-development-heritage-environment-violence-china-myanmar-jade-trade/>
7 Heffron, R.J. (2020). The role of justice in developing critical minerals. *The Extractive Industries and Society*, 7(3), pp.855-863

rights, which has been popular with community-based approaches in the global north experiencing the hard edge of energy transition. However, our goal is not just to understand the academic dimensions of this but also to consider the ways in which the concerns related to REEs can be integrated into practical applications.

A further distinctive element of our approach is to recognise that publics in the global north also require more knowledge and education about these issues. This takes seriously the call by the UN and others that Education for Sustainable Development (ESD) is vital to the successful achievement of the UN's Sustainable Development Goals, and the collective need for knowledge growth in how we tackle the climate emergency through energy transition. In the creation of educational resources, we work from the pedagogical perspective of ESD, rooted in humanist and cognitivist perspectives and a strong commitment to social justice. We all need more information from a variety of perspectives and experiences if solutions to our current global predicament are to be found. Embedding more knowledge about the supply chains of REEs and other critical minerals in the wider educational environment will be an important part of the knowledge shift.

As noted, the work we have carried out in this project is exploratory and preliminary, not least because of its extremely challenging and sensitive foundations in communities in Myanmar at a time of national crisis. These are complex and wide-ranging issues. Our findings are therefore preliminary, open to discussion, and hopefully may be the subject of further research.

Key findings

- The energy transition has become a primary focus of international governments, including the UK, for tackling the climate crisis in the short to medium term. The 17 Rare Earth Elements (REEs) are an important group of minerals used in the development of technologies that will support the transition to carbon zero, especially energy generation and e-mobility. Rare Earth Elements (REEs) provide significant technological advantages in delivering a carbon zero future and should remain part of a basket of solutions.
- The UK will be dependent upon global supply chains for REEs and REEs products in both the short and medium term. Recycling and developing a circular economy for REEs is technologically challenging. Diversifying supply through the development of alternative sources of primary materials and products, or improving the circular economy for REEs, will not be achievable in the short term. Alternative and multiple parallel approaches will be required, including improving responsible source in supply chains, technological developments for REEs recycling and re-use, discussion of cost benefits of REEs relative to other materials.
- There are considerable challenges in developing more diverse supply chains. There is relatively limited, if any, public understanding of REEs and their importance for energy transition, costs, and benefits. Most public and political discourse has focused on geo-political rivalries with China.
- The UK has world leading expertise in REEs mining and technology and materials development, including research into improving the circular economy of REEs. There is concern among these experts about the role that Myanmar plays in the global supply chain, and considerable interest in developing a stronger knowledge base. Myanmar is poorly understood as a piece of the global REEs jigsaw.
- The dominance of China in the global supply chain for REEs has raised concerns about the vulnerabilities for downstream industries, including those in the UK. Supply chain issues have already impacted automotive production on several occasions in the UK, for example. E-mobility is a major component of the UK government's zero carbon plan.
- Although it is difficult to obtain reliable data, Myanmar is recognised within Chinese government customs data as being a significant supplier of REEs for China's primary REEs technology sector; this, in turn, dominates the global supply chain. Imports from Myanmar are put at 74%-94% of all China's REEs imports.
- Most of the REEs from Myanmar comes from the north-eastern borderlands of Kachin State, adjacent to Yunnan. This area that has been in conflict against the Myanmar government in a struggle for greater political autonomy for many decades, most recently from 2011, following the collapse of a 17 years long ceasefire agreement. The Kachin region has provided a bulwark for the civil disobedience and armed resistance movements in Myanmar since the military coup in February 2021.
- Policy changes within China over the last decade aimed at restricting unregulated mining and preventing environmental damage domestically have pushed more

mining into unregulated borderland environments such as in Kachin State. Chinese mining and related companies have sought ways to maintain or increase REEs output in face of domestic quotas and more stringent mining regulations.

- Militarised organisations have been involved in controlling access to areas suitable for REEs mining as they generally fall outside or are at the edges of government civil administration. Since February 2021, civil administration in this region has faced innumerable challenges, as elsewhere in the country.
- Militarised actors include significant armed ethnic organisations, pro-government military government Border Guard Forces, small militias, and the Myanmar army itself. Since 2009, the Myanmar military's direct and indirect control over zones that have become sites of REEs extraction has increased. Myanmar army-related business interests and those of their proxies are key actors in the development of the unregulated trade in REEs.
- The recent military coup of February 2021 seems not to have disrupted extraction, although the zero-Covid policies of the Chinese state through the Government of Yunnan can lead to the closure of the border when outbreaks occur, which can impact illicit as well as licit cross-border traffic. However, broader market fluctuations have significant local impact, affecting livelihoods for local people connected with the mines.
- Without proper site assessments, it is very difficult to understand the impact of unregulated REEs mining in this region. However, it is clear that the mining is predominantly a low technology in situ leaching process. This is suitable for extracting valuable and important heavy REEs, which are especially useful in energy transition technologies.
- The in-situ leaching process has the potential to be the least environmentally damaging form of extraction. However, without proper surveys and preparation to minimise impact and the implementation of recovery plans, this form of mining can easily become highly damaging including water contamination and landslides. Recovery costs for this kind of extraction when not done properly make the damage environmentally irreparable.
- Since 2011, China has developed significant expertise in the development and management of in situ leaching extraction processes, as it has been promoting this technology due to its potential for reducing environmental damage. This could be of benefit to mining development in the Kachin borderlands.
- Before the military coup in Myanmar February 2021, mining data relating to REEs from Myanmar was obscure, with almost no information available about mining companies, permits, supply chains etc. However, from 2018 there were some attempts by the NLD-led government to pressure the Government of Yunnan to control unregulated mining. This had generally been responded to positively, although at a higher level only, with limited on-the-ground impact. However, it demonstrates that the Yunnan Government must take seriously the wider domestic agenda for limiting environment harms of REEs production.
- Calls for penalties or boycotts of companies using REEs from Myanmar reflect an array of ethical concerns, yet international companies using REEs cannot trace their supply chains, especially to unregulated mine production in Myanmar. Public pressure on this issue involving boycotts of smartphones or electric vehicles, for example, which would be unrealistic, unachievable, and in many ways undesirable. More creative interventions to improve supply chain issues

therefore must be found.

- International pressure to stop all mining in this region is equally likely to have limited or no impact given the present political situation in Myanmar and the impunity of state and non-state actors involved in REEs extraction. The importance of REEs for tackling climate change and the need to ensure that source communities also benefit and are not harmed by the trade need to be presented as mutually reinforcing issues.
- The UK government's historical links with Myanmar do not necessarily give it an advantage in relation to influencing outcomes in the country, despite rhetoric to the contrary. The legacies of British colonialism are significant and are considered by many Myanmar nationals to varying degrees to be a source of many of the country's contemporary challenges. However, the UK's claims to leadership in the development of a socially responsible and ethically grounded energy transition may gain credibility from a considered focus on addressing and improving supply chain issues of REEs originating in Myanmar, addressing colonial legacies in a constructive way.
- The complexities of REEs supply and use get to the heart of what a just planetary transition means and what it requires to make it just. The global inequalities that are revealed through the Myanmar case study reveals important fault lines in the energy transition that need practical solutions rooted in the realities of local contexts and experiences.
- There is a need to increase public understanding and education about the value, costs, and benefits of REEs. This is needed to encourage a wider range of actors pay attention to how REEs products are sourced, used, and recycled as part of a green circular economy that is factored into all aspects of design, manufacturing, and development. The more education about these issues to support young people to engage in informed ways with the competing and demanding realities of our desire for REEs-deployed technologies, and the difficulties in sourcing supplies of those materials, the better the chances of developing sustainable solutions in the medium and long term.

Recommendations

- Actors involved in the development of REEs-related policy in the UK and internationally can benefit from having access to more information about the role that Myanmar plays in the global supply chain of REEs. Myanmar-focused researchers and policy makers also need more technical information about mining and REEs-related developments. For all parties, there is a lack of detailed information about the nature of the extractive process on the ground. Opportunities for collaborative engagement and knowledge exchange should be developed.
- The UK aspires to a leadership role in relation to responsible stewardship of the energy transition and responsible sourcing of critical technology minerals, including REEs. Demonstrating a commitment to principles of local inclusion, accountability, and ethical management of REEs supply chains is a way of demonstrating this leadership, while also addressing historical legacies in the colonial and post-colonial development of Myanmar's borderlands in this region.
- The presence of REEs in the Kachin-China borderlands, especially highly sought after Heavy REEs, is potentially a significant asset to this region. Yet to date, apart from a few individuals, there have been almost no positively structured and planned ripple down effects from unregulated mining to support the development of local communities. Given the increasing demand that is projected for these minerals in the short, medium, and long term, a commitment should be made to improving the outcomes for local people of this asset, based on their local assessment of economic opportunities, balanced against environmental concerns.
- Support should be given to improve the technical knowledge and skills of people within local communities or the adjacent region – CSOs, environmentalists, community youth leaders with technical capacities. While local activists are often trained in documenting human rights abuses and other issues, there are few or no local people with technical skills in mining assessment, or environmental reclamation planning around in situ mining. This limits the degree to which local actors can engage meaningfully with the opportunities that good mining practices might bring.
- As considerable research has already taken place in the last decade, especially in China, about how to minimise the environmental harm from in situ leaching, as well as how to recover landscapes where mining has taken place, this research should be shared with local communities in mining affected areas. The danger of the energy transition sacrifice zone is that local communities remain always distanced from such developments when access to knowledge and support, both financial and technical, should be prioritised.
- In the short term at least, it is difficult to see any prospect of a cessation of violence in this region, from the Myanmar military, proxy Border Guard Forces, ethnic armed organisations, or militias. An increase in unregulated mining is predicted, rather than a reduction, based on experience and in response to increased global demand. Calls by international actors for a cessation of mining, therefore, although well-intentioned and ethical, are therefore unlikely to have much if any impact on on-the-ground realities. However, it has been shown that

the Yunnan Government is responsive to pressures that come from a national level to restrict unregulated mining of REEs. Increasing representations to actors on the China side to ensure that companies working across the border improve standards of environmental management, including proper site assessments and recovery plans, may have more impact than generalised and unrealistic demands for the cessation of all mining.

- Calls to boycott international companies using REEs sourced from Myanmar may be well-intentioned but would be ultimately poorly focused as it is almost impossible to trace products in this way. However, providing information to major downstream REEs product using companies so that they can exert pressure upon Chinese supply chains to improve their sourcing, in turn placing pressure on companies working across the border to improve their environmental outcomes, may have more success in improving responsible sourcing. Responsible sourcing is an increasingly important issue across a range of industries and sectors and is increasingly important for the business models of leading manufacturers in the energy transition and other high technology sectors. Focusing on the ways influence can be exerted upon unregulated Chinese origin mining companies from within China may prove more productive of improvements in local mining practice where this is connected to the need to implement state policy on improving environmental outcomes from REEs mining and development.
- The UK's relationship with Myanmar is complex. However, the UK could effectively show its support for highly disadvantaged communities in Myanmar with whom it has a historical relationship. Providing leadership for the development of responsible sourcing of technology minerals coming from Myanmar, would be in line with multiple business, environmental, industrial, and foreign policy agendas..
- Improving public understanding of REEs is an important issue, given the challenges that will be faced in the move to carbon zero. It is especially important that young people learn about these issues from a young age, so that they can quickly emerge as thought leaders and technical experts with the knowledge and skills to address these challenges over the longer term. Education for sustainable development is an important tool for developing knowledge and competence to deal with these present and future challenges. Incentives should be developed to promote ESD about REEs in the existing education system, including teacher-focused support to manage the complexities of the subjects with which they may not be familiar. REEs industry stakeholders can play a key role in promoting REEs education through scholarship and outreach programs. This should involve young people also in the communities where the mines are located.

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