



Green Conflict Minerals:

The fuels of conflict
in the transition to a
low-carbon economy

IISD REPORT

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Clare Church
Alec Crawford

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August 2018

Written by Clare Church and Alec Crawford

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Executive Summary

The mining sector will play a key role in the transition toward a low-carbon future. The technologies required to facilitate this shift, including wind turbines, solar panels and improved energy storage, all require significant mineral and metal inputs and, absent any dramatic technological advances or an increase in the use of recycled materials, these inputs will come from the mining sector. How they are sourced will determine whether this transition supports peaceful, sustainable development in the countries where strategic reserves are found or reinforces weak governance and exacerbates local tensions and grievances.

Through extensive desk-based research, a mapping analysis, stakeholder consultations, case studies and an examination of existing mineral supply chain governance mechanisms, this report seeks to understand how the transition to a low-carbon economy—and the minerals and metals required to make that shift—could affect fragility, conflict and violence dynamics in mineral-rich states.

Key Findings

- At least 23 key minerals will be critical to the development and deployment of solar panels, wind turbines, electric vehicles and energy storage technologies. Many of these minerals are projected to surge in demand in the coming decades, in part due to the global transition to the low-carbon economy.
- Significant reserves of all of these identified minerals are found in states perceived to be both fragile and corrupt, as defined by Transparency International's Corruption Perceptions Index and the Fund for Peace's Fragile States Index.
- After overlaying a map of global reserves for these keys minerals with measures of state fragility, a picture emerges of potential hotspots for increased fragility, conflict and violence resulting from growing mineral extraction. Regionally, these hotspots are concentrated in South America, sub-Saharan Africa and Southeast Asia.
- The increased extraction of many of the identified minerals—through both artisanal and small-scale mining and large-scale mining operations—has, in the past and at present, been linked with local grievances, tensions and (in the worst cases) violence.
- Some of the building blocks needed to ensure the responsible sourcing of the minerals required for green energy technologies, however, are in place or starting to emerge: strong guidance on responsible supply chains, empowered consumers, engaged communities, responsible companies and accountable governments.

For the minerals required to make the transition to a low-carbon economy, there are real risks of grievances, tensions and conflicts emerging or continuing around their extraction. In order to meet global goals around sustainable development and climate change mitigation, while contributing to lasting peace, the supply chains of these strategic minerals must be governed in a way that is responsible, accountable and transparent. Achieving this vision will require concerted action from civil society, the private sector and governments.



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Acronyms and Abbreviations

3TG	tin, tungsten, tantalum and gold
ASM	artisanal and small-scale mining
DDPP	Deep Decarbonization Pathways Project
DRC	Democratic Republic of the Congo
EITI	Extractive Industries Transparency Initiative
EU	European Union
EV	electric vehicle
GDP	gross domestic product
LME	London Metal Exchange
LSM	large-scale mining
OECD	Organisation for Economic Co-operation and Development
RMI	Responsible Minerals Initiative
SDG	Sustainable Development Goal
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change



1.0 Introduction

The mining sector will play a key role in the transition toward a low-carbon future. The technologies required to facilitate this shift, including wind turbines, solar panels and improved energy storage, all require significant mineral and metal inputs, and, absent any dramatic technological advances or an increase in the use of recycled materials, these inputs will come from the mining sector. How they are sourced will help ensure whether this transition supports peaceful, sustainable development in the countries where strategic reserves are found or reinforces weak governance and exacerbates local tensions and grievances.

The shift toward a low-carbon economy is accelerating, in part due to two recent landmark international agreements. The Paris Agreement, which entered into force in November 2016, aims to keep global temperature increases below 2°C this century (United Nations Framework Convention on Climate Change [UNFCCC], 2018). To date, 176 parties have ratified the agreement, demonstrating an internationally concerted effort to address the impacts of climate change. In addition, the Sustainable Development Goals (SDGs), adopted by the United Nations General Assembly

in 2015, lay out a global agenda for eliminating poverty, protecting the environment, and ensuring that all people can enjoy equality, peace and prosperity. SDG 13 commits UN member states to taking urgent action to combat climate change and its impacts, while SDG 7 calls for affordable and clean energy for all (United Nations, 2018).

With this transition underway, many actors, including governments, civil society and the private sector, have increased their efforts to contribute to climate change mitigation through the adoption of green energy technologies. In the United States, renewable energy projects made up more than 62 per cent of new power construction in 2017—thanks in part to solar and wind technologies becoming more cost-competitive (Morris, 2018). The Chinese government has pledged to spend USD 360 billion on clean energy projects by 2020, creating 13 million new jobs in the process, in an effort to address local and global environmental challenges (Forsythe, 2017). Costa Rica generated more than 99 per cent of its electricity in 2017 using green energies, including hydropower, wind, geothermal and solar (Embury-Dennis, 2017). Germany expanded its onshore wind power capacity

by about 5,300 megawatts in 2017, its largest annual increase in capacity (Wehrmann, 2018). The governments of the United Kingdom and France both recently announced they would ban the sale of diesel- and gasoline-fuelled cars completely by 2040, pivoting instead to electric vehicles to curb the flow of carbon emissions.

States are not alone in driving this shift; consumer preference and the private sector are also fuelling the change. In the last two years, EUR 15 billion has been divested from fossil fuels by the world's leading insurers, while the car manufacturer Volvo announced in 2018 that by 2019 all of its new vehicles will be at least partially electrified (Watts, 2017). The pace of change has been so significant that the International Energy Agency now predicts renewable energy will comprise 40 per cent of global power generation by 2040 (Berke, 2017).





Demand for green energy technologies—and corresponding demand for the materials needed to build, transport and install these technologies—is predicted to increase dramatically in the years and decades ahead. In a recent report, the World Bank estimated that demand for the minerals required for solar panels—including copper, iron, lead, molybdenum, nickel and zinc—could increase by 300 per cent through 2050 should the international community stay on track to meet its 2°C goal (Arrobas et al., 2017). Similarly, demand for minerals like cobalt, lithium and rare earths¹ is expected to grow at unprecedented rates due to their strategic role in the production of wind turbines, electric vehicles (EVs) and energy storage.

This increased demand should be an economic boon to those countries that are home to the principal reserves of minerals like cobalt, lithium and bauxite; increased investments in their extraction should, in a well-governed sector, result in increased revenues to the state from taxes and royalties, improved infrastructure, more jobs, and increased

spending on local businesses, health and education.

Unfortunately, not all strategic reserves of these minerals are found in countries applying international best practice to mining sector management.² As such, while green energy technologies may contribute to the achievement of SDGs 7 and 13, failure to engage in responsible sourcing practices could increase conflict and fragility risks along the green energy supply chains of these key minerals and metals, stalling or reversing local development gains. This would jeopardize the achievement of another, foundational SDG: SDG 16 explicitly identifies that promoting peaceful and inclusive societies, providing justice for all, and building effective, accountable, inclusive institutions are all integral to sustainable development (United Nations, 2017).

In countries struggling with political instability, where governance for the mining sector is weak, the extraction of these minerals can be linked to violence, conflict and human rights abuses. The Democratic Republic of Congo (DRC), for example, supplies more than 63 per cent of the world's cobalt. The mining of cobalt in the DRC has so often been connected to violence that the mineral has been dubbed the “blood diamonds of

this decade” by various news outlets (Wilson, 2017; Safehaven.com, 2017). The extraction of nickel, a mineral critical for both solar panels and energy storage, has been linked to murder, sexual violence and forced displacement in Guatemala (Kassam, 2017). Further, some rare earths mines have been called “sites of exploitation” due to incidents of child labour, high levels of exposure to toxic substances and dangerous working conditions (Schlanger, 2017). And while supply chain governance for certain minerals, including tin, tungsten, tantalum, gold and diamonds, is improving, such initiatives have not yet been expanded to include most of the minerals and metals central to green energy technologies.

¹ The term “rare earths” refers to 17 elements often found in the same ore deposits, including cerium, dysprosium, erbium, europium, gadolinium, holmium, lanthanum, lutetium, neodymium, praseodymium, promethium, samarium, scandium, terbium, thulium, ytterbium and yttrium.

² In addition to the mining sector, increased extraction may exacerbate tensions surrounding the weak governance of other sectors—like waste management, water and energy. In an effort to keep up with the surging demand, mineral-rich fragile states may engage in poor environmental practices (e.g., using fossil fuels to power mines, the unsafe disposal of mining waste), thereby shifting the environmental burden from consuming to producing countries in the shift to a low-carbon economy.



Green energy technologies like wind turbines, solar panels and EVs will undoubtedly aid the transition to a low-carbon economy. However, the emergence or exacerbation of fragility, conflict and violence along the supply chains of the minerals needed to produce these technologies could threaten the overall “green” nature of this transition. There is a need to examine the supply chain of these minerals to understand whether increased demand for green energy technologies and the minerals and metals they require will have the potential to exacerbate existing tensions, grievances and conflicts relating to mineral extraction, and what can be done about it.

1.1 Overview and Objectives

This report seeks to understand the extent to which increased demand for the minerals critical to green energy technologies could affect fragility, conflict and violence in producing states, and explores what would be required of the international community to mitigate these local and national threats. It builds on extensive desk-based research, as well as a mapping analysis, case studies and findings from consultations with key stakeholders and experts. The mapping analysis identifies which minerals may be required for green energy technologies and determines where these minerals are found in high reserves. It then overlays this map with key measures of fragility to determine where potential conflict hotspots might emerge. The case studies seek to highlight current and potential conflict implications related to the increased extraction of minerals required for green energy technologies in mineral-rich fragile states. The stakeholder and expert consultations look at possible pathways to improving the supply chains of green energy technologies and mitigating the potential for conflict. Facilitators from OCAD University’s Strategic Innovation Lab (sLab) also led a group of stakeholders in a workshop looking at possible pathways to a future where relevant mineral supply chains are conflict-free, the findings of which are integrated into the report’s pathways and recommendations section.

Section 2 provides background and context on green conflict minerals, exploring some of the common drivers of conflict in the extractive sector and expanding upon the growing demand for minerals in a low-carbon economy. Section 3 presents the mapping exercise, in which fragility indicators are overlaid with current reserves of minerals required for green energy technologies. This exercise highlights potential hotspots for fragility in green energy supply chains and identifies five regions for further study. These identified states and regions are covered in Section 4, which analyzes the fragility, conflict and violence implications of the extraction of cobalt, rare earths, nickel, bauxite and alumina, and lithium. Section 5 draws conclusions from the case studies and further examines existing frameworks and potential gaps to govern the supply chains of minerals required for green energy technologies. Section 6 concludes the report with possible pathways and recommendations for policy-makers, as well as next steps and avenues for future research.



2.0 Background and Context

2.1 Green Energy and the Demand for Minerals

Global greenhouse gas emissions grew by almost 90 per cent between 1970 and 2010 (U.S. Environmental Protection Agency, 2017). Most of these emissions come from fossil fuel use and industry, with other emissions deriving from agriculture, deforestation and other land use changes (U.S. Environmental Protection Agency, 2017). The transportation sector accounts for nearly 18 per cent of current emissions worldwide (Naaeke, 2017).

The release and accumulation of greenhouse gases in the atmosphere is having a severe impact on the global climate. Higher temperatures, increasingly variable rainfall, rising sea levels, more droughts and floods, coral bleaching and crop failure are some of the ways in which a changing climate will affect people and ecosystems. Scientists predict that temperatures will continue to rise in the coming decades and that the impacts will be felt across the globe, with the severity of impacts varying, depending on the region (NASA, 2018). Current estimates suggest that global average temperatures are likely to increase anywhere between 0.3°C and 4.8°C relative to 1985–2005 temperatures, by 2100 (Intergovernmental Panel on Climate Change, 2014).



In an effort to combat the impacts of climate change, 178 parties ratified the 2016 Paris Agreement, which aims to keep global temperature increase below 2°C above pre-industrial levels and to pursue initiatives that limit the temperature increase even further to 1.5°C or lower (UNFCCC, 2018). The Paris Agreement highlights that appropriate financial flows, new technologies and enhanced capacity building will be required to reach this goal (UNFCCC, 2018). Key to this agreement and the aforementioned requirements will be a shift to a low-carbon economy, equipped with green energy technologies to decarbonize existing industries.

The Deep Decarbonization Pathways Project (DDPP) is a global collaborative of researchers that charts different methods to limit global temperature rise to 2°C or less. In its 2015 report, DDPP found that all successful pathways to decarbonization were accomplished in part by replacing fossil-fuel-based electricity generation with an array of renewable energies—like solar, wind, geothermal and hydropower (DDPP, 2015). Similarly, a report in the journal *Nature* found that, in order to meet the goals set out by

the Paris Agreement, “a third of oil reserves, half of gas reserves, and over 80 per cent of current coal reserves” must remain unused through 2050 (McGlade & Ekins, 2015). Further, the International Energy Agency stated the 2°C goal will only be met if 10 per cent of the transportation sector becomes low-carbon by 2030 and 30 per cent by 2050 (International Energy Agency, 2015).

Within the past few years, global investments in the green energy sector have surged. According to the International Finance Corporation, climate-related projects have received more than USD 1 trillion in investments globally (Edwards D., 2017). Companies like Google and Amazon have made major commitments to renewable technologies, purchasing



enough wind and solar power in 2017 to compensate for their energy needs (Donnelly, 2017). In 2016 the deployment of new energy storage technologies—most notably batteries—grew by more than 50 per cent (International Energy Agency, 2017). And car companies—most prominently Tesla, Volvo and BMW—have taken significant strides to electrifying their fleets, pledging to make EVs not only available, but also affordable by the early 2020s.

This report will analyze four green energy technologies: solar panels, wind turbines, EV and energy storage batteries. These technologies are already on the market, have made the biggest gains in the past decade and are projected to increase in demand exponentially through 2050.

As the demand for these technologies grows, so too does the demand for a number of minerals required to develop and facilitate them. Solar panels, for example, were the fastest growing source of renewable energy in 2016 (Levin Sources, 2017b). According to the World Bank, solar technologies could represent anywhere from 2 to 25 per cent of total global energy production in a low-carbon economy through 2050 (Arrobas et al., 2017). While the minerals required to construct solar technologies vary depending on the type and make of the panel, key minerals including gallium, germanium, indium, iron, nickel, selenium, tellurium and tin are projected to see their demand increase considerably through this transition.

Wind technologies are also becoming more widespread and price-competitive with traditional fossil-fuel-based energy. In 2017, wind power supplied almost 12 per cent of electricity in the European Union (EU), with Denmark, Portugal and Ireland leading the way by deriving nearly a quarter of their power from turbines (Global Wind Energy Council, 2018). The minerals required for wind technologies vary, depending on whether they are located offshore or onshore and whether they use geared or direct-drive technologies. Geared technologies, for example do not require as much lead or rare earths as direct drive, but are generally less reliable and have a lower capacity to handle intense wind speeds (Arrobas et al., 2017).

EVs are expected to be as affordable as gas-powered cars by 2022, with the greatest demand coming from China (NetworkNewsWire, 2017). Approximately 33 per cent of the cost of manufacturing EVs comes from their rechargeable batteries, which are typically lithium-ion due to their excellent energy-to-weight ratios (NetworkNewsWire, 2017; Arrobas et al., 2017). Lithium-ion batteries are also used to store energy outside of EVs, including that generated by solar panels and wind turbines. Due to the increasing demand for EVs and energy storage technologies, the demand for and price of minerals like lithium, cobalt and manganese—all used in lithium-ion batteries—is already rising. The price of manganese, for example, nearly doubled from 2015 to 2017 (USA News Group, 2017). Other estimates suggest that in order to meet upcoming lithium demand at least one new lithium mine will need to begin operations each year through 2025 (Baystreet Staff, 2017).

The predicted mineral requirements for each green energy technology are included in Figure 1. These minerals were determined based on data from the World Bank, Levin Sources, the U.S. Geological Survey, Bloomberg New Energy Finance and the American Exploration & Mining Association. Although other minerals may be required in addition to those listed, the minerals in the following graphic were verified and cross-referenced by multiple sources and represent strategic components of the technologies in question. It is important to note that, due to the rapid rate of technological advances and possible opportunities for metal substitutions, these minerals are subject to change and dependent on market fluctuations (e.g., the proliferation of offshore versus onshore wind turbines, lithium-ion versus lead-acid energy storage, etc.).

Minerals Required for Green Energy Technologies



Al Bauxite & Aluminum	In Indium	Si Silicon
Cd Cadmium	Fe Iron	Ag Silver
Cu Copper	Pb Lead	Te Tellurium
Ga Gallium	Ni Nickel	Sn Tin
Ge Germanium	Se Selenium	Zn Zinc

Al Bauxite & Aluminum	Pb Lead
Cr Chromium	Mn Manganese
Co Cobalt	Mo Molybdenum
Cu Copper	* Rare Earths
Fe Iron	Zn Zinc

Al Bauxite & Aluminum	Fe Iron	Ni Nickel
Co Cobalt	Pb Lead	* Rare Earths
Cu Copper	Li Lithium	Si Silicon
C Graphite	Mn Manganese	Ti Titanium

* The "Rare Earths" designation refers to 17 different elements, including dysprosium and neodymium (critical for wind technologies and energy storage), as well as praseodymium (critical for electric vehicles and energy storage).

SOLAR TECHNOLOGY

WIND TECHNOLOGY

ELECTRIC VEHICLES & ENERGY STORAGE



Figure 1. Minerals required for green energy technologies (see previous page)

The mining sector will play a key role in the shift to a low-carbon economy. And while minerals like cobalt, lithium and rare earths have featured heavily in international headlines due to their strategic importance to green energy, base metals like aluminum, copper, iron and lead should be noted as well, as they are required for each of the analyzed technologies.

The variety of minerals and metals required, and the quantities of each that will be needed, places stakeholders from across the mining life cycle—including exploration, extraction and processing entities—in a strategic position to contribute to the shift to a low-carbon economy. Exploration is expected to surge in order to meet the blooming demand and projected mineral supply deficits. However, the rate of change in the transition to a low-carbon economy has so far been too rapid for the exploration industry to keep pace; while the price of metals can increase quickly, it takes anywhere from 10 to 15 years from the discovery of a new deposit to the presence of fully operating mines at the site (Allen, 2017).

Mineral recycling could alleviate some of the pressure placed on extractive operations; however, to date most of the listed minerals have poor end-of-life collection and recycling rates. Improving collection rates and recycling technologies have the potential to increase the number of secondary minerals on the market, but so far many of these technologies have not yet proved to be economically viable in comparison to using existing extraction sites. Even in a scenario where recycling rates improve, studies have shown that supplies of lithium and cobalt in particular will deplete significantly by 2060 (Manberger & Stenqvist, 2018). As a result, the development of new technologies and metal substitution pathways are likely to play a far greater role in addressing potential supply deficits.

2.2 Natural Resources, Conflict and Mining

Mineral resources—their extraction and the responsible investment of the revenues generated—can be a key driver of sustainable development. Well-managed minerals and metals can be a source of significant revenue for developing countries, revenues that, when collected and distributed with transparency, can support national investments in health, education, infrastructure and other sectors crucial to a country's growth and prosperity. Large-scale mining (LSM) can be a significant source of foreign investment, jobs, shared infrastructure and procurement for local goods and services, while artisanal and small-scale mining (ASM) can provide viable livelihoods in regions where opportunities may be limited. Ensuring that mining contributes to sustainable development will depend on the presence of strong laws and policies for the sector, as well as mechanisms and institutions in place for their implementation and enforcement.

When carried out in a context of weak governance, the exploitation of natural resources can also contribute to fragility, conflict and violence. According to UN Environment, more than 40 per cent of internal conflicts from 1950 to 2009 were connected to the exploitation of natural resources, and those conflicts linked to natural resources are twice as likely to relapse during peacetime (United Nations Environment Programme, 2009). Further studies on civil conflicts have found that natural resource-dependent countries tend to have higher rates of poverty, ethnic fractionalization and weak institutions for conflict resolution (Hasan & Lahiri, 2017).

The history between mining, extractives and conflict is long, and the relationship is complicated. The potential for conflict always exists for the mining sector—a function of the impacts mining activities have on communities, economies and the environment (Andrews, et al., 2017). These conflicts are rarely the result of a single actor, but rather the result of interactions between multiple actors including companies, governments (local, district, national), communities and civil society organizations (Andrews, et al., 2017). It should also be noted that conflict in and of itself is not necessarily a bad thing; disagreements among stakeholders can lead to dialogue, debate and constructive change. Violent conflict, conversely, is never an optimal solution to differing opinions and approaches.



When done responsibly, mining can generate employment, income and trade. However, there are a number of scenarios—for both LSM and ASM—in which the extraction and trade of mineral resources can fuel grievances, tensions and conflict, particularly when they happen in a context defined by weak governance, multidimensional poverty, human rights violations and youth unemployment. In the absence of a strong tax collection system, reliance on resource rents by the central government (and associated elites) can make the state more accountable to mining companies than its citizens, eroding the social contract between the state and its population, weakening the government’s legitimacy and increasing political instability (Bah, 2014). A lack of effort to address



community concerns over the social, economic and environmental impacts of mining can undermine a company’s social licence to operate, increase grievances and further weaken state–citizenry relations. Conflict over access to land and resources between LSM and ASM miners can flare up into localized violence at the mine site. Mining projects can displace communities, exacerbate land disputes and disrupt local livelihoods, all of which can drive violent extremism in areas at risk of recruitment and radicalization (Sharland, Grice, & Zeiger, 2017). And gaining control of the extraction and trade of valuable, artisanally mined minerals can serve to motivate armed groups and further fund violence.

Conflict minerals are defined by the EU as those minerals that “finance armed groups, fuel forced labour and other human rights abuses, and support corruption and money laundering” (European Commission, 2017). Diamonds in Sierra Leone and Angola are a prominent example: gaining control of the country’s rich alluvial diamond deposits was a key incentive for rebel groups to carry out violence during the country’s civil war, and the stones were used as a funding source for their ongoing operations. Similarly, illegal tin, tungsten,

tantalum and gold (3TG) mining continues to fuel violence in the DRC. Beyond Africa, armed groups exert control over 3TG operations in South American countries as well; notable examples include the ELN in Colombia and drug smugglers and illegal groups in Venezuela (Jamasmie, 2017a; Diaz-Struck & Poliszuk, 2012). Prolonged resource conflicts contribute to further human rights abuses and facilitate corruption, as well as undermine state legitimacy and resource governance institutions.

Conflict minerals are, of course, not the sole source of tension in the sector. As mining activities expanded from 2000 to 2012 due to high commodity prices, driven by increasing global demand for raw materials, incidences of social conflicts around mining increased in parallel, driven and experienced by a diverse range of state, non-state and private actors (Dietz & Engels, 2016). Between January 2006 and July 2013, 843 large-scale protest movements—relating to a range of societal issues—took place in 87 countries (Andrews, et al., 2017). This was a dramatic increase from preceding years; with increased mining activities, more protests formed around environmental issues, land tenure, unequal benefit sharing and levels of repression in the mining communities (Andrews, et al., 2017).

These protests were and continue to be most prevalent in Latin America, Africa and Asia, and have continued despite downturns in both commodity prices and mining activities. In December 2017, for example, thousands of



protesters in Jerada, Morocco called for government intervention and regulation in the country's coal mining sector, known locally as the "mines of death," according to news reports (Leotaud, 2017). During a protest in Boké, Guinea, in September 2017, one person died and 20 were injured by Guinean forces during protests against the impact of local bauxite mining operations. In Obuasi, Ghana, illegal miners occupied AngloGold Ashanti's mining sites in February 2016 and attacked employees, resulting in the death of the head of AngloGold Ashanti Communications and other officials (Adogla-Bessa, 2016).

Encouragingly, conflict minerals have garnered considerable attention from both the media and international policy-makers over the past two decades. Efforts have been made to address these issues, mainly through responsible supply chain management initiatives, such as the Organisation for Economic Co-operation and Development (OECD) Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas, and through laws and regulations, including the U.S. Dodd-Frank Act and the EU's regulations on supply chain due diligence obligations. The governments of Burundi, the DRC and Rwanda, for

example, have integrated tools from the OECD Due Diligence into their legal frameworks as part of the Lusaka Declaration, signed in 2010 (OECD, 2018a). The United Nations Security Council has also called for the implementation of the OECD Due Diligence recommendations in Cote d'Ivoire, Sudan and the Central African Republic, among other states (OECD, 2018a). There are also cases where the private sector has positively contributed to peace processes. A report from CDA Collaborative identified 10 case studies where individual enterprises and business associations, some involved in mining, positively affected peace (Miller, Cechvala, & Ernstorfer, 2018).

This report will analyze the fragility, conflict and violence implications of both LSM and ASM operations. While the prevalence of conflict minerals is more commonly associated with ASM sites, the high rates of protests, civil unrest, environmental degradation, corruption and other financial crimes associated with LSM operations necessitate that both be analyzed to fully understand the range of conflict implications associated with an increased demand for the minerals required for green energy technologies.



In the Democratic Republic of Congo, the United Nations Mine Action Coordination Centre clears unexploded ordnance. UN Photo/Sylvain Liechti.



3.0 Mapping Analysis: Identifying global hotspots for green conflict materials

The minerals and metals identified as critical to the development and deployment of four key green energy technologies—solar, wind, EVs and energy storage—are presented in Figure 1. These minerals include, but are not limited to: aluminum, cadmium, chromium, cobalt, copper, gallium, germanium, graphite, indium, iron, lead, lithium, manganese, molybdenum, nickel, rare earths, selenium, silicon, silver, tellurium, tin and zinc. Recycled minerals—or secondary minerals—are not yet in sufficient supply to meet the predicted demand, and therefore the majority of these minerals and metals will continue to be sourced from mining sites.

Given the historical links between conflict and mining, it is essential to determine if increasing extraction of these minerals has the potential to aggravate grievances and tensions at current and future sites of extraction. Regions that are vulnerable to these dynamics—each potential hotspots for green conflict minerals—were identified by overlaying fragility indicators with global reserves of the identified minerals. Fragility was determined using the latest versions of both the Fund for Peace’s Fragile States Index as well as Transparency International’s Corruption Perceptions Index. The Fragile States Index defines fragility using 12 indicators relating to internal cohesion, the economy, politics, cross-cutting factors including demographic pressures, refugees and internally displaced persons, and external intervention (Fund for Peace, 2018). Transparency International calculates perceptions of corruption in the public sector using 13 different data sources from 12 different institutions (Transparency International, 2017).

Fragility and corruption measures are presented in Figure 2; the darker the shading, the more fragile and corrupt the state is, according to the 2017 and 2018 data sets. As can be seen, fragility and corruption are not endemic to any one particular region; all countries struggle with these issues to varying degrees. However, higher rates of fragility and corruption are found in the Sahel and Central Africa, the Middle East and North Africa, Southeastern Asia, Central America and some parts of South America.

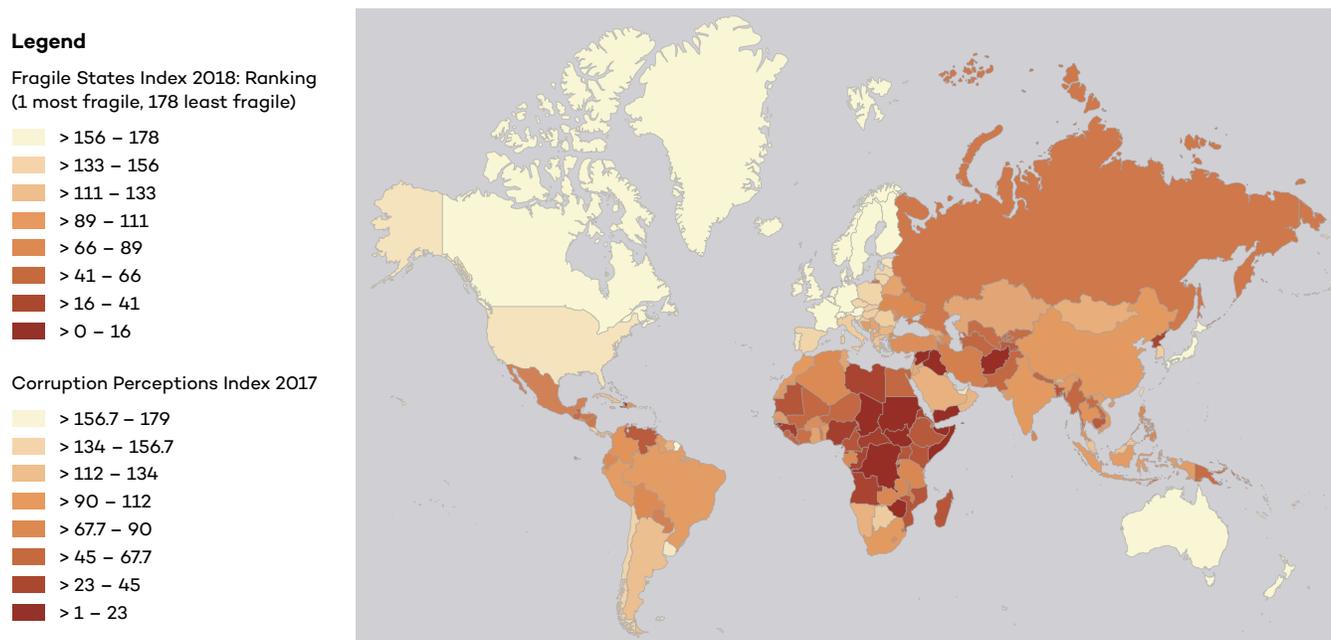


Figure 2. Fragility and corruption indicators

Source: Fund for Peace, 2018; Transparency International, 2017



Fragility indicators can then be overlaid with established mineral reserves—defined as resources known to be economically feasible for extraction—to see if any of these strategic reserves are found in countries already plagued by instability. While data on existing mineral deposits—a natural concentration of minerals in the Earth’s crust—is readily available and may indicate larger quantities of select minerals, these deposits have not been identified as economically viable and are therefore excluded from the analysis. Bolivia, for example, has more lithium deposits than any other country in the world, but its confirmed reserves remain limited. Bolivia’s abundant lithium deposits are therefore not reflected in this visualization.

The U.S. Geological Survey collects and disseminates data on global mineral production and reserves every year in its *Mineral Commodity Summaries*. While extensive, the report has notable data gaps resulting from reporting and collection inefficiencies, particularly in developing countries. For this reason, it is important to note that, even if a country has been designated as having minimal to no mineral reserves, this does not necessarily indicate the country lacks the mineral in question, only that data is unavailable to determine if there are significant reserves. The following maps (Figures 3 through 20) display reserve quantities of 18 of the minerals listed in Figure 1; the size of the circle corresponds to the relative global quantity of the country’s reserves in metric tonnes. Mineral reserve data was unavailable for cadmium, gallium, germanium, indium and silicon.^{3,4}

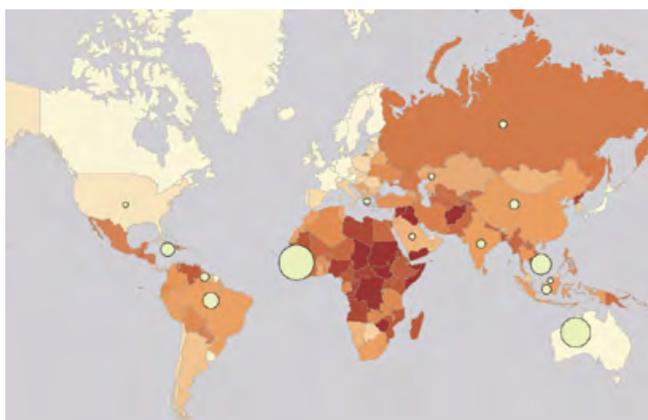


Figure 3. Bauxite and alumina reserves 2018

Source: Fund for Peace, 2018; Transparency International, 2017; U.S. Geological Survey, 2018

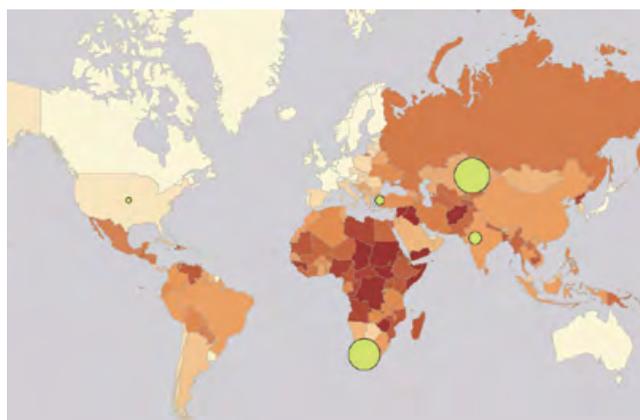


Figure 4. Chromium reserves 2018

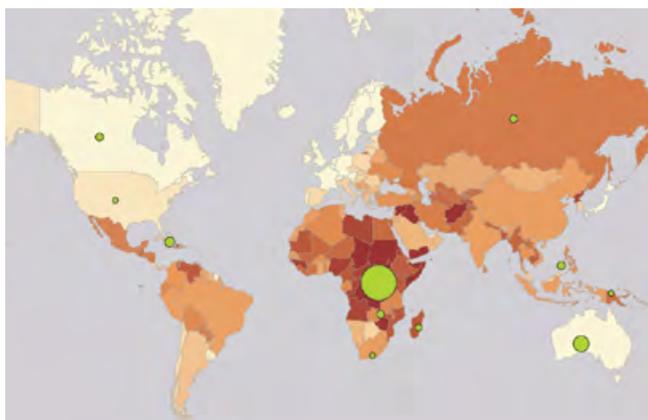


Figure 5. Cobalt reserves 2018

Source: Fund for Peace, 2018; Transparency International, 2017; U.S. Geological Survey, 2018

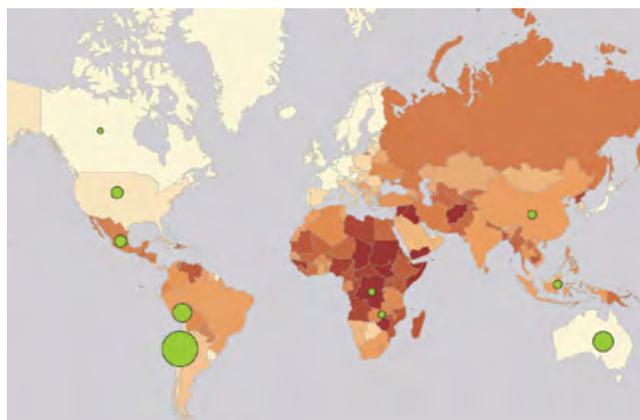


Figure 6. Copper reserves 2018

³ Dots signifying reserves are geotagged to the country only, and not to the particular region within the country.

⁴ The colours of the dot have no significance, other than to differentiate between the various minerals.

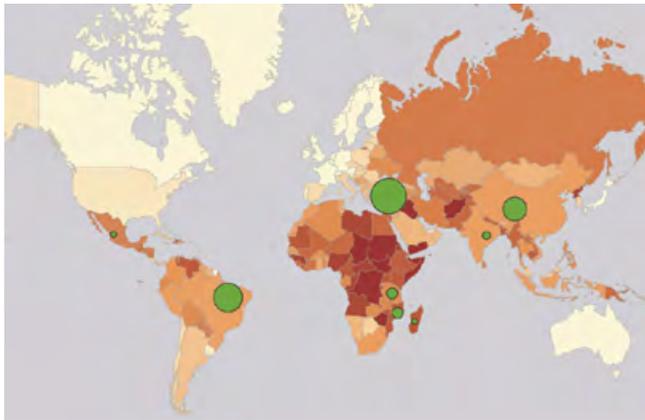


Figure 7. Graphite reserves 2018

Source: Fund for Peace, 2018; Transparency International, 2017; U.S. Geological Survey, 2018

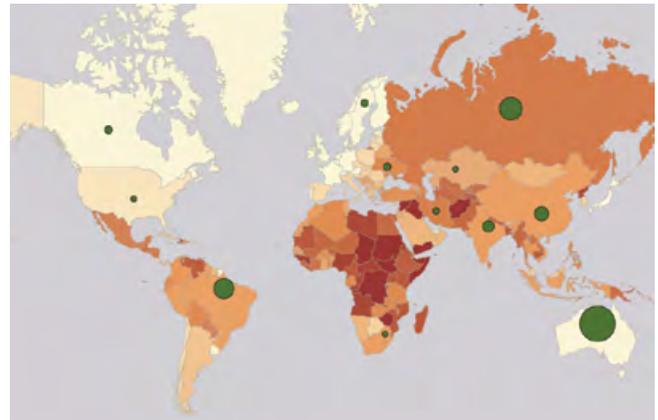


Figure 8. Iron ore reserves 2018

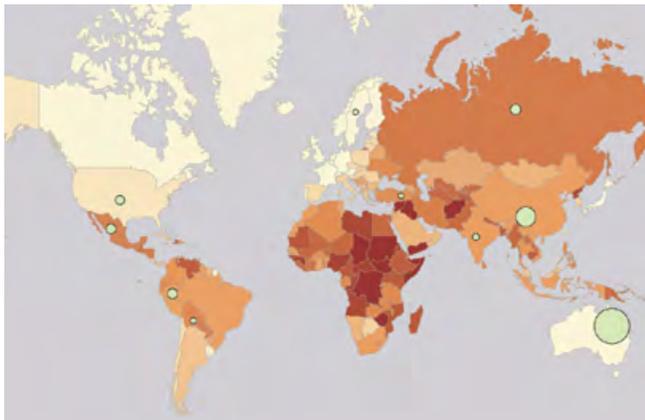


Figure 9. Lead reserves 2018

Source: Fund for Peace, 2018; Transparency International, 2017; U.S. Geological Survey, 2018

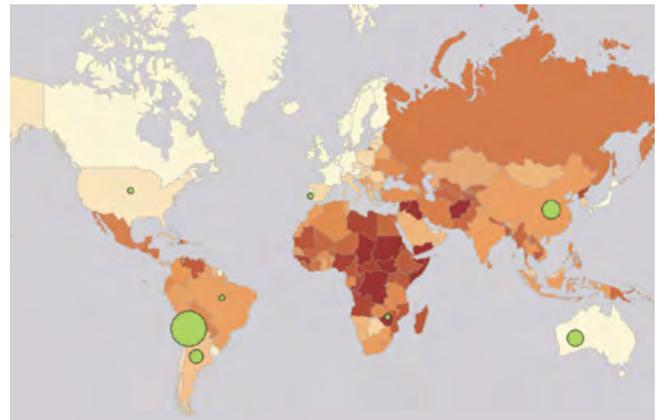


Figure 10. Lithium reserves 2018

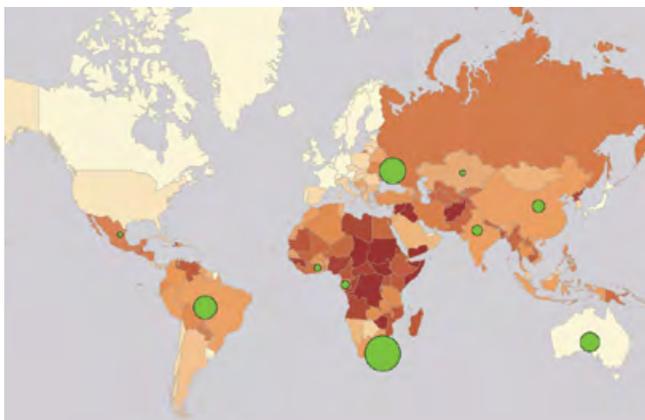


Figure 11. Manganese reserves 2018

Source: Fund for Peace, 2018; Transparency International, 2017; U.S. Geological Survey, 2018

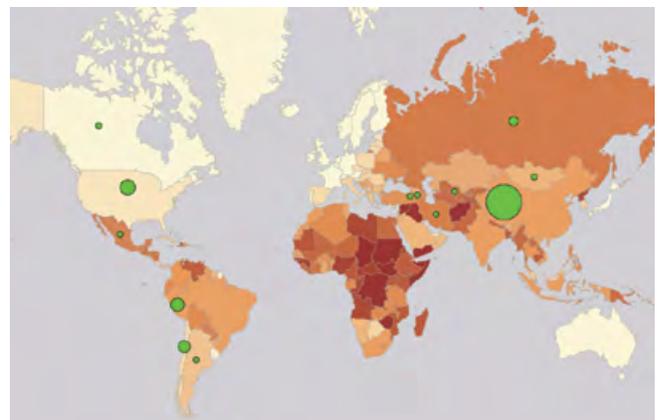


Figure 12. Molybdenum reserves 2018

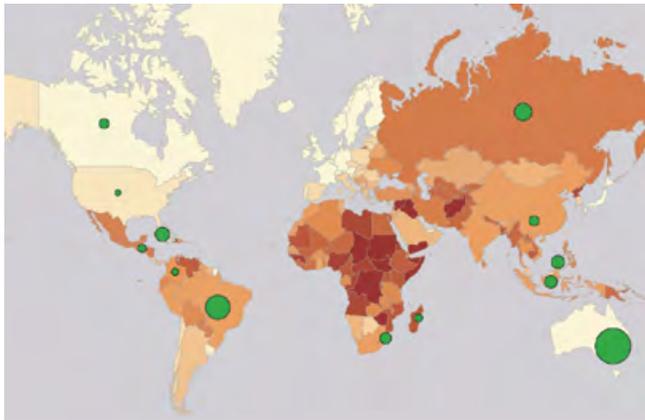


Figure 13. Nickel reserves 2018

Source: Fund for Peace, 2018; Transparency International, 2017; U.S. Geological Survey, 2018

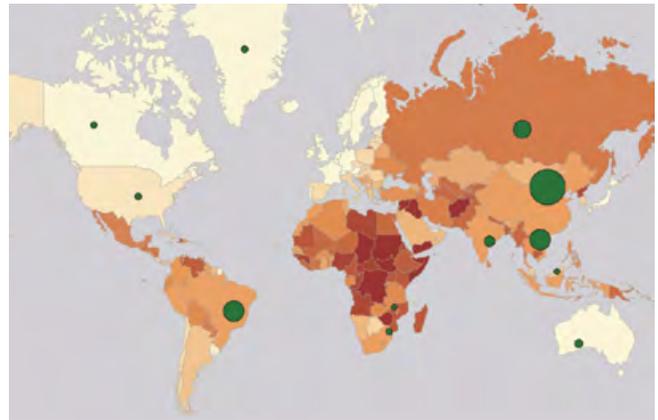


Figure 14. Rare earths reserves 2018

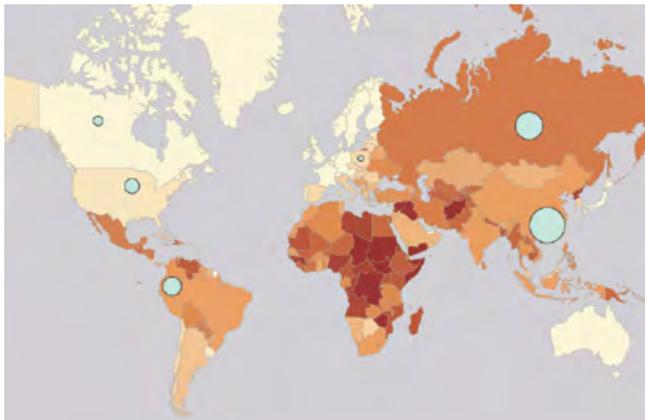


Figure 15. Selenium reserves 2018

Source: Fund for Peace, 2018; Transparency International, 2017; U.S. Geological Survey, 2018

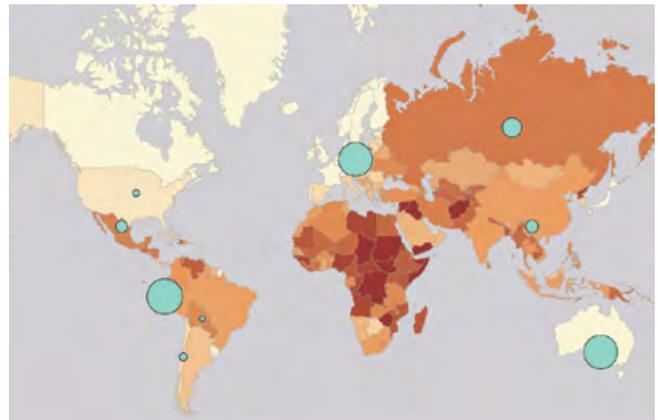


Figure 16. Silver reserves 2018

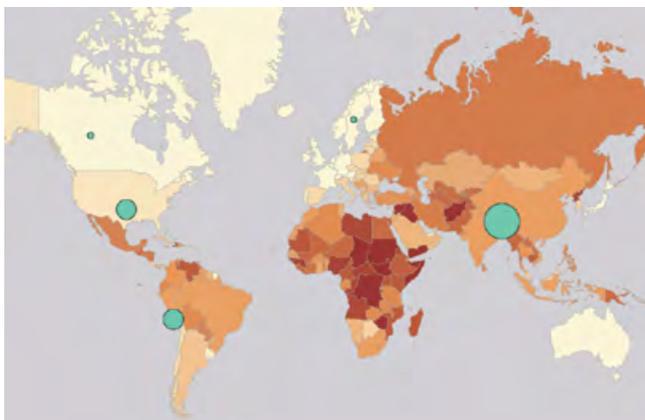


Figure 17. Tellurium reserves 2018

Source: Fund for Peace, 2018; Transparency International, 2017; U.S. Geological Survey, 2018

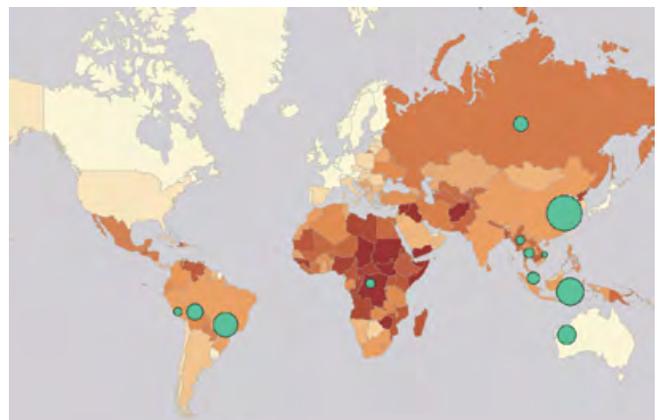


Figure 18. Tin reserves 2018

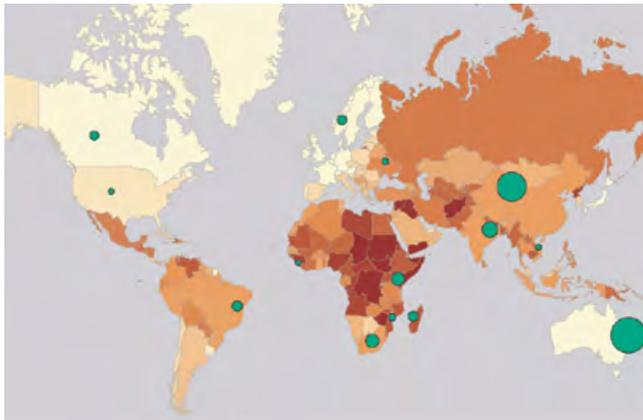


Figure 19. Titanium⁵ reserves 2018

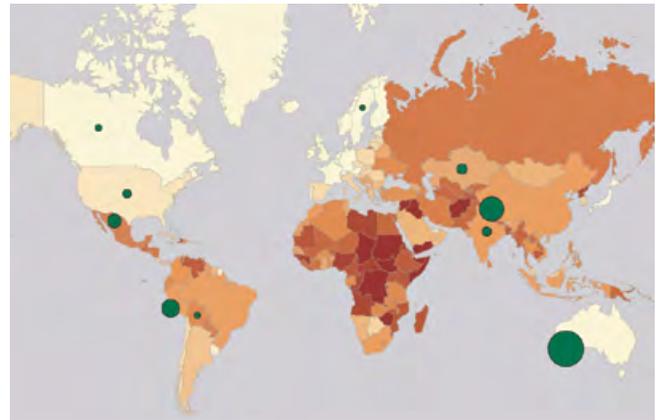


Figure 20. Zinc reserves 2018

Source: Fund for Peace, 2018; Transparency International, 2017; U.S. Geological Survey, 2018

As can be seen from the maps above, a substantial percentage of the minerals required for green energy technologies are located in states with high measures of fragility and corruption. Cobalt, graphite, copper and rare earths are of particular concern; significant deposits of all three are concentrated in vulnerable regions.

While the maps do not reflect current levels of production, the presence of strategic minerals in fragile states, coupled with expected increases in demand for these minerals in the decades to come, point to the emergence of a number of potential hotspots for green conflict minerals. Figure 21 consolidates information on reserves for all minerals required for green energy technologies. This shows that there are significant reserves of these strategic minerals in South America, sub-Saharan Africa, Southeast Asia and Australia. These regions, with the exception of Australia, have middle to high measures of fragility and corruption, underscoring the potential vulnerability of these areas to conflict with the proliferation of green energy technologies.

⁵ Refers to titanium mineral concentrates.

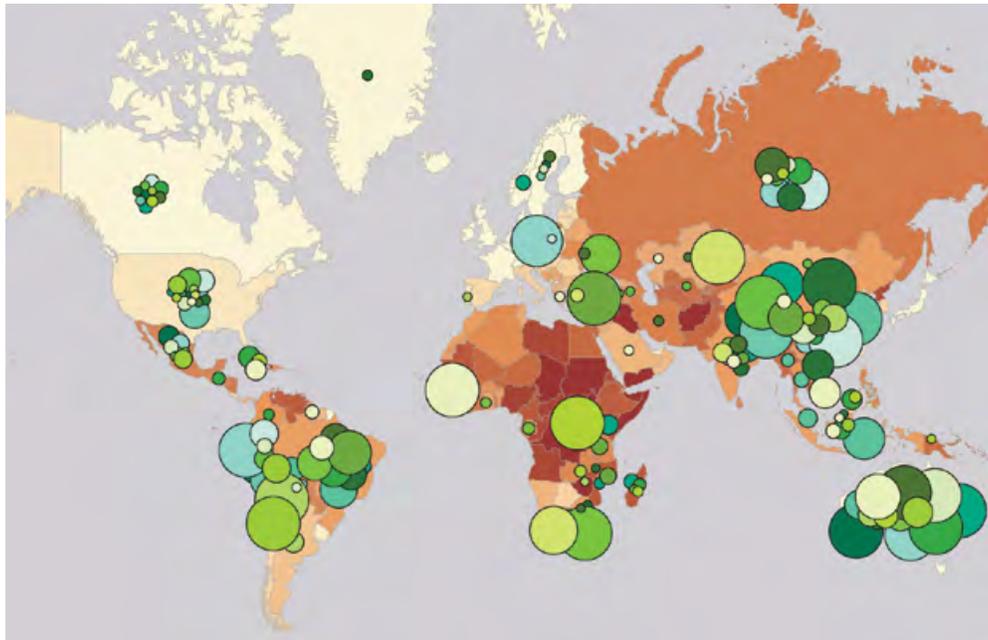


Figure 21. Global reserves of minerals required for green energy technologies overlaid with fragility and corruption measures^{6,7}

Source: Fund for Peace, 2018; Transparency International, 2017; U.S. Geological Survey, 2018

Table 1 further illustrates the possibility for conflicts emerging around these minerals. The table lists the percentage of known global reserves located in either fragile or corrupt states. Twenty-eight per cent of bauxite and alumina reserves, for example, are found in a very fragile state: Guinea. Fifty-six per cent of cobalt reserves are located in a very fragile and very corrupt state: the DRC. Notably, 100 per cent of chromium and graphite reserves are found in states perceived to be either corrupt or very corrupt. In fact, substantial reserves of all 18 studied minerals are found in states perceived to be either corrupt or very corrupt in 2017 (Transparency International, 2017).

Five key minerals were selected for further case studies: cobalt, rare earths, nickel, aluminum and lithium. These minerals were selected based on their importance to the development and deployment of green energy technologies and the rates of fragility and corruption where current reserves are found. Each case study examines the mineral's use in green energy technologies, as well as the conflict, fragility and violence implications of increased mineral extraction in one country, typically the country with the most reserves.

⁶ Dots signifying reserves are geotagged to the country only, and not to the particular region within the country.

⁷ The colours of the dots serve to differentiate between the various minerals.

**Table 1. Mineral reserves in states with high fragility and high corruption⁸**

Mineral	Fragility		Corruption	
	Global Reserves Located in Very Fragile States ^a	Global Reserves Located in Fragile or Very Fragile States ^b	Global Reserves Located in States Perceived as Very Corrupt ^c	Global Reserves Located in States Perceived as Corrupt or Very Corrupt ^d
Bauxite & Alumina	28%	44%	0%	68%
Cadmium	<i>Data not available</i>			
Chromium	0%	55%	0%	100%
Cobalt	56%	70%	56%	70%
Copper	4%	41%	4%	41%
Gallium	<i>Data not available</i>			
Germanium	<i>Data not available</i>			
Graphite	1%	73%	7%	100%
Indium	<i>Data not available</i>			
Iron	0%	42%	0%	60%
Lead	0%	49%	0%	49%
Lithium	0%	21%	0%	34%
Manganese	0%	66%	0%	86%
Molybdenum	0%	70%	0%	72%
Nickel	2%	42%	2%	59%
Rare Earths	0%	58%	0%	94%
Selenium	0%	76%	0%	76%
Silicon	<i>Data not available</i>			
Silver	0%	52%	0%	52%
Tellurium	0%	67%	0%	67%
Tin	6%	69%	3%	84%
Titanium	12%	57%	6%	62%
Zinc	0%	52%	0%	59%

Source: Fund for Peace, 2018; Transparency International, 2017; U.S. Geological Survey, 2018

^a Labelled as “alert,” “high alert” or “very high alert” on the 2018 Fragile States Index: receiving a score of 90.00 or higher (113.4 is the highest score, held by South Sudan).

^b Labelled as “elevated warning,” “high warning,” “alert,” “high alert” or “very high alert” on the 2018 Fragile States Index: receiving a score of 70.00 or higher (113.4 is the highest score, held by South Sudan).

^c Receiving a score of 25.00 or lower on the 2017 Corruption Perceptions Index. A score of 1 denotes a highly corrupt state; a score of 100 denotes a very clean state.

^d Receiving a score of 43.00 or lower on the 2017 Corruption Perceptions Index. A score of 1 denotes a highly corrupt state; a score of 100 denotes a very clean state.

⁸ Cells are bolded to denote significance.



4.0 Case Studies

4.1 Cobalt in the DRC

4.1.1 Mineral Profile

Cobalt is used in the batteries of most modern electronics, like smartphones, digital music players and laptops. Critical to the low-carbon economy, cobalt is also instrumental to the development and facilitation of EVs and energy storage technologies. For EVs in particular, cobalt is found in three out of the four major lithium-ion batteries on the market: lithium cobalt oxide, nickel manganese cobalt and nickel cobalt aluminum (Levin Sources, 2017a). Lithium-ion batteries are also used to store energy derived from solar, wind and other green technologies, thereby making the batteries—and the minerals required to power them—an integral part the transition to a low-carbon economy.

Surging demand for cobalt has been a recurring theme in recent headlines. The World Bank estimated that if the international community is able to keep global temperature rise to 2°C (instead of the projected 6°C) through the widespread adoption of green energy, demand for cobalt could see an increase of an exponential magnitude (Arrobas et al., 2017). Other reports estimate that cobalt demand could grow by 700 per cent by as early as 2020 (Safehaven.com, 2017). Future demand and pricing are largely predicated on changes in the automotive industry, namely the shift toward lithium-ion batteries. Some estimates suggest that the price of cobalt could increase to USD 100,000 per tonne by 2030 (compared to USD 60,000 per tonne in 2017) as a result of the transition to EVs and green energy storage technologies (NetworkNewsWire, 2017). Much of this demand comes from Chinese manufacturing and consumer markets (Levin Sources, 2017a).

Global cobalt supply is subject to potential shortages. Some estimates suggest a 20 per cent global cobalt supply gap by 2025, even with new mining operations in Canada coming online in the interim (Safehaven.com, 2017). The British Geological Survey's 2015 Risk List gave cobalt a score of 8.1 out of 10, indicating a relatively high supply risk (British Geological Survey, 2015). In addition to unprecedented demand for the mineral, this risk and supply gap is in part due to the way that cobalt is mined; cobalt is mined as a by-product of either nickel or copper and therefore can be dependent on price fluctuations and demand of the two.⁹

Global cobalt supply is also designated as high-risk because fragile countries host a large majority of the cobalt reserves and production. The DRC has the largest global reserves of cobalt, with an estimated 3,500,000 metric tonnes—50 per cent of world reserves (U.S. Geological Survey, 2018). Other, less significant reserves are found in Australia, Cuba, the Philippines, Zambia, Russia, Canada, Madagascar, Papua New Guinea, South Africa and the United States (U.S. Geological Survey, 2018). In 2017, the DRC produced more than 58 per cent of global cobalt, with the next closest country, Russia, producing only 5 per cent (U.S. Geological Survey, 2018). Cobalt can be mined through both ASM and LSM operations.

4.1.2 Country Context

Despite a vast wealth of mineral resources and biodiversity, the DRC's recent history has been defined by fragility, corruption and violence. The centre of what was called Africa's World War, or the Second Congo War, from 1998–2003, legacies of human rights abuse, weak governance and exploitative practices still permeate the lives of many Congolese citizens. The country still scores high on global indicators of fragility and corruption, ranked the sixth most fragile country in the world and the 17th most corrupt (Fund for Peace, 2018; Transparency International, 2017). Although the Ibrahim Index of African Governance demonstrates that, in recent years, the DRC has shown increasing improvement in developing a sustainable economy, it also highlights a continued deterioration of human development,

⁹ Cobalt can also be found in manganese-bearing nodules on the floors of the Atlantic, Indian and Pacific Oceans. However, it is unclear if these nodules will be mined.



political participation and human rights (Ibrahim Index of African Governance, 2016). Its positive peace ranking is low, indicating that, despite marginal economic improvements, the state's stability is still prone to shocks (Institute for Economics & Peace, 2017).



The DRC's mining industry is its largest source of export income (BBC News, 2018a). In addition to cobalt, the country is a major global producer of copper, tantalum, tin and gold. Despite the potential the DRC's mineral wealth holds for its economy and development, the country's history of war, weak governance and grand corruption pose a risk to the responsible management of ongoing mining operations.

The DRC's resource governance scores have either been poor or on the cusp of failing for years, indicating that there are minimal established procedures and practices to govern the country's minerals (Natural Resource Governance Institute, 2017). Throughout and after the Second Congo War, mineral resources, including 3TG, fuelled violence and human rights violations. Illegal armed groups fought for control of the mines, exploited miners and used profits from the minerals to fund their continued violence. These activities, in addition to other global examples, contributed to the emergence of thinking on "conflict minerals," referring to minerals that are extracted from conflict zones and fund continued violence. While legislation like the U.S. Dodd-Frank Act

(Section 1502) have taken measures to prevent the flow of conflict minerals from the DRC and nine neighbouring countries, gaps in the legislation, a lack of transparency in global supply chains, weak governance structures and poor enforcement mechanisms enable the continued trade in conflict minerals from the DRC. The Dodd-Frank legislation can also have the unintended effect of incentivizing some downstream companies to look elsewhere for their minerals, rather than sourcing responsibly from Congolese mines. As a result, many miners unconnected to the violence saw their markets dry up despite not contributing to the ongoing violence.

In addition to these conflict and violence implications, mineral resources in the DRC can be subject to corruption schemes and financial crimes, as seen in the ongoing U.S. sanctions against Dan Gertler and associated entities (Global Witness, 2017a). Gertler, the businessman, has been integral to a number of mining operations in the Congo—including the extraction of cobalt—and has been associated with bribery scandals and grand corruption (Global Witness, 2017b). Corruption can erode the social contract between the state and its citizens, diverting funding away from the core services that need it most and impoverishing communities, further exacerbating fragility.

Current in-country dynamics present considerable additional obstacles to the responsible extraction of the DRC's rich resources. In addition to continued violence in the east of the country, the country's president, Joseph Kabila, has refused to leave office despite reaching his term limit and widespread public opposition; it is unclear if and when free and fair elections will take place. Kabila and his officials have also been accused of widespread corruption linked to the violence and to mining, siphoning off profits from gold ore and copper sales (Loffman, 2017).



4.1.3 Current Conflict Implications

The continued permeation of fragility, conflict and violence into the mining sector, as well as ongoing records of corruption and weak governance, pose considerable risks for the responsible extraction of Congolese cobalt for green energy technologies. Already, cobalt has been tied to some of the same exploitative and violent practices seen in the mining of 3TG; these mines have been connected to child labour, dangerous working conditions, extortion and human rights abuses.

Approximately 10 per cent of the global supply of cobalt and 20 per cent of the DRC's total cobalt exports come from ASM operations (Amnesty International, 2017). ASM sites are not inherently dangerous, but are prone to risk due to minimal oversight, regulation and safety measures (Reuters, 2018). ASM operations can be associated with high rates of death and injuries, due to the lack of safety equipment and protective gear.



The United Nations Stabilization Mission in the Democratic Republic of the Congo conducts a patrol in the Ituri Province. UN Photo/Michael Ali

In 2016, Amnesty International visited ASM operations in the south of the DRC and interviewed workers at five mining sites. Researchers interviewed 17 children, all of whom were employed at the mining sites for less than USD 2 per day, and found that several children had been beaten by the mining companies' security guards for trespassing on the companies' concessions (Amnesty International & Afreewatch, 2016). The researchers also found that workers did not have access to protective equipment, were exposed to harmful chemicals, and that state officials extorted illegal payments from the artisanal miners (Amnesty International & Afreewatch, 2016).

As a result of these risks, some companies have tried to avoid sourcing from the DRC altogether, looking instead to Australia, Canada or the Philippines. First Cobalt Corp, for example, stated in 2017 that it would abandon seven cobalt exploration properties in DRC and instead focus on exploring Canadian deposits (Lewis, 2017). Given the DRC's rich reserves, however, leading producers of cobalt will most likely

continue to work in the African country. Efforts should be focused on mitigating conflict risks by addressing the root causes and stopping human rights abuses around the DRC's mining states, which will ultimately improve certainty in the supply chain.

Despite the relatively widespread reporting of these ongoing conflict implications, only marginal improvements have been made to secure the responsible sourcing of cobalt. Cobalt is not officially classified as a conflict mineral in legislation like the U.S. Dodd-Frank Act, and therefore any regulations aimed at curbing the illegal flow of conflict minerals may not explicitly apply to cobalt. Amnesty International conducted an assessment in 2017 of 26 electronic and EV companies and found that all failed to conduct human rights due diligence in line with international standards on their cobalt supply chains (Amnesty International, 2017). Some groups—like the World Economic Forum's Global Battery Alliance and the Responsible Cobalt Initiative—have started to take measures to address these inefficiencies and gaps in international legislation and supply chain governance. However, given the ongoing human rights abuses and surging demand for cobalt, additional improvements in the responsible sourcing of cobalt are still sorely needed.



Box 1. Cobalt in Cuba

The fall of the Soviet Union in the early 1990s sparked an economic crisis in Cuba; the country's GDP fell by a third, and media reports spoke of severe famine and malnutrition resulting from widespread shortages across industries (McRae, 2016). Many predicted a long period of fragility for Cuba. However, by the early 2000s, indicators of human development, peace and economic well-being had already begun to improve dramatically.

Cuba's mineral resources demonstrate the positive role that the extractive sector can play in the economic development of states struggling with economic and political instability. Since the late 1990s, Cuba has developed well-defined mineral resources and a highly trained workforce, and it has taken measures to improve transparency and boost foreign direct investment (Lacy, 2016). It has also consistently improved its stability and fought corruption (Fund for Peace, 2018; Transparency International, 2017).

Cuba has approximately 7 per cent of world cobalt reserves and is responsible for 4 per cent of global production (U.S. Geological Survey, 2018). Given its strong resource governance mechanisms, companies are increasingly investing in the island state to meet the booming cobalt demand. With the gradual improvement of U.S.-Cuba relations, it is expected that investment in Cuba's nickel and cobalt resources will continue to grow as an important source of foreign income and contribute to the country's continued development.

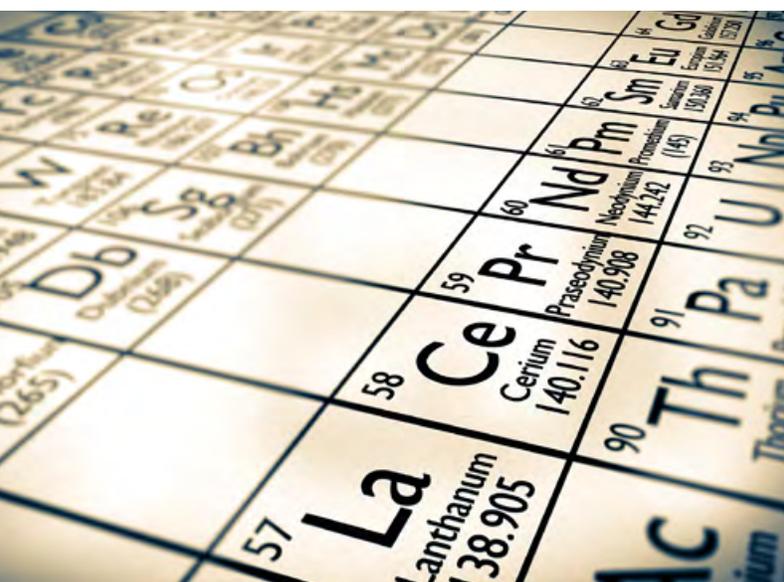
4.2 Rare Earths in China

4.2.1 Mineral Profile

The term "rare earths" refers to 17 different elements, often found together in the Earth's crust. Of the 17, three are of particular importance to the development of green energy technologies: dysprosium, neodymium and praseodymium.¹⁰ These minerals are necessary for the production of specialized magnets used in both EVs and energy storage technologies as well as in wind turbines. The magnets are favoured for EVs because they are generally lighter, stronger and more efficient than induction motors that rely on copper coils (Desai, 2018).

Similarly, use of these magnets has significant advantages in the production of wind turbines, cited for their efficiency, weight, size and maintenance properties (Pavel, et al., 2017). The World Bank notes that the use of these magnets in wind turbines is preferred, particularly for offshore turbines, due to their reliability and capacity to handle higher wind speeds (Arrobas et al., 2017). Some substitutions are available for rare earths; however, most of these are still in the research phase and in general have been found to be less effective.

The prices of wind turbines and EVs are increasingly competitive, making the deployment of both a rapid reality. The demand for rare earths to meet this reality, and for neodymium and praseodymium in particular, is expected to surge in the coming years with this



The term "rare earths" refers to 17 different elements.

¹⁰ Trace amounts of the rare earths lanthanum and cerium are also found in EV batteries (Toyota, 2018).



transition. The global demand for neodymium last year was approximately 31,700 tonnes, outstripping supply by 3,300 tonnes (Desai, 2018). And without viable substitutions, demand for neodymium will need to increase by more than 250 per cent through 2050 for the international community to meet its Paris Agreement goals (Arrobas et al., 2017).

Both the demand for and supply of rare earths are concentrated in China. China accounted for 80 per cent of rare earths production in 2017 and is home to 36 per cent of world reserves (U.S. Geological Survey, 2018). Reserves are also located in Vietnam, Brazil, Russia, India, Australia, the United States, Canada, South Africa, Malawi and Malaysia, but these have yet to be developed to the same extent as the Chinese reserves (Australia hosts the only other major rare earths operations in the world).¹¹ Increasing demand for and prices of rare earths are spurring the rapid development of rare earths projects around the world; however, most of the projects will not come online until the late 2020s. China's monopoly of the rare earths market, however, is set to continue for the coming decade at a minimum (Shaw, 2017).

4.2.2 Country Context

In addition to rare earths, China is rich in multiple mineral resources key to green energy technologies. Most notably, China has some of the largest global reserves of lead, selenium, tellurium, tin and zinc, which are critical to solar technology, as well as graphite, lithium and titanium, which are critical for EVs and energy storage technologies. The country also has reserves of bauxite and alumina, copper, iron, manganese, nickel and silver. This vast mineral wealth places China in a unique global position, in some cases allowing the state to exert a quasi-monopoly on several critical minerals. A number of the producers and refiners for minerals required for green energy technologies, like cobalt, are also located in China. Virtually all lithium-ion battery production is done in China: the country is the largest global importer of cobalt, nickel and manganese, as well as lithium, despite having large reserves of its own, and it is the largest producer of graphite (RCS Global, 2017). As such, any discussion of green energy supply chains must pass through China.

China has mid-range scores of fragility and corruption (Fund for Peace, 2018; Transparency International, 2017). It has high positive peace scores, indicating high levels of resilience and the appropriate attitudes, institutions and structures needed to sustain a peaceful society (Institute for Economics & Peace, 2017). However, the Natural Resource Governance Institute labels China's resource governance as "weak," indicating that the sector has a mix of strong and problematic areas of governance; indicators like value realization, revenue management and establishing an enabling environment for extraction have ample room to improve (Natural Resources Governance Institute, 2017).

4.2.3 Current Conflict Implications

Mining and industrial development more generally in China have often come at the cost of the environment, growing alongside dangerous levels of air and water pollution. Since the 1990s, environmental activism, driven by localized grievances against pollution, has grown and manifested in the form of protests, petitions and, in some cases, violence (Ho & Yang, 2018). In 2011 communities from the Qinghai province in China, for example, urged the government to take action against lead mining in the Ganhetao Industrial District, which was known to cause high levels of water pollution and endanger the lives of local residents (Environmental Justice Atlas, 2018b). Similar protests and pleas have also been recorded against controversial copper mining in Tibet, gold mining along the Gu Chu River, cadmium extraction in the Guangdong Province and cement production in the Madang Province (Environmental Justice Atlas, 2018b).

Rare earth mining can be both destructive and toxic to surrounding environments. Almost all rare earth ores contain the radioactive elements thorium and uranium (Huang et al., 2016). As a result, the extraction and processing of rare

¹¹ Rare earths may be found in high reserves elsewhere; however, a lack of geological data in developing country regions prevents the acquisition of this knowledge.



earths can be highly toxic and have a negative effect on soil, water and human health. In 1958, the Baotou Iron and Steel Company began producing rare earths near the city of Baotou in Inner Mongolia; by 1980 crops in the nearby villages had already started to fail due to the pollution of soil and groundwater attributed to rare earth mining and processing (Bontron, 2012). Today, the lands surrounding Baotou are stripped of topsoil while streambeds contain thousands of gallons of acid (Bradsher, 2010a). Dalahai village, located close to a Baotou rare earths tailing pond, has been named a “death village” due to the high incidence of lung cancer, brain cancer, respiratory illnesses and cardiovascular diseases suffered by local residents (Huang et al., 2016). Ganzhou, the so-called “rare earths kingdom,” has been described as a “site of devastation” by the *ChinaDialogue*, plagued as it is with crude open air mines, smelters, polluted water supplies and reduced crop yields (Hongqiao, 2016). Coupled with the growth of environmental

activism, rare earths mining in China could lead to increasing tensions at the local level.



Aerial view of a rare earths mine in Baotou, Inner Mongolia, China.

The nature of deposits located in the southern province of Ganzhou make rare earth extraction relatively easier than in Inner Mongolia. These deposits are also free of radioactive thorium. However, as a result of the ease of extraction and rising global prices for rare earths, a substantial number of illegal rare earth mines emerged in the area. These mines are cited to sell to organized crime syndicates and exploit workers, some of which are children (Bradsher, 2010a; Schlanger, 2017). Some estimates suggest that tens of thousands of tonnes of rare earths are illegally mined and sold on China’s black market every year (Hongqiao, 2016). In response, both the central and provincial governments have taken measures against illegal mining operations, including instituting new regulations against illegal exploration as well as dispatching police to outlaw the illegal mines (Yan, 2012). The traceability of rare earths supply chains, however, is still relatively unexplored, and is not regulated to the same extent as other conflict minerals.

been used as political and economic leverage in past state-level disputes. In 2010, amid a territorial disagreement over disputed islands with Japan, China suspended its shipments of rare earths to its neighbour (Bradsher, 2010b). Chinese officials later lifted the embargo and denied that the ban was in response to the dispute with Japan, claiming they had instead reduced export quotas to mitigate pollution and environmental concerns (Bradsher, 2010b). Nevertheless, the period raised a number of concerns with companies and countries around the world regarding the diminishing supply, rising prices and implications of China’s dominant position in the rare earths market.

In addition to the risks of exacerbating local and global grievances surrounding pollution and public health, China’s majority share of rare earth production has



Box 2. Recycling in the green energy supply chain

Green energy minerals like lithium and rare earths historically have insignificant rates of recycling. This in part is due to poor collection rates as well as technology gaps that make it uneconomical to recycle these minerals. Recently, however, public and private actors have started investing in improving technologies and facilities for mineral recycling in order to meet the demands of increased consumption and mitigate the projected supply shortages. In 2009, for example, the U.S. Department of Energy awarded millions of dollars to Retriev Technologies to construct a recycling facility for lithium-ion vehicle batteries in Ohio (U.S. Geological Survey, 2018). The facility officially opened its doors in 2015.

Secondary minerals—or minerals that have been recycled—have the potential to alleviate some of the concerns around fragility, conflict and violence that have been associated with mining, by reducing pressures on the mines and extraction sites. However, the supply chains of secondary minerals are often more opaque and less regulated than those of primary minerals. Battery recycling facilities in Bangladesh, China and India have been linked to poor working conditions, child labour and environmental degradation (NL-Aid, 2013). Shipbreaking—the process of stripping a ship for scrap metal and parts—takes place mainly in Turkey, Pakistan, India and Bangladesh, and can be a critical source of secondary minerals. However, labour and environmental governance of the shipbreaking industry is weak, resulting in high rates of worker accidents, illness and death, as well as oil spills and toxic substance leaking. The responsible management of supply chains for secondary minerals is therefore essential to ensuring transparency and accountability in the transition to a low-carbon economy.

4.3 Nickel in Guatemala

4.3.1 Mineral Profile

Cobalt and lithium tend to dominate discussions around the mineral required for the green energy transition. This is in part due to the fact that base metals like nickel are not exclusively produced for green energy technologies; nickel is used in more than 300,000 products worldwide, including those with consumer, industrial, aerospace, marine and architectural applications (Nickel Institute, n.d.). Of the 2.1 million metric tonnes of nickel content produced in 2017, approximately 65 per cent was used to manufacture stainless steel, while only 6 per cent was devoted to the production of coins, electronics and rechargeable batteries (U.S. Geological Survey, 2018; Nickel Institute, n.d.). However, its use in the production of steel is also expected to benefit from green energy technologies, and its use in rechargeable batteries is expected to comprise a growing share of nickel production annually. Nickel can only be mined through industrial LSM operations.

Nickel is required for multiple green energy technologies, including EVs and energy storage products. Currently, two types of lithium-ion batteries make up the majority of the EV market due to their efficiency, price and ease in manufacturing: nickel manganese cobalt and nickel cobalt aluminum batteries (Hunt, 2018). Rates of 30 and 80 per cent of nickel are required for nickel manganese cobalt and nickel cobalt aluminum batteries respectively. As such, nickel will be crucially important to the green energy transition, regardless of which EV battery leads production in the coming decade (Hunt, 2018).

While nickel production has slowed in recent years due to an abundance of supply and price fluctuations, the transition to EVs is expected to revitalize global interest in the commodity. Should EVs capture only 2 per cent of vehicle sales by 2020, for example, global demand for nickel could increase by 85,000 tonnes from 2016 (Els, 2017). Further, if EVs occupy 32 per cent of vehicle sales by 2030, nickel supplies would need to increase by more than 56 per cent (from 2016) (Els, 2017). China is a significant source of this growing demand, accounting for 52 per cent of world nickel demand and more than 40 per cent of the world's EV car stock (International Nickel Study Group, 2018; Kennedy, 2018).



According to the World Bank, the transition to solar technologies could increase the demand for nickel by 300 per cent through 2050 (Arrobas et al., 2017). This number increases dramatically when EVs and energy storage technologies are included, with a predicted increase in demand for nickel of up to 1,200 per cent (Arrobas et al., 2017).

Nickel extraction and production are not as concentrated as cobalt or rare earths. Nickel is currently mined in more than 40 countries, with significant quantities of reserves in 13 (U.S. Geological Survey, 2018). However, of these reserves, 38 per cent are found in states given an “elevated warning” or worse on the Fragile States Index (Fund for Peace, 2018), and 54 per cent of reserves are located in states perceived to be corrupt or very corrupt on the Corruption Perceptions Index (Transparency International, 2017). Indonesia and the Philippines were the top producers of nickel for 2017; however, in that year the government of the Philippines ordered the closure of 23 of its mines (most of which were nickel producers) in an effort to address the environmental degradation caused by the industry (U.S. Geological Survey, 2018; Dela Cruz, 2017). Guatemala is currently ranked 10th in terms of world reserves, with an estimated 1,800,000 metric tonnes of nickel content (U.S. Geological Survey, 2018).



Mining site in Guatemala.

At the height of this violence, the Canadian mining firm INCO (previously the International Nickel Company, now Vale) won a monopoly on nickel extraction in Central America and controlled nearly 54 per cent of the nickel market in North and South America (Price, 2015). New mines were primarily opened in Guatemala’s rural areas, where the majority of Indigenous Maya people reside. Indigenous opposition to mining during the civil war manifested as protests against illegal land use, environmental degradation and connections to colonialism associated with LSM operations. In response, armed groups and private security forces were sometimes deployed to remove Indigenous-led opposition to mining (Price, 2015).

Throughout the armed internal conflict, more than 200,000 civilians were killed and more than 1.5 million were displaced (PBS News Hour, 2011; Agence France-Presse, 2015). Guatemala’s Historical Clarification Commission

4.3.2 Country Context

Guatemala is one of the most resource-rich and populated countries in Central America. Despite this richness, the country ranks poorly on indicators of fragility, corruption and violence (Fund for Peace, 2018; Transparency International, 2017). Although the Indigenous Maya comprise almost 50 per cent of the population, they are disproportionately affected by development challenges and the negative impacts of the country’s mining industry (BBC News, 2018b).

Mining activity currently makes up approximately 3 per cent of Guatemala’s overall GDP (McGill Research Group Investigating Canadian Mining in Latin America, n.d.). Along with nickel, Guatemala possesses rich deposits in gold, silver and copper, although not all have been deemed economically viable to mine. On the 2017 Resource Governance Index, Guatemala’s mining sector was given a “poor” ranking, having established minimal procedures and practices to govern resources (Natural Resources Governance Institute, 2017).

Nickel mining is relatively new to Guatemala, having emerged during the country’s armed internal conflict, which began in the early 1960s and lasted until 1996.



later found that the majority of these abuses were perpetrated by the state military and that 83 per cent of victims were Indigenous Maya (Amnesty International, 2014).

4.3.3 Current Conflict Implications

A recent report by Amnesty International found that mining companies in Guatemala throughout the civil war neglected to address existing community tensions and, in many cases, “failed to adhere to international standards on business and human rights” in regards to consultation and security operations (Amnesty International, 2014). Although the civil war ended in 1996, the legacy of violence continues to affect Guatemalan society, often manifesting around the mining of nickel.

Fenix Mining project is one of the largest nickel mines in Central America (Hill, 2014). Throughout the past decade, the project—located near the Lote Ocho Indigenous community in El Estor—has been linked to allegations of forced displacement, murder and sexual violence. Due to poor access to dispute resolution mechanisms and a weak judiciary, victims—the majority of which are Indigenous—have been unable to successfully bring criminal cases against their perpetrators within Guatemala (Kassam, 2017). Some victims, however, have been able to bring forward civil lawsuits in the home jurisdictions of the foreign mining companies that own the mine (and their subsidiaries) (Kassam, 2017).



Stockpile of ammunition turned in following the cease-fire signed by the Government of Guatemala and the Unidad Revolucionaria Nacional Guatemalteca in 1996. UN Photo/John Olsson

In the case of *Caal v. Hudbay*, 11 Maya Q’eqchi’ women are suing the mining company HudBay in its home jurisdiction of Ontario (Klippensteins, Barristers & Solicitors, 2018). The women allege that in January 2007, private security personnel from the Fenix Mining project forced villagers off their ancestral lands, burned their homes and sexually assaulted the women (Klippensteins, Barristers & Solicitors, 2018). In addition to this lawsuit, community groups are suing HudBay and its subsidiaries for the 2009 murder of the community leader Adolfo Ich Chamán and the shooting of German Chub Choc. HudBay denies culpability, stating that the sexual assaults were carried out before their involvement in the mine and that mining personnel were not involved in the 2009 evictions; HudBay bought the mine from the Guatemalan Nickel Company in 2008 (Kassam, 2017; Price, 2015; Hudbay Minerals Inc., 2017).

While these cases represent a landmark move to bridge the disconnect between foreign mining companies and the actions of its local subsidiaries, they also reflect how increased mineral demand in resource-rich states like Guatemala can result in an exacerbation of land ownership disputes between private companies, governments and community groups. A decade after the aforementioned incidents, nickel mining in Central America is still associated with the destruction of surface land resources, a primary source of livelihoods for many Indigenous communities (Fox, 2014). As such, conflicts over the use of land and who it belongs to continue to manifest in Guatemala and surrounding countries.

If the demand for nickel increases at its predicted rates, it is essential to ensure that mining companies and governments adhere to international human rights and business law, as well as actively respect the human and land



rights of Indigenous persons. This consideration, as well as improved access to effective dispute resolutions, will be necessary to mitigate ongoing community tensions and grievances surrounding extraction, and to contribute to the responsible supply chain governance of nickel and other base metals.

Box 3. Nickel in the Philippines

The Philippines is currently the second largest producer of nickel in the world and has the fifth largest reserves (U.S. Geological Survey, 2018). Despite this ranking, production has declined significantly, in part due to a campaign in which the government shut down 26 mines and banned new open-pit mining projects in 2017, in an effort to curb associated environmental damage and land-use violations (Barrera, 2018).

The Natural Resources Governance Institute (2017) rates the governance of the mining sector in the Philippines as weak, stating that there is a mix of strong and problematic features in the country's governing mechanisms. Disputes surrounding nickel extraction mainly pertain to the sector's history of and potential to negatively affect livelihoods that rely on natural resources (i.e., fishing and farming), degrade biodiversity and essential ecosystems, harm human health and impose on Indigenous ancestral lands. For example, concessions granted to the Pujada-Hallmark nickel mine in the Oriental Davao overlap with drainage systems, watersheds, habitats for endangered species and the ancestral lands of the Mandaya Indigenous Peoples (Environmental Justice Atlas, 2015). Community groups mobilized against mining companies in the form of petitions and protests. In response, some mining companies have strengthened their private security forces, often further aggravating social tensions (Environmental Justice Atlas, 2015). As one of the top producers of nickel worldwide, understanding and taking steps to mitigate ongoing tensions in the Philippines' mining sector is integral to ensuring the responsible sourcing of solar technologies, EVs and energy storage.

4.4 Bauxite and Alumina in Guinea

4.4.1 Mineral Profile

Bauxite is not a mineral but a rock composed of aluminum-bearing minerals (King, 2018). While aluminum can technically be drawn from clay resources, virtually all commercial aluminum on the market has been extracted from bauxite ores using LSM operations. As a result, a closer examination of aluminum resources in this section will be analyzed through the lens of bauxite reserves.



Bauxite mine in Hungary. Bauxite is the world's main source of aluminum.

Bauxite and alumina are required, to varying degrees, for all of the studied green energy technologies: solar, wind, EVs and energy storage. In EVs, aluminum can be found in multiple parts of the car: the body, wheels and in some lithium-ion batteries (Levin Sources, 2017a). In addition, aluminum is a critical component to other technologies potentially associated with the low-carbon economy, like carbon capture and storage and light-emitting diodes (Arrobas et al., 2017).

Demand for aluminum is expected to increase in correlation with increased demand for wind, solar and energy storage technologies; demand could increase



by almost 200 per cent through 2050 (Arrobas et al., 2017). Despite this growing demand, international headlines and civil society groups have not echoed similar supply concerns to those seen over cobalt, rare earths and lithium; according to the U.S. Geological Survey (2018), global aluminum resources are “essentially inexhaustible,” estimated at between 55 billion and 75 billion metric tonnes. Multiple countries host reserves of the metal, with no one state holding a monopoly on production. Top reserve holders include Guinea, Australia, Vietnam, Brazil, Jamaica, China and Indonesia. Guinea has approximately 28 per cent of global reserves, or 7,400,000 metric tonnes (U.S. Geological Survey, 2018). But while supply is seemingly robust and reserves dispersed, aluminum extraction can still be associated with fragility, conflict and violence.

4.4.2 Country Context

Guinea continues to struggle to translate its resource wealth into sustainable economic and social development for its population. Despite being rich in natural resources—including minerals, forests and agriculture—the country remains plagued by chronic poverty and development challenges: in 2016, Guinea ranked 183 of 188 countries on the UN’s *Human Development Report* (United Nations Development Programme, 2016). Life expectancy at birth is just 59 years, with women on average living slightly longer than men, while children spend on average just 2.6 years in school (1.5 year for girls, 3.9 years of boys) and gross national income per capita is USD 1,058 (USD 848 for women, USD 1,267 for men) (United Nations Development Programme, 2016).



UN Photo/Loey Felipe

Weak resource governance is a key part of Guinea’s development challenges. Sustained instability, political risks (including a coup in 2008 and a failed coup in 2011) and a lack of infrastructure continue to impede the country from fully benefitting from its mineral wealth (KPMG, 2014). Guinea ranked 63 of 89 countries on the 2017 Resource Governance Index, indicating that, while some minimal procedures and practices are in place to govern the country’s natural resources, most of the elements required to ensure that society benefits from those resources are missing (Natural Resource Governance Institute, 2017). In addition, fragility and corruption remain key challenges: according to the 2018 Fragile States Index (The Fund for Peace, 2018), Guinea ranked 13 of 178 countries, while it ranked a low 148 of 180 countries on Transparency International’s 2017 Corruption Perceptions Index.

Mining is crucially important to the Guinean economy: it is responsible for approximately 20 per cent of the country’s GDP and 90 per cent of its exports (KPMG, 2014). Two minerals central to renewable technologies dominate the sector. High-grade bauxite takes up the biggest share: at an estimated quarter of global reserves, no other country

has as much of the mineral as Guinea. The country also has among the world’s largest high-grade iron ore reserves, which are mostly untapped, as well as important gold and diamond deposits. Beyond large-scale mining operations, ASM is a significant source of income and livelihood in Guinea; an estimated 300,000 people work directly in ASM and another 1.5 million benefit from the activity (Huntington, 2016).



4.4.3 Current Conflict Implications

Guinea avoided the resource conflicts that embroiled many of its neighbours in the 1990s and 2000s. This is, in part, a function of the minerals themselves; bauxite and iron ore are mined through large-scale operations requiring significant capital and infrastructural investments, often in partnership with the state, and production is not easily smuggled across borders. This stands in contrast to the civil conflicts in neighbouring Sierra Leone and Liberia, which were fuelled by easily looted and artisanally mined alluvial diamonds. Despite the presence of abundant resources, weak governance and severe poverty, all typical triggers for violence, Guinea managed to avoid descending into widespread violence.

This is not to say that the domestic mining sector is immune to conflict. The Guinean state remains heavily reliant on revenues generated from the sector for its budget, rather than on a tax-paying citizenry. This reduces the state's accountability to the Guinean people and weakens the social contract between the government and the population (Bah, 2014). When combined with a lack of visible, local development benefits from mining for those communities living adjacent to mine sites, few jobs, high levels of youth unemployment and the negative environmental impacts commonly associated with a poorly governed sector, the potential for grievances and tensions is significant.

Some of these tensions are already emerging for the bauxite sector. Mining for the mineral is concentrated in the Boké region, in the west of the country near the Atlantic coast; the Bauxite Company of Guinea has been operating in the region since the early 1970s. Despite 45 years of mining in the region, the villages near the mines and related transportation routes have seen few benefits emerge from the sector (Environmental Justice Atlas, 2018a). Instead, they continue to suffer from the negative consequences of extraction while their concerns remain unaddressed. Houses weakened by nearby dynamite explosions have collapsed (Environmental Justice Atlas, 2018a). The fertility of fields and gardens is decreasing, threatening local food security. Muddy waters are contaminating local waterways, while livestock is endangered by polluted vegetation. Villagers are also seeing an increase in respiratory problems, linked to increased dust and water pollution (Environmental Justice Atlas, 2018a).

With no adequate funding allocated to address these problems, either by the company or the government, the result has been a steady rise in local tensions and violence. Multiple riots broke out in Boké in 2017 following local protests organized in response to frustrations over the impact of bauxite mining operations. Grievances extend beyond environmental concerns to general disappointment that mining activities have failed to deliver on job creation and improved living standards in the region; for example, despite the presence of large-scale, industrial mining, Boké itself remains without a reliable source of electricity (Africa Times, 2017). The riots in September 2017 culminated in Guinean forces opening fire on protestors, leaving one dead and 20 injured (Africa Times, 2017).

The Government of Guinea plans to significantly increase the country's production of bauxite; while production has stayed below 20 million tonnes per year, expansion in the sector and the opening of new mines has the government targeting 60 million tonnes produced by 2020 (Reuters, 2017). In addition to increased bauxite production, Rio Tinto's Simandou iron ore project is currently the largest planned integrated mining and infrastructure development project in Africa.

Demand for both bauxite and iron ore is expected to increase with rising demand for renewable energies; both are required for solar, wind and energy storage technologies. And while both minerals are produced in countries around the world, Guinea's reserves are substantial, and its production is of high quality. This reduces the likelihood that all customers down the supply chain will substitute Guinean bauxite and iron ore for other production in response to government's inability to tackle the local grievances surrounding mining. The product they offer is too competitive. Nevertheless, the government, in collaboration with the private sector, should make all efforts to ensure that local economic, social and environmental concerns are addressed and that the mining sector contributes to sustainable development. Beyond the very real human costs of current practices, increased tensions and violence around bauxite and iron ore mining will threaten companies' social licence to operate and potentially discourage future investments in the country.



Box 4. Manganese in Ghana

Ghana is a globally significant producer of manganese, a key mineral for the production of wind turbines and electric vehicles due to its use in both batteries and steel. The country produces ore of a high manganese-to-iron ratio, which is low in heavy metal impurities like phosphorus and alumina. It has been producing the mineral for over 100 years: Nsuta manganese mine, in the southwest of the country, first opened in 1916. The Ghana Manganese Company, a joint venture between ConsMin (90 per cent ownership) and the Government of Ghana (10 per cent ownership), operates the mine and holds a 175 km² concession, of which only 3 per cent has been mined to date.

With the rise in demand for both wind energy and energy storage, Ghana can expect to see increased demand for its manganese. Fortunately, these changes are happening in a context of relative stability; Ghana is among Africa's least fragile states, corruption is perceived to be relatively low and the country's positive peace ranking is high (Fund for Peace, 2018; Transparency International, 2017; Institute for Economics & Peace, 2017). The country's mining law and mining policy are up to date, with the latter committed to ensuring that the mining sector is integrated into the economy and contributes to sustainable development. While conflicts have emerged in the recent past around mining, particularly between large-scale and illegal small-scale gold mining, the manganese sector has operated in a context of relative calm over the past decade (Okoh, 2014). The Ghana Manganese Company is also an active member of the UN Global Compact, indicating that they have committed to aligning their strategies and operations with universal principles on human rights, labour, environmental and anti-corruption.

4.5 Lithium in Zimbabwe

4.5.1 Mineral Profile

Lithium is a crucial component of EVs and green energy storage technologies. Nearly half of all mined lithium (46 per cent) goes into batteries; the rest is used for a variety of products, including ceramics, glass, lubricating greases and polymers (U.S. Geological Survey, 2018). Lithium-ion batteries dominate the EV market, due to

their high energy-density-to-weight ratio (Arrobas et al., 2017). They are also used to power mobile phones, electric tools and electricity grids when connected to wind turbines and photovoltaic cells (The Economist, 2017).

As the market for EVs continues to grow, so too will demand for lithium. This demand increased by 13 per cent to 43,000 tonnes in 2017; it is expected to more than double by 2024 due to the expansion in the production of EVs (U.S. Geological Survey, 2018; Sabo-Walsh, 2017). Much of this demand comes from China, where the vast majority of the world's lithium batteries are made. While lithium-acid, lead-acid, nickel-based, flow and sodium-based batteries are candidates for EVs, numerous reports have identified lithium-ion as the most viable option for the coming decades (Desjardins, 2016; Arrobas et al., 2017).





The supply of lithium is not expected to grow at the same pace. Some estimates suggest that the demand for lithium will outstrip supply by 2023, driving prices higher (O'Brien & Nickel, 2016). Production is currently concentrated in only seven countries: Argentina, Australia, Brazil, Chile, China, Portugal and Zimbabwe. Deposits are found outside of these countries—in Afghanistan and Bolivia, for example—however, these have yet to be deemed economically viable (U.S. Geological Survey, 2018).

Lithium can only be accessed through large-scale industrial mining operations, either by mining hard rock or by extracting the metal from brines (Levin Sources, 2017a). The majority of lithium comes from the latter process, particularly in the lithium triangle region of Argentina, Chile and Bolivia. The process of extracting lithium from brines, however, is extremely water-intensive and prone to high pollution rates. Although this South American region hosts approximately 58 per cent of world lithium resources, countries like Zimbabwe, Australia and China have lithium deposits found in hard rock, giving them a potential competitive advantage.



Coal mining in Hwange Colliery, Zimbabwe.

4.5.2 Country Context

Zimbabwe is believed to hold among the world's largest deposits of lithium, hosting an estimated 23,000 metric tonnes in reserves (U.S. Geological Survey, 2018). While these deposits have yet to be extensively exploited, a number of new mining projects, ranging from exploration to construction, could start production in the next few years, a prospect that is increasingly likely as demand for the mineral grows with rising demand for lithium-ion batteries. Adding lithium to a rich mining sector that already includes diamonds and platinum would further increase the sector's importance to the Zimbabwean economy, underscoring its role as a key driver of growth for President Mnangagwa's new government.

Ensuring that the benefits of lithium mining support Zimbabwe's population and their development will depend on how the new government tackles reforming the sector and strengthening its governance. Traditionally, management of the sector has been defined by corruption and a lack of transparency. Zimbabwe ranked near the bottom of the 2017 Resource Governance Index; categorized as having "failing" governance, this means the country has

almost no framework in place to ensure resource extraction benefits society, while it is highly likely that the benefits of mining flow only to a select group of companies and elites (Natural Resource Governance Institute, 2017). Similarly, Zimbabwe ranks very low on rankings of corruption perceptions (157 of 180 countries) and of state fragility (10 of 178 countries) (Transparency International, 2017; Fund for Peace, 2018).

4.5.3 Current Conflict Implications

Mining has, in the past, contributed to Zimbabwe's culture of political repression and instability (Gibb, 2017). The country's military and security forces have been among the principal beneficiaries of Zimbabwe's diamond revenues, and, beyond personal enrichment, they have been accused of using revenues from the sector to wage campaigns aimed



at discrediting opposition parties and intimidating their leaders (Gibb, 2017). Shareholding within the Zimbabwe Consolidated Diamond Company remains opaque; calls for transparency and reform in the sector and in the management of its revenues have been largely unanswered (Gibb, 2017). The decision, in 2011, to allow the export of diamonds from Zimbabwe under the Kimberley Process was widely condemned by many of the certification process' member states and civil society due to the presence of armed forces in the country's diamond fields and the human rights abuses they carried out against miners, including killings, beatings and forced labour (Human Rights Watch, 2011).

Large-scale lithium mining is, of course, quite different in practice from artisanal diamond mining. The risks associated with projects requiring large-scale capital investments differ from those of alluvial mining; however, lessons for Zimbabwe's future can still be drawn from its mining past. In the absence of meaningful reform to both the mining industry and state security forces, or progress on improving the transparency of mine governance, the revenues generated by lithium mining—from taxes, royalties and other mechanisms—could be used to further entrench and enrich the ruling Zanu-PF party. The capture of resource rents by the government, and a corresponding lack of accountability to Zimbabwean taxpayers, could further fray the social contract between the state and society, particularly if affected communities are not seeing visible development benefits (including jobs, infrastructure and investments in health and education) coming out of the mining sector. In addition, a lack of government oversight and enforcement could elevate the local environmental and health risks of mining and promote poor conditions for miners. This could all lead to the emergence of local grievances and tensions targeting both the sector and the government.

Demand for lithium, driven by soaring demand for EVs and energy storage, is currently outstripping supply. This makes it difficult for actors further down the supply chain to substitute one producer for another in response to human rights abuses or conflict. In the absence of international regulations, it is likely that once Zimbabwe's lithium mines are in production, buyers will emerge for the valuable mineral regardless of the sector's governance. To protect Zimbabwe's miners as well as ensure that lithium mining contributes to the country's development, all affected stakeholders—including the government and foreign investors—should work toward reforming the sector to strengthen its governance.

Box 5. The Lithium Triangle

The border region between Argentina, Chile and Bolivia, an area known as the Lithium Triangle, was home to 46 per cent of global lithium production in 2017 and 59 per cent of known world reserves (U.S. Geological Survey, 2018). Chile is currently responsible for a large proportion of the region's production, though Argentina is looking to increase its share by improving its investment attractiveness through reduced export taxes and currency controls. Bolivia, meanwhile, has more identified lithium resources than any other country in the world (The Economist, 2017; O'Brien & Nickel, 2016).

South American lithium is mined primarily through the extraction of lithium from brines, an extremely water-intensive and polluting process. As a result, conflicts related to lithium mining in all three countries mainly pertain to water access and control, as well as alleged encroachments by mining companies onto Indigenous or protected lands.

Chile's largest salt flat, Salar de Atacama, is a fragile ecosystem with great cultural importance to the local Indigenous communities (Environmental Justice Atlas, 2017). Lithium mining in the area and the associated diversion of water for mine operations has been cause for public demonstrations in the region by communities who reject extensions of the existing mining operations (Environmental Justice Atlas, 2017). Salar de Uyuni in Bolivia and the Province of Jujuy in Argentina have also witnessed conflicts and demonstrations for reasons similar to those in Salar de Atacama. The governments of all three countries will have to work with both communities and companies to ensure that the former are adequately consulted and involved in decision making around mine planning and operations. A failure to do so could further exacerbate tensions that are already emerging around lithium mining in the region.



5.0 Supply Chain Governance

The mapping exercise and case studies demonstrate that there are considerable risks in increasing the extraction of minerals needed to facilitate the transition to a low-carbon economy, which could lead to the emergence or exacerbation of tensions, violence and fragility among stakeholders in producing countries. Some of the minerals—like cobalt in the DRC—are mined in high-risk areas already affected by conflict and human rights abuses. Others—rare earths in China, for example—are major sources of pollution, environmental degradation and related grievances for local communities. In some cases, such grievances have already evolved into local protest and civil unrest, as in Guatemala and Guinea.

Some states, international agencies and private sector entities have introduced legislation and guidance to curb the flow of conflict minerals and promote responsible mineral supply chains. This includes the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas. In line with the UN Guiding Principles of Business and Human Rights, the OECD Guidance provides a framework for companies operating in contexts of fragility to conduct due diligence on their supply chain by assessing potential risks, preventing and mitigating these identified risks, and adopting a risk management plan (OECD, 2016). The guidance applies to all minerals but has specific supplements for 3TG.

The EU recently passed legislation designed to ensure that all EU importers of 3TG meet the OECD Guidance. Regulation 2017/821, the EU's Conflict Mineral Regulation, comes into force on January 1, 2021¹² and aims to ensure sustainable sourcing of more than 95 per cent of all EU imports of 3TG. The regulations directly apply to almost 1,000 EU importers and indirectly apply to 500 smelters and refiners of 3TG, based both inside and outside EU (European Commission, 2016, 2017). As the regulations only apply to 3TG, the majority of green conflict minerals will not fall under the regulations as they currently stand. However, additional minerals could be added to the regulation in 2024, when the EU executive is set to undergo a review of the bill.

The Chinese Chamber of Commerce for Metals, Minerals & Chemicals Importers & Exporters (2015) also introduced a framework to operationalize the OECD Guidance. The framework provides guidelines and tools to those Chinese companies that extract or use minerals in their products to help them identify, prevent and mitigate risks of conflict, human rights abuses and misconduct throughout the entire life cycle of a mine. The framework can be applied to all minerals; however, it remains voluntary.

The U.S. Dodd-Frank Act is another prominent mechanism designed to promote responsible mineral supply chains, though with more limited geographic scope. Passed in 2010, Section 1502 of the act requires U.S. publicly traded companies to assess and address any risks in the supply chains of 3TG that may originate from the DRC or neighbouring countries. While the scope of this legislation neglects the potential for other minerals and regions beyond sub-Saharan Africa to finance armed groups in mineral-rich fragile states, the legislation was a landmark example of public sector action against corruption, human rights abuses and violence in the mining sector. Under the original legislation, companies were required to submit an annual conflict minerals disclosure report to the U.S. Security and Exchange Commission (Global Witness, 2017c). However, in 2017 the U.S. Security and Exchange Commission issued a statement that it would no longer enforce this requirement (Braumiller Law Group, 2017). Further, in 2017, the U.S. House of Representatives passed the Financial Choice Act, which effectively repeals Section 1502 of the act (One Earth Future - OEF Research, 2017). The law, however, is still in place and active as the repeal has not yet been ratified by the Senate.

In addition to these leading public sector mechanisms, civil society groups and private sector actors have also taken steps to ensure the responsible sourcing of minerals and metals. The Extractive Industries Transparency Initiative

¹² Although the EU has encouraged companies to begin implementing this regulation before 2021.



(EITI), for example, promotes the open and accountable management of oil, gas and mineral resources (EITI, 2018). Currently, 51 countries implement EITI, which mandates a set of implementation requirements, including regular disclosures regarding the countries' exploration and production, revenue collection, revenue allocation and impacts of the extractive industry (EITI, 2018). Companies, regardless of their home jurisdictions, have to disclose any payments made in EITI member countries (Edwards S., 2017).

In addition, the London Metal Exchange (LME), the world's biggest market for industrial metals, has increased efforts to monitor and investigate cobalt sourcing; in 2017, LME launched an investigation into cobalt sourcing and its connections to child labour (Jamasmie, 2017b). In July 2018, the exchange announced that it would require all companies that receive a minimum of 25 per cent of their metal from ASM mines in the DRC to undergo a

professional audit; LME is also expected to issue industry standards on the responsible sourcing of cobalt in late 2018 (Desai & Daly, 2018; Sanderson, 2018). These moves demonstrate the growing awareness of the conflict-related risks associated with cobalt extraction in fragile states.

Industry schemes like the Responsible Minerals Initiative (RMI) are also contributing to the improved international governance of mineral supply chains. RMI is a coalition of more than 360 member companies aiming to improve the human rights conditions of mineral supply chains, by administering third-party audits of mineral sourcing in conflict-affected and high-risk areas, among other measures (Sustainable Brands, 2018). In 2016, the OECD began to assess five industry schemes, including RMI, regarding the schemes' alignment with the OECD Guidance and overall due diligence in sourcing practices. Although the official policies of the industry schemes were increasingly aligned with the OECD Guidance, the assessment found in its 2018 report that implementation of the due diligence processes lagged behind this alignment (OECD, 2018a). Reporting and monitoring by civil society groups has pointed to sometimes shallow improvement in due diligence practices by mining companies and industries as well. The Responsible Sourcing Network, for example, assessed companies'

efforts to provide strong supply chain due diligence in their use of conflict minerals (Deberdt & Jurewicz, 2017). The report found that, although more than 70 per cent of assessed companies followed the OECD guidelines, most did so only superficially and few used the guidance in full (Deberdt & Jurewicz, 2017). After an analysis of 20 of the largest companies in consumer electronics and jewelry retailers, the Enough Project determined that, while improvements have been made in due diligence and reporting, both must be ongoing, iterative and proactive to be meaningful (Callaway, 2017).

This implementation gap is common across the various public sector, private sector and civil society actions to monitor and regulate the mineral supply chain, posing a risk to the responsible sourcing of green energy technologies and the minerals required to develop and deploy them. While legislation like Section 1502 of the Dodd-Frank Act and the upcoming EU Conflict Mineral Regulation represent significant milestones to responsible



The UN Organization Stabilization Mission in the Democratic Republic of Congo receives firearms training. UN Photo/Abel Kavanagh



mineral governance, many are not yet applicable to minerals beyond 3TG. In the past few years, the conflict risks of cobalt sourcing have started to garner international attention. Subsequently, some civil society groups and private sector actors have started to incorporate responsible cobalt sourcing into their mandates. However, the supply chains and associated risks of other green conflict minerals like bauxite and alumina, lithium, nickel and rare earths are still largely unexplored and therefore largely absent from the current field of mineral supply chain governance.

Innovation and technological advancements in the mining sector have the potential to increase transparency and accountability along the supply chain and subsequently improve the effectiveness of governance mechanisms. The global startup Everledger, for example, announced in February 2018 that it would use a blockchain-based technology to track diamonds and engage all actors along the supply chain (Vella, 2018). In addition, the Camborne School of Mines recently identified methods to predict the environmental and social costs of sourcing rare earth deposits (University of Exeter, 2017). While these innovations and more are still in relatively early stages, their extension into the supply chains of minerals critical to green energy technologies could aid existing and future transparency and governance mechanisms.



6.0 Pathways Forward and Recommendations

6.1 Pathways

Mining can be an inherently risky industry. Companies and small-scale miners alike constantly struggle with accessing uncertain deposits, managing volatile commodity prices, ensuring worker health and safety, and avoiding environmental catastrophe. Conflict adds another, significant risk to mining: it can interrupt operations, undermine social licence to operate, damage reputations and, at its most extreme, threaten the lives of those involved. It is bad for business, communities and governments, and reducing conflict risks is in the interests of all stakeholders.

For the minerals required to make the transition to a low-carbon economy, there are real risks of grievances, tensions and conflicts emerging or continuing, as has been made clear in the case studies and mapping exercise presented above. For fragile states, weak governance, corruption, and the inadequate implementation and enforcement of existing laws all work against ensuring that the benefits of mining accrue to the population and the country's sustainable development. Local voices are often left out of important decision making, and meaningful

engagement with communities does not always occur prior to the start of mining activities. Depending on the mineral, individuals can be subject to health and safety violations, human rights abuses, environmental risks and child labour.

There remains a lack of transparency across a number of key supply chains, including those for cobalt, lithium and bauxite. This opaqueness extends to the recycling industry, which will be an increasingly important part of mineral and material provision in the future. Regulations and laws supporting increased transparency are not yet widespread enough to capture all relevant minerals, though important lessons can be drawn from international efforts to eliminate conflict from 3TG supply chains. The complexity of these supply chains, which include miners, traders, smelters, refiners, manufacturers, transporters and consumers, can be intimidating, but should not deter the international community from the important work that needs to be done to ensure they are conflict-free.

With this context as a starting point, and working with the OCAD University's Strategic Innovations Lab (sLab), key stakeholders were brought to

together for this research project to think through possible pathways for the extraction and trade of green conflict minerals between now and 2040. A future was envisioned in which the minerals and metals required for wind, solar and energy storage are extracted and traded in a conflict-free way. In this future, responsible supply chains are transparent and enforced by law. The costs of compliance are low, and mining companies continue to reap profits from stable markets. Automation has eliminated many of the physical dangers of large-scale mining,¹³ and ASM has been formalized, both economically and legally. Communities are fully informed and involved in decision making

¹³ However, automation can also have unintended negative consequences, including local worker displacement and high initial capital expenditure, among others.



around mining activities, and they see visible, local development benefits from these activities in their communities. Consumers and investors are aware of the impacts of their purchase decisions on conflict dynamics and respond in a way that minimizes these risks. Recycled minerals and metals are an increasingly important part of supply chains, and their supply chains are understood and regulated.

Achieving this vision by 2040 will require concerted action from a number of actors. Thankfully, stakeholders identified a variety of trends and initiatives already underway and in place that can be built upon and expanded to help achieve this vision. A number of responsible supply chain initiatives, due diligence guidelines and laws designed at reducing conflicts in mining are in place or under development and can be modified (if necessary) and applied to green conflict minerals. The supply chains of a handful of key minerals and metals have been mapped; OECD, for example, will release their Portal for Supply Chain Risk Information this year, which will help companies map and understand associated risks in their supply chains (OECD, 2018c). Ensuring that this work is extended to cover the green conflict minerals and the metal recycling industry would facilitate increased transparency and the identification of entry points for policy-makers. Civil society groups, in addition, have worked for years to identify governance weaknesses and methods to improve supply chain transparency. Ensuring that these identified best practices in responsible sourcing are not only addressed but also incentivized to private and public sector actors should be encouraged. Blockchain technologies could also be leveraged to facilitate increased supply chain transparency and accountability.

The ability of communities and civil society to act as watchdogs, through the rapid and widespread dissemination of information on mining activities, continues to grow and underscores the importance for companies to maintain their social licence to operate and minimize the reputational risks associated with conflict minerals.¹⁴ Financial investment funds are starting to divest from sectors and businesses that are having negative social and environmental impacts. Increasing information on the provenance of goods is also empowering consumers to make more informed decisions around their purchases, decisions that are further helped by a proliferation of scorecards on the social and environmental performance of companies. Automation, digitization and electrification are rapidly transforming health and safety risks for workers and nearby communities, while mining policy and law increasingly mandate that both are meaningfully engaged in decision-making processes across the whole mine life cycle, including the post-mining transition. Many countries are in the processes of designing and implementing policies, laws and regulations to formalize ASM activities.

6.2 Recommendations

As seen in the mapping exercise above, many of the minerals central to the transition to a low-carbon economy are found in high concentrations in states struggling with fragility, weak governance and corruption. This has not, historically, been a good combination; more often than not, the extraction and trade in mineral resources from such countries has been associated with grievances, tensions and, in the worst cases, violence. With the emergence and expected rapid growth of green energy technologies worldwide, many of these states can expect to see rising demand for their mineral riches. How they manage this increase will determine whether their populations prosper and thrive as a result of their country's mineral wealth or if the benefits are simply captured by a select few.

Thankfully, the foundations are in place for ensuring that these 23 minerals do not emerge as the conflict minerals of the coming decades. Strong existing guidance on conflict-free supply chains, increasingly empowered consumers, more responsive and responsible companies, and increasingly accountable governments are the building blocks to ensuring that the risks posed by increased mineral extraction in fragile states are identified and mitigated. Civil society groups, the private sector and governments must work together to ensure that the future is one in which the green technologies designed to improve the planet also improve life at the local level. As the global community

¹⁴ In parallel, however, an increasing number of environmental activists and defenders are the victims of violence (The Guardian and Global Witness, 2017).



takes commendable steps toward meeting the aims of the Paris Agreement, it is essential that it does so without undermining peace, justice and strong institutions.

The following recommendations were developed based on the findings of the mapping exercise and case studies, as well as in coordination with select stakeholder consultations and the aforementioned pathways scenario.

6.2.1 Civil Society

Improve and expand mineral supply chain mapping for green conflict minerals. Concentrated efforts should be taken to map the supply chains of each of the minerals required for green energy technologies, with priority given to cobalt, lithium, graphite and rare earths. Doing so will help in the identification of conflict risks, as well as entry points for policy or legal interventions. Such a mapping exercise should incorporate end-of-life uses, the potential for mineral substitution and any risks in the recycling supply chain.

Raise awareness of green conflict minerals among policy-makers, businesses and the general public. While the conflict-related risks of 3TG are increasingly known and are being incorporated into private and public sector regulations, knowledge of the risks associated with green conflict minerals remains extremely limited. Civil society groups are encouraged to advocate for the responsible sourcing of these minerals as well as disseminate information regarding the conflict-related risks of these minerals' supply chains to policy-makers, the private sector and consumer audiences. The goal of these efforts should be to ensure that companies operate in a responsible way in these contexts, rather than avoiding them altogether due to the conflict risks involved.

Monitor and report on the due diligence implementation gap. While some improvements have been made in the alignment of company and government policies with due diligence best practices on conflict minerals, the implementation of these efforts has often lagged. Civil society groups are encouraged to continue to monitor company and government efforts at implementation and report on any improvements or failures, ensuring that responsible sourcing is meaningful and iterative rather than simply an exercise in checking boxes.

Support local communities to ensure they have the tools and capacities needed to engage in decision making. Local communities must play an integral role in the responsible development, management and closure of mining operations and should share in the socioeconomic benefits of mining. As such, local communities should be engaged in decision making across the mining life cycle. Civil society groups should support this by providing information, toolkits, guidance and training to build local capacities to effectively engage in these processes.

6.2.2 Private Sector

It is in the best interests of private companies—both upstream and downstream—to reduce conflict risks in mining operations; doing so is a key part of maintaining their social licence to operate in the given communities. In addition, consumers are increasingly placing pressure on private and public sector actors to provide responsibly sourced products. Preventing mine-related conflicts and establishing and maintaining strong local relationships supports local development and reduces reputational risks. It also increases certainty across the supply chains of these minerals and green energy technologies.

Increase transparency along the entire supply chain. Private sector actors should take measures—regardless of home country legislation—to publicly report on any conflict-related risks found in their supply chain, in adherence with applicable laws and best current practices, such as the OECD Due Diligence for Responsible Supply Chains of Minerals. Upstream, downstream and recycling companies should conduct due diligence in their product sourcing on an ongoing basis and disclose this information publicly.

Engage communities in a meaningful way across the mineral life cycle. Companies should incorporate meaningful and informed consultations with stakeholders and local communities throughout both the



development and maintenance of mining operations. Private sector actors are encouraged to use international best practices and models to do so, such as the International Finance Corporation's Performance Standards 1 on Assessment and Management of Environmental and Social Risks and Impacts (International Finance Corporation, 2018). Private sector actors are encouraged to engage local communities in decision-making processes across the entire mineral life cycle, including the post-mining transition. Ongoing engagement will help to mitigate the risk of protests, civil unrest and dissatisfaction with the mining operations, improving certainty in mining operations and strengthening the social licence to operate.

Promote the use of responsibly sourced secondary minerals. Increasing the supply of secondary recycled minerals has the potential to alleviate some of the pressures that may result from increased mining in producing countries. The private sector is encouraged to engage in innovative strategies to improve mineral recycling and incorporate secondary minerals into their supply chains. These minerals must, however, be recycled in a way that aligns with current due diligence and responsible sourcing best practices.

Work with ASM miners to reduce conflict. Conflicts often emerge between ASM operations over access to land and resources. Companies should work with ASM miners, as well as with governments, to ensure that all stakeholders can benefit from a region's mineral resources. This engagement could include assigning lands within an LSM concession to ASM miners for their use; providing training programs and technical assistance to increase

the efficiency and environmental performance of ASM operations, while reducing health and safety impacts; and developing skills among ASM miners that can be applied to jobs at the mine site but will still be viable livelihoods once the mine has closed (e.g., carpentry, masonry, bookkeeping). Particular attention should be paid to the differing gender dynamics of ASM operations, to ensure that benefit sharing and consultations are equitable and representative.



6.2.3 Governments

Governments have an important role to play in ensuring that the conflict risks associated with these minerals are minimized. But they must also work to ensure that the regulatory burden does not drive the private sector away from green technology; action on climate change still depends on the widespread adoption of solar, wind, EV and energy storage technologies.

Expand existing supply chain regulations to apply to green conflict minerals. Commendable measures have been taken in the past decade to improve the strength and transparency of supply chains for 3TG, both in producer and consumer

countries. Governments should build upon the success of these regulations, using these mechanisms as a blueprint to expand responsible sourcing beyond 3TG and beyond the DRC to include all minerals required for green energy technologies. Particular priority should be given to cobalt, lithium and rare earths, due to projected rapid increases in their demand and their importance to the low-carbon transition.

Encourage improvements in the implementation measures of existing due diligence and responsible sourcing regulations. The public sector should take measures to improve the implementation gap in current



supply chain governance. Governments are encouraged to work with both civil society groups and the private sector to learn from successes and failures in industry- and NGO-led initiatives and should work to enhance monitoring and reporting mechanisms and requirements. Governments also create an enabling environment to implement these international standards and best practices in order to bridge the implementation gap by offering incentives to champions of responsible sourcing in the private sector, by improving reliable data collection and by promoting dialogue between stakeholders (OECD, 2018d).

Ensure benefits of the mining industry are shared in a way that is equitable, fair and visible at the local level. Building out of meaningful community engagement, governments should ensure that the financial and socioeconomic benefits of the mining industry, including any benefits derived from innovative technologies and automation, are shared in a manner that is equitable, fair and transparent among stakeholders. Dialogue should be both proactive and engaging, as well as involved at the design, implementation and closing of mining operations, as is defined in programs like Toward Sustainable Mining's Guiding Principles (The Mining Association of Canada, 2018).

Incorporate mechanisms for stakeholder and community consultation into mining law and policy. Governments should ensure that community engagement and stakeholder consultations are not only included in mining policy and regulations, but that these policies and laws are also enforced. Communities should be able to participate in informed consultations throughout the development and maintenance of mining operations. The incorporation of meaningful community engagement throughout the entire mining life cycle is integral to the responsible sourcing of all minerals and has the potential to mitigate risks around fragility, conflict and violence.

Continue efforts to strengthen ASM operations. Governments should work to strengthen ASM operations, both economically and legally. This includes working to ensure that the women and men involved in ASM have clarity over their rights to land and resources; are aware of the laws and regulations that govern their participation in the sector (including those on labour and environment); and have access to the courts and to dispute resolution mechanisms should conflicts and disagreements arise.



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