Introduction

The climate crisis is deepening and accelerating, and highlights the urgent need to reduce anthropogenic carbon dioxide emissions and ‘transition’ away from the current fossil fuel energy system. As a response, a range of bold political and economic programmes are being proposed, which are centred on decarbonising the energy system and moving towards renewable energy generation, which includes expanding investments in renewable energy technologies, ‘green industry’ and energy-efficient transport. Among these programmes, Green New Deal proposals are among the most prominent.

The shift away from a fossil fuel powered economy, is making way for a so-called ‘green’ electric-based economy, which increases the need for electric vehicles and battery storage systems. In turn, this is driving a significant growth in the demand for critical ‘transition minerals’ such as cobalt, lithium and nickel to support these new green technologies. This shift illustrates a wider phenomenon: Transitions to more so-called ‘climate-friendly’ economies – mostly in line with the current hegemonic economic model – will be resource-intensive, requiring significant amounts of raw materials and the expansion of mineral extractive frontiers. Many of these raw materials are located in places that are inhabited by potentially vulnerable or marginalised populations and ecosystems, and the mining of these materials often have damaging or devastating socio-ecological consequences. As such, increasing demands for these materials is likely to generate further con-
In recent years, critical research in geography and political ecology has explored the contentions and conflicts surrounding renewable energy infrastructures, particularly wind energy. However, relatively few studies provide comprehensive explorations of the nexus between the ongoing shift towards “low-carbon” technologies and the expansion of mineral extraction. In addition, nickel is one of the most important ‘transition minerals’ yet, along with other metallic raw materials, it has received much less attention in the grey or scientific literature compared to other ‘transition minerals’.

Our research contributes to the emerging evidence base on “transition minerals” and the socio-ecological impacts of their extraction, by focusing on the case of nickel. The guiding questions for this research were: What are the consequences of nickel extraction and smelting processes of nickel and six other metals contribute to seven percent of global annual emissions.

### Table 1. Overview of some of the core ecological impacts of nickel mining and processing

| Ecological Impacts                      | Sources                                                                 |
|----------------------------------------|-------------------------------------------------------------------------|
| Air pollution                          | Sulphur dioxide release; mining processes generate large emissions of dust containing nickel, copper, cobalt and chromium; transportation of ores also loads dust into the atmosphere. |
| Contribution to global warming and climate change | Nickel has one of the highest global warming potential associated with its mining and processing compared to most metals. |
| Water catchment pollution and seawater contamination | Incorrect disposal/accidents of slag; mine tailings, fuel spillage or other waste; acid leaching (used primarily in laterite production) can consume chemicals with significant effects on water quality (sulphuric acid and ammonia). Lateritic processing done in tropical areas and humid regions requires the removal of large amounts of water. |
| Soil or crop contamination             | Incorrect disposal/accidents of slag, mine tailings, fuel spillage or other waste. |
| Groundwater contamination              | Incorrect disposal/accidents of slag, mine tailings, fuel spillage or other waste. |
| Landscape fragmentation or loss        | Acid drainage from nickel operations linked to significant damages to crops and territories. |
| Biodiversity loss                      | Clearance of ecologies and deforestation. Coral reefs are particularly at risk from sea waste disposal. |
| Fishery depletion                      | Disposal of tailings into water bodies                                   |
| Noise pollution                        | Extractive machinery and processing facilities.                          |
| Landslides                             | Clearance of ecologies; erosion linked to deforestation.                 |

Source: compilation from the Environmental Justice Atlas.
traction and processing as well as its end-of-life? Which ecologies and populations have been affected by the increased demand for nickel? What types of socio-ecological conflicts have been created as a result? This brief also presents a series of systemic and practical policy recommendations for regional actors, states, sub-national governments and municipalities as potential ways to work towards a socially and environmentally just economy that protects the world’s ecosystems and vulnerable populations whilst tackling climate change through innovative and sustainable practices.

Consequences: From Extraction to End-of-Life

The case of nickel is particularly concerning due to its highly pollutive and energy-intensive extraction, processing and smelting processes. In addition, conflicts are not new to nickel frontiers: since the beginning of its extraction in the 19th century, it has been widely associated with conflicts and violence relating to siting disputes, and it has been associated with several significant socio-ecological impacts over the last century (See Table 1). As such, the potential expansion of nickel extraction to support the renewable energy technologies and transport systems, carries the potential for further devastating impacts in the future.

Where and who are affected?
Geographies and conflicts of nickel

Nickel, in contrast to many other transition materials, is geographically widely distributed, currently being mined in over 40 countries. Overall, 40 percent of global nickel reserves are in protected areas or regions with high biodiversity, and 35 percent are in areas with high water stress. Virtually all nickel laterite deposits are located in biodiverse and protected areas. Furthermore, some of the largest socio-ecological impacts of nickel mining and smelting have emerged from the energy apparatus required to sustain it. Moreover, multiple human rights and labour rights violations have been documented across nickel extraction supply chains over the last decades (See Table 2).

In focus: The Cerro Matoso mining project, Colombia

Cerro Matoso, for example, is one of the world’s largest openair ferronickel mines, located in the southern part of Colombia’s Córdoba department, in the North of the country. The mine and ferronickel processing facility, currently operated by Australian mining company South32 (a demerger from mining conglomerate BHP Billiton), has been linked to multiple socio-ecological impacts, particularly severe water, soil and air pollution. In fact, Cerro Matoso is noteworthy for the sheer intensity of its ecological impacts. For example, it is the most energy-consuming project in the entire country, uses significant amounts of water, and is one of the mining concessions in Colombia associated with the highest levels of deforestation.

In 2018, Colombia’s Constitutional Court affirmed the existence of a ‘delicate public health situation’ surrounding the mine, in addition to grave damage to the surrounding ecosystems. Afrodescendant, Indigenous and rural communities have all been disproportionately affected by the mine given the proximity of their territories, and have accused the mining project of encroaching on their ancestral lands.
Table 2. Reported socio-ecological impacts and conflicts related to nickel production around the world

| Mining Project Name                                                                 | Country     | Company                                                                 | Ecosystem Type                     | Documented Impacts                                                                 |
|------------------------------------------------------------------------------------|-------------|-------------------------------------------------------------------------|------------------------------------|-----------------------------------------------------------------------------------|
| Various (projects across Taimyr peninsula, Amur region, Murmansk region, Kola peninsula and Krasnoyarsk krai) | Russia      | Nornickel                                                              | Tundra/taiga                       | Biodiversity loss; landscape destruction; soil and air pollution; waste overflow; water pollution through oil spills; Indigenous rights violations |
| Cerro Matoso                                                                       | Colombia    | South32                                                                | Semi-tropical/ arid grassland      | Indigenous & Afro-Descendant rights violations; water and airborne pollution       |
| Various (Sorowako, Asera, Pomalaa)                                                 | Indonesia   | Vale, Solway Investment Group, Indonesia Asahan Aluminium              | Tropical, marine                   | Water and airborne pollution; sea waste disposal; deforestation; dangerous tailings accumulation; Indigenous rights violations |
| Rönnbäckenn (proposed project)                                                     | Sweden      | Nickel Mountain                                                        | Subarctic                          | Land rights; Indigenous rights violations; pollution                              |
| Various                                                                           | Cuba        | Sherritt International, Cubaniquel                                     | Cloud forests; pine forests; coral reefs | Waterborne, air and soil pollution                                                |
| Various projects in Western Australia (including the Kalgoorlie Nickel Smelter)    | Australia   | BHP Billiton                                                           | Subtropical desert                 | Pollution, respiratory impacts, acid depositions on soils and plants, impairment of visibility, dispersion of sulphur dioxide |
| Selebi Phlwe (nickel copper mine)                                                  | Botswana    | BCL Limited                                                            | Savannah, tableland                | Pollution of sulphur dioxide; widespread respiratory health concerns; significant contamination of air linked to smelting |
| Various (Raglan, Voisey’s Bay, Sudbury Area)                                       | Canada      | Glencore, Vale, Jin Horoc Nonferrous Metal Group                       | Boreal forests; Tundra; sub-arctic tundra | Landscape fragmentation; loss of woodland; fuel spillage; soil contamination; Indigenous treaty rights violations; Indigenous (Inuit and Innu) rights violations; impacts on fisheries; water pollution; waste overflow; impact on biodiversity |
| Various (Rio Tuba, Santa Cruz, Coral Bay, Mindoro)                                  | Philippines | Nickel Asia Corporation, Intex Resources                                | Tropical rainforest; Evergreen forests; Malesian flora | Air and waterborne pollution; landscape destruction; loss of food security from lands rendered infertile; tailing spills; deforestation; loss of water quality; damage to reefs |
| Ramu NiCo                                                                          | Papua New Guinea | Metallurgical Corporation of China (MCC)                              | Tropical rainforest                | Wastewater pollution; sea tailings disposal; damage to fisheries and crops; poisoning of local species |
| Onca Puma                                                                          | Pará, Brazil | Vale                                                                    | Tropical                           | Violations of the community rights of Xikrin and Kayapó peoples; deforestation; water quality damage |
| Voisey’s Bay                                                                       | Labrador, Canada | Vale                                                                   | Subarctic tundra                   | Indigenous (Inuit and Innu) rights violations; impacts on fisheries; water pollution; waste overflow; impact on biodiversity |
| Ambatovy                                                                           | Madagascar | Sumitomo Corporation, Korea                                           | Subtropical                        | Fishery depletion; water and air pollution; leaks of sulphur dioxide              |
| Talvivaara                                                                         | Finland     | Terrafame                                                              | Boreal forest                      | Water pollution                                                                   |

Source: own elaboration with data from the Environmental Justice Atlas.32
The current extractivist economic model must be challenged. Simply trying to address the climate crisis without reconfiguring the structure, rhythm and nature of the economy is not a viable way forward. Achieving climate safety and environmental justice will heavily depend on establishing comprehensive understanding of the problems and daring to design and implement the necessary supportive policies and processes. More in depth, critical and transdisciplinary analyses of the diverse impacts of nickel - and other raw mineral - extraction are needed to understand the full extent of the problems. This type of knowledge can be used to inform more effective local and global policies and actions aiming to support the transition away from high-carbon energy systems and intensive material extractivism. In this way, it can help us work more effectively towards a socially and environmentally just economy and sustainable practices that supports and protects the world’s ecosystems and vulnerable populations, rather than exploiting and destroying them.

Policy Recommendations

Applying learning from the case of Nickel, we include a list of policy recommendations for regional actors, states, subnational governments and municipalities to consider as potential ways to work towards a socially and environmentally just economy that protects the world’s ecosystems and vulnerable populations whilst tackling climate change through innovative and sustainable practices.

Macro level/Long term

- Adopt green, equitable economic recovery plans. Implement bold new economic policies to tackle the current climate emergency, by
‘degrowing’ i.e. slows down economic growth, reducing the current ecological overshoots and working towards living sustainably within our planetary boundaries. This requires a de-prioritisation of the pursuit of ‘economic growth’, production and material consumption, and the prioritisation of the reduction of resource use within countries, particularly in high income settings. Research by the European Environmental Bureau suggests the European Union, for example, needs to reduce resource use by 65% by 2050 to maintain the region’s economy within planetary boundaries.

- **Ensure a just and more sustainable energy transition.** Governments must avoid a collapse of the energy system and prioritise the transformation of the current energy system towards a local, equitable and renewables-based model of energy production. The aim of this is to reduce both materials and energy consumption, and ensure everyone can have access to clean energy, while remaining within our planetary boundaries. This will require designing policies that promote more local and moderate consumption, and improving renewable energy performance, while consuming less scarce materials, particularly those produced in other countries.

- **Build a just, sustainable post-extractive economy.** Develop and promote non-extractive economic policies that support the transformation away from infinite growth, excessive consumption and waste production, towards the widespread reduction, recycling and recirculation of materials, and local production. This should include commitment to the practice of indispensable extraction, whereby the extraction of minerals and metals is limited and done with extreme care, abiding by the needs of communities. Furthermore, this must be accompanied by simultaneously reducing the need for new mining and strengthening community safeguards, as detailed in others recommendations, as well as the revision of current trade rules, diversification of economic activity, and a shift of public revenue dependence away from extractive windfalls.

- **Build and ensure sustainable governance for nickel and other ‘transition materials’.** Create a global governance mechanism or body for nickel and other critical ‘transition materials’ used in the green transition. This body would need to work across state, regional and global bodies to regulate the mining, processing and waste management of the entire supply chains of nickel, as well those of other raw materials. In addition, this body would need to ensure the inclusion and participation of regularly silenced constituencies (e.g. indigenous groups) in the decision making processes.

- **Ensure accountability for socio-ecological crimes.** Advocate for and implement a Binding Treaty on Transnational Corporations and Human Rights at the United Nations. At the European level, the European Union should be accountable for the impacts generated by raw materials extraction and manufacturing of the end use products consumed within its borders, regardless of where these actions have taken place in other parts of the world. At the national level, governments should enshrine and enact binding mechanisms and legal norms that hold corporate entities to account for socio-ecological crimes.

- **Guarantee the protection of indigenous populations’ community rights.** Ensure the collective rights of indigenous communities to defend their territories and to the ‘Right to Say No’ to extractive projects, in line with previous international treaties. See the International Labour Organization (ILO) Indigenous and Tribal Peoples Convention of 1989 (No. 169). Alongside this, the rights of all environmental defenders should be strengthened and protected.
Meso-micro level/ Short term

- **Develop mechanisms that effectively incorporate local communities in environmental policymaking.** Establish new ways to promote the active inclusion of affected communities’ perspectives in environmental policymaking processes. Local needs and perspectives must be prioritised over the interests of corporations.

- **Promote transparency throughout raw material extraction and production processes.** Implement policies and systems that improve the transparency of activities, finances and environmental impacts by all actors involved throughout the entire nickel extraction and production process.

- **Encourage more sustainable mobility and reduce dependency on natural resources.** States and subnational governments should promote the transformation of the transport sector to be more centred on public transit, vehicle-sharing and active mobility, decreasing car dependency and demand for private vehicles, particularly cars. In addition, they promote the replacement of petrol-fuelled vehicles with electric vehicles. Research suggests that in the European Union, for example, if five petrol-fuelled cars were replaced with one electric vehicle, the material demand for certain transition minerals would be halved.

- **Strengthen legal frameworks for waste management.** Existing legislation on the management of electrical and electronic equipment waste, such as the European Union’s Waste from Electrical and Electronic Equipment (WEEE) Directive, is important to promote sustainable production and consumption, yet this legislation is limited. It is crucial to revise these frameworks in line with new waste concerns linked to the ‘green transition’ given the increasing amounts of WEEE that will be generated. In addition, frameworks need to be developed to improve the assessment of the disposal options of deep sea tailing waste, generated from nickel mining, by government regulators.

- **Promote and incentivize the reusability and recycling of raw materials.** Adopt measures that incentivize recycling, reuse and repurposing of materials. Promote new products and technologies to be more recycling-friendly by design, and ensure that an end of life management strategy is developed during the design-phase of renewable energy source technologies. In addition, compel manufacturers to take responsibility for the entire life-cycle of products - potentially through the setting of targets - to increase the recyclability and reusability of materials and waste management in society, dissuade ‘cheap’ new production and planned obsolescence.

- **Reduce the demand for critical raw materials for batteries.** Promote the diversification of the energy storage capacity of batteries away from critical raw materials by using a combination of different technologies.

- **Provide complementary education for citizens on these issues.** New actions and policies should be accompanied by complementary general education for citizens to increase recognition of the problems and promote general awareness of the issues. This may help to support the cultural changes necessary to make the transition to a viable sustainable, post-extractive economy.
Further Reading

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