Towards an understanding of Voluntary Sustainability Initiatives in the extraction and processing of lithium-ion battery cathode precursor materials: Preliminary results

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Abstract

Decarbonizing transportation is inducing a shift towards the adoption of electric vehicles (EV) and demand growth for commodities used in battery production such as lithium, cobalt, and other specialty metals, which will require new mining operations and expansion of existing ones increasing the related potential social and environmental impact. This study examines and synthesizes the drivers and barriers that might lead extractive companies to voluntarily adopt sustainability practices, including certification, to increase value-chain transparency related to social and environmental impact. Through a thematic analysis, drivers and barriers are surfaced and classified against their respective agents across the lithium-ion battery value-chain. This research aims to provide a system level perspective of factors influencing the adoption of voluntary sustainability initiatives related to raw material extraction and processing within lithium-ion battery supply chains. A preliminary analysis of two key themes emerging from this research is provided.

Keywords: Voluntary Sustainability Initiatives, Mining, System Analysis, corporate social responsibility (CSR)

1. Introduction

The transportation sector is expected to adopt an electrification strategy to curb greenhouse gas (GHG) emissions and mitigate the impact of climate change [1]. Several countries have already planned to phase-out sales of petrol- and diesel-powered cars [2]. To achieve the shift towards renewable energy generation and clean energy storage, we can expect increased demand for energy transition minerals (ETMs) such as lithium, cobalt, nickel, and rare earth elements [3]. Most of these specialty minerals and metals have only previously been mined in small amounts, creating supply concerns as demand rapidly increases [4]. Alongside this, are broader concerns regarding whether ETMs can be mined in a low-impact way that contributes to economic development, avoids environmental and social harm, and protects the dignity and rights of workers and mine-affected communities.

The commoditized nature of mined products has limited the industry's exposure to customer-related risk. Nonetheless, recent regulatory developments, such as the Dodd-Frank Act (2010) reflected an increased emphasis on accountability and transparency for US listed companies [5] [6]. Besides this, the Organization for Economic Co-operation and Development (OECD) has publicly issued the *OECD Due diligence guidance for responsible supply chains of minerals from conflict-affected and high-risk areas* as a guideline for responsible mineral supply chain management [7]. These guidelines provide practical recommendations for establishing mineral provenance and custody throughout the supply chain, enabling companies to meet new regulatory requirements and address growing stakeholder expectations [8]. The development of strategies adopted by the mining industry to cope with ESG reporting expectations reflects and anticipates further public and regulatory pressure related to sustainability challenges that the mining sector is currently facing [9]. One established way to act and communicate more sustainable practices at all stages of raw material extraction, production, and processing is through the adoption of Voluntary Sustainability Initiatives (VSIs), which according to Franken encompass both *initiatives* and *standards*, inclusive of voluntary standards and voluntary certification schemes [10]. This paper provides preliminary insights from a broader systematic thematic analysis being undertaken to look at the agents involved in the extraction of precursor cathode active material, their role in the lithium-ion battery supply-chain and how they affect the adoption and diffusion of VSIs by mining companies at a mine-site level. The result of this thematic coding allows an expanded understanding of the drivers and barriers to adoption of VSIs by industry. This research is contributing to development of a broader systems perspective of these issues.

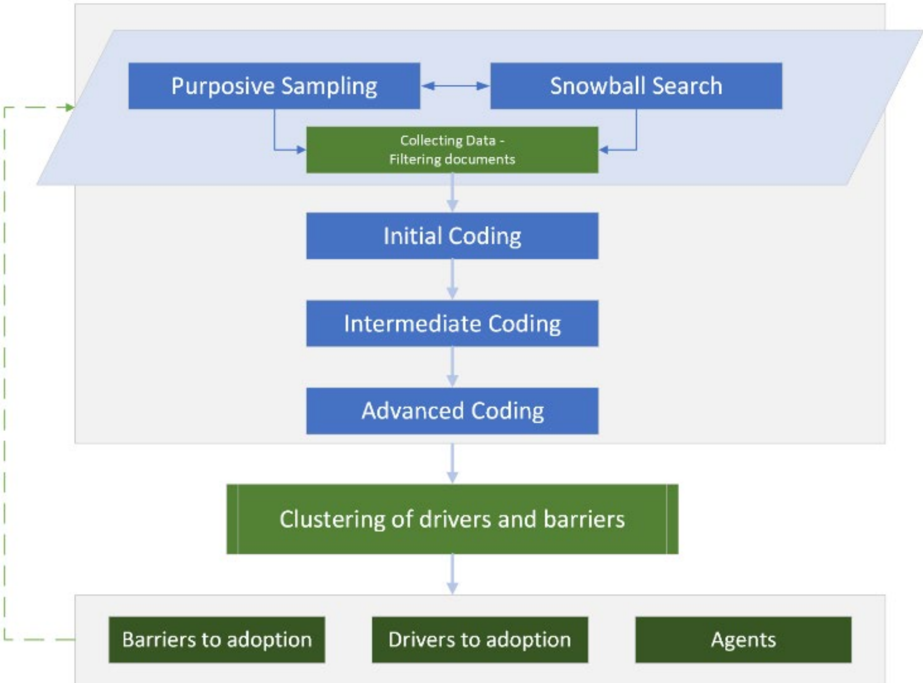
2. Research Methodology

This research has the objective to answer the following question:

> *What is driving the adoption and diffusion of voluntary sustainability initiatives applied to raw material extraction used for precursor cathode active materials in the lithium-ion battery minerals' supply chain?*

Available literature was reviewed and filtered to identify articles of potential high relevance for addressing this question. Using these, a thematic analysis incorporating a grounded theory methodology is being performed to code the analysed material, supporting an identification of drivers, barriers, and agents to VSI adoption within the precursor cathode active material supply chain for EV lithium-ion batteries. After the coding process, the codes were clustered into sub-categories of **drivers** and **barriers.** A descriptive overview of the methodology used in this research can be found in **Figure 2.1**:

Figure 2.1: *Descriptive methodological overview*



Within the context of this study:

i. **Drivers** are the internal or external forces that are responsible for the uptake of Voluntary Sustainability Initiatives related to the lithium-ion cathode materials extractive value-chain that involves Australia; and

ii. **Barriers** are the internal or external forces that demotivate companies or prevent them from engaging with Voluntary Sustainability Initiatives related to the lithium-ion cathode materials extractive value-chain that involves Australia.

3. Preliminary analysis from thematic coding

127 pieces of potentially relevant literature have been considered to date, with subsequent thematic coding being applied to 30 articles. Here we provide a preliminary analysis of two of the focus concepts that are emerging from this process.

a. EV production might drive higher ESG standards for mining, prompting VSI adoption.

Expectations related to sustainable sourcing have been on the rise for the past decades – with a stronger focus on social aspects such as workers' rights and human rights due diligence, and environmental aspects such as cutting of carbon emissions [11]. This growing pressure to abide has led agents in the supply chain to respond differently, according to their interests and power to act, with the level of demand across stakeholder groups varying significantly [12]. Host governments have taken part on an ongoing effort focused on worker rights and human rights due diligence which in turn might be translated into laws related to land-acquisition, compensation, and permitting processes [13]. Nonetheless, the fragility of central and municipal governments in host nations can be translated into a lack of compliance or corruption. Moreover, for mining projects that involve resources deemed 'critical' to a nation's economic development (such is the case of ETM mining projects), there have been efforts to systematically streamline their development with public policies both at the national and state level, with an example being efforts to *"cut the green tape"* in Australia [14], an emerging political narrative that potentially leverages the need for fast approvals related to battery minerals.

VSI adoption might emerge from private organizations when national standards are unsatisfactory. Standards are often a way to reduce uncertainty and legitimize a claim within a multi-tiered supply chain [15]. Well established company brands that act on the end-consumer facing tier of a multi-tiered supply chain work towards translating their reputational risk to minimum required standards by their suppliers [16]. This is done to mitigate the reputational risk they might be exposed to due to association with the social and environmental impacts of their suppliers. The legitimacy of these standards come from the implementation, support, and verification of a diverse conglomerate of involved stakeholders. The success of voluntary sustainability standards is defined by their ability to solve a problem, their behavioural effectiveness, the market diffusion, and its constitutive effectiveness (acceptance) [17]. Their main objective is to provide assurances to agents across the supply chain about reliability of claims related to social and environmental aspects, whilst promoting a positive impact on communities, environment, and local economy.

b. VSIs and industries other than mining

The adoption and acceptance of VSIs in other extractive industries is well stablished, with non-governmental organisations pushing for VSI creating, diffusion, and adoption over 30 years ago [18]. Agricultural industries have long documented the advantages from implementing certification schemes, with some advantages mentioned being cost reductions, as it is the case for export companies that implement the ISO 14001 environmental certification [19]. Unlocking market access can also play a role in adopting certifications and standards [20]. To that extent, VSIs have been widely adopted in some commodities' supply chains, in the case of cocoa, for example, the rate of annual growth of standard-compliant production has surpassed the growth of non-standard-compliant production [18] and product labelling is already present in agricultural sectors (having as examples fairtrade, rainforest alliance, etc.). Nonetheless, until 2017, most of the literature around certification schemes focuses on forestry, agrifood, and marine sectors [17].

Batteries are far more intricate in terms of material complexity than other products containing a single commodity with little value added through manufacturing. Coffee has about 20% of its value-added during the extraction phase [21], whereas in the case of a lithium-ion battery, the percentage of value-added during the extraction phase lies around 0.5% [22]. Moreover, electric vehicle's manufacturers often engage with thousands of suppliers in their supply-chain. One of the top-three EV battery manufacturers, Panasonic, has more than 10,000 suppliers worldwide [23]. Such complexity and intricacy not only make auditing and supplier due-diligence harder, but potentially makes acknowledgement of deep-supplier issues less likely. Moreover, small to medium size enterprises (SMEs) depend on their suppliers significantly more than established larger companies, having minimal buying power and less influence upstream [24], making it more susceptible to volatile conditions and not necessarily affecting sourcing practices as much. Nonetheless, with the development of new technologies and innovation of processes that support this communication such as fingerprinting and decentralized ledger [25], VSIs might play a stronger role in communicating the mitigation of social and environmental impacts. Not only limited to impact mitigation, VSIs might also be used to communicate positive developments in local infrastructure, gender-inclusiveness, business integrity, cultural heritage protection, and many more [26].

4. Future directions

As the widespread adoption of EVs continues, the demand for energy minerals such as lithium, nickel, manganese, and cobalt will inevitably increase. In response, government and private companies are emphasizing the importance of securing sustainable and responsible sources of these minerals. This research contributes to the growing body of literature on voluntary sustainability initiatives, with a specific focus on the lithium-ion battery supply chain. Through thematic coding of existing literature, the drivers, barriers, and agents to the adoption of voluntary sustainability initiatives by the extractive and processing industry are being identified, providing valuable insights for mining companies, battery manufacturers, EV manufacturers, and policymakers. These findings can serve as a foundation for more comprehensive understanding of the system dynamics governing the adoption of voluntary sustainability initiatives.

This paper provided just a glimpse of the themes and understanding being developed through this process. As we continue to systematically categorise the various agents, drivers, and barriers to VSI adoption, we are aiming to develop a system level understanding that can inform critical discussions regarding leveraged interventions that can influence VSI adoption. Besides this, our future research we will be taking a more participatory approach to uncovering internal managerial drivers for adoption, as well as the views and perspectives of different stakeholder groups. This will include a series of structured interviews and workshops. Please reach out if you would like to participate or be engaged in this process.

Declaration of Competing Interest

No conflict of interest.

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CRediT author statement

Bernardo Mendonca: Conceptualization, Methodology, Data curation, Writing - Original Draft, Visualization **Damien Giurco**: Writing - Review & Editing, Supervision. **Stephen Northey**: Writing - Review & Editing, Supervision.

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