Scramble for Critical Green Minerals: Achieving Energy Transition without Violating ESG and Sustainability Tenets?

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Scramble for Critical Green Minerals: Achieving Energy Transition without Violating ESG and Sustainability Tenets?

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Abstract

This paper critically examines how global energy transition can be achieved by sustainably harnessing critical green minerals. The paper defines critical green minerals. It argues that the success of global energy transition depends on the availability and sustainable use of critical green minerals including copper, lithium, cobalt, manganese, graphite, nickel and rare earth elements. The paper notes that critical green minerals are essential components of many renewable energy technologies and consequently, they are the heart of energy transition. Despite playing an important role in fostering energy transition, the paper notes that the scramble for critical green minerals is fuelling sustainability concerns. It examines some of the negative impacts associated with the extraction and use of critical green minerals. In light of these challenges, the paper proposes how critical green minerals can be harnessed to achieve energy transition without violating Environmental, Social and Governance (ESG) and sustainability tenets.

1.0 Introduction

Energy transition is gaining pace globally in the pursuit of Sustainable Development. The concept of energy transition refers to a transformative shift in how energy is produced, distributed and consumed, with the goal of moving away from fossil fuels towards a system centred on renewable energy sources[1]. Energy transition has also been defined as the transformation of the global energy sector from fossil-based to zero-carbon sources with emphasis on renewable sources of energy, hydrogen and sustainable biomass[2]. The

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[1] United Nations Development Programme., 'What is the sustainable energy transition and why is it key to tackling climate change?' Available at https://climatepromise.undp.org/news-and-stories/what-sustainable-energy-transition-and-why-it-key-tackling-climate-change (Accessed on 20/11/2025)

[2] International Renewable Energy Agency., 'Energy Transition Outlook' Available at https://www.irena.org/Energy-Transition/Outlook (Accessed on 20/11/2025)

idea of energy transition therefore envisions the global energy sector's shift from fossil fuel- based systems of energy production and consumption – including oil, natural gas and coal – to renewable energy sources like wind, solar and geothermal energy with the goal of achieving zero carbon emissions[3]. It has been argued that energy transition involves the long-term structural change to energy systems from fossil-fuel based systems to cleaner and sustainable systems such as renewable sources of energy[4]. Further, it has been pointed out that energy transition is a continuing process requiring long-term energy strategies and planning, with country-tailored focus on applying appropriated energy technologies to reach net-zero emissions[5].

Achieving energy transition is crucial goal for the global community in the quest for Sustainable Development. Despite playing an important role in all development processes, the energy sector can also undermine sustainability by fuelling environmental, economic and health threats. For instance, it has been noted that fossil fuels such as coal, oil and natural gas are by far the largest contributor to global climate change, accounting for over 75 percent of global greenhouse gas emissions and nearly 90 percent of all carbon dioxide emissions[6]. In addition to causing climate change, the burning of fossil fuels also contributes to air pollution with devastating impacts on human health and the environment[7]. Further, it has been argued that fossil fuels are non-renewable and can

[3] The Energy Transition., Available at https://www.enel.com/learning-hub/energy-transition (Accessed on 20/11/2025)

[4] Nalule. V., & Leal-Arcas. R., 'Energy Decentralization and Energy Transition in Poland.' *Electricity Decentralization in the European Union* 2nd Edition., 2023 pp 209-240

[5] United Nations Development Programme., 'Energy Transition' Available at https://www.undp.org/energy/our-work-areas/energy-transition#:~:text=Annual%20energy%2Drelated%20CO2%20emissions,90%25%20of%20the%20necessary%20reduction. (Accessed on 20/11/2025)

[6] United Nations., 'Renewable Energy – Powering a Safer Future' Available at https://www.un.org/en/climatechange/raising-ambition/renewable-energy (Accessed on 20/11/2025)

[7] Solomon. B., & Krishna. K., 'The Coming Sustainable Energy Transition: History, Strategies, and Outlook.' *Energy Policy* 39 (2011) 7422-7431

depleted and thus placing too much reliance on them can affect global energy supply and security with severe consequences for economic growth at all levels[8].

Consequently, transitioning from fossil fuels to a system of energy centred on renewables such as wind, solar and geothermal energy is necessary for both people and planet. Renewable sources of energy are abundant globally, are cheaper and are a healthier option for people and the planet[9]. In addition, it has been argued that generating renewable energy creates far lower emissions than burning fossil fuels and as a result, renewable sources of energy are key in confronting climate change[10]. The United Nations *2030 agenda for Sustainable Development*[11] acknowledges the role of energy transition in the quest towards sustainability. Consequently, Sustainable Development Goal (SDG) 7 seeks to ensure access to affordable, reliable, sustainable and modern energy for all including through substantially increasing the share of renewable energy in the global energy mix[12]. Achieving energy transition is therefore paramount if the Sustainable Development agenda is to be realised.

This paper critically examines how global energy transition can be achieved by sustainably harnessing critical green minerals. The paper defines critical green minerals. It argues that the success of global energy transition depends on the availability and sustainable use of critical green minerals including copper, lithium, cobalt, manganese, graphite, nickel and rare earth elements. The paper notes that critical green minerals are essential components of many renewable energy technologies and consequently, they are

[8] Ibid
[9] United Nations., 'Climate Action.' Available at https://www.un.org/en/climatechange/howcommunities-are-embracing-renewable-energy (Accessed on 20/11/2025)
[10] United Nations., 'What is Renewable Energy?.' Available at https://www.un.org/en/climatechange/what-is-renewable-energy (Accessed on 20/11/2025)
[11] United Nations General Assembly., 'Transforming Our World: the 2030 Agenda for Sustainable Development.' 21 October 2015, A/RES/70/1., Available at https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf (Accessed on 20/11/2025)
[12] ibid

the heart of energy transition. Despite playing an important role in fostering energy transition, the paper notes that the scramble for critical green minerals is fuelling sustainability concerns. It examines some of the negative impacts associated with the extraction and use of critical green minerals. In light of these challenges, the paper proposes how critical green minerals can be harnessed to achieve energy transition without violating Environmental, Social and Governance (ESG) and sustainability tenets.

2.0 Critical Green Minerals and Energy Transition: Promises and Pitfalls

It has been argued that minerals are considered critical when they are vital for economic and technological progress and development but face potential supply risks due scarcity, supply concentration and geopolitical factors among other reasons[13]. Further, it has been argued that some minerals are considered 'green' since they support the transition to a sustainable and net-zero future[14]. Green minerals are economically and strategically important but have a high-risk associated with their supply[15]. Critical green minerals include lithium, cobalt, copper, nickel, manganese, graphite, rare earth elements, and platinum, niobium, silicon and vanadium[16]. It has been argued that these minerals as classified as '*critical*' not because they are considered as scarce but because they have significant economic importance in key sectors including the environment, health, defence, and consumer electronics[17]; they have a high-supply risk due to the very-high

[13] International Council on Mining and Metals., 'Critical Minerals' Available at https://www.icmm.com/en-gb/mining-metals/critical-minerals?gad_source=1&gad_campaignid=22530173703&gbraid=0AAAAA-kBgRCZXtrLZ9MYG8uhIaflq2Xw-&gclid=CjwKCAiA8vXIBhAtEiwAf3B-g_Velvd3VbNSwExZ45rmE28ASrQNI-52fzPB7NPO88SXKMr2IkYzyxoC_4cQAvD_BwE (Accessed on 20/11/2025)

[14] Adolfsen. J.F., Kedan. D., & Lappe. M-S., 'The Geopolitics of Green Minerals' Available at https://www.ecb.europa.eu/press/blog/date/2024/html/ecb.blog240710~bb2bab6345.en.html (Accessed on 20/11/2025)

[15] CRM Alliance., 'Critical Raw Materials' Available at https://www.crmalliance.eu/critical-raw-materials (Accessed on 20/11/2025)

[16] African Union., 'Africa's Green Minerals Strategy (AGMS)' Available at https://au.int/en/documents/20250318/africas-green-minerals-strategy-agms (Accessed on 20/11/2025)

[17] CRM Alliance., 'Critical Raw Materials' Op Cit

import dependence and high level of concentration in particular countries[18]; and they lack viable substitutes due to their unique properties and applications[19].

Critical green minerals are crucial towards achieving energy transition. According to the United Nations Environment Programme (UNEP), the transition from fossil fuels to clean sources of energy depends on critical green minerals[20]. It has been argued that these minerals form essential components of clean energy technologies including wind turbines, solar panels and electric vehicles[21]. Consequently, it has been correctly noted that the technologies required to facilitate global energy transition, including wind turbines, solar panels and improved energy storage, all depend on critical green minerals[22]. Further, critical green minerals are widely used in energy transmission infrastructure such as power lines[23].

According to the International Energy Agency (IEA), critical green minerals are essential for a wide range of today's sustainable energy technologies and for the broader economy[24]. For instance, minerals such as cobalt, manganese, nickel, graphite and lithium are crucial for battery performance[25]. In addition, rare earth elements are widely utilised in wind turbines and electric vehicles[26]. Further, it has been pointed out that electricity

[18] Ibid
[19] Ibid
[20] United Nations Environment Programme., 'Critical Energy Transition Minerals' Available at https://www.unep.org/topics/energy/renewable-energy/critical-energy-transition-minerals (Accessed on 20/11/2025)
[21] Ibid
[22] International Institute for Sustainable Development., 'Green Conflict Minerals' Available at https://www.iisd.org/story/green-conflict-minerals/ (Accessed on 20/11/2025)
[23] World Resources Institute., 'The Critical Minerals Conundrum: What You Should Know' Available at https://www.wri.org/insights/critical-minerals-explained (Accessed on 20/11/2025)
[24] International Energy Agency., 'Critical Minerals' Available at https://www.iea.org/topics/critical-minerals (Accessed on 20/11/2025)
[25] Ibid
[26] Ibid

transmission networks need vast amounts of copper and aluminium[27]. Due to their key role in today's clean energy technologies, critical green raw minerals have been described as energy transition minerals[28]. It has been argued that if sustainably harnessed, critical green minerals can accelerate Sustainable Development by fostering energy transition, creating jobs and helping countries to reduce poverty[29].

Due to their vital role in fostering energy transition, there has been an increased global interest and extraction of critical green minerals. It has been pointed out that the global quest to combat climate change and achieve sustainability has brought critical minerals into sharper focus[30]. Consequently, the demand and extraction of critical green minerals is expected to continue rising all over the world[31]. IEA estimates that the demand for critical green minerals could increase six fold by 2040 depending on how rapidly governments act to reduce carbon emissions[32].

The demand for critical green minerals is therefore soaring as the world pursues net-zero targets. While this is commendable towards achieving energy transition, the scramble for critical green minerals is also fuelling sustainability concerns. The United Nations notes that without proper governance, the increasing demand for critical green minerals risks perpetuating commodity dependence, fuelling geopolitical tensions and environmental and social challenges, including impacts on livelihoods, human rights, the environment,

[27] Valverde. J., 'What Are Critical Minerals, and Why Are They So Important?' Available at https://unu.edu/merit/news/what-are-critical-minerals-and-why-are-they-so-important (Accessed on 20/11/2025)
[28] United Nations Environment Programme., 'What are energy transition minerals and how can they unlock the clean energy age?' Available at https://www.unep.org/news-and-stories/story/what-are-energy-transition-minerals-and-how-can-they-unlock-clean-energy-age (Accessed on 20/11/2025)
[29] Ibid
[30] International Council on Mining and Metals., 'Critical Minerals' Op Cit
[31] Ibid
[32] International Energy Agency., 'Clean energy demand for critical minerals set to soar as the world pursues net zero goals' Available at https://www.iea.org/news/clean-energy-demand-for-critical-minerals-set-to-soar-as-the-world-pursues-net-zero-goals (Accessed on 20/11/2025)

health and human security[33]. In particular, it has been pointed out that extracting, processing and shipping of critical green minerals releases greenhouse gas emissions which can harm people and planet[34]. Further, it has been observed that a significant proportion of critical minerals mines are situated in water-stressed areas fuelling high demand and competition for water[35]. Unsustainable extraction of critical raw materials can therefore take a huge toll on the environment through environmental degradation, water scarcity, deforestation, pollution, and biodiversity loss[36].

The scramble for critical green minerals can also undermine human rights. It has been pointed out that there are concerns of human rights abuses including forced labour and child labour and negative impacts on indigenous peoples who are often displaced from their ancestral lands during extraction of critical raw materials[37].

In light of the foregoing, it is imperative to ensure that critical green minerals are sustainably extracted and utilised in order to achieve energy transition without violating ESG and sustainability tenets.

3.0 Achieving Energy Transition without Violating ESG and Sustainability Tenets

The availability, extraction and use of critical green minerals is a prerequisite towards attaining energy transition. These precious resources are vital in the energy transition by supporting key technologies including wind turbines, solar panels, electricity transmission lines and electric vehicles[38]. It has been argued that as the climate crisis intensifies, the global demand is soaring for critical green minerals which are important for clean energy technologies – from wind farms to solar panels and electric vehicle

[33] United Nations., 'The UN Secretary-General's Panel on Critical Energy Transition Minerals' Available at https://www.un.org/en/climatechange/critical-minerals (Accessed on 20/11/2025)
[34] World Resources Institute., 'The Critical Minerals Conundrum: What You Should Know' Op Cit
[35] Ibid
[36] United Nations Environment Programme., 'What are energy transition minerals and how can they unlock the clean energy age?' Op Cit
[37] United Nations Environment Programme., 'Critical Energy Transition Minerals' Op Cit
[38] Ibid

batteries[39]. The scramble for critical green minerals therefore provides an opportunity to fast-track energy transition for sustainability. In addition, it has been noted that developing countries hold the bulk of the world's critical green minerals reserves[40]. For example, Africa holds significant deposits of the planet's critical green minerals including cobalt, bauxite, chromium, copper, graphite, manganese and rare earths[41]. The abundance of critical green minerals in developing countries provides opportunities not only to achieve energy transition but also to create jobs, boost revenues and diversify economies[42].

Despite the abundance of critical green minerals all over the world and their pertinent role in the quest towards energy transition, the scramble for these minerals is also violating ESG and sustainability tenets including through human rights violations and environmental threats such as pollution, climate change, deforestation, loss of biodiversity, and pressure on vital natural resources including water[43]. In light of these challenges, it is imperative to sustainably harness critical green minerals in order to achieve energy transition without violating ESG and sustainability tenets. Achieving this ideal involves responsible, ethical and sustainable mining and use of critical green minerals[44]. It has been argued that by embracing responsible extraction practices, ensuring stability in supply and reducing demand through measures such as responsible sourcing and resource circulation, it is possible to achieve balance between the demand and supply of critical green minerals for socially just and environmentally sustainable energy transition[45]. Responsible extraction, sourcing and supply of critical green minerals

[39] United Nations Trade and Development., 'Critical Minerals' Available at https://unctad.org/topic/commodities/critical-minerals (Accessed on 21/11/2025)
[40] Ibid
[41] Mo Ibrahim Foundation., 'Africa's Critical Minerals: Africa at the Heart of a Low-Carbon Future' Available at https://mo.ibrahim.foundation/sites/default/files/2022-11/minerals-resource-governance.pdf (Accessed on 21/11/2025)
[42] United Nations Trade and Development., 'Critical Minerals' Op Cit
[43] United Nations Environment Programme., 'Critical Energy Transition Minerals' Op Cit
[44] Ibid
[45] Ibid

has been identified as a fundamental objective towards achieving energy transition while protecting people and planet[46]. It is therefore imperative to embrace sustainable practices including minimizing waste, recycling materials and protecting the environment and ecosystems during extraction of critical green minerals in order to achieve energy transition without violating ESG and sustainability tenets[47].

In addition, it is imperative to protect human rights throughout critical green minerals supply chains. It has been noted that there have been cases of poor working conditions, forced labour and child labour during the extraction of critical green minerals especially in developing countries[48]. Further, in some instance, mining activities are carried out in land and territories occupied by indigenous peoples and local communities leading to forced displacements, loss of culture and traditional livelihoods, and health risks linked to pollution from mines[49]. It is therefore vital to foster sound labour practices and safety standards including investing in the tools, equipment and training needed to safeguard workers involved in extraction of these resources and ensuring that workers are adequately paid[50]. In addition, there is need to prohibit and eliminate child labour in the extraction of critical green minerals[51]. Further, there is need to protect the rights of indigenous peoples and local communities including through ensuring their Free, Prior,

[46] International Council on Mining and Metals., 'Critical Minerals' Op Cit

[47] World Economic Forum., 'What are critical minerals - and why are they key to a greener future?' Available at https://www.weforum.org/stories/2023/05/critical-minerals-technology-geopolitical-greener-future/?gad_source=1&gad_campaignid=22234048793&gbraid=0AAAAAoVy5F44dOzs9wCLCKmPyjfFERd90&gclid=CjwKCAiA8vXIBhAtEiwAf3B-g3EfisHxlPPATKtBvTDakE_9rtjDPIJZzWsQC25OBwqpBKriKhViixoC1nkQAvD_BwE (Accessed on 21/11/2025)

[48] World Resources Institute., 'The Critical Minerals Conundrum: What You Should Know' Op Cit

[49] Ibid

[50] Sammour. J., 'What Exactly is Ethical Mining?.' Available at https://www.daintylondon.com/blogs/news/what-is-ethical-mining#:~:text=Whether%20mining%20metals%2C%20diamonds%20or,its%20workers%20a%20fair%20wage (Accessed on 21/11/2025)

[51] DRC: Cobalt Mines, Child Labour and the Green Transition., Available at https://www.savethechildren.net/stories/drc-cobalt-mines-child-labour-and-green-transition (Accessed on 21/10/2025)

and Informed Consent (FPIC) in all decision making processes during the extraction of critical green minerals[52]. It is also necessary to ensure that the countries and local communities endowed with critical green minerals receive adequate benefits for justice, fairness and equity[53].

4.0 Conclusion

The scramble for critical green minerals provides an opportunity to accelerate progress towards energy transition. However, if not sustainably harnessed, critical green minerals can undermine ESG and sustainability tenets by causing environmental degradation, affecting human rights and worsening inequalities[54]. In light of these challenges, it is vital to embrace sustainable and responsible mining practices, uphold human rights and ensure equitable sharing of benefits accruing from critical green minerals[55]. By effectively harnessing critical green minerals, it is possible to achieve energy transition without violating ESG and sustainability tenets for people and planet.

[52] United Nations., 'Securing Indigenous Rights in the Energy Transition: Preventing Harm, Ensuring Consent, and Promoting Equity in Transition Minerals Extraction' Available at https://social.desa.un.org/sites/default/files/inline-files/Galina_Angarova_EGM_2024_0.pdf (Accessed on 21/11/2025)
[53] United Nations., 'The UN Secretary-General's Panel on Critical Energy Transition Minerals' Op Cit
[54] United Nations Trade and Development., 'Critical Minerals' Op Cit
[55] World Resources Institute., 'The Critical Minerals Conundrum: What You Should Know' Op Cit

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