

**Economic and Social Commission for Western Asia (ESCWA)**

Committee on Energy
Fourteenth session
Beirut, 20–22 June 2023



Item 5 of the provisional agenda

Role of minerals and critical raw materials in support of the energy transition in the Arab region

Summary

The present document provides an overview of the supply and demand for critical minerals and raw materials, and of their role in supporting the energy transition in the Arab region. It builds on the outcomes of United Nations work on extractive industries for sustainable development, following the [global policy brief](#) entitled “Transforming Extractive Industries for Sustainable Development” and the related call for action by the United Nations Secretary-General in 2021.

The present document also sets out the key challenges and opportunities for the sector, and covers the outcomes of the Group of Experts on [minerals and raw materials in support of the energy transition](#), held online by the Economic and Social Commission for Western Asia (ESCWA) on 6 December 2022. It highlights the existing gap in supply and demand fundamentals of energy transition materials and potential resources in the Arab region, providing a set of strategic pillars and policy recommendations to ensure that extraction of critical minerals supports the energy transition in the region. The Committee on Energy is invited to review the present document and comment on the proposed recommendations.

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Introduction

1. The global energy transition is characterized by a rapid increase in renewable energy generation, replacement of energy carriers, penetration of energy efficient technologies, large scale electrification, and greater energy system flexibility.
2. Renewable energy technologies, such as wind turbines and solar PV, are mineral-intensive, and hence a transition to a cleaner energy system will significantly increase demand for minerals, raw materials and metals, sometimes referred to as energy transition minerals/metals (ETM) or critical raw materials (CRM).
3. Global trends also indicate that demand for metals and minerals required for the energy transition will multiply in the next few decades. In the long term, a shortage of minerals may lead to increasing geopolitical competition and may delay the clean energy transition.
4. There is also growing recognition that the mining sector, if well managed, can play a positive role in promoting sustainable development and structural economic transformation. ETMs are key to achieving Sustainable Development Goal (SDG) 7 on affordable and clean energy and SDG 13 on climate action. Furthermore, mining has an indirect impact on SDG 1 on ending poverty, SDG 3 on good health and well-being, SDG 5 on gender equality, SDG 6 on clean water and sanitation, SDG 8 on decent work and economic growth, SDG 9 on industry, innovation and infrastructure, SDG 10 on reduced inequalities, SDG 11 on sustainable cities and communities, SDG 12 on responsible consumption and production, SDG 14 on life below water, SDG 15 on life on land, and SDG 16 on peace, justice and strong institutions in the local context.
5. Energy transition minerals offer several opportunities for resource-rich Arab countries, including the potential for economic diversification, higher revenue generation and an increase in direct and indirect jobs, given Arab countries' wealth of renewable energy resources and the large potential for adoption of clean energy technologies. However, many challenges need to be overcome to achieve this, including overdependence on revenues from extractive industries, a lack of long-term planning, sub-optimal management of natural resources, and a lack of transparency.
6. In response to the United Nations Secretary-General's directions, substantive work on extractive industries as an engine for sustainable development in the Arab region was undertaken by the Economic and Social Commission for Western Asia (ESCWA), with a focus on energy transition minerals and materials, which are increasingly relevant for the global clean energy transition.

I. Global supply and demand and high-risk energy transition minerals

7. Although minerals have different uses, some such as chromium, lead, manganese, molybdenum, nickel and zinc are considered important for the energy transition, as they are required in equipment for renewable energy generation (including hydro and geothermal generation), and for carbon capture and storage technologies. Apart from these, rare earth elements are used in generators for wind turbines; indium, silicon and silver are required for solar photovoltaics (PV) cells; and cobalt, graphite, lithium and vanadium are needed for batteries and fuel cells for energy storage in electric vehicles. Minerals such as aluminum and iron are required for structural support, and copper is necessary for electricity transmission networks. The deployment of batteries, light-emitting diode (LED) lighting and electric motors will also lead to higher demand for copper, chromium, lead, silicon and rare earth elements. Furthermore, minerals like antimony, bismuth, gallium and iridium will be required in evolving technologies, such as robotics, communication systems, automated vehicles (drones and unmanned aerial vehicles), three dimensional (3D) printing, and computing hardware, which are considered necessary to support the energy transition.

8. While there is no consensus on the definition and the elements that constitute “critical minerals”, this term, as used in the present document, refers to all non-fuel mineral materials required for the energy transition, which have strategic and economic importance and are vulnerable to supply chain disruption. Rare earth elements comprise 17 elements, including 15 of the lanthanide series; they are also considered critical minerals owing to their demand in several advanced technology-based applications.

9. Although all minerals are valuable from an economic point of view, an attempt was made to identify high-risk minerals based on their strategic and economic importance, and their vulnerability to supply disruption.

Minerals for energy transition (Number of minerals used in each technology)

Directly used in technologies for energy transition ^a		Used in supporting technologies	
Wind	11	Robotics	37
PV	16	Drones	40
Batteries	12	3D printing	18
Fuel cells	24	Information and communication technology	33
Motors	8		
Nuclear fuel	2		
Unique	37	Unique	7

Source: European Commission, [Critical Raw Materials for Strategic Technologies and Sectors in the EU: A Foresight Study](#), 2020.

^a Hydro, geothermal and electricity transmission have not been considered separately, but use the same minerals.

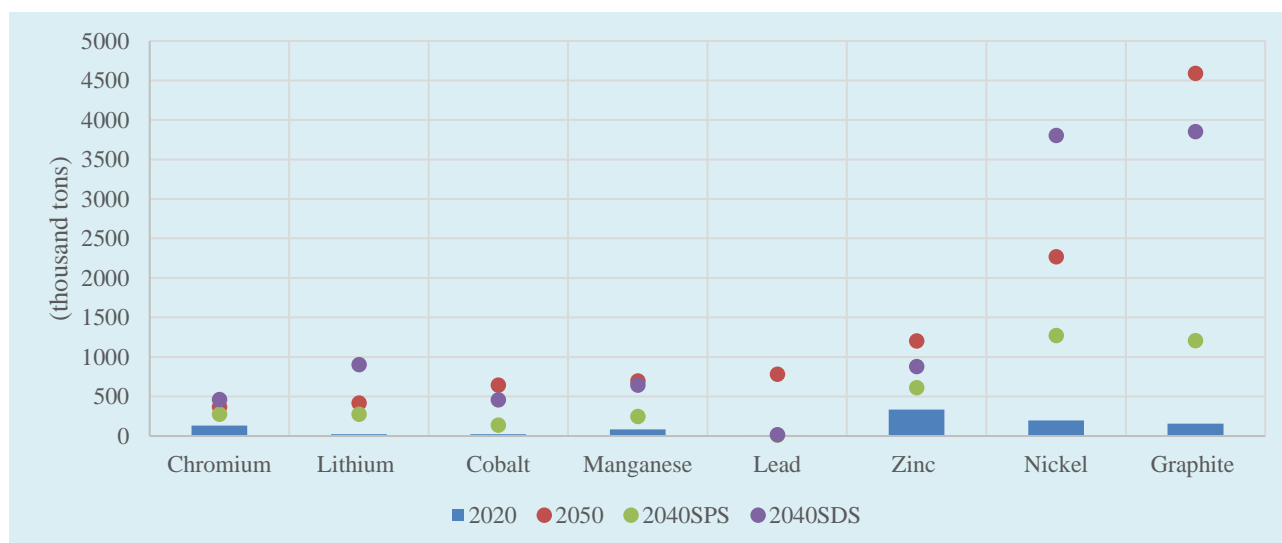
Note: “Unique” means the total number of minerals used in these technologies, without taking into account the overlap of the same minerals counted in the different technologies.

10. Mineral reserves are several orders of magnitude higher than their current annual production. Moreover, increased exploration activities can facilitate the discovery of new mineral sources, while higher prices of mineral commodities can make mining from existing reserves economically viable, thereby contributing to higher production.

II. Increasing supply-demand gap for critical minerals

11. While the global supply-demand gap for minerals may be increasing in the short term, there is no limit on the availability of minerals. Continued investment in exploration and mine development can lead to enhanced production so as to meet growing demand.

Figure 1. Growth in demand for selected minerals from clean energy technologies in the sustainable development scenario (SDS), 2040 and 2050 relative to 2020

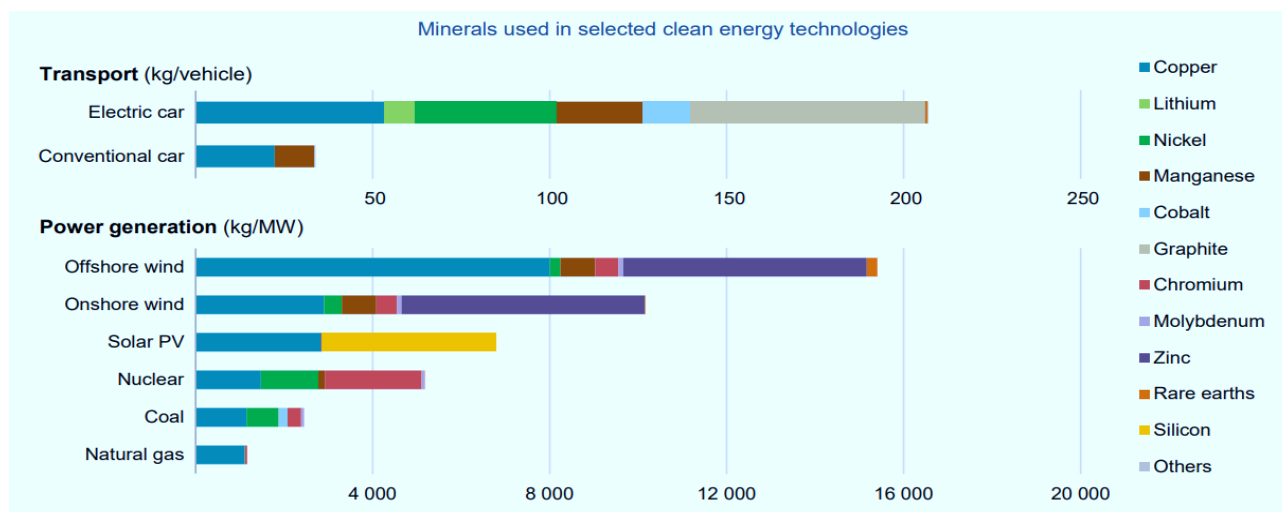


Source: ESCWA calculations based on data from the International Energy Agency (IEA) and the World Bank.

Note: SPS – stated policies scenario.

12. The mineral intensity of electricity generated from renewable energy technologies is much higher than that from fossil fuel-based infrastructure. Therefore, a rapid increase in deployment of clean energy technologies implies that global demand for minerals will increase significantly in the coming decades.

Figure 2. Minerals used in selected clean energy technologies

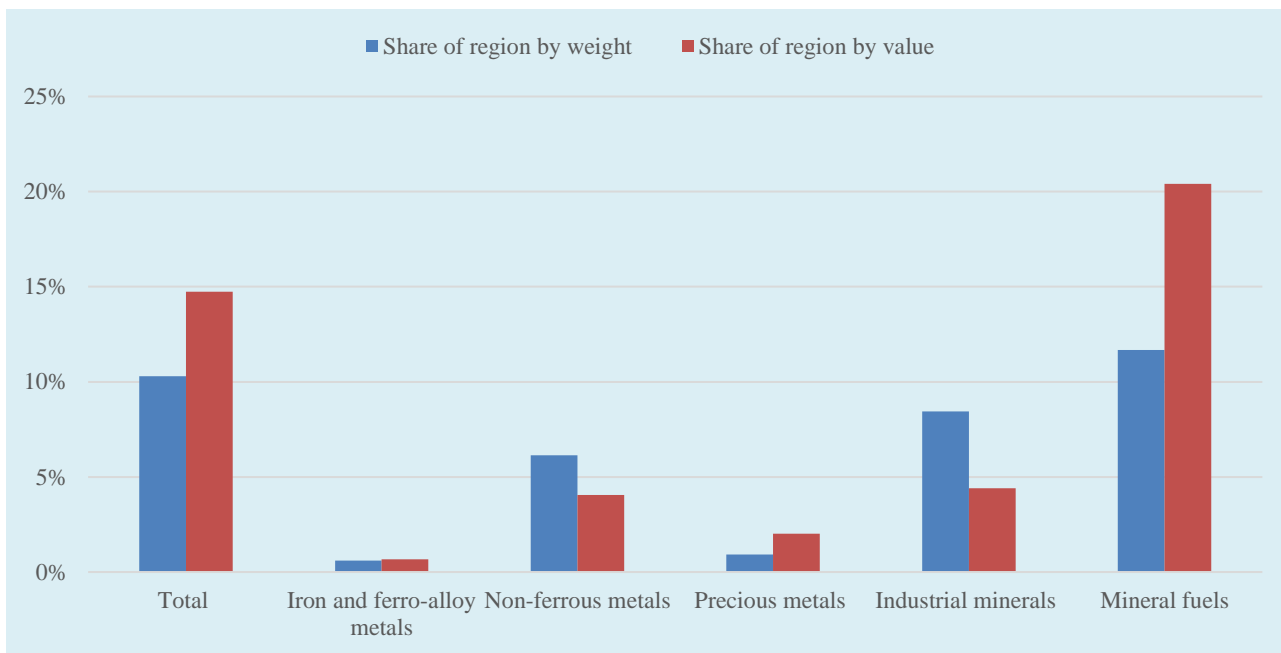


Source: IEA, [World Energy Outlook Special Report, The Role of Critical Minerals in Clean Energy Transitions](#), 2021.

III. Mineral resources in the Arab region

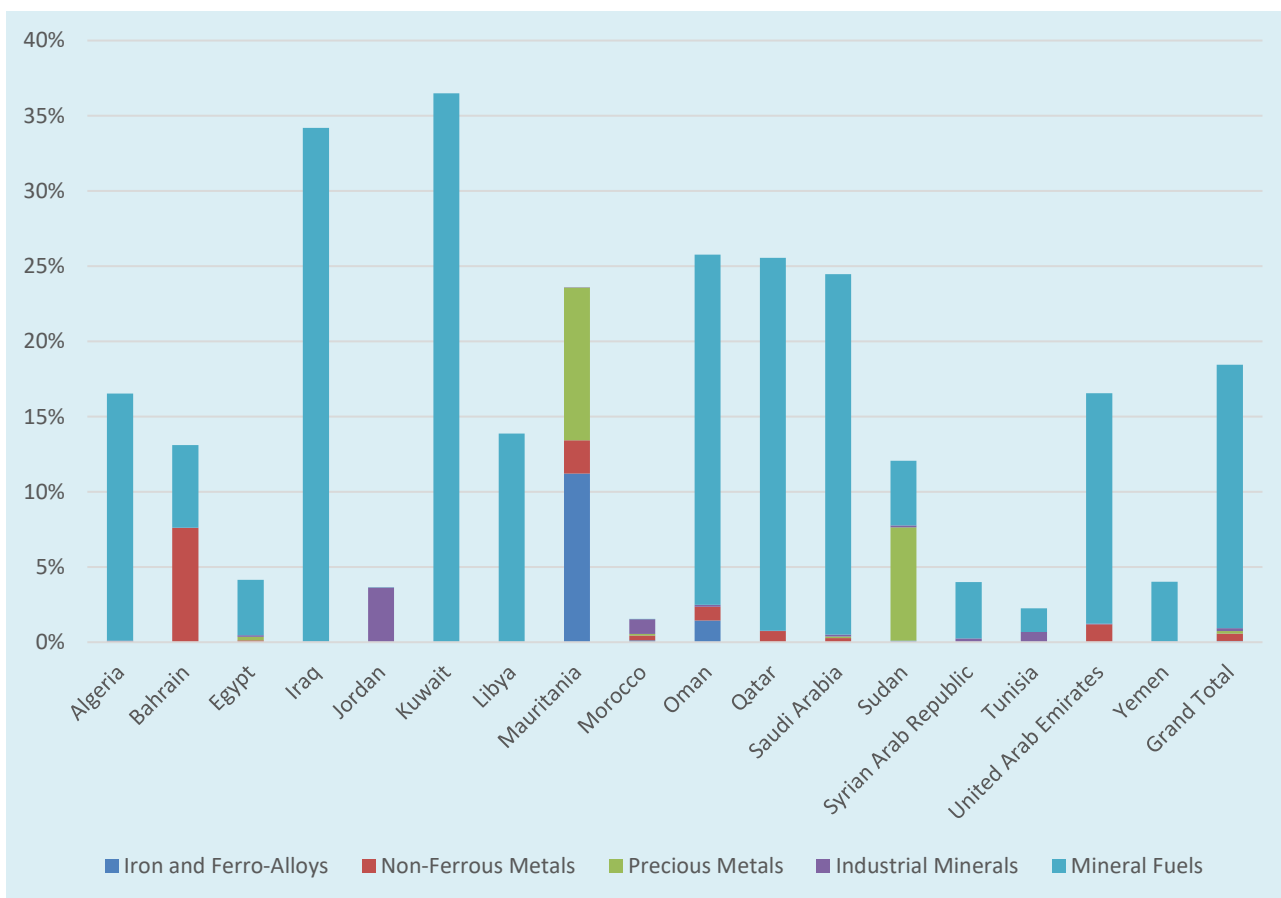
13. Arab countries possess significant resources, especially in the form of mineral fuels such as natural gas and petroleum. The total share of global mineral production in the Arab region is about 10 per cent by weight and 15 per cent by value. Mineral fuels contribute to the largest share, followed by industrial minerals and non-ferrous metals.

Figure 3. Global share of mineral production in the Arab region, 2020 (by weight and value)



Source: Austrian Federal Ministry of Agriculture, Regions and Water Management, [World Mining Data](#), 2022.

Figure 4. Contribution of minerals to GDP in the Arab region



Source: Austrian Federal Ministry of Agriculture, Regions and Water Management, [World Mining Data](#), 2022.

14. Minerals contribute significantly to the gross domestic product (GDP) of countries in the Arab region. In 2020, the value of non-fuel minerals in these countries was estimated at \$23 billion. Figure 4 shows the share of different mineral subgroups in the GDP of Arab countries. While mineral fuels dominate by production value in many Gulf Cooperation Council (GCC) countries, non-fuel minerals contribute to a high share of GDP in Mauritania (24 per cent), Bahrain (8 per cent), the Sudan (8 per cent) and Jordan (4 per cent). The share of non-fuel minerals in the value of total minerals extracted was high in Morocco (99 per cent), Tunisia (30 per cent), Egypt (11 per cent), and Oman (10 per cent). The value of non-fuel minerals extracted in Saudi Arabia (\$3.5 billion) and the United Arab Emirates (\$1 billion) also points to the economic potential of minerals in the Arab region.

15. Furthermore, as the region is rich in mineral resources, there is a high potential of finding additional mineral reserves following geological surveys and development of mineral resource maps.

IV. Challenges for the sector

16. A rapid increase in the demand of minerals has led to stiffer geopolitical competition for mineral resources, increased price volatility, and a high risk of supply chain disruption. Moreover, social and environmental criteria for mining is rightly becoming more stringent, leading to several delays in granting permits, and there is a strong pressure from environmentalists to incorporate cleaner processes.

17. Mining for critical minerals can have a significant environmental impact in resource rich areas, including habitat destruction, water pollution, air pollution, land degradation and waste generation, exacerbated often by poor management.

18. Mapping mineral resources in the Arab region and other unexplored areas requires advanced techniques, such as satellite and airborne sensors, and geochemical, geophysical and geological analysis, but is hindered by a lack of prior geologic information and the need to select prospective areas, which can be costly and time-consuming.

19. Lack of long-term planning results in poor infrastructure development, higher dependency on other countries for minerals, risk of higher environmental degradation, negative social impacts, higher economic inefficiency, and high legal/regulatory challenges, which can result in missed opportunities for economic growth and development.

20. Mining companies encounter hurdles in acquiring permits and licences owing to intricate regulatory frameworks, which can be time-consuming and require detailed plans and environmental assessments. Mining necessitates significant infrastructure and capital investment, and can take decades to move from exploration to production. Increasing production capacity and meeting mineral demand requires time, and the resulting gap between supply and demand is causing mineral prices to rise.

21. Lack of clarity or stability in government policies and regulations affects the feasibility and attractiveness of mining projects. Moreover, price volatility varies across minerals, potentially destabilizing mining-dependent countries. Both policy uncertainty and price signals can deter investment in sustainable mining projects.

V. Recommendations for sustainable mining in the Arab region

22. The Committee on Energy is invited to comment on the following recommendations:

(a) Adopt critical mineral strategy and transition plans: long-term planning and a thorough understanding of the industry and related operations (mineral demand estimation, mapping and reporting) is necessary for developing a high-level integrated strategic plan and a roadmap for energy transition minerals. This requires a comprehensive approach that considers the economic, social and environmental impacts of the mining industry, and aims to balance the needs of all stakeholders;

(b) Address environmental and social concerns: by adopting global environmental, social and governance (ESG) standards linked to a possible SDG risk index and ensuring strict compliance. Arab countries should implement sustainable sourcing practices, which include environmental and social impact assessments, engagement with local communities, responsible sourcing policies and environmental regulations, and should promote good practices in critical mineral extraction and use. Environmental and social impact assessments and performance standards and reporting can identify and mitigate potential environmental and social risks, while engaging with local communities and implementing responsible sourcing policies that ensure equitable sharing of benefits and reduce human rights abuses and gender inequality;

(c) Strengthen governance structures, transparency and accountability: strengthening regulatory and legal frameworks and stable tax regimes allows mining revenues to be traced, which ensures government accountability. Adoption of ethical business practices and strict implementation of corporate governance standards results in greater oversight and increased transparency in contracts;

(d) Adopting a circular carbon economy framework for the critical mineral sector: circular carbon economy (CCE) under the 4Rs (reduce, reuse, recycle and remove) can facilitate the transition to a low-carbon economy by reusing, repairing, and recycling materials and resources. Adoption of CCE involves deployment of improved technologies for upstream mining activities, re-use and recycling of raw materials and goods, substitution of critical materials, and efficient collection and recycling of products at end-of-life. Practices that aim to minimize the use of fossil fuels, reduce greenhouse gas emissions, and promote the use of clean energy sources can also support CCE;

(e) Encourage investment in the critical mineral sector and promote research and development: investing in research, development and innovation is vital, as is adopting advanced technology to lower the environmental impact of mining and obtaining higher productivity along the entire mining value chain. The focus should be on identifying alternative minerals or technologies that can be used in clean energy transitions. Investment efforts into research, development and technology should adopt a broad-based strategy for fostering technology innovation, developing supply chain resilience, enhancing recycling, and introducing sustainability standards;

(f) Enable private sector investment through the entire value chain: by creating favourable market conditions throughout the value chain for the critical mineral sector by adopting clear policies, de-risking investment and promoting innovative business models. Public-private partnerships are key to establishing a critical mineral supply chain. Governments should reduce policy uncertainty and provide the necessary interventions to de-risk private investments and promote innovative business models;

(g) Strengthen multi-stakeholder partnerships among mining companies, Governments and stakeholders to promote sustainable and responsible mining practices: robust partnerships are essential for integrating global supply chains of critical raw materials and ensuring continuity of supply. Collaboration on technology and innovation can facilitate sharing of knowledge, resources and expertise, and enable joint identification and implementation of solutions;

(h) Invest in capacity-building and training of personnel to improve understanding and skills: capacity-building and training can play a vital role in promoting sustainable mining practices by helping to improve the knowledge and skills of involved stakeholders, which can in turn support implementation of sustainable and responsible practices in the mining sector. Training should cover mining companies, local communities, civil society organizations, Governments and regulatory bodies. This will pave the way for better policymaking and public reporting;

(i) Foster regional collaboration and knowledge-sharing among Arab countries to enable faster deployment of cleaner mining technologies and boost the region's ability to address critical mineral supply challenges;

(j) Forge global partnerships for reliable, secure and sustainable critical mineral supply chains: this can mitigate supply chain risks, promote economic benefits, and contribute to achieving the SDGs. Improved coordination and coherence in the global mineral market are vital for a clean and just energy transition, addressing ESG governance risks and promoting sustainable and equitable economic growth.¹

¹ World Bank Group, [Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition](#), 2020.