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Southern Africa Resource Watch

Critical Minerals and Renewable Energy Value Chains in Namibia: A Study of Actors and Initiatives

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Grateful appreciation is expressed to the researchers, in particular, the research effort of Gilbert Jemwa and the editorial guidance of Dr. Claude Kabemba and Davie Malungisa.

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LIST OF ACRONYMS

ASX	Australian Securities Exchange
CAGR	Compounded annual growth rate
CNUC	China National Uranium Corporation Limited
CSP	Concentrated solar power
Cu	Copper
DFS	Definitive feasibility study
DMT	Deutsche Montan Technologie (DMT Group)
EU	European Union
EV	Electric Vehicle
FDI	Foreign direct investment
GCF	Green Climate Fund
GDP	Gross domestic product
GEC	Global Environment Facility
GHG	Greenhouse gas
IBML	International Base Metals Limited
IEA	International Energy Agency
IPP	Independent power producer
LSE	London Stock Exchange
MEFT	Ministry of Environment, Forestry and Tourism
MIT	Ministry of Industrialisation and Trade
MME	Ministry of Mines and Energy
Mn	Manganese
MNH	MN Holdings Limited
Mt	Metric tonnes
MW	Megawatts
NamDeb	Namibia Diamond Corporation
NDC	Nationally determined contribution
NGHRI	Namibian Green Hydrogen Research Institute
NREL	National Renewable Energy Laboratory
PEA	Preliminary economic assessment
PFS	Pre-feasibility study
PV	Photovoltaic
REE	Rare earth element
REFIT	Renewable energy feed-in tariff
SADC	Southern African Development Community
SCDI	Southern Corridor Development Initiative
TREO	Total rare earth oxide
TSX	Toronto Stock Exchange
UNAM	University of Namibia
UNDP	United Nations Development Programme

EXECUTIVE SUMMARY

This study delved into the key actors and initiatives in Namibia's critical minerals and renewable energy sectors, highlighting their pivotal roles in propelling the country's energy transition, climate action, and sustainable development. Namibia, blessed with strategic minerals such as lithium, cobalt, uranium, and rare earth elements, stands at the forefront of the global shift towards cleaner energy systems, offering a promising future in renewable energy. The potential of Namibia's green hydrogen economy has attracted international investment interest, notably from Germany.

The research explored government policies, published literature, private sector involvement, and international partnerships shaping Namibia's renewable energy landscape.

Namibia has made significant strides in renewable energy, with substantial solar, green hydrogen, and wind power projects in the pipeline. Government incentives such as the Renewable Energy Feed-In Tariff (REFIT) programme promote the role of independent power producers (IPPs) in generating electricity from renewable sources. Key projects, such as the 37-megawatt solar plant in Mariental and the 44-megawatt wind farm in Lüderitz, underscore the private sector's role in advancing renewable energy infrastructure.

However, the link between its critical minerals wealth and renewable energy value chains has been weak. Namibia imports green technologies for its renewable energy projects. Enhancing incentives to attract investment in mineral beneficiation and renewable energy projects is necessary to ensure the best returns on its mineral wealth. This may involve pursuing regional value chains. Therefore, urgent collaboration with regional partners to establish beneficiation plants and address local raw material shortages and skill gaps is a crucial step. Given the lack of access to affordable finance in capital markets, Namibia should utilize innovative financing mechanisms (such as climate finance and investment partnerships with industrialized countries) to realise mining beneficiation and establish a viable linkage with its renewable energy projects.

The study strongly recommends that the Namibian government implement transparent licensing procedures and strengthen regulatory oversight. This will not only build public trust but also ensure fair and just resource management, including adherence to environmental, social, and governance (ESG) standards. As in many other African states, the sustainable extraction and processing of critical minerals in Namibia is necessary. This approach helps to mitigate environmental risks, protect biodiversity, and ensure community well-being. The expansion of renewable energy infrastructure is also highlighted as a crucial step in addressing energy poverty in Namibia, where nearly half the population lacks access to electricity. Improved energy access can significantly enhance livelihoods, promote economic development, and foster social inclusion — the essence of a just energy transition. In corporate governance, mining companies must be held accountable for addressing transfer pricing manipulation and tax avoidance issues to guarantee that tangible fiscal benefits reach state coffers.

Conclusively, this study notes that Namibia's abundant strategic minerals are crucial for the renewable energy transition, offering significant sustainable development and economic growth opportunities. Namibia can drive its energy transition and promote regional industrialisation by aligning mineral development with national climate goals, regional integration, and fostering international cooperation. Addressing transparency, financing, and environmental protection challenges is essential for a prosperous, equitable and just energy future.

1. INTRODUCTION

Namibia is endowed with an abundance of the strategic minerals essential for renewable energy technologies, such as lithium, cobalt, uranium and rare earth elements. Its mining sector, a cornerstone of its economy, has historically focused on diamonds and uranium, making it the world's fourth-largest uranium producer. Zinc and emerging critical minerals like cobalt and lithium further diversify the mining landscape. These mineral resources are pivotal in the global shift towards cleaner energy systems.

This study explores the current landscape of Namibia's renewable energy sector, the initiatives undertaken to harness these minerals, and the various stakeholders involved, including government bodies, private enterprises, and international partners. The analysis further examines how Namibia is leveraging its strategic mineral resources to drive the energy transition, fostering socio-economic development, and contributing to regional and global sustainability goals. Furthermore, the report delves into the challenges and opportunities presented by the energy transition, examining the policies and legal frameworks governing the sector, the role of local and international actors, and the socio-economic impacts of renewable energy projects. By highlighting Namibia's efforts and strategies, this report aims to provide valuable insights into the broader regional context of Southern Africa's energy transition and the critical role of strategic minerals in achieving sustainable development.

From reports available in the public domain and discussion with seven selected key stakeholders, the research employed desk and interview research methods to gather information on socio-economic and political opportunities to advance the renewable energy minerals supply chain that supports mitigation, inclusion, and resilience, and the opportunities to promote structural economic transformation in Namibia.

This study explores the current landscape of Namibia's renewable energy sector, the initiatives undertaken to harness these minerals, and the various stakeholders involved, including government bodies, private enterprises, and international partners.

2. OVERVIEW OF NAMIBIA'S MINERALS ECONOMY

2.1. MINING SECTOR

Namibia's mining sector is a vital component of its economy, contributing about 10 per cent of the country's GDP annually. Diamond mining, led by key players like NamDeb and Debmarine Namibia, has historically contributed a significant portion of the country's trade in commodities and export revenue. Namibia is the world's fourth-largest producer of uranium oxide, with mines such as Husab and Rössing Uranium, operated by China General Nuclear Power Group, and China National Uranium Corporation Limited (CNUC) respectively.

Rössing Uranium is majority (68.62 per cent) owned by CNUC, 15 per cent by the government of Iran, 10 per cent by Industrial Development Corporation of South Africa, 3 per cent by the government of Namibia and 3 per cent by local individual shareholders. Swakop Uranium Husab Mine is owned by Swakop Uranium, which is 90 per cent owned by Taurus Minerals and 10 per cent by Epangelo Mining, the two leading uranium mining companies in the country.

The Husab mine, which is adjacent to the Rössing Mine, is believed to be the world's fourth-largest uranium deposit. Paladin's Langer Heinrich mine commenced commercial production operations in 2006, and was placed into care and maintenance in 2018 due to sustained low uranium prices. The mine resumed commercial production on 30 March 2024. French nuclear company Orano's Trekkopje mine has not been in production since 2013, again due to flat international uranium prices.

Namibia's uranium is sold as "yellowcake" and there is neither policy nor capacity to fabricate it into electricity. Namibia is in a favourable position on the international market because uranium plays a crucial role in the production of clean energy, particularly in the generation of nuclear power. Considering that Namibia is currently importing electricity from neighbouring countries, its access to uranium resources can provide a degree of energy independence by relying on nuclear power. Furthermore, an opportunity exists for Namibia to take its uranium value chain regionally by working with South Africa which has capacity to fabricate the uranium into electricity for local and regional markets or to fabricate its uranium internationally and accrue the highest value for its shareholding in the mines. However, there are no clear motivations for the development of nuclear energy in the current global energy transition.

Namibia is in a favourable position on the international market because uranium plays a crucial role in the production of clean energy, particularly in the generation of nuclear power. Considering that Namibia is currently importing electricity from neighbouring countries, its access to uranium resources can provide a degree of energy independence by relying on nuclear power.

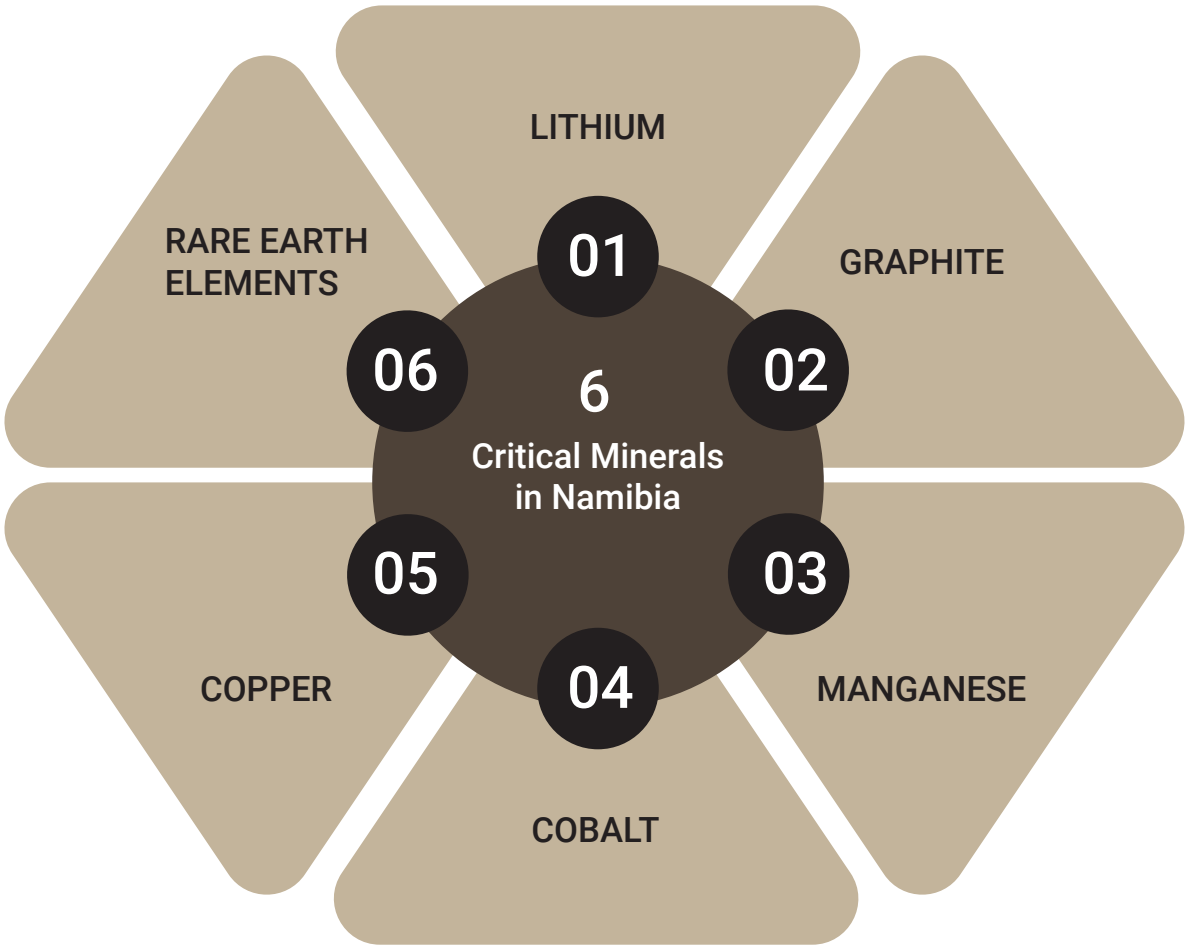
The Otjikoto and Navachab gold mines are currently the only gold-producing mines in the country. Osino Resource's Twin Hills Gold project is a fully licensed advanced project (mining and environmental and social permits have been obtained). Namibia's mineral resource endowment also includes cement-grade limestone mined by Ohorongo Cement and Cheetah Cement. Flocked Consultancy is developing a huge deposit in the Karibib area. Silica, salt, various semi-precious stones, feldspar, sodalite, and cadmium are found in Namibia.

3. NAMIBIA'S CRITICAL MINERALS AND THE ENERGY TRANSITION

As new and cleaner energy technologies are required to replace existing high GHG-emitting technologies, the demand for critical minerals used in these technologies is increasing too. Namibia is home to copper, zinc, graphite, lithium, cobalt, manganese, and rare earth elements, critical minerals needed to manufacture these clean energy technologies.

Namibia is emerging as a source of critical minerals like cobalt and lithium, crucial for renewable energy technologies. The country also revealed a substantial find of rare earth elements (REEs) in 2022, seeking partnerships with investors from the United States of America (US).

Figure 1: Namibia's Critical Minerals



3.1. LITHIUM

Namibia has several key lithium projects. UK-owned Andrada Mining has commenced lithium concentrate production at the Uis tin mine, aiming to reach 250 tonnes per month.[1] The mine is currently operating a pilot plant producing tin concentrate sold to an off-taker in Thailand. Askari Metals has expanded its Uis Lithium Project, acquiring additional exploration licences and reporting promising mineralisation of lithium, tantalum, tin, and rubidium.[2] The Karibib Lithium Project, a fully permitted advanced project, is majority-owned by Australia's Lepidico Chemicals. Meanwhile, Prospect Resources is advancing the Omaruru Lithium Project, having initiated Phase Two drilling to explore the extent of its lithium deposits.[3] These developments underscore Namibia's growing importance in the global lithium market.

3.2. GRAPHITE

Namibia hosts notable graphite projects, particularly the Aukam Graphite Mine managed by Gratomic Inc. This mine is undergoing commercial commissioning, aiming to produce high-quality vein graphite with a target of reaching 12 000 tonnes per year by late 2024. Gratomic plans to expand the facility to meet growing demand, leveraging its strategic position to supply critical minerals outside of Chinese control.[4,5] Additionally, Northern Graphite's Okanjande project, set to resume by the end of 2024, aims for an annual production of 31 000 tonnes of graphite concentrate.[6] This project benefits from Namibia's stable political environment and access to deep-water ports, enhancing its competitiveness (The Extractor Magazine). Rhombus Investments' Black Range Graphite Project has a non-code compliant resource of 13.3Mt at 4.69 Carbon as Graphite (CGR). Rhombus is seeking funding through equity or debt financing to further develop the project.

3.3. MANGANESE

Manganese is being extracted from Otjosondu manganese fields. The operation has a planned monthly production of 30 000Mt and this project has been operational since 2019. Located near Okahandja, this project is focused on producing high-grade manganese, crucial for steel production and battery technologies. MN Holdings Limited (MNH) has secured a $1.35 million loan from Premier African Minerals Limited and Cambrian Limited to acquire plant and equipment for its Otjozondu manganese project.[7] This acquisition aims to boost manganese production significantly. MNH has also entered sale and purchase contracts with the liquidator of Purity to acquire plant and equipment from the Purity Manganese Project, three mining licences and the Purity or Ebenezer farm.[8] The country's strategic location and infrastructure support efficient manganese export, primarily to Asian markets.

3.4. COBALT

Celsius Resources Limited is developing the prospective Opuwo Cobalt Project in northern Namibia. The company has a 95 per cent interest in the project, and local Namibians own the remaining 5 per cent. Celsius Resources is an Australian company listed on ASX and LSE.[9] The revised mineral resource estimate for the Opuwo project, published in July 2021, indicates a resource of 225.5 million tonnes, with grades of 0.12 per cent cobalt, 0.43 per cent copper, and 0.54 per cent zinc.[10] This positions Opuwo to potentially produce 259 000 tonnes of cobalt, highlighting Namibia's significance as a future key supplier for the battery industry.

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[1] Mining Technology, "Andrada produces first lithium concentrate at Namibia mine" (Mining Technology, November 28, 2023)<https://www.mining-technology.com/news/andrada-first-lithium-concentrate-namibia-2/ > accessed 29 November 2022.
[2] Joe Toft, "Askari Metals acquires lithium project in Namibia", (Global Mining Review, Wednesday, 07 December 2022) <https://www.globalminingreview.com/mining/07122022/askari-metals-acquires-lithium-project-in-namibia/> accessed 5 March 2024.
[3] Prospect Resources, "Omaruru Lithium Project Namibia, Africa" (Prospect Resources, n.d.)<https://prospectresources.com.au/omaruru-lithium-project/> accessed 21 March 2024.
[4] Gratomic, "Gratomic Targets 12,000 Tonnes of Vein Graphite Production at Namibia's Aukam Mine this Year" (Gratomic,)<https://batterymetalsafrica.com/gratomic-targets-12000-tonnes-of-vein-graphite-production-at-namibias-aukam-mine-this-year/> accessed 18 March 2024
[5] Gratomic, "Gratomic Provides Commercial Commissioning Update of Its Aukam Graphite Mine in Namibia" (Gratomic, 15 November 2023) <https://www.accesswire.com/803504/gratomic-provides-commercial-commissioning-update-of-its-aukam-graphite-mine-in-namibia> accessed 18 March 2024
[6] The Extractor, "2024 HOPEFULS: Okanjande/ Okorusu project return set for late 2024" (The Extractor, December 30, 2024) <https://theextractormagazine.com/2023/12/30/2024-hopefuls-okanjande-okorusu-project-return-set-for-late-2024/> accessed 10 January 2024.
[7] Premier African Minerals, "Otjozondu Mining Plans to Expand Manganese Production" (Premier African Minerals, July 2019) <https://www.premierafricanminerals.com › downl...> accessed 5 October 2024.
[8] Ibid
[9] https://celsiusresources.com/wp-content/uploads/2023/01/CLA-Admission-Appendix-Final-20230127.pdf
[10] https://www.mining-technology.com/news/licence-celsius-namibia-cobalt/#?cf-view

3.5. COPPER

International Base Metals Limited (IBML) and Greenstone Ventures Group, through Craton Mining Exploration (Pty) Ltd are developing the Omitiomire Copper Project. The Omitiomire deposit has a JORC[11]- -compliant indicated and inferred resource of 137Mt of ore at 0.54 per cent copper at 0.25 per cent cut-off grade for a 740 000t contained copper. The project was granted a mining license valid for 20 years on 24 December 2017 (IBML, 2023). Omitiomire Copper is owned 53.7 per cent by Greenstone Ventures Group of the United Kingdom, and 46.3 per cent by IBML of Australia through Omico Copper Limited, a company registered in Mauritius. Omico Copper Limited owns 95 per cent of Craton Mining and Exploration (Pty) Ltd. Deep-South Resources, a Canadian company listed on the TSX, through Haib Minerals (Pty) Ltd., owns Haib Copper Project 100 per cent. The Haib Copper Project has an indicated resource of 456.9Mt at 0.31 per cent copper, and 342.4Mt at 0.29 per cent inferred. Trigon Metals recently announced the shipment of the first concentrate from their Kombat Copper mine in Namibia (Trigon Metals, 2023).

Namibia is a prominent zinc producer, with mines including Skorpion Zinc and Rosh Pinah. Zinc is a key component in various types of batteries, including zinc-carbon batteries and alkaline batteries.

3.6. ZINC

Namibia is a prominent zinc producer, with mines including Skorpion Zinc and Rosh Pinah. Zinc is a key component in various types of batteries, including zinc-carbon batteries and alkaline batteries. These batteries are commonly used in electronic devices, remote controls, and other portable electronics. Andrada Mining, Uis Tin Mine, Lepidico Karibib Lithium project, Askari Uis Project, Xinfeng's Kohore, and Karlowa Lithium are the major lithium projects in the country. Lithium is one of the critical minerals in battery manufacturing.[12]

3.7. RARE EARTH ELEMENTS (REES)

The REE projects in Namibia include Namibia Critical Metals' Lofdal, an advanced exploration project with a declared code-compliant resource of 53Mt, with 4.7 million kg of contained dysprosium and 725 000 kg of terbium. Lofdal rare earth deposit is one of only two xenotime-type heavy rare earth deposits under development in the world. A preliminary economic assessment (PEA) carried out in 2014 established that Lofdal is one of the world's richest dysprosium and terbium deposits outside China. A pre-feasibility study (PFS) in the first quarter of 2024 is expected to be followed by the definitive feasibility study (DFS) and a construction decision. The Lofdal Project is fully permitted with a 25-year mining license. Dysprosium and terbium are critical metals used in permanent magnets for electric vehicles (EVs), wind turbines, and other electronics at the heart of energy transition (Namibia Critical Minerals, 2023). The Eureka REE is a discovery stage project with an inferred resource of 310Kt at 4.8 per cent total rare earth oxide (TREO) and a cut-off grade of 0.1 per cent as of 2021 (E-Tech, 2023). The mineralisation has been constrained by a shallow reverse circulation drilling campaign, is reportedly open in all directions, and has been confirmed to continue to a depth of 160m. The REE minerals are contained in the mineral monazite hosted in carbonatite. Ongoing step-out drilling is expected to add to the mineral resources (E-Tech, 2023).

Einsenberg REE is 100 per cent owned by Broad Mind Mining, a Namibian company. The Einsenberg REE is a discovery-stage exploration project with a code-compliant inferred mineral resource of 570Mt at 0.9 per cent TREO. The preliminary work by DMT South Africa proved that 96 per cent of REE could be recovered using the PyEarth process, a novel technology developed by Mintek (South Africa).

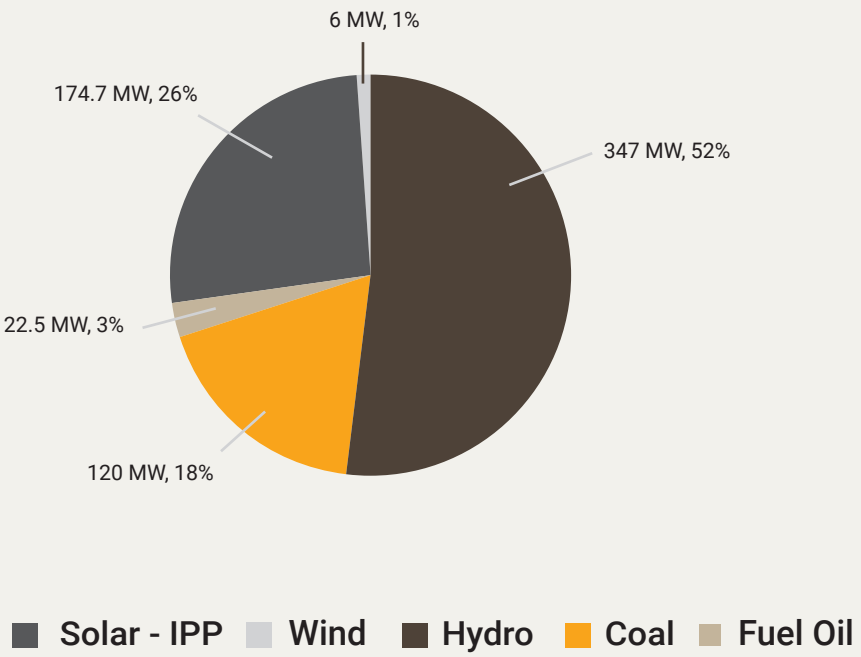
Due to underdeveloped domestic capital markets, the Namibian government is actively inviting foreign direct investment (FDI) to advance and modernise its mining industry.

[11] The 'the JORC Code' is the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves is a professional code of practice that sets minimum standards for Public Reporting of minerals Exploration Results, Mineral Resources and Ore Reserves.
[12] Mining Review Africa March 30, 2023, "A new lithium discovery for Prospect Resources in Namibia" < https://www.miningreview.com/battery-metals/a-new-lithium-discovery-for-prospect-resources-in-namibia/> accessed 2 April 2024.

4. NAMIBIA'S ENERGY MIX

Namibia continues to increase its local generation of electricity, particularly from renewable energy resources, although imports remain the mainstay.[13] In 2019, electricity imports totalled 70 per cent due to a significant drop in local generation in part because of the impact of drought on the Ruacana Hydro Plant.[14] The domestic share of Namibia's electricity comes from hydropower, coal, heavy fuel oil, solar and wind.[15] Namibia is listed as having some of the highest solar photovoltaic (PV) and concentrated solar power (CSP) potential in the world.[16] Currently, some 200MW of solar photovoltaics are part of the national grid, contributing 8.58 per cent of total electricity consumed nationally and approximately 26 per cent of local generation.[17] There are clear indications that new energy storage will soon be incorporated into the national grid for use by NamPower to store energy and support increased penetration of renewable energy systems.[18]

Figure 2: Local Electricity Sources (2019)



Namibia's current local electricity generation capacity is about 486.5MW, rendering a deficit of about 200MW. The country imports 61 per cent of its energy from neighbouring countries. The total electricity demand is currently estimated at 600MW per year.[19] This demand is expected to grow at approximately 5 per cent annually in the coming years. Of the available generation capacity, 332MW is clean energy capacity from the Ruacana HydroPower Station, and 154.5MW capacity is from high GHG-emitting technologies (108MW from Van Eck Coal Power Station, 24MW from Paratus Diesel Power Station, and 22.5MW from Anixas Power Station) (MIT, 2020).

[13] WWF Namibia Briefing, " Clean Energy: Towards a brighter future for Namibia" (WWF Namibia Briefing, May 2023) <https://wwfafrica.awsassets.panda.org/downloads/wwf_coming_clean_on_energy_1.pdf> accessed February 2024.
[14] Electricity Control Board. (2019). ESI Statistical Bulletin 2019. Windhoek: Electricity Control Board
[15] Ibid
[16] Hermann, S., Miketa, A., & Fichaux, N. (2014).
[17] NamPower. (2021), "NamPower Annual Report 2021" (NamPower, May 2025) <https://www.nampower.com.na/public/docs/annual-reports/NamPower%20Annual%20Report%202021.pdf> accessed 7 May 2024.
[18] WWF Namibia Briefing (n 13)
[19] International Trade Admistration (2024)

Figure 3: Total Energy Supply (2021)

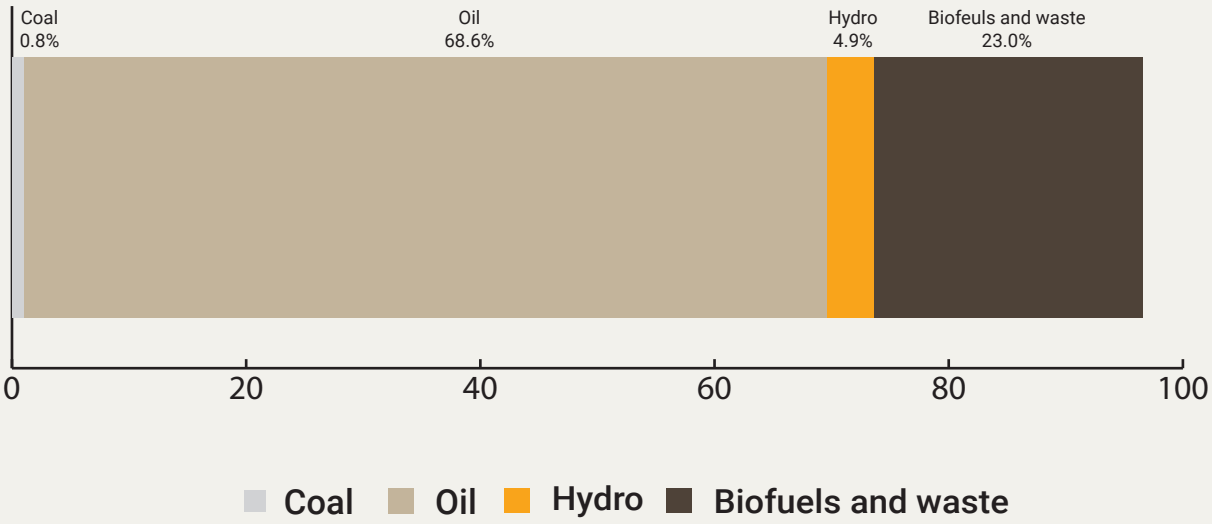
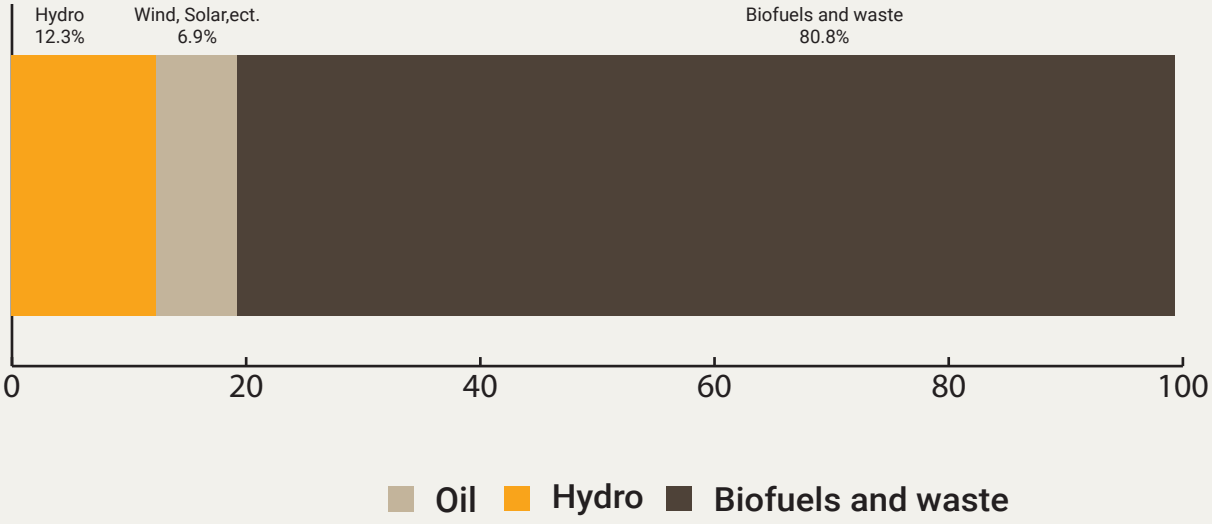


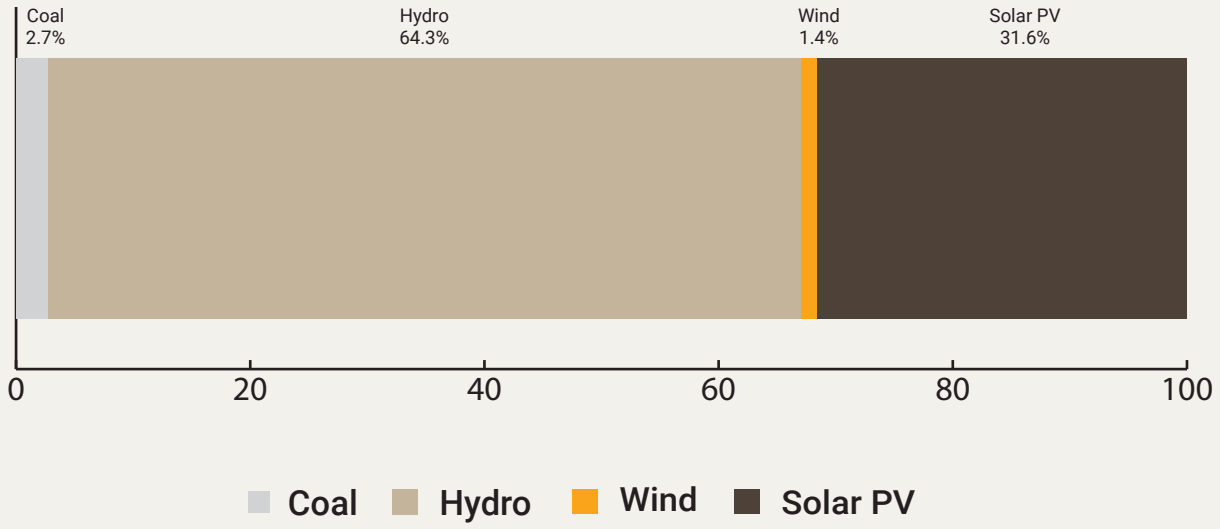
Figure 4: Domestic Energy Production (2021)



Source: International Energy Agency (2024)

According to the IEA (2024), most of Namibia's electricity is generated by hydropower. The country has stated its interest in introducing nuclear power into its domestic mix because it is one of the ten largest uranium resource-holders in the world and provides 8.2 per cent of global production. In its nationally determined contributions (NDCs) the Namibian government wants to deploy 568MW of clean energy technologies generation capacity, replacing imported electricity and that generated from high-emitting technologies by 2030 (MEFT, 2021).

Figure 5: Electricity Generation Mix, Namibia, 2021



Source: International Energy Agency 2024

Namibia's energy mitigation objective is twofold. Firstly, it wants to reduce the total electricity imported from neighbouring countries and build the country's capacity by replacing it with renewable energy technologies. Secondly, it wants to replace power generated from high-emitting plants with power generated from cheap, clean, and efficient renewable energy technologies. According to the interviews conducted with the Ministry of Mines and Energy's Renewable Energy Directorate, up to 300 000 Namibian rural households do not have access to electricity. This constitutes about 70-80 per cent of rural households, while figures in urban areas are much smaller.

5. RENEWABLE ENERGY ACTORS AND INITIATIVES

5.1. SOLAR ENERGY PROJECTS

Namibia has made significant strides in harnessing its abundant solar resources through various large-scale solar projects. Key examples include the Omburu Solar PV Plant near Omaruru, the Osona Solar Park near Okahandja, and the Hardap Solar PV Plant near Mariental, each contributing 4.5 to 5MW to the national grid. Additional projects like the Trekkopje Solar PV Plant near Arandis, the Karibib Solar PV Plant, the Otjiwarongo Solar PV Plant, and the Aussenkehr Solar PV Plant further bolster Namibia's renewable energy capacity. These projects, developed by companies such as OLC Solar Energy, InnoSun Energy Holdings, Momentous Solar One, Greenam Energy, HopSol Africa, SunEQ and Emesco, exemplify the country's commitment to reducing reliance on imported electricity, lowering carbon emissions, and promoting sustainable development.

5.2. WIND ENERGY PROJECTS

Namibia is capitalising on its favourable wind conditions through several key wind energy projects, such as the Ombepo Wind Farm near Lüderitz, which generates 5MW and is developed by InnoWind and Emesco. Another notable project is the Diaz Wind Farm, also near Lüderitz, which aims to produce 44MW once completed and is spearheaded by United Africa Group and Quantum Power. The planned Rosh Pinah Wind Farm, developed by NamPower, will contribute an additional 20MW to the national grid. These projects are instrumental in reducing Namibia's reliance on imported electricity, lowering carbon emissions, and promoting sustainable development, while also creating job opportunities and supporting local economies.

5.3. GREEN HYDROGEN ECONOMY PROJECTS

Green hydrogen is hydrogen gas produced through the process of electrolysis, where water (H2O) is split into hydrogen (H2) and oxygen (O2) using electricity generated from renewable energy sources such as wind, solar, or hydroelectric power.[20] This method is considered environmentally friendly because it does not produce carbon dioxide (CO2) or other greenhouse gases, unlike traditional methods of hydrogen production, which often rely on fossil fuels.[21] Green hydrogen (GH2) is one of the key energy carriers of the future and the basis for a variety of Power-to-X (PtX) products like green ammonia or sustainable aviation fuels (SAF). For Namibia, green hydrogen has been identified as strategic to the decarbonisation of industries such as mining.

Namibia is at the forefront of developing a green hydrogen economy, leveraging its abundant renewable energy resources to produce green hydrogen as a sustainable energy source. Namibia believes that only hydrogen produced using renewable energy sources is sustainable in the long term. Using its world class solar and wind resources offers Namibia a long-term competitive advantage in producing green hydrogen and green ammonia. The country is currently advancing its green hydrogen economy through several key projects, which include the following initiatives.

5.3.1. Green Hydrogen Applications in the Port Environment

The "Green Hydrogen Applications in the Port Environment" project, located at Walvis Bay, involves the installation of a 5MW electrolyser and an H2 mobile refueller with a capacity of 945kg at 500 bars. Valued at 5.66 million euros, this innovative project is a collaboration between Cleanergy Solutions Namibia, CMB Germany, GmbH & Co. KG, Namport, and the University of Namibia (UNAM). It aims to utilise green hydrogen for port operations, demonstrating the feasibility and benefits of hydrogen as a clean fuel alternative in maritime and logistics applications. This initiative not only underscores Namibia's commitment to sustainable energy solutions but also enhances the operational efficiency and environmental sustainability of Walvis Bay port.

[20] Zhou, Y., Li, R., Lv, Z., Liu, J., Zhou, H. and Xu, C., 2022. Green hydrogen: A promising way to the carbon-free society. Chinese Journal of Chemical Engineering, 43, pp.2-13.
[21] Ibid

5.3.2. Hydrogen-Diesel Dual Fuel Locomotive Project Proposal for Namibia

The "Hydrogen-Diesel Dual Fuel Locomotive Project Proposal for Namibia with Supporting Research Projects" aims to convert a fleet of 50 locomotives to hydrogen-diesel dual fuel operation along the Walvis Bay to Kranzberg corridor managed by TransNamib. Valued at 7.63 million euros, this project is a collaboration between CMB.TECH, UNAM, Hyphen Technical, TransNamib, the Namibian Green Hydrogen Research Institute (NGHRI), and Nicholas Holding. The initiative focuses on reducing carbon emissions and enhancing the sustainability of Namibia's rail transport system. By integrating green hydrogen into locomotive fuel systems, the project seeks to demonstrate the practical application of hydrogen technology in heavy-duty transportation, supporting Namibia's broader green energy and environmental goals.

5.3.3. Daures Green Village

The Daures Green Village project is in the Erongo Region, specifically in the Daures Constituency, approximately 20 km from Uis and 234 km from Swakopmund. In its pilot phase, the project aims to produce 500 kg of anhydrous ammonia per day, with plans for subsequent phases to ramp up production to 350 000 tons of ammonia per year. Valued at 15.1 million euros for Phase 1, this initiative is a partnership between Enersense Energy Namibia, Windwise, the University of Stuttgart, the NGHRI at UNAM, and various other providers. The project focuses on utilising renewable energy to produce green ammonia, contributing to Namibia's green hydrogen economy and promoting sustainable industrial practices.

5.3.4. H2-Pilot Plant / Refuelling Station in Walvis Bay

The H2-Pilot Plant / Refuelling Station in Walvis Bay involves the establishment of a 5MW electrolyser and a hydrogen refuelling station in Walvis Bay. With a project value of 25 million euros, this initiative is a collaboration between CMB.TECH and the Ohlthaver & List Group, operating under the joint venture Cleanergy Solutions Namibia. The project aims to produce green hydrogen and provide refuelling infrastructure to support the adoption of hydrogen as a clean fuel alternative in various sectors. By advancing hydrogen technology and infrastructure, this pilot plant contributes to Namibia's renewable energy objectives, promoting sustainable energy solutions and reducing carbon emissions in the region.

5.3.5. The Hyphen Hydrogen Energy Project

The Hyphen Hydrogen Energy Project, located in the Tsau Khaeb National Park, represents a landmark initiative in Namibia's green hydrogen strategy. Aiming to produce approximately 300 000 tons of green hydrogen annually at full scale, it is poised to become a significant contributor to both regional and global hydrogen markets. Valued at US$9.4 billion, the project is fully financed by Hyphen Hydrogen Energy and benefits from strategic partnerships with the National Renewable Energy Laboratory (NREL) of the US Department of Energy, the EU Global Technical Assistance Facility on Sustainable Energy, the Green Hydrogen Council, and the Namibian government. This project will not only act as a catalyst for the rapid scale-up of green hydrogen production within Namibia's Southern Corridor Development Initiative (SCDI) but also establish the necessary legal and regulatory framework for future projects, marking a critical step toward economic growth and global decarbonisation.

Namibia is one of the five top locations globally for co-located wind and solar resources, near to sea and land export routes. The development of green hydrogen has therefore been identified as an essential industry to drive economic growth and assist Namibia and the world in achieving global decarbonisation goals. Unlike grey hydrogen, green hydrogen will play an increasingly pivotal role in decarbonisation through producing low-carbon compounds and fuels, including green ammonia for decarbonising nitrogen fertilisers, sustainable aviation fuel, and e-methanol for maritime transport.

5.3.6. Financing Hydrogen Infrastructure

The EU has promised to mobilise €1 billion of public and private investment for Namibia's renewable hydrogen and raw materials infrastructure. Through the Federal Ministry of Education and Research, Germany has committed

to contribute €40 million in grant funding to deepen green hydrogen cooperation with Namibia in selected priority areas, including developing a Green Hydrogen National Strategy and scholarships. In 2021, through Germany's Federal Ministry for Economic Affairs and Climate Action and Namibia's National Planning Commission, the two countries signed a Joint Communiqué of Intent (JCoI) to work together in the production, processing, storage, and transportation of green hydrogen.[22] In the communique, the German minister stated:

> *"The global race for the best hydrogen technologies and the best sites for hydrogen production is already on. We believe that Namibia has an excellent chance of succeeding in this competition. We want to take this chance together. I am proud that Germany is the first country to officially form a hydrogen partnership with Namibia. The Federal Research Ministry will provide up to 40 million euros in funding from the economic stimulus package for cooperation within the framework of this partnership."* [23]

From the German government's perspective, the deal was directly linked to the country's future energy needs. The rationale was therefore apparent in that Germany projected its interests as follows:

> *"The National Hydrogen Council estimates that hydrogen demand of German industry alone (excluding refineries) will amount to 1.7 billion tons per year – and this demand is likely to grow further. This estimate underlines that we need large amounts of hydrogen and we need it quickly and at low cost. Namibia can provide both."* [24]

The excerpt from the communique makes it apparent that partnerships emerging in the renewable energy sector are linked to developed countries' needs, especially energy security.

> *"Namibia has enormous potential for scaling up a green hydrogen industry. It has a lot of vast unused space. High wind speeds in Namibia mean that the generation of wind power is particularly profitable. Solar power harbours an even greater potential thanks to over 3,500 hours of sunshine per year. This is almost twice as much as Germany has to offer. We therefore think that one kilogramme of hydrogen from Namibia will eventually cost between €1.50 and €2.00. This would be the most competitive price in the world which would be a huge locational advantage for hydrogen 'made in Namibia'.*[25]

This partnership includes the marketing and support of green hydrogen projects by the private sector.

The Belgian government will assist Namibia in developing a hydrogen refuelling station and medium-sized solar power plant, while the Netherlands has agreed to collaborate on various areas, especially positioning Namibia's ports as green hydrogen export hubs and facilitating the forecast growth and flow of the green hydrogen supply chain from Namibia to Rotterdam in the Netherlands.[26] The agreement allows Namibia to form part of the energy supply mix to serve northwestern Europe.

5.4. WEAK LINKAGES BETWEEN CRITICAL MINERALS BENEFICIATION AND THE CLEAN ENERGY TRANSITION

There are direct opportunities arising from the growing global demand for clean energy technologies needed to reduce GHG emissions so that countries can meet their national climate change commitments as required by the Paris Agreement. Growing demand for clean technologies is driving a rapid growth in demand for specific minerals needed to manufacture renewable energy technologies. Minerals-rich countries such as Namibia that have long been selling most of their minerals in raw form now have an opportunity to induce the investments needed to develop upstream and downstream segments of their minerals value chain to capture the highest values for these minerals before selling them on the international markets.

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[22] "Federal Ministry of Education and Research, "Germany and Namibia form partnership for green hydrogen" (BMBF, 8 August 2021) <https://www.bmbf.de/bmbf/shareddocs/pressemitteilungen/de/2021/08/172_namibia_eng.pdf?__blob=publicationFile&v=1> accessed 5 June 2024
[23] Ibid
[24] Ibid
[25] Ibid
[26] The Brief, "Namibia "Belgium ink green hydrogen pact"
(The Brief, November 4, 2021) <https://thebrief.com.na/2021/11/namibia-belgium-inks-green-hydrogen-deal/> accessed 16 April 2024.

6. KEY STAKEHOLDERS IN THE CRITICAL MINERALS SECTOR

The minerals sector consists of several stakeholders, including public entities, private sector, and non-governmental organisations. The Namibian mining sector is governed by the Ministry of Mines and Energy (MME), which attracts private investment, regulates industries, and ensures safety and environmental standards. Other government stakeholders include the Ministry of Environment, Forestry and Tourism (MEFT), overseeing environmental compliance; the Ministry of Finance (MoF), managing revenues and budgeting; and the Ministry of Industrialisation and Trade (MIT), promoting economic growth and trade. The Chamber of Mines (CoM) advocates for the sector, while private companies and associations also play significant roles. The Geological Survey of Namibia (GSN) manages geoscientific data, and the National Energy Fund supports energy-related projects.

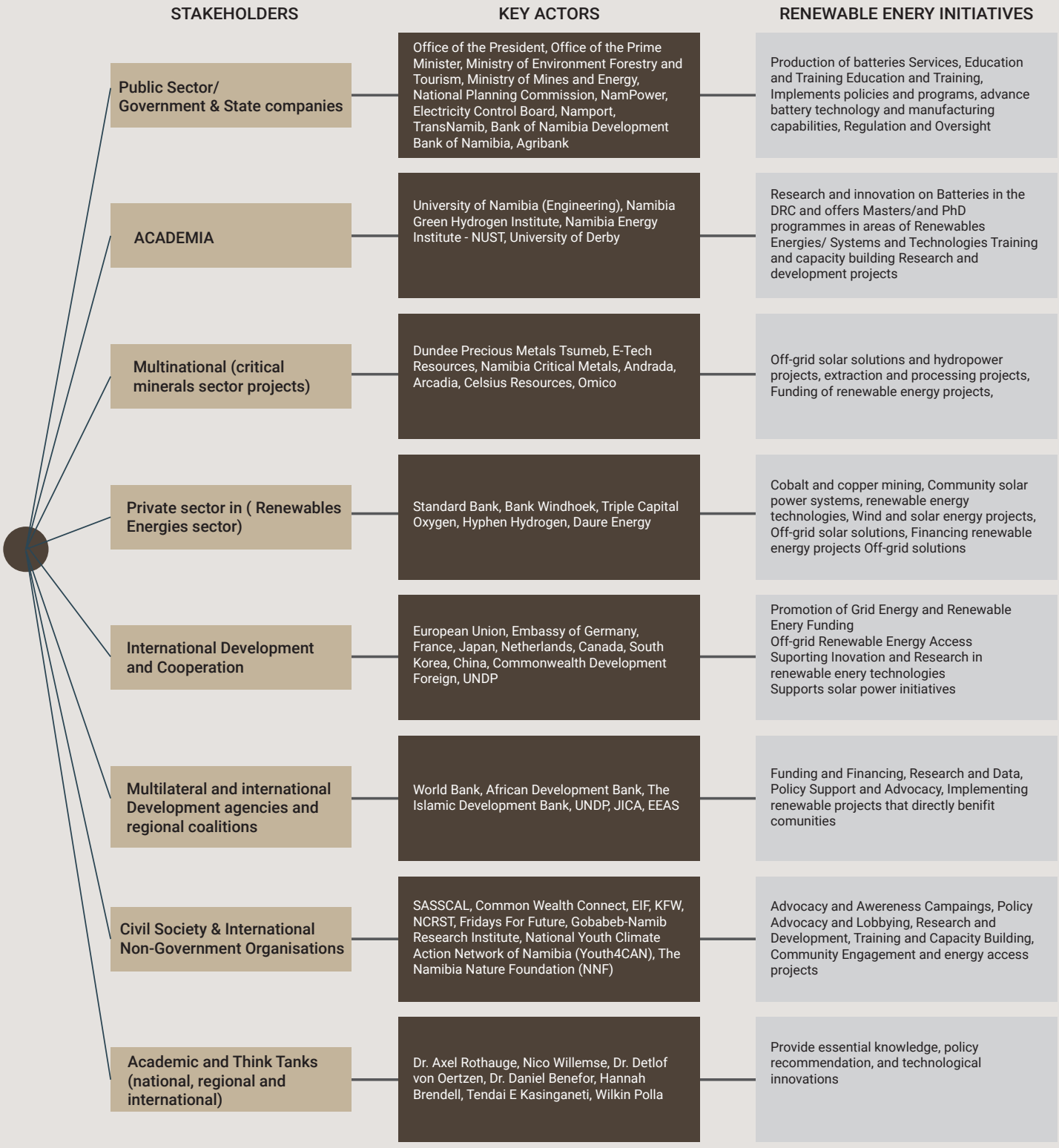
In Namibia's mining sector, civil society organisations (CSOs) advocate for responsible mining practices, environmental protection, and community rights by engaging in policy dialogue, monitoring industry practices, and ensuring that mining activities benefit local communities without harming the environment. Meanwhile, the Namibia University of Science and Technology (NUST) operates as a hub for research and innovation, collaborating with industry and government to enhance mining technologies and practices for sustainability and efficiency. Philanthropic organisations support community development, environmental conservation, and education initiatives related to mining, funding projects aimed at mitigating social and environmental impacts while promoting sustainable development in mining communities. The following table presents a list of key companies within the mining sector, their nationalities, projects involved, commodities, and funding.

Table 1: Key Companies: Nationalities, Projects, Commodities and Funding

Name of Company	Country	Project	Commodity	Funding
Andrada Mining	British	Uis Tin Mine	Lithium	Listed on AIM
Broadmind Mining	Namibian	Eisenberg Carbonatite REE Project.	REE	Private
Celsius Resources Limited	Australian	Opuwo Cobalt	Cobalt, Copper, Zinc	ASX and LME listed
Deep-South Resources	Canadian	Haib Copper Project	Copper	TSX listed
Gratomic Inc	Canadian	Aukam	Graphite	Listed on TSX and Frankfurt
IBML	Australian	Omitiomire Copper	Copper	Equity and ASX listed
Lepidico Chemicals	Australian	Karibib Lithium	Lithium	Listed on ASX
Namibia Critical Metals		The Lofdal REE Project	REE	Equity
Northern Graphite Corporation	Canadian	Okanjande	Graphite	Listed on TSX
Otjozondu Mining		Otjosondu	Manganese	Equity
Xinfeng Investments	Chinese	Kohore and Karlowa	Lithium	Private

Chinese companies have a significant stake in Namibia's critical minerals projects. Huayou Cobalt has a stake in Australia's Askari Metals, which is exploring Uis in the Erongo region from which it has obtained solid lithium assay values from rock chip samples (including lithium oxide). Chinese Xinfeng Investments is mining lithium from the Kohore Mine while developing the Karlowa lithium project.

In addition to mining corporations, there are other stakeholders that are influential in the critical minerals and renewable anergy transition sphere in Namibia. The following stakeholder groups, key actors and initiatives play a significant role in realising a just energy transition in Namibia.



Stakeholders who have wielded much influence on Namibia's critical minerals, hydrogen and other renewable energy value chains are international investors (for capital provision) and powerful governments such as Germany (and the EU bloc), China, and the US. Multilateral development institutions have also been influential as on international development and cooperation. Notable entities include the World Bank, UNDP, and embassies. Namibian institutions have promoted academic and scientific research and development on hydrogen, critical minerals beneficiation and policy, and provided leadership regarding the energy transition and climate change.

7. THE GLOBAL ENERGY TRANSITION AND DEMAND FOR TRANSITION MINERALS

Developing clean energy technologies requires huge amounts of renewable energy minerals. The type and volume of minerals depend on the type of technology and, in some cases, the components of the technology. For example, zinc and copper are key in the manufacture of solar Pvs; rare earth elements are critical for the manufacture of wind turbines; chromium, aluminium, zinc, nickel, and copper are central in the manufacture of concentrated solar power (CSP); bioenergy systems require aluminium, copper, and zinc; electricity networks development is underpinned by copper and aluminium; lithium, graphite, manganese, nickel, and rare earth elements are essential for electric vehicles and battery storage systems; and nickel and platinum group metals (PGMs) are key in the manufacture of hydrogen systems (IEA, 2022). The global demand for lithium carbonate equivalent is expected to surpass 2.4 million metric tonnes, doubling the demand forecast for 2025, driven by increased battery demand for electric vehicles. Lithium consumption in electric car batteries is expected to reach 3.8 million tonnes by 2035 (Statista, 2023). The IEA (2022) estimates the demand for lithium to grow by 75 per cent due to the rapid uptake of EV deployment in the IEA Stated Policies Scenario (STEPS), and over 90 per cent in the Sustainable Development Scenario (SDS) by 2040.

Overall, the supply of critical minerals will need to increase by four times to meet climate goals and increase six-fold to hit global net zero targets by 2050, driven by the uptake of clean energy technologies as nations endeavour to meet their climate action commitments as per the Paris Agreement.

Global natural graphite market size is projected to grow from US$14.83 billion in 2021 to US$25.70 billion in 2028 at a compounded annual growth rate (CAGR) of 8.2 per cent in the forecast period, 2021 to 2028 (Fortune Business Insight, 2023). The global manganese mining market was valued at US$26 850 million and is expected to increase to US$43 619 million by 2029, at a CAGR of 7.2 per cent (Research, Analysis and Insights (ReAnIn), 2023). The market value of cobalt is anticipated to more than double between 2023 and 2030, from an estimated US$10.8 billion in 2023 to US$24.9 billion in 2030 (Statista, 2023). Rare earth element oxides demand is estimated to increase from 171 300 metric tonnes in 2022 to 238 700 metric tonnes by 2030, driven by using rare earth magnets as part of the ongoing digital and clean energy transition demand growth. In 2021, magnets accounted for 43.2 per cent of global rare earth elements demand. The demand for neodymium (NdFeB) magnets is estimated to grow at a CAGR of 7.5 per cent between 2023 and 2040 (Global X, 2023).

Overall, the supply of critical minerals will need to increase by four times to meet climate goals and increase six-fold to hit global net zero targets by 2050, driven by the uptake of clean energy technologies as nations endeavour to meet their climate action commitments as per the Paris Agreement (IEA, 2023).

8. MINERAL BENEFICIATION IN NAMIBIA

8.1. GEOPOLITICS: MORE OF A SCRAMBLE FOR RAW CRITICAL MINERALS THAN FINISHED GREEN TECHNOLOGIES

There is no doubt that the renewable energy space is contested. This paper has extensively covered the interest of the EU in Nambia's hydrogen economy. Such interests are evident in the critical raw materials space. As noted under the aims of AfricaMaVal, securing the access to raw materials represents a critical issue for the European ambition to deliver its Green Deal. This EU and Africa business networking on the whole critical raw materials value chains is a 42-month project gathering 18 partners from 11 countries.[27] The influence of China in Namibia reflects the general trend of Chinese investment in the minerals economy of Southern Africa.

At the same time, African countries are aware of the need for their critical raw materials. They are looking for ways to add more value to what they produce – meaning not just mining but processing materials before export. "We are going to insist that all lithium mined within the country has to be processed in the country" Tom Alweendo, Namibia's mines minister, told Reuters on 23 February 2023. The geopolitical competition between China and the major economies of the global north can also be regarded as an opportunity for Namibia to work in cohort with other SADC countries to promote the integration of the mineral supply chains and their governance performance in the mineral sector (Muller, 2023). This is so because the global supply chains are decided by political actors. Thus, stronger coordination of SADC states to determine who gets what could improve the region's bargaining position and create the conditions to capitalise on opportunities that might otherwise prove evasive (Muller, 2023). Namibia and her peers in the SADC region have an opportunity to negotiate better terms and to induce investments downstream of these minerals value chains that have eluded the sector in the past (Muller, 2023).

8.2. LOCAL CONTENT AND CRITICAL MINERALS VALUE CHAINS

According to the UN Conference on Trade and Development (UNCTAD), (2013), to take advantage of the opportunities at each stage of the mineral value chain, upstream, midstream, and downstream linkages need to be strengthened. The host country's policy, legal, and regulatory framework should be designed to deliberately promote its citizens' participation in numerous opportunities available in the country's mineral value chains. Jourdan (2016) provided a list of opportunities available at the mineral value chain's exploration, mining, processing, and refining stages around which the host country can develop its local content policy.[28]

Currently, value addition in the country varies with some mineral commodities sold on the international markets in their raw form or as first-stage flotation concentrates. At the same time, a few are exported as refined metal. To enable local industrialisation and economic growth, further beneficiation of the semi-processed mineral products is necessary. Local processing capacity varies from first-stage concentration, as in the case of zinc concentrates from Rosh Pinah, to refining capacity, as in the case of zinc (99.99 per cent pure) ingots from Skorpion Zinc, and 99.99 per cent copper cathode capacity at the mothballed Tschudi Mine.

8.3. NAMIBIA'S MINERAL BENEFICIATION POLICY

The Minerals Beneficiation Strategy of Namibia propounds the creation of a well-governed mining sector for the expansion of mineral beneficiation and manufacturing sectors that is inclusive and appreciated by all stakeholders (including the surrounding communities) through alignment of mineral beneficiation promotion and taxation policies and legislation to promote investment, minimising bureaucracy relating to permit processes across the value chain, implementing effective engagement with stakeholders to gain a social license to operate, and increasing the participation of women, youth and people with disabilities in the industrialisation process (Dzinomwa et al., 2021). A policy gap is that despite the opportunity presented by the global energy transition, Namibia does not have a list of

[27] Also see the European Union's Critical Raw Minerals Act (CRMA), which is an important step in reducing the bloc's dependency on external sources for critical raw materials through increased production, recycling, and refining of critical materials.

[28] IThe Natural Resource Governance Institute has highlighted the differing interpretations regarding what constitutes local content in a workforce or supply chain. It points out that, regarding local procurement, in some usages the term is equated with local ownership, whereas at the other extreme it is sometimes used simply to describe any business that maintains a permanent operational office within a given area. Local content is also defined as the wealth that local companies create in transforming materials and services purchased from other countries into revenue-generating output. The International Petroleum Industry Environmental Conservation Association (IPIECA) also refers to local content as the added value brought to a host nation (or region or locality) through workforce development (employment and training of local workforce), and investments in supplier development (developing and procuring supplies and services locally). Value added is the wealth that local companies create by transforming materials and services purchased from other countries into revenue-generating output.

minerals that it has classified either as critical or strategic. As a result, the country does not have specific policies, rules, and incentives for critical minerals investors.

The fact that many developing countries' minerals do not fetch much on the global value chain has been attributed to critical minerals being sold on the international markets in their raw form. This is because mineral-rich developing countries lack the capacity to fully process the minerals to capture value on the global market (Ndubuisi & Owusu, 2021; Abreha et al., 2021, in Andreoni and Avenyo, 2023:6). Key stakeholders in the mining sector of Namibia have, on numerous occasions, failed to show the capacity to achieve the creation of a value adding sector as envisioned by the country's minerals beneficiation strategy.

Studies by Dzinomwa et al (2021) show that mineral beneficiation in Namibia varies with minerals and projects and that local beneficiation capacity varies from first-stage concentration to refined metals.

8.3.1. Lithium Export Restrictions

On 7 June 2023, the cabinet approved a prohibition on the export of critical minerals, including unprocessed, crushed lithium ore, cobalt, manganese, graphite, and rare earth elements. The cabinet decision grants the Minister of Mines and Energy discretionary authority to permit limited quantities of the minerals for export, subject to endorsement by the cabinet. This provision allows flexibility in cases where restricted export of these minerals may still be necessary or beneficial (Ministry of Information and Communication Technology, 2023). By implementing this prohibition, the Namibian government intends to stimulate local industrial development and enhance the economic benefits derived from the mining sector. Mining companies will be required to process these minerals locally before export, fostering the growth of downstream industries and creating more employment opportunities.

However, lithium companies such as Lepidico plan to produce only lithium concentrate at its Karibib operations. For processing battery-grade lithium, the company plans to do so at the hydrometallurgical plant that it intends to build in Abu Dhabi.[29] The argument is that the investment climate in Abu Dhabi is more attractive as it offers immediate logistical efficiencies, an established industrial park with available shared infrastructure, and "straightforward" permitting.

8.3.2. Refining of Copper for Export Markets

In Namibia, the refining of critical minerals is primarily focused on copper. The country has facilities for producing copper cathodes and blister copper by smelting sulphide ores. All the advanced lithium mineral projects in the country intend to mine, crush, mill, and produce first-stage flotation concentrates, which they will export to overseas facilities for further processing into final products. Currently, Namibia's potential for manufacturing EV batteries is sketchy, but it is possible that the country could process its lithium to battery-grade lithium carbonate and lithium hydroxide products.

8.3.3. Processing of other Critical Mineral Ores

Rosh Pinah processes their ore to produce zinc concentrates while Skorpion Zinc refines the ore to produce (99.99 per cent pure zinc) ingots. Tschudi Mine processes and refines copper ore to produce pure copper cathode (Grade A cathode). Gold is partially refined in the country and exported for refining at the Rand Refinery in South Africa. Uranium is exported as "yellow cake" to overseas markets, where it is further processed and fabricated to produce energy. Some mineral commodities are extracted and sold to international markets as raw ores, some as mineral concentrates and refined metals. To enable local industrialisation and economic development, these minerals must be processed and refined locally before being taken to international markets.

8.3.4. Processing of Battery Grade Minerals

Recent value chain studies (sponsored under the AfricMaVal) of the critical raw materials in the Namibian mining sector have established that of the four key battery minerals projects being developed in the country, the companies intend to process their ores only up to first-stage flotation concentrates which are then sold to the international market. First-stage flotation concentration is part of the upstream segment of the mineral value chain, where only 1 per cent value is added to the minerals. Yet, this segment accounts for over 60 per cent of the entire value chain cost.

[29] Nelson Banya and Nyasha Nyaungwa, "Namibia's battery metal ambitions rest on infrastructure, miners say" (Reuters, October 25, 2023) <https://www.reuters.com/markets/commodities/namibias-battery-metal-ambitions-rest-infrastructure-miners-say-2023-10-25/> accessed 1 May 2024.

9. FINANCING THE GREEN TRANSITION

9.1. MOBILISING DOMESTIC RESOURCES

Namibia can utilise public finance instruments, including royalties, taxes, and subsidies, to fund its energy transition initiatives. The government can also offer tax credits or deductions for businesses and individuals who invest in critical minerals and renewable energy value chains. A direct link must be established between critical minerals mining and industrialisation to reap fiscal benefits. In this regard, Namibia must promote value addition activities in the context of the high demand for these resources. Increasing downstream processing capacity will increase earnings for fiscal gains. Namibia has used tools such as export restrictions of lithium to increase local processing. Revenues earmarked for domestic resource mobilisation should be considered for channelling to a special purpose facility such as a competently structured and managed Sovereign Wealth Fund.

9.2. HARNESSING PUBLIC-PRIVATE PARTNERSHIPS (PPPS)

Public-private partnerships (PPPs) allow Namibia to collaborate with the private sector in financing green projects. By sharing risks and resources, PPPs can facilitate the implementation of large-scale renewable energy and sustainability initiatives, leveraging private sector expertise and investment to accelerate the country's green transition. Domestic financial services firms must provide capital market solutions in essential minerals and energy financing. Market instruments may include green loans or bonds linked to ESG investing and related sustainability practices.

The partnerships must also include philanthropies involved with various dimensions of the energy transition and critical minerals value chains, including skills, research, innovation, and scholarship funding.

9.3. ACCESSING INTERNATIONAL CLIMATE FINANCE MECHANISMS

Accessing international climate finance mechanisms such as the Green Climate Fund (GCF) and the Global Environment Facility (GEF) provides Namibia with additional financial support for climate-related initiatives. These mechanisms offer grants, loans, and technical aid tailored to address Namibia's specific climate challenges and transition needs, supplementing domestic resources. The country must develop a Just Energy Transition Investment (JETI) plan to establish its energy transition pathway, including investment in the processing of its minerals. Following the example of countries such as South Africa, Senegal, and Indonesia, Namibia must forge an investment and finance partnership that can be developed with rich countries under the JET Partnerships (JETPs) model. This will increase the attraction and targeting of international capital within the scope of the Paris Climate Agreement.

Following the example of countries such as South Africa, Senegal, and Indonesia, Namibia must forge an investment and finance partnership that can be developed with rich countries under the JET Partnerships (JETPs) model.

10. JUST ENERGY TRANSITION AND THE PARADOX OF ABUNDANT GREEN MINERALS

Namibia's growing poverty rate is partly attributable to a public policy failure to link natural resource exploitation to the broader economy, which would enable poor countries to use their mineral resources as a vehicle for higher and sustained economic growth and industrialisation (African Centre for Economic Transformation (ACET), 2017). This fits well into the perennial story of the African resource curse. Mineral resources have not been used as a vehicle for higher and sustained economic growth and industrialisation. The discovery of mineral resources alone does not always lead to economic growth and development. Despite massive and increasing foreign direct investments (FDI) into the critical mineral sectors, the expected social and environmental benefits fail to materialise. The promise of a just energy transition will not be realised if transformational linkages are not pursued strategically.

10.1. UNEMPLOYMENT AND GREEN JOBS

Green jobs are created at every stage of the value chain. This approach is limited because it only focuses on developing upstream and downstream integration targeting specific segments with the potential for higher value creation. It disregards the structural interdependencies and the effect of upgrading for other sectors (Andreoni and Avenyo, 2023). There is limited emphasis on broader indirect job creation from related sectors. Namibia's 2023 unemployment rate is forecast at 20.95 per cent, representing 0.42 million people of a population of 2.5 million. The population living on less than US2.15 dollars per day is estimated at 19 per cent for 2023.

10.2. THE CALL FOR MINERAL-ENERGY TRANSITION LINKAGE FOR STRUCTURAL TRANSFORMATION

Andreoni and Avenyo (2023) proposed a structural transformation approach where the development of these renewable energy minerals and increasing the quota of processing is also connected to unlocking opportunities by enabling the development of several sectoral value chains. They argue that the focus should be directed at integrating opportunities in the global value chain diversification for inclusive and sustainable development of other sectors' value chains while making sure that greening and energy efficiency are accepted as normal across the productive sectors; exploiting investments in certain sectors for unlocking opportunities in others; creating and reaching sufficient demand for energy and technologies so to exploit economies of scale and cost-competitive business opportunities; and exploiting opportunities for cross-sectoral value chains development, both locally and regionally.

10.3. RISK OF CORRUPTION AND THE PREVALENCE OF TRANSFER PRICING

As for the mining companies, research by SARW in 2021 revealed a disturbing practice by some mining companies. The research revealed a high risk of transfer pricing manipulation by mining companies in the country, carried out in many ways. For example, the SARW research found that mining companies inflate their investment expenditure to offset profits and avoid paying corporate taxes, a phenomenon referred to as pre-commercial production cost loading. This tax avoidance practice is rampant throughout the entire extractive sector. At the time of the research, over 90 per cent of the corporate tax of the entire sector for the period 2017 to 2019 was paid by one company, yet this company's revenue was only 37 per cent of the total sector revenue.

10.4. CLIMATE CHANGE ACTION: A COMMITMENT TO RENEWABLE ENERGY INVESTMENTS

Namibia demonstrates its commitment to combating climate change through investments in renewable energy. By prioritising renewable energy sources such as solar and wind power, Namibia aims to reduce its carbon footprint and contribute to global efforts to mitigate climate change. Namibia's commitment to renewable energy investments is evident in projects like the 37-megawatt solar photovoltaic (PV) plant in Mariental. Completed in 2018, this plant is one of the largest solar installations in sub-Saharan Africa, providing clean energy to Namibian households and reducing carbon emissions. The country has also invested in wind energy with projects like the 44-megawatt wind

farm in Lüderitz. This wind farm, operational since 2017, harnesses Namibia's abundant wind resources to generate clean electricity, reducing reliance on fossil fuels and mitigating greenhouse gas emissions. Its use of solar and wind in the production of green hydrogen demonstrate Namibia's commitment to a just energy transition.

The Renewable Energy Feed-In Tariff (REFIT) programme, launched in 2017, offers favourable tariffs to independent power producers (IPPs) generating electricity from renewable sources.[30] This initiative incentivises private investment in renewable energy projects, fostering growth in the sector and contributing to Namibia's transition to a low-carbon economy.

10.5. UNIVERSAL ENERGY ACCESS: CLEAN AND AFFORDABLE ENERGY

Around 1 million Namibians still lack access to electricity, representing a significant portion of the population. Almost half of the country is without access at all (~53 per cent has access and ~47 per cent has no access).[31] Addressing this disparity is crucial for achieving universal energy access and ensuring that all Namibians have access to clean and affordable energy. By expanding electricity infrastructure and promoting renewable energy solutions, Namibia can improve livelihoods, foster economic development, and enhance social inclusion.

10.6. LOW EMISSIONS, YET HIGH LOSS AND DAMAGE

The countries that are particularly hard hit by the effects of global warming are those that have virtually no carbon emissions, including Namibia. An estimated 30 gigatonnes of carbon dioxide (CO2) is dumped into the earth's atmosphere every year: this is the main source of greenhouse gases (GHG) that contribute to climate change, and most of these gases come from the use of fossil fuels, non-renewable energy production, and polluting human activities. Namibia accounts for a mere 0.03 per cent of the total global carbon emissions despite being part of a region suffering the most devastating effects of climate change.

According to the International Panel on Climate Change Conference (IPCCC, 2018), the most severe impacts of climate change can still be avoided if efforts are made to transform the current energy systems. Renewable energy sources, whose development is underpinned by renewable energy minerals, such as lithium, cobalt, graphite, copper, nickel, and others, they argue, have huge potential to remove GHG emissions by replacing fossil fuel-powered engines and thereby mitigating climate change. In addition, if they are correctly applied, renewable energy sources can contribute to social and economic development, wider energy access, a secure and sustainable energy supply, and reduced negative effects of energy provision on the environment and on human health. Furthermore, the increasing global demand for renewable energy minerals not only plays a key role in enabling clean energy transition but also, if these minerals are exploited responsibly, can be used as tools for reducing poverty amongst some of the world's poorest communities (IEA, 2022).

10.7. IMPACT ON THE NATURAL ENVIRONMENT AND BIODIVERSITY

The increased demand for critical renewable energy minerals will result in increased impacts of extraction and processing on the environment, water sources, biodiversity (including protected areas and endangered species), and frontline communities. Namibia is already grappling with approximately 260 mines abandoned by their owners without any remediation measures (Hahn et al., 2004). Studies (Mapani et al., 2014) found the presence of high concentrations of arsenic, lead, and cadmium in most of the fruits and vegetables (marula fruits, pumpkins, chili, and tomato), which correlate with the heavy metal values of the underlying contaminated topsoils derived from the old Tsumeb mine and dump. The concentrations exceed the World Health Organisation levels. Salom and Kivinen (2019) found that ecosystems and communities throughout the country were exposed to significant hazards from more than 250 abandoned mines.

[30] IEA, "Namibia Feed-in Tariff," (IEA/IRENA Policy and Measures Database, 9 August 2015) <https://www.iea.org/policies/5746-namibia-feed-in-tariff#> accessed 5 March 2024

[31] Energypedia, "Namibia Energy Situation" (Energypedia, n.d.) <https://energypedia.info/wiki/Namibia_Energy_Situation> accessed 27 April 2024.

In 2017, in the absence of organised civil society in the sector, Genady Kondarev (a Bulgarian campaigner) exposed Dundee Precious Metals Tsumeb custom smelter environmental contamination and its impact on communities. The Tsumeb smelter is fed with concentrate from the Chelopech mine in Bulgaria and the El Brocal Colquijirca mine near Cerro de Pasco in Peru. The former is operated by Dundee and financed by the European Bank for Reconstruction and Development (EBRD). The EBRD is supporting Dundee with a revolving debt of up to €250 million (Benchmark, 2017). In 2016, the Canadian Dundee Precious Metals announced plans to expand production at the Tsumeb smelter by 50 per cent to 370 000 tonnes of processed dirty copper concentrate yearly. The planned increase in production would boost SO2 emissions by 53 per cent, PM 10 emissions by 19 per cent, arsenic emissions by 54 per cent, and H2SO4 emissions by 42 per cent, significantly increasing levels of the already polluted air (Benchmark, 2017). During this process, toxic fumes of the highly carcinogenic arsenic trioxide affected the workers in very high concentrations before spreading further to Tsumeb and the surrounding villages.

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11. PRACTICAL RECOMMENDATIONS

11.1. PROMOTE TRANSPARENCY AND ACCOUNTABILITY IN NAMIBIA'S MINING SECTOR

The Namibian government must institute transparent licensing procedures within the Ministry of Mines and Energy, ensuring that decisions regarding mineral rights allocation are made impartially and documented for public scrutiny. Concurrently, enhancing regulatory oversight mechanisms is imperative, including the establishment of an independent body for monitoring and investigating misconduct. The government should address issues raised by stakeholders, such as pricing manipulation by mining companies. This demands collaborative efforts between the government and its stakeholders to enforce regulations and ensure fair taxation. Promoting stakeholder engagement through inclusive dialogue platforms can foster trust and address community concerns, paving the way for a more responsible and equitable mining industry in Namibia.

11.2. INTERNATIONAL COOPERATION

Namibia should engage in international cooperation for research and innovation in renewable energy manufacturing, particularly in the context of critical minerals. Partnering with countries like Germany, which has expertise in green hydrogen technologies, can facilitate the knowledge transfer and skill development essential for building a hydrogen-centred economy. This collaboration can include joint research projects, technology transfer agreements, and capacity-building initiatives to leverage international expertise and resources.

11.3. REGIONAL VALUE ADDITION HUBS

Namibia lacks sufficient raw materials for local beneficiation and manufacturing activities. While there is a lot of exploration, the country should consider tapping into regional and international sources for its beneficiation plants or collaborating with its SADC peers and establishing regional value-addition hubs such as the one agreed between Zambia and the DRC.

Namibia also lacks the specialist skills required for cost-effective mineral beneficiation, manufacturing, related innovation, and applied research and development. Namibia must therefore facilitate skills importation and transfer and promote applied research and development in mineral beneficiation.

11.4. INCENTIVES TO ATTRACT INVESTMENT INTO MINERALS BENEFICIATION AND MANUFACTURING

While Namibia's mineral code is considered one of the best by investors for mineral exploration purposes, the country's investment ratings are poor. The country needs to review and streamline existing fiscal and non-fiscal incentives to enhance and attract investments for its minerals beneficiation and manufacturing industries.

Such incentives should include facilitating the procurement, installation, and utilisation of modern technology and related infrastructure for efficient and cost-effective beneficiation of minerals and manufacturing products for local, regional, and international markets, facilitating the sourcing and installation of mineral beneficiation technology, providing supporting infrastructure for mineral beneficiation industries and related value addition activities to connect minerals and other sectors with infrastructure development, and ensuring greater environmental sustainability.

Finally, Namibia lacks the market needed to support the beneficiation and manufactured products. The government needs to stimulate the demand for Namibian products in targeted local and foreign market segments through quality and sustainability management (certification) combined with product differentiation and promotion (branding) efforts, enhancing visibility and recognition of Namibian beneficiated products internationally, increasing domestic consumption of locally beneficiated products, strengthening the competitiveness of local products, and increasing regional and international consumption of products manufactured in Namibia (Dzinomwa et al., 2021).

The country needs to review and streamline existing fiscal and non-fiscal incentives to enhance and attract investments for its minerals beneficiation and manufacturing industries.

11.5. REGIONAL INTEGRATION

Namibia's trade relations depend on regional integration initiatives such as the Southern African Customs Union (SACU), the Southern African Development Community (SADC) Trade Protocol, and the African Continental Free Trade Area (AfCFTA). By actively participating in these regional and continental frameworks, Namibia can enhance trade relations, promote cross-border investment, and facilitate the movement of goods and services, contributing to the growth of its green energy and critical minerals sectors within the broader regional context.

12. CONCLUSION

In conclusion, a just energy transition in Namibia, fuelled by the development of its abundant mineral resources, can significantly address energy poverty, improve livelihoods, and enhance social and economic opportunities for all rural communities, while expanding access to electricity. Namibia's rich endowment of key battery minerals such as graphite, lithium, cobalt, and manganese, along with other renewable energy resources like solar, wind and hydrogen present a significant opportunity for a just energy transition. However, the country currently lacks a list of minerals classified as critical or strategic, and there are no specific policies or rules designed to inform their development, except for a ban on exporting them in raw form. By aligning the development of its renewable energy minerals with the country's NDCs, Namibia can leverage these resources to attract investments in both the upstream and downstream segments, capturing higher value before international sales. This integration can facilitate sustainable economic growth and industrialisation. Yet, the transformation faces significant challenges that Namibia must address to succeed.

Enhanced cooperation within the framework of climate finance involving international partners and multilateral agencies is essential to bring climate finance pledges into practice and support Namibia's climate action efforts under the Paris Agreement. Foreign direct investment (FDI) could play a pivotal role in driving private capital towards renewable energy projects, contributing to the global transition to a low-carbon economy. Transition mineral beneficiation thus becomes a vital lever for domestic resource mobilisation, feeding into Namibia's finance for climate-resilient development.

By fostering inclusive strategies and integrating renewable energy solutions, Namibia can advance towards a more sustainable and equitable energy future, supporting the well-being of its citizens and promoting industrialisation.

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