Executive summary

The Namibian economy currently consumes about 640 MW of power per annum. A large part of this energy requirement is imported from neighbouring countries and from the Southern African Power Pool (SAPP). NamPower, the power utility, imports between 50% and 60% of the country's energy requirement. All the country's renewable sources are intermittent. This includes the hydropower resources in the country's perennial, yet highly variable rivers, most notably the Kunene River, as well as solar and wind resources.

Namibia has an abundance of renewable energy resources, namely solar, wind and bioenergy,and a well-established electricity supply industry (ESI). The country boasts the world's second highest solar and wind regimes. Namibia possesses a technical wind potential of over 100GW, making it one of the windiest places in the world with a capacity factor of around 50%. In addition, Namibia has a large capacity of rangeland and biodiversity which make it suitable for the accumulated biomass opportunities from bush thinning, creating an economically viable resource for value addition opportunities. In addition, the development of a green hydrogen industry, which will rely heavily on renewable energy, is under way. Currently, renewable energy (other than large hydro), only accounts for a small amount of the installed capacity in the country, leaving a lot of scope for its development to its full economic potential.

The import of approximately half of Namibia's needed electricity has exposed the country to high prices in the past and represents a real risk in the future, given that the entire region is grappling with energy shortages. There is also economic evidence suggesting that building new plants in Namibia can stimulate the economy and increase employment. For this reason the country has adopted a Modified Single Buyer (MSB) market model to allow more Independent Power Producers (IPPs) to invest in energy generation and hence to foster growth in economic activities.

The MSB was designed to overcome some of the shortcomings of the existing Single Buyer (SB) structure and to give consumers and investors a choice and an opportunity to invest in and benefit from reducing generation costs and new technologies. In addition to providing customers with a choice, the MSB also recommends further unbundling of tariffs and the introduction of new products and services in response to the changing technology environment. This presents an opportunity for IPPs to invest in and capitalise on the country's abundant renewable resources. There are also opportunities to invest in projects along the green hydrogen value chain, as well as in the manufacturing of products and technologies that support the growing renewable energy sector.

Overview of the Sector

Namibia aspires to become an industrialised nation by 2030 and has announced her bold ambitions of becoming the sustainable energy capital of Africa.. These ambitious goals require sufficient energy supply to power both industries and households. At the moment Namibia is a net energy importer and relies on its neighbours, mainly South Africa, to meet its energy requirements. Namibia's energy generation capacity totalled approximately 488 MW. A large share of this capacity comes from the Ruacana hydro-electric power station situated along the Kunene River at the border with Angola. The Ruacana hydro-electric power station was commissioned in 1972 with a generation capacity of 249MW; and was upgraded to 330 MW in 2012. It is by far the only source of base load power in the country and depends on the river's water flow. There's no big dam at or near the power station and only a small reservoir is available to manage water storage for 24 hours. So, in the dry season the Ruacana power

station operates below full capacity. This reduces the feeding of electrical energy into the national power grid and increases the country's energy short fall.

The remainder of the domestic generation capacity comes from the Van Eck power station located in Windhoek, which was commissioned in 1972 with a capacity of 120MW, as well as the Paratus power station —commissioned in 1976 in Walvis Bay (24MW), and the relatively new Anixas power station— commissioned in 2011, also located in Walvis Bay (22.5MW). The Van Eck power station is coal-fired, while the Paratus and Anixas power plants are powered by heavy fuel-oil and, due to high fuel and operating costs, operate mainly during peak times. The Van Eck power station is no longer able to produce electricity at its rated capacity due its obsolete infrastructure.

Amidst this limited domestic generation capacity, Namibia is abundantly endowed with various renewable energy resources. This includes one of the best *solar* irradiation regimes in the world, suitable for solar power generation. The commercial use of Namibia's solar resource is increasing, most notably as a result of solar PV (electricity generation) and thermal energy uses (e.g. solar water heating). The potential for photovoltaic (PV) power in Namibia is highest along the country's western and southern parts—in particular, Kunene, Erongo, Hardap and Kharas regions.

Biomass is another important renewable resource in Namibia. The 2015/16 Namibia Household Income and Expenditure Survey indicates that firewood is the most common source of energy for cooking in the country and is used by nearly half (48.6%) of households. The use of firewood is more prevalent in rural areas (85.5%) compared to urban areas (17.3%). This nationwide use of biomass therefore implies that this resource remains a national energy source of considerable importance. In addition to being a renewable energy resource in the electricity sector and as a fuel source to displace coal/liquid fuels for thermal application, biomass also has important agricultural and other commercial uses. It serves as an animal fodder and as a primary feedstock to the charcoal industry.

Moreover, Namibia is also endowed with a strong *wind* resource which is located along most of the country's coastline, as well as in certain inland locations. These wind energy potentials can be harnessed for electricity generation. In addition, *hydropower* potential exists in the Kunene River, and to a lesser degree in the Okavango and Orange rivers.

The country's potential for *geothermal* resources remains to be proven. However, *s*ome evidence of geothermal potential exists, for example in the southern, central and north-western parts of Namibia, and hot springs are found at Ai-Ais (Windhoek), Gross Barmen and near Kamanjab, amongst others. However, none of the known resource fields are currently considered to be exploitable for power generation. In addition, Namibia has a long coastline which offers the likely potential for harvesting energy from *waves* and the ocean tide. This resource potential also awaits to be explored.

More recently, *green hydrogen* has been added to Namibia's potential energy mix. Green hydrogen offers plenty of export opportunities, as Namibia can export excess electricity to countries which are also experiencing energy shortfalls. This, however, is another resource whose viability is yet to be proved beyond the apparent potential.

By 2019 Namibia had a total power generation capacity of 526MW. This came from about 20 plants, of which 17 were Independent Power Producers (IPPs) which provided a combined generation capacity of 126.5MW. The Namibian electricity sector served 275,000 customers. Of these, 251,000 were domestic consumers and 20,000 were commercial customers, with 2,500 large power users and approximately 1,000 institutional users. About 82% of all grid-connected electricity customers were served by the three

Regional Electricity Distribution companies (REDs) and the City of Windhoek. The northern regional distributor (NORED) supplied to about 30% of the country's total electricity customers, followed by central Namibia (including Windhoek) which served some 27%; 14% were served by the Erongo regional distributor (Erongo RED) and 11% by the central regional distributor (CENORED), which serves central areas excluding Windhoek.

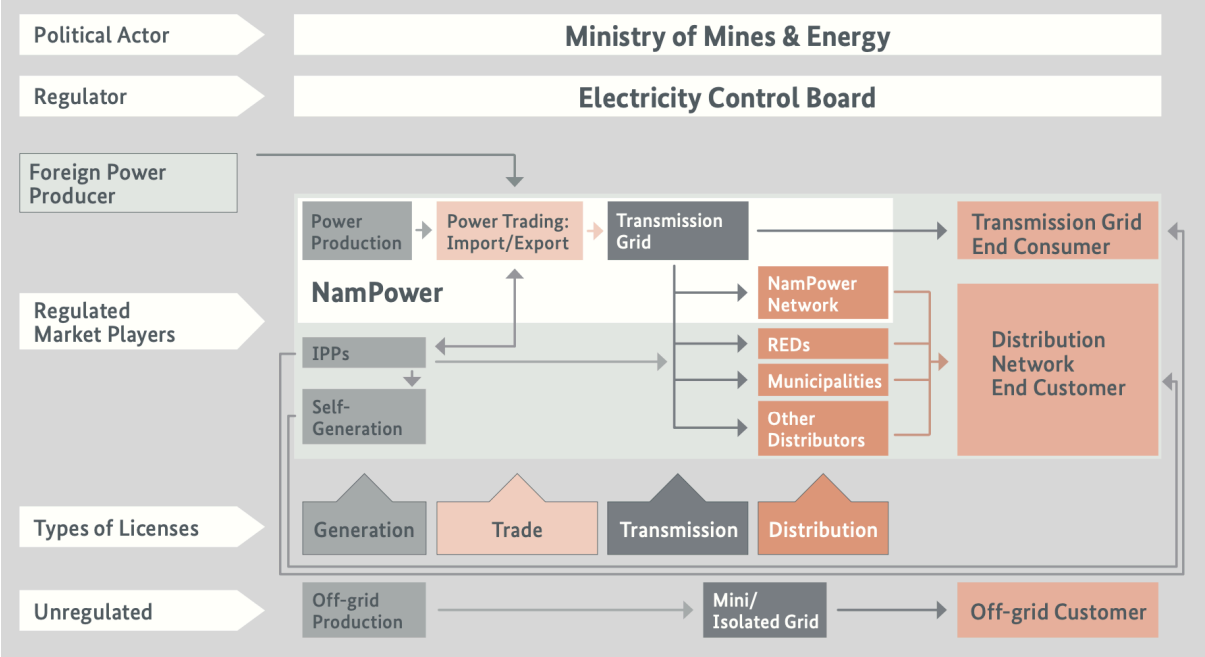
Namibia's Electricity Supply Industry (ESI) is regulated, operated and managed by several agents *(Table 1).* The Ministry of Mines and Energy (MME) is responsible for energy policy and legislation, while the Electricity Control Board (ECB) is the regulator. The ECB is the statutory regulatory authority for the electricity sector, established in terms of the Electricity Act (Act 2 of 2000) and repealed by Act 4 of 2007. The ECB has the core responsibility of exercising control over Namibia's ESI, which regulates the generation, transmission, distribution, supply, use, import and export of electricity in Namibia.

Namibia Power Corporation (NamPower), a commercial public entity, is responsible for electricity generation, transmission and energy trading. There are also Regional Electricity Distributors (REDs) and some local authorities which are licensed to distribute electricity, while a number of Independent Power Producers (IPPs) are licensed to generate renewable energy. Various licences are required to operate in the sector and these licences are issued by the ECB. Depending on the specific project, an Environmental Clearance Certificate might be required from the Department of Environmental Affairs (DEA) under the Ministry of Environment, Forestry and Tourism.

In summary, the key role players in Namibia's energy sector include:

- Ministry of Mines and Energy
- Ministry of Environment, Forestry and Tourism
- Electricity Control Board
- NamPower
- Regional Electricity Distributors (NORED, Erongo RED and CENORED)
- Local Authorities
- Independent Power Producers

Figure 1: Structure and Key Players in the Namibian Electricity Market



Source: GIZ, 2022

Historically, Namibia's electricity market has been dominated by NamPower, which owns a world-class transmission system and a network of 66 kV to 400 kV overhead lines spanning a distance of more than 11,700 km. Continuous investments are being made to strengthen and maintain the national grid in a superior condition to ensure an efficient, reliable and effective network with minimal disruptions.

NamPower's dominance in the market is beginning to lessen with the recent introduction of the Modified Single Buyer Model (MSB) market model. The MSB market model builds incrementally from the Single Buyer (SB) market model and seeks to create a more liberalised, more flexible and cost-reflective electricity market which is open to private sector players and investments. The main change to the current SB model is that the MSB will allow electricity consumers and IPPS to transact with each other directly for the supply of electricity. Certain customers are, therefore, able to buy a portion of their energy requirements directly from a private generator. The MSB also allows private generators to build new generation capacity in Namibia and for export purposes, as well as to take advantage of the country's world-class renewable energy resources. The MSB is a ring-fenced entity within NamPower, therefore, the power utility remains a critical player in the electricity sector, responsible for building new supply, procuring new supply and acting as the Supplier of Last Resort. The shift from the SB model was done to address a couple of issues such as the perceived conflict with NamPower being both a generator of electricity and the only off-taker from IPPs, the slow pace of implementation and decision-making, lack of competition and choice, and the limited progress in reducing reliance on imports.

Policy Framework

The most prominent pieces of legislation in relation to the renewable energy sector are:

- Electricity Act, 2007
- Environmental Management Act, 2007
- National Renewable Energy Policy 2017
- National Energy Policy 2017
- National Policy for Independent Power Producers 2018

- National Integrated Resource Plan 2016

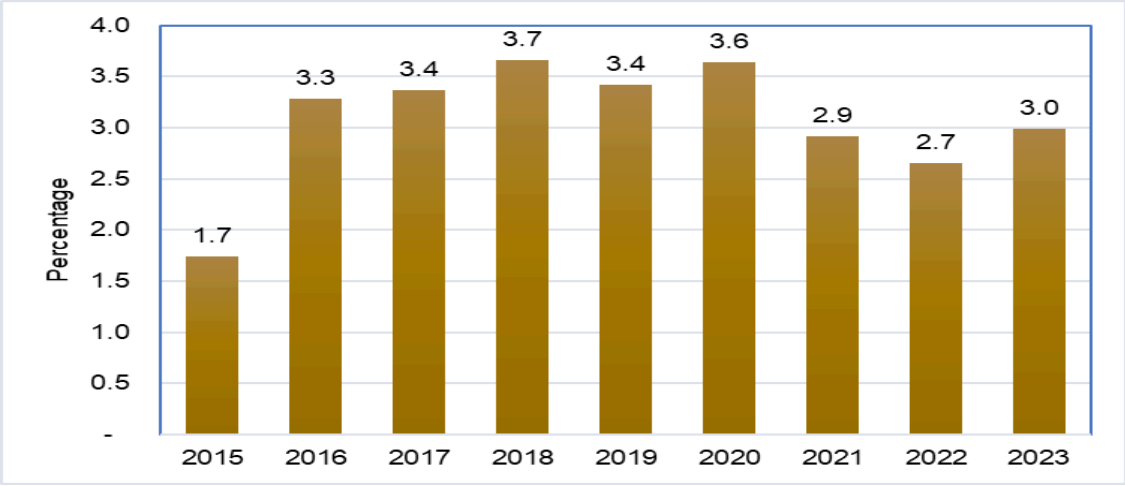
The National Renewable Energy Policy (2017) seeks to, among other things, provide guidance to the government on how to develop the renewable energy sector and how to scale-up the contribution of power from renewable sources in the country's electricity mix. The policy targets to achieve 70% or more of electricity generated in the country to be from renewable energy sources by 2030. In addition, Namibia launched its National Green Hydrogen Strategy at COP27 in November 2022 and has agreed with the EU to develop renewable hydrogen. Some agreements also exist between Namibia and other European countries like Germany to develop green hydrogen.

One relevant policy instrument in Namibia that seeks to promote private investments in renewable energy has been the Renewable Energy Feed-in Tariffs (REFiTs) which are long-term contracts with renewable energy producers, typically based on the cost of generating the renewable energy technology. Namibia announced in 2015 an interim REFiT programme that aimed to increase investment in non-hydro sources. Overall, the policy environment has remained clear and stable. New laws, policies or regulations undergo a thorough public consultative process before they take effect. This process fosters transparency and dialogue between stakeholders in the public and private sectors.

Contribution to the Economy

The utilities sector contributed an average of 3.1 percent to the country's Gross Domestic Product (GDP) during the past five years (2019 - 2023) (Figure 2). This performance was attributed mainly by the electricity subsector through the increase in local generation of electricity.

Figure 2: Contribution of Electricity and Water to GDP (%)

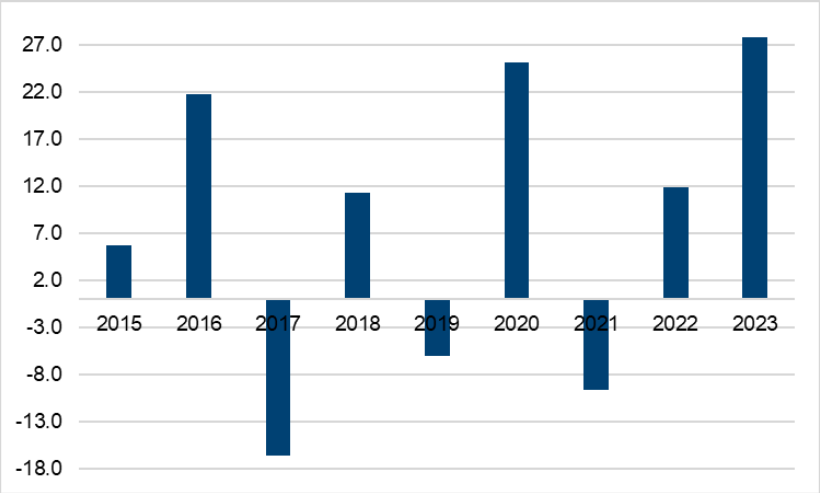


Source: Namibia Statistics Agency

During the past nine years (2015 and 2023), the utilities sector posted an average real growth of 7.96 percent, thanks to double-digit growth rates of 11.9 and 27.9, recorded in 2022 and 2023, respectively. The robust performance in the sector is attributed to the Electricity subsector that recorded a growth of 17.5% in real value added for 2022, compared to a deterioration of 16.3% posted in 2021. The great

performance is ascribed to the increase in domestic production, although it's not clear how much of that growth was driven by the renewable energy sub-sector.

Figure 3: Real Growth: Electricity and Water



Source: Namibia Statistics Agency

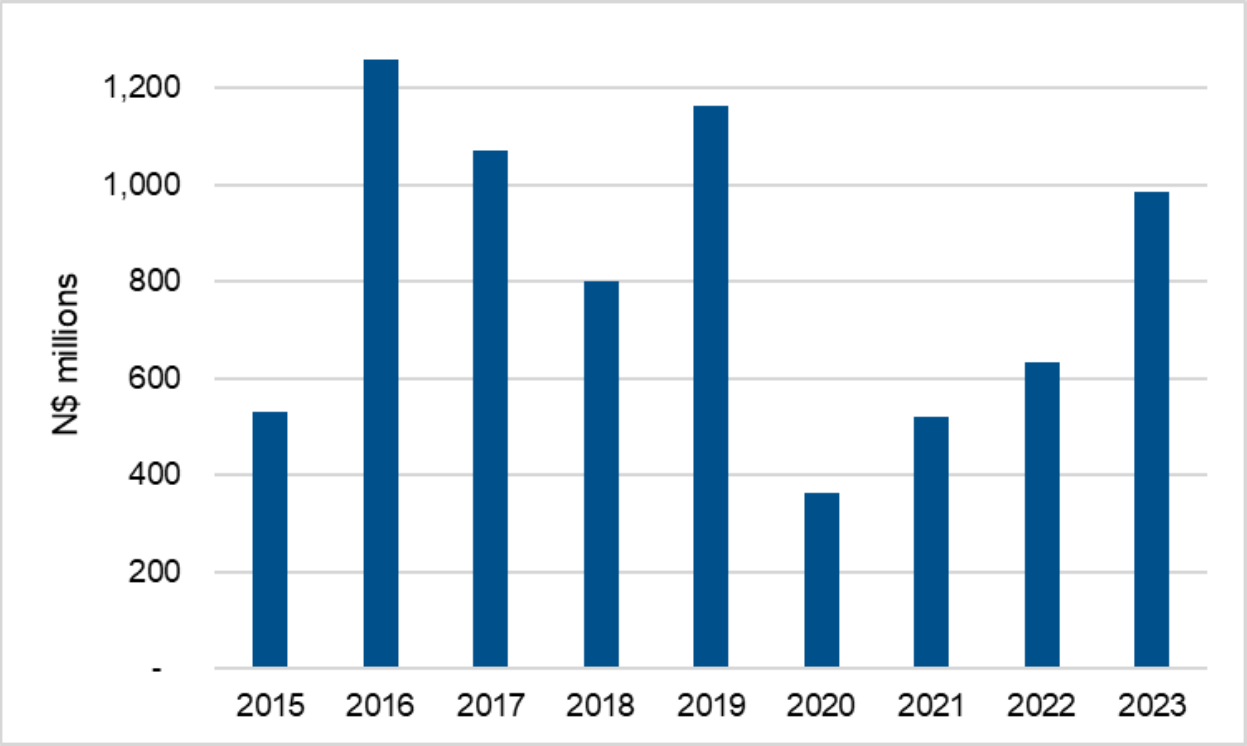
In terms of direct employment, the 2018 Namibia Labour Force Survey recorded that 3,278 people were employed in the Electricity and related industries (i.e., gas, steam and air conditioning). This represented 0.5% of the total employment in the country. Workers in this sector earned a monthly average wage of N$17,795, almost on par with Mining and Quarrying at N$17,963 and below Financial and Insurance activities where the average monthly wage was recorded at N$20,459, the highest across all industries.

The Electricity and related industries displayed one of the lowest levels of youth employment (0.6%). The relatively higher average wages and the low level of youth employment (aged 15 to 34) in the sector could be attributed to the many years of training and work experience required for workers in this industry.

The renewable energy sector can become an important source of job creation, because the related technologies provide more jobs in operations and maintenance than those for fossil fuels. Furthermore, due to its relations with other productive sectors, renewable energy investment can create jobs across several industrial sectors and support. The OECD estimated that in 2021, the renewable energy sector in Southern Africa accounted for about 19% of total energy jobs in Africa. In South Africa, for example, an injection of US$4 billion into renewable energy production is estimated to create more than 30,000 jobs by 2030 across the energy value chain.

Investments in electricity and water-related fixed assets continue to be on a steady path of recovery from the significant slowdown recorded in 2020 by reaching a real value of N$985 million in 2023, an upbeat 55 percent increase from the levels recorded in the year before. This indicates an increasing level of spending in the sector on fixed assets such as plants and equipment.

Figure 4: Gross Fixed Capital Formation: Water and Electricity (N$ millions)



Source: Namibia Statistics Agency

Research & Development

Namibia's expenditure on Research and Development (R&D) is generally low. Results of the 2013/14 R&D Survey indicate that Namibia's Gross Domestic Expenditure on R&D (GERD) as percentage of GDP is only 0.34 percent. This spending was mainly driven by the government sector which spent N$216.6 million on in-house R&D activities in 2014, accounting for 45.9% of the GERD and making it the largest contributor to R&D expenditure in the country. The country's low spending on R&D-related activities is reflected in its low ranking on the Global Innovation Index (GII). In 2022, Namibia was ranked 96th among the 132 economies featured in the GII. This is an improvement from being ranked 104th in 2000 and 100th in 2021, and places Namibia at 6th position among the 27 economies in Sub-Saharan Africa. However, it still leaves the country in the bottom half of the table globally hence room for improvement.

In terms of energy, there is some research activities being undertaken in the country, mainly at academic institutions such as at the Namibia Energy Institute (NEI) which operates within the structure of the Namibia University of Science and Technology (NUST), as well as the Namibia Green Hydrogen Research Institute (NGHRI) which is housed at the University of Namibia. With the commitment from the government to develop the green hydrogen industry in Namibia, more funding and more research and development activities are expected, particularly at the NGHRI.

Challenges

The country has a significant potential of variable renewable energy (VRE) to meet its domestic and

regional market requirements. However, VRE creates several costly issues for the Namibian grid that need to be addressed to ensure reliable grid operations, efficient supply to energy intensive industries and facilitate exports. As the supplier of last resort, Nampower is required to maintain sufficient operating reserves to fulfil its mandate and mitigate the resource risks associated with variable renewable energy plants; however the investment in the provision of this and other ancillary services cannot be made at the expense of the stakeholders not participating in the MSB. This may require a review of the market framework to ensure that participants in the MSB market properly contribute to the cost of providing ancillary services, without negatively affecting the investment attractiveness of the Namibian market. So, at the moment there are some teething problems with the full implementation of the MSB framework.

Investment Opportunities

The renewable energy industry in Namibia is set to expand as the country seeks to develop the Green Hydrogen industry. Further , an increase in demand for energy is expected to be driven by the general quest for industrial development across the region and the continent at large. This presents an opportunity for Namibia to generate energy not only for domestic consumption but also to meet the needs of the export market.

Therefore, opportunities for Independent Power Producers (IPPs) exist as supported by the Modified Single Buyer Market (MSB) model which was introduced in 2019 and which allows large electricity customers to buy up to 30% of their demand directly from an IPP rather than from NamPower. The MSB framework is expected to add 450 MW of solar power to the national generation capacity, once fully implemented, as well as export into the Southern African Power Pool (SAPP). Apart from renewable energy generation there are also opportunities to manufacture products and technologies that are focused on supporting the entire renewable energy industry.

For its new power projects, NamPower undertakes a systematic procurement process and invites potential bidders through a competitive procurement process. Private off-takers generally negotiate Power Purchase Agreements (PPAs) with IPPs and in some cases they apply a competitive procurement process. Specific requirements for applications to obtain a generation licence can be obtained from the ECB, including detailed IPP application guidelines, information requirements, a standard advertisement format and a generation licence application.

Opportunities will also become apparent as the country gears up to develop the green hydrogen industry and its associated value chains (Table 1). These include upstream opportunities such as local parts manufacturing and assembly—namely, wind foundations and blades manufacturing, turbine assembly, and copper cable manufacturing. It is expected that most of the equipment to be used in the green hydrogen industry will be imported from countries with technology expertise and manufacturing plants. However, there will be opportunities for the wind turbine foundations, blades and racking to be manufactured in Namibia. Downstream opportunities also exist, including the production of synthetic fuel and methanol, fertilisers, green steel, green zinc and green iron. So, Namibia has a unique opportunity to draw in green manufacturing activities.

Table 1: Green Manufacturing Opportunities

Industry	**Opportunity**	**Macro-Sector**
Renewable Energy Hardware	*Solar panel manufacturing*: Assembly of	Electronics and

Manufacturing	imported cells for photovoltaic solar panels.	machinery
	Electrolyzer manufacturing: Manufacturing & assembly of non-membrane stacks and Balance of Plant for electrolyzers.	Electronics and machinery
	Wind turbine manufacturing: Manufacturing & assembly of towers and blades for wind turbines.	Electronics and machinery
Clean Energy Use	*Flat glass production:* Manufacturing of smooth, uniform sheets of glass	Chemicals and Basic Materials
Green Hydrogen Derivatives	*Synthetic fuel production:* Production of synthetic hydrogen based fuels.	Chemicals and Basic Materials
	Hot Briquetted Iron (HBI) production: Compacting direct reduced iron (DRI) into dense briquettes.	Metal mining and related industries

Source: Green Manufacturing Strategy for Namibia (2023)