International Labour Organization

Sectoral Review Study and Drafting of a Sector Skills Strategy for the Energy Sector in Namibia

Sector Background Study

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Acronyms and Abbreviations

CERIM	CERIM Lüderitz Energy
ECB	Electricity Control Board
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GWh	Giga Watt hours
HEI	Higher Education Institutions
HVAC	Heating, Ventilation, and Air Conditioning
IEA	International Energy Agency
ILO	International Labour Organization
IPP	Independent Power Producer
IPPR	Institute for Public Policy Research
IRENA	International Renewable Energy Agency
IUM	International University of Management
MANWU	Metal and Allied Namibian Workers Union
MHETI	Ministry of Higher Education, Technology and Innovation
MSMEs	Micro, Small and Medium Enterprises
MUN	Mineworkers Union of Namibia
MW	Mega Watt
N-BiG	Namibia Biomass Industry Group
NAD	Namibian Dollar
NAMCOL	The Namibia College of Open Learning
NAMCOR	National Petroleum Corporation of Namibia
NAMRENA	Namibia Renewable Energy Association
NANLO	Namibia National Labour Organization
NATAU	Namibia Transport and Allied Workers Union
NCCI	Namibia Chamber of Commerce and Industry
NCRST	National Commission on Research, Science and Technology
NDP	National Development Plan
NEC	Namibia Energy Corporation
NEF	Namibia Employers' Federation
NEI	Namibia Energy Institute
NIMT	Namibian Institute of Mining and Technology
NIPDB	Namibia Investment Promotion and Development Board
NIRP	National Integrated Resource Plan
NISO	Namibia Informal Sector Organization
NIT	National Institute of Technology
NQF	National Qualifications Framework
NQA	Namibia Qualifications Authority
NSA	Namibia Statistics Agency
NTA	Namibia Training Authority
NUNW	National Union of Namibian Workers
NUST	Namibia University of Science and Technology
PETROFUND	Petroleum Training and Education Fund
PtX	Power-to-X
PV	Photo voltaic (solar panels)
R&D	Research and Development
REFiT	Renewable Energy Feed in Tariff

REIAoN	Renewable Energy Industry Association of Namibia
SADC	Southern African Development Community
SASSCAL	Southern African Science Service Centre for Climate Change and Adaptive Land Management
SMEs	Small and Medium Enterprises
STEM	Science, Technology, Engineering, and Mathematics
STED	Skills for Trade and Economic Diversification
TUCNA	Trade Union Congress of Namibia
TVET	Technical and Vocational Education and Training
UK	United Kingdom
UNAM	University of Namibia
UNDP	United Nations Development Programme
VVTC	Valombola Vocational Training Centre
WVTC	Windhoek Vocational Training Centre

Key Definitions

Term	Definition
Green Hydrogen	Hydrogen produced using renewable energy sources, such as solar or wind power, through a process called electrolysis, which splits water into hydrogen and oxygen.
Non-Renewable Energy	Energy derived from sources that do not replenish at a sustainable rate, such as oil, natural gas, and coal.
Renewable Energy	Energy derived from natural processes that are replenished at a faster rate than they are consumed. Examples include solar, wind, hydropower, biomass, and biofuels.
Energy Efficiency	The goal of reducing the amount of energy required to provide products and services. This can be achieved through technological advancements, improved processes, and behavioural changes.
Energy Security	The uninterrupted availability of energy sources at an affordable price. It involves diversification of energy sources and ensuring reliable supply chains.
Energy Access	The availability of modern energy services to all individuals and communities, particularly in underserved and remote areas.
Sustainable Growth	Economic development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It involves balancing economic, social, and environmental considerations.
Economic Resilience	The ability of an economy to withstand and recover from external shocks, such as fluctuations in global energy markets or environmental changes.

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Executive Summary

Overview

Namibia's energy sector is poised for significant growth, driven by investments in renewable energy and supportive government policies. This executive summary provides an analysis of the economic and labor force dynamics, business environment, skills demand and supply, and strategic recommendations to enhance the sector's capabilities and support sustainable economic development.

Economic and Labor Force Analysis

The energy sector, encompassing both renewable and non-renewable resources, is a critical contributor to Namibia's GDP. Investments in solar, wind, and green hydrogen projects are expected to drive substantial economic growth and job creation. However, the sector faces challenges such as skills shortages, infrastructure constraints, and the need for substantial investments in technology and capacity building.

Key Findings:

- Economic Contribution: The energy sector significantly contributes to Namibia's GDP, with renewable energy investments driving growth.
- Employment Trends: The sector has experienced varying growth rates across its subsectors, with renewable energy showing the highest growth. Employment projections indicate substantial job creation, particularly in green hydrogen and renewable energy.
- Workforce Demographics: The workforce is predominantly male, with women representing approximately 30% of the total workforce. Efforts are needed to increase female participation and address gender disparities.
- Skills and Education: There is a significant demand for skilled workers, particularly in engineering, technical, and project management roles. The need for upskilling and aligning education and training programs with industry needs is critical.

Business Analysis

The business environment in Namibia's energy sector is characterized by strong government support, but also by regulatory complexities and infrastructure constraints. Small and medium enterprises (SMEs) play a vital role in driving economic activity, particularly in renewable energy solutions for the domestic market.

Key Findings:

- Regulatory Frameworks: Simplifying and streamlining regulatory processes is essential to attract investment and facilitate project development.
- Investment Needs: Significant investment is required to achieve energy self-sustainability and support green industrialization.
- Technological Advancements: The integration of advanced technologies, such as smart grids and energy storage solutions, is essential for improving efficiency and reliability.
- Local Content Development: Developing local manufacturing capabilities and strengthening local supply chains can create jobs and reduce import dependency.

Skills Demand Analysis

The transition to renewable energy and the development of green hydrogen projects are driving demand for new skills and occupations. There is a high demand for technical and engineering skills, project management, and digitalization expertise.

Key Findings:

- High Demand for Technical Skills: Significant demand for technical skills in renewable energy technologies across all levels of occupations, with engineering skills particularly at the high-skill level.
- Emerging Roles: New roles in green hydrogen and ammonia production require specialized skills.
- Project Management: Growing need for project managers with skills in planning, risk management, and stakeholder engagement.
- Digital Skills: Demand for skills in data analytics, automation, and digital literacy.

Skills Supply Analysis

The quality of training provided by educational institutions varies, with some lacking modern equipment and facilities. Access to training opportunities is limited in rural areas, and there is a need for updated curricula and enhanced instructor training.

Key Findings:

- Training Quality: Variations in the quality of training provided by different institutions.
- Access to Training: Limited access to training opportunities in rural areas.
- Updated Curricula: Need for regularly updated curricula to reflect industry needs.
- Instructor Competence: Ongoing professional development for instructors is critical.

Recommendations

For Skills Demand:

- Develop specialized training programs in emerging fields.
- Promote continuous professional development.
- Enhance project management training.
- Integrate digital skills into training programs.
- Focus on environmental and sustainability education.

For Skills Supply:

- Invest in modern training facilities and equipment.
- Expand access to training in rural areas.
- Regularly update curricula to reflect industry needs.
- Enhance instructor training and development.
- Strengthen collaboration with industry partners.

- Promote public-private partnerships to leverage expertise and investment.

Introduction and context

The Namibian energy sector is at a pivotal juncture, poised for significant growth and transformation driven by investments in renewable energy, technological advancements, and supportive government policies. Namibia's ambitions to create a prosperous and peaceful society that provides for the health and wellbeing of the nation are well articulated in the country's Vision 2030. This long-term development framework is aimed at transforming Namibia into an upper middle-income industrialized nation by the year 2030. Tabled in 2004 as the country's overarching guiding framework, it has been implemented through successive iterations of the National Development Plan in 5-year cycles (currently in its 5th iteration with the 6th draft to be tabled in 2024).

Namibia's energy sector is characterized by a diverse mix of renewable and non-renewable energy sources. The country has abundant solar and wind resources, making it well-positioned to capitalize on the global shift towards clean energy. However, the sector also faces significant challenges, including heavy reliance on energy imports, underdeveloped infrastructure, and rising domestic energy consumption. Additionally, energy access remains a significant challenge, with nearly 45% of Namibians still lacking access to electricity, particularly in rural areas (IEA 2024).

Since gaining independence, Namibia has made considerable progress in expanding access to education and improving literacy rates. The government has prioritized education, resulting in near-universal primary education and significant improvements in secondary education enrolment. Despite these achievements, challenges remain, particularly in aligning education and training programmes with industry needs, especially in emerging fields like renewable energy and green hydrogen. The energy sector's growth is further influenced by factors such as technological advancements, demographic shifts, urbanization and international trade dynamics. Effective policy frameworks and international partnerships are essential for attracting investment and fostering sustainable development in the sector.

Overcoming these challenges will depend on the country's ability to transform its resources into broader socio-economic benefits that would increase employability for Namibians in decent work. As the driver of the country's business investment and development agenda, the Namibia Investment and Promotion Development Board (NIPDB) has partnered with the International Labour Organization (ILO) to better understand how to address the mismatch between skills supply and demand across the country's Energy sector and implement actionable strategies in the short, medium and long term. This aligns with overarching ILO objectives to bolster employability, especially across skill levels and genders, and contribute to the country's economic diversification, while leaving no-one behind.

The project's strategic objectives focus on enhancing the Technical and Vocational Education and Training (TVET) system, fostering private sector engagement in skills development, and supporting demand-led curricula development with an emphasis on the promotion of an inclusive green economy. The process enables stakeholders' consultations and dialogues, which are intended to foster partnerships to implement the recommendations of a skills strategy. This inclusive process supports alignment with the Namibian government's vision for sustainable economic growth and competitiveness, which is to become a world leader in the renewable energy sector and develop a sustainable local green economy that provides Namibians with increased access to decent work opportunities.

Purpose of the Report

The purpose of this Sector Background Study is to contextualise the current skills landscape within the Namibian energy sector. It is a foundational component of the ILO's Skills for Productivity, Environment, and Economic Diversification (SPEED) methodology, derived from the ILO's Skills for Trade and Economic Diversification (STED) approach, which aims to align skills development with the needs of key economic sectors to enhance trade

performance and economic diversification. The study provides evidence and analysis of strategic development challenges that the Energy sector is facing and the contribution skills can make to address those challenges.

It takes a forward-looking approach to reviewing relevant policy, the institutional and socio-economic context for the sector development, anticipated skills implications, and together with supply side analysis, aims to generate an overview of current and emerging skills gaps and challenges.

Scope of the Study

The scope of this study is to collate all available information, which encompasses a literature review and collection of current data, for an analysis of the Namibian energy sector. For the purposes of this study, the research covers Namibia's renewable and non-renewable energy sectors, with a specific focus on the oil and gas, renewable energies (mostly solar and wind with some reference to hydropower), Green Hydrogen and the Bioenergy sub-sectors, which are considered priority subsectors, for different reasons, and analysed throughout the report. The study aims to provide an understanding of the current state of the energy sector, including its economic contribution, workforce profile, and business environment. It also seeks to identify the skills required to support the sector's growth and transformation, particularly in emerging renewable energies, such as GH2.

Methodology and Approach

The methodology for this study is the ILO's STED diagnostic process, which is a process-oriented approach combining evidence-based analysis with stakeholders' forward-looking consultations. This approach integrates both quantitative and qualitative data collection methods as inputs to this background study. The desk research involves a review of existing literature, reports and official data sources to gather background information and provide contextual understanding of the energy sector.

In areas where there may be a lack of current or reliable data, particularly related to suppliers and ancillary services, indirect or induced industry information is mentioned where available. Additionally, the process seeks to gather views and fill data gaps through consultation methods such as the foresight workshop, direct key informant interviews, and focus group discussions.

Key components of the study include the collection and analysis of the following data:

- **Economic and Workforce Profile**: Analysis of the sector's contribution to GDP, employment trends, and workforce demographics.
- **Business Environment**: PESTEL analysis to understand the political, economic, social, technological, environmental, and legal factors influencing the sector.
- **Skills Supply Side Analysis**: Examination of the TVET system in Namibia, including alignment with industry needs, curriculum development, quality of training, governance, funding, and training provision.
- **Skills Demand Analysis**: Anticipating future skills requirements based on investments and big pipeline projects, technological advancements, market dynamics, policy and regulatory changes, and socio-economic factors.
- **Mapping Existing Actions on Skills Development**: Review of current initiatives by government, industry associations, and development partners, identifying gaps and overlaps in efforts.
- **Comparative Analysis**: Evaluation of the energy sector's growth and skills demand with a focus on the prioritised subsectors.

The ILO's SPEED methodology will be applied to identify current skills gaps and anticipate future skills needs, and propose actionable recommendations. This process seeks to surface the sector's challenges and opportunities to

enhance the workforce capabilities of Namibia's energy sector. It is a collaborative effort involving governmental bodies, employers, workers organizations, and local partners.

Limitations

While every effort has been made to gather, collate and analyse the most current information and data available, it should be noted that in many instances official (both public and private sector) data is not collected nor disaggregated in ways that can respond to the level of detail hoped for and all questions posed by the ILO terms of reference guideline. For instance, the most recent Labour Force Survey was conducted in 2018, which is pre-pandemic data, and while Namibia's 2023 Census offers more current demographic data, information related to employment and industries is reported to be released in January 2025 i.e. unavailable to contribute to this study's analysis. There may also be other sources of data not in the public domain that stakeholders and foresight workshop participants may hold or be aware of and willing to share. We welcome and would be most grateful for additional contributions for inclusion in the final study report, but as of writing these are not known or available to the authors to include in this draft version.

Sector Definition and Scope

Namibia's energy sector is defined by a combination of renewable and non-renewable resources, governed by a framework of policies, such as the National Energy Policy and the National Renewable Energy Policy, that aim to ensure sustainable growth, energy security, and social equity (Ministry of Mines and Energy, 2017). Strategic goals embedded in Vision 2030 and the National Development Plan (NDP5) further outline a roadmap for Namibia's energy sector. More recently, Namibia's Green Hydrogen Strategy is positioning the country as a global leader in hydrogen (and its derivatives, such as ammonia) production, export and utilisation, contributing to the international energy transition (Ministry of Mines and Energy, 2023). These policies and strategies collectively shape Namibia's approach to managing its energy resources, fostering a balanced mix of renewables and non-renewables. The focus on renewables like solar, wind, and green hydrogen aligns with global clean energy goals, while non-renewables like oil, natural gas and petroleum address immediate energy needs within a framework that emphasizes social and environmental responsibility (Ministry of Mines and Energy, 2023).

This study's energy sector definition— renewable and non-renewable energy sources (see key definitions) —aligns closely with Namibia's goals for sustainable growth, energy security, and economic resilience. This broad definition includes all stages of the production, distribution, and consumption of energy, accounting for diverse facets such as energy efficiency and conservation, which prioritize sustainable consumption practices and reduced wastage (International Energy Agency, 2020). By concentrating on renewables such as **solar, wind, hydropower, biomass and biofuels,** and **green hydrogen** as well as **oil and gas** within the non-renewable category, this targeted approach reflects Namibia's strategic emphasis on its natural resource strengths and evolving energy needs (ILO, 2022). Renewable resources are being prioritized to harness Namibia's abundant solar and wind potential, which along with biomass production, are especially important for increasing domestic electricity access and energy security for Namibia's rural populations. Advances in newer opportunities in green hydrogen production also have significant export market potential contributing to the fiscus as well as major investments in new infrastructure and upgrades, which will have cross-sectoral spillover effects. However, oil and gas remain vital for generating revenue, supporting economic development, and ensuring a diversified energy mix (Ministry of Mines and Energy, 2023).

The focus on specific energy types supports **sector-specific skill development** and policy frameworks, which are critical for sustainable sector growth and for aligning with national economic objectives (National Planning Commission, 2017). A targeted approach enables the study to contribute insights for each subsector, addressing workforce needs, infrastructure demands, and policy requirements—key elements that enhance Namibia's preparedness for energy transitions and resilience against external energy market fluctuations (IRENA, 2021).

Increasing **investment through public-private partnerships** and international collaboration also mirrors global energy sector standards, facilitating shared expertise and resource mobilization to bolster Namibia's goals for

sustainable energy and economic diversification (World Bank, 2019). This alignment with global standards fosters stakeholder engagement, data-driven policy development, and resource efficiency, all of which are critical to achieving Namibia's long-term energy objectives.

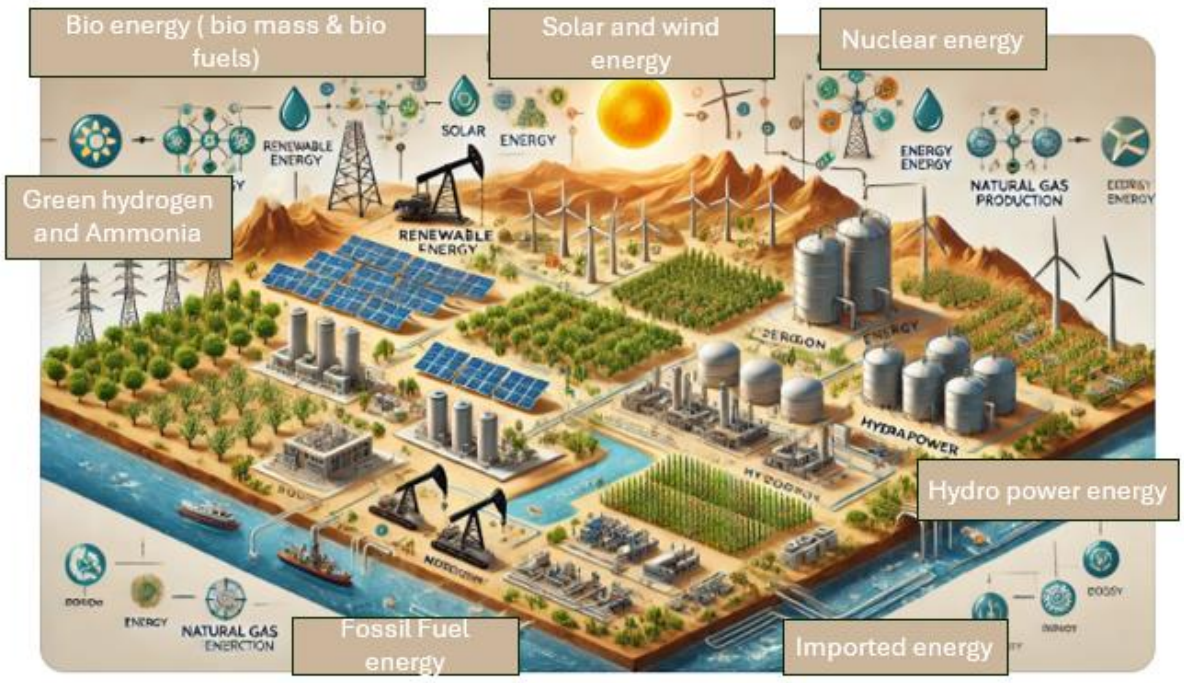
Research and development (R&D) is also driving technological advancements and fostering innovation that increases efficiency and reduces costs in clean energy (IEA, 2020). **Energy access and equity** initiatives target universal energy access, supporting economic and social upliftment in underserved areas, while **decentralized and off-grid solutions** provide viable energy alternatives in remote regions where traditional grid access is limited (World Bank, 2019). By addressing these dimensions, the energy sector framework promotes a **holistic approach** that integrates energy type, infrastructure, policy, economic, and social-environmental aspects to meet current and future energy needs sustainably.

This framework's structure aligns with **international best practices** by incorporating elements of **energy efficiency, storage, policy and regulation, energy access, and decentralized solutions**. These dimensions promote a comprehensive understanding of Namibia's energy landscape, creating a foundation for sector-specific recommendations. Such categorization is essential in the context of Namibia's Vision 2030 and the National Development Plan (NDP5), both of which emphasize economic growth, sustainability, and social equity through targeted skills development and strategic energy investments (National Planning Commission, 2004).

Sector Profile, Trends and Outlook

Namibia's government has identified the energy sector as critical to its economic growth and development, with a strong emphasis on increasing the energy mix of renewables, improving energy access, and exploring untapped oil and natural gas reserves (Gov of Republic of Namibia. 2024. A blueprint for Namibia's green industrialisation). Domestic electricity is still mainly generated from thermal coal power stations and hydroelectric power but more recently Namibia is increasingly turning towards renewable energy sources like solar and wind. Harnessing both renewable and non-renewable energy resources provides the foundation for the country's future-looking energy strategy and its ability to respond to development goals around energy security and social inclusion challenges such as increasing electricity access.

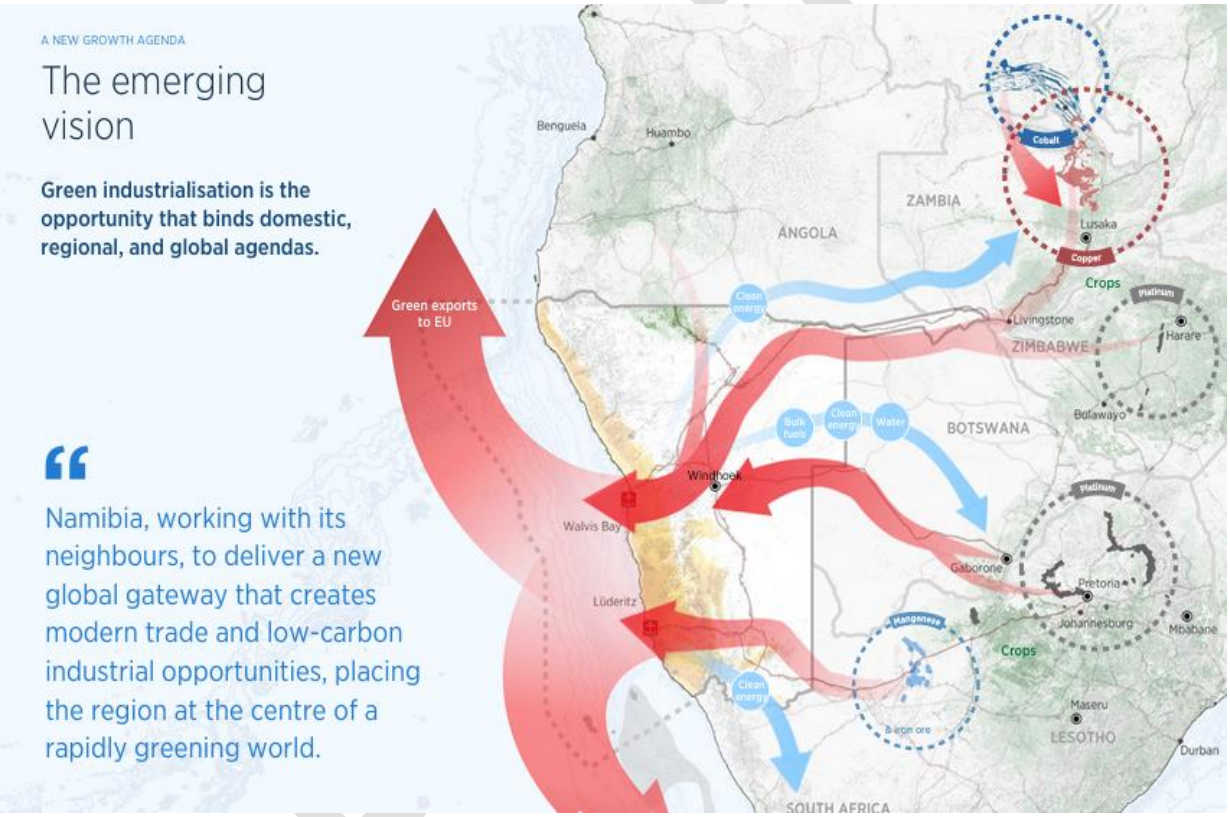
Figure 1: Namibia's energy landscape



While the country is prioritising the development of its green energy sector (as can be seen through the more advanced Green Hydrogen Programme) it is also not losing sight of the opportunities for employment and revenues from exploration of its potential oil and gas reserves as well as through the more labour-intensive bioenergy subsector through biomass and biofuels production, which are unlocking new employment opportunities.

Namibia's vision for its energy sector not only promises economic growth but is also expected to create employment opportunities. Figure 2 from the government's blueprint for Namibia's green industrialisation roadmap indicates an ambitious and well developed plan for achieving these goals, which positions the country as a gateway for regional trade and low-carbon industrial opportunities. While the upgrading of current and development of new port and rail infrastructure is primarily intended to facilitate Namibia's export of clean energy to neighbouring countries and international markets, it will also play an important role in offering alternative export transport routes for mineral producers in Botswana, Zambia and South Africa.

Figure 2: Namibia's Green Industrialisation Vision



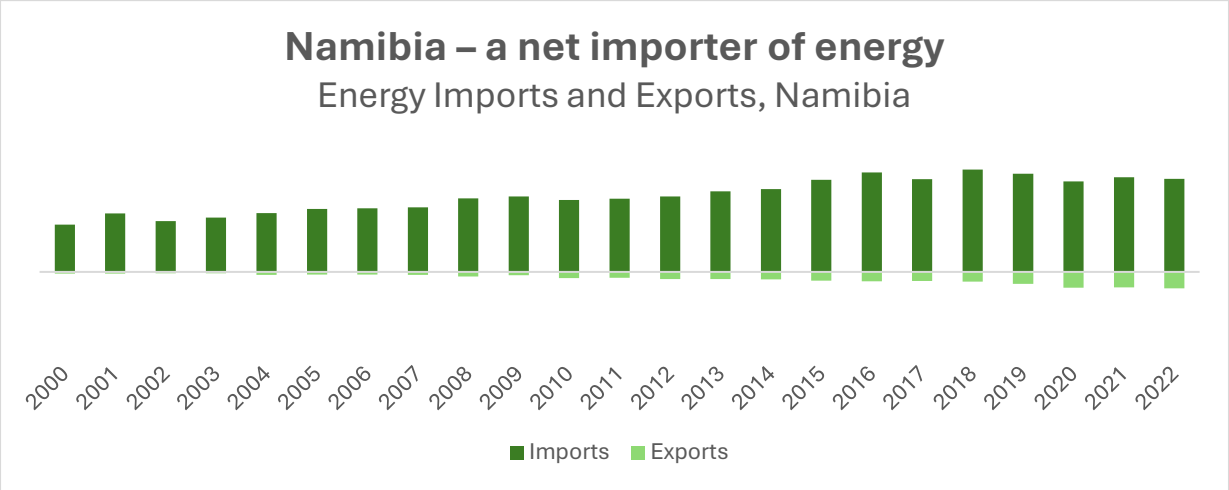
Source: Gov of Republic of Namibia. 2024. A blueprint for Namibia's green industrialisation

The development of energy storage solutions, such as advanced battery energy storage systems, is also seen as critical to balancing supply and demand, especially for intermittent renewable sources like solar and wind (Namibia Energy Institute, 2023). Linked with other decentralised approaches such as off-grid installations of renewable energy micro-grids, these efforts have the opportunity to unlock employment but also increase productivity in other sectors by providing electricity and energy security. Efforts to modernize Namibia's grid infrastructure are ongoing, with investments in smart grid technologies designed to improve reliability and integrate renewable energy sources into the national grid (NamPower, 2023).

Economic performance of the sector

Namibia remains a net importer of energy (evidenced by the trend represented in Figure 3) and relies on a combination of domestic production and imports to meet its energy needs. In 2022, the country's total energy supply was 20'523 GWh (equivalent to 73'882 TJ), with renewable energy sources contributing nearly 40% percent of the total energy mix (IEA, 2023). On the consumption side, Namibia consumed 17'722 GWh (63'798 TJ) energy during 2022, with the transport and "commercial and public services" sectors being the largest consumers, accounting respectively 42% and 24% of total final energy consumption (IEA, 2023). When broken down by source, oil products and electricity were the predominant sources, contributing 70% and 20% to the total energy consumption, respectively (IEA 2023). Specifically, according to the IEA, 3'531 GWh of electricity was used in 2022, with the industrial sector being the largest consumer (38%) of the total final electricity consumption.

Figure 3: Namibia a net importer of energy



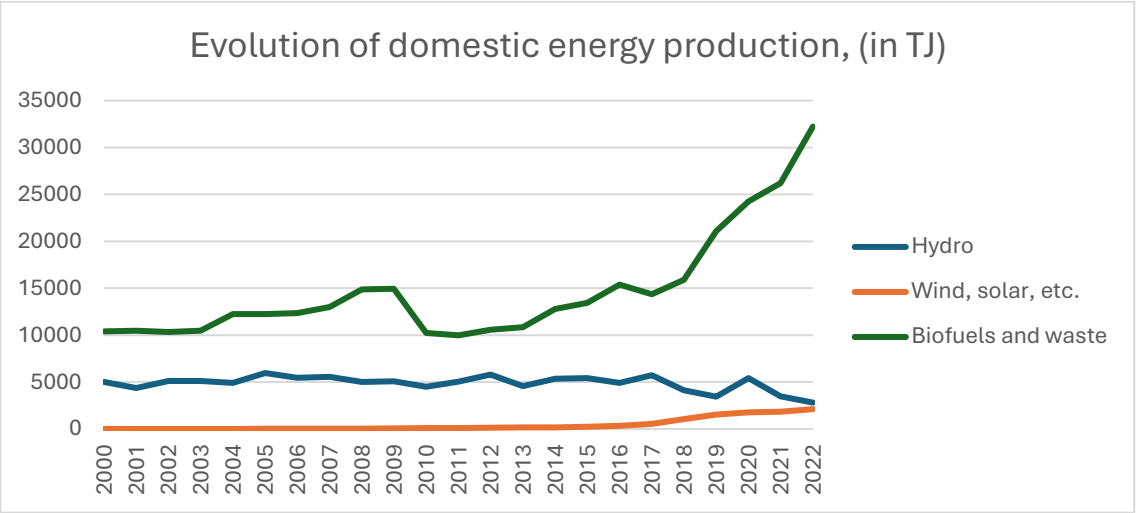
Source: International Energy Agency, 2023

Trends in Energy Supply and Consumption

Namibia's renewable energy sector is growing steadily, with an installed capacity of 501 megawatts (MW) as of 2024, largely powered by solar energy. Solar photovoltaic (PV) installations alone provide over 75 percent of the renewable energy capacity, thanks to Namibia's abundant sunshine, which ranks among the highest radiation levels globally (International Energy Agency, 2024). The country also has several wind energy projects underway, particularly along the coastal regions, which are expected to add an additional 90 MW by 2025 (Ministry of Mines and Energy, 2023).

Figure 4 shows the consistent growth in solar and wind energy since 2017 with declining hydropower since 2021. This may be related to drought conditions being experienced across Southern Africa. The use of biofuels and waste as energy sources has shown the most growth, increasing considerably since 2017. Biomass and biofuels production is an emerging sector, with significant potential for growth. The country has abundant biomass resources from overgrown bush, which are being harvested for energy production (Cleanergy Solutions Namibia, 2023).

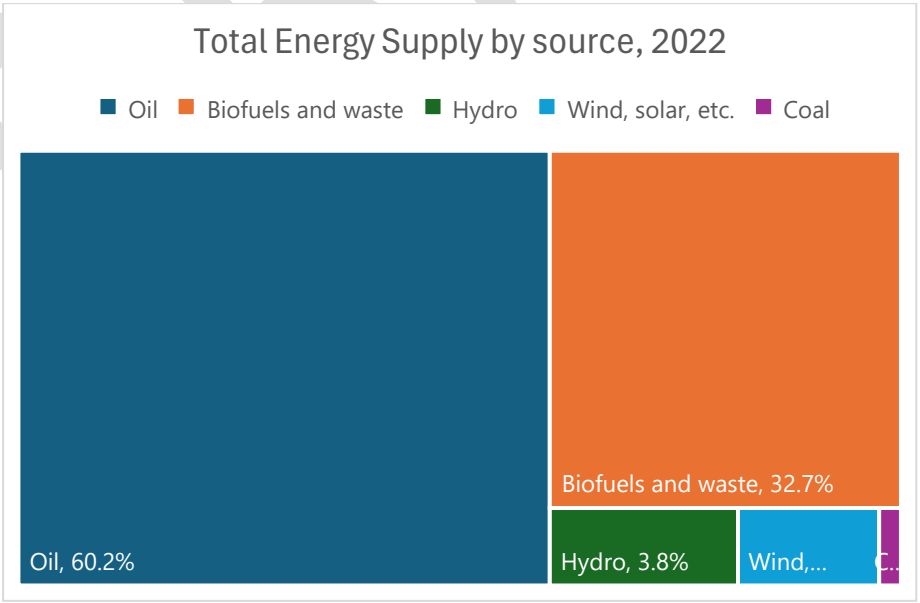
Figure 4: Domestic renewable energy production from 2000 to 2022



Source: International Energy Agency, 2023

Despite the rise of renewable energies, Namibia remains reliant on coal-fired power stations to meet its electricity needs as the country's energy needs are not yet supported by domestic oil and gas reserves. As shown in Figure 5, oil and gas imports represent a major share of Namibia's total energy supply (60.2 percent in 2022), and this dependency exposes the country to fluctuations in global oil prices. For instance, diesel and gasoline, which are critical for transportation and heavy industries, are entirely imported (primarily from South Africa) underscoring Namibia's reliance on neighbouring markets (Namibia National Petroleum Corporation, 2023).

Figure 5: Namibia's total energy supply by source in 2022



Source: International Energy Agency, 2023

Trends in Demand

Electricity demand in Namibia is influenced by both residential and industrial sectors. Liquid fuels, including petrol and diesel, make up approximately 63 percent of Namibia's total energy net consumption, primarily due to their importance in transportation and mining operations. Overall electricity consumption follows at 17 percent, with renewable sources gradually gaining a larger share as they become more economically viable (Namibia National Planning Commission, 2023). This high reliance on imported liquid fuels makes Namibia particularly vulnerable to international fuel price fluctuations, which impact overall economic stability and consumer costs.

Although commercial and public services and residential demand is growing due to rapid urbanization, population growth and increased access to modern energy services, transport has remained the highest energy demand category followed by an increase in commercial and public services over the last two decades, as reflected in Figure 6.

Figure 6a: Total Energy Consumption by source

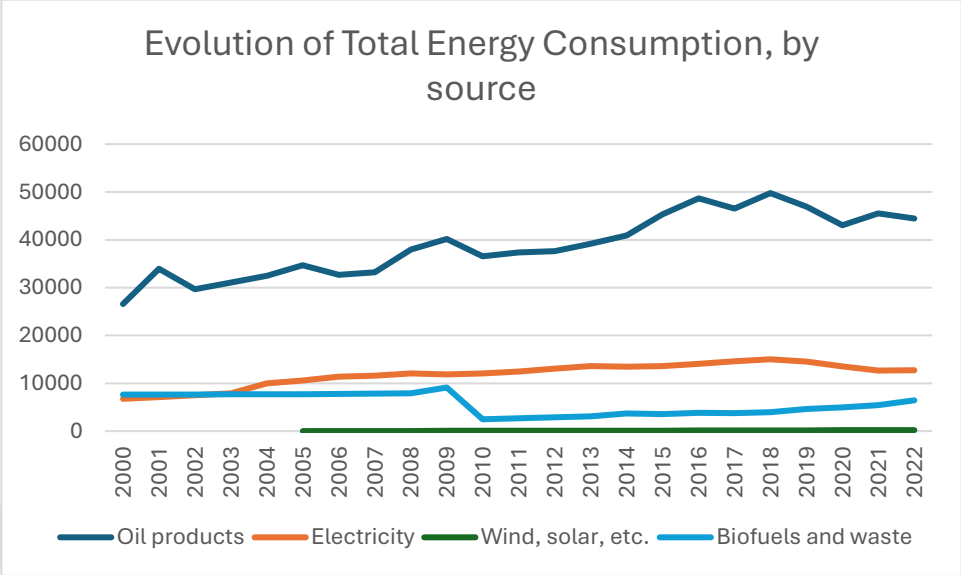
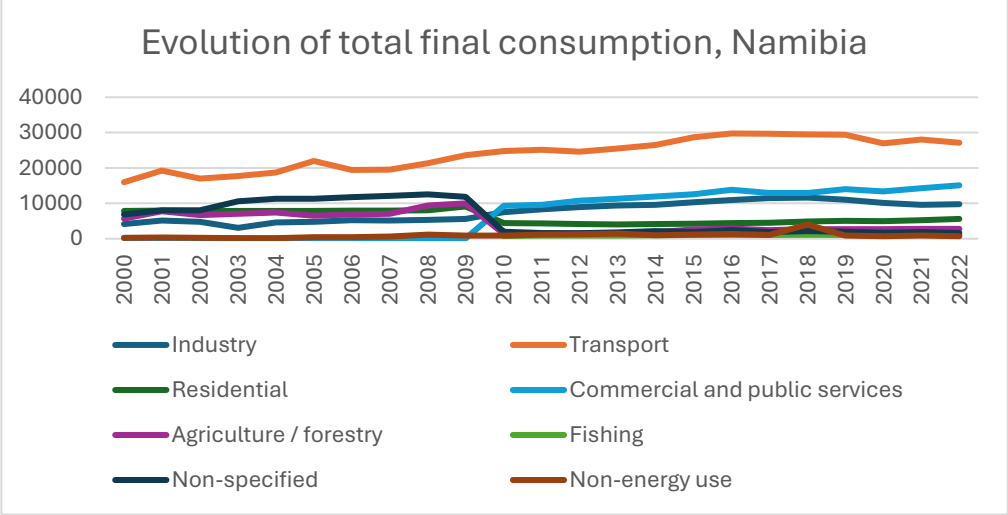


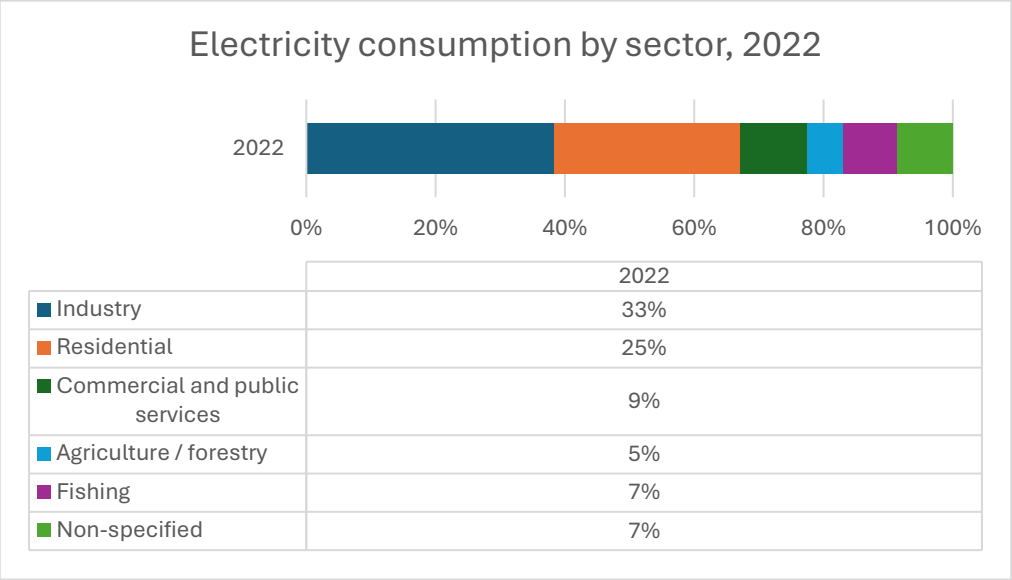
Figure 7b: Total Energy Consumption by sector from 2000 to 2022



Source: International Energy Agency, 2023

Figure 7 shows that in 2022, the industrial sector was the largest consumer of electricity at 33 percent (IEA, 2023). Mining alone, which accounts for 14 percent of Namibia's GDP, uses about 21 percent of the country's total electricity supply. Major mining companies, such as De Beers and Namdeb, require substantial power for mineral extraction and processing, driving demand for both reliable and cost-effective electricity (Namibia Chamber of Mines, 2023).

Figure 8: Electricity consumption by sector in 2022

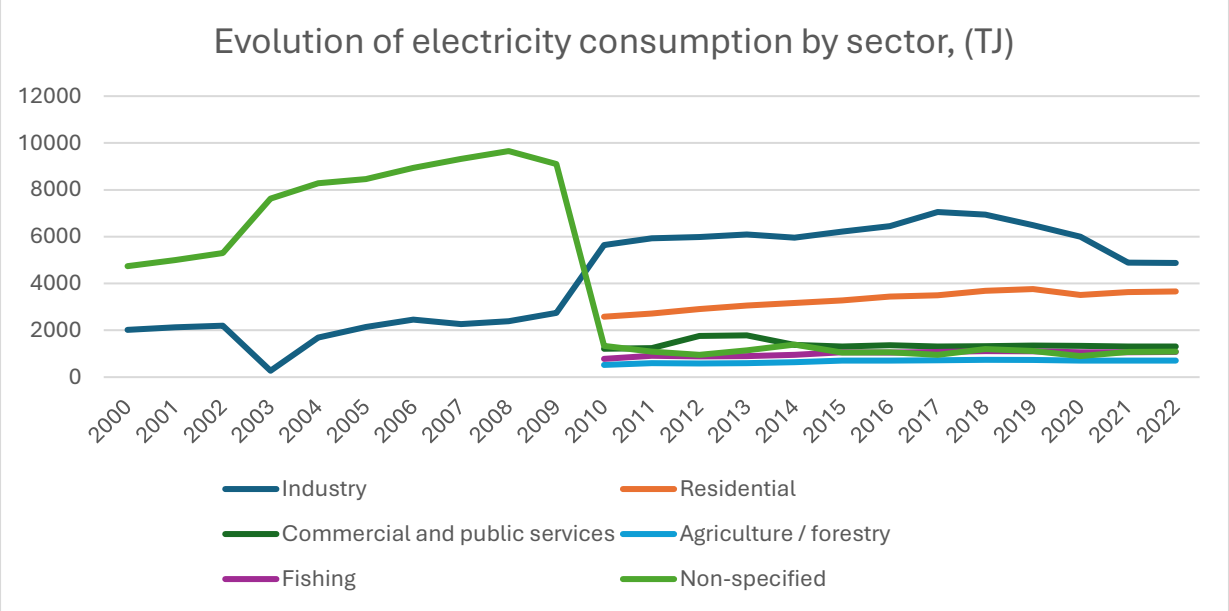


	2022
Industry	33%
Residential	25%
Commercial and public services	9%
Agriculture / forestry	5%
Fishing	7%
Non-specified	7%

Source: International Energy Agency, 2023

When viewed across a timespan from 2000 to 2022, data from the IEA in Figure 6 shows the agriculture/forestry and fishing sectors' consumption of electricity has not varied much between 2010 and 2022, but there have been increases in industry and residential consumption over the same period..

Figure 9: Evolution of Namibia's electricity consumption by sector from 2000 to 2022



Source: International Energy Agency, 2023

The graph depicting the evolution of Namibia's electricity consumption by sector from 2000 to 2022 (Figure 8) provides valuable insights into the changing patterns of energy use across different sectors, including industry, residential, commercial and public services, agriculture/forestry, fishing, and non-specified categories.

The industry sector has shown a significant increase in electricity consumption over the period from 2000 to 2022. This growth can be attributed to the expansion of industrial activities, particularly in mining and manufacturing. The mining sector requires substantial power for mineral extraction and processing and the increase in industrial consumption reflects the sector's role as a major driver of economic growth in Namibia. It is not clear from the data how much demand can be attributed to manufacturing specifically related to the energy sector.

The residential sector has also experienced a notable rise in electricity consumption. The increase in residential consumption is likely due to population growth, urbanization, and improved access to electricity. As more households gain access to modern energy services, the demand for electricity in residential areas has risen. This trend underscores the importance of expanding energy infrastructure to meet the growing needs of the population.

The commercial and public services sector has shown a steady increase in electricity consumption. The growth in this sector can be linked to the expansion of services such as retail, tourism, financial services and public administration. As the largest contributor to Namibia's Gross Domestic Product (GDP), the services sector's increasing energy demand highlights the need for reliable and cost-effective electricity to support economic activities.

The electricity consumption in the agriculture/forestry and fishing sectors has remained relatively stable over the period. The stability in these sectors suggests that their energy needs have not changed significantly. However, it is important to consider the potential for future growth in these sectors, particularly with advancements in agricultural technology and sustainable fishing practices.

There has been a dramatic change in the non-specified electricity consumption category since 2010. The significant variation in this category may be related to changes in data collection practices or the inclusion of new activities that were previously unclassified. Clarifying the reasons behind this change would provide a better understanding of the underlying factors.

Implications for Energy Policy and Economic Development

The increasing electricity consumption across various sectors supports the need for continuous investment in energy infrastructure. Expanding the grid, enhancing generation capacity, and integrating renewable energy sources are critical to meeting the growing demand.

The rise in electricity consumption presents an opportunity to accelerate the integration of renewable energy sources such as solar and wind. This would not only address the demand but also contribute to Namibia's sustainability goals, reduce reliance on energy imports and improving the country’s energy security through self-generation.

Implementing energy efficiency measures across all sectors can help manage the rising demand. Encouraging the use of energy-efficient appliances, promoting energy-saving practices, and investing in smart grid technologies are essential steps.

Given the significant increase in industrial electricity consumption, policies that support industrial growth while ensuring energy sustainability are vital. This includes providing incentives for energy-efficient industrial practices and investing in cleaner technologies.

The growth in residential electricity consumption highlights the importance of expanding access to modern energy services. Ensuring that all households, particularly in rural areas, have reliable and affordable electricity is key to social and economic development.

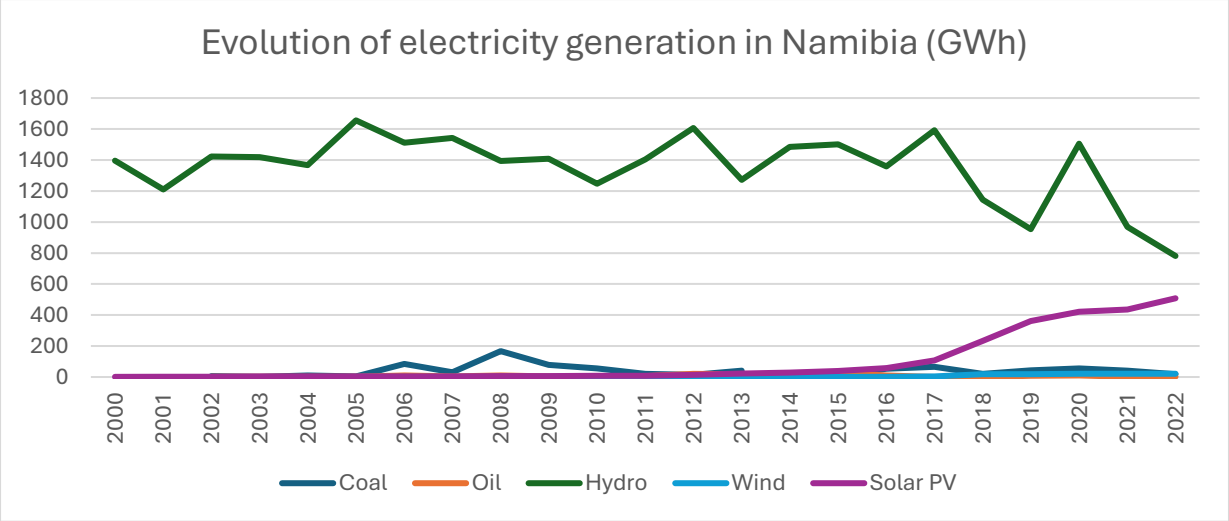
Improving data collection practices and ensuring accurate classification of electricity consumption across sectors will enhance the ability to make informed policy decisions. Understanding the specific needs and trends within each sector is crucial for effective energy planning.

Supply (by Source)

Due to limited domestic production, Namibia imports around 60 percent of its total energy demand, mainly from neighbouring countries (South Africa, Botswana and Zambia). Namibia's domestic electricity production includes thermal coal power stations while the Ruacana Hydropower Station remains the primary hydroelectricity producing facility (NamPower, 2023). Electricity generation from hydropower faces potential challenges with declining share of energy output due to protracted droughts in the Southern African region, including Zambia, which has until recently been an important source of imported electricity for Namibia.

The country is exploring domestic natural gas through the Kudu Gas Field, which has potential to reduce import dependency in the coming years, although significant investments are still required for full-scale production (National Petroleum Corporation of Namibia, 2023). Data from the IEA in Figure 9 shows the decline in electricity generation from hydropower and the rise solar PV over the last few years.

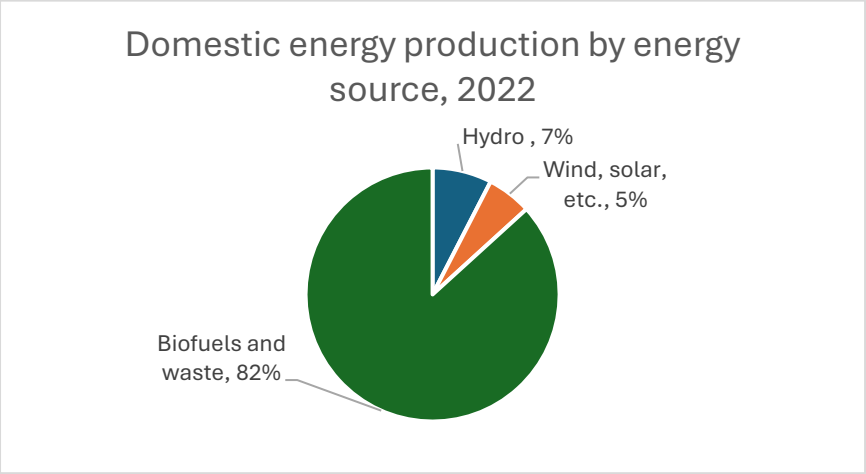
Figure 10: The evolution of electricity generation (GWh) by source from 2000 to 2022



Source: International Energy Agency, 2023

To improve its energy security, Namibia has set ambitious targets for renewable energy, aiming for 70 percent renewable energy production by 2030, an increase expected to be met by expanding solar and wind capacities (Ministry of Mines and Energy, 2023). Several solar projects, including the 20 MW Omburu Solar PV plant and the anticipated 50 MW solar farm at Khan, will help achieve this target. These projects not only contribute to local energy needs but also position Namibia to become a future exporter of clean energy to neighbouring countries (IEA, 2024). In 2022, Namibia’s local energy production was predominantly from biofuels (82 percent), followed by hydropower (7 percent) and other renewable energies (wind, solar, etc.) at 5 percent as shown in Figure 10.

Figure 11: Namibia's domestic energy production by source in 2022



Source: International Energy Agency, 2023

Namibia is also making efforts to improve energy efficiency and conservation to reduce wastage and promote sustainable consumption practices. The government has implemented various energy efficiency measures, including promoting the use of energy-efficient appliances and encouraging energy-saving practices among consumers (Ministry of Mines and Energy, 2023). In addition, the development of energy storage solutions, such as advanced battery energy storage systems, is viewed as critical to balancing supply and demand, especially for intermittent renewable sources like solar and wind (Namibia Energy Institute, 2023).

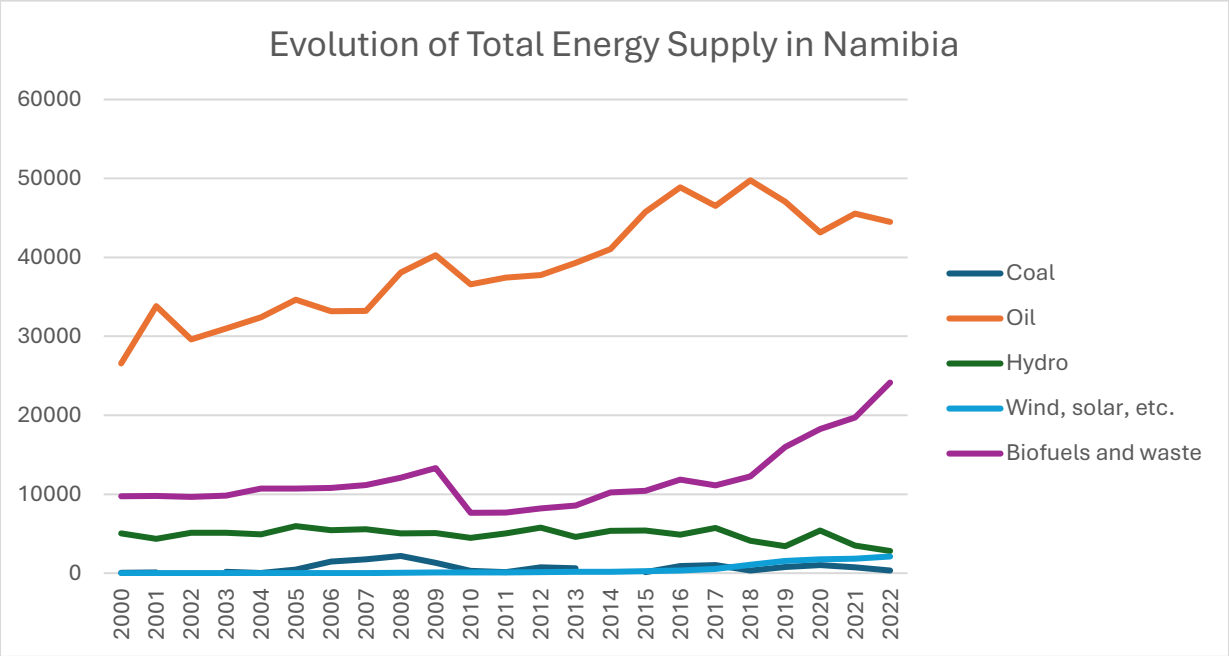
GDP Contribution

Namibia's energy sector has demonstrated robust growth, playing an increasingly significant role in the nation's Gross Domestic Product (GDP). It contributed approximately 10 percent to GDP, with a total economic output of NAD 10 billion in 2022 (Namibia Statistics Agency, 2023).

Trends show that the sector's growth is driven by substantial investments in renewable energy projects, oil exploration and infrastructure development (Namibia Statistics Agency, 2023). A view of the evolution of energy supply from 2000 to 2022 in Figure 11 shows the marked increase in biofuels and waste as energy sources with the rise of renewable energies such as wind and solar and decline in hydropower.

The use of coal remained consistent and oil has continued to be an important energy source. The oil and gas subsector remains vital for generating revenue, supporting economic development, and ensuring a diversified energy mix. However, its growth has been slower compared to renewables, with an average annual growth rate of 2 percent over the past five years (Deloitte Touché Tohmatsu Limited, 2024).

Figure 12: Historical view of Namibia's energy evolution from 2000 to 2022



Source: International Energy Agency, 2023

In 2023, the United Kingdom (UK) Department for Business and Trade reported that NAD 6bn was added to the economy from green hydrogen projects and NAD 5bn from green manufacturing and indirect/induced sectors, with the total benefits from infrastructure only partially accounted for. This positive trajectory indicates that the energy sector has the potential to more than double the size of the current economy, adding an estimated NAD 10 billion to GDP (UK Department for Business and Trade, 2023).

In addition, Namibia's Green Industrialisation blueprint seeks to establish a new growth trajectory through export markets, targeting NAD 20 billion plus, which is a five-fold increase of current national exports of NAD 4.7 billion. Projections estimate this can be achieved this by:

- NAD 12bn of green hydrogen exports (assumes 5mtpa H2e at NAD 2,400/tH2e)
- NAD 10bn from new green manufacturing sectors
- Infrastructure investment to enable improved transport and logistics

(Source: UK Department for Business and Trade, 2023)

However, when viewed against other major GDP contributing sectors, the data reveals that Namibia's energy sector is still minor by comparison (Statista 2012-2022).

1. **Agriculture**: Contributed about 8.38 percent to GDP; includes activities such as crop production, livestock farming, and fishing.

2. **Industry**: Accounted for approximately 29.7 percent of GDP; encompasses mining (including diamonds and uranium), manufacturing, and construction. Mining on its own contributes around 14 percent to the Industry GDP contribution.

3. **Services**: The largest sector, contributing around 54.2 percent to the GDP; includes tourism, financial services, retail, and public administration.

Trade and Investment

Investments in renewable energy projects are expected to drive economic growth and industrialization in Namibia, creating jobs and attracting foreign direct investment (FDI). For instance, the newly proposed Green Hydrogen initiative, supported by Germany and other nations, could place Namibia as a leader in Africa's renewable energy sector and contribute significantly to its GDP through the export of clean energy (Namibia Investment Promotion and Development Board, 2024). Namibia's energy sector reflects a balance between increasing renewable energy investments and existing dependencies on non-renewable imports. The use of coal for electricity production is expected to decline gradually as renewable energy sources become more prevalent (NamPower, 2023). With ongoing developments in solar, wind, and green hydrogen, Namibia is well-positioned to become a regional leader in renewable energy and sustainable economic growth.

Imports

Despite advances in energy production, Namibia remains reliant on energy imports. In 2022, the country imported approximately 2,700 GWh of electricity, at a cost that has reached approximately USD 5 billion annually. This dependence poses a significant financial burden and underscores the importance of expanding domestic energy production to improve energy security (NamPower, 2023).

Most of these imports came from neighbouring South Africa and Zambia. Interestingly, as shown in Figure 3 previously, Namibia also exported a small portion of its electricity, totalling 200 GWh in 2022, to neighbouring countries, which reflects the country's effort to engage in regional energy trade while still addressing its own energy security challenges (NamPower, 2023). Until such time as green hydrogen and other renewable energy projects become operational, the country continues to rely on a mix of domestic energy production and imports.

Exports

Namibia has ambitions to lead the region in renewable energy exports, particularly through green hydrogen production. The Namibian government is collaborating with international partners to establish hydrogen production facilities, with the goal of becoming a supplier to European and Southern African markets by 2030. These exports are expected to diversify Namibia's economy and increase resilience against energy imports (International Renewable Energy Agency, 2024).

Investment

In 2022, the total investment (public and private sector) in Namibia's energy sector reached NAD 5 billion. A notable portion of this investment (NAD 2.5 billion) came from FDI, as international companies, particularly those involved in solar, wind, and green hydrogen projects, began to recognize Namibia's potential in renewable energy production (Namibia Investment Promotion and Development Board, 2023). Both the government and private investors are actively collaborating to increase investment flows, aiming to position Namibia as a renewable energy hub in the region. Measures to encourage investment include initiatives such as tax incentives and partnerships with international companies to attract substantial capital (Namibia Energy Report, 2023).

Public-private partnerships are key to scaling up energy projects and encourage FDI. A successful example of this can be seen in Namibia's Renewable Energy Feed-In Tariff (REFIT) Programme (initiated in 2015 by the Electricity Control Board), which was designed to increase investments in renewable energy technologies by offering long-term contracts to renewable energy Independent Power Producers[1]. Through this programme, NamPower signed 14 Power Purchasing Agreements with various Independent Power Producers.

[1] Jan-Barend Scheepers, Namibia's Renewable Energy Feed-In Tariff (REFIT) Program, 1 year in . Economic Association of Namibia, October 2016. (https://ean.org.na/download/namibias-renewable-energy-feed-in-tariff-refit-program-1-year-in-jan-barend-scheepers/)

International financial institutions and development partners, such as the African Development Bank and the World Bank, have and continue to play an important role in funding projects, such as upgrades to electricity transmission and transport infrastructure. Key sources of FDI flows include South Africa, China and Europe and there is growing interest from Middle Eastern investors (UK Department for Business and Trade, 2023).

Renewable Energy Investment

Significant investments are being funnelled into Namibia's renewable energy sector, particularly in solar and wind energy projects (solar and wind). There is also growing interest in bioenergy initiatives, such as cultivating plants species such as Jatropha as a sustainable feedstock for biodiesel production (Brüntrup & Herrmann, 2021). The hydropower subsector has limited growth potential due to the scarcity of suitable sites for new projects and concerns around increasing prevalence of droughts in the region.

Although still in the early stages of development and project feasibility studies, significant investments are being made into the development of the Green Hydrogen subsector. For example, the Hyphen Hydrogen Energy Project, with an investment of NAD 3 billion, aims to produce 300,000 tons of green hydrogen annually (Namibia Investment Promotion and Development Board, 2023).

Oil and Gas investment

The oil and gas subsector has experienced slower growth, with an average annual growth rate of 2 percent over the past five years, largely due to fluctuating global oil prices and increasing regulatory pressures to reduce carbon emissions (Namibia Statistics Agency, 2023). The exploration of domestic natural gas through the Kudu Gas Field has the potential to reduce import dependency and contribute to the energy mix (National Petroleum Corporation of Namibia, 2023).

However, to enable the country to achieve energy self-sustainability, as outlined in its Green Industrialisation blueprint, much higher levels of investment will be required. For example, NAD 40bn is the estimated requirement to kickstart green hydrogen projects and green manufacturing industries, and over NAD 15bn to support regional connectivity and port developments (UK Department for Business and Trade, 2023).

Key infrastructure enablers identified for investment from 2024 to 2027 (and beyond)*

- **Rail:** Trans Caprivi (upgrade Walvis Bay-Tsumeb line, new rail Otavi-Katima Muilo and connection to Zambia), Trans Kalahari (upgrade Windhoek-Gobabis line, new rail to Gaberone) and Trans Orange (upgrade Lüderitz-South Africa line)
- **Port:** Lüderitz (Quay extension, Angra Point deepwater, dry/liquid bulk export terminals), Walvis Bay (North Port deepwater, container terminal upgrades and extension) and Kunene (Cape Fria HG2 derivatives port)
- **Green Hydrogen:** Southern Valley (7.5GW solar/wind power, 370ktpa hydrogen plant and desalination, 2mtpa ammonia plant, power connection to South Africa), Central Valley (GH2 Pilot projects on tugs/cranes, locomotives, green villages, refuelling, utility power, solar/ammonia plant and desalination) and Northern Valley (solar/wind/ammonia plant and diesel)
- **Electricity:** NamPower Generation, IPP generation, Transmission backbone and battery energy storage systems
- **Industrial Zones:** Lüderitz, Walvis Bay and inland Trade & Logistics hubs

Investable Industries identified with Capex by 2050*

Renewable energy hardware:

- Solar panel manufacturing located at Walvis Bay and Lüderitz - NAD 170m
- Electrolyser manufacturing located at Lüderitz or Walvis Bay – NAD 250m
- Wind turbine manufacturing located at Lüderitz and Kunene – NAD 200m

Mineral refining:

- Lithium refinery located at Walvis Bay – NAD 900m
- Rare earth elements refinery located at Walvis Bay or Kunene – NAD 300m

Low-CO2 industry:

- Flat glass production located at Walvis Bay – NAD 1,5bn

GH2 derivatives:

- Synthetic fuel production located at Walvis Bay and Kunene – NAD20bn
- Hot briquetted iron production located at Walvis Bay – NAD 6bn

*Source: Gov of Republic of Namibia. 2024. A blueprint for Namibia's green industrialisation

Workforce Profile and Detailed Labour and Workforce Analysis .

The energy sector in Namibia is a key employment driver, providing jobs in renewable energy, oil and gas exploration, and various related industries along the value chains.

The 2018 Labour Force Survey, which categorises sector employment under 'Electricity, gas and related industries', reported that there were 2,810 Employees (0.7 percent of total employment) with 314 Employers (0.7 percent of total employment) and 154 Own Account Workers (0.1 percent of total employment). Approximately 12.4 percent of the workforce in the electricity and related industries is informally employed, accounting for 408 individuals.

However, The Sectoral report February 2024 - Electricity produced by the Namibia Statistics Agency reports the energy sector employs approximately 15,000 people, representing 2.5 percent of the total workforce in Namibia. According to this 2024 Sectoral report, employment in the sector has grown by an average of 3 percent annually over the past five years and is projected to increase to 20,000 by 2030, largely driven by the expansion of renewable energy projects (Namibia Statistics Agency, 2023).

Table 2 indicates the workforce breakdown and approximate numbers of employees per sub sector that could be found according to various industry sources. It must be noted that the employment numbers cited from various sources still do not add up to the approximately 15,000 reported to be employed in the energy sector above. This raises the issue of serious discrepancies with how data is collected and organised.

Table 1: Workforce per subsector, skilled, semi-skilled and approximate number of employees

Subsector	Skilled Workers	Semi-skilled Workers	Employment Numbers
Solar Energy	Engineers, technicians, and project managers	Installation and maintenance staff	Approximately 3,000 people employed in solar energy (Namibia Renewable Energy Policy, 2021)
Wind Energy	Engineers, technicians, and project managers	Installation and maintenance staff	Approximately 1,000 people employed in wind energy (Namibia Renewable Energy Policy, 2021)
Green Hydrogen	Engineers, chemists, and project managers	Plant operators and maintenance staff	Projected to create tens of thousands of jobs by 2025 (Namibia Green Hydrogen Strategy, 2024)
Bio-mass and Biofuels	Engineers, technicians, and project managers	Plant operators and maintenance staff	Approximately 500 people employed in bio-mass and biofuels (Namibia Renewable Energy Policy)
Oil and Gas	Engineers, geologists, and project managers	Drilling and extraction staff	Approximately 4,000 people employed in oil and gas (Namibia Oil and Gas Industry Report, 2023)

Sources: Cited in text (the categories of Skilled and Semi-skilled workers listed above are not exhaustive and are provided as an illustrative example).

The bioenergy subsector is a case in point with data from 2019 indicating the charcoal subsector employed an estimated 10,000 people. Of these, around 7,700 were men and 770 were women involved in production, while 716 men and 623 women worked in processing. In the bush feed subsector, there were about 1,000 employees, primarily male. The firewood subsector, employing around 380 people, also had a predominantly male workforce. Overall, the biomass sector employed approximately 11,300 people in 2019, with the charcoal subsector accounting for 87% of the total sector employment.

A review of various reports indicates the energy sector has experienced varying growth rates across its subsectors:

- **Renewable Energy** has seen an average annual growth rate of 5% over the past five years, driven by increasing investments in solar and wind projects (Namibia Energy Institute, 2023).
- **Green Hydrogen and Ammonia** subsector is projected to grow at an annual rate of 15% over the next decade, driven by government initiatives and international investments (Hyphen Hydrogen Energy, 2023).
- **Oil and Gas** has experienced slower growth, with an average annual growth rate of 2% over the past five years (Deloitte Touché Tohmatsu Limited, 2024).

An enquiry into the unemployment across the energy sector reveals it has a relatively low unemployment rate compared to other sectors in Namibia. The sector-specific unemployment rate is estimated to be around 5%, which is significantly lower than the national average of 20% (Namibia Statistics Agency, 2023).

Employment by gender

Gender disparities in the energy sector are attributed to cultural norms, lack of access to technical education for women, and limited opportunities for career advancement (Namibia Training Authority, 2023).

The energy sector workforce is predominantly male-dominated (70 percent), especially in non-renewable subsectors such as oil and gas. Women represent 30 percent of the workforce with a higher concentration in administrative and support roles. In technical and engineering roles, women are underrepresented, accounting for only 10 percent (Namibia Statistics Agency, 2023). Table 4 shows an approximate breakdown of women's representation in the energy subsectors, which was arrived at through a consolidation of different various reports and data sources.

Table 2: Energy sector workforce gender distribution estimates by subsectors

Workforce Demographics - Gender Distribution	Renewable Energy	Green Hydrogen and Ammonia	Non-Renewable Energy
Women represent approximately 30% of the total workforce	Women represent approximately 25%	Women represent approximately 20%	Women represent approximately 15%

Source: Namibia Statistics Agency (2019); Namibia Energy Institute (2023); Hyphen Hydrogen Energy (2023); Deloitte Touché Tohmatsu Limited (2024)

Employment by education

There are no disaggregated data available on levels of educational attainment that can be attributed specifically to energy subsectors. Table 4 indicates the national statistics for the labour force in 2018 per education level. While the national education attainment levels are captured in Table 5. This breakdown reflects the tendency for skilled

and professional roles to be filled by individuals with tertiary education, while primary and secondary education levels are more common among low skilled, semi-skilled, and technical roles.

Table 3: Employment by Education level

Education Level	Subcategory	Role Representation	Education Breakdown
Primary Education	Primary	Lower representation in skilled positions; more common in low skilled or semi-skilled roles	20%
Secondary Education	Junior Secondary: 31.6% Senior Secondary: 20.2%	Higher representation in technical and semi-skilled roles	51.6%
Tertiary Education	Technical/Vocational Certificate/Diploma: 2.2% Completed year 1 or 2 or 3: 1.7% University Certificate, Diploma or Degree: 8.2% Postgraduate Certificate, Diploma or Degree: 2.5%	Predominantly in skilled and professional roles	16,07%

Sources: Namibia Labour force survey 2018

Approximately 35 percent of the national workforce holds a tertiary qualification with degrees in fields such as engineering, environmental science, and business administration (Namibia University of Science and Technology, 2023). Around 40 percent of the workforce has received vocational training, primarily through the TVET system (Namibia Training Authority, 2023), and 25 percent have only completed secondary education (Namibia University of Science and Technology, 2023).

Workforce age

Most of the workforce is between 25-45 years old, indicating a relatively young and dynamic workforce (Namibia Training Authority, 2023).

A breakdown of the energy sector workforce in the 2018 Labour Force Survey (shown in Table 6) reveals it is mainly made up of younger workers (34 years and under) representing 55 percent of the workforce, middle-aged workers (35 to 54 years) representing 35 percent, and older workers (over 55 years) representing 10 percent. This distribution highlights how workforce roles generally align with age, with younger individuals in entry-level positions and older individuals occupying more senior or managerial roles.

However, there are challenges that have been identified with predominantly young workforce, such as younger workers often lacking practical experience. Older workers may need upskilling to adapt to new technologies and there is also a need for succession planning to ensure knowledge transfer from older to younger workers (Namibia Energy Institute, 2023).

Table 4: Employment by Age

Age Group	Role Representation	Age Breakdown
15-24 years	Higher representation in entry-level positions	15%
25-34 years	Predominantly in technical and skilled roles	40%
35-54 years	Higher representation in professional and managerial roles	35%
55+ years	Predominantly in senior and managerial roles	10%

Source: Namibia Labour Force Survey, 2018

Employment Projections

Namibia's Green Industrialisation strategy estimates that if realised, it could potentially create +250k jobs. This is equal to 1/5th of the 2040 projected labour force (UK Department for Business and Trade, 2023). This projection estimates 185,000 direct jobs will come from the hydrogen industry alone, with a further 70,000 direct, indirect and induced jobs. A large number of jobs are estimated to come from related activities in infrastructure upgrades to port and rail facilities (UK Department for Business and Trade, 2023).

In the non-renewable energy sector, a recently completed industrial baseline survey for the Namibian Oil and Gas Industry shows the employment impact assessment estimates (Deloitte Touché Tohmatsu Limited 2024) that during the construction phase (6-8 years) of an oil and gas project 5,000 direct jobs, 2,000 indirect jobs and 2,500 induced jobs could be created. In the production phase, which can last an average of 20 to 25 years, this drops to an estimated 600 direct jobs, 600 indirect jobs and increases to 5,800 induced jobs that could be maintained if a project goes into development (Deloitte Touché Tohmatsu Limited 2024). This makes the exploration of Namibia's oil and gas potential attractive from a long term employment perspective.

Table 6 is a consolidation of data from various sources for projected potential energy sector employment. This reveals a substantial increase in estimated numbers, which if achieved would have a significant impact on Namibia's population.

Table 5: Projected energy sector employment data

Total Energy Sector Employment	Renewable Energy	Green Hydrogen and Ammonia	Non-Renewable Energy
Approximately 50,000 individuals	Approximately 30,000 individuals	Approximately 10,000 individuals	Approximately 10,000 individuals

Source: Namibia Energy Institute (2023); Hyphen Hydrogen Energy (2023); Deloitte Touché Tohmatsu Limited (2024)

Table 6: Quantitative labour market modelling results for the green hydrogen and ammonia sub-sector, solar and wind energy sector, bioenergy sector, and oil and gas sector in terms of temporary, permanent and direct employment effects

Sub-Sector	Temporary Employment (FTE)	Permanent Employment (FTE)	Direct Employment Effects	Sources
Green Hydrogen and Ammonia	23,151 per annum during the four-year construction phase	26,700 permanent jobs, with 69% projected to be taken up by women	3,867 FTE per annum for solar and wind installation over four years	Namibian Statistics Agency (2019), ILO (2020), Jiang and La Marca (2023)
Solar and Wind Energy	Solar: 7.42 FTE/MW (e.g., 7,420 FTE for 1000 MW)	Solar: 0.58 FTE/MW (e.g., 580 FTE for 1000 MW)	Solar: 3,867 FTE per annum for installation over four years	IRENA (2020), Namibian Statistics Agency (2019)
	Wind: 5.29 FTE/MW (e.g., 5,290 FTE for 1000 MW)	Wind: 0.22 FTE/MW (e.g., 220 FTE for 1000 MW)	Wind: 3,867 FTE per annum for installation over four years	IRENA (2020), Namibian Statistics Agency (2019)
Bioenergy	4-6 FTE/MW (e.g., 400-600 FTE for 100 MW)	0.5-1 FTE/MW (e.g., 50-100 FTE for 100 MW)	400-600 FTE for construction of 100 MW bioenergy plant	IRENA (2020), Namibian Statistics Agency (2019)
Oil and Gas	10-15 FTE per million dollars of investment (e.g., 10,000-15,000 FTE for $1 billion project)	1-2 FTE per million dollars of investment (e.g., 1,000-2,000 FTE for $1 billion project)	10,000-15,000 FTE for construction of $1 billion oil and gas project	World Bank (2020), Namibian Statistics Agency (2019)

Sources: Cited above and expanded in footnote[2]

Notes: FTE – Full Time Equivalent

Wages and Retention Rates

Wages in the energy sector are notably higher than the national average. The average monthly wage for workers in the energy industry is NAD 15,000, compared to the national average of NAD 10,000 (Namibia Statistics Agency, 2023). However, there are significant wage disparities within the sector. Skilled workers earn an average of NAD 20,000 per month, while low skilled workers earn considerably less, at an average of NAD 8,000 per month (Namibia Statistics Agency, 2023).

Overall, the energy sector has a relatively high retention rate, with an annual turnover rate of 10 percent. This is lower than the national average turnover rate of 15 percent (Namibia Energy Institute, 2023). Key factors influencing retention include job security, competitive wages, and opportunities for career advancement (Namibia Training Authority, 2023). However, retention challenges exist in certain areas:

[2] Namibian Statistics Agency (2019), The Namibia Labour Force Survey 2018 Report, Namibian Statistics Agency, Windhoek, Namibia, Accessed on: https://nsa.nsa.org.na/wp-content/uploads/2021/05/Labour_Force_Survey_final_-_2018.pdf
International Labour Organization (ILO), ILOSTAT database, Accessed on: https://ilostat.ilo.org/
Jiang and La Marca (2023), Assessment Report for Zambian Great North Road Upgrading Project
International Renewable Energy Agency (IRENA), 2020, Renewable Energy and Jobs – Annual Review 2020, International Renewable Energy Agency, Abu Dhabi, Accessed on: https://www.irena.org/publications/2020/Sep/Renewable-Energy-and-Jobs-Annual-Review-2020
World Bank (2020), Oil and Gas Industry Employment Statistics, World Bank, Washington, D.C., Accessed on: https://www.worldbank.org/en/topic/oil-and-gas

- **Renewable Energy**: High demand for skilled workers has led to increased competition and higher turnover rates in the renewable energy subsector (Namibia Energy Institute, 2023).
- **Bioenergy (mainly biomass)**: The average monthly salary in this subsector was about NAD 2,550, with an annual salary of approximately NAD 23,000 correlating with a largely rural workforce.
- **Green Hydrogen and Ammonia**: As an emerging subsector, retention rates are currently stable, but they may fluctuate as the sector grows and competition for talent increases (Hyphen Hydrogen Energy, 2023).
- **Non-Renewable Energy**: The oil and gas subsector has relatively stable retention rates, but it faces challenges in attracting and retaining young talent due to the sector's slower growth and limited job creation (Deloitte Touché Tohmatsu Limited, 2024).

Business environment

The energy sector's growth and competitiveness are inextricably linked to the business environment in which it operates. Globally Namibia is ranked 104th by the World Bank for ease of doing business and 9th in the Sub-Saharan region[3]. It also ranks 76th in terms of getting electricity. An overview of key macro-environmental factors such as the political, economic, social and environmental conditions provides some context for understanding what is required for a enabling business environment.

Political Factors

Namibia is a democratic country recognized for its political stability since achieving independence in 1990. This stability provides a favourable environment for long-term investments and reduces the risks typically associated with energy projects, thus encouraging investment (World Bank, 2023). The government has strong social development mandate and has demonstrated robust support for the energy sector, particularly through policies that promote renewable energy and oil and gas exploration. For instance, the National Renewable Energy Policy and the National Integrated Resource Plan aim to increase the share of renewable energy in the country's energy mix (Ministry of Mines and Energy, Namibia, 2023).

Furthermore, Namibia's good international relations with neighbouring countries and global partners facilitate cross-border energy trade and attract foreign investment to the sector (Namibia Investment Promotion and Development Board, 2023). Namibia's role in the global energy transition also ties into broader goals of regional energy security within the Southern African Development Community (SADC). As neighbouring countries look to diversify their energy sources and reduce dependency on fossil fuels, Namibia's renewable energy resources could offer a stable, sustainable energy supply. Its contribution could thus play a key role in enhancing energy security for regional and national socio-economic development while advancing sustainable development practices. However, careful governance will be essential to ensure that the country's energy projects foster positive environmental and social outcomes for its citizens.

Economic Factors

Namibia ranks in the top ten for GDP per capita in Sub-Saharan Africa. It is one of Africa's few upper-middle income countries with an average GDP growth rate of +3.5 percent between 1990 and 2023. However, in recent years growth has stagnated and it remains one of the most unequal countries in the world despite its relatively high incomes (per capita income has doubled in constant USD terms).

There is a prominent north-south divide with the northern regions more densely populated and reliant on subsistence farming. The southern regions are more arid and sparsely populated but are home to more commercial activity, largely due to economic linkages with its main trading partner, South Africa.

[3] Retrieved from: https://archive.doingbusiness.org/en/data/exploreeconomies/namibia

Namibia has good economic infrastructure and plays an important role in connecting land-locked neighbours to export routes but relies heavily on imported electricity. The energy sector operates within a comprehensive regulatory framework that includes the Electricity Act, the Renewable Energy Policy, and the National Integrated Resource Plan. These regulations provide a structured environment for sectoral growth and set the guidelines for energy production, distribution, and consumption (Ministry of Mines and Energy, Namibia, 2023). However, energy projects currently require multiple licenses and permits, and the complexity of the processes can be time-consuming and impact project implementation. Streamlining these processes is essential for attracting investment and expediting project implementation (Namibia Energy Institute, 2023).

Intellectual property rights protections in Namibia are robust, fostering innovation and encouraging technology providers to invest in the energy sector. Patent laws support the development and commercialization of new technologies (World Intellectual Property Organization, 2023).

Social Factors

At only 3m, Namibia's population is small and sparsely distributed with a population growth rate of 2.1 percent per annum. With only a handful of major towns, led by Windhoek, recent rapid urbanisation is set to continue with urban areas expected to account for 60 percent of the population by 2030. This urbanization trend creates new opportunities for energy projects, particularly in urban infrastructure and smart city initiatives (Namibia Statistics Agency, 2023).

Energy access remains a constraint with only 56 percent of the total population reported to have access to electricity in 2020. This is further compounded in rural areas where sparse, low population density makes electrification difficult with only 35 percent of the rural population having access to electricity. Only about 40% of the country's electricity needs can be met from its own generation[4]. Despite this, there has been a positive trend in access to electricity, which has increased by 100 percent between 1990 and 2023, with 55 percent of the population having regular access.

Poverty remains significant, heavily constraining living standards outside of urban centres. According to UNHABITAT 2021 the informality rate is relatively high with approximately **40% of the population** living in informal settlements, which often lack access to basic services such as water, sanitation, and hygiene. Additionally, around **33.4% of the labour force** operates fully within the informal economy, and another **17.4% are employed informally**. NAMSTATS 2016

Although people living below the poverty line has halved between 1990 and 2023, the persistence of poverty in certain areas and household is strongly associated with the exclusion of many Namibians from the mainstream economy. Many Namibians, because of their level of education, location or health, cannot participate fully in the modern economy and are therefore vulnerable to falling into and remaining in poverty.

Despite the challenges of inequality and poverty, health and education coverage is good with high attendance rates at schools. Although 92% of the population are literate, secondary education outcomes are poor in comparison with other southern and east African countries (Gov of Republic of Namibia. 2024. A blueprint for Namibia's green industrialisation).

Growing public awareness and acceptance of renewable energy sources are driving the demand for skills in the renewable energy subsector. Community engagement and education initiatives, such as the Renewable Energy Awareness Campaign, have played an important role in promoting renewable energy adoption (Namibia Energy Institute, 2023). For instance, the Omburu Solar PV Park has received strong community support, employing 50 individuals and contributing to local development (Namibia Energy Institute, 2023).

[4] Retrieved from: https://www.giz.de/en/downloads/giz2022-en-sector-brief-namibia-renewable-energy.pdf

Environmental Factors

The country's landscapes are defined by extreme aridity and low precipitation with the Great Escarpment splitting the country into a barren coastal strip and the more elevated Central Plateau, where the vast majority of the population live and work. Namibia has poor soil fertility with most of the country poorly suited for high production agriculture. These conditions significantly influence what the country can produce and why there is growing interest in alternative land use such as the use of water consuming alien invasive plant species for bioenergy fuels e.g. charcoal.

As a water scarce country, Namibia is committed to addressing climate change the impacts of which are already being experienced through unpredictable rainfall on the country's hydropower production. Recent and ongoing droughts in neighbouring countries, such as Zambia that rely heavily on hydropower, may result in energy exports to Namibia being curtailed or becoming unavailable. Environmental factors impacting the country's from which Namibia imports electricity present potential risks to Namibia's energy security.

The country's abundant natural resources, such as high solar irradiation and significant wind potential, are being utilized to reduce dependency on fossil fuels (Namibia Energy Institute, 2023). Environmental regulations governing energy projects are stringent, ensuring sustainable project development. Environmental impact assessments (EIAs) are mandatory for all major energy projects, ensuring compliance with environmental standards (Ministry of Environment, Forestry and Tourism, 2023). The Ministry of Environment, Forestry and Tourism (MEFT) provides data on environmental impact assessments for renewable energy projects, highlighting land use changes and biodiversity effects (Source: MEFT 2021, Environmental Impact Assessments for Renewable Energy Projects).

Business Structure

The energy sector in Namibia is diverse and consists of various enterprises ranging from micro to large in size. The quantitative data on the business sector within the energy industry is highly fragmented but can be categorized based on the size of enterprises. This categorization helps to illustrate the structure of Namibia's energy sector, where small and medium enterprises play a vital role in fostering innovation and sustainable practices, while large enterprises contribute to significant infrastructure and energy production projects.

Small Enterprises

Small-scale enterprises in Namibia's energy sector generally focus on renewable energy solutions for the domestic market such as solar panel installations, small-scale wind turbines, and biomass energy projects. In Namibia's energy sector, micro, small, and medium enterprises (MSMEs) are estimated to play a significant role in driving economic activity.

There are approximately 10,000 micro-enterprises, each with an estimated turnover of less than NAD 1 million, 3,000 small enterprises with turnovers ranging between NAD 1 million and NAD 3 million (typically employ fewer than 30 people) and 2,000 medium enterprises generating turnovers between NAD 3 million and NAD 10 million. While these figures provide a general estimate, they are not specifically disaggregated for the energy sector, reflecting broader MSME trends in the country.

Namibia has approximately 15,000 micro, small, and medium enterprises (MSMEs) across all sectors, contributing significantly to the country's economy. However, the available data is not disaggregated for the energy sector specifically. (**Namibia Hub**: "List of SMEs in Namibia." Last modified October 2020. https://namhub.com/list-of-smes-in-namibia.)

Medium Enterprises

Medium-sized enterprises in the energy sector are more established and often involved in larger renewable energy projects such as wind farms, solar power plants, and biofuel production. These businesses usually employ between

31 and 100 people and have an annual turnover of up to NAD 10 million. While specific data for medium enterprises within the energy sector is not readily available, they are an important part of the sector's growth, contributing to both the expansion of renewable energy infrastructure and local employment opportunities, often in the services and ancillary suppliers categories.

Large Enterprises

Large enterprises in Namibia's energy sector include major national and international companies that undertake extensive energy projects. These projects include large-scale solar farms, wind energy initiatives and oil and gas exploration activities. Large enterprises typically employ more than 100 people and have annual turnovers exceeding NAD 10 million. Key players in this category include NamPower, the national power utility, and international oil companies such as Total Energies, Chevron, Shell, and ExxonMobil, Hyphen Energy, HDF Energy, Cleanergy and the Daures Green Hydrogen Village, which are involved in major energy projects across the country (Namibia - The Energy Year, 2024).

Table 1 highlights Namibia's major energy sector projects, their respective capacities and employment estimates.

Table 7: Major Projects (operational and planned) and employment per subsector

Solar Energy Projects	**Capacity**	**Location**	**Status**	**Employed**
Omburu Solar PV Park	20 MW	Near Omaruru	Operational	50
Otjiwarongo Solar PV Park	5 MW	Otjiwarongo	Operational	20
Arandis Solar Plant	3.4 MW	Arandis	Operational	15
Khan Solar Project	45 MW	Near Usakos	Planned - 2025	100 est.
Mariental Solar Farm	37 MW	Mariental	Planned - 2025	80 est.
Wind Energy Projects	**Capacity**	**Location**	**Status**	**Employed**
Ombepo Wind Farm	5 MW	Near Lüderitz	Operational	30
Lüderitz Wind Power Project	40 MW	Lüderitz	Planned - 2025	150 est.
Walvis Bay Wind Farm	30 MW	Walvis Bay	Planned - 2025	120 est.
Hydropower Projects	**Capacity**	**Location**	**Status**	**Employed**
Ruacana Hydropower Station	330 MW	Ruacana	Operational	100
Baynes Hydropower Project	600 MW	Kunene River (JV with Angola)	Planned - 2026	300 est.
Green Hydrogen Projects	**Capacity**	**Location**	**Status**	**Employed**
Hyphen Hydrogen Energy Project	300,000 tons of green hydrogen annually	Tsau Khaeb National Park	Development Stage	200
Daures Green Hydrogen Village	Pilot project	Daures	Planned - 2025	50 est.
Cleanergy Solutions Namibia	Ammonia and fertilizer production	Various locations	Planned - 2025	100 est.
Bioenergy Projects	**Capacity**	**Location**	**Status**	**Employed**
Cleanergy Solutions Namibia Biofuels Pilot	Pilot project	Various locations	Pilot Stage	20
NamBio Biofuels Project	50 million litres annually	Various locations	Planned - 2025	150 est.
Thermal Power Projects	**Capacity**	**Location**	**Status**	**Employed**
Van Eck Power Station	120 MW	Windhoek	Operational	80
Walvis Bay Thermal Power Plant	50 MW	Walvis Bay	Planned - 2025	100 est.
Cross-Cutting Projects	**Capacity**	**Location**	**Status**	**Employed**

Renewable Project	Green hydrogen integration into national grid	Various locations	Development Stage	50
National Grid Expansion and Modernization	N/A	Nationwide	Planned - 2025	200 est.

Sources: "Bioenergy Value Chains in Namibia: Opportunities and Challenges for Rural Development and Food Security" by Michael Brüntrup and Raoul Herrmann.; "Bioenergy in Namibia" by Detlof von Oertzen.; "Namibia's National Electrification Funding Portfolio" by the Ministry of Mines and Energy.; "Energy Profile Namibia" by the International Renewable Energy Agency (IRENA).

Institutional Mapping

Namibia's development trajectory is guided by a long-term development framework, **Namibia Vision 2030 (2004)**, which emphasizes the importance of sustainable and reliable energy to support socio-economic development and provides some quantitative targets and projections. This foundational document outlines the country's ambitions to transform into a prosperous and industrialised nation by 2030.

Vision 2030's strategic goals are articulated through iterative 5-year cycles of the **National Development Plan (NDP5 2017)**, which is currently in its 5th iteration with draft version 6 due to be tabled in 2024, the **Harambee Prosperity Plan II (HPP2, 2021)** and other supportive legislation. Strategic goals embedded in Vision 2030 and the National Development Plan (NDP5) further outline a roadmap for Namibia's energy sector. Vision 2030, for instance, seeks a diversified, sustainable energy mix by 2030, emphasizing renewable energy integration and sustainability (National Planning Commission, 2004).

NDP5 aligns energy goals with broader national development objectives, emphasizing energy access, economic growth, and environmental stewardship (National Planning Commission, 2017). The NDP5 and HPP2 include focus areas on expanding energy access, improving energy security, and increasing the share of renewables in the energy mix.

The **Sixth National Development Plan** (**NDP6** 2025/2026 – 2030/2031), which is currently in draft format, is titled Fostering Recovery, Inclusiveness, and Resilience for Quality and Sustainable Development. The Focus Areas described under Water and Energy Infrastructure identify particular Desired Outcomes as follows:

DO1: By 2030, Namibia will have a sustainable mix of the locally generated energy capacity from 33 percent to achieve 80 percent self-sufficiency.

DO2: By 2030, Namibia's access to electricity to support industry and household development increased from 50 percent to 60 percent.

National policies and strategies

Namibia's energy sector is shaped by a range of policies and strategies that reflect the government's commitment to a secure, sustainable, and affordable energy supply, with emphasis on energy security, economic competitiveness, social upliftment, and environmental sustainability.

The original **White Paper on Energy Policy (1998)** established Namibia's long-term energy vision. It sought to promote effective governance by establishing regulatory institutions, encouraging investment through favourable policies, and prioritizing sustainable growth by balancing economic development with environmental and social considerations (Ministry of Mines and Energy, 1998).

The National Energy Policy, National Renewable Energy Policy and the National Integrated Resource Plan provide a supportive framework for the development of renewable energy projects.

These policies emphasize the importance of skills development and workforce planning. Furthermore, as the energy sector is a capital intensive, the country's policy documents highlight the need for increasing domestic content.

Key government policies include:

- The White Paper on Energy Policy (1998)
- Renewable Energy Feed-In Tariff (REFIT) Programme (2011)
- National Integrated Resource Plan (2016)
- The National Energy Policy (2017)
- National Renewable Energy Policy (2017)
- Namibia Green Hydrogen and Derivatives Strategy (2022)

The **National Integrated Resource Plan (NIRP)** provides a comprehensive framework for the development of Namibia's energy sector. It includes plans for expanding renewable energy capacity, improving energy efficiency, and enhancing energy security. The NIRP emphasizes the importance of a skilled workforce in achieving these goals and outlines measures for skills development and capacity building (Ministry of Mines and Energy, 2023).

The **National Energy Policy (2017)** is a foundational document that highlights these priorities, establishing a framework for energy supply that is secure, affordable, and sustainable, emphasizing energy security, economic competitiveness, social upliftment, and environmental sustainability. The policy focuses on reliable energy access for underserved populations and encourages environmentally friendly energy practices (Ministry of Mines and Energy, 2017).

Complementing this, the **National Renewable Energy Policy (2017)** focuses specifically on the development and integration of renewable energy sources like solar, wind, and biomass as well as integrating green hydrogen production aiming to increase renewable energy's contribution to Namibia's energy mix. A cornerstone of this policy is fostering a conducive environment for private sector investments in renewable energy projects (NamPower, 2020).

In addition, the following Acts and Regulations also have an impact on Skills Development and Employment in Namibia's Energy Sector:

- **Labour Act (Act No. 11 of 2007):** consolidates and amends labour laws, establishing comprehensive labour rights and protections. It regulates terms and conditions of employment and ensures the health, safety, and welfare of employees (Government of the Republic of Namibia, Labour Act, 2007).
- **Electricity Act (Act No. 4 of 2007)**: governs the production, distribution, and consumption of electricity in Namibia. It provides the legal framework for the regulation of the electricity sector, including licensing and permitting processes, tariff setting, and consumer protection. The Act also supports the integration of renewable energy sources into the national grid (Ministry of Mines and Energy, 2023).
- **Petroleum Products and Energy Act (Act No. 13 of 2007)**: regulates the oil and gas subsector as well as the production, importation, and distribution of petroleum products and energy in Namibia (Government of the Republic of Namibia, Petroleum Products and Energy Act, 1990).
- **Higher Education Act (Act No. 23 of 2006):** regulates higher education through the National Council for Higher Education, which provides for the registration, deregistration and closure of private higher education institutions; funding of public higher education institutions; and a panel of enquiry into the affairs of higher education institutions.
- **Vocational Education and Training Act (Act No. 1 of 2008):** regulates the provision of vocational education and training through the Namibia Training Authority; provides for funding of vocational education and

training as well as the imposition of vocational education and training levy. It also covers the appointment of inspectors and designation of quality system auditors.

- **MSME Policy 2016:** major objectives of the policy are to foster the development of MSMEs by adopting international good practices for modernisation and upgrading of technology

Policies on green transition (commitments and goals related to the sector)

Namibia's long-term development framework, **Vision 2030**, integrates sustainable energy goals, outlining an ambitious vision that includes the transition to a diversified, resilient energy mix. These long-term objectives are embedded in the **NDP5**, which links energy sector goals to broader national development objectives (National Planning Commission, 2017).

The **National Climate Change Strategy and Action Plan (2013-2020)** also plays a pivotal role in Namibia's energy policy landscape, focusing on mitigating climate change impacts and mainstreaming climate resilience across sectoral policies (National Planning Commission, 2013). The country's Climate Change Policy aligns with global decarbonization goals and commits to reducing greenhouse gas emissions by 30 percent by 2030. The policy promotes the adoption of renewable energy technologies and energy efficiency measures, and highlights the need for skills in environmental management and sustainability (Ministry of Environment, Forestry and Tourism, 2023).

More recently, Namibia released its updated **Nationally Determined Contribution (NDC) Measures for the Energy Sector (2023).** This document outlines eight key mitigation measures to address energy-related emissions and are summarised in Table 8. These measures aim to accelerate the transition to renewable energy sources, improve energy efficiency, and reduce reliance on fossil fuels across various sectors.

Table 8: Nationally Determined Contribution Measure for the Energy Sector, 2023

Measure	Sector	Description
Measure 1	Energy Industries – Electricity Generation	Substitute fossil fuels with renewable resources for electricity generation.
Measure 2	Energy Industries – Electricity Use	Implement energy efficiency measures in electricity consumption.
Measure 3	Transport – Road Transportation	Transition from fossil fuels to green hydrogen (H_2) and electric vehicles (EVs).
Measure 4	Transport – Rail	Replace diesel and heavy fuel oil (HFO) locomotives with green hydrogen-powered ones.
Measure 5	Commercial and Institutional	Increase reliance on renewable energy for lighting and water heating systems.
Measure 6	Residential	Transition from fuelwood and fossil products to renewable electricity; replace water heaters with solar-powered systems.
Measure 7	Agriculture	Use solar energy as a substitute for fossil fuels.
Measure 8	Fishing	Convert fossil fuel-powered fishing vessels to run on green hydrogen.

Source: Namibia NDC, 2023

Sectoral policies and strategies

In 2024, Namibia introduced its **Green Industrialisation Blueprint**, a forward-looking strategy aimed at leveraging renewable energy resources and green hydrogen to drive economic growth through the development of clustered zones (known as the Northern, Central and Southern "green valleys") as well as significant upgrades to its port and rail infrastructure. This blueprint underscores Namibia's intent to become a leader in green industrialization, positioning its renewable resources as a key economic driver (Ministry of Mines and Energy, 2024).

Key interventions to support these policy and strategy goals include large-scale **renewable energy projects** in solar and wind, green hydrogen and ammonia development, and bioenergy production aimed at increasing domestic energy production and reducing reliance on imports. Specifically, Namibia's Green Hydrogen Strategy is positioning the country as a global leader in hydrogen production and export, contributing to the international energy transition (Ministry of Mines and Energy, 2023).

Namibia's **Green Hydrogen Strategy** is an ambitious and forward-thinking plan set to transform the country into a global powerhouse in hydrogen production with the aim of producing 10 million metric tons of green hydrogen annually by 2030. This strategy not only positions Namibia at the forefront of the green energy revolution but also promises to generate thousands of employment opportunities, driving sustainable economic growth.

The strategy includes establishing a robust regulatory framework, developing shared infrastructure, launching pilot projects to build local expertise, and implementing capacity-building programs. These initiatives are designed to ensure Namibia can meet global energy demands while contributing significantly to global decarbonization efforts.

Key interventions, programmes and investments

Initiated in 2015, Namibia's **Renewable Energy Feed-In Tariff (REFIT) Programme (2011)** can be considered successful as it addressed one of the major institutional challenges in the sector by contracting independent power producers to develop renewable energy assets. The REFIT Programme was designed to increase investments in renewable energy technologies by offering long-term contracts to renewable energy Independent Power Producers. Through this programme, NamPower signed 14 Power Purchasing Agreements with various Independent Power Producers. The REFIT programme has led to the installation of 70 MW of renewable energy capacity, with subsidies and incentives playing an important role (Economic Association of Namibia, 2016).

The **National Electrification Funding Portfolio (2021)** focuses on expanding access to electricity in rural areas through diversified funding sources, addressing equity and inclusivity within Namibia's energy strategy (NamPower, 2021). This includes support for the Rural Electrification Programme.

Other significant initiatives, such as the **Invest in Namibia Roundtable** and the **National Youth Tax Incentive and Internship programme,** have also created platforms for stakeholders to discuss recent advancements in the energy sector, including new discoveries in oil and gas, the development of the green hydrogen value chain, and the expansion of renewable energy resources. This multi-stakeholder approach is supported by various institutions responsible for implementing and regulating Namibia's energy strategy.

Institutional/stakeholders' mapping

The **National Planning Commission (NPC)** coordinates development planning across sectors, ensuring that energy sector strategies align with national development goals. The **Ministry of Mines and Energy** is the government

department responsible for the development and implementation of Namibia's energy policies and regulations, ensuring sustainable and secure energy supply.

Other government ministries with mandates related to the energy sector are the **Ministry of Labour, Industrial Relations and Employment Creation** (labour market information, skills development policies, and employment statistics), **Ministry of Agriculture, Water, and Forestry** (environmental regulations) and the **Ministry of Higher Education, Technology and Innovation,** which oversees the **Namibia Training Authority (NTA)**.

Several state-owned and semi-autonomous institutions play critical roles in the energy landscape, ensuring compliance with regulations and promoting investment in energy infrastructure, as summarised in Table 9:

Table 9:State-Owned and Semi-Autonomous Institutions

Institution	Role
Electricity Control Board (ECB)	Oversees NamPower, regulates electricity supply, tariffs, and licensing.
Petroleum Commissioner	Regulates the oil, gas, and petroleum sectors.
National Petroleum Corporation (NAMCOR)	Manages petroleum exploration and production in upstream and downstream value chains.
Namibia Investment Promotion and Development Board (NIPDB)	Promotes investment and business development in Namibia.
Namibia Green Hydrogen Programme	Coordinates Namibia's green hydrogen initiatives as an entity under the Ministry of Mines and Energy.
Namibia Statistics Agency (NSA)	Provides official data and statistics on employment, economic performance, and energy-related statistics.
Petroleum Training and Education Fund (PETROFUND)	Offers scholarships and supports capacity building in the petroleum sector.
National Commission on Research, Science, and Technology (NCRST)	Promotes research and development in energy and technology.

Source: Author compiled

Table 10 summarises relevant energy sector research institutions and think tanks (more detail on educational institutions and training providers are covered in the skills provision section later in the report).

Table 10: Research Institutions and Think Tanks

Institution	Role
Namibia University of Science and Technology (NUST)	Conducts renewable energy research and provides skills development.
University of Namibia (UNAM)	Publishes studies and research papers on energy and economic development.
Namibia Energy Institute (NEI)	Focuses on energy research, education, and training.

Namibia Green Hydrogen Research Institute	Advances green hydrogen energy science and research.
Institute for Public Policy Research (IPPR)	Produces reports and policy briefs on economic and energy issues.
Th!nk Namibia Campaign	Educates the public on environmental issues and renewable energies.
Hanns Seidel Foundation	Promotes democratic values, economic growth, and environmental stewardship.

Industry associations and private sector organisations are summarised in Table 11:

Table 11: Industry Associations and Private Sector

Association/Organization	Role
Namibia Employers' Federation (NEF)	Advocates for labour laws and policies beneficial to the energy sector.
Namibia Chamber of Commerce and Industry (NCCI)	Addresses skills gaps and collaborates on training programs.
Namibia Renewable Energy Association (NAMRENA)	Offers workshops and capacity-building programs in renewable energy.
Renewable Energy Industry Association of Namibia (REIAoN)	Provides information on renewable energy trends and skills needs.
Namibia Charcoal Association (NCA)	Represents charcoal producers, and companies such as Carbo Charcoal Namibia and Etosha Charcoal Namibia.
Namibia Biomass Industry Group (N-BiG)	Promotes biomass innovation and market diversification.
Namibian Petroleum Operators Association	Facilitates collaboration between government and private entities.
Green Hydrogen Association	Engages public and private entities in green hydrogen initiatives.

Trade Unions and workers organisations/federations that are relevant to the energy sector, including those that are official ILO constituents, are summarised in Table 12.

Table 12: Trade Unions and Workers' Organizations

Trade Union/Federation	Role
National Union of Namibian Workers (NUNW)	Represents workers and is affiliated with the ruling party (SWAPO).
Trade Union Congress of Namibia (TUCNA)	Represents workers independently of political affiliations.

Namibia National Labour Organization (NANLO)	Advocates for workers' rights, including those in the energy sector.
Namibia Informal Sector Organization (NISO)	Represents workers in the informal sector.
Mineworkers Union of Namibia (MUN)	Represents workers in energy-related mining activities.
Metal and Allied Namibian Workers Union (MANWU)	Covers workers in energy-adjacent industries like construction.
Namibia Transport and Allied Workers Union (NATAU)	Represents workers in energy transportation sectors.

Various development partners also contribute to the advancement of the energy sector in Namibia. International organisations with energy-related programmes or interests in Namibia are summarised in Table 13.

Table 13: International Organizations and Development Partners

Organization	Role
International Labour Organization (ILO)	Provides technical assistance and supports skills strategies in the energy sector.
World Bank	Conducts economic and energy sector assessments.
United Nations Development Programme (UNDP)	Funds training initiatives and supports energy policy development.
Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL)	Implements green hydrogen and adaptive land management projects.

International and regional market trends and key drivers of change for Namibia

This section explores Namibia's energy sector position and trends within international and regional markets. The following trends and drivers demonstrate the interconnected nature of global and regional energy markets and underscore the opportunities for Namibia to develop a sustainable energy sector through innovation, policy support, and international cooperation.

International Trends

Global Shift to Clean Energy

The global energy sector is undergoing a significant transition toward clean and renewable energy sources, largely driven by international climate commitments and decreasing costs of renewable technologies (Energy Information Administration, 2022; International Energy Agency, 2021). The renewable energy sector is experiencing rapid growth, driven by technological advancements and increasing investments powered by critical energy transition minerals. The International Renewable Energy Agency (IRENA) reports that global renewable energy capacity

reached 2,799 GW in 2020, with solar and wind energy accounting for the majority of new installations (IRENA, 2021). Namibia's energy sector is influenced by these global trends, particularly in terms of technology adoption and investment flows.

Green Hydrogen Market Growth

Green hydrogen has garnered substantial international interest as a promising clean energy source. Namibia, recognizing its natural resources and geographic advantages, is strategically positioning itself to become a leading player in this emerging market (International Renewable Energy Agency, 2021). The government has ambitious plans to develop green hydrogen projects, which are expected to create significant economic and employment opportunities and support global climate goals (Hyphen Hydrogen Energy, 2021).

Technological Innovation

Advancements in energy storage, smart grids, Power to X (PtX) technologies and digitalization are reshaping the global energy landscape. These innovations play a critical role in integrating renewables into national grids and enhancing energy efficiency, offering models that can be adapted to Namibia's context (World Bank, 2021).

Regional Trends

Renewable Energy Expansion and Cooperation

In Southern Africa, including Namibia, there is a marked shift towards renewable energy investments, particularly in solar and wind power. This trend is driven by a need to reduce dependence on fossil fuels and enhance energy security (Southern African Development Community, 2021).

Increased regional cooperation is a key trend within the Southern African energy sector and Namibia's trade relationships with neighbouring countries are vital for its energy sector. The Southern African Power Pool (SAPP), for example, enables cross-border electricity trade, fostering energy trade stability and resource optimization within the region (African Union, 2020). The Southern African Development Community (SADC) plays a significant role in facilitating regional energy trade and cooperation and Namibia's participation in regional trade agreements has enhanced its energy security and market access (SADC, 2023).

Energy Access Initiatives

In recent years Namibia has made enormous progress to attract independent power producers, which is opening the electricity market to domestic and international investors. The government plans to build on this by positioning Namibia at the centre of a regional opportunity for green growth by fostering strategic cooperation and two-way trade in southern Africa. The intention is to increase trade and export capacity for land locked countries through improved economic linkages and economies of scale, which includes increasing the efficiency of cross-border movement through the African Continental Free Trade Area Agreement (Source: Gov of Republic of Namibia. 2024. A blueprint for Namibia's green industrialisation).

In terms of socio-economic development, efforts to improve energy access in rural and underserved areas across Southern Africa are accelerating. These initiatives include off-grid solar solutions and mini-grids to bring electricity to remote communities, helping to bridge the energy access gap and drive social development (United Nations Economic Commission for Africa, 2021). At a national level, the development of renewable energy projects and green hydrogen production is seen as a strategic move to enhance local energy security and reduce reliance on imported electricity (NamPower, 2023).

Electricity prices in Namibia are competitive compared to regional benchmarks. The average electricity price is NAD 1.50 per kWh, which is lower than the regional average of NAD 2.00 per kWh (NamPower, 2023). Fuel prices, however, have been volatile, impacting the cost of energy production and transportation. Exchange rate fluctuations also impact the cost of imported equipment and technology, influencing project and business viability.

Global fluctuations in energy prices may also have an impact on the cost of production and the competitiveness of Namibian energy exports. Therefore stable and competitive domestic energy prices will be important for attracting investment and supporting local industrialization.

Key Drivers of Change

The energy sector is expected to drive economic growth and direct and indirect job creation, particularly through investments in green hydrogen and renewable energy projects. These initiatives are projected to generate high-skill employment opportunities in tech-advanced green industries and jobs at all skill levels in value-adding industries through low-cost, clean energy (Namibia Statistics Agency, 2023).

Digitalization, including the use of data analytics and automation, is creating new opportunities and challenges for the workforce (International Renewable Energy Agency, 2023). Namibia is also investing in research and development around innovative emerging technologies such as Power-to-X (PtX)[5], which converts renewable electricity into various products like hydrogen and ammonia (International Renewable Energy Agency, 2023).

Technological Advances

Innovations in renewable energy technologies, such as more efficient solar panels and wind turbines, are pivotal in the shift to cleaner energy sources. These advancements make renewable solutions more viable for regions like Namibia, which has abundant solar and wind resources (International Energy Agency, 2022). Substantial improvements in battery energy storage systems are also set to play an important role in implementation of small-scale and off-grid energy systems, which will have a positive impact for rural and remotely located populations.

The adoption of emerging and advanced technologies is transforming Namibia's energy sector. Solar, wind and green hydrogen in particular are driving the expansion of the renewable energy sector. These technologies are becoming increasingly efficient and cost-effective, making them more attractive for energy production (International Renewable Energy Agency, 2023).

Green Transition

The global focus on sustainability and reducing carbon emissions is influencing energy policies and investments in Namibia. This push toward sustainable energy aligns with global efforts to address climate change, with Namibia adopting policies to encourage renewable energy growth (Energy Policy Tracker, 2021). Smart grids, energy storage solutions, and advanced renewable energy systems are becoming increasingly prevalent. Smart grid technologies are being integrated into the national grid, enabling better management of energy supply and demand (NamPower, 2023).

Demographics and Urbanization

Population growth and rapid urbanization across Southern Africa has increased energy demand, necessitating expanded energy infrastructure. This trend is particularly relevant for Namibia, where infrastructure development is needed to meet growing demand (World Bank, 2022). As more people move to urban areas, the need for reliable and sustainable energy sources becomes more critical. This demographic shift is driving investments in energy infrastructure and renewable energy projects (Namibia Statistics Agency, 2023).

Trade and Globalization

International partnerships and investments are essential for developing new energy markets and securing funding for clean energy projects. Such collaborations provide Namibia with financial support and access to new

[5] Power-to-X (PtX) refers to a group of technologies that use electricity to produce a wide range of products that are part of the effort to decarbonize industries by using renewable electricity to create sustainable alternatives to fossil fuel-derived products. They play a critical role in energy transition strategies, especially in sectors that are hard to electrify directly, like transport, heating, and industrial processes.

technologies, promoting sustainable development (African Development Bank, 2022). Namibia's strategic location and abundant renewable resources position it as a potential exporter of renewable hydrogen and electricity to international markets (Namibia Investment Promotion and Development Board, 2023).

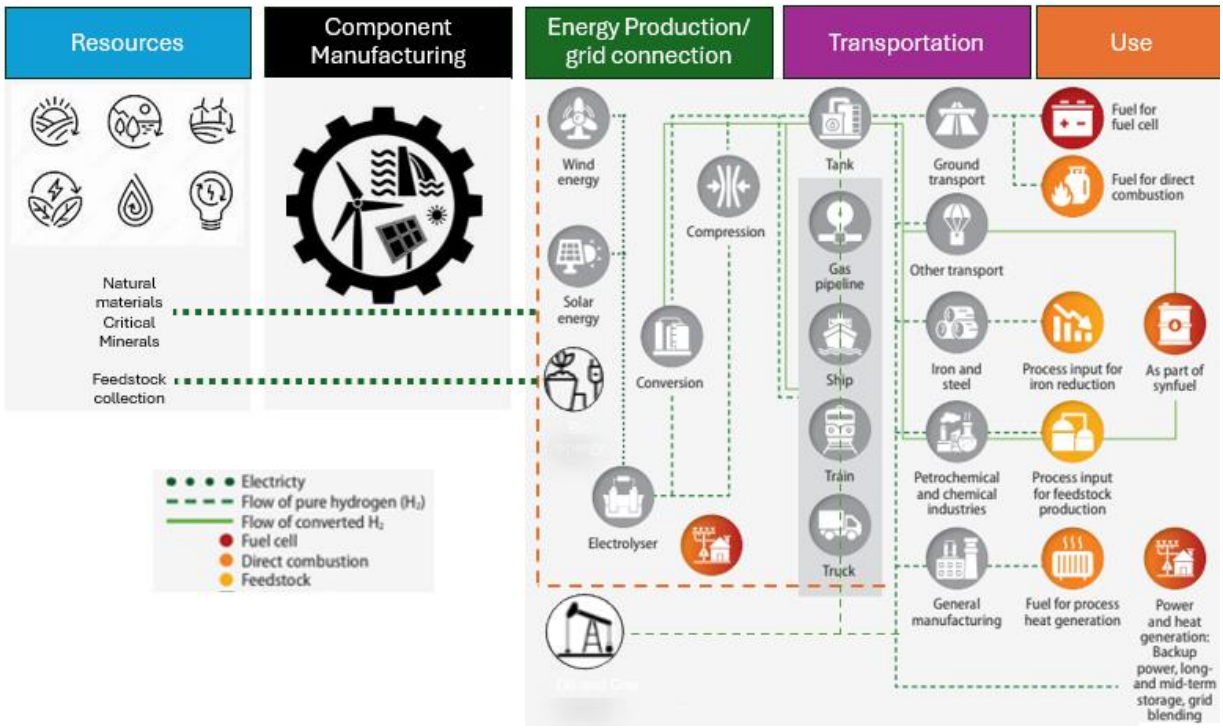
Policy Frameworks

Effective policy frameworks are vital for attracting investment in the energy sector. Transparent and predictable energy policies contribute to the successful implementation of energy projects and create an environment conducive to sustainable growth (Namibian Ministry of Mines and Energy, 2021). Namibia's government has implemented various policies and incentives to promote renewable energy development and support the green transition (Ministry of Mines and Energy, Namibia, 2023).

Value chain analysis

Understanding the value chains of the renewable and non-renewable energy sectors is important for aligning education and training programmes with industry needs and ensuring a skilled workforce capable of supporting the energy sector's growth and innovation. This section considers the value chains of four key subsectors and why they should be prioritised for skills development. Figure 13 provides a visual representation of the energy sector's value chains.

Figure 13: Energy value chain connections



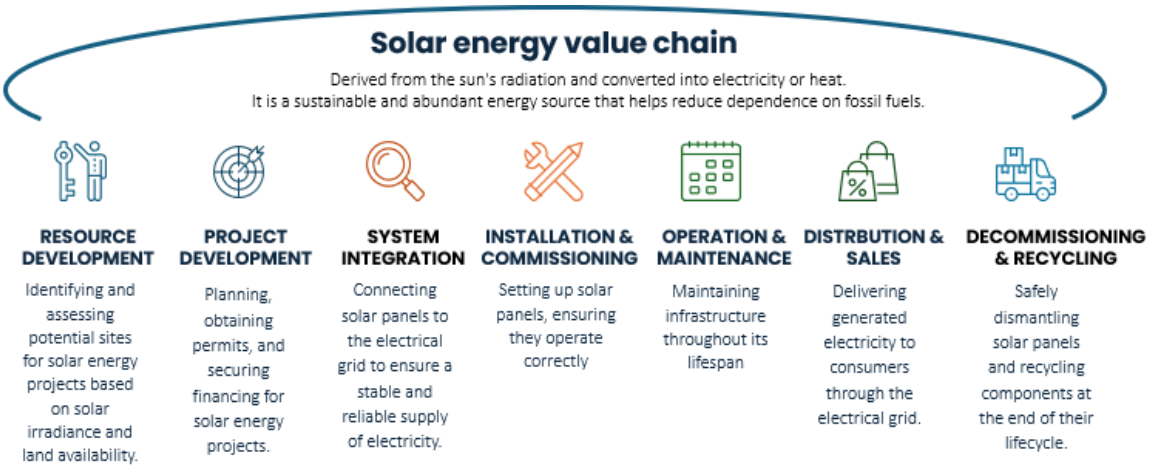
Renewable energy

Solar and Wind

The solar and wind value chains offer significant potential short and medium term opportunities for employment and skills development. Currently solar leads prospects due to large-scale solar PV farms already operated by Independent Power Producers, with more coming onstream. The number of wind projects are also projected to increase substantially as both wind and solar are critical to Namibia's plans to develop its green hydrogen sector.

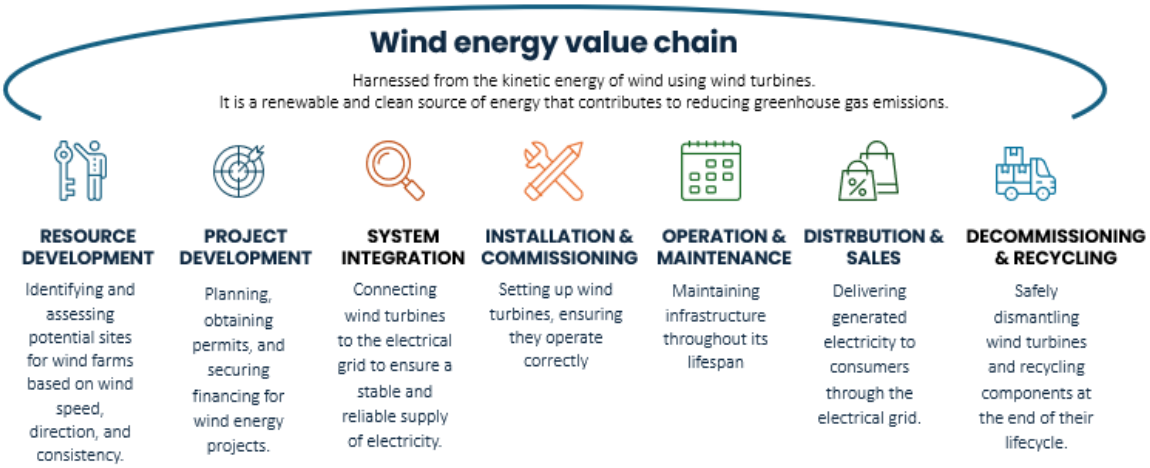
Both the solar and wind energy subsectors will require a significant number of people with specialised professions and technical skills along their value chains and there are also significant spillover effects to the construction and transport industries.

Figure 14: Solar energy value chain overview



Solar, in particular, is growing in terms of prospects for medium and small-scale businesses offering services and supplying equipment as well as increasing installation of small-scale and off-grid solutions implemented in residential and rural areas. This segment offers great employment options for lower skilled workers as there are business opportunities in ancillary services like solar panel cleaning and maintenance and small wind turbine installation and maintenance. Wind energy has excellent potential to diversify employment along the coastal regions where employment opportunities have traditionally centred on the fishing and maritime diamond mining activities.

Figure 15: Wind energy value chain overview



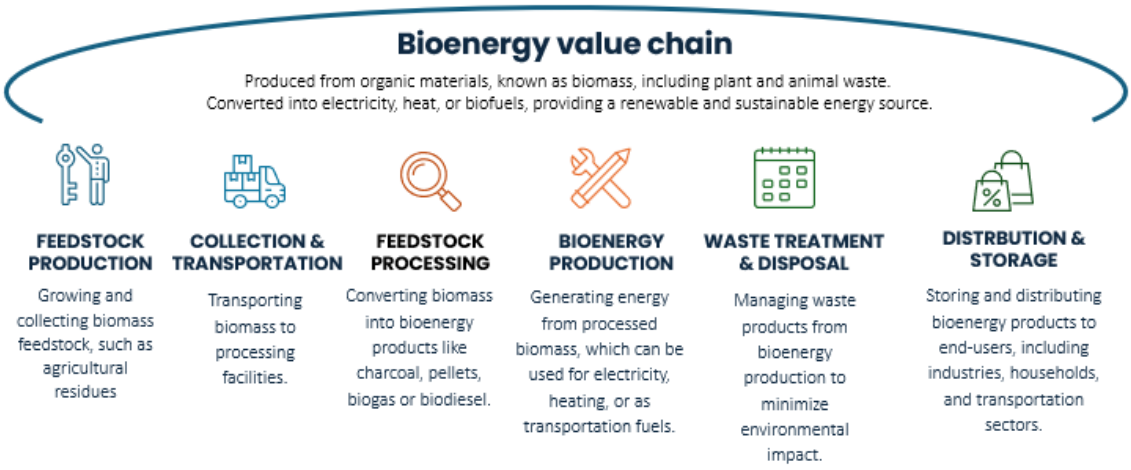
Biomass and biofuels

Namibia has significant biomass resources from overgrown bush, especially through the removal of invasive species such as encroacher bush. This is increasingly being harvested for energy production as a fuel for cooking (particularly in rural areas), as a source of electricity and for use in industrial heating processes. Policy shifts enabling commercial harvesting in communal areas affected by bush encroachment have been initiated, alongside

the development of various business models for bush biomass commercialization on communal land. Sustainable harvesting in these areas is poised to create jobs, generate income, and rehabilitate land, thereby boosting farming productivity and securing rural livelihoods.

Converting invasive woody shrubs into bioenergy, including charcoal, wood gas and wood fuel briquettes, not only helps manage this invasive issue but also generates energy for local electrification and export. Producing wood pellets and torrefied pellets from compressed wood biomass offers an efficient and renewable fuel source for heating and electricity generation. These activities, from harvesting to commercial production require high, medium and low skills along the value chain. It also diversifies the range of occupations compared to the other energy subsectors in that it encompasses agricultural and environmental sciences. The potential for biofuels is being explored, but this remains a developing area with minimal large-scale production. However, this subsector, which already employs over 12,000 individuals, offers substantial growth in employment and skills development opportunities.

Figure 16: Bioenergy value chain overview



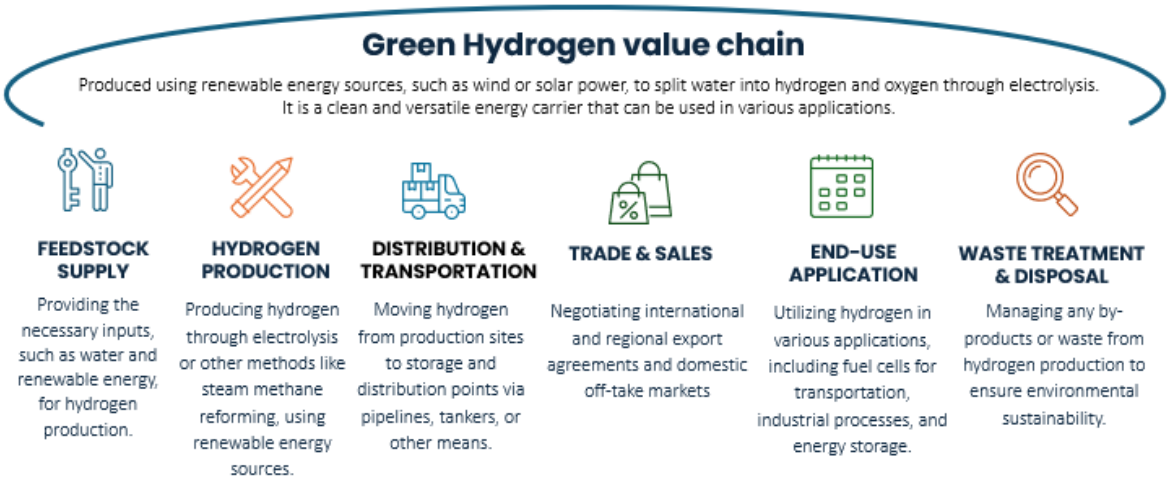
Green Hydrogen and Ammonia

The government has established a dedicated Green Hydrogen Programme to focus on attracting investment and developing industrial capacity, which includes the production of green ammonia. There are already advanced strategies that take into consideration employment opportunities and the occupations and skills required along its value chain.

This includes spillover effects that could boost employment across different economic sectors, such as construction, business services, transportation and manufacturing, with projections estimating the creation of 85,000 direct jobs by 2030, increasing to 185,000 by 2040. An additional 60,000 indirect jobs by 2030, rising to 130,000 by 2040 is further anticipated due to increased economic activity. **(Namibia Economist**, https://economist.com.na/62776/special-focus/green-hydrogens-socioeconomic-impact-explored)

However, direct employment in this kind of energy production typically requires a greater proportion of higher-skills, which are not readily available locally. In the short to medium term it may be better to focus on opportunities along the value chain such as welding and fabrication, routine equipment checks, ammonia tank cleaning, basic electrolyser maintenance, hydrogen purity testing, leak detection and repair.

Figure 17: Green Hydrogen value chain overview

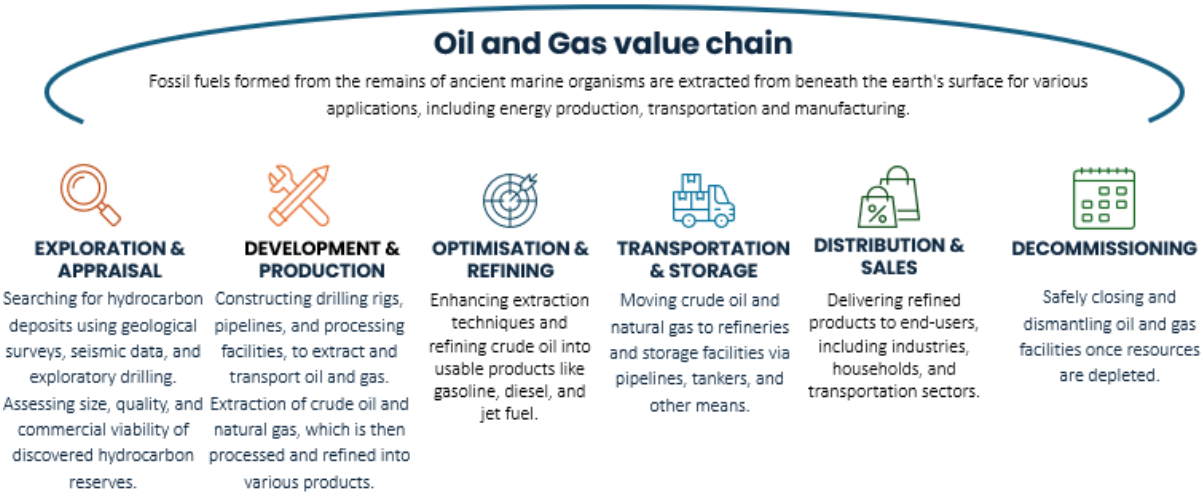


Non-Renewable Energy

The oil and gas subsector requires skilled workers for exploration, production, refining and storage, and distribution. Multinational companies involved in this industry tend to employ highly skilled foreign workers as this subsector has unique skills requirements. A recent demand and supply analysis of the workforce for the Namibia oil and gas Industry notes that although some qualifications were found to have sufficient local availability, further upskilling will be required to meet oil and gas industry standards (Deloitte Touché Tohmatsu Limited 2024). Key occupations in demand include petroleum engineers, geologists, drilling engineers, mechanical technicians and refinery operators.

The evaluation of supply chain readiness and the potential contribution of the oil and gas industry to Namibia's skills development reveals that this sector remains an important contributor to future employment despite challenges faced with global issues around fossil fuels. However, without development of downstream production, this subsector has limits to its short and medium term value chain opportunities.

Figure 18: Oil and Gas value chain overview



Skills and occupational demand in the sector

The workforce in the Namibian energy sector is diverse, encompassing a range of occupations at all skill levels. As the country continues its transition toward green energy, the need for expertise in key areas is becoming increasingly critical and is expected to increase significantly (Namibia Training Authority, 2023). This section examines the occupations and skills required across value chains, considers career pathways based on industry trends and technological advancements, and offers findings and evidence on skills gaps and shortages from exisiting reports and studies.

Key occupations and skills requirements along energy subsector value chains

The government's plans for the development of its energy sector presents significant opportunities for opening a diversity of career pathways for Namibians. Presently many local employment opportunities are concentrated in the construction, installation and maintenance phases of projects across the energy sector. This makes it important to consider what is needed to train and/or upskill the current workforce to meet global industry standards and improve their career advancement prospects. It is equally critical to promote local content to open new channels for careers that might previously have been offshored, as well as to consider new opportunities that rapidly advancing technologies in the energy sector present.

A scan of reports from Namibian organisations reveals the following careers have strong prospects due to demand:

- **Engineers**: The demand for electrical, electronics, and telecommunications engineers, with a current workforce of 10,000 is projected to increase to 12,300 by 2030, driven by the expansion of renewable energy projects and the adoption of advanced technologies (Namibia Energy Institute, 2023).
- **Technicians and Artisans**: The demand for technicians and artisans, with 50,000 currently employed, is expected to rise to 61,500 by 2030, with significant growth in roles related to solar PV installation, wind turbine maintenance, and energy storage solutions (Namibia Training Authority, 2023).
- **Project Managers**: The need for project managers will grow as the number of energy projects increases. Skills in project planning, risk management, and stakeholder engagement will be essential (Namibia Investment Promotion and Development Board, 2023).
- **Emerging Roles**: New roles, such as Hydrogen Production Specialists, Smart Grid Engineers, Energy Storage Technicians, and Energy Efficiency Consultants will emerge as the sector evolves. Skills in electrolysis, hydrogen storage, and ammonia synthesis will be increasingly important as Namibia expands its green hydrogen and ammonia production capabilities (International Renewable Energy Agency, 2023).
- **Energy Storage and Efficiency:** The development of advanced energy storage solutions and installation of Power-to-X (PtX) technologies will drive demand for skills in battery technology, energy management, and grid integration. Careers include Battery Technicians, Energy Storage Engineers, and Grid Integration Specialists (Namibia Energy Institute, 2023).
- **Digitalisation:** The integration of smart grid technologies will require skills in data analytics, automation, and digital literacy. Roles such as Smart Grid Engineers, Data Analysts, and Automation Technicians will be in demand (NamPower, 2023).

- **Urban Planning and Infrastructure**: The shift towards urban areas is creating new opportunities for energy projects, particularly in urban infrastructure, energy services and smart city initiatives. This opens career opportunities in urban planning, infrastructure development, and energy management. (Namibia Statistics Agency, 2023).

- **Construction and logistics infrastructure:** The growth of Namibia's energy sector is directly linked to the construction of the "Green Valleys" and the rail and port infrastructure required to connect them across the country. This offers numerous career opportunities for occupations at all skill levels in the construction, transport and logistics sectors.

- **Policy and Administration:** Cross-border energy trade and regional partnerships will create opportunities for careers in areas such as energy policy, regulatory compliance, and international project management (Namibia Statistics Agency, 2023).

- **Cross-cutting and Enabling Roles:** In addition to the specific skills required in each subsector, and described above there are many employment opportunities in cross-cutting skills and occupations that support the overall energy sector. For example, educators and trainers, in trade associations and professional organisations, IT professionals, Health and Safety consultants, sales and marketing specialists, and management and administration.

The following section considers in more detail the key occupations and core skills required across the four subsector value chains as well as the cross-cutting occupations and skills that are involved in supporting these subsectors.

Renewable Energy Subsector – solar and wind

Growth in the renewable energy subsector, particularly in solar and wind energy production, is driving demand for specialised skills such as environmental scientists, engineers, technicians, and project managers to support the expansion of projects. In solar, key roles include solar PV Installers, electrical engineers, renewable energy engineers, and solar project managers. Technical skills in solar panel installation, maintenance, and system integration are in high demand (Namibia Energy Institute, 2023).

In wind energy there is high demand for wind turbine technicians, mechanical and electrical engineers, and wind farm project managers. Skills in turbine installation, maintenance, and wind resource assessment are also critical (Namibia Energy Institute, 2023). The occupations identified in the tables below are based on global studies in terms of typical value chains. Although Namibia may have some specific nuances, these tables illustrate the span of occupations and skills levels across the various stages of the renewable energy value chain, including research and development, equipment manufacture, project development, installation, operation, maintenance, and support services. An important task for participants in the foresight workshop is to develop a list of key occupations specifically for Namibia.

Table 14 summarizes occupations in the renewable energy sector across solar, wind and hydropower value chain segments with the required skill levels (High, Medium, Low).

Table 14: Renewable Energy (solar, wind and hydropower) key occupations and skills levels by value chains

Value Chain Segment	Occupations	Skill Level
Equipment Manufacture & Distribution	R&D engineers (computer, electrical, environmental, mechanical, wind power design) Software engineers Modellers Industrial mechanics Manufacturing engineers	High High/Medium High/Medium Medium High

	Manufacturing technicians	Medium
	Manufacturing operators	Low
	Manufacturing quality assurance experts	High/Medium
	Certifiers	High
	Logistics professionals	High/Medium
	Logistics operators	Low
	Equipment transporters	Low
	Procurement professionals	High/Medium
	Marketing specialists	High/Medium
	Sales personnel	High/Medium
Project Development	Project designers (engineers)	High
	Environmental impact assessment specialists	High/Medium
	Economic/financial/risk specialists	High
	Atmospheric scientists	High
	Social impact specialists	High
	Lawyers (feed-in contract, grid connection and financing contract, construction permit, power purchase agreement)	High
	Planners (permit monitoring)	Medium
Construction and Installation	Construction managers	High
	Site supervisors	High/Medium
	Electricians	Medium
	Plumbers	Medium
	Roofers	Medium
	General construction workers	Low
	Heavy machinery operators	Medium
	Welders	Medium
	Pipe-fitters	Medium
	HVAC technicians	Medium
Operation and Maintenance	Operations managers	High
	Maintenance technicians	Medium/Low
	Monitoring specialists	High/Medium
	Plant operators	High/Medium
Cross-Cutting/Enabling and Decommissioning Activities	Policy-makers and government office workers	High/Medium
	Trade association and professional society staff	High/Medium/Low
	Educators and trainers	High
	Management	High/Medium/Low
	Administration	High/Medium/Low
	Publishers and science writers	High/Medium
	Insurer representatives	High/Medium
	IT professionals	High/Medium
	Human resources professionals	High
	Other financial professionals (accountants, auditors, and financiers)	High
	Health and safety consultants	High/Medium
	Sales and marketing specialists	High/Medium

Source: ILO 2019. Skills and Employability in the Renewable Energy Sector; IRENA 2020. Renewable Energy Jobs: Status Report

Bioenergy subsector – biomass and biofuels

The biomass industry in Namibia has significant potential, with an estimated value chain worth NAD 21 billion (Namibia Regulatory Authority, 2024). The bioenergy value chain spans multiple stages, from feedstock collection to the installation of systems and their ongoing management. For example, charcoal production is typically carried out through manual or semi-mechanized harvesting at the farm level, with an average production rate of 3 tons per producer per month. Bush feed production is mainly for personal use, though some commercial activity exists. Firewood production, involving manual or semi-mechanized cutting, averages about 15 tons per worker per month.

The sector faces several challenges, including variability in biomass feedstock availability, the need for ongoing technology development to improve efficiency, and the requirement for supportive government policies such as incentives and regulations. Factors such as financing, land agreements, and policy support are key for the successful development of biomass and biofuels projects while ongoing training, maintenance and performance monitoring are necessary to ensure sustainability and efficiency in operation.

Roles such as biomass plant operators, chemical engineers, process engineers, and bioenergy project managers are essential. Skills in biomass processing, biofuel production, and environmental management are needed (Cleanergy Solutions Namibia, 2023). Table 15 outlines the occupations for each stage of the bioenergy value chain, with the required skill levels (High, Medium, Low).

Table 15: Bioenergy (biomass and biofuels) key occupations and skills levels by value chains

Value Chain Segment	Occupations	Skill Level
Equipment Manufacture & Distribution	Biochemists and microbiologists	High
	Agricultural, biological, chemical, and physical scientists	High
	Chemical, biological, mechanical, and electrical engineers	
	Material scientists in R&D	High
	Software engineers	
	Manufacturing engineers	High
	Manufacturing quality assurance specialists	High
	Manufacturing technicians	High
	Quality assurance specialists	High/Medium
	Logistics professionals	High/Medium
	Logistics operators	High/Medium
	Equipment transporters	High/Medium
	Procurement professionals	Low
	Marketing specialists	Low
	Sales personnel	High/Medium
		High/Medium
		High/Medium
Project Development	Resource assessment specialists	High
	Project designers (engineers and scientists) (H)	High
	Sustainability specialists	High
	Debt financier representatives	High
	Society and trade administrators	High/Medium
	Land use negotiators	High
	Communications specialists	High
	Lobbyists	High
	Mediators	High
Construction and Installation	Environmental and Social NGO representatives	High/Medium
	Public relations officer	High
	Procurement professionals	High/Medium
Biomass Production	Agricultural scientists	High
	Biomass production managers	High/Medium
	Plant breeders and foresters	High/Medium
	Agricultural/forestry workers	Low
	Transportation workers	Low
Cross-Cutting/Enabling Activities	Policy-makers and government office workers	High/Medium
	Trade association and professional society staff	High/Medium/Low
	Educators and trainers	High
	Management	High/Medium/Low
	Administration	High/Medium/Low
	Publishers and science writers	High/Medium
	Insurer representatives	High/Medium

Source: ILO 2019. Skills and Employability in the Renewable Energy Sector; IRENA 2020. Renewable Energy Jobs: Status Report

Green Hydrogen and Ammonia Subsector

The emerging green hydrogen and ammonia subsector requires specialized skills in production, storage and distribution. Key roles in hydrogen production include electrolysis technicians, chemical engineers, hydrogen systems engineers, and hydrogen production managers. Skills in demand will also be in electrolysis system design, hydrogen handling, and safety standards (Hyphen Hydrogen Energy, 2023). For ammonia production demand is high for chemical process engineers, ammonia plant operators, and ammonia production managers. Skills in ammonia synthesis, plant operation, and maintenance are also required (Namibia Energy Institute, 2023). Table 16 provides the occupations related to the green hydrogen and ammonia value chains, with the required skill levels (High, Medium, Low).

Table 16: Green Hydrogen and Ammonia key occupations and skills level by value chain

Value Chain Segment	Occupations	Skill Level
Equipment Manufacture and Distribution	Electrochemical Engineers	High
	Chemical Engineers	High
	Mechanical Engineers	High
	Electrical Engineers	High
	Software Engineers	High
	Manufacturing Engineers	High
	Manufacturing Technicians	Medium
	Quality Assurance Specialists	High
	Logistics Professionals	High
	Procurement Professionals	High
	Marketing Specialists	High
	Sales Personnel	Medium
Project Development	Project Designers (Engineers)	High
	Environmental Impact Assessment Specialists	High
	Economic/Financial/Risk Specialists	High
	Social Impact Specialists	High
	Lawyers (Contracts, Permits)	High
	Planners (Permit Monitoring)	High
Construction and Installation	Construction Managers	High
	Site Supervisors	High
	Electricians	Medium
	Plumbers	Medium
	General Construction Workers	Low
	Heavy Machinery Operators	Medium
	Welders	Medium
	Pipe-Fitters	Medium
	HVAC Technicians	Medium
Operation and Maintenance	Operations Managers	High
	Maintenance Technicians	Medium
	Monitoring Specialists	High
	Plant Operators	High
Cross-Cutting/Enabling Activities	Policy-Makers and Government Office Workers	High
	Trade Association and Professional Society Staff	High/Medium/Low
	Educators and Trainers	High
	Management	High/Medium/Low
	Administration	High/Medium/Low
	Publishers and Science Writers	High/Medium

	Insurer Representatives IT Professionals Human Resources Professionals Other Financial Professionals (Accountants, Auditors, Financers) Health and Safety Consultants Sales and Marketing Specialists	High/Medium High/Medium High High High/Medium High/Medium

Sources: (Namibia Economist, 2024), (The Brief, 2024),(PtX Hub, 2024), (The Namibian, 2024)

Oil and Gas Subsector

The Oil and Gas subsector is highly specialised with stringent health and safety standards that must be met at all times. This subsector tends to operate with a global workforce that moves between multinational companies and projects, which means that high skilled occupations are usually filled by foreign contract workers with medium to low skilled roles filled by local workers.

Key occupations in demand include petroleum engineers, geologists, drilling engineers, and refinery operators. Skills in exploration, drilling, and refining processes are also in demand (Ministry of Mines and Energy, 2023). Table 17 provides an overview of the various occupations involved in the oil and gas sector in Namibia, highlighting the skills required at each stage of the value chain. (High, Medium, Low).

Table 17: Oil and Gas key occupations and skills levels by value chain

Value Chain Segment	Occupations	Skill Level
Exploration and Production	Petroleum Engineers Geologists Geophysicists Drilling Engineers Reservoir Engineers Seismic Technicians Field Technicians Environmental Specialists	High to Low High High High High Medium Medium High
Project Development	- Project Designers (Engineers) - Environmental Impact Assessment Specialists - Economic/Financial/Risk Specialists - Social Impact Specialists - Lawyers (Contracts, Permits) - Planners (Permit Monitoring)	High High High High High High
Construction and Installation	- Construction Managers - Site Supervisors - Electricians - Plumbers - General Construction Workers - Heavy Machinery Operators - Welders - Pipe-Fitters - HVAC Technicians	High High Medium Medium Low Medium Medium Medium Medium
Operation and Maintenance	- Operations Managers - Maintenance Technicians - Monitoring Specialists - Plant Operators	High Medium High High
Cross-Cutting/Enabling Activities	- Policy-Makers and Government Office Workers - Trade Association and Professional Society Staff - Educators and Trainers - Management	High High/Medium /Low High

	- Administration - Publishers and Science Writers - Insurer Representatives - IT Professionals - Human Resources Professionals - Other Financial Professionals (Accountants, Auditors, Financers) - Health and Safety Consultants - Sales and Marketing Specialists - Clients	High/Medium /Low High/Medium /Low High/Medium High/Medium High/Medium High High High/Medium High/Medium High/Medium /Low

Sources: **(Namibia Investment Promotion and Development Board, 2022) (Namibia Energy Institute - Centre for Oil and Gas, n.d.)**, **(Shell Namibia, n.d.) (Commonwealth of Nations, n.d.) (International Trade Administration, 2023)**

Findings and Evidence on Skills Gaps and Shortages

The Namibia government recognises that the country faces significant workforce challenges, particularly in specialized areas such as renewable energy technologies, engineering and project management (Namibia Energy Institute, 2023). It is also important to recognise that much of the focus is on occupations that are higher-skilled in more technologically advanced careers. While this is important for future development, it should not neglect the needs of domestic suppliers, which is a challenge for inclusivity and sustainability of sector growth. If the skills needs and challenges of suppliers and services to the energy sector along local value chains are not considered, then the competitiveness of the sector may be in question. More broadly, the opportunity of the country to address inequality and enable those who are disadvantaged to have access to opportunities, through the energy sector's growth, may be lost. The following section highlights key findings from various existing studies.

Key Findings

The workforce in Namibia's energy sector is composed of 60 percent skilled workers and 40 percent low skilled workers. The National Renewable Energy policy's target of increasing the share of renewable energy in the national energy mix to 70 percent by 2030 will drive increased demand for skills in renewable energy technologies and project management (Ministry of Mines and Energy, 2023). The Namibia Training Authority (NTA) estimates a talent gap of 55-60,000 workers by 2030, rising to 120-130,000 by 2040 (NTA 2021, Skills Demand and Supply in Namibia).

Across all subsectors employment is highest during construction and installation phases, which has a positive impact on lower skilled employment (more people are involved in labour intensive work) but fewer permanent jobs are available in operation and maintenance phases.[6]

Ensuring that marginalized communities, women and rural populations have access to education and training opportunities (especially in renewable energy like solar), is essential for equitable economic growth. Programmes that focus on skills development in underserved areas can help bridge the gap and promote social inclusion (Dejene, 2020).

Namibia's climate commitments to reducing greenhouse gas emissions by 30 percent by 2030, stricter environmental regulations and global decarbonization commitments are driving the demand for skills in areas such

[6] https://www.namibian.com.na/employment-dynamics-in-renewable-energy-sector/

as environmental management, sustainability, and compliance (Ministry of Environment, Forestry and Tourism, Namibia, 2023).

Installation and maintenance of renewable energy off-grid and micro-grids in remote communities plays a critical part in helping communities adapt to changing environmental conditions and become more resilient to climate change. This is key to enabling climate adaption strategies, especially for climate-smart agriculture and sustainable water management in the more populous northern regions where agriculture is a vital economic activity (UNECA, 2017).

Renewable energy – solar and wind

The solar energy subsector is one of the fastest-growing areas in Namibia's energy sector. The demand for skilled workers in this subsector is driven by the increasing number of solar PV installations and the need for maintenance and operation of these systems. There is a shortage of high and medium skilled workers in technical roles like solar installers and professional occupations such as electrical engineers, which hinder rapid renewable energy project deployment.[7] Wind energy is another critical area of growth in Namibia's renewable energy sector. The demand for skilled workers in this subsector is driven by the development of wind farms and the need for ongoing maintenance and operation. There is also a need for professionals in sales, finance, inspection, auditing, and legal services to support the renewable energy sector.[8]

Bioenergy – biomass and biofuels

The bioenergy subsector, encompassing biomass and biofuels, is an emerging area with significant potential for growth. The demand for skilled workers in this subsector is driven by the development of bioenergy projects and the need for ongoing operation and maintenance. However, its most important contribution is that it can create jobs in remote areas, support rural development, and contribute to sustainable energy production while providing environmental services through clearing of invasive plant species (Namibia Environmental Agency, 2024) (Namibia Environmental Agency, 2024). Challenges in this subsector include the need for better infrastructure, access to technology and knowledge transfer to ensure efficient and sustainable biomass utilisation.

Green Hydrogen and Ammonia

The green hydrogen and ammonia subsector is an emerging area with significant potential for growth. The demand for skilled workers in this subsector is driven by the development of hydrogen production facilities and the need for ongoing operation and maintenance. As this subsector requires high skills levels for its processes, the challenge here will be balancing the need for imported skills while ramping up local skills development to fulfil these roles. At the present most of the anticipated job creation lies in related construction and transport activities.

Oil and Gas

The non-renewable energy subsector, including oil and gas, remains a vital part of Namibia's energy mix. The demand for skilled workers in this subsector is driven by ongoing exploration, production, and refining activities. In the oil and gas subsector, there is a lack of locally qualified workers in specialised occupations such as petroleum, electrical, mechanical and chemical/industrial engineering. There are also shortages in the local workforce with qualifications in maritime and petroleum studies, laboratory/chemistry fields, pipefitting, welding (specific to oil and gas), and industrial processes (Deloitte Touché Tohmatsu Limited 2024).

[7] https://economist.com.na/82405/energy/skills-shortages-in-namibias-renewable-energy-sector/
[8] https://namibiafactcheck.org.na/report/renewable-energy-growth-and-employment-trends/

Education and skills provision in the sector

This section provides an overview of the skills supply landscape in the Namibian energy sector. It examines the provision of relevant education and training qualifications as well as alignment with industry needs. The analysis also identifies key systemic challenges impacting skills supply to meet the energy sector's evolving demands.

Key Institutions and Education and Training Providers (Formal and Informal)

Education and skills provision in Namibia's energy sector is characterized by a mix of formal and informal learning, including workplace learning, apprenticeships, and online learning platforms. Namibia has 18 Higher Education Institutions (small number of universities with regional satellite campuses and colleges), which offer programmes in engineering, science, technology, and business management (Ministry of Higher Education, Training, and Innovation, 2023). There are also approximately 70 Namibia Qualifications Authority accredited training providers that are a mix of public and private education facilities. These tertiary education institutions are the primary source of local skill supply to the country's economic sectors.

While the Ministry of Mines and Energy plays a key role in coordinating skills development initiatives and ensuring alignment with national energy goals (Ministry of Mines and Energy, 2023), **Public and private universities** fall under the purview of the Ministry of Higher Education, Technology and Innovation (MHETI). These are:

- The University of Namibia (UNAM) - public
- The Namibia University of Science and technology (NUST) – public
- The Namibia College of Open Learning (NAMCOL) - public
- The International University of Management (IUM) - private
- Welwitchia University – private

Under the Vocational Education and Training Act, 2008 (Act No. 1 of 2008), the **Namibia Training Authority (NTA)** is responsible for regulating and coordinating the TVET system in Namibia, has approximately 50 TVET institutions, including public and private centres. The NTA also provides accreditation and quality assurance for private training providers (approximately 30) and has placed a strong emphasis on improving vocational and technical education to align with the demands of its growing energy sector (Namibia Training Authority, 2023).

Other key government bodies are the **Namibia Qualifications Authority (NQA)**, which provides a standardized National Qualifications Framework (NQF) for recognizing and certifying skills, and the **Namibia Energy Institute (NEI)**, which is a research and training institution that collaborates with government agencies, industry stakeholders, and educational institutions to promote skills development and innovation in the energy sector (Namibia Energy Institute, 2023).

Many companies in the energy sector offer workplace learning and apprenticeships. These programmes and on-the-job training are designed to develop the skills of their employees. This includes hands-on training in technical skills, safety protocols, and project management (Namibia Training Authority, 2023). They also provide valuable practical experience to help newly qualified graduates bridge the gap between theoretical knowledge and real-world application (NamPower, 2023). Successful partnerships between educational institutions and industry stakeholders, such as those between NamPower and TVET institutions, have led to the development of specialized training programmes and internships.

Formal and informal training programmes for Community-Based Training are another important skills development avenue. These are often organized by community groups and non-governmental organizations to provide skills

development opportunities for individuals in rural and underserved areas. These programmes focus on practical skills and entrepreneurship (Namibia Training Authority, 2023).

Additionally, a few private training providers offer specialized courses in energy technologies contributing to the overall capacity building within Namibia's energy sector (Namibia Energy Institute, 2023). For example, the Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL) has setup a Youth for Green Hydrogen (Y4hydrogen) Scholarship for Namibian students that attracted 1,154 applicants in 2022. The intention is that hydrogen development projects will be carefully sequenced to manage spikes in labour demand and provide continuous employment (Namibia GH2 Strategy, gh2namibia.com).

The availability of Online Learning Platforms has further increased access to training and education as they offer flexibility and distance learning. These platforms provide courses, certifications, and professional development programmes allowing individuals to learn at their own pace and convenience (Namibia Energy Institute, 2023).

Relevant Programmes, Qualifications, and Certifications by Education and Training Providers

Namibia's universities offer diploma and degree programmes in engineering, environmental science, and project management, which are essential for developing the advanced skills required for leadership and innovation in the energy sector. They are also involved in research and development activities, contributing to the advancement of renewable energy technologies and sustainable practices (Namibia University of Science and Technology, 2023). Table 18 is an example of higher skilled qualifications in engineering disciplines offered by the National Institute of Technology (NIT).

Table 18: Engineering courses and qualifications offered at NIT

Engineering Discipline	Level	Qualification Type
Civil Engineering	Level 4	Certificate
	Levels 5 & 6	Diploma
	Bachelor	Bachelor of Technology
Electrical and Electronic Engineering	Level 4	Certificate
	Levels 5 & 6	Diploma
	Bachelor	Bachelor of Technology
Mechanical Engineering	Level 4	Certificate
	Levels 5 & 6	Diploma
	Bachelor	Bachelor of Technology
Network Engineering	Level 4	Certificate
	Levels 5 & 6	Diploma
	Bachelor	Bachelor of Technology
Software Engineering	Level 4	Certificate
	Levels 5 & 6	Diploma
	Bachelor	Bachelor of Technology

Source: NIT

A sample of other training institutions and courses offered are shown in Table 19.

Table 19: Institutions offering energy sector related training courses and their qualification types

Institution	Engineering Discipline	Level	Qualification Type
Namibia Institute of Public Administration and Management (NIPAM)	Electrical Engineering	Level 3	National Vocational Certificate
Namibian Maritime and Fisheries Institute (NAMFI)	Electrical Engineering (Instrumentation and Control)	Level 2	National Vocational Certificate
	Electrical General	Levels 1–3	National Vocational Certificate
Namibian Institute of Mining and Technology (NIMT)	Electrical General	Level 3	National Vocational Certificate
	Instrumentation	Level 3	National Vocational Certificate
	Air-Conditioning and Refrigeration	Level 3	National Vocational Certificate
	Millwright	Level 3	National Vocational Certificate
Nakayale Vocational Training Centre	Electrical Engineering	N1 to N3	Modular Qualification (Trade Tested)
NamWater Human Resource Development Centre	Civil and Building Services Engineering (Plumbing)	Levels 1–3	National Vocational Certificate
River Higher Institute of Technology	Electrical and Electronic Engineering	Levels 4–6	Certificate/Diploma
	Telecommunication Systems	Levels 4 & 5	Certificate/Diploma
	Electrical Installation	Levels 4 & 5	Certificate/Diploma

The **TVET** system plays a role in providing the technical skills required by the energy sector with programmes designed to equip students with practical skills in occupations such as engineering, construction and electrical work. These programmes aim to prepare students for immediate entry into the workforce, addressing skills shortages in critical technical fields and supporting national economic growth (MHETI, 2021). TVETs also offer initial vocational training programmes in various trades, including electrical and renewable energy technologies, and mechanics. These programmes provide core skills for entry-level positions in the energy sector (Namibia Training Authority, 2023). TVET programmes are increasingly adopting competency-based training approaches, which focus on developing specific skills and competencies required by the energy sector (Namibia Training Authority, 2023).

Key TVET institutions include the Namibia Institute of Mining and Technology (NIMT), the Windhoek Vocational Training Centre (WVTC), and the Valombola Vocational Training Centre (VVTC) (Namibia Training Authority, 2023).

The only TVET that could be identified as having energy sector specific training was the Namibia Vocational Institute, which offers National Vocational Certificates in Solar Equipment Installation and Maintenance from Level 1 to 3. No specific courses or institutions related to wind, hydro, or bio energy were identified. Data was also not available for the green hydrogen and ammonia nor oil and gas subsectors. Table 20 shows other TVETS that could possibly have energy sector related programmes, although these appear to be more artisan trades that will fulfil the need for projected construction workers.

Table 20: Vocational training centres offering possible energy sector related qualifications

Institution	Engineering Discipline	Level	Qualification Type
Rundu Vocational Training Centre (RVTC)	Bricklaying and Plastering	Levels 1–3	National Vocational Certificate
	Bricklaying and Construction	Level 4	National Vocational Certificate
Zambezi Vocational Training Centre (ZVTC)	Bricklaying and Plastering	Levels 1–3	National Vocational Certificate
	Plumbing	Levels 1–3	National Vocational Certificate
Okakarara Vocational Training Centre	Bricklaying and Plastering	Levels 1–3	National Vocational Certificate
Eenhana Vocational Training Centre (EVTC)	Bricklaying and Plastering	Levels 1–4	National Vocational Certificate
	Plumbing	Levels 1–4	National Vocational Certificate
DAPP Vocational Training School	Bricklaying and Plastering	Levels 1–3	National Vocational Certificate

As many of the qualifications and skills required are related to emerging energy sector developments, it is not surprising that data is not available to respond to very specific question. However, this does highlight an opportunity to at this early stage already put in place systems to gather this kind of more detailed and disaggregated information as it will serve the country well going forward for monitoring and evaluation purposes

The **NQA** is an important role player in Namibia's skills supply for recognizing and certifying skills and qualifications through a standardised framework (the NQF). This framework ensures that qualifications are consistent and comparable across different institutions and industries (Namibia Qualifications Authority, 2023). Certification and accreditation of training programmes and institutions for the energy sector will be essential for maintaining quality and credibility, especially as programmes are recognized by employers and can provide assurance that graduates have met the required standards (Namibia Qualifications Authority, 2023). This may be of great importance to international companies who wish to high local workers but require assurance that standards meet their expectation.

Enrolment, dropout and graduate numbers and trends

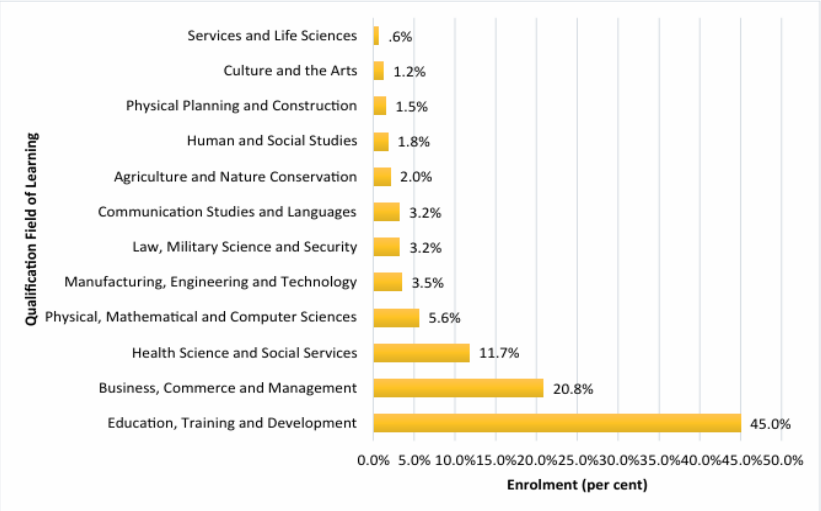
The data of enrolment numbers from 2013 to 2022 reveals a positive trend of steadily increasing numbers of students enrolling at Higher Education facilities (HEI). Data from the National Council for Higher Education shows that a total of 71,820 students enrolled in 2022 compared with 68,932 in 2021. Female students represented 64 percent of the total students population, compared with 36 percent for male students. Although fewer male students appear to have enrolled over the same time period, there was a marginal increase of 1.4 percent from 2021 to 2022 (Namibia Higher Education Statistical Yearbook, 2022). However, it must be noted that these totals include all HEI students irrespective of the mode of study.

HEI data from 2022 reveals that two-thirds (66 percent) of the students were studying full-time, with 22 per cent studying part-time and 12 percent engaged in distance learning. A total of 21,766 students (30 percent) were enrolled in both undergraduate and postgraduate programmes in their first year of studies. The majority (64 percent) of students were pursuing undergraduate degrees (Bachelor/Professional and Honours), followed by 30 percent pursuing other undergraduate qualifications (Certificates/ Diplomas), and only 6 per cent enrolled in Master and Doctoral programmes. Among the twelve fields of learning, the largest group of students was enrolled in education, training, and development (43 percent), followed by business, commerce, and management studies (20 percent). Additionally, 28 percent of students were enrolled in programmes in STEM fields (Namibia Higher Education Statistical Yearbook, 2022).

In 2022, just over two-thirds (68.4 percent) of the total students (71,820) progressed to the next academic year. Conversely, a quarter (25 percent) failed examinations and did not progress to the next year of studies. Generally, male students demonstrated a lower pass rate and a higher failure rate, compared to female students. In the 2022 academic year, a total of 24,485 undergraduate students sat for final examinations and of these, 43 percent successfully obtained qualifications. Students studying in STEM fields had a higher graduation rate compared to their peers in non-STEM fields (Namibia Higher Education Statistical Yearbook, 2022) and one can assume that these graduates may find themselves in energy sector related careers.

As of 2022, TVET institutions enrolled approximately 15,000 students in energy-related programmes, with a graduation rate of 70% (Namibia Training Authority, 2023). However, there is a need to increase enrolment and improve graduation rates to meet the growing demand for skilled workers. Figure 14 illustrates enrolment figures for 2021 by National Qualification Fields (NQF). In the absence of more robust TVET data, this is useful as it clearly shows a strong trend in qualifications that are related to public services, such as health Science and Social Services (11.7 percent), Business, Commerce and Management (20.8 percent), and Education, Training and Development (45 percent).

Figure 19: Enrolment by NQF field of learning (percent), 2021



In total, approximately 24 percent of students were enrolled in the Science, Technology, Engineering and Mathematical (STEM) fields. Male students' proportion was higher than their female counterparts (30.9 percent compared to 20.8 percent). The most concentrated field in STEM is Health Sciences (11.7 per cent). It is also notable that majority of female students who are in STEM and are in this field (13.6 percent). Most male students in the STEM fields pursued qualifications in Physical, Mathematical and Computer Sciences (10.1 percent), Health Sciences and Social Services (8.1 percent) and Manufacturing, Engineering and Technology (7.2 percent) fields.

Key Systemic Challenges of Skills Supply

To contextualise systemic challenges in education provision that will also impact the energy sector, one needs to zoom out and appreciate the national situation. Since independence education has received considerable government backing with the result that Namibia has a relatively strong and diverse education system comprising both state and private institutions.

Compulsory primary education is free and near universal with 97 percent attendance resulting in one of the highest literacy rates in Sub-Saharan Africa at 91.5 percent. Secondary education has also received strong support and enrolment has risen over the decades resulting in a vast reduction in illiteracy in the working population. Around 28.5 percent of Namibia's population aged 25 and older have completed at least lower secondary education. This reflects the country's progress in expanding access to education and improving literacy levels (Namibia Statistics Agency, 2021).

However, despite good access to secondary schools, educational outcomes remain insufficient and a mismatch with the labour market. There are persistent challenges related to early dropout rates and poor teaching standards. Facility standards also present challenges especially in disadvantaged regions. For example, electrification of schools in the Kavango and Oshikoto regions lag significantly. These challenges result in secondary education offering limited avenues to tertiary education, which is limiting employability in the more highly-skilled occupations required by Namibia's growing energy sector.

Tertiary education is limited but growing consistently with enrolment increasing, as noted above. Reports highlight that an increasing portion of Namibia's population has pursued higher education, with many completing tertiary education. This demonstrates an ongoing effort to develop a skilled workforce through HEIs and TVET centres (MHETI, 2021). Despite these efforts, several challenges persist. Some of the challenges experienced in the Higher Education and TVET system are:

- There are variations in the **quality of training** provided by different institutions (Namibia Qualifications Authority, 2023). At a minimum, TVET institutions are required to meet accreditation standards set by the NQA as these standards ensure the quality and relevance of training programmes.
- **Accessing training opportunities**, especially in rural areas due to limited availability of decentralized training centres and a lack of online learning platforms. This restricts opportunities for individuals in remote regions to acquire relevant skills (Namibia Energy Institute, 2023).
- The **competence of instructors** is critical to the quality of training. There is a need for ongoing professional development and training for instructors to ensure they are equipped with the latest industry knowledge and teaching methodologies (Namibia Training Authority, 2023).
- The quality of training is influenced by the **availability of modern facilities and equipment**. Many TVET institutions face challenges with outdated equipment and limited access to advanced technologies. Investments in modern facilities and equipment are essential for improving the quality of training (Namibia Training Authority, 2023).
- Although curricula for TVET programmes are regularly updated to reflect changes in technology, industry practices, and labour market demands, there is a need for **disaggregated data** collection to support greater **alignment with specific industry needs** to reduce skills mismatch between the training provided

by educational institutions and the actual needs of the energy sector (Namibia University of Science and Technology, 2023).

- Higher education institutions and TVET centres need to **deepen collaboration with industry partners** to develop and update curricula that reflect the latest industry standards and technological advancements (Namibia University of Science and Technology, 2023).
- **Skills mismatch** is particularly pronounced in emerging fields such as renewable energy and green hydrogen, where the skills required are not adequately addressed by current programmes (Namibia Training Authority, 2023). Specialized training programmes and courses in areas like electrolysis, hydrogen handling, and energy storage as well as digital literacy, and environmental sustainability are needed to meet the sector's evolving demands (Namibia Energy Institute, 2023).
- **Governance** of the education system involves multiple stakeholders, including the MHETI, the NTA, and industry representatives. Better coordination for the implementation of policies and programmes is needed across all levels of education provision to avoid duplication of efforts (Ministry of Higher Education, Training, and Innovation, Namibia, 2023).
- **Adequate and sustainable funding** is necessary to support the expansion and improvement of TVET programmes for specific skills for local energy sector value chains (Namibia Training Authority, 2023). Funding and resources for training programmes are insufficient, with many institutions lacking modern equipment and facilities needed for practical, hands-on training. This hampers the overall effectiveness of skills development initiatives (Namibia Training Authority, 2023).

SWOT Analysis

Strengths:

- **Natural Resources**: Abundant solar and wind resources (Namibia Energy Institute, 2023).
- **Government Support**: Strong government policies and initiatives supporting renewable energy (Ministry of Mines and Energy, 2023).
- **Political Stability**: A stable political environment conducive to long-term investments (World Bank, 2020).

Weaknesses:

- **Skills Shortages**: Notable skills mismatch between training provided by educational institutions and actual needs of the energy sector (Namibia Training Authority, 2023).
- **Infrastructure Constraints**: Limited infrastructure, particularly in rural areas hinders the development of energy projects (Namibia Energy Institute, 2023).
- **Regulatory Barriers**: Complex licensing and permitting processes slow down project implementation (Namibia Energy Institute, 2023).
- **Funding and Resources**: Adequate and sustainable funding is necessary to support the expansion and improvement of TVET programmes, which hampers the overall effectiveness of skills development initiatives (Namibia Training Authority, 2023).

Opportunities:

- **Emerging Technologies**: Advancements in renewable energy technologies and energy storage solutions present significant growth opportunities, including adoption of PtX and other advanced decarbonisation technologies (International Renewable Energy Agency, 2023).
- **New Skills Development**: These technologies require new skills in electrolysis, hydrogen storage, and ammonia synthesis offering opportunities for increasing employment in decent work.

- **Digitalization**: The integration of digital technologies, such as smart grids and energy storage systems, for enhancing energy efficiency and productivity requires more skills in data analytics, automation, and digital literacy.
- **Regional Cooperation**: Opportunities for cross-border energy trade and collaboration through regional partnerships can enhance energy security (Namibia Statistics Agency, 2023).
- **Investment in Renewables**: Increasing investment and expansion in solar, wind, and green hydrogen projects can create new job opportunities and drive economic growth (Namibia Investment Promotion and Development Board, 2023).

Threats:

- **Global Energy Prices**: Fluctuations in global energy prices impacting project viability (NamPower, 2023).
- **Environmental Challenges**: Stricter environmental regulations and climate change impacts (Ministry of Environment, Forestry and Tourism, 2023).
- **Regional Competition:** Competing against instead of collaborating with neighbouring countries could impact energy trade, skills retention and attracting investment.

Summary Of Key Findings of Sector Analysis and Recommendations

Economic and Labour force analysis and findings summary

The economic and labour force analysis of Namibia's energy sector reveals several key findings:

1. **Economic Contribution and Growth**: The energy sector, including both renewable and non-renewable sources, significantly contributes to Namibia's GDP. Investments in renewable energy, particularly solar and wind, are driving growth and are expected to continue expanding, supported by government policies and international cooperation.
2. **Employment Trends and Projections**: The sector has experienced varying growth rates across its subsectors. Renewable energy has seen an average annual growth rate of 5%, while the green hydrogen and ammonia subsector is projected to grow at an annual rate of 15% over the next decade. The oil and gas subsector has a slower growth rate of 2% annually. Employment projections indicate substantial job creation, particularly in the green hydrogen and renewable energy sectors.
3. **Workforce Demographics and Gender Disparities**: The energy sector workforce is predominantly male, with women representing approximately 30% of the total workforce. Efforts are needed to increase female participation and address gender disparities across different subsectors and roles.
4. **Skills and Education**: There is a significant demand for skilled workers, particularly in engineering, technical, and project management roles. The need for upskilling and aligning education and training programs with industry needs is critical. The Technical and Vocational Education and Training (TVET) system plays a vital role in addressing skills shortages and preparing the workforce for emerging technologies and industry standards.
5. **Policy and Institutional Frameworks**: Effective policy frameworks and international partnerships are essential for attracting investment and fostering sustainable development in the energy sector. The government's strategies, such as the National Energy Policy and the Green Hydrogen Strategy, aim to ensure sustainable growth, energy security, and social equity.

6. **Unemployment and Labor Market Dynamics**: The energy sector has a relatively low unemployment rate compared to other sectors in Namibia. However, there is a need for more detailed and disaggregated data to fully understand the employment landscape and address skills gaps effectively.

7. **Technological Advancements and Industrialization**: Technological advancements and the transition to renewable energy sources are driving changes in the sector. The focus on green hydrogen and renewable energy aligns with global clean energy goals and presents opportunities for industrialization and economic diversification.

8. **Challenges and Opportunities**: The sector faces challenges such as skills shortages, infrastructure constraints, and the need for substantial investments in technology and capacity building. Addressing these challenges will require coordinated efforts from the government, educational institutions, and private sector companies.

In summary, Namibia's energy sector is poised for significant growth, driven by investments in renewable energy and supportive government policies. By addressing skills gaps, promoting workforce development, and leveraging technological advancements, Namibia can enhance its energy sector's capabilities and support sustainable economic development.

Recommendations

Based on the key findings from the economic and labour force analysis of Namibia's energy sector, the following recommendations are proposed:

1. **Enhance Skills Development and Training Programs**:
    - **Align Education with Industry Needs**: Strengthen the alignment of educational curricula, particularly in Technical and Vocational Education and Training (TVET) programs, with the specific skills required by the energy sector. This includes updating curricula to incorporate emerging technologies and industry standards.
    - **Promote STEM Education**: Increase the focus on Science, Technology, Engineering, and Mathematics (STEM) education at all levels to build a pipeline of skilled professionals capable of meeting the demands of the energy sector.
    - **Implement Apprenticeship and Internship Programs**: Develop and expand apprenticeship and internship programs to provide hands-on experience and bridge the gap between theoretical knowledge and practical skills.
2. **Address Gender Disparities**:
    - **Promote Gender Diversity**: Implement initiatives to increase female participation in the energy sector, such as scholarships for women in STEM fields, mentorship programs, and gender-sensitive workplace policies.
    - **Support Women in Leadership**: Encourage and support women to take on leadership roles within the energy sector through targeted training and development programs.
3. **Foster Public-Private Partnerships**:
    - **Collaborate on Skills Development**: Deepen collaboration between the government, educational institutions, and private sector companies to develop and implement training programs that meet industry needs.

- **Leverage Industry Expertise**: Engage industry experts in the design and delivery of training programs to ensure they are relevant and up-to-date.

4. **Invest in Infrastructure and Technology**:
    - **Upgrade Training Facilities**: Invest in state-of-the-art training facilities and equipment to provide high-quality training that prepares graduates for the rapidly evolving energy sector.
    - **Support Technological Advancements**: Encourage the adoption of new technologies and innovations in the energy sector through incentives and support for research and development.
5. **Strengthen Policy and Institutional Frameworks**:
    - **Implement Effective Policies**: Ensure that policies and regulations support the growth and development of the energy sector, including incentives for renewable energy investments and measures to promote energy efficiency.
    - **Enhance Data Collection and Analysis**: Improve the collection and analysis of data related to the energy sector, including employment trends, skills gaps, and the impact of policies and regulations. This will support evidence-based decision-making and strategic planning.
6. **Promote International Collaboration**:
    - **Engage with International Partners**: Strengthen relationships with international organizations, such as the International Labour Organization (ILO), United Nations Development Programme (UNDP), African Development Bank (AfDB), and World Bank, to access funding, technical assistance, and knowledge-sharing opportunities.
    - **Participate in Global Initiatives**: Actively participate in global initiatives and forums related to renewable energy and skills development to stay informed about best practices and emerging trends.
7. **Support Local Content Development**:
    - **Encourage Local Manufacturing**: Promote the development of local manufacturing capabilities for energy sector equipment and components to create jobs and reduce reliance on imports.
    - **Develop Local Supply Chains**: Strengthen local supply chains by supporting small and medium enterprises (SMEs) and encouraging their participation in the energy sector.
8. **Focus on Green Industrialization**:
    - **Implement the Green Hydrogen Strategy**: Continue to develop and implement the Green Hydrogen Strategy to position Namibia as a global leader in hydrogen production and export, creating new economic opportunities and jobs.
    - **Promote Renewable Energy Projects**: Support large-scale renewable energy projects, such as solar and wind, to increase domestic energy production and reduce reliance on fossil fuels.

By implementing these recommendations, Namibia can address the challenges identified in the economic and labour force analysis, enhance the capabilities of its energy sector workforce, and support sustainable economic development.

Business analysis findings summary

The business analysis of Namibia's energy sector reveals several key findings:

1. **Business Environment**:
    - **Regulatory Frameworks**: The regulatory environment is complex, with licensing and permitting processes that can slow down project implementation. Streamlining these processes is essential to attract investment and facilitate project development.
    - **Government Support**: There is strong government support for renewable energy through policies and initiatives, which creates a favourable environment for investment in the sector.
2. **Investment and Infrastructure**:
    - **Investment Needs**: Significant investment is required to achieve energy self-sustainability and support green industrialization. This includes investments in renewable energy projects, infrastructure upgrades (such as rail and port facilities), and technology.
    - **Infrastructure Constraints**: Limited infrastructure, particularly in rural areas, hinders the development of energy projects. Upgrading and expanding infrastructure is crucial for the sector's growth.
3. **Small and Medium Enterprises (SMEs)**:
    - **Role of SMEs**: SMEs play a vital role in driving economic activity in the energy sector, particularly in renewable energy solutions for the domestic market. They are involved in activities such as solar panel installations, small-scale wind turbines, and biomass energy projects.
    - **Challenges for SMEs**: SMEs face challenges such as limited access to finance, lack of modern equipment, and insufficient business development support. Addressing these challenges can enhance their contribution to the sector.
4. **Local Content and Value Chain Development**:
    - **Local Manufacturing**: There is potential to develop local manufacturing capabilities for energy sector equipment and components, which can create jobs and reduce import dependency.
    - **Supply Chain Development**: Strengthening local supply chains by promoting the participation of local businesses in energy projects can enhance the sector's resilience and support economic growth.
5. **Technological Advancements**:
    - **Adoption of New Technologies**: The integration of advanced technologies, such as smart grids, energy storage solutions, and digitalization, is essential for improving the efficiency and reliability of the energy sector.
    - **Research and Development (R&D)**: Investing in R&D can drive innovation and support the development of new energy solutions, contributing to the sector's growth and competitiveness.
6. **Skills and Workforce Development**:
    - **Skills Mismatch**: There is a notable skills mismatch between the training provided by educational institutions and the actual needs of the energy sector. Addressing this mismatch is critical for the sector's development.
    - **Workforce Training**: Enhancing training programs, particularly in Technical and Vocational Education and Training (TVET), and promoting continuous professional development can help build a skilled workforce capable of supporting the sector's growth.

7. **Gender and Inclusion**:

    - **Gender Disparities**: The energy sector workforce is predominantly male, with women underrepresented in many roles. Efforts are needed to increase female participation and address gender disparities.

    - **Inclusive Growth**: Ensuring that the benefits of energy sector growth are inclusive and contribute to reducing poverty and improving livelihoods for all Namibians is important for sustainable development.

8. **International Cooperation and Partnerships**:

    - **Global Partnerships**: International partnerships and investments are essential for developing new energy markets and securing funding for clean energy projects. Such collaborations provide financial support and access to new technologies.

    - **Policy Frameworks**: Effective policy frameworks are vital for attracting investment and promoting sustainable growth. Transparent and predictable energy policies contribute to the successful implementation of energy projects.

In summary, Namibia's energy sector has significant potential for growth and development, driven by government support, investment in renewable energy, and technological advancements. However, addressing challenges such as regulatory complexities, infrastructure constraints, skills shortages, and gender disparities is essential to fully realize this potential and support sustainable economic development.

Recommendations

Based on the business analysis of Namibia's energy sector, the following recommendations are proposed:

1. **Enhance Business Environment and Investment Climate**:

    - **Streamline Regulatory Frameworks**: Simplify and streamline regulatory processes to attract both domestic and international investments in the energy sector. This includes reducing bureaucratic hurdles and ensuring transparency in licensing and permitting processes.

    - **Promote Public-Private Partnerships (PPPs)**: Foster public-private partnerships to leverage private sector expertise and investment in energy projects. This can help bridge funding gaps and accelerate the development of critical infrastructure.

2. **Support Small and Medium Enterprises (SMEs)**:

    - **Facilitate Access to Finance**: Improve access to finance for SMEs involved in the energy sector through targeted financial instruments, such as grants, low-interest loans, and guarantees. This will enable SMEs to invest in new technologies and expand their operations.

    - **Provide Business Development Services**: Offer business development services, including training, mentorship, and advisory support, to help SMEs enhance their capabilities and competitiveness in the energy market.

3. **Promote Local Content and Value Chain Development**:

    - **Encourage Local Manufacturing**: Support the development of local manufacturing capabilities for energy sector equipment and components. This can create jobs, reduce import dependency, and enhance the resilience of the energy supply chain.

- **Develop Local Supply Chains**: Strengthen local supply chains by promoting the participation of local businesses in energy projects. This includes providing incentives for local procurement and fostering collaboration between large enterprises and local suppliers.

4. **Leverage Technological Advancements**:

   - **Adopt Advanced Technologies**: Encourage the adoption of advanced technologies, such as smart grids, energy storage solutions, and digitalization, to improve the efficiency and reliability of the energy sector.

   - **Invest in Research and Development (R&D)**: Support R&D initiatives to drive innovation in the energy sector. This includes funding research projects, establishing innovation hubs, and fostering collaboration between academia, industry, and government.

5. **Address Skills Shortages and Workforce Development**:

   - **Align Training Programs with Industry Needs**: Ensure that training programs, particularly in Technical and Vocational Education and Training (TVET), are aligned with the specific skills required by the energy sector. This includes updating curricula to reflect industry standards and emerging technologies.

   - **Promote Continuous Professional Development**: Encourage continuous professional development for the existing workforce through upskilling and reskilling programs. This will help workers stay current with industry advancements and improve their career prospects.

6. **Enhance Policy and Institutional Frameworks**:

   - **Implement Effective Policies**: Develop and implement policies that support the growth and sustainability of the energy sector. This includes policies that promote renewable energy, energy efficiency, and the transition to a green economy.

   - **Strengthen Institutional Capacity**: Enhance the capacity of key institutions involved in the energy sector, such as regulatory bodies, industry associations, and training providers, to effectively implement policies and support sector development.

7. **Promote Gender Equality and Inclusion**:

   - **Address Gender Disparities**: Implement initiatives to address gender disparities in the energy sector, such as promoting female participation in STEM fields, providing scholarships for women, and ensuring gender-sensitive workplace policies.

   - **Support Inclusive Growth**: Ensure that the benefits of energy sector growth are inclusive and contribute to reducing poverty and improving livelihoods for all Namibians.

8. **Foster International Cooperation and Partnerships**:

   - **Engage with International Organizations**: Strengthen relationships with international organizations, such as the International Labour Organization (ILO), United Nations Development Programme (UNDP), and African Development Bank (AfDB), to access funding, technical assistance, and knowledge-sharing opportunities.

   - **Participate in Global Initiatives**: Actively participate in global initiatives and forums related to renewable energy, skills development, and sustainable development to stay informed about best practices and emerging trends.

9. **Support Green Industrialization and Renewable Energy Projects**:

- **Implement the Green Hydrogen Strategy**: Continue to develop and implement the Green Hydrogen Strategy to position Namibia as a global leader in hydrogen production and export, creating new economic opportunities and jobs.
- **Promote Large-Scale Renewable Energy Projects**: Support the development of large-scale renewable energy projects, such as solar and wind farms, to increase domestic energy production, reduce reliance on fossil fuels, and contribute to climate change mitigation.

By implementing these recommendations, Namibia can create a conducive business environment, attract investments, and support the sustainable growth and development of its energy sector. This will enhance the sector's contribution to the economy, create jobs, and improve energy access and security for all Namibians.

Skills demand analysis – key findings

The skill demand analysis of Namibia's energy sector reveals several key findings

1. **High Demand for Technical and Engineering Skills**:
    - There is a significant demand for technical and engineering skills, particularly in renewable energy technologies such as solar and wind energy. Key roles include electrical engineers, mechanical engineers, and renewable energy engineers.
2. **Emerging Roles in Green Hydrogen and Ammonia**:
    - The green hydrogen and ammonia subsector is creating new roles that require specialized skills in electrolysis, hydrogen storage, and ammonia synthesis. Key occupations include hydrogen production specialists, chemical engineers, and electrolysis technicians.
3. **Project Management and Professional Skills**:
    - As the number of energy projects increases, there is a growing need for project managers with skills in project planning, risk management, and stakeholder engagement.
4. **Skills in Digitalization and Smart Technologies**:
    - The integration of smart grid technologies and digitalization in the energy sector is driving demand for skills in data analytics, automation, and digital literacy. Roles such as smart grid engineers, data analysts, and automation technicians are in demand.
5. **Maintenance and Operational Skills**:
    - There is a high demand for technicians and artisans for the installation, maintenance, and operation of renewable energy systems. This includes solar PV installers, wind turbine technicians, and energy storage technicians.
6. **Environmental and Sustainability Skills**:
    - Skills in environmental management, sustainability, and compliance are increasingly important due to Namibia's climate commitments and stricter environmental regulations.

Recommendations

Recommendations for Skills Demand

1. **Develop Specialized Training Programs**:

- Create specialized training programs in emerging fields such as green hydrogen, ammonia production, and renewable energy technologies. This includes courses on electrolysis, hydrogen handling, and energy storage.

2. **Promote Continuous Professional Development**:
    - Encourage continuous professional development for existing workers through upskilling and reskilling programs. This will help workers stay current with industry advancements and improve their career prospects.
3. **Enhance Project Management Training**:
    - Develop and offer training programs focused on project management skills, including project planning, risk management, and stakeholder engagement, to meet the growing demand for project managers.
4. **Integrate Digital Skills into Training Programs**:
    - Incorporate digital skills, such as data analytics, automation, and digital literacy, into existing training programs to prepare the workforce for the integration of smart technologies in the energy sector.
5. **Focus on Environmental and Sustainability Education**:
    - Develop training programs that focus on environmental management, sustainability, and compliance to meet the increasing demand for these skills in the energy sector.

Skills supply analysis – key findings

The skills supply analysis of Namibia's energy sector reveals several key findings:

1. **Variations in Training Quality**:
    - There are variations in the quality of training provided by different institutions, with some TVET centers and higher education institutions lacking modern equipment and facilities.
2. **Limited Access to Training in Rural Areas**:
    - Access to training opportunities is limited in rural areas due to the lack of decentralized training centres and online learning platforms, restricting opportunities for individuals in remote regions.
3. **Need for Updated Curricula**:
    - Curricula for TVET programs need to be regularly updated to reflect changes in technology, industry practices, and labour market demands. There is a need for greater alignment with specific industry needs to reduce skills mismatches.
4. **Competence of Instructors**:
    - The competence of instructors is critical to the quality of training. There is a need for ongoing professional development and training for instructors to ensure they are equipped with the latest industry knowledge and teaching methodologies.
5. **Collaboration with Industry Partners**:

- There is a need for deeper collaboration between higher education institutions, TVET centres, and industry partners to develop and update curricula that reflect the latest industry standards and technological advancements.

Recommendations

1. **Invest in Modern Training Facilities and Equipment**:
    - Invest in state-of-the-art training facilities and equipment to provide high-quality training that prepares graduates for the rapidly evolving energy sector.
2. **Expand Access to Training in Rural Areas**:
    - Develop decentralized training centers and online learning platforms to increase access to training opportunities in rural areas. This will help individuals in remote regions acquire relevant skills.
3. **Regularly Update Curricula**:
    - Ensure that curricula for TVET programs are regularly updated to reflect changes in technology, industry practices, and labour market demands. This includes incorporating emerging technologies and industry standards.
4. **Enhance Instructor Training and Development**:
    - Provide ongoing professional development and training for instructors to ensure they are equipped with the latest industry knowledge and teaching methodologies. This will improve the quality of training provided.
5. **Strengthen Collaboration with Industry Partners**:
    - Deepen collaboration between higher education institutions, TVET centers, and industry partners to develop and update curricula that reflect the latest industry standards and technological advancements. This will help reduce skills mismatches and ensure that training programs meet industry needs.
6. **Promote Public-Private Partnerships**:
    - Foster public-private partnerships to leverage private sector expertise and investment in training programs. This can help bridge funding gaps and enhance the quality of training provided.

By implementing these recommendations, Namibia can address the skills demand and supply challenges in its energy sector, ensuring that the workforce is well-prepared to support the sector's growth and development.

Conclusion

Namibia's overall economic growth has a direct impact on the energy sector. The country's GDP growth rates and economic forecasts indicate a positive outlook, driven by investments in renewable energy and infrastructure development. Reaching energy self-sustainability through green industrialisation could establish a new growth trajectory for the Namibian economy as a whole.

The country is well positioned geographically to become an important transport and logistics provider for the export of energy, especially green hydrogen, if it can attract the investment required to develop its rail and port infrastructure and Green Valleys. Furthermore, its competitive energy prices are attractive to investors and support

the growth of energy projects. Maintaining stable energy prices, including electricity and fuel prices, will play an important role in the sector's development if it is to have a spillover effect on broader socio-economic development and industrialisation.

Trends Analysis

The trends analysis highlights several insights for Namibia's energy sector, such as increasing adoption of renewable energy technologies, favourable policies and positive investment trends, all of which present significant opportunities for economic growth and job creation. However, challenges such as skills gaps, technological adoption and regulatory compliance need to be addressed. The country also faces potential risks in not delivering on its ambitious transport and infrastructure plans. This would impact employment projections for local content development and expansion of manufacturing as well as sufficient local skills development to meet the projected demand. Tackling these hurdles will require substantial investments in infrastructure, education, capacity building and technology. All these factors are key to maintaining the sustainability of energy projects on which Namibia is basing its green industrialisation strategy.

Education and Higher Learning Institutions

While the government, educational institutions and private sector companies are collaborating in some areas to update curricula and create training programmes that align with industry needs and technological advancements, deepening public-private partnerships will play a vital role in advancing skills development and the quality of training. Up-skilling and re-skilling the labour force through TVET programmes for the unemployed and recent graduates in alignment with NQA standards could fill a large share of medium and lower skilled jobs, e.g., technician and construction roles, by 2025. Implementing apprenticeship programmes, continuous professional development, and mentorship schemes can help bridge the skills gap between different age groups

Particular attention needs to be paid to increasing STEM education in schools to strengthen a pipeline of next generation tertiary STEM graduates capable of fulfilling the highly skilled occupations required to keep pace with the rapidly evolving renewable energy landscape. Initiatives to promote gender diversity and inclusion, such as scholarships for women in STEM fields, mentorship programmes, and gender-sensitive workplace policies, are essential to address these disparities. Securing adequate funding and resources to support the expansion of TVET programmes and investment in state-of-the-art training facilities and equipment are also critical elements to prepare graduates and trainees for rapidly evolving energy sector workplace environments.

While these approaches will require planning and collaboration between various stakeholders before strategies can be implemented, in the short-term harnessing the expertise of highly skilled foreign workers through workplace skills transfer requirements could begin to address the quality of local skills, albeit on a small scale.

International Collaboration

International collaboration, knowledge-sharing and partnerships will also be key to overcoming constraints and enable Namibia to build the robust governance structures necessary to oversee its energy transition, reduce energy imports and foster a more sustainable economy. Organizations, such as the ILO, UNDP, AfDB and World Bank are valuable development partners that are actively involved in promoting global skills development through facilitating knowledge sharing, technical assistance, providing funding, supporting capacity-building initiatives and infrastructure development to help countries develop the skills needed for sustainable development. Strengthening relationships with these organisations can open access to green energy transition funding, boosting skills development and training programmes specific to Namibia's needs.

Evidence-based Decision Making

A critical area for decision makers is access to current, relevant data. Several gaps exist in measuring energy sector sub-sectors, such as granular data on renewable energy, especially on small-scale and off-grid installations, and all local value chains. Employment data in energy sub-sectors like solar and wind is sparse, and there is limited information on the skills and training needed for the workforce in green manufacturing. The last Labour Force

Survey was conducted in 2018 with the result that much of the employment data in nearly all reports and strategy documents related to the energy sector is projected rather than actual.

Moreover, comprehensive data on energy efficiency measures and their impact on consumption are not readily available. Environmental impact assessments, including data on land use changes and biodiversity effects due to renewable energy projects, are insufficiently detailed. Financial metrics, such as the cost-effectiveness and return on investment for green energy initiatives, are also underreported. Finally, there is a need for more robust data on the effectiveness of policies and regulations in promoting renewable energy adoption, as well as the impact of subsidies and incentives on the growth of the green energy sector. Addressing these data and information gaps is a critical challenge but also an important opportunity.

Namibia's energy sector is poised for significant growth, driven by investments in renewable energy and supportive government policies. By addressing skills gaps identified, promoting workforce development, and leveraging technological advancements, Namibia can enhance its energy sector's capabilities and support sustainable economic development.

References

"Namibia's National Electrification Funding Portfolio" by the Ministry of Mines and Energy. Windhoek, Namibia: Ministry of Mines and Energy, 2024.

African Development Bank. 2022. "International Partnerships and Investments in Developing New Energy Markets."

Brüntrup, Michael, and Raoul Herrmann. "Bioenergy Value Chains in Namibia: Opportunities and Challenges for Rural Development and Food Security." Paper presented at the GTZ Symposium on Renewable Energy, Berlin, Germany, October 13-14, 2009.

Eline van der Linden (Namibia Green Hydrogen Programme Head of Impact and ESG): "The Green Hydrogen Industry to Create Over 100,000 Jobs for Namibians." Published on Eagle FM.

International Labour Organization (ILO). 2019. "Skills and Employability in the Renewable Energy Sector."

International Renewable Energy Agency (IRENA). "Energy Profile Namibia." Abu Dhabi, UAE: IRENA, 2023.

International Renewable Energy Agency (IRENA). 2020. "Renewable Energy and Jobs – Annual Review 2020."

Jiang, X., and La Marca, A. 2023. "Employment Effects of Renewable Energy in Namibia."

Ministry of Education, Arts and Culture. *Education Management Information System (EMIS) Education Statistics 2023*. Windhoek, Namibia: Ministry of Education, Arts and Culture, 2023. Available at: https://moe.gov.na/wp-content/uploads/2024/09/MoEAC-EMIS-Education-Statistics-2023.pdf

Ministry of Mines and Energy. "Green Hydrogen Strategy: Aims to Position Namibia as a Global Leader in Hydrogen Production and Create Employment Opportunities." Windhoek, Namibia: Ministry of Mines and Energy, 2023.

Namibia Economist: "Green Hydrogen's Socioeconomic Impact Explored." Published on Namibia Economist.

Namibia Energy Institute. 2023. "Energy Storage and Efficiency in Namibia."

Namibia Investment Promotion and Development Board. 2023. "Investment Opportunities in Namibia's Energy Sector."

Namibia Statistics Agency. "Namibia Labour Force Survey 2018." Windhoek, Namibia: Namibia Statistics Agency, 2019.

Namibia Statistics Agency. 2019. "Employment Data in Namibia's Energy Sector."

Namibia Training Authority. 2023. "Technicians and Artisans in Namibia's Energy Sector."

Namibian Ministry of Mines and Energy. 2021. "Policy Frameworks for Attracting Investment in the Energy Sector."

NamPower. 2023. "Digitalisation and Smart Grid Technologies in Namibia."

PtX Hub: "Skills needs and gap analysis in Namibia's PtX sector." This study explores the skills requirements, gaps, and education-related barriers in Namibia's Power-to-X (PtX) sector, including green hydrogen and ammonia. Link

Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL). 2023. "Green Hydrogen and Adaptive Land Management Projects."

The Brief: "Green Jobs – Namibia Green Hydrogen Programme." Published on The Brief.

The Brief: "Job Opportunities in Namibia's Green Hydrogen Sector." Published on The Brief. Link

The Namibian: "Job Opportunities in Namibia's Green Hydrogen Sector." Published on The Namibian.

von Oertzen, Detlof. "Bioenergy in Namibia." GTZ/Namibia Renewable Energy Programme, 2008.

World Bank. 2020. "Economic and Energy Sector Assessments."

Government of the Republic of Namibia. 2007. "Labour Act, Act No. 11 of 2007." Link

Government of the Republic of Namibia. 2007. "Electricity Act, Act No. 4 of 2007." Link

Government of the Republic of Namibia. 1990. "Petroleum Products and Energy Act, Act No. 13 of 1990." Link

Government of the Republic of Namibia. 2006. "Higher Education Act, Act No. 26 of 2003." Link

Government of the Republic of Namibia. 2008. "Vocational Education and Training Act, Act No. 1 of 2008." Link

Ministry of Mines and Energy. 1998. "White Paper on Energy Policy." Link

Ministry of Mines and Energy. 2011. "Renewable Energy Feed-In Tariff (REFIT) Programme." Link

Ministry of Mines and Energy. 2016. "National Integrated Resource Plan." Link

Ministry of Mines and Energy. 2017. "National Energy Policy." Link

Ministry of Mines and Energy. 2017. "National Renewable Energy Policy." Link

Ministry of Mines and Energy. 2022. "Namibia Green Hydrogen and Derivatives Strategy." Link