Initiative for
Climate Action
Transparency

Namibia's New Energy Scenarios and Emissions Projections

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Initiative for Climate Action Transparency - ICAT

Report on new energy scenario and GHG emissions projections for the energy sector and explain data improvement

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Executive Summary

Namibia is advancing a transformative vision for its energy sector that balances economic growth, energy security, and climate responsibility. This report presents a comparative scenario analysis of Namibia's greenhouse gas (GHG) emissions trajectory through 2050, assessing three key pathways: Business-as-Usual (BAU), With Measures (WM), and With Additional Measures (WAM). Using the GACMO modeling tool, the analysis quantifies sector-specific mitigation impacts and evaluates the feasibility of reaching national and international climate commitments.

Under the BAU scenario, Namibia's energy-related emissions are projected to rise from 4,000 ktCO_2e in 2020 to 5,200 ktCO_2e by 2050, driven by growing fossil fuel use in transport, industry, and electricity generation. This pathway reflects minimal intervention and continued reliance on energy imports and legacy technologies.

In contrast, the WM scenario incorporates moderate mitigation actions such as efficient lighting, fuel-efficient vehicles, and a 30% renewable energy share by 2030. These measures reduce emissions to 3,200 ktCO_2e by 2030 and stabilize around 3,500 ktCO_2e by 2050, indicating the potential of near-term interventions to slow emissions growth.

The WAM (Net-Zero) scenario presents an ambitious yet achievable pathway, demonstrating an 87% reduction in emissions by 2050—down to 680 ktCO_2e. This scenario assumes large-scale deployment of renewable energy (solar, wind), broad electrification of transport and industry, energy efficiency improvements, and the development of a green hydrogen economy. By 2030, the energy sector achieves a 2,000 ktCO_2e reduction compared to BAU, contributing 17% toward Namibia's national NDC target of 11,900 ktCO_2e.

The analysis confirms that targeted policy support, international climate finance, and public-private collaboration are essential for realizing the WAM pathway. Investments in grid modernization, domestic renewable generation, and human capital will accelerate Namibia's shift toward a low-carbon energy system, reducing import dependence while generating green jobs and economic resilience.

This report underscores the strategic importance of the energy sector in delivering Namibia's climate ambitions and provides a roadmap for aligning sectoral planning with long-term low-emission development goals.

1 Introduction

1.1 Background

This report evaluates Namibia's energy sector emissions and explores the transformative potential of new energy scenarios to align with the country's climate objectives. Namibia, as a party to the Paris Agreement, has committed to a low-carbon development pathway that ensures sustainable economic growth while reducing GHG emissions. This report specifically focuses on quantifying emissions from the energy sector, analysing the implications of different energy scenarios, and recommending actionable pathways to meet national and international climate targets. By addressing emissions from electricity generation, transportation, and industrial energy use, the report serves as a foundational tool for policymakers, industry stakeholders, and international partners.

Namibia's energy sector, which currently relies heavily on imported electricity and fossil fuels, contributes significantly to its GHG emissions, with the energy sector accounting for approximately 30% of the national total. Despite its significant renewable energy potential, especially in solar and wind, the current energy mix is constrained by limited infrastructure and investment in green technologies. This report outlines how targeted interventions in renewable energy and energy efficiency can mitigate these challenges while supporting national development goals.

Namibia's updated Nationally Determined Contribution (NDC) commits to a 2030 target of reducing GHG emissions by 11,900 $KtCO_2e$, equivalent to 11.6% of its BAU projections. This target includes both conditional measures, dependent on international financial and technical support, and unconditional measures implemented through domestic resources.

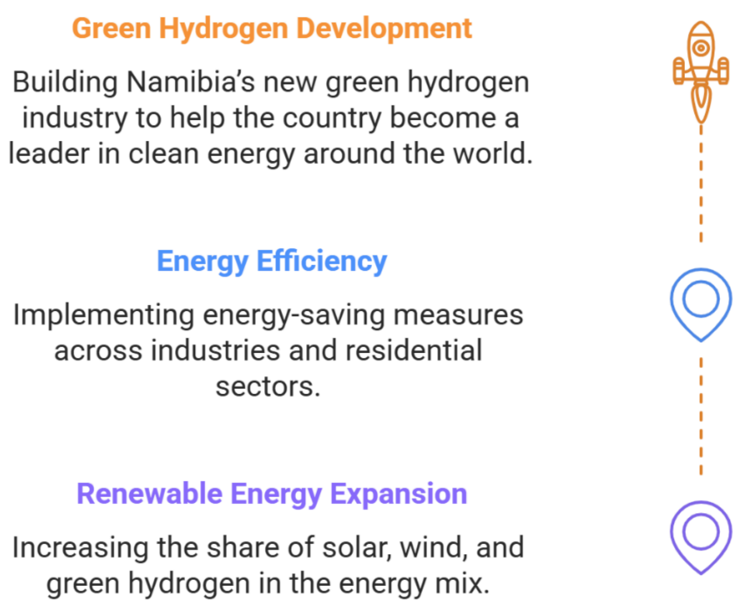


Figure 1. Achieving Energy Sector Goals.

The energy sector plays a central role in delivering Namibia's climate ambitions, particularly as outlined in the updated Nationally Determined Contribution (NDC). As visually illustrated in **Figure 1**, Namibia's low-emission development pathway is anchored on three strategic pillars:

1. **Green Hydrogen Development:** Developing Namibia's emerging green hydrogen industry is a strategic move to position the country as a global leader in the clean energy transition. It offers opportunities to decarbonize domestic sectors such as transport and mining, while also creating a future export market that supports global emissions reduction.

2. **Energy Efficiency:** Implementing energy-saving measures across industrial, commercial, and residential sectors is a cost-effective mitigation strategy. By improving performance standards, reducing energy waste, and optimizing systems, Namibia can lower energy intensity while enhancing competitiveness and affordability.

3. **Renewable Energy Expansion:** Expanding the share of solar, wind, and green hydrogen in the national energy mix is fundamental to reducing dependency on fossil fuel imports. With world-class solar irradiation and untapped wind potential, Namibia is well-positioned to decarbonize its grid and improve energy access sustainably.

These priorities reflect an integrated vision where mitigation, energy security, and economic opportunity intersect. The diagram provides a streamlined roadmap, reinforcing the NDC's focus on targeted, high-impact interventions that can drive transformational change in Namibia's energy sector.

Evidence from scenario modelling indicates that under the With Additional Measures (WAM) scenario, Namibia could achieve emissions reductions of up to 87% by 2050 compared to BAU, demonstrating the feasibility of meeting and even exceeding its NDC targets. This report provides detailed analyses of such scenarios to guide decision-making processes.

1.2 Leveraging Renewable Energy for Emissions Reduction and Energy Security in Namibia

Namibia currently imports between 60–70% of its electricity supply, primarily from neighbouring countries. This high dependency not only poses energy security risks and exposes the economy to regional price and supply volatility, but also indirectly contributes to emissions over which Namibia has limited control. As shown in **Figure 2**, this dependency underscores the urgent need to expand domestic renewable energy production as a strategic priority for both resilience and climate mitigation.

Namibia benefits from one of the highest solar irradiation levels globally, with solar potential exceeding 5.4 kWh/m²/day. This exceptional natural resource, illustrated in **Figure 2**, provides a powerful foundation for transforming the national energy system. Accelerated deployment of solar photovoltaic (PV), alongside wind and green hydrogen infrastructure, can significantly reduce the country's reliance on fossil fuels—particularly in electricity generation and transport—and support sustainable industrial development.

As of 2022, energy-related emissions stood at approximately 3,500 KtCO_2e per year, largely driven by fossil fuel combustion for power and transportation. Transitioning to renewables, as outlined in the diagram, presents a credible pathway to cut emissions and align with Namibia’s updated NDC, which targets substantial reductions from the energy sector by 2030.

By linking energy sector reform to NDC implementation, this report underscores the co-benefits of climate action: enhancing energy independence, fostering green economic growth, and contributing to global efforts to limit temperature rise to 1.5°C. **Figure 2** captures the strategic vision for integrating renewables, reducing emissions, and securing long-term energy sovereignty for Namibia..

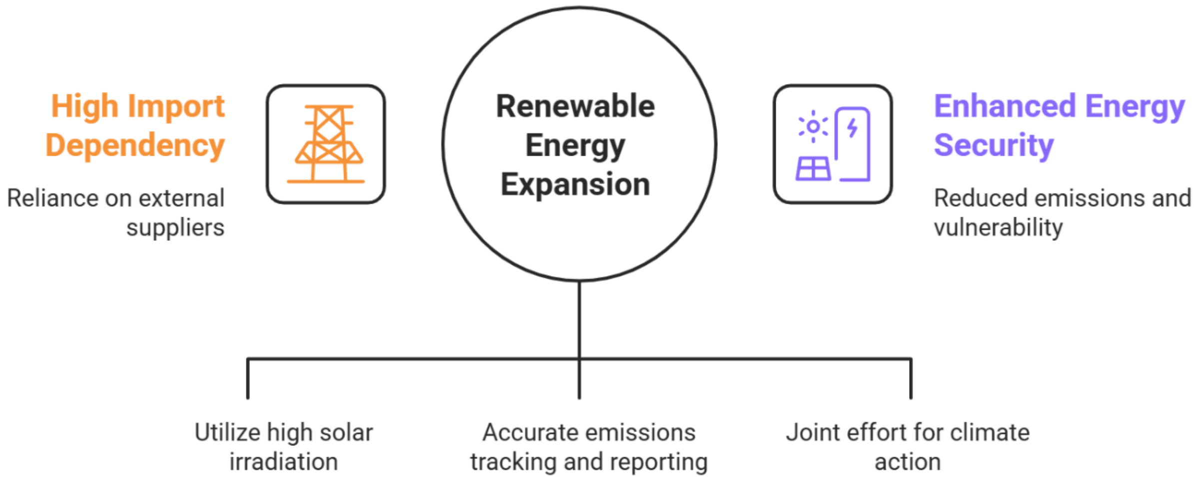


Figure 2. Renewable Energy for Namibia's Energy Security.

2 Current Energy Sector Overview

2.1 Energy Mix

Namibia's energy sector is heavily reliant on imported electricity, which accounts for approximately 65% of the country's total energy consumption. This reliance makes the energy sector vulnerable to external market fluctuations and supply disruptions, particularly from neighbouring countries such as South Africa and Zambia.

- **Imported Electricity**: Namibia sources much of its power through imports, primarily via the Southern African Power Pool (SAPP).[1] The dependency on imports underscores the need for expanding domestic generation capacity.
- **Renewable Energy**: Despite abundant renewable energy resources, including solar and wind, renewables only contribute around 4% to the energy mix. Namibia has one of the highest solar irradiation rates globally, with an average solar potential exceeding 5.4 kWh/m²/day, presenting significant opportunities for expansion.[2]
- **Petroleum and Coal**: Fossil fuels, including petroleum products for transport and coal for limited industrial processes, represent about 30% of the energy mix, contributing significantly to GHG emissions.[3]

2.2 GHG Emissions

Namibia's energy sector remains the most significant contributor to its national greenhouse gas (GHG) emissions, driven primarily by activities in electricity generation and fossil fuel consumption within the transport sector. These emissions reflect a combination of domestic energy production challenges and a heavy reliance on imported electricity. Below is a detailed analysis of sectoral contributions (**Figure 3**):

2.2.1 Electricity Generation

Electricity generation contributes approximately 1,800 $KtCO_2e$ annually (**Figure 3**). Namibia's electricity production relies on a mix of renewable and non-renewable sources, with the Ruacana Hydropower Plant accounting for most of the domestic renewable production. However, fossil fuel plants, such as the Van Eck coal-fired power station and Anixas diesel power station, play a significant role in supplementing the energy mix during peak demand periods. The dependency on imported electricity, primarily coal-generated power from neighboring countries like South Africa, adds to the indirect GHG emissions burden.

[1] Southern Africa Power Pool (SAPP) – Imports https://www.nampower.com.na/Page.aspx?p=169
[2] Sector Profile: Renewable Energy https://nipdb.com/wp-content/uploads/2022/12/Namibia-Sector-Profile-Renewable-Energy.pdf
[3] Energy Demand and forecasting in Namibia: Energy for economic Development https://www.npc.gov.na/wp-content/uploads/2023/06/Energy-Demand-Forecasting-in-Namibia-Energy-for-Economic-Development-2013.pdf

2.2.2 Transport Sector

The transport sector contributes 1,200 ktCO_2e to the national GHG inventory (**Figure 3**). This is primarily driven by road transport, with widespread use of diesel and petrol vehicles. Namibia's sprawling geography and the reliance on road transport for both goods and passenger movement amplify the sector's emissions. Aviation and navigation emissions, while relatively smaller, have shown consistent growth, contributing approximately 110 ktCO_2e and 156 ktCO_2e, respectively, in 2022.

2.2.3 Industry and Residential Energy Use

Collectively, industrial and residential energy demands contribute 400 ktCO_2e (**Figure 3**). In rural areas, residential energy consumption is dominated by biomass, particularly firewood, which raises sustainability concerns. Conversely, urban households are increasingly shifting toward electricity and solar solutions, showcasing a gradual transition to cleaner energy sources. Industrial emissions are relatively modest but are expected to grow as Namibia industrializes further.

2.2.4 Trends and Projections

Between 1990 and 2022, emissions from the energy sector increased by 259%, reflecting a combination of economic growth, urbanization, and rising energy demand. While renewable energy's share has grown significantly, particularly through hydropower and solar projects, fossil fuels remain a substantial part of the energy mix.

Sector	Electricity Generation	Transport	Industry & Residential Use
Contribution (ktCO_2e)	1,800	1,200	400
% Share	46%	30%	24%

Figure 3. Sectoral GHG Contributions in the Energy Sector (2022).

2.3 Key Challenges

1. **Reliance on Imports**: Approximately 71% of electricity demand is met through imports, primarily coal-based, which heightens emissions and energy security risks.
2. **Limited Renewable Integration**: Despite having immense solar and wind potential, renewable energy accounts for a small proportion of the overall energy supply.
3. **Data Gaps**: There is insufficient granularity in GHG data collection, particularly for fugitive emissions and sectoral disaggregation, which hinders effective policy design.

Namibia's energy transition strategies must focus on scaling up renewable energy capacity, electrifying the transport sector, and implementing robust Monitoring, Reporting, and Verification (MRV) systems to effectively track and mitigate emissions.

2.4 Opportunities and Challenges

2.4.1 Challenges

High Reliance on Imports

Namibia imports approximately 65% of its electricity, primarily from neighbouring countries such as South Africa and Zambia (**Table 1**). This dependency on regional energy markets exposes the country to supply disruptions, price volatility, and the environmental impact of coal-based electricity imports. As demand for electricity grows with urbanization and industrial development, this reliance presents an increasing risk to energy security and sustainability.

Table 1. Namibia Energy Mix (2024).

Energy Source	Contribution (%)
Imported Electricity	65
Coal	10
Petroleum	20
Renewables (Solar/Wind)	4
Other	1

Limited Investment in Renewable Energy Infrastructure

Despite its abundant solar and wind resources, Namibia faces significant barriers to renewable energy development. Challenges include inadequate financing mechanisms, limited technical capacity, and underdeveloped grid infrastructure to integrate renewable energy at scale. These factors delay the transition to a more sustainable energy system and constrain Namibia's ability to meet its Nationally Determined Contribution (NDC) targets.

2.4.2 Opportunities

Expanding Solar and Wind Energy Capacity

Namibia has some of the world's highest solar irradiation levels, averaging over 5.4 kWh/m²/day, and vast untapped wind energy potential along its coastline. Expanding solar photovoltaic (PV) and wind projects can significantly reduce reliance on imports while cutting GHG emissions. Recent advancements, such as the establishment of independent power producers (IPPs) and renewable energy auctions, indicate a growing momentum in this sector.

Green Hydrogen Development:

Namibia is uniquely positioned to become a global leader in green hydrogen production due to its abundant renewable energy resources and favourable geographic conditions for export. Green hydrogen has the potential to diversify the economy, reduce dependence on fossil fuels, and position Namibia as a supplier to international markets seeking sustainable energy solutions. The establishment of the Namibia Green Hydrogen Council and ongoing pilot projects reflect the country's commitment to tapping this transformative opportunity.

2.4.3 Balancing Opportunities and Challenges

While Namibia faces hurdles in transitioning to a sustainable energy system, strategic investments and robust policies can unlock its vast potential. A comprehensive approach that prioritizes infrastructure development, fosters international partnerships, and strengthens institutional capacities will enable Namibia to overcome its challenges and capitalize on its opportunities, paving the way for a low-carbon and resilient energy future.

3 New Energy Scenarios

3.1 Description of Scenarios

3.1.1 Description of Scenarios

Business-as-Usual (BAU) Scenario

The Business-as-Usual (BAU) scenario represents a continuation of existing energy trends without the implementation of significant policy interventions or investments in low-carbon technologies. It projects a future where Namibia's energy and emissions trajectory remains aligned with historical patterns, driven by economic and population growth.

Key Features

- **Energy Supply**: Under the BAU scenario, Namibia remains heavily reliant on imported electricity, primarily coal-based power from regional markets, and fossil fuels for domestic energy needs. This reliance perpetuates economic vulnerabilities and limits the country's energy sovereignty. Domestic power generation continues to be supplemented by fossil fuel-powered plants like the Van Eck coal station and Anixas diesel plant.

- **GHG Emissions**: Emissions from the energy sector increase steadily as energy demand grows. Economic expansion, urbanization, and industrialization amplify energy consumption, particularly in transport, residential, and industrial sectors. By 2030, energy sector emissions are projected to exceed 4,500 $KtCO_2e$ annually, further straining Namibia's ability to meet its climate commitments.

- **Renewables**: Investment in renewable energy infrastructure remains minimal in this scenario, with renewables contributing less than 10% of the energy mix by 2030. Solar and wind projects, while technically feasible, do not scale up significantly due to a lack of incentives, financing mechanisms, and supportive regulatory frameworks. The limited penetration of renewables hinders Namibia's progress toward energy independence and emissions reductions.

3.1.2 Implications of the BAU Scenario

- **Economic Risks**: Continued dependence on imported electricity exposes Namibia to price volatility and supply disruptions in regional energy markets, undermining energy security and economic stability.

- **Environmental Consequences**: Increasing GHG emissions exacerbate climate change impacts, placing Namibia at greater risk of climate-related vulnerabilities, such as water scarcity and extreme weather events.

- **Missed Opportunities**: The lack of investment in renewable energy infrastructure prevents Namibia from capitalizing on its abundant solar and wind resources, missing an opportunity to transition to a sustainable energy system and position itself as a regional clean energy leader.

The BAU scenario highlights the urgent need for transformative energy policies and investments to shift Namibia's energy trajectory toward a more sustainable and resilient future.

3.1.3 Low-Carbon Scenario

The Low-Carbon Scenario envisions Namibia taking deliberate yet moderate steps toward a sustainable energy transition by integrating renewable energy sources and implementing energy efficiency measures across key sectors. This scenario demonstrates how targeted interventions can achieve meaningful emissions reductions while balancing economic growth and development goals.

Key Features

a) **Energy Supply**: **Energy Supply**: Renewables, including solar and wind, expand to account for approximately 30% of Namibia's electricity generation by 2030. This growth is driven by the implementation of incentive mechanisms such as feed-in tariffs, public-private partnerships, and international climate finance. The scenario assumes the installation of approximately 760 MW of new capacity from solar photovoltaic (PV) and 120 MW from wind farms between now and 2030, bringing the total renewable contribution to a significantly higher share of the national energy mix. These additions will be supported by upgraded grid infrastructure to accommodate the intermittent nature of renewable energy sources.

b) **Efficiency Measures**: Comprehensive energy efficiency measures are adopted across industrial, residential, and transport sectors, leading to a 20% reduction in energy intensity by 2030:

   - **Industrial Sector**: Deployment of modern, energy-efficient technologies in manufacturing and processing industries.
   - **Residential Sector**: Adoption of energy-saving appliances, improved building insulation, and rooftop solar systems in urban and rural households.
   - **Transport Sector**: Enhanced fuel economy standards and a gradual shift to hybrid and electric vehicles.

c) **GHG Reductions**: Reduced reliance on fossil fuels and enhanced energy efficiency result in a significant decline in GHG emissions:

   - By 2030, emissions from the energy sector are projected to decline to 3,200 $KtCO_2e$, compared to 4,600 $KtCO_2e$ under the Business-as-Usual (BAU) scenario—representing a reduction of approximately 30%.
   - The shift toward renewables and energy-saving measures is the primary driver of this mitigation.

Impact of the Low-Carbon Scenario

a) **Economic Benefits**:

   - Energy efficiency reduces energy costs for businesses and households, freeing up resources for reinvestment.
   - Renewable energy development creates job opportunities, particularly in solar and wind energy installations, operations, and maintenance.

b) **Environmental Gains**:

   - Diversification of the energy mix enhances energy security and reduces Namibia's carbon footprint.
   - The transition to renewables decreases dependence on imported electricity, reducing indirect emissions from coal-fired power plants in neighbouring countries.

c) **Pathway to NDC Goals**:

   - The Low-Carbon Scenario aligns closely with Namibia's updated Nationally Determined Contribution (NDC), demonstrating the feasibility of achieving its 11,900 KtCO_2e emissions reduction target by 2030 through moderate yet impactful interventions.

The Low-Carbon Scenario underscores the importance of incremental yet decisive steps toward sustainability. By leveraging its abundant renewable energy potential and prioritizing energy efficiency, Namibia can reduce its emissions while fostering socio-economic development. This pathway represents a balanced approach, setting the foundation for more aggressive decarbonization efforts in the future.

3.1.4 Net-Zero Scenario

The Net-Zero Scenario outlines an ambitious and transformative pathway for Namibia to achieve near-total decarbonization by 2050. This scenario leverages Namibia's abundant renewable energy resources, innovative technologies, and strategic policy frameworks to eliminate fossil fuel dependency and position the country as a global leader in climate action.

Key Features

a) **Energy Supply**: By 2050, renewable energy sources, including solar, wind, and green hydrogen, dominate Namibia's energy mix, accounting for over 80% of total electricity generation. Large-scale solar PV installations, wind farms along the coastal regions, and green hydrogen plants are key drivers of this transition. Export markets for green hydrogen and ammonia contribute to economic growth while supporting global decarbonization efforts.

b) **Electrification**: Extensive electrification across transport and industrial sectors forms a cornerstone of the Net-Zero Scenario:

   - **Transport Sector**: Widespread adoption of electric vehicles (EVs) and electrified public transit systems reduce reliance on diesel and petrol. EV charging networks are supported by renewable energy sources and battery storage solutions.
   - **Industrial Sector**: Industrial Sector: Industries transition to electricity-based are not available in GACMO, the estimated impacts were assessed using complementary analysis from the LEAP model.
   - **Energy Storage**: Advanced storage technologies, including battery systems and pumped hydro storage, address the intermittency challenges of renewable energy, ensuring reliable energy supply.

c) **GHG Emissions**: The Net-Zero Scenario achieves near-zero emissions by 2050 through:

- **Fossil Fuel Elimination:** Phasing out coal, diesel, and petrol from the energy system across power generation, transport, and industry.
- **Carbon Sequestration:** Although primarily associated with the land-use and AFOLU sectors, carbon sequestration is included in this scenario to account for offsetting residual energy-related emissions—for example, from hard-to-abate sectors such as aviation and heavy transport. Measures include nature-based solutions like reforestation and improved soil carbon practices, as well as emerging technologies such as carbon capture and storage (CCS) at industrial sites. These approaches are estimated to contribute up to 500–800 KtCO_2e/year in emission offsets by 2050, helping to close the final gap to net-zero..

Impact of the Net-Zero Scenario:

a) **Economic Transformation**:

- Investments in renewable energy and green hydrogen create substantial employment opportunities and attract foreign direct investment.
- Namibia's positioning as a major exporter of green hydrogen and related products enhances economic resilience and diversifies revenue streams.

b) **Energy Security and Independence**:

- A renewable-dominated energy mix eliminates reliance on electricity imports, enhancing Namibia's energy sovereignty and reducing exposure to external market risks.

c) **Environmental Leadership**:

- Achieving net-zero emissions aligns Namibia with global efforts to limit warming to 1.5°C under the Paris Agreement. This positions Namibia as a regional leader in sustainable development and climate mitigation.

d) **Challenges and Enablers**:

- **Challenges**: High upfront costs for renewable energy infrastructure, storage technologies, and grid expansion, as well as the need for skilled labour and institutional capacity.
- **Enablers**: International climate finance, technology transfer, and policy support from mechanisms like the Paris Agreement's Article 6 and the Enhanced Transparency Framework.

The Net-Zero Scenario demonstrates Namibia's potential to achieve a transformative energy transition while fostering economic growth and environmental stewardship. Through bold investments, strategic policies, and strong international partnerships, Namibia can realize its vision of a sustainable, net-zero future by 2050.

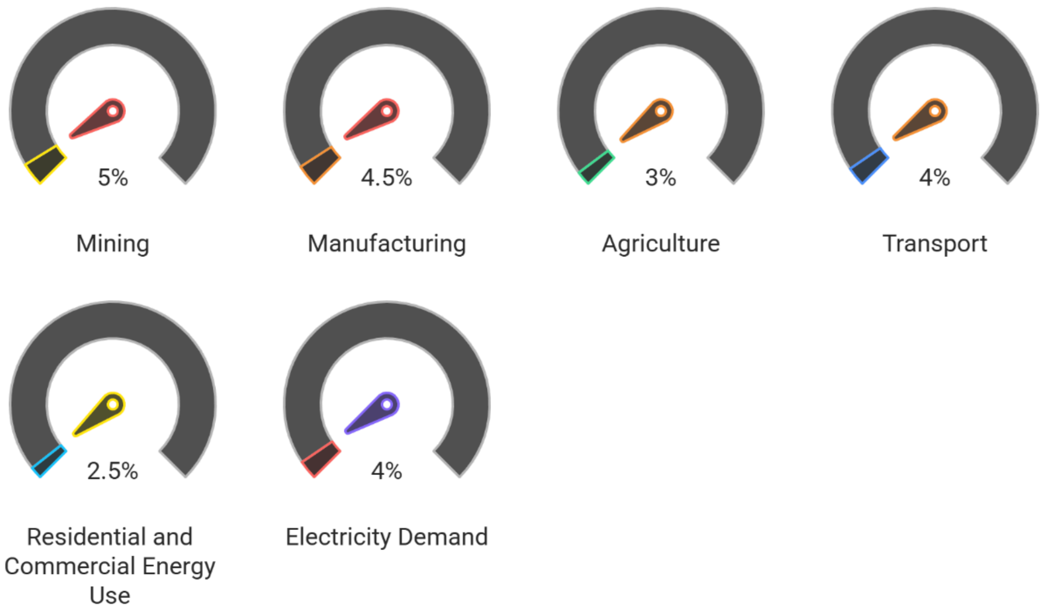
3.2 Assumptions and Methodologies

3.2.1 Key Assumptions

The projections for Namibia's energy sector under the different scenarios are grounded in key assumptions reflecting economic, technological, and energy trends. These assumptions serve as the foundation for modelling Namibia's transition pathways using the GACMO tool, supplemented where necessary by complementary tools such as LEAP.

1. **Start Year and Energy Balance Data**
   Projections begin in 2020, the selected base year for GACMO modelling. Energy balance data were sourced from the Namibia Statistics Agency (NSA)[4] and complemented by International Energy Agency (IEA)[5] datasets, ensuring accuracy in historical energy use and fuel composition across sectors.

2. **Economic Growth Rates**
   While an overarching GDP growth rate of 4% per annum is assumed to reflect Namibia's broader development trajectory,[6] GACMO does not directly use GDP for emissions projections. Instead, sector-specific annual growth rates were applied to estimate activity data changes, which in turn drive emissions under each scenario. The sectoral growth rates used in the modelling are as follows:[7]



[4] Namibia Statistics Agency. *Gross Domestic Product (GDP) Second Quarter 2024 Report*. Retrieved from https://nsa.org.na/wp-content/uploads/2024/09/Gross-Domestic-Product-GDP-Second-Quarter-2024.pdf.
[5] International Energy Agency (IEA). *Renewable Energy Opportunities for Namibia*. Retrieved from https://www.iea.org/reports/renewable-energy-opportunities-for-namibia.
[6] World Bank. *Namibia Economic Overview*. Retrieved from https://www.worldbank.org/en/country/namibia/overview.
[7] Namibia Statistics Agency. *National Accounts 2023 Report*. Retrieved from https://nsa.org.na/wp-content/uploads/2024/09/Namibia-National-Accounts-2023.pdf.

Figure 4. Annual growth rates by sector in Namibia.

These growth rates reflect historical trends, projected development priorities, and stakeholder inputs. Under the BAU scenario, this rising demand is met primarily through fossil fuels and imported electricity. In contrast, the Low-Carbon and Net-Zero scenarios assume a gradual transition toward domestic renewable energy and energy efficiency, enabling economic growth while reducing emissions.

3. **Energy Intensity**

   a) In the BAU scenario, energy intensity remains unchanged, reflecting inefficiencies in industrial, residential, and transport energy use.

   b) In contrast, the Low-Carbon and Net-Zero scenarios assume a 20–30% reduction in energy intensity through.

4. **Technological Adoption**

   a) The Low-Carbon Scenario assumes moderate adoption of renewables, including utility-scale solar PV and wind projects supported by investments in grid upgrades and storage.

   b) The Net-Zero Scenario incorporates rapid deployment of advanced technologies, including:

      - Expansion of solar, wind, and green hydrogen capacity.
      - Electrification of transport and industrial sectors.
      - Energy storage systems such as lithium-ion batteries and pumped hydro.
      - Carbon sequestration through reforestation and direct air capture.

5. **Sectoral Growth Rates**
   Energy demand projections are based on sector-specific annual growth rates, reflecting economic expansion, infrastructure development, and demographic trends. While overall GDP growth is assumed at 4% per year, sectoral energy demand grows at differentiated rates as follows:

      - **Transport**: 4.5% per year – driven by increased freight movement and urban vehicle use
      - **Industry (Manufacturing and Mining)**: 5.0% per year – linked to new investments and mineral processing
      - **Agriculture**: 3.0% per year – reflecting mechanization and irrigation demand
      - **Residential and Commercial (Buildings)**: 2.5% per year – due to population growth and electrification

- **Overall Electricity Demand**: 4.0% per year – matching GDP but with varying sectoral intensity

These growth rates provide the foundation for emissions projections across Business-as-Usual and mitigation scenarios.

6. **Selected Mitigation Options and Units of Penetration (GACMO)**
Table 3 presents the key mitigation actions modeled for Namibia's energy sector using the GACMO tool, specifying what each measure targets, how its impact is quantified, and how much deployment is expected by 2030.

Table 2. Selected Mitigation Options

Mitigation Option	Penetration Unit	Assumed Deployment by 2030	Additional Details
Solar PV deployment	MW installed capacity	~760 MW	Utility-scale and distributed solar
Wind power	MW installed capacity	~120 MW	Grid-connected wind farms
Efficient lighting (households)	Number of efficient light bulbs	~1,000,000 LED bulbs[8]	Assumes 50% penetration across 500,000 households[9]
Solar water heating	% of urban residential buildings	25% of urban homes	Targets middle- to high-income households
Electric vehicles (EV adoption)	% of total vehicle fleet	5% of vehicle stock (approx. 25,000 EVs)	Includes passenger and light commercial vehicles
Industrial energy efficiency improvements	% reduction in energy intensity	10% reduction across major subsectors	Includes food processing, mining, cement

Implications of Assumptions:

- Economic Growth vs. Emissions: Under BAU, economic expansion results in increased emissions. However, Low-Carbon and Net-Zero scenarios demonstrate that emissions can be decoupled from growth through efficiency and renewable technologies.
- Energy Efficiency as a Catalyst: Lowering energy intensity improves cost-effectiveness, enhances competitiveness, and contributes to household affordability.

[8] This scenario assumes the replacement of 1 million incandescent bulbs with LED lamps, equivalent to 50% of households, assuming an average of 2 bulbs per household upgraded in ~500,000 households.
[9] Based on national census data and household electrification trends. https://census.nsanamibia.com/wp-content/uploads/2024/10/2023-Population-and-Housing-Census-Main-Report-28-Oct-2024.pdf

- Role of Technological Innovation: Technological advancements under the Net-Zero scenario highlight the critical importance of climate finance and international cooperation for Namibia's long-term decarbonization goals.

These assumptions provide a robust analytical framework for evaluating Namibia's energy transition and aligning it with its climate and development objectives.

3.2.2 Methodologies:

The methodologies applied in modelling Namibia's energy sector scenarios and emissions projections align with international best practices, ensuring accuracy and relevance to the country's unique circumstances. Key methodological elements include the following:

Emission Factors

- Emissions projections are calculated using IPCC Tier 1 guidelines, which allow for greater specificity by incorporating activity data and emission factors that are tailored to Namibia's energy profile.
- Country-Specific Factors: Where available, Namibia-specific emission factors are applied to reflect the unique characteristics of its energy systems. For example:
  - Emission factors for coal and diesel in electricity generation consider the efficiency levels of local power plants, such as the Van Eck and Anixas stations.
  - Transport sector emissions are derived using fuel-specific factors for diesel and petrol, adjusted for fleet composition and road usage patterns.
- International Standards: For data gaps or unavailable local factors, default values from the IPCC are utilized to maintain consistency with global reporting frameworks.

3.3 Scenario Analysis

3.3.1 GHG Emissions Trajectories

The analysis of GHG emissions trajectories provides a comparative overview of Namibia's potential emissions pathways under three scenarios: Business-as-Usual (BAU), Low-Carbon, and Net-Zero. These scenarios illustrate the impact of varying policy and technological interventions on emissions trends up to 2050.

BAU Scenario

Under the BAU scenario, GHG emissions rise steadily to 5,200 $KtCO_2e$ annually by 2050 (**Table 3**). This trajectory is driven by:

- **Fossil Fuel Reliance**: Continued dependence on coal and diesel for electricity generation and imported coal-based electricity exacerbates emissions.
- **Energy Demand Growth**: Economic and population growth increase demand across industrial, residential, and transport sectors, with no significant improvements in energy efficiency.

- **Minimal Renewable Integration**: Renewables remain below 10% of the energy mix, failing to offset fossil fuel consumption.

Low-Carbon Scenario

In the Low-Carbon Scenario, emissions decline to 2,800 KtCO_2e by 2050, achieving a moderate reduction compared to BAU (**Table 3**). This outcome is achieved through:

- **Enhanced Renewable Energy Integration**: Solar and wind energy expand to account for 30% of electricity generation, reducing reliance on fossil fuels.
- **Energy Efficiency Measures**: Improvements in energy efficiency across transport, industrial, and residential sectors reduce energy intensity by 20%.
- **Sectoral Impact**:
    - Transport emissions decline with the gradual adoption of fuel-efficient and hybrid vehicles.
    - Industrial emissions decrease through process optimization and energy-efficient technologies (**Table 2**).

Net-Zero Scenario

The Net-Zero Scenario represents an aggressive decarbonization pathway, with GHG emissions approaching near-zero levels by 2050, a reduction of over 87% compared to BAU (Table 3). Key drivers include:

- **Dominance of Renewables**: Over 80% of the energy mix comprises solar, wind, and green hydrogen, virtually eliminating reliance on fossil fuels.
- **Electrification**: The transport and industrial sectors are fully electrified, with renewable energy supporting operations.
- **Carbon Sequestration**: Technologies such as carbon capture and storage (CCS) and reforestation offset any remaining emissions.
- **Economic Opportunities**:
    - Green hydrogen production positions Namibia as a global supplier of clean energy, contributing to the global decarbonization effort while fostering domestic economic growth.

Table 3. Comparison of Emissions Trajectories.

Scenario	GHG Emissions (2050)	Reduction Compared to BAU	Key Characteristics
BAU	5,200 KtCO_2e	-	High fossil fuel reliance, minimal renewables
Low-Carbon	2,800 KtCO_2e	46%	Moderate renewables integration, energy efficiency
Net-Zero	680 KtCO_2e	87%	Renewables dominate, full electrification, sequestration

Key Insights

- The BAU trajectory highlights the risks of inaction, with rising emissions undermining Namibia's climate commitments and economic resilience.
- The Low-Carbon Scenario demonstrates the feasibility of significant emissions reductions through moderate interventions, aligning with Namibia's NDC targets.
- The Net-Zero Scenario showcases Namibia's potential to achieve transformative decarbonization, ensuring long-term sustainability and positioning the country as a regional leader in climate action.

Through robust policy implementation, Namibia can shift from incremental progress to transformational change, ensuring both environmental and socio-economic benefits.

3.4 Comparative Analysis:

The comparative analysis of the BAU, Low-Carbon, and Net-Zero scenarios highlights critical differences in energy supply, costs, and demand management strategies, emphasizing the transformative potential of the latter two pathways (Table 4).

3.4.1 Energy Supply

- Under the **BAU scenario**, renewables remain a minor component of the energy mix, contributing less than 10% by 2050. This minimal investment perpetuates dependency on fossil fuels and imported electricity.
- The **Low-Carbon scenario** achieves moderate progress, increasing renewables' share to 30% of electricity generation, primarily through solar and wind energy projects.
- In the **Net-Zero scenario**, renewables dominate the energy mix, exceeding 80%, driven by large-scale solar, wind, and green hydrogen development. This transformation significantly reduces Namibia's reliance on imported fossil fuels and enhances energy security.

3.4.2 Costs

- **BAU Scenario**: Requires minimal upfront investment in renewable energy infrastructure but results in cumulative energy system costs of approximately USD 6.1 billion by 2050. This scenario incurs higher long-term costs due to continued fossil fuel imports, energy price volatility, and growing climate-related damages.
- **Net-Zero Scenario**: Requires estimated initial investments of USD 2.8 billion by 2030 and USD 4.6 billion by 2050 in renewable energy systems, grid upgrades, electric vehicles, and industrial efficiency. However, it yields average abatement costs of USD 18–35 per tCO_2e avoided, depending on the mitigation measure. Long-term savings stem from reduced fossil fuel imports, avoided emissions penalties, and revenue generation from green hydrogen exports—estimated to reach USD 300–500 million annually by 2050 under high-demand scenarios.

3.4.3 Demand Management

- Both the Low-Carbon and Net-Zero scenarios incorporate demand-side management strategies to optimize energy use, including:
    - Deployment of energy-efficient appliances and systems in residential and industrial sectors.
    - Electrification of transport systems to improve energy efficiency and reduce emissions.
    - Smart grid technologies to enhance energy distribution and minimize losses.

Table 4. Comparative Metrics for Energy Scenarios (2020-2050).

Metric	Scenario	2020	2025	2030	2035	2040	2045	2050
GHG Emissions ($KtCO_2e$)	BAU	4,000	4,200	4,600	4,900	5,100	5,200	5,200
	Low-Carbon	4,000	3,800	3,200	2,900	2,900	2,900	2,800
	Net-Zero	4,000	3,500	2,600	1,400	1,000	800	680
Renewables Share (%)	BAU	10	12	15	18	20	22	24
	Low-Carbon	10	22	30	35	40	45	50
	Net-Zero	10	30	45	60	70	80	82
Energy Intensity Reduction (% vs 2020)	BAU	0	0	0	0	0	0	0
	Low-Carbon	0	8	15	20	20	20	20
	Net-Zero	0	10	20	25	28	30	30
Fossil Fuel Dependence (%)	BAU	85	88	90	91	91	90	90
	Low-Carbon	85	72	60	50	45	40	35
	Net-Zero	85	50	30	20	15	9	8

Clarification on the Energy Intensity Indicator

Energy intensity is defined as the ratio of total final energy consumption (in terajoules, TJ) to gross domestic product (GDP, in constant USD). It reflects the energy efficiency of the economy and is expressed as energy used per unit of economic output (e.g., TJ per million USD of GDP).

Quantification Method

The indicator was estimated using GACMO-compatible parameters, based on sector-specific energy activity projections and national macroeconomic assumptions. While GDP growth rates provided general context (e.g., 4% annually). Instead, energy intensity reductions were derived from projected changes in energy consumption across key sectors, using 2020 as the base year. Improvements reflect scenario-specific assumptions, such as the penetration of efficient lighting, fuel-efficient vehicles, and industrial energy-saving technologies under the With Measures (WM) and With Additional Measures (WAM) pathways..

Contextual Role in Modelling

- In the BAU scenario, energy consumption scales directly with GDP, maintaining constant energy intensity.

- In Low-Carbon and Net-Zero scenarios, targeted efficiency interventions reduce energy use per unit of GDP, resulting in improved energy intensity and lower emissions.

3.5 Implications of Energy Transition Scenarios

The comparative analysis underscores the urgency of transitioning away from the BAU trajectory, which locks Namibia into unsustainable energy and emissions patterns. The Low-Carbon scenario demonstrates the feasibility of significant emissions reductions through moderate investments and policy adjustments. However, the Net-Zero scenario showcases the transformative potential of ambitious decarbonization measures, aligning Namibia's energy sector with its climate commitments while delivering long-term economic, social, and environmental benefits.

To realize the full potential of the Low-Carbon and Net-Zero scenarios, Namibia must prioritize investments in renewable energy infrastructure, energy efficiency programs, and green hydrogen development. These actions are critical for meeting the country's Nationally Determined Contribution (NDC) targets and fostering a sustainable, resilient energy future.

4 Energy Sector GHG Emissions Projections

4.1 Methodology

4.1.1 Models Utilised

GACMO (Greenhouse Gas Abatement Cost Model):

- GACMO is a comprehensive tool employed to model energy demand, supply projections, and emissions pathways under different scenarios. It generates detailed outputs on energy flows, emissions reductions, and the financial implications of various policy measures.
  - **Key Features**:
    - **Energy Demand Projections**: Models sectoral energy demand, including residential, industrial, and transport needs, based on economic growth and population trends.
    - **Scenario Analysis**: Simulates the effects of interventions such as renewable energy integration, energy efficiency improvements, and electrification of transport. Specific mitigation actions selected in GACMO include:
      - ✔ **Solar PV Deployment:** 760 MW installed capacity by 2030
      - ✔ **Wind Power:** 120 MW installed capacity by 2030
      - ✔ **Electric Vehicles:** 25,000 units (approx. 5% of vehicle stock) by 2030
      - ✔ **Energy-Efficient Lighting:** 50% penetration in residential households
      - ✔ **Solar Water Heating Systems:** Installed in 25% of urban households by 2030
      - ✔ **Industrial Energy Efficiency:** 10% reduction in energy intensity through technology upgrades.[10]

[10] This was modeled in GACMO using the mitigation option titled **"Energy efficiency in industry."** The intervention applies a 10% reduction in energy demand across key industrial sectors (e.g., cement, mining, food processing). Emissions reductions are estimated by entering sector-specific baseline energy use and applying the 10% savings, with calculations based on GACMO's default emission factors for electricity and fuel use in industry.

- **Cost Implications**: Provides insights into the cost-benefit profiles of abatement options, helping policymakers prioritize investments.

IPCC Guidelines:

- Emissions accounting is based on the IPCC Tier 1 methodologies, which ensure enhanced accuracy by utilizing country-specific emission factors.
- **Methodological Approach**:
  - **Activity Data:** Includes Namibia-specific data on fuel consumption, electricity imports, and sectoral energy use. Fuel consumption data were primarily sourced from the Namibia Statistics Agency (NSA) energy balance reports and cross-validated with International Energy Agency (IEA) datasets and national utility records (e.g., NamPower, Ministry of Mines and Energy).
  - **Emission Factors**: IPCC default emission factors were applied for most fuel types, while locally specific activity data—such as fuel consumption volumes for diesel in the transport sector—were used where available to improve accuracy. Where country-specific emission factors were not available, default values from the 2006 IPCC Guidelines for National GHG Inventories were used.
  - **Sectoral Granularity**: Accounts for emissions contributions from electricity generation, transport, industry, and residential sectors, ensuring detailed representation of Namibia's GHG profile.

4.2 Integration of Models

By combining GACMO's scenario modelling capabilities with IPCC's robust emissions accounting methodologies, Namibia ensures:

- **Scientific Accuracy**: Emissions projections are aligned with international standards, enhancing credibility in global reporting.
- **Policy Relevance**: The models generate actionable insights tailored to Namibia's unique circumstances, enabling informed decision-making on energy and climate policies.
- **Comparative Analysis**: Outputs allow for clear comparisons between the BAU, Low-Carbon, and Net-Zero scenarios, supporting the evaluation of policy impacts on emissions trajectories.

These methodologies form the backbone of Namibia's GHG emissions projections, providing the analytical rigor necessary to support its energy transition and climate action goals.

4.3 Parameters:

4.3.1 Key Parameters

The parameters used in modelling Namibia's GHG emissions projections are critical for understanding the dynamics of energy demand, economic growth, and technology adoption under various scenarios. These parameters influence the projected outcomes of the BAU, Low-Carbon (WM), and Net-Zero (WAM) scenarios.

4.3.1.1 Sectoral Activity Growth Rates (Used in Place of GDP)

- **Assumption**: While a national GDP growth rate of 4% provides contextual economic background, GACMO does not use GDP directly. Instead, emissions are projected based on sectoral energy activity growth rates, which were derived considering economic trends, infrastructure development, and population dynamics.
  - **Transport**: 4.5% annual growth in energy demand, driven by increasing vehicle ownership and freight transport.
  - **Industry (e.g., mining, manufacturing)**: 5.0% annual growth, reflecting expansion in extraction, processing, and export sectors.
  - **Agriculture**: 3.0% annual growth, influenced by mechanization and irrigation development.
  - **Residential and Commercial**: 2.5% growth, aligned with electrification and urbanization trends.
  - **Overall Electricity Demand**: 4.0% average annual increase across all sectors.
- **Impact**: These sector-specific growth rates inform the business-as-usual (BAU) emissions trajectory. In mitigation scenarios, emissions are reduced through targeted interventions (e.g., energy efficiency, renewable adoption, electrification).

4.3.1.2 Energy Demand Assumptions

- **Assumption**: Energy demand is modeled as a function of sectoral activity levels rather than as a derivative of GDP. GACMO incorporates baseline activity data (e.g., kWh consumed, liters of fuel used, number of vehicles) and projects demand forward using the above growth rates.
- **Impact by Sector**:
  - **Electricity**: In the BAU scenario, increased demand is met with continued fossil-based generation and imports. Mitigation scenarios replace this with renewables and grid improvements.
  - **Transport**: Under BAU, diesel and petrol consumption rises with vehicle growth. The WM and WAM scenarios reduce this through fuel-efficient and electric vehicle penetration.
  - **Industry**: Energy-intensive growth is partially offset in mitigation scenarios via energy-efficient technologies and electrification.

4.3.1.3 Scenario Relevance

- **BAU Scenario**: Assumes continued growth in energy demand without mitigation, resulting in steadily increasing emissions from fossil fuels.
- **WM Scenario**: Incorporates moderate adoption of mitigation measures such as efficient lighting, fuel-efficient vehicles, and industrial energy efficiency.
- **WAM (Net-Zero) Scenario**: Assumes broad adoption of high-impact technologies including electrification of transport, 100% renewables in electricity, and deep energy intensity reductions across sectors.

Table 5. Sectoral Energy Activity Growth Rates and Scenario Relevance.

Sector	Annual Growth Rate (%)	Key Drivers	Scenario Impact
Transport	4.5%	Vehicle ownership, freight transport, road infrastructure	BAU: Increased diesel/petrol use; WM/WAM: EVs and fuel-efficient vehicles reduce emissions
Industry (Mining, Manufacturing)	5.0%	Mineral processing, construction, export-oriented production	BAU: High fossil energy use; WM/WAM: Industrial energy efficiency interventions
Agriculture	3.0%	Mechanization, irrigation, agri-processing	Moderate energy increase, targeted in WM through equipment upgrades
Residential & Commercial	2.5%	Urbanization, electrification, population growth	BAU: Increased grid demand; WM/WAM: LED lighting, efficient appliances
Overall Electricity Demand	4.0%	Cross-sectoral energy use	BAU: Fossil and imported power; WM/WAM: renewable expansion and grid upgrades

Table 6 provides a detailed overview of how energy demand is expected to grow by sector in Namibia, based on assumptions used in the GACMO model. Each sector is modeled separately using specific annual growth rates, which allows for more accurate projections of greenhouse gas emissions and the identification of sector-specific mitigation opportunities.

4.3.2 Key Insights from Parameter Assumptions

Under the Business-as-Usual (BAU) scenario, energy-related emissions in Namibia increase in parallel with sectoral activity growth, reflecting a strong linkage between economic expansion and fossil fuel dependence. However, in the Low-Carbon (WM) and Net-Zero (WAM) scenarios, this relationship is disrupted. Through the integration of targeted mitigation measures—such as energy efficiency improvements, electrification of transport and industrial processes, and accelerated renewable energy deployment—emissions growth is significantly curbed, even as energy demand continues to rise.

The WM and WAM scenarios highlight the critical importance of demand-side interventions. These include the adoption of LED lighting, fuel-efficient and electric vehicles, and optimized industrial energy use, which together mitigate the upward pressure on energy consumption across key sectors.

In particular, the WAM scenario demonstrates the transformative role of technology. The deployment of advanced solutions such as solar PV, wind power, electric mobility, and green hydrogen enables Namibia to reduce energy sector emissions from an estimated 4,600 $ktCO_2e$ under BAU to 2,600 $ktCO_2e$ by 2030. This trajectory shows the feasibility of achieving deep decarbonization through rapid technological adoption and supportive policy frameworks.

Overall, the sector-specific parameters used in GACMO underscore the value of evidence-based planning. They reinforce the need for strategic investments in clean energy infrastructure, efficiency programs, and innovation to support Namibia's long-term transition to a sustainable, low-carbon energy future.

4.4 Findings

4.4.1 GHG Emissions Projections by Scenario

Figure 4 illustrates the projected greenhouse gas (GHG) emissions from Namibia's energy sector under three scenarios: **Business-as-Usual (BAU)**, **With Measures (WM)**, and **With Additional Measures (WAM)**, for the period 2020 to 2050. Emissions are presented in kilotonnes of CO_2 equivalent ($ktCO_2e$), providing a detailed view of potential emissions trajectories based on policy and technological choices.

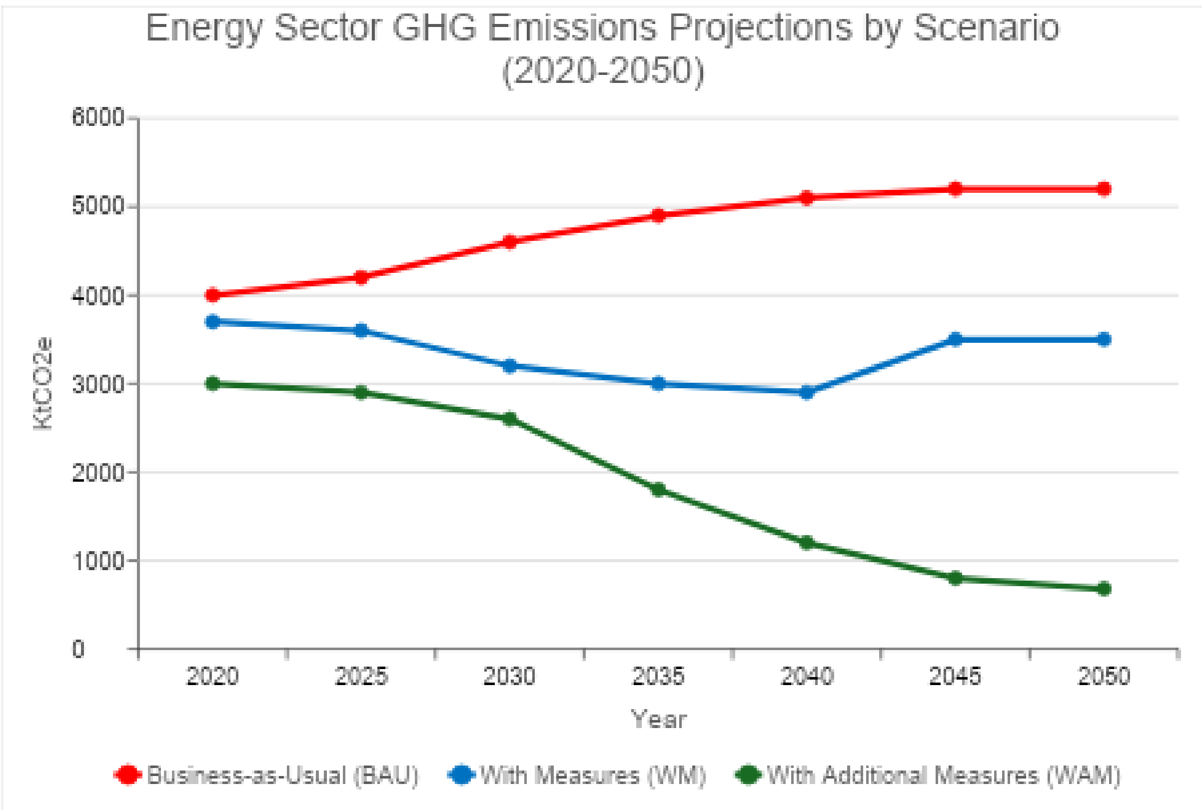


Figure 5. Energy Sector GHG Emissions Projections by Scenario (2020-2050).

Under the BAU scenario, emissions increase steadily from 4,000 ktCO_2e in 2020 to just over 5,200 ktCO_2e by 2050. This trajectory assumes continued reliance on fossil fuels and imported electricity, driven by economic growth, urbanization, and industrial expansion without significant mitigation interventions.

In contrast, the WM scenario demonstrates a more moderate emissions path. Emissions decline from 3,700 ktCO_2e in 2020 to 2,900 ktCO_2e by 2040, reflecting the impact of early mitigation actions such as energy efficiency programs, fuel-efficient vehicles, and incremental renewable energy integration. However, emissions rise again slightly to 3,500 ktCO_2e by 2050, indicating that while moderate interventions can slow growth, they may not be sufficient to sustain long-term reductions.

The WAM (Net-Zero) scenario presents a transformative pathway. Emissions drop sharply from 3,000 ktCO_2e in 2020 to just 680 ktCO_2e by 2050. This outcome is enabled by widespread deployment of renewable energy (solar, wind), rapid electrification of transport and industry, and early adoption of advanced technologies such as green hydrogen and grid modernization. The steep decline post-2030 highlights the cumulative effect of full implementation of mitigation options available in GACMO.

Overall, the figure underscores the urgent need for Namibia to move beyond incremental measures and adopt a comprehensive energy transition strategy to align with its long-term climate and development goals. The 2,000 ktCO_2e gap in 2030 between BAU and WAM represents the energy sector's potential contribution toward national mitigation targets under the updated NDC.

4.4.2 Comparative Insights

The comparative analysis of the Business-as-Usual (BAU), With Measures (WM), and With Additional Measures (WAM) scenarios underscores the divergent emissions outcomes, economic implications, and energy transitions under each pathway (see **Table 6**).

Emissions Reduction

The WAM (Net-Zero) scenario achieves a dramatic reduction in energy-related GHG emissions—from 4,000 ktCO_2e in 2020 to just 680 ktCO_2e by 2050, representing an 87% decrease compared to the BAU trajectory. This deep decarbonization is made possible through full-scale deployment of renewable energy (solar, wind), widespread electrification, and the introduction of green hydrogen technologies.

By comparison, the WM scenario results in a more moderate decline, reaching 3,500 ktCO_2e by 2050. While this reflects progress through efficiency measures and incremental technology adoption, it falls short of delivering sustained long-term emissions reductions. Under the BAU scenario, emissions steadily rise to 5,200 ktCO_2e by 2050, driven by continued reliance on fossil fuels, limited mitigation investment, and growing energy demand.

Economic Impacts

The economic implications vary across scenarios and are closely tied to the structure of energy investments and fossil fuel dependence:

- In the WM scenario, moderate reductions in fossil fuel imports yield cost savings and improve energy security. A 30% renewable energy share in the electricity mix helps buffer against price volatility and supply risks, particularly for diesel and coal imports.
- The WAM scenario delivers more profound economic gains. Namibia capitalizes on its high solar and wind potential to expand domestic generation capacity, reduce energy import costs, and create jobs in the renewable energy and green hydrogen sectors. This pathway fosters economic diversification by establishing Namibia as a future exporter of green hydrogen, opening new revenue streams and strengthening its role in global low-carbon markets.

Table 6. Energy Sector Emissions, Renewables Share, and Fossil Fuel Dependence by Scenario (2020–2050).

Year	Scenario	Emissions ($ktCO_2e$)	Renewables Share (%)	Fossil Fuel Dependence (%)
2020	BAU / WM / WAM	4,000	10	85
2025	BAU	4,200	12	88
	WM	3,600	22	72
	WAM	3,000	30	50
2030	BAU	4,600	15	90
	WM	3,200	30	60
	WAM	2,600	45	30
2035	BAU	4,900	18	91
	WM	3,000	35	50
	WAM	1,800	60	20
2040	BAU	5,100	20	91
	WM	3,000	40	45
	WAM	1,200	70	15
2045	BAU	5,200	22	90
	WM	3,500	45	40
	WAM	800	80	10
2050	BAU	5,200	24	90
	WM	3,500	50	35
	WAM	680	84	8

Link to Namibia's 2030 NDC Target

Namibia's updated Nationally Determined Contribution (NDC) aims to reduce national greenhouse gas (GHG) emissions by 11,900 $ktCO_2e$ by 2030 relative to the Business-as-Usual (BAU) baseline. According to this study's results, under the With Additional Measures (WAM) scenario, the energy sector alone contributes a 2,000 $ktCO_2e$

reduction in emissions—decreasing from 4,600 ktCO_2e in the BAU scenario to 2,600 ktCO_2e in the WAM scenario by 2030. This represents approximately 17% of the national reduction target, underscoring the pivotal role of the energy sector in achieving Namibia's 2030 climate goals.

4.4.3 Key Implications

The findings emphasize the critical need for Namibia to adopt and scale measures under the WAM scenario to meet its Nationally Determined Contribution (NDC) targets and ensure long-term sustainability. By prioritizing investments in renewable energy and green hydrogen, Namibia can achieve transformative emissions reductions while securing energy independence. These actions not only contribute to global climate objectives but also bolster Namibia's socio-economic resilience, creating opportunities for green jobs and fostering sustainable economic growth.

The analysis underscores that the path to sustainability lies in bold policy actions, robust investments, and innovative solutions that align Namibia's energy sector with its climate ambitions and development goals.

5 Data Improvement Measures

5.1 Challenges

5.1.1 Gaps in Activity Data and Opportunities for Enhanced Monitoring

Namibia faces key challenges in collecting reliable and up-to-date activity data and applying appropriate emission factors, which are the foundation of its national GHG inventory using IPCC Tier 1 and Tier 2 methodologies. Currently, emissions data are compiled retrospectively, often based on aggregated or infrequent activity data from various sectors. This leads to delays, limited resolution, and potential inconsistencies in GHG estimates.

Sectors such as energy, transport, and waste are particularly affected due to rapid changes in activity and limited sectoral reporting systems. These data gaps hinder timely tracking of emissions trends, making it more difficult to evaluate the impact of mitigation actions or adjust strategies in response to changing realities.

While real-time monitoring is not required for Tier 1 and Tier 2 approaches, leveraging digital monitoring tools, sensors, and integrated data platforms can enhance the accuracy, granularity, and timeliness of the underlying activity data. These tools can support:

- More frequent and disaggregated data collection.
- Early identification of emissions hotspots.
- Better verification of mitigation results.

Enhancing Namibia's ability to generate high-quality activity data is also essential to meeting the transparency requirements under the Enhanced Transparency Framework (ETF) of the Paris Agreement and strengthening the credibility of its MRV system in the eyes of climate finance providers.

5.1.2 Fragmented Data Systems

The management of emissions data in Namibia is fragmented, with multiple government agencies collecting and handling data independently. This siloed approach results in inefficiencies, duplication of efforts, and inconsistencies across datasets. Additionally, there is a lack of integration between critical sectors such as energy, agriculture, and waste management. This sectoral disconnect complicates efforts to develop a unified national GHG inventory, which is essential for comprehensive reporting and effective climate action planning.

5.1.3 Institutional and Technical Barriers

Namibia's national agencies face significant limitations in technical capacity, particularly in the application of advanced tools for data collection and analysis. Compounding this issue is the inadequate allocation of financial and human resources to support robust data management systems. Limited funding restricts the acquisition of modern technologies, while staffing shortages hinder the capacity for sustained improvements. These challenges underscore the need for Namibia to enhance its climate reporting systems. By addressing gaps in real-time data collection, integrating data management across sectors, and building institutional capacity, the country can significantly improve the accuracy and reliability of its GHG inventories. This, in turn, will enable Namibia to better inform policy decisions, meet its obligations under the Enhanced Transparency Framework of the Paris Agreement.

5.1.4 Strategies

Establish Centralized MRV Systems

The establishment of a centralized Monitoring, Reporting, and Verification (MRV) system is essential for ensuring accurate, consistent, and transparent emissions data across all sectors. The objective of this strategy is to create a unified platform that integrates emissions data, enabling better decision-making and compliance with climate commitments. Implementation involves leveraging best technologies to collect granular emissions data even in real time. These tools are particularly effective in capturing sector-specific emissions, such as those from energy production and agricultural activities.

Advanced tools, including satellite-based monitoring, can track renewable energy generation and land-use changes, enhancing data accuracy and transparency. For example, Namibia could adopt satellite-based systems similar to Kenya's, which have proven effective in monitoring solar and wind energy outputs.[11] By integrating such technologies, Namibia can significantly improve the granularity and reliability of its emissions inventories while building trust with international stakeholders through transparent reporting.

Capacity-Building Initiatives

Strengthening institutional and technical capacities is a critical strategy for improving Namibia's emissions data management systems. The objective is to equip government agencies and sectoral stakeholders with the skills and tools needed to collect, analyse, and manage emissions data effectively. Implementation includes targeted training programs to familiarize officials with MRV methodologies and GHG accounting aligned with IPCC

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[11] Solar and Wind Energy Resource Assessment
https://kerea.org/wp-content/uploads/2012/12/Kenya-Solar-Wind-Energy-Resource%20Assessment.pdf

guidelines. These programs ensure that data collection and reporting are standardized and scientifically rigorous.

In addition to training, fostering partnerships with international organizations is key. Such collaborations can provide technical expertise and funding to support advanced monitoring systems, including digital platforms. These partnerships also facilitate the exchange of best practices, enabling Namibia to align its MRV systems with global standards and enhance its credibility in international climate discussions.

Data Harmonization Across Agencies

Effective data harmonization across government agencies is essential to streamline emissions data collection and reporting. The objective of this strategy is to define clear roles and responsibilities for key agencies, such as the Ministry of Environment, Forestry, and Tourism (MEFT) and the Namibia Statistics Agency (NSA), to ensure that efforts are coordinated and efficient. This alignment reduces duplication of work and ensures consistency in data management across sectors.

To implement this strategy, standardized protocols and data-sharing agreements must be developed. These protocols facilitate the seamless integration of emissions data from diverse sources, such as energy, agriculture, and waste management, into a unified national inventory. Regular inter-agency coordination meetings and joint capacity-building initiatives can further strengthen collaboration and ensure that all stakeholders are aligned in their efforts to improve emissions reporting.

By focusing on centralized MRV systems, capacity-building initiatives, and data harmonization, Namibia can address critical gaps in its emissions data management framework. These strategies will enable the country to develop a robust and transparent GHG inventory system, aligning with the Enhanced Transparency Framework of the Paris Agreement and supporting its broader climate and development goals.

5.1.5 Case Studies

South Africa

South Africa provides a valuable example of implementing a centralized MRV system under its National Climate Change Response Policy.[12] This centralized emissions data platform has significantly improved the accuracy and transparency of emissions tracking, particularly in key sectors such as mining and energy. The system allows for comprehensive data integration and ensures consistency in reporting, which supports South Africa's climate commitments. For Namibia, adopting a similar centralized approach could streamline data collection and management across sectors like energy, agriculture, and forestry, addressing the current fragmentation in its emissions data systems.

Kenya

Kenya demonstrates how satellite-based systems can be used effectively for renewable energy monitoring.[13] These systems track solar and wind energy generation, providing real-time data on their contributions to emissions reductions. This capability not only

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[12] The National Climate Change Response Monitoring and Evaluation System Framework
https://www.dffe.gov.za/sites/default/files/reports/nationalclimatechangeresponse_MESF.pdf

[13] Solar and Wind Energy Resource Assessment
https://kerea.org/wp-content/uploads/2012/12/Kenya-Solar-Wind-Energy-Resource%20Assessment.pdf

enhances the transparency of Kenya's climate reporting but also makes it more attractive for international climate finance. Namibia, with its abundant solar resources, is well-positioned to implement similar satellite-based monitoring systems. Such systems would enable Namibia to better quantify the impact of renewable energy projects on its emissions and strengthen its case for accessing global climate finance.

Ghana

Ghana provides a strong example within West Africa of how to develop and maintain a robust national GHG inventory system, particularly in the energy sector. The country has institutionalized regular inventory compilation supported by clear data flows between ministries, energy utilities, and regulatory bodies. Ghana's approach includes detailed tracking of fuel combustion by sector, electricity generation emissions, and energy transformation processes, enabling accurate and transparent reporting aligned with IPCC guidelines. For Namibia, Ghana's experience offers valuable lessons in establishing sustained inter-agency coordination, improving energy data quality, and leveraging inventory outputs for evidence-based climate policy and reporting under the Paris Agreement.[14]

Table 7. Summary: Challenges, Strategies, and Benefits.

Challenge	Strategy	Expected Benefit
Incomplete or outdated activity data	Strengthen data-sharing agreements across sectors; improve frequency of data collection for fuel use, land use, and industrial production	Improved accuracy and completeness of GHG inventories
Absence of country-specific emission factors	Commission localized studies to develop emission factors for major sectors (energy, AFOLU, transport)	More representative emissions estimates aligned with national circumstances
Limited access to disaggregated energy data (e.g. electricity generation by fuel type, off-grid use)	Improve collaboration with utilities and mining/energy sector for timely, detailed energy statistics	Enhanced granularity for modelling and emissions estimation
Gaps in energy balance and grid emission factors	Integrate GHG and energy data into unified energy balance systems using LEAP or similar tools	Coherent emissions tracking and scenario development
Lack of comprehensive mitigation option data	Develop sector-specific MAC curves and technology databases through tools like GACMO and LEAP	Evidence-based prioritization of mitigation interventions

[14] UNFCCC. (2024). *Ghana's National Inventory Report Submission.* https://unfccc.int/sites/default/files/resource/gh_NID1_submissions_28122024.pdf

Challenge	Strategy	Expected Benefit
Fragmented data systems	Establish centralized MRV and data management platforms	Streamlined data integration and improved reporting readiness
Limited technical capacity	Targeted training and institutional support in GHG accounting and scenario modelling	Sustainable in-country capacity for LT-LEDS development

Namibia's emissions estimation challenges stem more from systemic gaps in the availability, accessibility, and granularity of critical data inputs. Key limitations include sporadic activity data collection, the reliance on IPCC default emission factors, and limited disaggregated data from sectors such as electricity generation, industrial fuel use, and transport. The country also lacks comprehensive marginal abatement cost (MAC) data for prioritizing mitigation options across sectors. Addressing these challenges requires not only institutional reforms and capacity building but also targeted investments in country-specific data generation and harmonized MRV systems.

By addressing these challenges and implementing targeted strategies, Namibia can significantly enhance its emissions data systems (Table 6). Drawing lessons from neighbouring countries such as South Africa, Kenya, and Ghana, Namibia can integrate centralized MRV systems, improve technical capacities, and deploy advanced monitoring tools. These measures will enable Namibia to meet its reporting obligations under the Paris Agreement and reinforce its climate action framework, ensuring accurate and transparent emissions tracking to support its transition to a low-carbon future.

6 Policy Implications and Recommendations

6.1 Recommendations

6.1.1 Accelerate Renewable Energy Policies

To mitigate Namibia's heavy reliance on imported electricity and fossil fuels, renewable energy policies should focus on rapidly deploying projects that capitalize on the country's vast solar and wind resources. These policies will reduce emissions, enhance energy security, and create economic opportunities in the renewable energy sector.

6.1.2 Incentives for Solar and Wind

Establishing financial incentives is essential to attract investment in renewable energy projects. Measures such as tax breaks, low-interest loans, and feed-in tariffs can stimulate the development of solar and wind energy infrastructure. For example, Namibia could emulate Kenya's success with feed-in tariffs, which were instrumental in advancing wind and geothermal energy projects. These incentives not only lower the cost of renewable energy investments but also encourage broader participation from independent power producers (IPPs).

Namibia's high solar irradiance potential, averaging 5.4 kWh/m²/day, provides an excellent opportunity to scale up rooftop solar PV installations for residential and commercial sectors. Policies that promote rooftop solar adoption, including subsidies for installation costs and simplified permitting processes, can increase renewable energy penetration and reduce dependence on imported electricity.

6.1.3 Infrastructure Development

Infrastructure investments are crucial to support the integration of renewable energy projects into Namibia's power system. Developing energy storage solutions, such as lithium-ion batteries or pumped hydro storage, can address the variability of solar and wind energy, ensuring a stable and reliable power supply. These systems can store excess energy generated during peak production periods and release it during times of low generation.

Enhancing the national grid infrastructure is another priority to enable the seamless integration of large-scale renewable energy projects. Grid upgrades, including transmission line expansions and smart grid technologies, are necessary to manage the increased energy flow from decentralized solar and wind systems. Improved infrastructure will also reduce energy losses, enhance distribution reliability, and make the energy system more resilient to disruptions.

Accelerating renewable energy policies through targeted incentives and infrastructure development will enable Namibia to harness its renewable energy potential effectively. These measures will not only reduce the country's reliance on imported electricity but also position Namibia as a regional leader in renewable energy production and climate action. By fostering a supportive policy environment, Namibia can attract private investment, stimulate economic growth, and ensure a sustainable energy future.

6.1.4 Regulatory Frameworks for Green Hydrogen

Namibia has identified green hydrogen as a key opportunity to transition its energy sector, enhance domestic energy security, and establish itself as a global leader in clean energy exports. If fully realized, the green hydrogen sector could reduce Namibia's national emissions by an estimated 1,200–2,000 KtCO$_2$e annually by 2035, depending on production scale and displacement of fossil fuel use in transport, industry, and exports. Additionally, integrating green hydrogen into regional and global decarbonization pathways (e.g. ammonia and e-fuel exports) can generate indirect global mitigation co-benefits. Developing robust regulatory frameworks will be critical for managing water use, ensuring sustainability, and securing international certification standards that unlock finance and market access.

Framework Development

Developing a comprehensive regulatory framework is a critical first step in advancing Namibia's green hydrogen sector. This framework should provide clear guidelines addressing essential aspects such as land use, water resource management, and environmental impacts. By establishing standards that prioritize sustainability and equitable resource allocation, Namibia can mitigate potential conflicts and environmental challenges associated with green hydrogen production.

Namibia can draw inspiration from Germany's national hydrogen strategy, which outlines governance structures, funding mechanisms, and a clear division of responsibilities among stakeholders. For example, Germany's approach emphasizes environmental safeguards, streamlined permitting processes, and financial incentives for green hydrogen projects. Adapting these elements to Namibia's context could create a well-regulated environment that fosters investment and ensures the long-term viability of green hydrogen initiatives.

Attracting Investment

The development of green hydrogen infrastructure requires significant capital investment, which can be facilitated through public-private partnerships (PPPs). These partnerships enable the pooling of resources from government, private sector, and international investors to finance large-scale projects. PPPs can also help transfer expertise and technology, accelerating the development of Namibia's green hydrogen capabilities.

Namibia should actively pursue export agreements with global markets, targeting countries with strong commitments to decarbonization, such as Germany, Japan, and South Korea. Establishing long-term supply agreements with these markets will enhance Namibia's competitiveness and provide a stable revenue stream to support further infrastructure development. Additionally, participating in international green hydrogen trade agreements and forums will help Namibia align its standards with global practices and attract strategic partners.

A strong regulatory framework and targeted investment strategies are fundamental for the successful development of Namibia's green hydrogen sector. By implementing clear guidelines and fostering collaborations through PPPs, Namibia can unlock the transformative potential of green hydrogen to meet domestic energy needs and become a global clean energy supplier. These efforts will not only advance Namibia's climate action goals but also contribute to economic diversification and global decarbonization efforts.

Emissions Reduction Potential

While the primary emphasis of Namibia's green hydrogen strategy is energy security and economic transformation, its role in climate mitigation is also significant. Green hydrogen produced using Namibia's abundant renewable energy emits no direct greenhouse gases, making it a crucial alternative to fossil fuel–based hydrogen (e.g. grey hydrogen from natural gas), diesel, or petrol.

According to the International Energy Agency (IEA), replacing grey hydrogen with green hydrogen can avoid up to 10 kg of CO_2 per kilogram of hydrogen produced. Similarly, substituting diesel in heavy transport applications with hydrogen fuel cells can reduce emissions by approximately 2.5 to 3.5 kg of CO_2 per kilogram of hydrogen used.

In Namibia's context, the full extent of emissions reduction will depend on the end-use applications of the hydrogen—such as domestic transport, electricity generation, or export. Detailed quantification will require further modelling based on Namibia's energy mix and hydrogen deployment scenarios. Such analysis is recommended in future national MRV planning to integrate hydrogen fully into emissions accounting frameworks.

6.1.5 Establish Carbon Markets

Namibia has a significant opportunity to leverage carbon market mechanisms under Article 6 of the Paris Agreement to finance mitigation efforts and accelerate its transition to a low-carbon economy. Establishing a domestic carbon market and actively participating in international markets will enable Namibia to unlock climate finance, promote emissions reductions, and create economic opportunities.

Domestic Carbon Market

To establish a robust carbon market domestically, Namibia should prioritize the development of a national carbon registry and trading platform. This platform would serve as the backbone of emissions trading, enabling businesses and sectors to trade carbon credits efficiently and transparently. A centralized registry would track mitigation outcomes, ensuring compliance with national climate targets and alignment with international reporting standards.

A domestic carbon market can also drive investment in renewable energy, energy efficiency, and sustainable land management by creating a financial incentive for emissions reductions. Sectors such as energy, agriculture, and forestry could generate tradable credits, while businesses looking to meet sustainability goals could purchase these credits, fostering a market-driven approach to mitigation.

Participation in International Markets

Namibia should develop the capacity to generate Internationally Transferred Mitigation Outcomes (ITMOs) for export to countries needing offsets to meet their climate targets under the Paris Agreement. Participation in international carbon markets offers a dual benefit:

- Revenue Generation: By selling ITMOs to global buyers, Namibia can attract significant climate finance to fund mitigation projects, particularly in renewable energy and green hydrogen development.
- Technology Transfer and Collaboration: International partnerships can provide access to advanced monitoring, reporting, and verification (MRV) technologies, as well as opportunities for knowledge exchange.

For Namibia to fully leverage these opportunities, it is essential to:

- Build institutional capacity to manage ITMO transactions effectively.
- Establish agreements with potential buyers, particularly industrialized nations with high emissions reduction commitments.
- Ensure transparency and environmental integrity in credit generation to meet global standards and maintain market credibility.

Establishing a carbon market offers Namibia a pathway to finance its climate ambitions while fostering economic growth and innovation. A domestic carbon market can drive internal investments in sustainability, while participation in international carbon markets allows Namibia to export high-quality ITMOs, aligning with global climate goals. These efforts will position Namibia as a regional leader in leveraging market-based solutions for climate action.

6.2 Alignment with International Frameworks

Namibia's climate policies must align with the cooperative mechanisms established under Article 6 of the Paris Agreement to maximize opportunities for climate finance, foster international collaboration, and achieve its mitigation commitments. Effective alignment will ensure Namibia can leverage the mechanisms to advance its Nationally Determined Contribution (NDC) while contributing to global climate goals.

6.2.1 Paris Agreement's Article 6

Article 6.2 Cooperative Approaches

The Article 6.2 cooperative approaches provide a framework for countries to voluntarily cooperate in the implementation of their NDCs by transferring emissions reductions internationally. For Namibia, this involves implementing corresponding adjustment mechanisms to ensure that any emissions reductions transferred to other countries do not compromise its own NDC commitments.

By adopting robust monitoring, reporting, and verification (MRV) systems, Namibia can ensure the environmental integrity and transparency of these transactions. Corresponding adjustments are particularly relevant as Namibia engages in carbon market activities, such as the generation and sale of Internationally Transferred Mitigation Outcomes (ITMOs). This approach safeguards Namibia's climate goals while enabling it to contribute to the global carbon market effectively.

Article 6.4 Mechanism

The Article 6.4 mechanism, also known as the Sustainable Development Mechanism (SDM), establishes a global carbon crediting system to support sustainable development and enhance ambition. Namibia can capitalize on this mechanism by developing projects that are eligible under the SDM, particularly in high-potential sectors such as:

- Renewable Energy: Large-scale solar and wind projects that contribute to Namibia's energy transition while generating tradeable carbon credits.
- Forestry: Initiatives that promote afforestation, reforestation, and sustainable land-use practices to sequester carbon and reduce emissions from deforestation and degradation.

Participation in the SDM not only attracts international climate finance but also fosters co-benefits such as job creation, improved land management, and enhanced biodiversity. Namibia's alignment with this mechanism ensures that its projects are recognized globally for their contribution to both mitigation and sustainable development.

By aligning its policies with Article 6 of the Paris Agreement, Namibia can effectively leverage international mechanisms to enhance climate finance and mitigation capabilities. Implementing Article 6.2 cooperative approaches ensures that emissions reductions are transparent and do not undermine national targets. Developing Article 6.4 projects under the SDM provides a pathway for Namibia to generate carbon credits while achieving co-benefits in renewable energy and sustainable land management. This alignment strengthens Namibia's role in global climate action while advancing its domestic climate and development priorities.

6.2.2 UNFCCC Enhanced Transparency Framework (ETF)

Namibia's climate policies must comply with the Enhanced Transparency Framework (ETF) established under the Paris Agreement to ensure comprehensive reporting, tracking of emissions, and monitoring of climate actions. Adhering to ETF requirements is crucial for maintaining credibility in international climate negotiations, accessing climate finance, and demonstrating progress toward Namibia's Nationally Determined Contribution (NDC) targets.

Reporting Improvements

Strengthening Monitoring, Reporting, and Verification (MRV) systems is a priority for improving the accuracy, transparency, and reliability of Namibia's emissions reporting. A robust MRV framework enables:

- Accurate Data Collection: Robust systems that incorporate sector-specific data collection tools—such as digital fuel tracking, utility-reported consumption data, and automated monitoring of energy production—enable more precise and timely emissions tracking.
- Transparent Reporting: Enhanced transparency fosters trust with international partners and stakeholders, which is critical for securing climate finance and demonstrating accountability.
- Progress Tracking: Improved reporting allows Namibia to monitor its mitigation progress effectively, identify gaps, and adapt strategies to achieve its NDC commitments.

By aligning MRV improvements with ETF guidelines, Namibia ensures compliance with international standards and enhances its capacity to report emissions and mitigation outcomes comprehensively.

Capacity Building

Building institutional and technical capacity is essential for meeting the stringent requirements of the ETF. Namibia should:

- Engage with International Partners: Collaborate with global organizations, such as the UNFCCC Secretariat and development agencies, to access training, funding, and technical resources. These partnerships can facilitate knowledge transfer, provide expertise on ETF compliance, and support the implementation of advanced reporting systems.
- Train Local Stakeholders: Conduct training programs for government officials, sectoral experts, and data managers to enhance their understanding of ETF reporting requirements and MRV methodologies. These initiatives will strengthen Namibia's institutional framework and ensure consistency in emissions reporting across all sectors.

Adhering to the UNFCCC's Enhanced Transparency Framework ensures that Namibia's climate policies and actions are tracked and reported with precision and integrity. Strengthening MRV systems provides the foundation for accurate data collection and transparent reporting, while capacity-building initiatives equip Namibia with the skills and resources needed to meet ETF requirements. By focusing on these priorities, Namibia can enhance its global standing, attract climate finance, and effectively demonstrate its commitment to achieving its climate goals.

6.3 Summary

Namibia's sustainable energy transition requires a combination of targeted policy measures, strategic investments, and alignment with international frameworks. Table 7 summarizes key policy recommendations, actionable steps, and their expected outcomes:

Table 8. Policy Recommendations and Expected Outcomes.

Recommendation	Actionable Steps	Expected Outcome

Accelerate renewable energy policies	Incentives for solar and wind; grid upgrades	Increased energy security and reduced GHG emissions
Green hydrogen framework	Develop regulatory and investment guidelines	Boosted international exports and energy independence
Carbon market establishment	Build national carbon registry and trading platform	Access to climate finance and enhanced mitigation efforts

By aligning these policies with international frameworks, Namibia can achieve a transformative energy transition that balances economic growth with environmental stewardship. These efforts will not only support Namibia's climate goals but also establish the country as a global leader in sustainable energy and climate action.

7 Conclusions

Namibia's energy transition represents a transformative pathway toward sustainable development. It offers the dual opportunity to establish the country as a regional leader in climate action while ensuring energy security and socio-economic resilience. With vast renewable energy potential in solar and wind, coupled with emerging opportunities in green hydrogen, Namibia is uniquely positioned to lead sub-Saharan Africa in clean energy innovation and emissions reductions.

7.1 Key Insights

7.1.1 Energy Transition as a Climate Action Catalyst

Shifting from fossil fuel reliance to renewable energy offers Namibia a critical opportunity to address both climate and energy security challenges. Expanding the share of renewables in the energy mix can significantly reduce Namibia's dependency on imported electricity, lower energy costs, and mitigate greenhouse gas (GHG) emissions. This transition ensures a cleaner, more sustainable energy future while fostering economic growth.

7.1.2 Economic and Social Resilience

Namibia's energy transition supports its socio-economic goals by creating green jobs, particularly in renewable energy development and green hydrogen production. Investments in climate-smart infrastructure, such as energy storage systems and grid enhancements, further bolster community resilience to climate impacts. These measures strengthen Namibia's adaptive capacity, ensuring that both rural and urban populations benefit from sustainable development initiatives.

7.1.3 Critical Role of Policies and MRV Systems

Transformative policies are essential to accelerate Namibia's energy transition. These include incentives for renewable energy, frameworks for green hydrogen, and mechanisms to establish carbon markets. In addition, robust Monitoring, Reporting, and Verification (MRV) systems are vital to ensure transparency, attract international climate finance, and track progress toward Namibia's Nationally Determined Contribution (NDC) targets. Together, these policies and systems form the backbone of Namibia's climate strategy.

7.2 Path Forward

7.2.1 Scale-Up Renewable Energy Deployment

To achieve its climate goals, Namibia must capitalize on its abundant solar and wind resources. By targeting a renewable energy share of over 80% by 2050, as outlined in the Net-Zero Scenario, Namibia can transition to a clean, reliable energy system. This shift will reduce fossil fuel dependence, enhance energy security, and position Namibia as a regional leader in renewable energy production.

7.2.2 Leverage International Mechanisms

Participating in carbon markets under the Paris Agreement's Article 6 offers Namibia the opportunity to secure funding for mitigation projects. By generating and selling Internationally Transferred Mitigation Outcomes (ITMOs), Namibia can attract international climate finance while contributing to global climate objectives. This dual benefit supports both domestic development and global decarbonization efforts.

7.2.3 Enhance Institutional Capacities

Strengthening institutional capacities is crucial for implementing Namibia's climate policies effectively. Investments in capacity building for emissions data management, MRV systems, and policy implementation will enhance Namibia's ability to meet its climate goals. Training programs and international partnerships can further ensure that Namibia aligns with global best practices.

7.3 Strategic Way Forward for Energy Sector Transformation

The success of Namibia's energy transition hinges on collective action among government, private sector, and international stakeholders. Collaboration and innovation are key to achieving a low-carbon, resilient future. Namibia's leadership and commitment to sustainable energy development provide a model for other nations in the region and the world. By fostering proactive partnerships and scaling transformative measures, Namibia is poised to emerge as a global leader in climate action, setting an example of sustainable development in sub-Saharan Africa.

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