ICAT Initiative for Climate Action Transparency

Developing Indicators for GHG and SD Impact Tracking of Namibia's Energy Policies under the ICAT Framework

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Initiative for Climate Action Transparency - ICAT

Developing Indicators for GHG and SD Impact Tracking of Namibia's Energy Policies under the ICAT Framework

Deliverable #3

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Table of contents

List of Figures

List of Tables

Executive Summary

Namibia is strengthening its ability to track the climate and development impacts of energy-sector policies in line with its NDC commitments and the Enhanced Transparency Framework (ETF) under the Paris Agreement. This report, prepared with support from ICAT, establishes a practical indicator framework to measure greenhouse gas (GHG) reductions and sustainable development (SD) co-benefits.

A set of core indicators has been identified using ICAT causal chain methodology, covering six thematic categories: GHG emissions, economic impacts, social inclusion, environmental sustainability, health, and gender equity. Each indicator is assigned to an institutional custodian including MEFT, MME, ECB, NamPower, NSA, and research partners ensuring accountability and alignment with national systems.

The monitoring framework is designed for annual and biennial reporting, with robust QA/QC procedures and feedback loops to ensure transparency, accuracy, and adaptive management. Standardized templates, scorecards, and dashboards will facilitate data collection, scenario analysis, and communication to stakeholders ranging from Parliament to civil society.

An **implementation roadmap** outlines the next steps after validation:

- Formalization of institutional agreements
- Development of metadata and QA/QC annexes
- Targeted training for technical staff
- Pilot application to rural electrification and net metering policies
- Public dissemination through briefs, infographics, and dashboards

By institutionalizing this framework, Namibia will be able to track policy impacts, demonstrate SDG-aligned co-benefits, and strengthen its case for international climate finance and technical support, while embedding evidence-based monitoring into national development planning (Vision 2030, NDP6).

The report provides a sound basis for monitoring the sustainable development impacts of Namibia's energy policies. To improve its alignment with the ICAT Sustainable Development Methodology, further refinement is recommended. This includes the articulation of clear causal chains linking policy measures to development outcomes, a systematic distinction between qualitative and quantitative indicators, and the explicit mapping of indicators to both the Sustainable Development Goals and national priorities. These refinements will improve the clarity, coherence, and policy utility of the indicator framework.

Acronyms

AFOLU	Agriculture, Forestry and Other Land Use
BTR	Biennial Transparency Report
CAPEX	Capital Expenditure
ECB	Electricity Control Board (Namibia)
ETF	Enhanced Transparency Framework (under the Paris Agreement)
FTE	Full-Time Equivalent (jobs)
GACMO	Greenhouse Gas Abatement Cost Model
GHG	Greenhouse Gas
ICAT	Initiative for Climate Action Transparency
IPCC	Intergovernmental Panel on Climate Change
IPPs	Independent Power Producers
LEAP	Long-range Energy Alternatives Planning System

LCOE	Levelized Cost of Energy
MEFT	Ministry of Environment, Forestry and Tourism (Namibia)
MME / MIME	Ministry of Mines and Energy (Namibia) – previously known as MME
MoU	Memorandum of Understanding
MRV	Measurement, Reporting and Verification
NAD	Namibia Dollar (currency)
NDC	Nationally Determined Contribution
NDP6	Namibia's Sixth National Development Plan
NSA	Namibia Statistics Agency
$PM_{2.5}$	Particulate Matter ≤ 2.5 micrometers in diameter
PV	Photovoltaic (solar technology)
QA/QC	Quality Assurance / Quality Control
RE	Renewable Energy

SD	Sustainable Development
SDG	Sustainable Development Goal
SAPP	Southern African Power Pool
UNFCCC	United Nations Framework Convention on Climate Change

1 Introduction

Namibia is committed to enhancing transparency and accountability in its climate actions under the Paris Agreement. As part of its obligations under Article 13 of the Agreement, Namibia is required to report on progress made in implementing and achieving its Nationally Determined Contributions (NDCs). This report contributes directly to the development of a robust, integrated monitoring framework to track the impacts of energy-sector policies on greenhouse gas (GHG) emissions and sustainable development (SD) outcomes.

The Initiative for Climate Action Transparency (ICAT) supports Namibia through technical and methodological assistance tailored to the country's needs. ICAT provides sector-specific methodologies notably for renewable energy and sustainable development which are particularly relevant given Namibia's strategic direction toward an inclusive, low-carbon, and climate-resilient economy. This work builds on the ICAT guidance and contributes to the operationalization of Namibia's Enhanced Transparency Framework (ETF).

The energy sector in Namibia is characterized by:

- High reliance on electricity imports (approximately 60% in 2023), primarily from the Southern African Power Pool (SAPP) and bilateral agreements with South Africa and Zambia.[1]
- Increasing electricity demand due to economic growth, electrification goals, and emerging green hydrogen industries.
- Ambitious targets under Vision 2030 and the Harambee Prosperity Plan II (2021–2025) to improve energy access and sustainability.

Several national policies underscore this transition, including the National Renewable Energy Policy (2017), the National Energy Policy (2017), and the Draft Green Hydrogen Strategy (2022). These instruments align closely with the NDC mitigation commitments submitted in 2021, which prioritize renewable energy deployment, energy efficiency, and sustainable transport.

To support evidence-based policy formulation, this report defines a set of core indicators and methodological guidance to:

- Assess the effectiveness of specific energy policies on GHG emissions.
- Track co-benefits and trade-offs with SDG-aligned development outcomes (e.g., jobs, gender equity, energy access, air quality).
- Build institutional capacity for MRV and NDC tracking through improved data systems.

[1] Ministry of Mines and Energy (MME), "National Energy Policy" (2017), pp. 22-25. See also: Namibia Statistics Agency (NSA), Energy Statistics Bulletin 2023.

This report builds on a suite of technical outputs produced under ICAT Namibia in 2024–2025, including:

- The **Diagnostic Study on Namibia's Energy and AFOLU Sectors** (2024)[2], which highlighted key gaps in data systems and institutional coordination.
- The **New Energy Scenario Report** (2025)[3], which modeled with/without-policy trajectories for selected energy interventions.
- The **Data Quality and Management Report** (April 2025)[4], which assessed the readiness of national institutions for transparent data collection, validation, and reporting.
- The **GACMO Inception Workshop Report** (2024)[5], which introduced modeling tools for scenario building and impact quantification.

Together, these initiatives lay the foundation for this present work: to translate policy objectives into trackable metrics and integrate them into Namibia's climate and development reporting architecture.

[2] Nzuma, T.M. (2024). *Diagnostic Study on Namibia's Energy and AFOLU Sectors*. Initiative for Climate Action Transparency (ICAT). Prepared for MEFT.

[3] Nzuma, T.M. (2025). *Namibia's New Energy Scenarios and Emissions Projections*. ICAT Report, May 2025.

[4] Nzuma, T.M. (2025). *Data Quality, Collection and Management Report*. ICAT Namibia Deliverable 1.2.3, April 2025.

[5] Ministry of Environment, Forestry and Tourism (MEFT). (2024). *Inception and Training Workshop on LEAP and GACMO Tools for Namibia's NDC Tracking*. ICAT Workshop Summary Report, September 2024.

2 Indicator Identification Methodology

This section outlines the systematic approach used to identify, select, and validate indicators for tracking policy impacts on GHG emissions and sustainable development in Namibia's energy sector. The methodology follows the ICAT Sustainable Development Assessment Guide[6], and is aligned with national policy priorities, institutional capabilities, and international reporting frameworks.

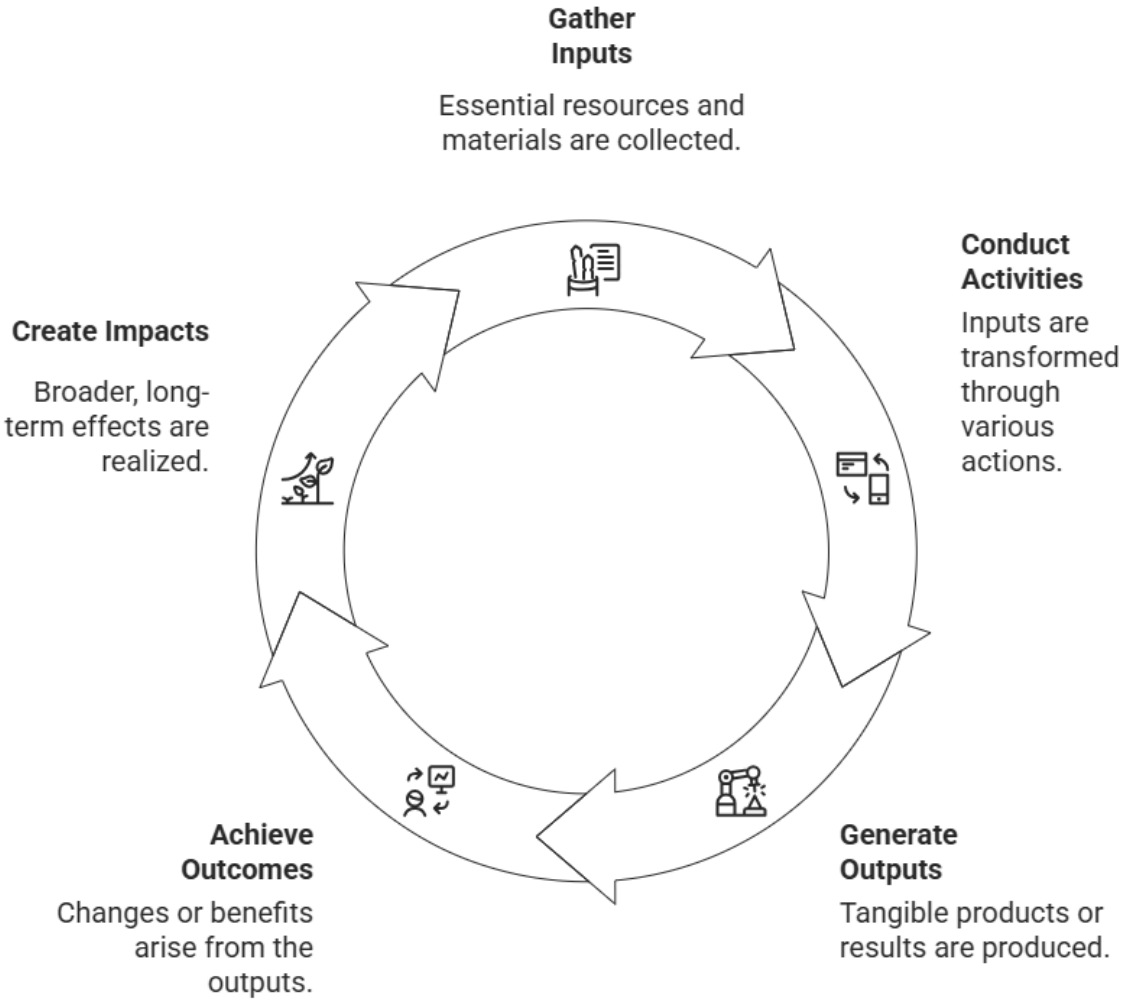

Figure 1. Policy Causal Chain Framework

Step 1: Define Policy Causal Chains

This step maps the logical sequence of how a policy intervention results in measurable impacts (Figure 1). For example, in the case of the Net Metering

[6] *ICAT (2020). Sustainable Development Methodology. Chapter 5: "Choosing which impact categories and indicators to assess." Available at: https://climateactiontransparency.org/icat-toolbox/sustainable-development/*

Support Scheme in Namibia which was introduced under the *Net Metering Rules (2015)*, developed by the Electricity Control Board (ECB) and incorporated into the *National Renewable Energy Policy (2017)*:

- **Inputs:** Financial incentives
- **Activities:** Installation of rooftop solar PV
- **Outputs:** Increase in decentralized renewable generation
- **Outcomes:** Reduced peak grid load, improved self-sufficiency
- **Impacts:** Reduced GHG emissions, improved air quality, job creation

Causal chains were co-developed with stakeholders during scenario planning workshops to ensure alignment with real-world policy implementation processes.[7]

Step 2: Select Impact Categories and Preliminary Indicators

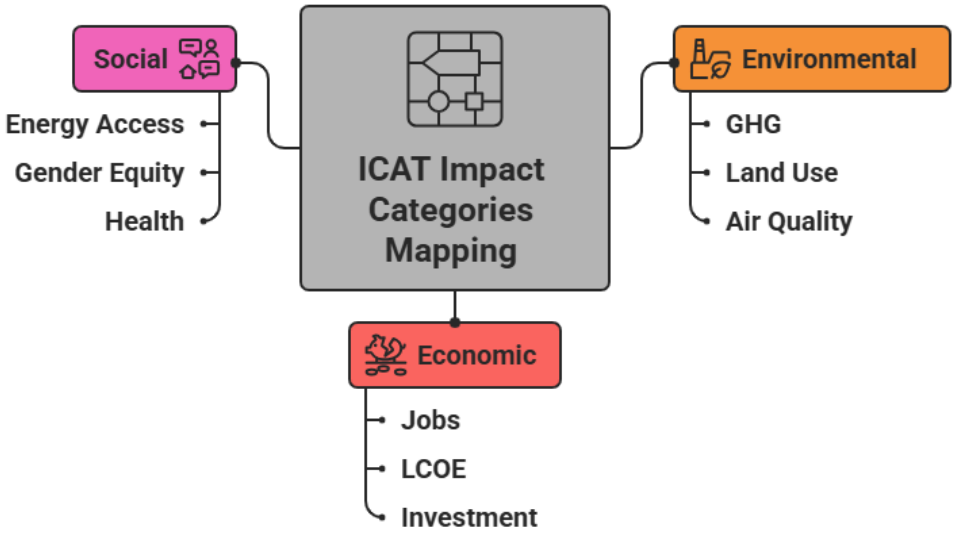

Figure 2. ICAT Impact Categories Mapping.

These categories in Figure 2 were derived from the ICAT SD framework and linked with Namibia's Vision 2030 pillars and NDP6. Each selected policy was mapped to at least one impact per category. A longlist of candidate indicators was drafted for each, subject to further screening (Figure 3).[8]

[7] The causal chain methodology follows the ICAT Renewable Energy and Sustainable Development Guidance, which helps map policy interventions from inputs to impacts in a structured manner. A causal chain links **inputs** (e.g., resources like finance), **activities** (e.g., solar panel installation), **outputs** (e.g., increased energy generation), **outcomes** (e.g., reduced fossil energy use), and **impacts** (e.g., lower GHG emissions). See: ICAT (2020). *Sustainable Development Methodology*; also adopted in Namibia's national energy assessments under the ICAT framework.

[8] The impact categories used are based on the **ICAT Sustainable Development Assessment Guide**, which identifies social, economic, and environmental categories. These are aligned with Namibia's **Vision 2030** a long-term national development framework and **NDP6 (Sixth National Development**

Step 3: Screening and Feasibility Assessment

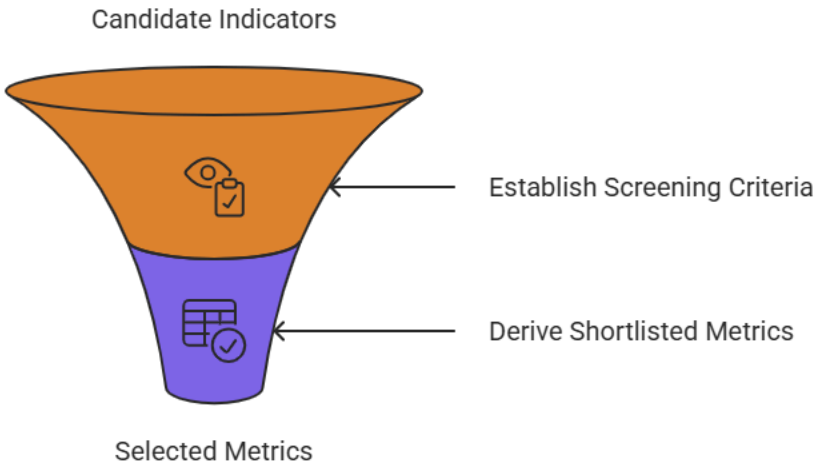

Figure 3. Indicator Screening Funnel.

The following criteria were applied:[9]

- **Relevance:** Is the indicator directly linked to policy objectives?
- **Measurability:** Is there an existing data source or can it be estimated?
- **Attribution:** Can we isolate the policy's effect using models?
- **Frequency:** Can the indicator be updated annually/biennially?
- **Custodianship:** Is there a clear institutional owner?

Where data was not readily available, proxy indicators or qualitative measures were proposed (Annexure A).

Step 4: Stakeholder Validation

Plan). See ICAT (2020) Sustainable Development Guidance; Government of Namibia (2017) *National Energy Policy*.

[9] Criterion drawn from the ICAT Sustainable Development Assessment Guide.

Figure 4. Stakeholder Feedback Loop.

Stakeholder review ensured that selected indicators were realistic, relevant, and reflected institutional mandates (Figure 4). Inputs were gathered through:

- Bilateral consultations with MEFT, MME, NSA, ECB, and NamPower
- A national validation workshop (*08 October 2025*)

These steps collectively ensure that the indicator framework is technically sound, operationally feasible, and nationally owned.[10]

[10] *Custodianship* assigns ownership of indicators to institutions, typically **MEFT** (climate), **MME** (energy), **ECB** (regulation), **NamPower** (utility data), and **NSA** (statistics). Clear ownership ensures accountability.

3 Core Indicators for GHG and SD Tracking

This section presents a consolidated set of indicators selected to monitor the effects of priority energy policies on GHG mitigation and sustainable development co-benefits. Indicators are aligned with the causal chain links defined earlier, categorized by impact type, and accompanied by practical metadata.

Each indicator will be further detailed in metadata sheets (Annex A), including definitions, methods of calculation, assumptions, QA/QC procedures, and institutional responsibilities.

Table 1 consolidates priority indicators that will be used to track the impacts of energy policies on GHG mitigation and sustainable development co-benefits. It is structured around the **causal chain logic** (outputs → outcomes → impacts), ensuring each indicator is directly tied to a stage in the policy results pathway.

Table 1. Proposed Indicators for Policy Impact Tracking.

Causal Chain Link	Category	Indicator Name	Definition	Unit	Data Source	Frequency	Custodian	Impact Type
Outputs	GHG Emissions	Grid emission factor	Emissions per unit of electricity delivered from the national grid	tCO_2/ MWh	NamPower, MEFT	Annual	NamPower	Environmental (Mitigation)
Outputs	GHG Emissions	Renewable-based generation	Total electricity generated from renewable sources annually	MWh	ECB, IPPs	Annual	ECB / MME	Environmental (Mitigation)
Outcomes	Economic	Jobs created in RE	Number of full-time equivalent (FTE) jobs created from RE investments	FTEs/ year	NSA, MME	Annual	MME / NSA	Social / Economic

Causal Chain Link	Category	Indicator Name	Definition	Unit	Data Source	Frequency	Custodian	Impact Type
Outcomes	Economic	Levelized Cost of Energy (LCOE)	Average lifecycle cost of electricity from RE technologies	NAD/ MWh	MME, developers	Biennial	MME	Economic
Impacts	Social	New electricity access	Number of new households electrified through RE systems	House-holds	MME, ECB	Annual	MME / ECB	Social (Access)
Impacts	Environmental	Land use for RE	Area of land newly converted for RE projects	Hectares	MEFT, Survey Dept	Biennial	MEFT	Environmental (Land-use)
Impacts	Health	Air pollution reduction	Estimated decrease in $PM_{2.5}$ due to fossil fuel displacement	$\mu g/m^3$	MEFT	Biennial	MEFT / Gobabeb (NASA)	Environmental / Health

Causal Chain Link	Category	Indicator Name	Definition	Unit	Data Source	Frequency	Custodian	Impact Type
Impacts	Gender	Women in RE employment	Share of RE jobs held by women	%	NSA	Annual	MME / NSA	Social (Gender Equality)

N.B. *This aligns* ***causal chain logic*** *(outputs → outcomes → impacts) with* ***SD dimensions*** *(GHG, Economic, Social, Environmental, Health, Gender).*

3.1 Causal Chain Linkage

In line with ICAT's guidance, the causal chain framework (Figure 5) provides a structured approach to assess how energy-sector policies influence outcomes over time from immediate outputs to long-term impacts. **Outputs** represent the direct, measurable effects of implementing a policy (Figure 5). For renewable energy (RE) interventions, two critical output indicators are the *grid emission factor* and *renewable-based electricity generation*, which together capture the immediate impact on the carbon intensity and composition of Namibia's electricity mix.

Figure 5. Causal Chain Linkage - Policy Impacts.

Moving along the chain, **outcomes** refer to the medium-term changes in system performance and socio-economic conditions (Figure 5). In this assessment, indicators such as the *number of jobs created in the RE sector* and the *levelized cost of electricity (LCOE)* are used to evaluate how policy actions contribute to employment and the affordability of clean energy - two vital pillars of Namibia's just energy transition.

Finally, **impacts** encompass the broader, long-term transformations in societal and environmental well-being (Figure 5). Indicators such as *increased electricity access*, *land use implications for RE infrastructure*, *reductions in air pollution*, and *women's participation in RE employment* reflect multidimensional co-benefits. These link policy efforts to national priorities around social inclusion, public health, gender equity, and environmental sustainability. This tiered linkage from outputs to outcomes to impacts facilitates a holistic understanding of how policies advance both climate and development objectives over time.

To enhance transparency and alignment with the ICAT Sustainable Development Methodology, this section presents a high-level causal chain linking energy-sector policy interventions to social, economic, and environmental outcomes. The chain

traces outputs such as renewable energy investment to intermediate outcomes like energy access expansion or reduced household energy costs, and ultimately to long-term SDG targets such as SDG 7.1 (universal access to energy) and SDG 13.2 (climate action integration).

A summary Figure 6 is provided below, and Table 2 in Section 3.2 cross-references each core SD indicator to specific SDG targets and Namibia's national development goals. This strengthens the policy relevance of the monitoring framework and supports integration into the national SDG reporting system.

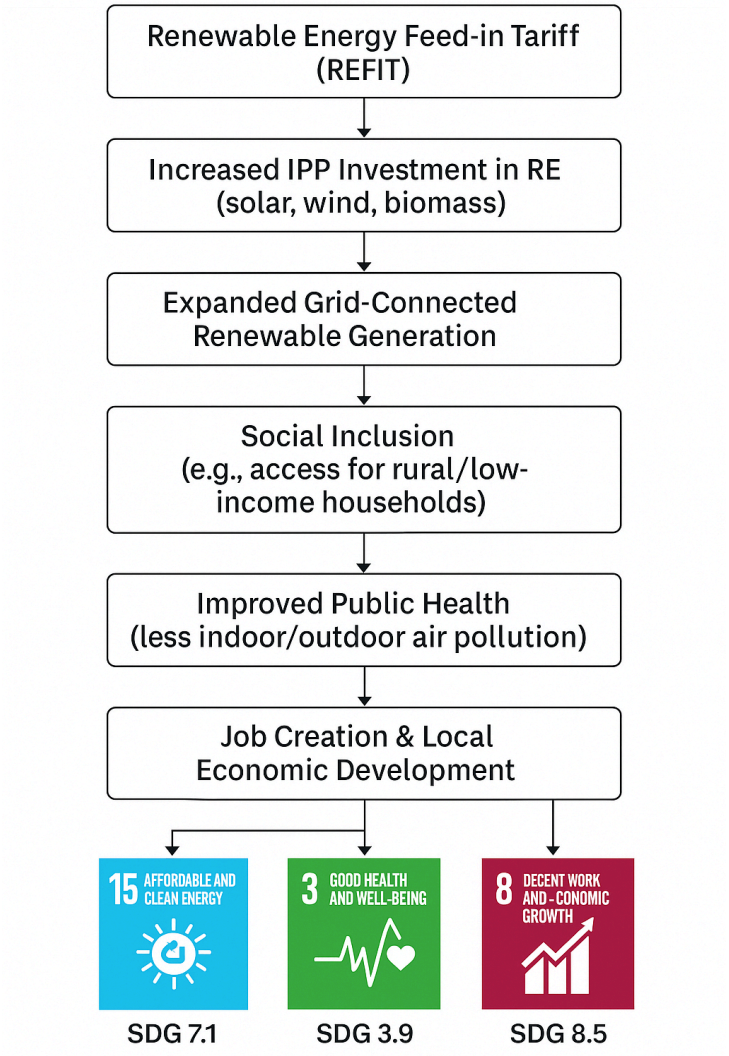

Figure 6. Causal Chain Linking REFIT Policy to Sustainable Development Outcomes and SDG Targets.

3.2 Thematic Categories

The sustainable development assessment of energy policies is structured around six thematic categories, aligned with Namibia's NDC priorities and ICAT guidance.

- **GHG Emissions**: This core category monitors the direct climate mitigation benefits of policies by tracking *grid emission factors* and the *volume of*

renewable electricity generated. These metrics are essential for evaluating progress against Namibia's mitigation targets under the Paris Agreement.

- **Economic**: This category assesses the policy's contribution to *job creation* in the renewable energy value chain and evaluates *energy affordability* through the *levelized cost of electricity (LCOE)*. These indicators reflect the socio-economic returns of clean energy investment.
- **Social**: Focused on *energy access*, this dimension measures the extent to which policies extend modern electricity services to underserved populations, particularly in rural and peri-urban areas, reinforcing national goals on equitable development.
- **Environmental**: This theme captures the *land use footprint* of renewable energy infrastructure, ensuring that expansion aligns with sustainable land management and biodiversity conservation goals.
- **Health**: The *air pollution reduction* indicator captures co-benefits from displacing fossil fuel-based generation, with expected gains in respiratory health, especially in urban and industrial zones.
- **Gender**: Addressing inclusivity, this dimension tracks *women's participation in the renewable energy workforce*, ensuring that the energy transition advances gender equity in employment and decision-making.

Each thematic category is linked to specific causal chain elements and monitored through tailored indicators, ensuring a comprehensive, policy-relevant impact assessment.

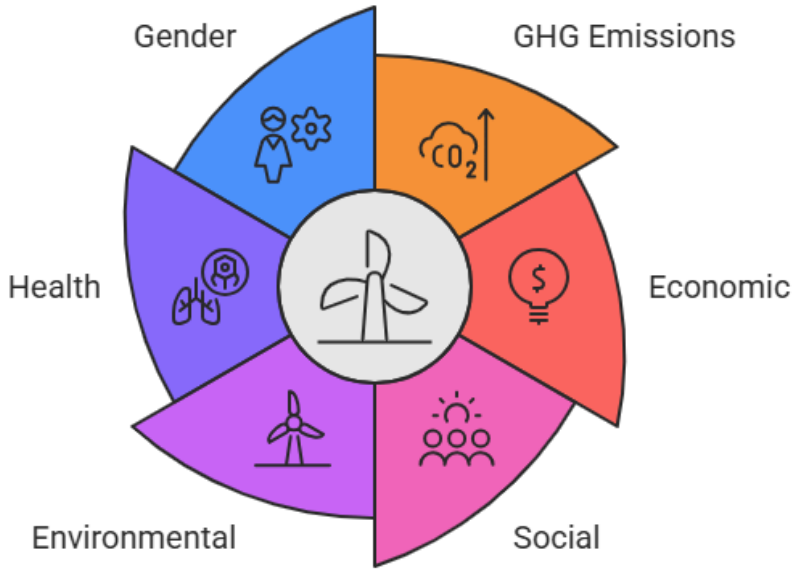

Figure 7. Six pillars of renewable energy impact.

Figure 7 illustrates the six thematic categories used to assess the sustainable development and climate impacts of renewable energy policies, based on the ICAT

Sustainable Development and Renewable Energy methodologies. At the core is renewable energy deployment, which drives systemic change across six interconnected dimensions. Together, these pillars provide a holistic framework to capture both direct and co-benefits of energy policy interventions in Namibia.

3.2 Thematic Categories

The sustainable development assessment of energy policies is structured around six thematic categories, aligned with Namibia's NDC priorities and ICAT guidance.

- **GHG Emissions**: This core category monitors the direct climate mitigation benefits of policies by tracking grid emission factors and the volume of renewable electricity generated. These metrics are essential for evaluating progress against Namibia's mitigation targets under the Paris Agreement.
- **Economic**: This category assesses the policy's contribution to job creation in the renewable energy value chain and evaluates energy affordability through the levelized cost of electricity (LCOE). These indicators reflect the socio-economic returns of clean energy investment.
- **Social**: This category encompasses a broader set of impacts beyond energy access, reflecting a more inclusive and resilient energy transition. It measures the extent to which policies extend modern electricity services to underserved populations, particularly in rural and peri-urban areas, and includes energy affordability for low-income groups. It also introduces indicators related to community capacity building and awareness-raising, which are essential for local empowerment, behavioural change, and the long-term sustainability of renewable energy policies.
- **Environmental**: This theme captures the land use footprint of renewable energy infrastructure, ensuring that expansion aligns with sustainable land management and biodiversity conservation goals.
- **Health**: The air pollution reduction indicator captures co-benefits from displacing fossil fuel-based generation, with expected gains in respiratory health, especially in urban and industrial zones. To strengthen alignment with ICAT guidance on outcome-level indicators, an additional metric has been included estimated reduction in respiratory illness incidence attributable to improved air quality which links environmental improvements directly to health outcomes using WHO exposure-response factors adapted to Namibia's baseline conditions.
- **Gender**: Addressing inclusivity, this dimension tracks women's participation in the renewable energy workforce, ensuring that the energy transition advances gender equity in employment and decision-making.

Each thematic category is linked to specific causal chain elements and monitored through tailored indicators (Figure 8), ensuring a comprehensive, policy-relevant impact assessment.

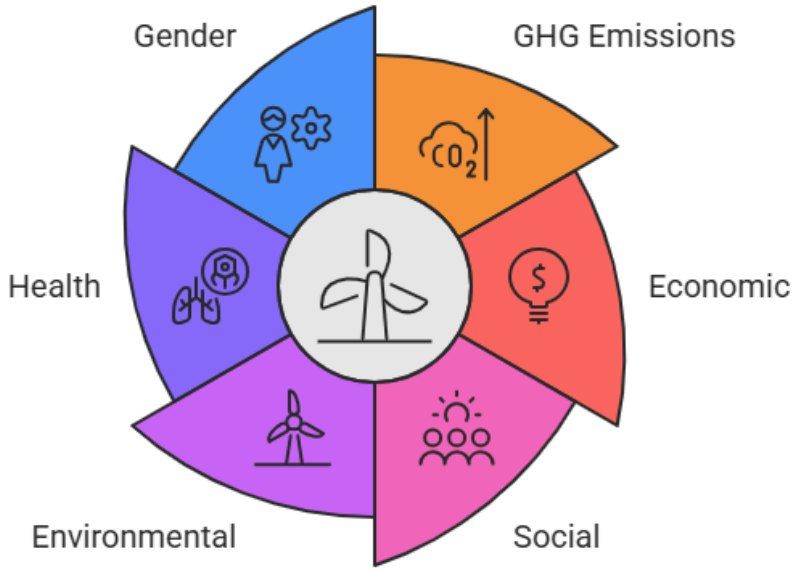

Figure 8. Six pillars of renewable energy impact.

Figure 6 illustrates the six thematic categories used to assess the sustainable development and climate impacts of renewable energy policies, based on the ICAT Sustainable Development and Renewable Energy methodologies. At the core is renewable energy deployment, which drives systemic change across six interconnected dimensions. Together, these pillars provide a holistic framework to capture both direct and co-benefits of energy policy interventions in Namibia.

3.2.1 Linking Indicators to SDG Targets and National Priorities

Building on the conceptual framework in Figure 6, Table 2 presents a crosswalk that connects each indicator within the six thematic categories to corresponding **Sustainable Development Goal (SDG) targets** and **Namibia's national development frameworks**, including *Vision 2030*, the *Harambee Prosperity Plan II*, and *NDP6*. In response to ICAT guidance and feedback, the Social category has been broadened to capture a more complete picture of local empowerment, affordability, and resilience.

Table 2. Mapping of SD Indicators to SDG Targets and National Development Priorities.

Thematic Category	Indicator	Unit	Relevant SDG Target(s)	Linked National Priority
GHG Emissions	Installed renewable capacity under REFIT	MW	SDG 7.2 – Increase renewable energy share	Harambee Prosperity Plan II – Pillar 2

Thematic Category	Indicator	Unit	Relevant SDG Target(s)	Linked National Priority
Economic	Jobs created in RE sector	Number	SDG 8.5 – Decent work & employment	NDP6 – Employment Creation
Social	Share of rural households with electricity	%	SDG 7.1 – Universal energy access	Vision 2030 – Social Equity
Social	Households paying <10% of income on energy	%	SDG 1.4 – Access to basic services	Energy Poverty Reduction Strategy
Social	Community RE awareness and training events held	Number	SDG 13.3 – Climate education and awareness	Environmental Education Policy
Social	Share of low-income HHs benefiting from subsidized energy access	%	SDG 1.2 – Reduce poverty via basic services	Harambee Prosperity Plan II – Pillar 1
Health	PM2.5 concentration reduction	µg/m³	SDG 3.9 – Reduce pollution-related deaths	National Health Policy
	Estimated reduction in respiratory illness incidence	Cases/year	SDG 3.4 – Reduce premature mortality from NCDs	National Health Policy / Health Sector Strategic Plan
Economic	RE project investments by Namibian SMEs	NAD	SDG 9.3 – Support to local enterprises	Industrialization Policy
Gender	Women employed in RE sector	% share	SDG 5.5 – Gender equality in decision-making	Gender Sector Policy

3.3 Institutional Custodianship

To operationalize the sustainable development and climate indicators, each is anchored to a designated institutional custodian responsible for data collection,

validation, and reporting. This custodianship structure enhances accountability and data integrity across Namibia's Measurement, Reporting, and Verification (MRV) system (Figure 9):

- **NamPower** serves as the technical authority for electricity generation data, including the calculation of the *grid emission factor* based on dispatch patterns and fuel inputs.
- The **Electricity Control Board (ECB)** and **Ministry of Mines and Energy (MME)** jointly oversee metrics on *renewable energy generation capacity* and *household electrification rates*, reflecting sector expansion.
- The **Namibia Statistics Agency (NSA)** is responsible for generating *socio-economic data*, including *employment* and *gender-disaggregated workforce statistics* related to renewable energy.

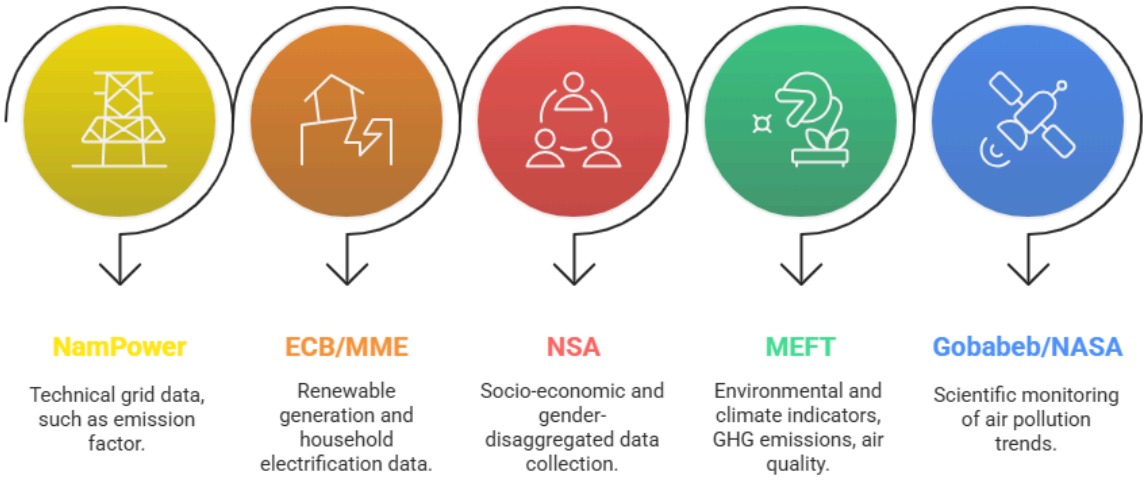

Figure 9. Responsible Institutions.

- The **Ministry of Environment, Forestry and Tourism (MEFT)** leads on *GHG emissions accounting*, *land use impacts*, and *air quality indicators* within the climate policy domain.
- For advanced monitoring of *air pollution trends*, *Gobabeb Research Centre* and external sources like NASA satellite data provide scientific inputs to strengthen atmospheric assessments.

This division of roles supports robust horizontal and vertical data flow from technical operators and regulators to national reporting entities ensuring alignment with the Enhanced Transparency Framework (ETF) under the Paris Agreement.

3.4 Frequency of Reporting

To balance the need for timely updates with resource efficiency, indicators are categorized by their optimal reporting frequency:

- **Annual indicators** include high-priority variables such as the *grid emission factor (EF)*, *renewable energy generation*, *job creation in the RE sector*, and *household electricity access*. These are essential for NDC progress tracking, ICAT-aligned scenario updates, and regular inputs to national reports and the Enhanced Transparency Framework (ETF).
- **Biennial indicators** such as *levelized cost of electricity (LCOE)*, *land use footprint of RE infrastructure*, *ambient $PM_{2.5}$ concentrations*, and *gender-disaggregated employment data* are reported every two years. This frequency ensures trend visibility while managing the costs and complexity of data collection and analysis.

This tiered reporting structure enables Namibia to maintain a practical and transparent MRV system that supports both domestic policy evaluation and international reporting commitments.

3.5 Impact Type Balance

The table demonstrates an integrated approach:

- Environmental: GHG reductions, land use, and air quality.
- Economic: Jobs and affordability.
- Social: Energy access and gender equity.
- Health: Pollution-related co-benefits.

This ensures Namibia can report not only on climate mitigation but also on SDG-aligned co-benefits, strengthening the case for international support (e.g., climate finance).

In summary Table 2 provides Namibia with a policy-linked, custodian-assigned, and SD-balanced monitoring framework. It is designed to feed directly into NDC tracking, ICAT reporting, and national planning processes (Vision 2030, NDP6).

The monitoring framework emphasizes a balanced distribution of impact types, capturing both mitigation and sustainable development co-benefits. The indicators span four major dimensions:

- **Environmental**: Including *GHG emission reductions*, *land use impacts* of renewable infrastructure, and improvements in *ambient air quality* critical for climate action and environmental sustainability.

- **Economic**: Focusing on *job creation* within the RE sector and the *affordability of electricity* through levelized cost metrics, linking directly to inclusive green growth.
- **Social**: Addressing *electricity access expansion* and *gender equity* through employment tracking, in line with SDG 7 (access to energy) and SDG 5 (gender equality).
- **Health**: Capturing the *co-benefits of reduced air pollution* (e.g., $PM_{2.5}$ exposure), contributing to public health improvements and reduced burden on health systems.

This integrated approach allows Namibia not only to monitor progress toward its NDC mitigation targets but also to demonstrate co-benefits aligned with the Sustainable Development Goals (SDGs). Such a comprehensive view strengthens the rationale for international climate finance and technical support.

In summary, Table 2 provides a policy-linked, custodian-assigned, and impact-balanced monitoring framework. It is structured to directly feed into Namibia's NDC tracking system, ICAT assessment reports, and national development processes, including Vision 2030 and NDP6.

4 Guidance Notes on Indicator Use

This section provides practical instructions for the application, interpretation, and integration of the selected indicators into Namibia's national measurement, reporting, and verification (MRV) systems, and future NDC tracking mechanisms.

4.1 Indicator Metadata and Documentation

Each indicator will be documented through a comprehensive metadata sheet to ensure consistency, transparency, and reproducibility. Metadata will include:

- **Definition and Scope:** Clear technical description of the indicator, including units.
- **Calculation Method:** Formula used, with data input requirements.
- **Assumptions:** Default values or contextual approximations (e.g., emission factors).
- **Data Sources and Collection Protocols:** Primary sources, responsible agencies, and timelines.
- **Frequency and Disaggregation:** Temporal resolution (e.g., annual, biennial) and relevant disaggregation (e.g., by region, gender).
- **QA/QC Procedures:** Steps for verification, validation, and anomaly checking.
- **Reporting Format:** Standardized templates aligned with NDC and ETF requirements.

The metadata will be aligned with the ETF's reporting guidance and Namibia's NDC indicator framework under development by MEFT and NSA.

4.2 Integration with National Systems

Selected indicators will be mainstreamed into Namibia's national climate data architecture. Integration steps include:

- Incorporating GHG indicators into GACMO models to generate annual emissions estimates under with/without-policy scenarios.
- Embedding SD indicators into the National Statistics Agency's reporting portals and harmonizing with SDG reporting cycles.
- Aligning energy access and cost indicators with ECB and MIME's regulatory reporting formats.

Cross-ministerial coordination will be essential, with roles defined through memoranda of understanding and regular inter-agency reporting schedules.

4.3 Reporting and Communication

The developed indicators will be integrated into Namibia's climate and development reporting architecture, supporting transparency, accountability, and evidence-based planning. Specifically, outputs will inform:

- **Biennial Transparency Reports (BTRs)** under the UNFCCC Enhanced Transparency Framework (ETF), ensuring consistent international reporting on mitigation and co-benefits.
- **NDC Implementation Progress Reports**, which are shared with national and international stakeholders to track delivery on climate commitments and mobilize support.
- **Sectoral Planning and Budgeting Documents** within the energy and environment ministries, enabling data-driven decision-making for policy refinement, infrastructure investment, and climate finance allocation.

To enhance accessibility and policy relevance, an indicator dashboard prototype is under development. This tool will feature:

- **Time-series visualizations** of GHG emissions and sustainable development trends,
- **Scenario comparisons** (e.g., with-policy vs. without-policy),
- **Regional disaggregation**, allowing subnational actors and planners to tailor interventions.

This reporting and visualization infrastructure strengthens Namibia's ability to translate technical insights into actionable policy, in line with national development goals and global climate obligations.

4.4 Capacity Building and Continuous Improvement

To ensure the long-term sustainability and institutional uptake of the indicator framework, a structured capacity-building and learning cycle will be implemented:

- **Targeted training workshops** will be conducted for technical staff at key institutions like MEFT, MIME, ECB, NamPower, and NSA focusing on indicator calculation methods, data management, and use for policy analysis.
- **Biennial feedback loops** will be established to assess the performance, usability, and relevance of each indicator. This process will identify data gaps, refine methodologies, and integrate lessons learned into periodic updates.
- **Pilot testing** of the full indicator suite will begin with two policies for example the rural electrification, net metering or the National Energy Compact in 2026, serving as a proof-of-concept for scaling to other energy-sector interventions.

This iterative approach ensures that the indicators evolve alongside Namibia's dynamic policy and energy landscape, maintaining their relevance and supporting robust decision-making over time.

5 Monitoring and Reporting Strategy

This section sets out a structured plan for operationalizing the selected indicators, including institutional arrangements, reporting channels, verification protocols, and timelines. The objective is to institutionalize a functional, low-burden system for evidence-based policy tracking and timely compliance with international reporting requirements under the Paris Agreement.

5.1 Institutional Roles and Responsibilities

To Effective indicator monitoring and reporting requires clear delineation of institutional roles across Namibia's energy and climate governance landscape (Table 3). The following lead institutions are proposed as primary custodians:

Table 3. Lead institutions and their primary roles.

Institution	Core Roles
MEFT	Overall coordination of indicator reporting; lead for UNFCCC submissions (BTR, NDC); oversight of GHG inventory and air quality metrics.
MME (formerly MIME)	Policy lead on renewable energy; responsible for data collection on RE deployment, electrification progress, and energy access.
ECB	Regulator for electricity markets; provides data on tariffs, grid composition, and mini-grid licensing and rollout.
NSA	National statistics authority; integrates SD indicators into broader development tracking frameworks, including SDGs.
NamPower	Utility-level operator; generates data on electricity production, grid emissions, and infrastructure expansion.
Academic and Research Centres	Provide technical expertise for GACMO modelling, peer review of assumptions, and sustainable development co-benefit analysis.

To institutionalize coordination, Memoranda of Understanding (MoUs) will be developed between MEFT and sectoral partners, outlining roles, responsibilities, and data-sharing protocols. This approach strengthens vertical and horizontal collaboration, ensuring that indicator tracking supports both national planning and international transparency commitments.

5.2 Data Flow and Reporting Cycle

Figure 10 illustrates the structured data flow underpinning Namibia's national indicator monitoring system for energy-sector GHG and sustainable development (SD) tracking. The process consists of four interlinked phases: Data Collection, Verification, Integration, and Reporting.

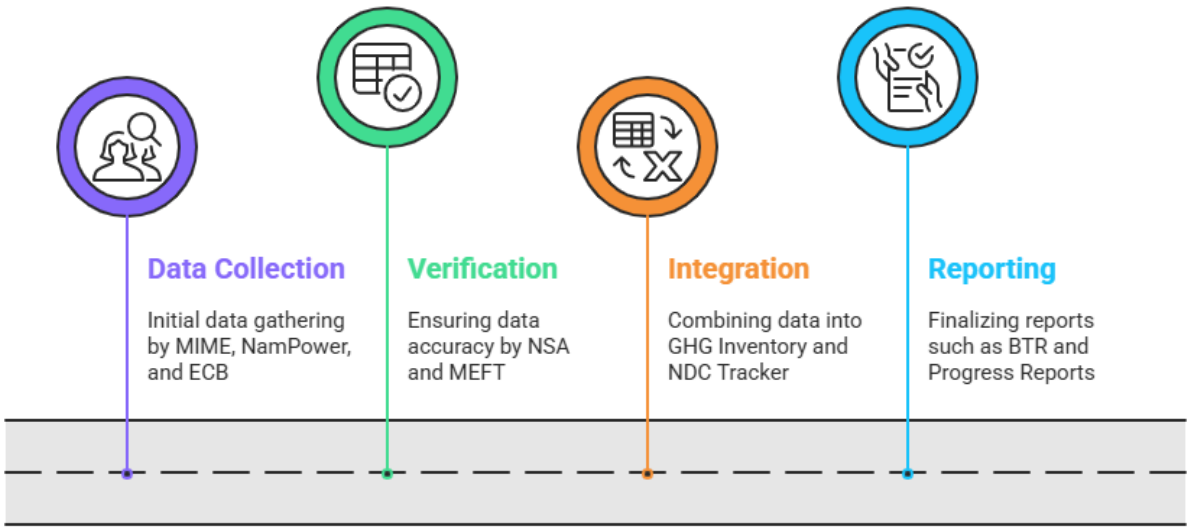

Figure 10. National monitoring data flow.

- **Data Collection**: Initial data is gathered by MME, NamPower, and ECB, covering indicators such as renewable energy capacity, electricity access, grid emissions, and tariff data.
- **Verification**: The Namibia Statistics Agency (NSA) and MEFT ensure data quality through consistency checks, metadata validation, and inter-agency coordination.
- **Integration**: Verified data is then combined within national platforms, notably Namibia's GHG Inventory, the NDC Tracking Excel Tool (developed under ICAT), and the NSA's National Indicator Framework.
- **Reporting**: Finalized data feeds into both Biennial Transparency Reports (BTRs) under the UNFCCC and domestic policy reports, including NDC implementation updates and sectoral planning documents.

To enhance institutional uptake and ensure long-term integration, the Namibia Statistics Agency (NSA) will serve as the central repository for sustainable development (SD) indicators related to energy-sector policies. The Ministry of Environment, Forestry and Tourism (MEFT) will lead periodic methodology reviews and validation processes through the National SDG Coordination Mechanism, ensuring alignment with national priorities and ICAT guidance. The Ministry of Mines and Energy (MME) and NamPower will provide primary data inputs on a regular basis. This collaborative framework supports inter-agency learning and ensures that annual and biennial reports are harmonized with the NSA's National Indicator

Framework and other official reporting systems, such as the GHG inventory and NDC implementation toolkits.

5.2.1 Synchronization with National Reporting Cycles

To optimize alignment:

- **Annual Data Collection** will be conducted for high-frequency indicators such as *RE installed capacity*, *grid emission factors*, and *jobs in the RE sector*.
- **Biennial Reporting** will cover broader metrics including *SDG-aligned social, health, and gender indicators*, with updates structured to support BTR and NDC reporting schedules.

All reporting templates and protocols will be harmonized with existing national systems, including:

- **Namibia's GHG Inventory Templates** (used in UNFCCC reporting),
- The **NSA National Indicator Framework** (for SDG alignment),
- **MEFT's NDC Tracking Toolkits**, developed under ICAT for scenario and progress tracking.

5.3 QA/QC and Data Validation

Ensuring transparency, credibility, and replicability of results is a core requirement of Namibia's monitoring system under the ICAT and UNFCCC frameworks. A three-tiered Quality Assurance and Quality Control (QA/QC) system will be embedded throughout the indicator lifecycle:

- **Tier 1 Checks**: These involve basic data validation, focusing on completeness (e.g., no missing values), correct units, internal consistency, and adherence to reporting formats. These checks will be performed at the point of data entry by technical teams at MME, NamPower, and ECB.
- **Tier 2 Checks**: Data will undergo institutional cross-verification, including checks against historical baselines and related datasets (e.g., comparing RE capacity with grid mix, or emissions with electricity output). NSA and MEFT will lead this inter-agency consistency review.
- **Tier 3 Checks**: Advanced QA will involve expert peer review, including recalculation or triangulation using Namibia's energy system models such as GACMO and LEAP, to validate emission trajectories and sustainable development co-benefits.

A QA/QC checklist will be developed and included in Annex C, detailing specific validation steps per indicator. Additionally, targeted training sessions will be provided to institutional focal points to build capacity in applying QA/QC protocols and addressing discrepancies proactively.

This structured approach ensures Namibia's indicator framework meets international standards for transparency and robustness, while fostering institutional ownership and continuous improvement.

5.4 Feedback and Adaptive Management

To maintain the effectiveness and policy relevance of the indicator framework over time, an annual review process will be institutionalized. These reviews will serve as a feedback mechanism to ensure that indicators remain technically sound, feasible to track, and aligned with evolving national priorities.

Key functions of the review process include:

- **Assessing reliability and relevance**: Reviewing each indicator's performance based on data availability, usability, and contribution to decision-making.
- **Updating methodologies**: Incorporating new data sources, technological developments (e.g., satellite monitoring), or policy changes (e.g., new electrification targets or RE incentives).
- **Phasing out non-material indicators**: Retiring indicators that no longer provide value or are too costly to monitor reliably.

To oversee this adaptive management process, an internal "Indicator Review Committee" will be established within MEFT, with formal representation from MME, NSA, ECB, and academic/research institutions. This committee will coordinate revisions to indicator definitions, QA/QC procedures, and documentation, ensuring continuous improvement and institutional ownership.

This adaptive governance approach ensures that Namibia's monitoring system remains fit-for-purpose, responsive to context, and resilient to future policy and data shifts.

5.5 Reporting Formats and Communication Products

To enhance usability, transparency, and stakeholder engagement, standardized reporting templates and visual communication tools will be developed. These will be implemented in Microsoft Excel and linked to interactive dashboards, with a full pilot planned for 2026. The following formats are proposed:

- **Policy Scorecards**: Concise, traffic-light dashboards summarizing progress on each policy across key GHG and SD indicators. These enable rapid performance assessment by decision-makers and regulators.
- **Impact Briefs**: Two-page summaries per indicator, featuring trendlines, recent data, and short analytical narratives, suitable for use in inter-ministerial briefings and stakeholder consultations.

- **Public Dashboard**: A **web-based platform** potentially hosted by MEFT or NSA to visualize time-series data, geographic disaggregation, and scenario comparisons. This will facilitate open access to climate and development information, aligned with Namibia's transparency commitments.

These communication products are designed to bridge the gap between technical analysis and policy engagement, ensuring accessibility for a wide range of users including Parliamentarians, development partners, civil society organizations, and local government officials.

6 Conclusion

To implement the proposed indicator framework, a set of coordinated actions will institutionalize data flows, strengthen technical capacity, and enable continuous improvement of Namibia's monitoring system for GHG mitigation and sustainable development co-benefits.

As illustrated in Figure 9, the implementation roadmap includes the following key steps:

- **Final Validation Workshop (Q1 2026)**: Present and refine the indicator set and dashboard prototypes with institutional stakeholders.
- **Institutional Agreements**: Establish data-sharing protocols through formal MoUs between MEFT and sectoral agencies.
- **Metadata and QA/QC Development**: Finalize technical annexes covering indicator definitions, methodologies, and quality control procedures.
- **Training and Capacity Building**: Conduct targeted training for staff from MEFT, MME, NSA, ECB, and NamPower.
- **Pilot Application**: Test the framework using two flagship energy policies such as rural electrification and net metering.
- **Public Dissemination**: Share key results and tools through policy briefs, infographics, and a public-facing dashboard.

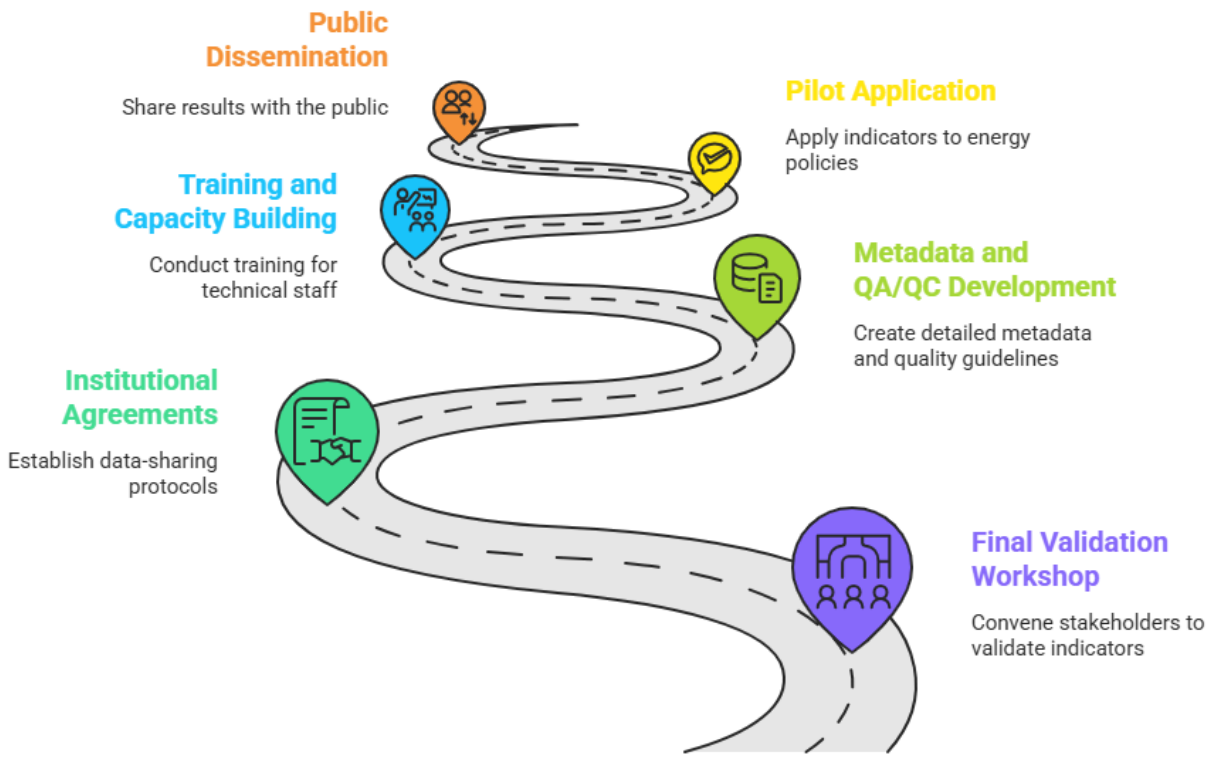

Figure 11. Indicator Implementation Roadmap.

Visualizing the key steps toward operationalizing Namibia's monitoring framework.

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Annexes

Annex A: Indicator Metadata Sheets

Indicator	Definition	Unit	Calculation Method	Source	Frequency	Custodian
Grid Emission Factor	CO_2 emissions per unit of electricity generated by national grid	tCO_2/MWh	Total grid CO_2 / Total grid MWh	NamPower, MEFT	Annual	NamPower
Renewable Electricity Output	Total annual electricity generated from RE sources	MWh	Sum of generation from all RE plants	ECB, IPPs	Annual	ECB
Jobs in Renewable Energy	Number of full-time equivalent jobs created through RE projects	FTE/year	Direct employment reports from IPPs and projects	NSA, MIME	Annual	MIME
Levelized Cost of Energy	Average cost per MWh of RE electricity over project lifetime	NAD/MWh	LCOE = CAPEX + OPEX / Lifetime Generation	Developer reports	Biennial	MIME
New Access via RE	Number of households newly electrified through RE systems	Households	Project data on RE grid/minigrid/SHS connections	MIME, ECB	Annual	MIME
Land Area Used for RE	Total land area utilized by RE installations	Hectares	GIS mapping, site survey data	MEFT, Survey Dept	Biennial	MEFT
PM2.5 Reduction Estimate	Estimated change in PM2.5 from fossil displacement by RE	$\mu g/m^3$	Modelled using LEAP or atmospheric dispersion models	NASA, MEFT	Biennial	MEFT
Share of Women in RE Jobs	Percentage of RE jobs held by women	%	Disaggregated labor reporting by employers	NSA	Annual	NSA

Annex B: Indicator Scorecards (Example)

Policy: Net Metering Support Scheme

Impact Area	Indicator	2024 Baseline	2026 Target	Status (2025)	Score
GHG	Grid Emission Factor (tCO_2/MWh)	0.72	0.65	0.68	🟡
	RE Generation (MWh/year)	48,000	75,000	60,500	🟡
	Avoided Emissions (tCO_2e/year)	-	35,000	28,600	🟡
Economic	Jobs in RE (FTE)	320	600	500	🟡
	LCOE of Net-Metered Systems (USD/MWh)	110	90	95	🟢
	Installed Rooftop Capacity (MW)	30	50	42	🟢
Social	New Access via RE (Households)	8,000	10,000	9,200	🟢
	Community Systems Installed (#)	18	25	21	🟢
Gender	Share of Women in RE Jobs (%)	22%	30%	24%	🟡
	Women-led RE SMEs Supported (#)	6	15	8	🟡
Health	$PM_{2.5}$ Reduction (µg/m³, est. avg.)	21	18	19.5	🟢
	Households Avoiding Diesel Use (#)	1,200	2,000	1,650	🟢
Environmental	Land Area Used for Rooftop RE (m²)	120,000	180,000	155,000	🟢
	Material Circularity in Equipment (%)	55%	70%	60%	🟡

Legend: 🟢 = On track, 🟡 = Slightly behind, 🔴 = Off track

Annex C: QA/QC Procedures and Checklists

This annex outlines the Quality Assurance and Quality Control (QA/QC) steps to be applied at each stage of the data collection, calculation, and reporting process. The procedures are designed to ensure accuracy, consistency, transparency, and institutional accountability, in line with ICAT and UNFCCC guidance.

1. Data Collection QA/QC

Step	Procedure
Field Completeness Check	Ensure all required fields in data templates are filled.
Unit & Frequency Validation	Confirm consistent use of units (e.g., MWh, tCO_2) and reporting periods (monthly vs. annual).
Outlier Detection	Flag anomalies by comparing current values to historical trends (±2σ rule).

2. GHG Calculation QA/QC

Step	Procedure
Emission Recalculation	Independently recalculate using LEAP or GACMO models to cross-validate results.
Emission Factor (EF) Comparison	Benchmark EF against IPCC defaults and NamPower grid-specific values.
Disaggregation Logic Review	Review how emissions are broken down (by tech type, fuel, or geographic area).

3. Sustainable Development (SD) Indicator QA/QC

Step	Procedure
Disaggregated Data Request	Require breakdown by gender, age, and region where applicable.
Verification by Implementers	Obtain signed verification from project owners or implementing agencies.
Cross-Indicator Consistency Check	Compare linked indicators (e.g., RE capacity vs. jobs created).

4. Institutional Review Process

Institution	Responsibility
MEFT	Reviews and validates GHG-related indicators and modelling inputs.
NSA	Reviews socioeconomic and gender indicators for national alignment.

Institution	Responsibility
Annual Peer Review	Independent review by academia/research partners prior to NDC or BTR submission.

Annex D: Draft Reporting Templates (Excel Overview)

To support consistent and efficient reporting by all sector institutions, a standardized Excel workbook will be used for data collection, scenario comparison, and communication. The workbook will consist of the following three core sheets:

Sheet 1: Indicator Summary Table

Purpose: Central registry for all monitored indicators, combining metadata and recent time-series values.

Column	Content
Indicator Name	E.g., Grid Emission Factor, Jobs in RE
Definition	Technical description based on ICAT/NDC metadata
Unit	tCO_2e/MWh, # of FTE jobs, etc.
Custodian Institution	MEFT, MME, NSA, NamPower, etc.
Data Source	Administrative records, models, surveys
QA/QC Status	Tier 1/2/3 validated
Values (2020–2025)	Time-series for past 5 years (pre-filled if available)

Sheet 2: Annual Data Submission Form

Purpose: To be completed each year by sectoral institutions as part of Namibia's MRV cycle.

Feature	Functionality
Indicator Rows (Pre-filled)	Standardized list of approved indicators per institution
Annual Value Entry (Editable)	Empty cells for current year values (e.g., 2026)
Drop-downs for Units	Ensures consistency in reporting format (MWh, %, tCO_2e, etc.)
Drop-downs for Custodian	Pre-set to validate which institution is submitting each indicator
Notes Field	Allows explanation of anomalies, method changes, or data caveats

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Sheet 3: Scenario Comparison Charts

Purpose: Support visual analysis of with-policy vs without-policy impacts and SD co-benefits over time.

Chart Type	Content
Line Graphs (GHG Impact)	Compare emissions trajectories under baseline vs policy scenarios (2020–2040)

Chart Type	Content
Bar Charts (SD Indicators)	Track change in jobs, access, gender inclusion, etc., over key policy years
Tooltip Integration (Optional)	Brief metadata pop-ups to clarify definitions or sources

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End of Report