Gap Analysis and Needs Assessment on MRV system in the Energy Sector – Sudan

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Republic of Sudan
The Higher Council for the Environment and Natural Resources

ICAT Initiative for Climate Action Transparency

Initiative for Climate Action Transparency - ICAT

Gap Analysis and Needs Assessment on MRV system in the Energy Sector – Sudan

Deliverable #1

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List of Acronyms

BCPR	Bureau for Crisis Prevention and Recovery
BUR	Biennial Update Report
CBD	Convention on Biological Diversity
CBIT	Capacity Building Initiative for Transparency
COP	Conference of the Parties
COVID-19	Corona virus disease, 2019
CSO	Civil Society Organization
DfID	Department for International Development (UK)
ERC	Evaluation Resource Centre
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
GIZ	GesellschaftfürInternationaleZusammenarbeit (Germany)
GHG	greenhouse gas
HCENR	Higher Council for Environment and Natural Resources (Sudan)
M&E	monitoring & evaluation
MEAs	Multilateral Environmental Agreements
MPGs	Modalities, Procedures and Guidelines
MRV	measurement, reporting and verification
MTR	Mid-Term Review
MWRIE	Ministry of Water Resources, Irrigation, and Electricity (Sudan)
NAP	National Adaptation Plan
NBSAP	National Biodiversity Strategy and Action Plan
NC	National Communication
NCSA	National Capacity Self-Assessment
NDC	Nationally Determined Contribution
NGO	Non-governmental organization
POPP	Programme and Operations Policies and Procedures
REDD+	Reducing Emissions from Deforestation and forest Degradation
QA/QC	Quality assurance/quality control
SEA	sexual exploitation and sexual abuse
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TOR	Terms Of Reference

UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

Introduction

About Sudan

Sudan (official name: Republic of Sudan) is located in between Sub-Saharan Africa and the Middle East. The country is bordered by Egypt to the north, Libya, Chad, and the Central African Republic to the west, a 1,937 km long border with South Sudan to the south, and Ethiopia, Eritrea, and the Red Sea to the east (Figure 1).

Figure 1: Map of Sudan. Source: https://www.worldatlas.com/maps

The total land area is about 1.89 million square kilometers, making it the 3rd largest in Africa and Arab league, and 16th largest in the world. This corresponds to the land area following the separation in July 2011 into Sudan and South Sudan.

Prior to the division of the country, Sudan was considered as the 17th fastest growing economy in the world due to rapid development from oil profits. Since then, Sudan has experienced adverse economic impacts due to the loss of oil revenue which had accounted for the largest share of exports and over 50% of governmental revenue. This has contributed to markedly less economic growth, double-digit consumer price inflation, increased fuel prices, and decreased fuel availability.

Nevertheless, Sudan is endowed with abundant natural resources including fertile lands, ample water resources, livestock, diverse forests, minerals (e.g., gold, copper), and energy resources (e.g., oil, and natural gas). Khartoum is the capital of Sudan, lies at the confluence of the White and Blue River Niles.

Sudan's population has been growing rapidly. Since 2008, the year of it last census, the estimated population has grown to 45 million in 2022, an average annual growth rate of about 2.5% over that period. Total estimated GDP (based on purchasing power parity) in 2021 was USD 194.5 billion and USD 3,838 on a per capita basis (Source: https://tradingeconomics.com/).

The country continues to face severe environmental challenges. Primarily, these challenges are associated with an increasing variable climate has led to catastrophic floods and recurrent drought episodes. In many cases the environmental challenges are directly linked to governance issues.

The energy sector has an essential role in Sudan's economy. It supports activities different public services such as health care, education, public transportation, and household electrification, as well as meeting the fuel and electricity needs of the agricultural and industrial sectors. The main sources of primary energy in Sudan are biomass, oil, and hydroelectricity. Coal, natural gas, and uranium are non-existent in Sudan. Currently, Sudan's primary energy mix consists of biomass, hydroelectric power,oil products, and a small amount of solar photovoltaic power.

Energy consumption is dominated by the household and transport sectors. Household energy use in the form of electricity, LPG, and biomass accounts for about 45% of all energy use and has been growing rapidly at an average annual rate of nearly 7% per year. For the transport sector, gasoline and diesel use accounts for about 34% of all energy use and has been growing more slowly at an average annual rate of about 3.3% per year. Combined, all other sectors (commercial, industrial, agricultural, others) account for only 20% although they are experiencing average annual growth of nearly 7% per year.

Contest for the ICAT study for Sudan

The Initiative for Climate Action Transparency (ICAT) aims to strengthen capacities in developing countries to assess the impacts of their climate policies and actions and to support greater transparency, effectiveness, ambition and trust in climate policies worldwide.

The Initiative works with countries to build capacities on understanding and applying tools and approaches to measure, report and verify (MRV) greenhouse gas (GHG) emissions reductions and adaptation action, as well as to strengthen existing institutional arrangements and processes for MRV of policies and actions.

The Paris Agreement marks a historic turning point in global climate action, committing all countries to limit global temperature rise, adapt to changes already occurring and regularly increase efforts over time. Countries also agreed on a process to prepare successive nationally determined contributions (NDCs) that raise ambition towards achieving the objectives of the Agreement. Mutual trust and confidence in the effective implementation of NDCs builds on enhanced transparency to support accelerated climate action. Article 13 of the Paris Agreement highlights the critical need for improved transparency to monitor the progress and assess the impacts of all climate actions to regularly increase efforts over time. ICAT seeks to address this need.

The immediate goal of the project is to meet enhanced transparency requirements as defined in Article 13 of the Paris Agreement by enhancing Sudanese institutional and technical capacity for measuring and reporting greenhouse gas emissions, GHG reductions from mitigation activities in Energy and Transport Sectors that can be achieved by meeting the stated objectives by ICAT-Sudan.

ICAT is designed to finance activities at the country, regional and global levels to drive immediate and long-term impacts that will result in sustained improvements to the administrative, legislative and institutional transparency infrastructure within countries. ICAT aims to facilitate effective decision making and policy design, rooted in credible data. it provides tools to collect more robust and consistent data on emissions, mitigation and adaptation efforts, capacity building and

support. Therefore, better availability and quality of data will allow for assessment of the impact and effectiveness of domestic climate policies and set in motion an upward spiral of ambition and implementation. In addition to providing the guidance and tools for policy evaluation, the Initiative will create a space for countries to share their experiences and lessons learned.

Combining broadly-applicable methodologies and tools with in-country capacity building, ICAT is uniquely positioned to use on-the-ground experiences to refine tools and guidance. With better information and data, ICAT enables countries to select the most efficient, cost-effective policies to achieve their sustainable development priorities and fulfill their reporting requirements.

The INDC, submitted by Sudan (Sudan the 2012 share of global GHG emissions is 0.85%) in 2015, did not quantified an GHG emission reduction target by 2030 although energy (Integration of renewable energy in the power system; Energy efficiency; Electricity thermal generation using Natural Gas), forestry (Afforestation and reforestation; National REDD+ strategy) and waste (Collection; Sanitary landfill; Zero waste concept) are the sectors covered by the program of action. Sudan's INDC goals depend on access to financial resources, including technology transfer and capacity-building. Sudan ratified the Paris Agreement on 2nd August 2017. However, according the lately submitted Sudan's First NDCs the targets in the energy sector are summarized as:

By working with countries' existing reporting commitments, ICAT also promotes harmonization with other transparency efforts and in-country strategies to help maximize the impact of country efforts.

1- Grid connect solar and wind power plants 2,140 MW (3,574,580 tCO2e avoided)
2- Standalone and mini grid (residential, agriculture and industry) 796 MW (1,086,360 tCO2e avoided)
3- Grid Loss in transmission & distribution 1,213 GWh (857,506 tCO2e avoided)
4- Promotion of using efficient appliances in residential 2,295 GWh (463,759 tCO2e avoided)

While, in the transportation sector:

1- Transition to public transportation
2- 10% biofuel blending
3- Switching to freight rail

In which 6,449,582 tCO2e will be avoided

Key official climate change policy/strategy document

The following official submissions to UNFCCC were made by Sudan:

1- NC1 submitted on 7th June 2003
2- NC2 submitted on 14th November 2013
3- NDC 28th October 2015
4- 3rd NC and 1st BUR (2022) competed but not officially published
5- Sudan NAMA framework submitted in 2015

ICAT Sudan objectives have been identified by the Government of Sudan via sharing of priority areas by Climate Change Unit to include the sectors of Energy and Transport. These have been expounded to develop the objectives as follows:

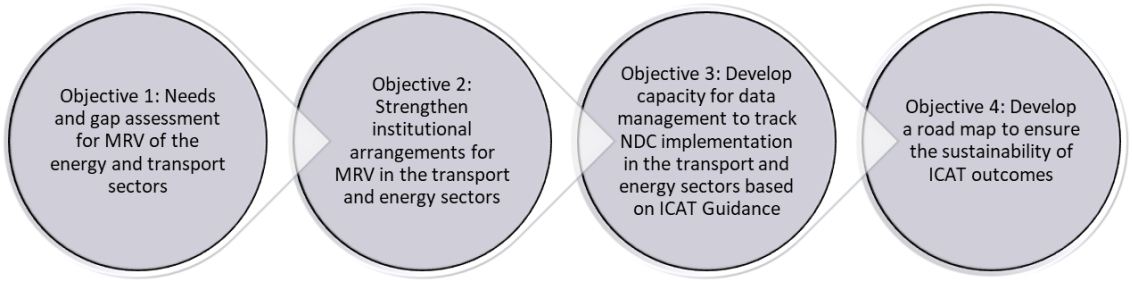


Figure 2: Objectives of the ICAT Sudan project

For coordination of all ICAT activities, the main institutional partner is the Climate Change Unit (CCU) at the Higher Council for Environment and Natural Resources (HCENR) constituting the ICAT focal point. The CCU will coordinate the work and deliverables of ICAT support to be implemented by national experts supported and contracted by UNEP-CCC.

The following chart summarize the flow of activities in this project as per the inception report.

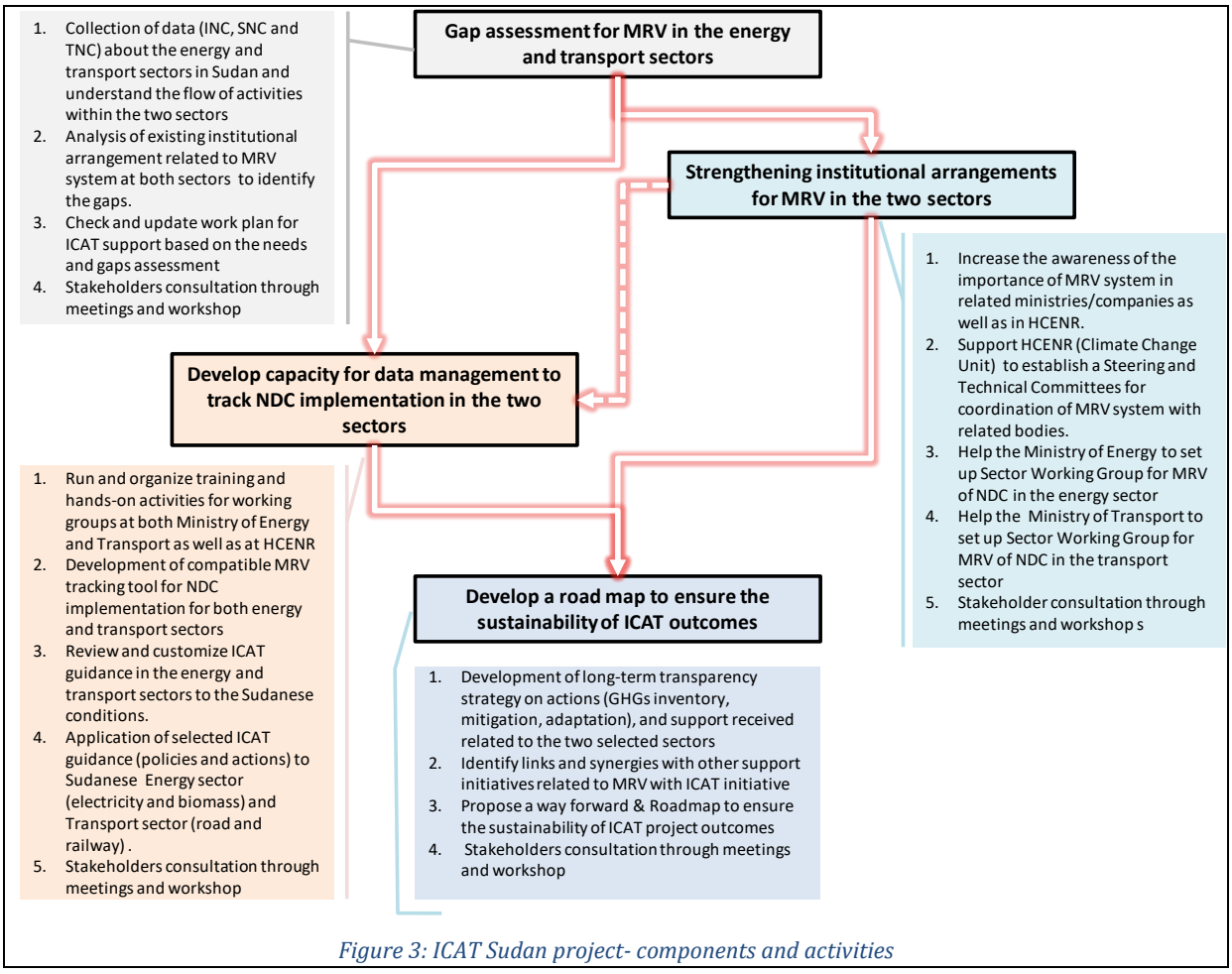


Figure 3: ICAT Sudan project- components and activities

Gap analysis objectives

ICAT objective is to provide policymakers around the world with tools and support to assess the impacts of their climate policies and actions, to further transparent and ambitious climate action and mobilize investment mainly with Two components ICAT series of guidance and Country support to build capacity. ICAT sought to support Sudan's efforts to establish a domestic Measuring, Reporting and Verification (MRV) system for tracking of progress with NDC implementation in the energy and transport sectors in line with the requirements of the enhanced transparency framework of the Paris Agreement.

The project aims to deliver a specific objective such Needs and Gap Assessment (MRV) of the NDC Implementation for the Energy and Transport Sectors in Sudan, strengthening Institutional Arrangements for (MRV) In the Energy Sector and development of a road map to ensure the sustainability of ICAT outcomes.

As shown in Figure 3 the gap assessment activity for energy and transport sectors is conducted through the following steps

1. Collection of data from all available sources (local and international) about the energy and transport sectors in Sudan and understand the flow of activities within the two sectors. Since the project kickoff, the local consultants started to collect data and information about the two sectors with the help from the HCENR focal point and the selected candidates from sector's related firms and authorities.
2. Analysis of existing institutional arrangement related to MRV system at both sectors: this step is discussed in a later section of this report.
3. Check and update work plan for ICAT support based on the needs and gaps assessment: the project workplan was updated several times due to technical and administrational issues.
4. Stakeholders consultation through meetings and workshop: workshop and number of meetings were held with the stakeholders as shown in Table 5.

Transparency framework

The Enhanced Transparency Framework (ETF) and MRV

The MRV system is a crucial part of the larger framework for climate action and accounting for emissions and achievement of the Nationally Determined Contribution. The MRV system is the method by which the stated ambitions of the Paris Climate pact go from hope to reality. This tool will help to keep us on track with our climate change commitments, both for reducing emissions as well as tracking climate resilience and adaptation.

Article 13 of the Paris Agreement, adopted in 2015 at the 21st Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC), established a requirement for an enhanced transparency framework for action and support. The article outlines the specific types of information required of Sudan as a non-Annex 1 Party which includes:

a) national inventory report detailing progress made in achieving nationally determined contributions (paragraph 7);
b) information related to climate change impacts and adaptation (paragraph 8); and
c) information on technology transfer and capacity building support needed and received.

According to paragraph 90 of Dec 1/CP.21, LDC Parties such as Sudan may submit the information referred to in Article 13 at their discretion.

Under the current international MRV Framework, all countries are submitting their National Communications (NCs) every 4 years (including the GHG inventory), Biennial Update Reports (BURs) every 2 years; present their NAPs and NAMAs and TNAs.

NCs are mainly to report on measures and policies undertaken to address climate change in the country. Besides information on GHG inventories, NCs are providing information on national circumstances, a general description of what steps and actions the country is taking or planning to mitigate and adapt to climate change, describing gaps and constraints and to state any needs for technical, financial or capacity building support.

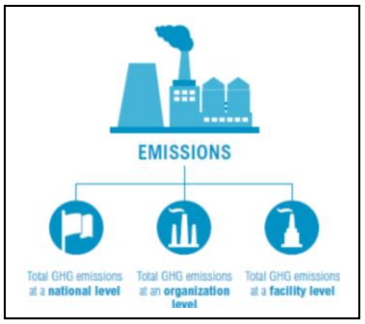
According to the enhanced transparency framework requirements, the main purpose of the NDC MRV system is to transparently demonstrate progress made towards the targets defined in the NDC (e.g. GHG emissions and GHG mitigation and adaptation impacts), tracking the progress made in the implementation of mitigation and adaptation actions, and tracking the use and results of means of implementation and support (e.g. capacity building and technical assistance, technology transfer, and finance).

> In order to meet the ETF requirements, in Sudan, we must fill the transparency gaps in data collection, quality assurance procedures, monitoring/reporting for GHG inventories, GHG mitigation, and adaptation effectiveness assessment.
>
> For GHG inventories/mitigation, these deficiencies have resulted in a lack of consistent progress in establishing credible metrics that could provide a basis for aggressive climate-related policymaking.

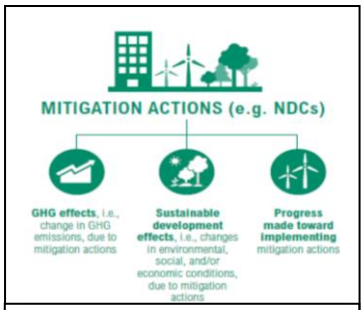
MRV of Support is traditionally an area where developed countries are required to track support provided for climate change mitigation activities but developing countries are demonstrating growing interest in the MRV of support received for reasons that include greater accountability of how allocated resources have been used as intended. One element which can benefit governments in data gathering, transparency, and verification is to create a national level centralized data and information reporting system which considers the linked MRV system. At present, there are often different data management systems used for different mitigation actions or on subsectoral and sectoral level. Creating this linkage to a master system on national level will require standards and guidelines for data inputs and aggregation, especially when including applicable sector and sub-sector information, and individual mitigation/adaptation actions. This system can start with core national level input/output data, and gradually expand into sectors, sub-sectors, and individual mitigation/adaptation actions (Source: www.transparencypartnership.net)

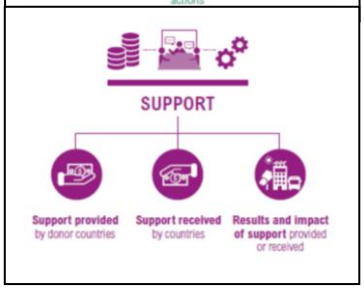
Elements of the MRV framework

From the World Bank prospective, the MRV refers to the multi-step process to measure the amount of greenhouse gas (GHG) emissions reduced by a specific mitigation activity, such as reducing emissions from fuel switching, over a period of time and report these findings to an accredited third party. The third party then verifies the report so that the results can be certified, and carbon credits can be issued. All nations' GHG emissions and reductions must be measured, reported and verified, therefore the MRV system is a structural mechanism to keep us on track with Paris Agreement climate commitments and is expected to be fully formalized in the legal framework to make emissions reporting mandatory. In general, MRV system shall include the followings:



a. GHG emissions inventory: To start, every emission reductions program must determine a "baseline" or "reference level" against which performance is measured periodically. The assumptions upon which these baselines are established and the accounting methodologies used to calculate emission reductions vary by sector and program scale.





b. Mitigation actions: Once a mitigation project or program activities are underway, data is collected and processed to calculate emission reductions achieved against the baseline during the monitoring period.

c. MRV of support: this shall include
Financial flows (from whom to whom, amount, type of financial instrument, private/public, new/additional), Type of support (financing, technology transfer/advice, capacity building), Supported activities and Impact of supported actions.

Institutional Arrangement

As the focal point for all Multilateral Environmental Agreements (MEAs), the HCENR is the leading institution coordinating Sudan's efforts to meet its MRV obligations under the UNFCCC and Paris Agreement. Initially, the HCENR undertook this responsibility under the auspices of its climate change unit which was established in 1998. Addressing Sudan's obligations under the UNFCCC is characterized by significant engagement of multidisciplinary teams of scientists, engineers, and planners representing relevant national institutions (i.e., federal ministries, universities, research centers, private sector entities, NGOs and other governmental bodies).

Based on the provisions of recent environmental legislation passed in 2020, HCENR is chaired by the Prime Minister of Sudan, and has an Inter-ministerial Committee comprised of ministers and heads of national institutions whose mandate includes environmental protection and conservation of natural resources. A new organizational structure for HCENR has been developed, approved and is currently being implemented. The new structure includes 5 General Directorates (Policies and Planning; Environmental Inspection; Sustainable Resources and Environment Protection; Climate Change, Desertification and Disaster Prevention; and Finance and Human Resources) and 15 departments/units across those Directorates.

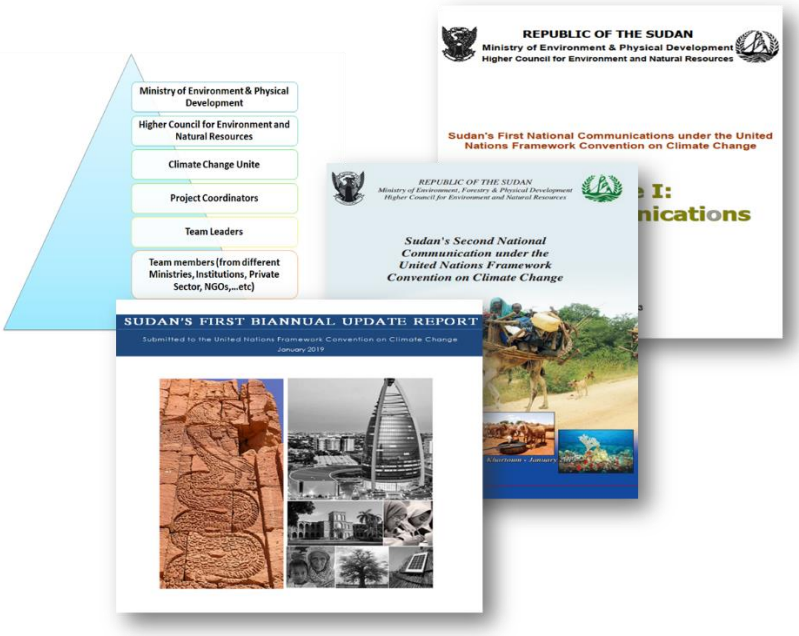
Under the 2020 legislation, the HCENR's Climate Change Unit operates as part of the General Directorate for Climate Change, Desertification and Disaster Prevention. It has five (5) major responsibilities as outlined below.

Planning, preparation, compilation and submission of the national climate change reports, such as National Communications, Biennial Update Reports, Biennial Transparency Reports, etc;
Establishment and coordination of the national climate change committee, as well as expert teams on GHG inventory development, GHG mitigation analysis, vulnerability assessment, identification of adaptation strategies, etc;
Establishment of formal working arrangements and procedures with climate related national institutions and stakeholders;
Definition and allocation of roles and responsibilities of the different institutions in meeting Sudan MRV obligations; and
Management of the GHG inventory preparation processes, including technical and institutional capacity building, data collection and archiving, quality controls, technical validation and the formal government approval process.

Benchmarking

Since the ratification of United Nations Framework Convention on Climate Change (UNFCCC) in 1993, the Kyoto Protocol in 2005 and Paris Agreement in 2017, Sudan is committed to international cooperation and the fight against the adverse effects of climate change. In 1998, Sudan established a Climate Change Unit within the Higher Council for Environment and Natural Resources (HCENR) to coordinate with different national institutions, including government, research, academia, the private sector and civil society institutions and organization in order to deal effectively with the challenge with respect to climate change actions and responsibilities. The HCENR mandate includes, among others, coordination of Sudan's efforts to join and implement the multilateral environmental agreements including climate change.

To date, Sudan has prepared its First and Second National Communications and finalized its Third National Communication and its First Biennial Update report to the UNFCCC. Sudan also prepared a National Adaptation Programme of Action (NAPA), a National Adaptation Plan (NAP), a Technology Needs Assessment (TNA) (including a Technology Action Plan, TAP) and a Nationally Appropriate Mitigation Actions (NAMA) framework. In line with its mandate as a coordinating body, the HCENR has taken the lead in coordinating Sudan's efforts to meet its obligations under the UNFCCC. The HCENR undertakes this responsibility through involving multidisciplinary teams representing its relevant member institutions and relevant national institutions, i.e., ministries, universities, private sector, NGOs and other governmental bodies.



1. First and Second National Communications

In compliance with the reporting commitments under the UNFCCC (Article 12 of the UNFCCC), Sudan has prepared and submitted its First National Communication (FNC) in 2003 and its Second National Communication (SNC) in 2013. The communications consist of an GHGs Inventory, assessment of vulnerability and adaption, mitigation measures for energy and non-energy sectors, besides other information considered relevant to achieve the UNFCCC objectives such as climate change research and systematic observations, education, training and public awareness. As per the GHG inventory for the second national communication which was based on IPCC revised 1996 guidlines, the total GHG emissions in 2000 were 77,650 GgCO2-equivalent (CO2e), which includes57,611Gg from agriculture, 9,392 Gg from LUCF, 8,539Gg from energy;2,015Gg from waste, and only 93Gg from industrial processes. Agriculture-related activities accounted for the dominant portion of GHG emissions in 2000. Approximately 74% of all CO2e emissions are associated with enteric fermentation and manure management.

2. National Adaptation Program of Action (NAPA)

Sudan's First National Communication identified agriculture, water and health as the highest priority sectors where urgent and immediate adaptation action is needed to confront increasing climatic variability and climate change. Therefore, the NAPA, which was prepared and submitted to the UNFCCC in July 2007, identified 32 urgent adaptation initiatives in these sectors to reduce the increasing vulnerabilities of the rural communities to current and future climatic risks. Some of the highest priority adaptation-focused interventions are currently being implemented to enhance food security through building adaptive management capacities of the rural population, particularly of rainfed farming and pastoral communities.

3. National Capacity Self-Assessment

The goal of the Sudan National Capacity Self-Assessment (NCSA) was to determine priority needs and establish a plan of action for developing Sudan's capacity to meet its commitments to national

and global environmental management. The NCSA was a highly participatory and consultative process that resulted in the production of several technical reports over a two-year period. These describe Sudan's capacity needs related to the "Rio Conventions" on biodiversity conservation, climate change, and desertification/land degradation in the context of the National Plan for Environmental Management (NPEM) in post-conflict Sudan. This Action Plan for Environmental Capacity Development in Sudan is the final product of the NCSA.

4. Sudan NAPA Follow-up Project:

Implementing NAPA Priority Interventions to Build Resilience in the Agriculture and Water Sectors to the Adverse Impacts of Climate Change in Sudan 2010-2014. The Project Objective was "to implement an urgent set of adaptation-focused measures that will minimize and reverse the food insecurity of small-scale farmers and pastoralists, thereby reducing vulnerability of rural communities resulting to climate change, including variability".

5. The National Adaptation Plan Process (NAP, 2014)

The NAP gave more emphasis to the most vulnerable sectors to the adverse impacts of climate change including the agriculture sector. Beside vulnerability assessment the NAP process also focused on the issues of mainstreaming of adaptation into national policies and plans. The aim was to enable broader and deeper explorations of the vulnerability of key livelihoods and development sectors to climate change in Sudan, together with developing a better understanding of potential adaptation strategies. The main outcome of the project is to develop a National Adaptation Plan (NAP) for Sudan in line with the UNFCCC Technical Guidelines for National Adaptation Plans, which describe Sudan's process for adaptation planning and implementation with clear priorities, actions, and direction for further investment and implementation modalities. A major achievement of the Sudan's NAP process was the establishment of adaptation-focused planning institutions in each of Sudan's 18 states. In each of the states, a focal point and inter-agency technical team of experts from related government, research institutions, academia and civil society organization, have been established. The capacity of these units has been strengthened during the NAP preparation through targeted training sessions; learning-by-doing programmes; and the establishment of networks to exchange knowledge and experience.

6. Sudan's Promoting Low Carbon Investment Project and Nationally Appropriate Mitigation Actions (NAMA) Framework (2015)

The development of the LCDS is recommended to be linked with a comprehensive Nationally Appropriate Mitigation Action (NAMA) framework. Various synergies can be achieved when synchronizing the design of NAMAs in different economic sectors in a NAMA framework under a LCDS umbrella, and ideally making NAMA identification the bottom-up process of elaborating the LCDS. To enable the setup of such a NAMA framework, detailed information about greenhouse gas (GHG) emission characteristics of relevant economic sectors is required. Based on that, elements of a Sudanese NAMA Framework, such as institutional set up, MRV system and NAMA identification process were established. Since mitigation actions require multi-stakeholder involvement from planning to implementation, the institutional arrangement for NAMAs needs a strong coordinating body with authority to set rules, roles and responsibilities. Stakeholders such as academic institutions, NGOs, financial institutions or other private players as well as governmental actors propose potential mitigation activities and submit their ideas to the authority level. A NAMA Project Management Unit (PMU) on domestic, governmental level represents the focal entity for NAMA institutional arrangement in Sudan. In case the idea is accepted, the NAMA

PMU informs the relevant stakeholders and identifies suitable implementation partners. Subsequently the NAMA will be fully developed and implemented - with the NAMA PMU supervising baseline establishment, identifying data gaps, and organizing the NAMA submission process, and with international support by consultants, international development agencies such as UNDP or developed country technical cooperation, if required. the MRV framework for an individual NAMA generates information that is relevant to the national context through the selection of appropriate indicators and methodologies. In this sense, some, but not all, parameters of MRV for the NAMAs could be determined top down by national governments – in accordance with the LCDS. Thus different NAMA activities are able to provide bottom-up data to the NAMA framework MRV that can than compile overall measurement results and report them to e.g. the LCDS and further to UNFCCC related platforms such as the NAMA registry or donors.

7. REDD+ Sudan

Reducing Emission from Deforestation and Forest Degradation; (REDD+) is a global mechanism to mitigate the climate change caused by forest loss or degradation, while mobilizing financial resources for socio-economic development in forest countries. The REDD+ project enabled Sudan to establish reference emissions levels / forest reference levels (ERL/FRL) and an MRV for the forestry sector

8. Sudan Nationally Determined Contribution to the Paris Agreement:

Sudan prepared and submitted its intended nationally determined contribution (INDC) to the Paris Agreement in 2015. Sudan's INDC consists of two components, mitigation contributions (M-INDC) and adaptation contributions (A-INDC). By its mitigation contributions, Sudan intends to pursue implementing low carbon development interventions in three sectors of energy, forestry and waste in line with national development priorities, objectives and circumstances. Sudan's M-INDC aims at contributing to the global mitigation efforts. These contributions are planned to ensure a deviation from the current development trajectory to a low carbon development. Currently, Sudan has neither an overall baseline emission scenario for all sources of emissions and removals in the three sectors covered in this contribution, nor sectoral baselines that can be used to define quantitative mitigation actions and assess their overall effects. As such, Sudan is planning to establish a baseline as part of its proposal for a low-carbon development strategy, of which its preparation is still pending availability of financial and technical support. Sudan is currently embarking on the implementation of its Readiness Preparation Proposal for REDD+, which will also enable Sudan to establish reference emissions levels / forest reference levels (ERL/FRL) and an MRV for the forestry sector. For the implementation of the intended contributions included in this INDC, Sudan foresees that sectoral or project level specific baselines should be established to enable a robust assessment of the effect of these mitigation contributions.

The overall aim of Sudan's A-INDC is based on the objective of the NAP, i.e. to pursue sustainable development and reduce poverty by reducing the long-term negative impacts of climate change. Having recognized the implications that climate change can have on national development the need for climate change adaptation in the context of sustainable development was identified as an area of a major concern. As such, Sudan's A-INDC is prepared with the view and in the context of achieving economic and sustainable development and poverty eradication, and in the context of Sudan's 25-year development strategy, the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs).

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Sudan Context to MRV

Sudan's MRV system

Sudan became a Party to the UNFCCC when it ratified the convention in 1993. The country signed the Paris Agreement on April 22, 2016 and ratified the Agreement on August 2, 2017. Since becoming a Party to the Convention, Sudan has completed and continued working on numerous Enabling Activities coordinated by the Climate Change Unit in the Higher Council for Environment and Natural Resources (HCENR). There is substantial evidence that a lack of transparency exists in data collection, quality assurance procedures, monitoring/reporting for GHG inventories, GHG mitigation, and adaptation effectiveness assessment.[1] For GHG inventories/mitigation, these deficiencies have resulted in a lack of consistent progress in establishing credible metrics that could provide a basis for aggressive climate-related policymaking.

MRV protocols and systems are introduced to forestry sector in Sudan. In 2012, the Forest National Corporation (FNC) requested to join the Forest Carbon Partnership Facility. In the years since, Sudan has sought to continually strengthen its partnership with other countries in reducing its own emissions from deforestation and forest degradation, forest carbon stock conservation, the sustainable management of forests, and the enhancement of forest carbon stocks (i.e., REDD+).

For the forestry sector, the current status of MRV is well-advanced with institutional mapping, gap analysis and capacity needs assessment already carried to establish a functioning REDD+ MRV system. To date, the process has identified key objectives and policy requirements; roles/responsibilities of key institutions, gaps; overlaps and training/procurement needs; and proposed coordination mechanisms among responsible institutions. For all other sectors, the current status of MRV is merely nascent. On the other hand, the MRV development process for non-forestry sectors has essentially been ad-hoc, mostly reliant on external consultants associated with NAMA scoping activities.

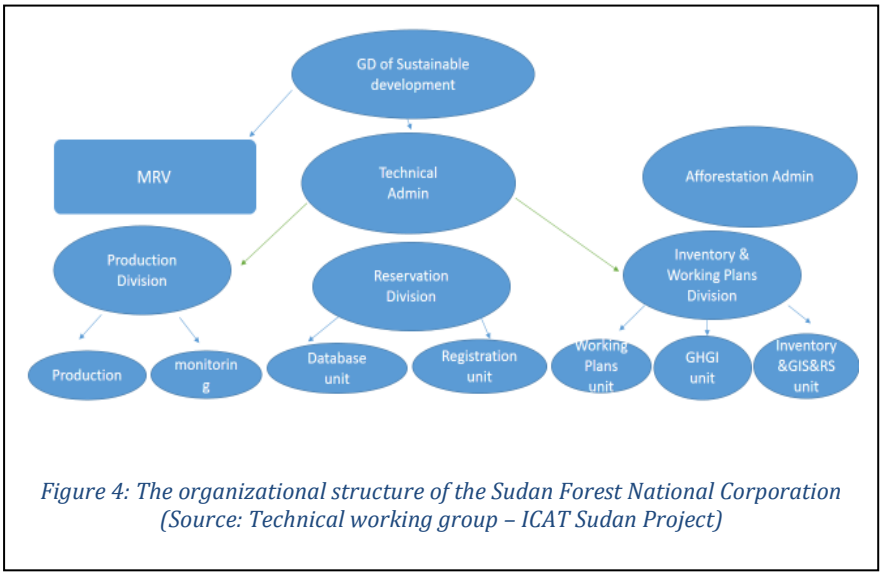


Figure 4: The organizational structure of the Sudan Forest National Corporation (Source: Technical working group – ICAT Sudan Project)

Another initiative for building an MRV system was in collaboration with the International Renewable Energy Agency (IRENA) for the electricity part of the Sudanese energy sector.

[1] Part II, Section 8 of the Project Identification Form for Sudan's Capacity Building Initiative for Transparency Project

Sudan is aiming to adopt digital MRV systems although they are still complex and expensive to implement, but long-term, they will help monitoring the support/finance received, reduce the cost of generating carbon credits while increasing transparency and meeting the ETF requirements. They will enable more efficient verification and the move toward real-time generation of carbon credits that will engage the private sector to invest and the energy and transport sectors.

Sudan needs to establish permanent transparency arrangements to communicate report and track progress in the implementation of its NDCs. Such arrangements can further be developed benefiting from knowledge exchange and sharing of lessons learnt at national as well as international levels through being actively engaged in the CBIT global coordination platform. Long-term transparency strategy on actions such as GHGs inventory, mitigation and adaptation is required. In addition, the integration of MRV and M&E systems into the related national institutions is highly required to track the implementation of Sudan's NDCs

Why MRV framework is needed

This lack of a functioning MRV system is particularly relevant to sustainable practices for Sudan's high-emitting agriculture sector as well to policies to promote renewable energy use in electricity production and adopt more energy efficient practices in transportation and other sectors. For adaptation, these deficiencies have led to entrenched imbalanced power relations among some groups due to lack of or unequal access to climate information, which has in turn led to widening disparities in access to social and economic opportunities. This is especially the case in rural areas where men and women's economic empowerment, participation, poverty reduction, and decision-making has lagged relative to urban communities.

The implementation of this ICAT project will coordinate with other GEF-funded and other projects funded by other organizations. This includes the ongoing GEF-funded project of Sudan's Capacity Building Initiative for Transparency (CBIT) . Overall coordination between the ICAT project and relevant projects will be augmented by maintaining regular communication with the CBIT project which is expected to support the development of a National Communications and Biannual Update Reports as well as the implementation of Sudan's NDCs.

An overview of previous and ongoing projects that will inform the implementation of this project are provided in the table below.

Table 1: Previous and ongoing projects that will positively impact the implementation of the ICAT Sudan project

Programme/ Project	Description	Period	Partners
Sudan's Capacity Building Initiative for Transparency (CBIT)	The overall goal of the project is to assist Sudan in mainstreaming climate change considerations into national and sub-national (i.e, state-level) development policies by strengthening and sustaining efforts to monitor, report, and verify mitigation and adaptation activities that address climate change.The immediate objective of the project is to meet enhanced transparency requirements as defined in Article 13 of the Paris Agreement and its modalities, procedures and guidelines (MPGs)by enhancing Sudanese	2021-2025	GEF/UNDP/HCENR

Programme/ Project	Description	Period	Partners
	institutional and technical capacity for measuring and reporting greenhouse gas (GHG) gas emissions, GHG reductions from mitigation activities, as well as the resilience-building effects of adaptation activities. The main components of the project are: 1) Strengthening of national institutions for transparency related activities; 2) Provision of tools, training and assistance for meeting the transparency provisions established in the Paris Agreement; 3) Improvement of transparency over time, and 4) Knowledge management and monitoring &evaluation. Key outputs include new MRV-related legal and procedural arrangements to enhance transparency; strengthened inter-institutional coordinating arrangements for transparency; strengthened institutional capacity for MRV, GHG inventory development, GHG mitigation analysis and adaptation assessment; and synthesis of lessons learned, and best practices shared via the newly developed online transparency platform. Taken together, these outputs will lead to an end-of-project situation that will reflect more accurate information and analysis of the policies, measures, and instruments that Sudan selects to mitigate and adapt to climate change.		
"Strengthening adaptation planning processes and capacity for implementation of adaptation actions in agricultural and water sectors in the Sudan"	The objective of this Readiness project is to strengthen climate change adaptation planning in the Sudan based on updated and reliable data. Data and information made available under this proposal will be absorbed and utilized through the 18 reactivated State-Level Technical Committees, which will operate in an inclusive participatory manner and inform the national-level adaptation planning in Sudan. The project's objectives overlap with several outputs of the CBIT project, namely the data management activities of Output 1.1.4 and the strategic planning aspects of Output 1.1.2. Efforts will be made to constructively exploit potential synergies while avoiding any duplicative efforts. Coordination between this project and the CBIT will be carried through consultative meetings between the respective project managers	2020-2022	GCF/FAO
"Leapfrogging Sudan's markets to more efficient lighting and air conditioners"	This project aims to transform Sudanese markets for energy efficient lighting and air-conditioners, thereby providing important greenhouse gas mitigation co-benefits and decreased energy poverty. Outputs include the development of standards, enforcement of regulations supporting energy efficient products, and building the institutional framework capable of maintaining steady market development, while mainstreaming gender into project activities.The project's mitigation objectives overlap with the MRV and M&E activities under Outcome 2.1. Efforts will be	2018-2022	GEF/UNDP/MWRIE

Programme/ Project	Description	Period	Partners
	made to constructively exploit potential synergies regarding tools and methods while avoiding any duplicative efforts. Coordination between this project and the CBIT will be carried through consultative meetings between the respective project managers		
"Promoting the Use of Electric Water Pumps for Irrigation"	This project promotes the use of solar PV-powered electric water pumps for irrigation in Sudan and it involved a large variety of stakeholders in its design phase. The project's major component calls for the installation of 28 pumps as part of a pilot phase, the establishment of a National PV Fund and coordinated loan facility and a minimum of 1,468 3off-grid PV pumps ranging in size from 3.12-29.6 kWp installed in farms in the Northern State of Sudan with support from the National PV Fund. The project's mitigation objectives overlap with the MRV and M&E activities.	2016-2022	GEF/UNDP/MWRIE
"Building resilience in the face of climate change within traditional rain fed agricultural and pastoral systems in Sudan"	This project seeks to support climate change adaptation efforts among subsistence agro-pastoralist and nomadic pastoralist communities in dryland zones across nine states in Sudan. The overall goal of the project to promote a paradigm shift in dryland pastoral and farming systems through an integrated approach to enhance water security in the face of changing climate conditions, climate resilient agriculture, climate resilient rangeland management, and gender mainstreaming. The project's approach to monitoring the impacts of adaptation interventions overlap with the review and application of M&E tools. Efforts will be made to constructively exploit potential synergies regarding tools and methods while avoiding any duplicative efforts. Coordination between this project and the CBIT will be carried through consultative meetings between the respective project managers.	2020-2025	GCF/UNDP/HCENR

Gaps in Sudan's MRV system

Building robust MRV systems in the NDC's related sectors are needed to meet the requirements of the enhanced transparency framework of the Paris Agreement.

Throughout the gap assessment, the following challenges that facing Sudan are identified:

1. Poor alignment between current institutional arrangements within national relevant institutions regarding monitoring/evaluation, data collection and reporting and the transparency obligations under Article 13;
2. Little to no awareness and knowledge by stakeholders and policy/decision makers regarding new transparency obligations;
3. Ineffective coordination and reporting arrangements between different institutions and stakeholders in term of communications, flow of information, and the delegation of responsibility;
4. Lack of proper data collection, data archiving, and Quality Assurance and Quality Control (QA/QC) systems across different institutions and stakeholders regarding GHG emissions.
5. Lack of a legal and procedural basis for an operational MRV system on GHG emission reductions compatible with Sudan's obligations on transparency under Article 13.
6. Inadequate institutional capacity for GHG inventory development in emitting sectors, specially ENERGY and TRANSPORT sectors; as well as for GHG mitigation analysis of priority policies and measures;
7. Inadequate institutional capacity for climate change vulnerability assessment and measuring the effectiveness of adaptation actions;
8. Need for transferring of tools and methods to help national teams collect and verify GHG emission activity data as well as to calculate and predict baseline emission trends and the impact of GHG mitigation measures; and
9. Need for financing technical support to develop and maintain effective institutional arrangements, M&E, and MRV systems for meeting Sudan's transparency obligations under Article 13.

Energy sector framework

Overview of Energy Sector in Sudan

The energy sector has an essential role in Sudan's economy. It supports activities different public services such as health care, education, public transportation, and household electrification, as well as meeting the fuel and electricity needs of the agricultural and industrial sectors. The main sources of primary energy in Sudan are biomass, oil, and hydroelectricity. Coal, natural gas, and uranium are non-existent in Sudan. Currently, Sudan's primary energy mix consists of biomass, hydroelectric power, oil products, and a small amount of solar photovoltaic power.

Sudan is one of the least developed countries, where energy use is increasing rapidly. The energy sector has an essential role in the sustainable development for Sudan. It helps in providing power to different public services such as health care, education, public transportation, and household electrification and other sectors as for agriculture, different industrial activities, mining… etc.

The main sources of primary energy in Sudan are biomass, oil and hydroelectricity. Coal, natural gas, and uranium are nonexistent in Sudan. Sudan primary energy consists of fossil fuel (about 40%), biomass (56%), hydroelectric (5%) and negligibly small portion of solar energy mainly

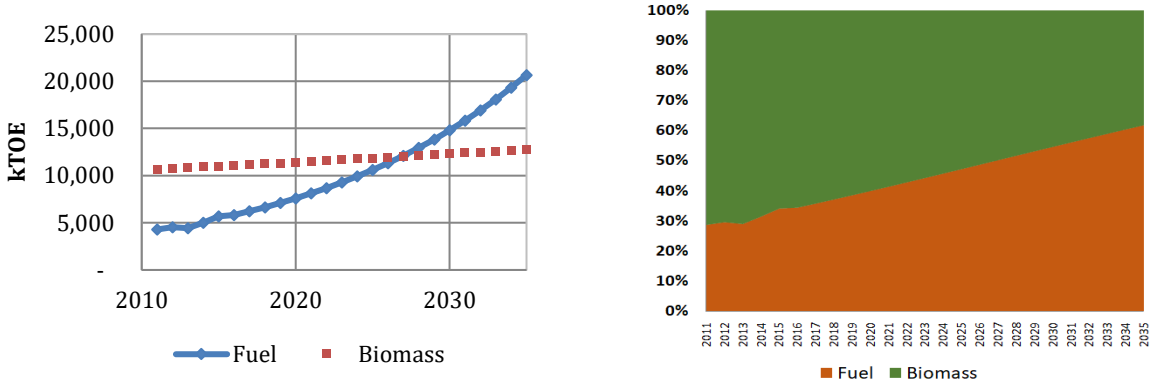


Figure 5: Shares of biomass and fossil fuels in Sudan's primary energy consumptions

photovoltaic.

Sudan has two operational oil refineries (Khartoum Refinery Corporation (KRC) and EL-Obied Refinery Corporation (ORC). The capacity of KRC 100,000 BPD and ORC is 15,000 BPD. The main products include fuel oil, gasoil, kerosene, gasoline, LPG, aviation fuel and Petroleum coke.

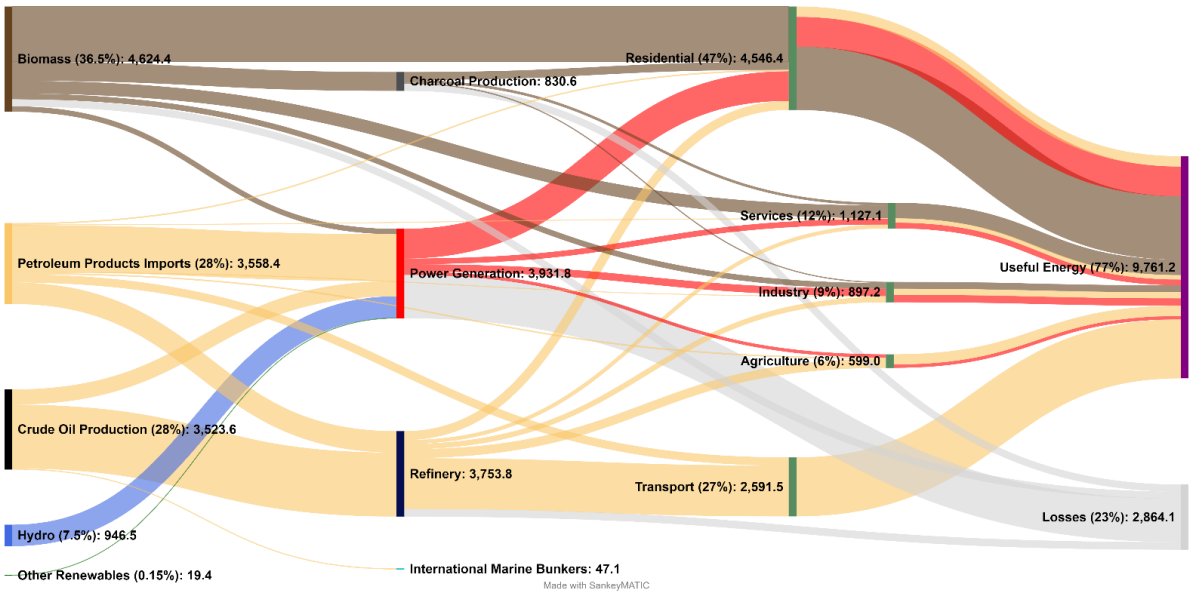
Table 2: Refineries in Sudan

#	Refinery Name	Location and Establishment	Specification	Capacity	Updates

1	Khartoum -Aljaili	Northen Khartoum, May 2000	Designed for low sulphur Nile Blend. Expansion 2006, handled heavier crudes	100,000 bbl/day	Upgraded for 50,000 bbl/d on 2006
2	El-Obaid	El-Obaid City, 1996	A small refinery which produces only three products: naphtha, diesel and fuel oil	15,000 bbl/day	
3	PortSudn	Portsudan, 1964	Under rehabilitation	21,700 bbl/day	Not working since early 1990's. Plans for upgrading
4	Abu Gabra	Abu Gabra	Small topping plant		Not working

Sudan is endowed with a significant amount of renewable energy resources such as solar, hydro, wind, geothermal, and biomass. At present, except for large hydro and biomass, renewable resources remain largely untapped.

The main sources of primary energy in Sudan are crude oil, hydroelectric and biomass. The main transformation and conversion process are electric power generation, oil refinery and wood to charcoal conversion. The following diagram shows the energy balance of Sudan in 2020.



1. Nodes				
1.1. Primary Energy Supply	*1.2. Energy Transformation*	*1.3. Final Energy Consumption*	*1.4. Useful Energy*	*1.5. Losses*
Biomass	Charcoal Production	Demand Sectors		
Petroleum Products Imports	Power Generation	1.4. Useful Energy		
Crude Oil Production	Refinery	1.5. Losses		
Hydro				
Other Renewables				

2. Flows
Crude oil and petroleum products
Biomass
Hydro
Other renewables
Electricity

Figure 6: Sudan energy balance for year 2020 (After Quosay, Amr and Yassir, 2022)

As shown in the above figure, the refined products of the Sudanese crude oil in addition to the imported ones are feeding many sectors, which include:

1- Transport,
2- Commercial/Services,
3- Household,
4- Industry and
5- Agriculture.

The shares of these sectors out of the total petroleum products consumption in Sudan in 2017 (base year for the first BUR) are as shown in Figure 7.

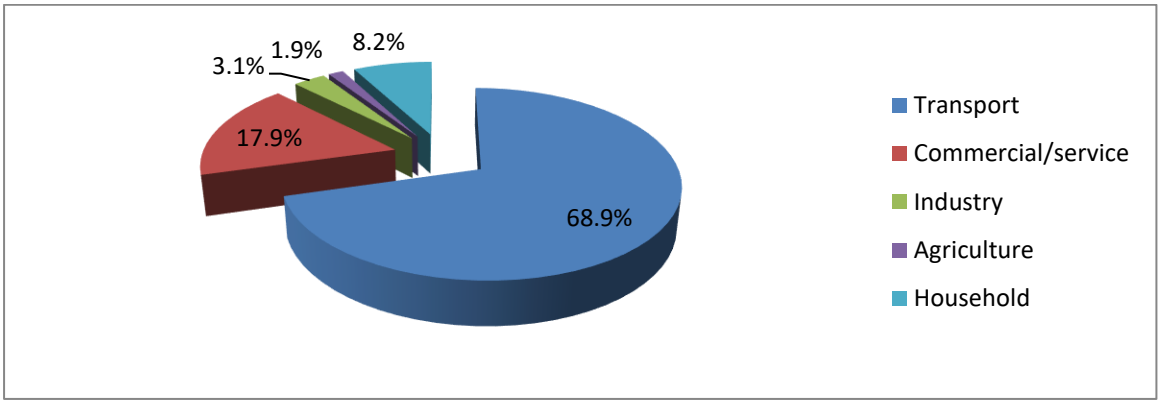


Figure 7: Sudan's petroleum product consumption by sector, 2017

While the share of each sector in the total final energy consumption (TFEC) is shown in the following table:

Table 3: TFEC by sector

While the share of each sector in the final energy consumption *Unit: kTOE*	**Residential**	**Services**	**Industry**	**Agriculture**	**Transport**	**Total**
2012 – 2017 Average	5,470	1,768	1,336	118	3,282	11,974
	46%	**15%**	**11%**	**1%**	**27%**	

Electricity:

Like many sub-Saharan countries Sudan is suffering from shortage of electricity service and the population electrification rate is about 40%. During the past couple of years, the National Grid is suffering from programmed shedding particularly in summer. The isolated loads in the western region of Darfour are only partially met due to fuel transportation difficulties. The Ministry is

planning to extend the National Grid at least to the capitals of Darfour and Kurdufan states followed by an ambitious plan to cover rural areas too (Source: Ministry of Energy and Petroleum)

At the end of 2018 the total installed capacity in Sudan (National Grid and of Off-Grid) is approximately 3579 MW, of which some 53.3% is hydroelectric and the remaining 46.7% is conventional thermal, as well as 75 MW IPP in Darfour region and 150MW rental in the Red Sea, where the total capacity available to meet the existing demand on the National Grid was about 2799MW.

There are several hydroelectric dams on the Blue and White Niles, including the Sennar and Roseires dams on the Blue Nile, and the Jebel Aulia Dam on the White Nile and Meroe Dam at the River Nile. There is also Lake Nubia on the Sudanese-Egyptian border. The total electric power potential from hydro dams is estimated at about 4,860 MW, with about 2,200 MW technically feasible through 2030 (Lahmeyer International, 2012; UNEP, 2017). Of this potential, Sudan's installed hydro capacity was 1,928 MW as of 2017 and consisted of six large reservoir dams (IRENA, 2019).

Renewable Energies:

The solar energy resource potential of Sudan is very high throughout the year and across the entire country (El Zein, 2017; Omer, 2015). Sudan is one of the 148 Sunbelt countries located close to the equator where the metrics used to quantify solar energy potential are very high for electricity generation via by photovoltaic (PV) or concentrating solar power (CSP) systems. Sudan's country-wide solar atlas for Global Horizontal Irradiance (i.e., the total amount of shortwave radiation received from above by a surface horizontal to the ground) shows values between 2,000 and 2,500 kWh/m2 indicating very good solar potential for the use of PV technology.

For wind, the highest average wind speeds are generally found in the areas close to the Red Sea as well as on ridgelines/plains in the central and northern parts of the country. At a height of 50 meters, there is a substantial wind resource in Sudan that could be tapped to generate electricity. At this height, the average wind power density ranges from about 250 to 664 watts (W) per m^2. The top 10% of land in the northern and north-eastern regions of the country have an average wind power density of 500 W/m^2 which is at the lower bound of Wind Power Class 5, signifying good potential .

Biomass (wood, agricultural residues, charcoal) availability is largely associated with use in rural communities across Sudan who rely on this resource for cooking (Omer, 2005; Omer, 2018). In rural areas of Sudan, most households do not have access to clean cooking fuels or modern technology and are reliant on inefficient cookstoves to burn biomass. In the case of firewood and charcoal, this has led to environmental degradation as supplies of dead firewood are used up and communities rely on cutting down live trees in an unsustainable manner.

There is about 400 MW of potential geothermal energy in Sudan (REEEP, 2012). Geothermal potential is located in different regions around the country. For instance, in the Darfur region the JabelMarra volcano and the Tagbo and Beidob hills have registered good measurements, while further north towardsthe Red Sea there is geothermal activity near the Bayud volcano. Although there is currently no electricity from geothermal sources, the government is looking to neighboring Kenya which has much experience in exploiting geothermal energy for guidance in this area (REEEP, 2012).

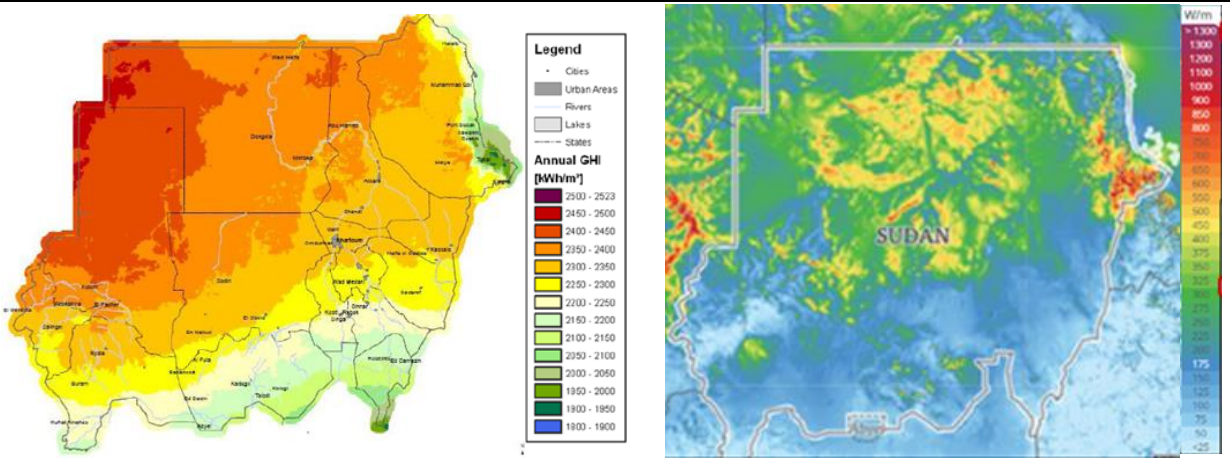


Figure 8: Left: Solar Global Horizontal Irradiance in Sudan (Lahmeyer International, 2012); Right: Wind resource potential of Sudan at 50 meters (DTU, 2019)

GHG emissions from the Energy Sector

For estimating the GHG emissions from the energy sector, the emissions were calculated from:

1- Fuel combustion activities (1.A)
2- Fugitive emissions (1.B)

For the period between 2011 to 2015 (as per the time series of the 3NC), the estimated GHG emissions are illustrated in Figure 9.

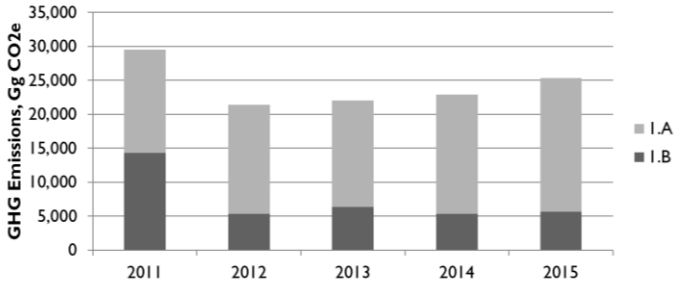


Figure 9: Trends in Sudan's energy sector emissions, 2011–2015 shown for fuel combustion (1.A) and fugitive emissions (1.B)

The category (1.A) for fuel combustion include the following subsectors:

1.A.1 Energy industries

- 1.A.1.a Main activity electricity and heat production
- 1.A.1.b Petroleum activity
- 1.A.1.c Manufacture of solid fuels and other energy industries

1.A.2 Manufacturing industries and construction

1.A.3 Transport sector

- 1.A.3.a Civil aviation
- 1.A.3.b Road transportation
- 1.A.3.c Railways
- 1.A.3.d Water-borne navigation

1.A.4 Other sectors

1.A.4.a Commercial/ institutional

1.A.4.b Residential

1.A.4.c Agriculture / forestry/ fishing/ fish farms

In which the IRENA initiative for establishment of MRV system covered the subsectors: 1.A.1.a and 1.A.2

According to the recent National GHG Inventory report (NIR), the calculated GHG emissions from 1.A activities are shown in the following figure

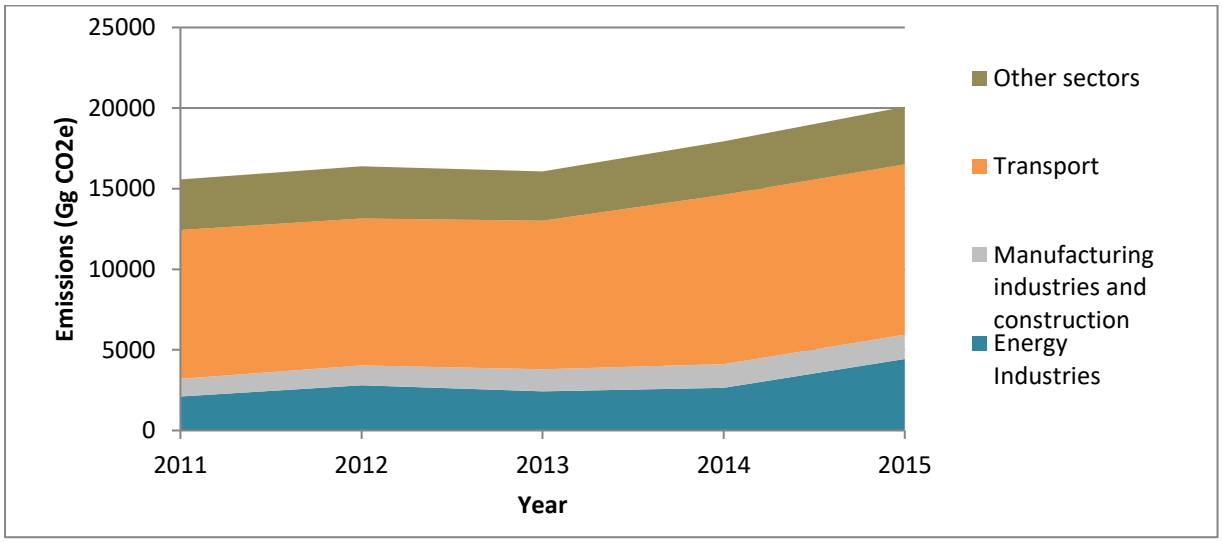
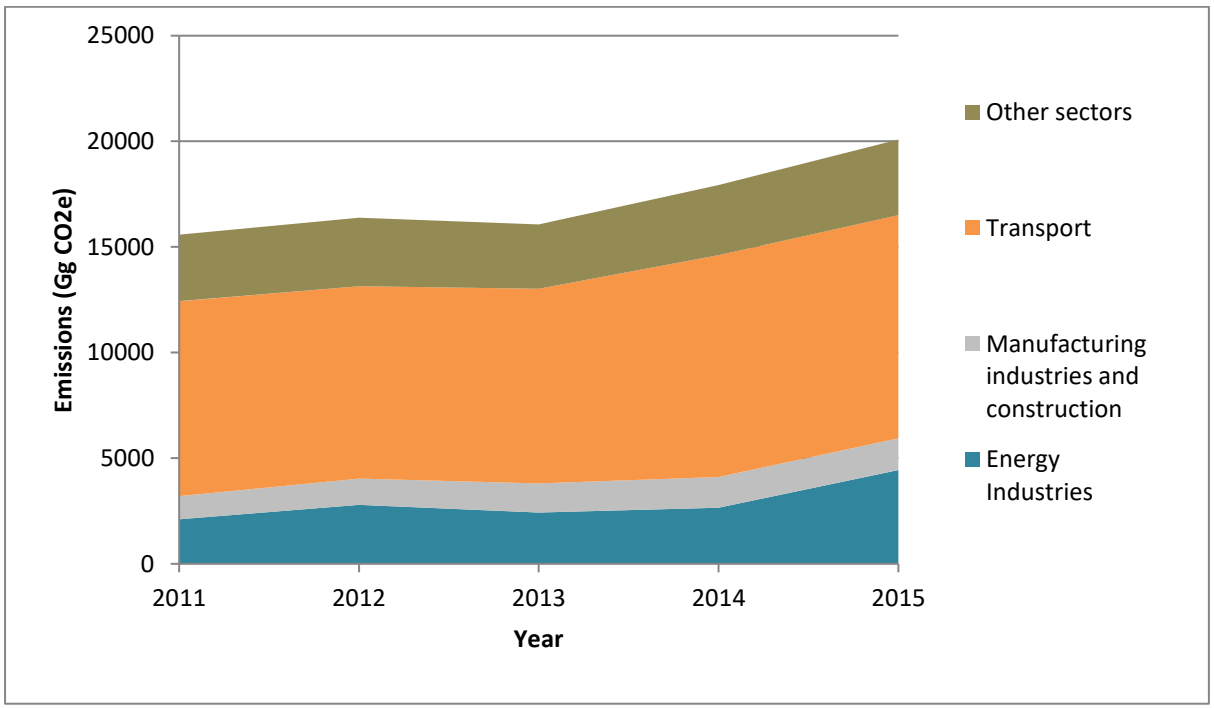


Figure 10: GHG emissions for fuel combustion (2011 to 2015)

In general, the energy sector is the second largest contributor to Sudan's total emissions. Relative to Sudan's overall anthropogenic GHG emissions, the energy sector represented shares of 7.6% in 2017 to 10.7% in 2017. Table 2-2 summarizes GHG emissions associated with energy sector for the years 2012 and 2017.



Energy sector emissions increased from 21,116 Gg CO_2e in 2012 to 25,886 Gg CO_2e, equivalent to

an average annual rate of 4.2%. The highest GHG-emitting category is fuel combustion which accounted for between 75% and 79% of energy sector emissions. These emissions grew at an average annual rate of 5.3% and accounted for about 97% of the increase of 4,769 Gg CO_2e between 2012 and 2017. Similarly, fugitive emissions from the energy sector increased during this period at a much lower rate of about 0.5% per year.

Situational analysis on Sudan's MRV systems- Energy Sector

General situational analysis

While Sudan has advanced relatively in capacity for GHG inventory development, mitigation analysis, vulnerability assessment, adaptation strategy formulation, and other information relating to climate change, there remain important technical, institutional, and financial barriers and limitations for achieving the transparency obligations under the Paris Agreement. A Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis has identified the following areas of need for meeting the transparency requirements under the Paris Agreement.

- Commitment. To improve policies and legal arrangements for planning and fulfilling Sudan's obligations towards the Paris Agreement, the proposed institutional arrangements need to have national long-term commitments and procedural arrangements on transparency, including adopting proper policies and legal arrangements to support the implementation of the country transparency obligations under the Paris Agreement in a regular and improved manner, without being affected by future institutional changes.
- Capacity. The climate change unit of the HCENR needs to be strengthened to enhance its role in coordinating transparency under climate change, including measurement, reporting and verification (MRV), monitoring and evaluation (M&E) for climate change actions and support and tracking of NDCs, as well as the current requirements, including national GHG inventories, communication reports, and biennial update reports and adaptation actions.
- Coordination. A national inter-institutional mechanism is needed for better coordination between national institutions in which policy/decision-makers and technical experts from relevant institutions. Key institutions include representatives from government institutions, research, academia, the private sector, and civil society, coordinated and supported by the HCENR.
- Knowledge. Gender-relevant knowledge-generating and sharing mechanisms need to be developed that are suitable for relevant stakeholders at different sectors (both public and private) and levels (including policy and decision-makers, technical and administrative personnel, new graduates, and students). This should also include accessing media and to support public awareness through designing and publishing of press materials and perform public awareness sessions.

Stakeholders Consultations

The relevant stakeholders in the transport and energy sector were identified in the public and private sectors, representing the main activity producers and relevant actors/stakeholders in the public sector. Consultations were conducted with the objective of ensuring that the ICAT project has broad stakeholders support and that beneficiary sectors have endorsed the project objectives and planned outcomes. Table 4 listing the stakeholders' entities targeted by the ICAT project – both energy and transportation sectors. Two technical working groups were formed one for the energy sector and the other for transportation sector, 15 representatives each.

Table 4: Stakeholders Targeted by ICAT Project for both Energy and Transport sectors

SN	Stakeholders Entities
1	Ministry of Interior
2	Ministry of Communications and Digital Transformation
3	Ministry of Finance and National Economy
4	Ministry of Energy and Petroleum
5	Ministry of Agriculture and Forestry
6	Ministry of Transport
7	Ministry of Urban Development, Roads and Bridges
8	Central Bureau of Statistics
9	National Research Centre
10	Energy Research Centre
11	Private sector and industrial facilities (Food Industry, Cement factories, Sugar companies, Energy, Oil & Gas industry)

Conducted stakeholders' consultation provided a platform to engage with different actors in order to confirm proper understanding of the project objectives and to ensure the fast and accurate data collection process.

The information gathered during consultations was used to support the gap identification and analysis, selection process for activities, training needs, and the general framework for the unified MRV system.

Interviews and meetings:

Stakeholders were briefed through a presentation by the project's targets and procedure, they're were informed by their roles, responsibilities and the rationale of each task.

Also, the challenges and the obstacles were highlighted and how to manage, inquiries were answered, generally the meetings cover the projects need, project objectives, description, outputs and outcomes Additionally, discussions took place on how a fixed data flow under fixed schedules could be sustained.

Legal framework and institutional arrangements: This cover the presence and clarity of a legal framework for the collection of energy and transport statistics, in terms of mandate and budget adequacy. For institutional arrangements, it covers data flows, data sharing processes between institutions, consultation processes, and monitoring and evaluation of transport and energy statistics.

Objectives and adequacy for project monitoring: For major actors in the energy sector, this

aspect addresses the presence and clarity of objectives for producing transport and energy statistics. Additionally, it also addresses their adequacy for policy making and project monitoring.

Methodologies and processes: This addressee the presence and viability of data collection and processing methodologies, in terms of standardised templates, questionnaires and sampling methods, estimation, data review, and validation. It also examines the manuals followed for all terms, in addition to documentation of all processes. This in turn reflects transparency, accuracy, completeness, consistency and comparability.

Data collection: For main activity producers, data was collected directly from the assigned focal points of this project (*i.e.*, the technical committee members) This activity involved outlining the required datasets to assigned representatives and then following up with them in terms of completing the missing data. Collected data sets were complemented by previous studies and reports carried out by the relevant institutions.

The following diagram shows the proposed structure for the transparency unit in HCENR, in which direct and indirect stakeholders of the energy related activities which include the sub sectors of: transport, oil and gas, power and services and commercial are identified.

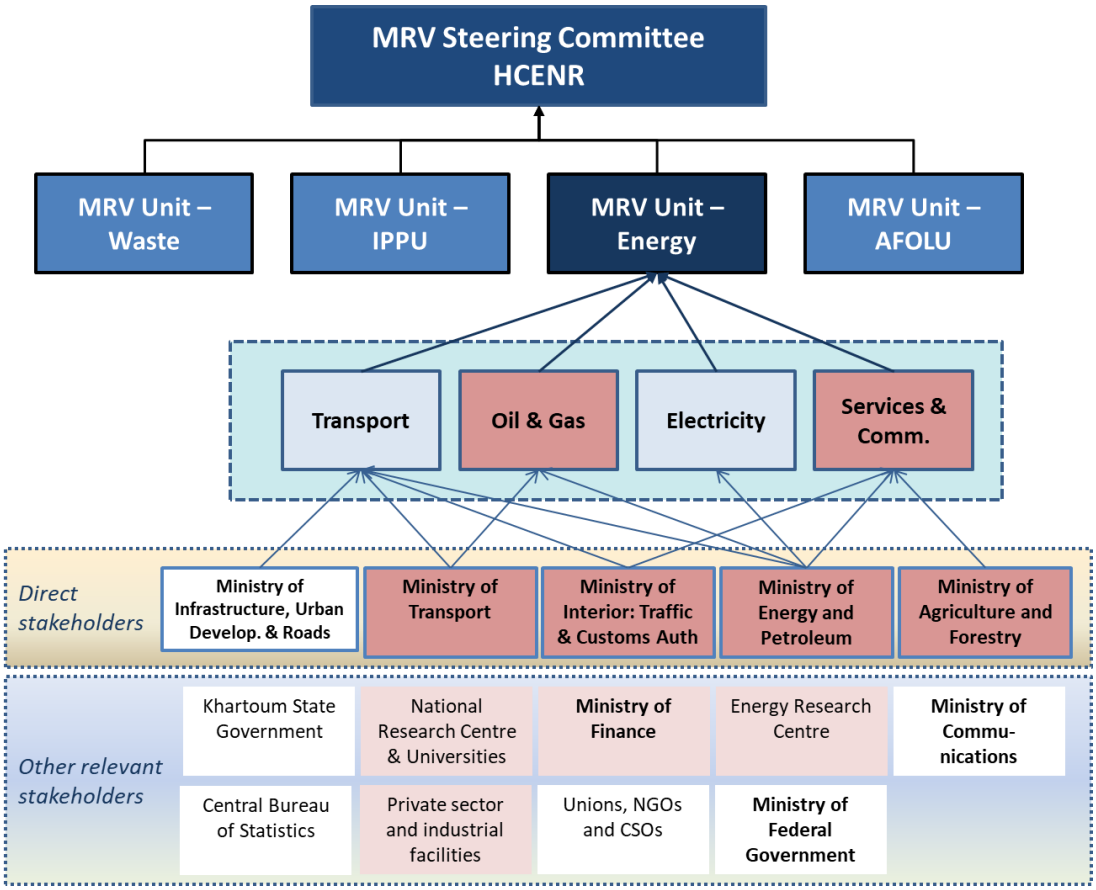


Figure 11: identified stakeholders' institutions related to the energy sector

Identified gaps by stakeholders

Ministry of Energy and Oil

5.1.1.A Electricity sector (SEHC)

Fuel consumption and electricity generation reports for both grid-connected and off-grid thermal power plants are produced monthly by the Information Unit in the Sudanese Thermal Power Generating Company (STPG). The Health and Safety Division produces monthly reports on emissions generated from power plants.

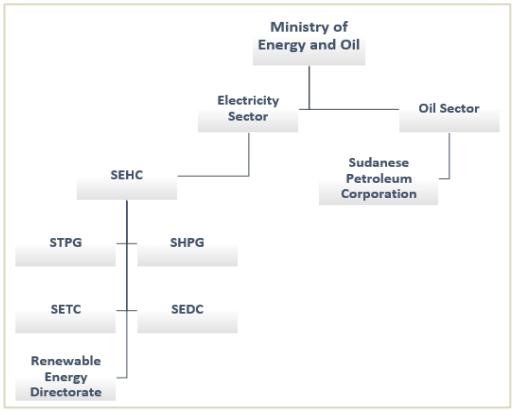


Figure 12 :Relevant departments under the Ministry of Energy and Oil

The SETC collects real-time data on electricity generation, imported electricity and fuel consumption through a Supervisory Control and Data Acquisition (SCADA) system. Daily reports are produced in spreadsheets (Excel) and archived in the National Load Dispatch Centre (NLDC) of SETC. The Sudanese Electricity Distribution Company (SEDC) produces monthly reports on electricity distribution, which are archived along with the data in the company's data centre. Hydropower dams are operated by the Sudanese Hydropower Generation Company (SHGC). Data for hydro power exist in both the SHGC and the Load Dispatch Centre in SETC.

SEHC data and reports are treated as confidential, and permits are required to obtain them.

5.1.1.a.1 Renewable Energy Directorate, SEHC

Sudan has been attracting renewable energy projects through SEHC represented by Renewable Energy Directorate. The Renewable Energy Directorate and the National Energy Research Centre are the main entitles responsible for conducting renewable energy studies, resource assessment, producing manuals, plans and conducting research in for solar, wind and hydropower. The Ministry of Mining's Geological Directorate is responsible for research related to geothermal energy.

5.1.1.B Oil sector (Sudanese Petroleum Corporation)

The Sudanese Petroleum Corporation (SPC) collects data on oil production, imports, exports, consumption, international marine bunkers, international aviation bunkers and stock changes as estimation reports on a monthly basis. Data focus on energy use. This is done through its various directorates, especially downstream: the General Directorate, Supplies and Marketing of Petroleum General Directorate and BAPCO and PETCO crude transportation companies. Data are provided and managed in files and papers. Oil data are considered confidential and official permission is required to obtain the data.

Data gaps identified in the Ministry of Energy and Oil and its relevant divisions/departments

Institutional arrangements:

- There is no lead institute to collect energy statistics.
- Structural changes of the different directorates lead to instability of the processes and results obtained.
- A lack of co-ordination between entities within the ministry leads to duplicated work and inefficient utilisation of funds.

Methodological and technical challenges:

- Different methodologies are used in calculations and estimations of energy balance.
- The application of international standards and methodologies is lacking.
- Tools required for energy data collection and management are insufficient.

Human resources:
- Insufficient numbers of staff are working on energy statistics.
- Staff lack understanding about energy processes and the information required to produce quality energy data.
- An absence of funding obstracts the establishment of effective data collecting, handling and disseminating systems.
- Linkages between databases from producers and users of energy data are absent.
- The production and publication of energy reports are delayed.
- Financial support is insufficient.

Forests National Corporation, Ministry of Agriculture

The Ministry of Agriculture, led by its entity Forests National Corporation (FNC), plays a significant role in integrated land use systems in Sudan with regard to socio-economic development and environmental protection functions. Also, it is responsible for tracking bioenergy fuel resource (wood fuel, charcoal and agriculture) residues in Sudan. The FNC has conducted several studies since the 1980s that could be used as a baseline for policy making and planning for bioenergy fuel resources. These include the following:

- The Forest Resources Conservation project by the FAO
- The Consumption of Forests Products study (1994)
- The National Comprehensive Strategy (1992-2002 & 2003-2027)
- The Natural Resources Strategy (2003-2027)
- Sudan's Forest Products Strategy (2003-2027)
- The National Action Plan to Combat Desertification (2003)
- Sudan's Intended Nationally Determined Contribution (2015)
- The National Biodiversity Strategy and Action Plan (2001, 2017)
- The National Adaptation Plan (2016)
- Sudan's first submission to the UNFCCC (January 2020).

Data gaps identified in the Ministry of Agriculture's FNC

- The legal framework with respect to the collection of energy statistics is unclear.
- Different methodologies used in calculations and estimations of energy statistics in term of biomass all through the supply chain.
- There is an absence of linkages between databases from producers and users.
- International tools required for energy data collection and management are lacking.
- Information on the methodology related to measurement units and conversion factors used in energy statistics and national reports need improvement.
- The number of trained staff is inadequate across the supply chain of biomass.
- A consultation process to facilitate data collection and review procedures is required.
- Financial support is insufficient.

Central Bureau of Statistics

The Central Bureau of Statistics (CBS) of Sudan collects data on hydro and thermal electricity generation, imported electricity from Ethiopia, electricity sales, and electricity consumption by state and sector on an annual basis. Data are collected and managed in electronic files. Additionally, the CBS conducts special surveys in collaboration with international organisations such as Multiple Indicator Cluster Survey (MICS) and other household surveys. These surveys in some cases include sections related to the use of biomass use in households. A MICS survey is planned to be conducted in 2022 in collaboration with UNICEF, which will include questions related to the use of bioenergy in households.

National Energy Research Centre (NERC)

Article (7) of the NERC draft law defines its terms of reference. The most important stated term is laying down policies and developing plans and programmes in the field of renewable energy, which will contribute to the national energy balance. In addition, the preparation of energy source inventories is within the centre's terms of reference, according to Article (7). Encouraging investments in energy, developing research and energy technologies, conducting technology transfer, and producing economic models are also included in the centre's objectives. The centre is moreover concerned with the provision of support for research, training of researchers and capacity building in the field of energy. NERC's most recent major project, Capacity Building and Assessment of Options for Increasing Access to Energy in Sudan, was executed in collaboration with the African Development Bank. The project involved a survey of the household energy situation in Sudan, with a report published in 2016.

NERC and energy statistics
According to the meeting with NERC, there is no legal framework or any institutional arrangements in place for energy statistics. Also, energy statistics are not accounted for separately in the centre's annual budget. They are only present within projects. The centre's Studies Unit has personnel experienced with qualitative and quantitative data collection for energy statistics, but they are insufficient in terms of number. The centre adapts questionnaires and survey forms to each project, meaning there are no standardised templates and questionnaires for energy statistics, nor do they follow any available manuals. Also, there are no particular processes followed for data validation or any methodologies documented for estimations. In terms of data dissemination, there are no fixed schedules for publishing energy data and statistics.

Summary of gap analysis in the energy sector

Group	ID	Description
Missing or unclear legal framework for energy statistics	**Gap 1: Leading agency**	The most significant gap in Sudan's energy statistics is the absence of a lead agency with a mandate to collect energy statistics. Therefore, and as all respondents from the public and private sectors stated, there is no legal framework for the collection of energy statistics. As such, there is no obligation for private sector actors to submit energy data to the Ministry of Energy or any other relevant governmental body, such as HCENR.
	Gap 2: Legal framework	Lack of clarity in legal frameworks can be seen in the relationship between companies (from public and private sector) and the ministries (and also between ministries) in relation to data sharing. The absence of a legal framework indicates that energy statistics are not budgeted for in any of the energy actors' institutions. There is no obligation for any institution to submit energy data to any institution. For example, currently, HCENR collects energy data from different actors through requests.
No institutional arrangements	**Gap 3: Data collection**	The ramifications of the absence of a legal framework and a lead agency for energy statistics extend to cause a lack of institutional arrangements within actors in the energy sector. This means that there is no co-ordination or consultations for the collection of energy statistics, in terms of methodologies, schedules for data collection, timelines for reporting, data quality control and assurance, and most importantly,

		consultations for improvement of energy data.
	Gap 4: Coordination	There is insufficient engagement between the public and private sectors when it comes to energy statistics. The lack of communication channels between institutions can lead to duplicate efforts, which is considered a mismanagement of resources. This could also be caused by a lack of understanding of roles between stakeholders/actors, especially from broad and imprecise mandates/terms of reference, and the lack of a lead agency in which energy statistics are centralized.
Insufficient budgets or financial support	**Gap 5: Financial support**	Institutions whose fulfilment of terms of references or mandates require energy data collection through surveys have stated that budgets are insufficient or lack financial support.
Insufficient skilled personnel	**Gap 6: Capacity building**	Institutions involved in energy data collection, have stated that the availability of skilled personnel is a challenge. This gap is strongly connected to lacking financial support.
Unclear or unenforced data collection methodologies/processes	**Gap 7: Standards and manual**	All institutions whose activities and terms of reference involve energy data collection do not use standardized templates and questionnaires. None of the institutions that collect energy data or produce energy statistics use proper manuals or international recommendations.
	Gap 8: QA/QC	There are no mechanisms present for checking, validating and reviewing the data collected and the methodologies used. This gap could be a result of the absence of a lead agency for energy statistics and an MRV system which underlies institutional, legal and procedural setups.
Archiving and dissemination of energy statistics	**Gap 9: Reporting and Publication**	Energy statistic reports from different actors are not published for the public regularly on a fixed timeline. Also, this gap group is linked to gap 1 of having no leading agency present with a legal framework and mandate for energy statistics, which, in turn, does not impose any obligation on any actor to submit energy data on a fixed schedule. On the other hand, no communication and consultations with energy statistics users take place for comments and feedback, when no fixed schedules are present for dissemination.
Energy statistics are not adequate for policy and project monitoring	**Gap 10: Transparency**	This gap could be considered a result of all the preceding gaps and serves as a conclusion that current energy statistics practices and coverage are inadequate for policy making and monitoring national targets such as NDCs and the underlying information needed for clarity, transparency and understanding.

Areas of MRV improvements- Energy Sector

After identification of energy data gaps and analysis of probable causes of those gaps, key solutions were reached. Below is an explanation of those key solutions and their components and how the identified gaps can be covered or reduced.

Establishing a legal framework for energy statistics in the power, biomass, and transportation subsectors

Such a mandate, along with an adequate legal framework for energy statistics that covers public and private sectors, can at least ensure that all or most of energy data are collected or submitted.

An adequate legal framework for energy statistics in the institutions involved in conducting surveys can guarantee a budget component specific to surveys, which in turn contributes to energy statistics personnel training and recruitment.

Setting and maintaining institutional arrangements that are based on consultations, co-operation and mutual benefit between institutions

Utilizing a bottom-up approach in setting institutional arrangements would require extensive consultations between actors in the energy sector. These consultations can help reach data sharing agreements or any other form of agreement or understanding between actors that can sustain a certain agreed-upon data flow, with a fixed schedule that aligns with national data dissemination report timelines. This can be achieved through memorandums of understanding between different actors and the selected lead agency for energy statistics or the MRV unit.

These agreements or understandings also include sharing of data collection and estimation methodologies, which enhances transparency. Regular consultations can help improve methodologies used. They could also result in the avoidance of duplicate efforts, and thus, contribute to good management of resources.

Strengthening methodologies and processes

Actors involved in energy data collection using surveys must use standardised templates, across different target data groups, appropriate to Sudan. These actors should also be encouraged to follow IPCC guidelines in tabulating activity data. This contributes to the enhancement of the consistency and comparability principles for energy data.

Digitalisation of archives and documentation, with the use of cloud storage and regular backups of data, can prevent data losses and ease access, retrieval and reuse of data.

Activities log

The table below provides the detailed log for the activates curried up to date.

Table 5: Implemented project activities

#	Date	Event	Notes
1	27 Sep. 2021	Project Kick off meeting : the work plan and budget was discussed and approved	Detailed budget breakdown of meetings and workshop is requested by the client
2	6th Oct. 2021 to 10th Dec. 2021	Submission and revisions of the project budget	The kick off the project implementation is subject of receiving workshops budget by the consultants
3	13th of Dec. 2021	Status meeting	Updates on institutional and political status in Sudan, status on processing of payments and preparation of Inception Workshop
4	10th of Jan. 2022	Agreement on bi-weekly meeting to track the project progress	The first bi-weekly meeting will be held on the 13th of Jan. 2022
5	13th of Jan.2022	The first bi-weekly meeting.	A short progress report was delivered to the DTU coordinator
6	19th of Jan 2022	First payments were received by the two consultants	The payments include USD5000 for each consultant to cover the cost of workshops and meetings
7	27th of Jan 2022	Initial suggested list of participants is prepared for the two sectors to attend the inception workshop	Communications with different stakeholders are ongoing while HCENR is preparing official letters to nominated candidates to attend the inception workshop
8	30st of Jan 2022	Contacted Key stakeholders and requested meeting with Undersecretaries	
9	7th of Feb. 2022	Bi-weekly meeting	Discussion covered the preparation for the inception workshop and changing the consultant's contract with the new client's arrangement
10	12th of Feb. 2022	Termination letter of the existing consultancy contract was received	- New contracts will be furnished to both consultants in order to replace the previous one with the same conditions and terms.
11	24th of Feb. 2022	Bi-weekly meeting	- Fixing date for the inception workshop - Participation of ICAT secretariat in the workshop - Themes and materials to be presented in the workshop

12	15th of March 2022	ICAT project – Inception workshop	- Technical working groups (Energy and Transport sectors) were formed - Workshop report is submitted to the client
13	17th of March 2022	Bi-weekly meeting	- Was canceled as a quick update was given by consultants one day before.
14	30th of March 2022	1st TWGs meeting	- Meeting minutes were taken and some tasks were given to the two groups as per item 9 of the project's working plan
15	31st of March 2022	Bi-weekly meeting	- Quick update was given by national consultants on project's progress. Shed light on the tasks given to the TWGs' members. The consultants requested update on new contracts and agreed to be updated on that before next meeting.
16	14th of April 2022	Bi-weekly meeting	- Meeting postponed to the 21st of April
17	19th of April 2022	2nd TWGs meeting	- Collected data that requested last meeting (only 7 members submitted their data and right now it is under review by consultants). - Agreed to start meeting with each entity to expedite data collection so as before the next meeting (mid of May) all data collection must be completed. - Two presentations were presented by TWG members: MRV system developed for electricity sector and the MRV system for National Forest Corporation. - Meeting minutes were taken and some tasks were given to the two groups
19	May- Oct 2022	Ad Hoc meetings and interviews with Key Informants by phone,	- Continued working on data collection about the institutional arrangement and MRV systems in Sudan - Analysis of data collected - Conducted number of biweekly meetings with project management team
20	Nov -Dec 2022	Started working on the gap analysis report	- Conducted number of biweekly meetings with project management team - Signed the amended contract

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