Technical Support and Capacity Building for Applying ICAT Guidance in Sudan's Energy Sector

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ICAT Initiative for Climate Action Transparency

Initiative for Climate Action Transparency - ICAT

Technical Support and Capacity Building for Applying ICAT Guidance in Sudan's Energy Sector

Deliverable #3

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List of Acronyms

BUR	Biennial Update Report
CBIT	Capacity Building Initiative for Transparency
CC	Climate Change
COP	Conference of the Parties
CSO	Civil Society Organization
CSP	Concentrating Solar Power
ERA	Electricity Regulatory Authority
FAO	Food and Agriculture Organization of the United Nations
FiT	Feed-in Tariff
FNC	Forests National Corporation
GEF	Global Environment Facility
GHG	Greenhouse gases
HCENR	Higher Council for Environment and Natural Resources (Sudan)
ICAT	International Climate Action Transparency
IRR	Internal Rate of Return
M&E	Monitoring & evaluation
MEAs	Multilateral Environmental Agreements
MPGs	Modalities, Procedures and Guidelines
MRV	Measurement, reporting and verification
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
PV	Photovoltaic
QA/QC	Quality assurance/quality control
RE	Renewable Energy
REDD+	Reducing Emissions from Deforestation and forest Degradation
ROI	Return on Investment
SCIA	Sudanese Chambers of Industries Association
SEHC	Sudanese Electricity Holding Company
SPC	Sudanese Petroleum Corporation
SWOT	Strengths, Weaknesses, Opportunities, and Threats

TOR	Terms of Reference
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

Background and objectives

Background: Addressing climate change stands as one of the most urgent and critical global challenges. Despite being a relatively low-emitting country, Sudan, similar to other developing nations, is grappling with the severe impacts of climate change. The country's commitment to climate action is articulated through its submissions to the United Nations Framework Convention on Climate Change (UNFCCC) in the form of the Nationally Determined Contributions (NDC). Sudan's foremost priorities in confronting climate change encompass the implementation of low-carbon development initiatives across the energy, forestry, and waste sectors, aligning with its national development agenda. In 2015, Sudan crafted its initial Intended Nationally Determined Contribution (INDC) within the framework of the Paris Agreement, and a revised NDC is anticipated shortly (an interim document was submitted by the government in 2021). These concerted efforts underscore Sudan's commitment to addressing climate change and aligning its strategies with international climate frameworks.

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. There are several *hydroelectric* dams on the Blue and White Niles. 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).

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 (Sudan Second national Communication, 2013).

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 m2.

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 cook stoves 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 Jabel Marra

volcano and the Tagbo and Beidob hills have registered good measurements, while further north towards the 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).

Objective of the report: Leveraging existing ICAT guidance and tools, we aim to re-assess the potential of mitigation activities and energy sector-related actions outlined in Sudan's NDC Implementation Plan. Specifically, we will analyze the role of Pricing Policy (feed in tariff as an example) in Sudan's energy sector and develop policy recommendations for the formulation of effective policies. To achieve our objectives, we will employ the ICAT Renewable Energy Methodology Guide, which covers assessment of RE Policies which includes FIT, Auction, and Incentives. This guide will serve as a roadmap for conducting a thorough analysis of FiT Policy in Sudan's energy sector.

Summary of the ICAT Pricing Assessment Guide and its application in the Sudanese Energy sector - A Pathway to Feed-in Tariffs for Renewable Energies:

The ICAT Renewable Energy Methodology Guide offers a comprehensive toolkit for evaluating greenhouse gas (GHG) mitigation. This guide provides a holistic and rigorous approach applicable across various governance levels with regard to the GHG reduction potential.

The analysis highlights the critical challenges impeding the successful implementation and adoption of renewable energy (RE) in Sudan. These obstacles include:

1. High Costs for RE Technologies: The prohibitive costs associated with solar photovoltaic (PV) systems and other RE technologies pose a significant barrier for the average citizen.
2. Absence of Government Incentives: The lack of financial incentives from the government to support homeowners and captive RE producers hinders the widespread adoption of RE.
3. Inadequate Grid Infrastructure: The need for grid infrastructure upgrades to facilitate the interconnection of diverse RE sources is crucial for seamless integration of RE into the grid.

Introducing a feed-in tariff (FiT) scheme has the potential to revolutionize the RE landscape by significantly reducing the payback period for RE investments. A FiT is a policy that establishes a fixed price for electricity generated from renewable sources, providing a guaranteed revenue stream for RE producers and encouraging investment in RE technologies.

Given the dynamic nature of a nation's environment, socio-economic conditions, and technological advancements, an effective energy policy must continually adapt to these changes to maintain its impact.

Pricing Policy Barriers: Overcoming Hurdles for RE Transition

The transition of the electricity sector towards low-emissions power generation faces significant barriers related to pricing policy. The literature review has identified four major categories of barriers:

1. Technical/Infrastructural Barriers:
    - Skilled Workforce Shortage: The lack of a skilled workforce to handle RE technologies and infrastructure poses a challenge.
    - Infrastructure Limitations: Insufficient grid infrastructure and energy imbalance hinder the integration of RE sources.

- System Adaptation Challenges: Adapting existing electricity systems to accommodate the variable nature of RE sources requires careful planning and upgrades.

2. Economic and Financial Barriers:
    - Access to Finance: Limited access to affordable financing for RE projects impedes their implementation.
    - Expected Return on Investment (ROI) Concerns: Investors may be hesitant to invest in RE due to perceived risks and uncertainty regarding ROI.
    - High RE Technology Costs: The high initial cost of RE technologies, particularly for RE projects, can be a deterrent for potential investors.
3. Financial Barriers:
    - High Electric Vehicle (EV) Prices: The prohibitive cost of EVs limits their adoption, hindering the growth of renewable energy consumption in the transportation sector.
    - Lack of Customer Demand or Customer Preferences: Customer preferences and limited demand for RE-based products and services can pose challenges for RE integration.
4. Institutional Barriers:
    - Regulatory Issues: Complex and unclear regulations can hinder the development and implementation of RE projects.
    - Lack of National Strategies: The absence of comprehensive national strategies for RE integration can lead to uncoordinated efforts and hinder progress.
    - Insufficient Institutional Structures: Inadequate institutional frameworks and support mechanisms can impede the effective deployment of RE technologies.

Addressing these barriers is crucial to unlocking the full potential of RE and enabling Sudan's transition towards a low-carbon energy future. By implementing appropriate policy measures, investing in infrastructure upgrades, and fostering public awareness, Sudan can overcome these challenges and harness the transformative power of RE.

Overview of ICAT Guidance and series of ICAT Assessment Guides

The ICAT guidance provides a comprehensive framework to enhance the transparency and accountability of climate actions. However, for the energy sector, the guidance should be tailored to address sector-specific challenges and opportunities, ensuring that it becomes a fit-for-purpose MRV (Monitoring, Reporting, and Verification) toolbox.

Description of the ICAT Guidance

In the context of the Paris Agreement, the Initiative for Climate Action Transparency (ICAT) is designed to assist countries in assessing the impacts of their climate actions. Its overarching goal is to foster greater transparency, effectiveness, ambition, and trust in climate policies. ICAT achieves this by integrating methodological guidance, capacity-building, and knowledge sharing to enhance the transparency and effectiveness of climate policies and actions on a global scale.

The guidance provided by ICAT is versatile, catering to a diverse range of users, including governments, donor agencies, financial institutions, businesses, research institutions, non-governmental organizations (NGOs), and stakeholders affected by policies and actions. This inclusive approach acknowledges the importance of engaging local communities and civil society organizations in the climate action discourse.

The ICAT series encompasses a comprehensive set of tools, including a toolkit of Policy Assessment Guides. This toolkit facilitates evidence-based decision-making by enabling policymakers and stakeholders to comprehend the intricate relationship between policies and their anticipated greenhouse gas (GHG) and other impacts. Additionally, ICAT offers supporting guidance to ensure that users can effectively apply the tools provided, fostering a holistic understanding of the impact of climate policies and actions.

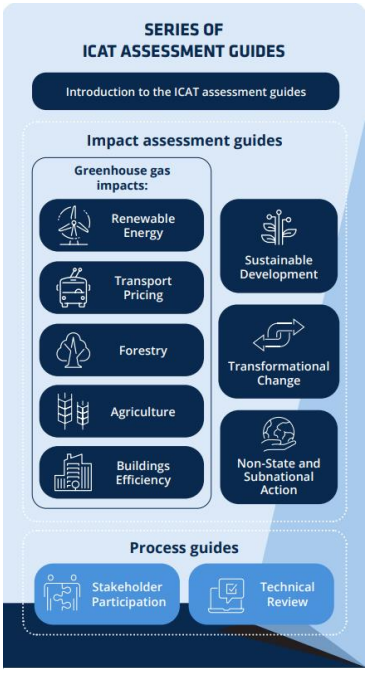


Figure 1 ICAT Assessment Guides source: Overview of the ICAT series of Assessment Guides

Impact Assessment Guidance

The ICAT assessment guides consist of a set of methodologies designed to evaluate the greenhouse gas (GHG), sustainable development, and transformational impacts of policies and actions. This integrated and comprehensive approach is applicable across all levels of governance. Comprising 10 guides along with an introduction that offers an overview for assessment planning, the ICAT series ensures a flexible approach. This flexibility enables policymakers and other users to apply the guides within the context of their specific objectives and circumstances.***Renewable energy:*** The Renewable Energy Methodology centers on commonly implemented and proven successful policies in promoting renewable energy deployment for electricity generation. These policies include feed-in tariff policies (including feed-in premiums), auction policies (including tenders), and tax incentive policies.

Transport Pricing: The Transport Pricing Methodology offers in-depth insights into transport

pricing policies, encompassing measures like the removal of fuel subsidies, the augmentation of fuel taxes and levies, the introduction of road pricing, and the establishment of purchase incentive programs for more efficient vehicles. When effectively implemented, these policies contribute to a reduction in vehicle travel, promoting shifts toward more efficient transport modes like public transit, and encouraging the adoption of fuel-efficient and alternative-fuel vehicles.

The following sectors are not included in this project:

Forest: The Forest Methodology aids policymakers and other users in evaluating the impacts of forest policies targeting specific activities. This assessment assists in addressing uncertainties related to the effectiveness of such policies and the permanence of increased carbon stocks. Ultimately, this methodology supports countries in accessing REDD+ funding and finance.

Agriculture: The Agriculture Methodology centers on policies pertaining to cropland management, the restoration of organic soils, and grazing land management. Enhancing soil carbon stocks is achievable through practices like agricultural residue management, agroforestry, and transitioning to no-till or conservation tillage agriculture. To reduce methane emissions from ruminant livestock, effective strategies include improving feeding practices, enhancing herd management and breeding, and implementing silvopastoral systems.

Building Efficiency: The Buildings Efficiency Methodology is applicable to both new and existing buildings, emphasizing regulatory policies (such as building codes, energy performance standards for appliances, and energy labelling programs) as well as financial support policies (including grants and subsidies for energy-efficient investments, tax incentives, or reduced value-added tax for energy-efficient investments).

Sustainable Development: The Sustainable Development Methodology assists policymakers and other users in systematically evaluating various development and climate impacts. This process facilitates the advancement of policies that align with multiple Sustainable Development Goals (SDGs) and priorities. By assessing and effectively communicating impacts that resonate with national audiences, it helps garner support for climate actions. Additionally, the methodology informs the design and implementation of policies to maximize positive impacts while addressing or avoiding unintended or negative consequences.

Transformational Change: The Transformational Change Methodology establishes a framework for GHG mitigation and breaks down this concept into a step-by-step process for gauging the degree to which a policy exhibits true transformational characteristics. Financial institutions and programs have shown interest in this methodology as it serves as a foundation for evaluating the anticipated or realized transformational impact of policies and investments.

Supporting Guidance

ICAT has a core objective of assisting countries in quantifying and evaluating the effects of their climate actions. A pivotal element in achieving this objective lies in the robust engagement of a diverse range of stakeholders and the inclusion of a Technical Review process. This multifaceted involvement plays a crucial role in enhancing transparency, effectiveness, trust, and ambition in climate policies. The active participation of various stakeholders, coupled with rigorous technical scrutiny, ensures a comprehensive and credible assessment of the impacts of climate actions, ultimately contributing to the advancement of more reliable and ambitious climate policies worldwide.

Non-State Subnational Action: The Non-State and Subnational Action Guide supports national policymakers and other users in evaluating the potential impact of these actions. This valuable information can be utilized to enhance the development of national greenhouse gas (GHG) trajectories, climate policies, and future targets. The guide is versatile in its application, allowing

for the aggregation of contributions from non-state and subnational actors or the seamless integration of these actions into national projections.

Stakeholder Participation in design, implementation and assessment of policies and actions: The Stakeholder Participation Guide serves as a valuable resource for policymakers seeking to facilitate meaningful stakeholder engagement in the pursuit of their goals. Specifically designed to complement the ICAT impact assessment methodologies, this guide provides a comprehensive framework for policymakers to ensure that diverse stakeholders are actively involved in the decision-making process. By offering guidance on effective stakeholder participation strategies, the guide enhances the overall impact assessment process, fostering inclusivity, transparency, and the incorporation of varied perspectives. This collaborative approach ensures that policies and actions are not only well-informed but also enjoy broader support, ultimately contributing to more effective and sustainable outcomes.

Technical Review: The Technical Review Guide is a valuable tool for both policymakers and technical reviewers, providing guidance on conducting thorough and productive reviews that significantly enhance the quality of policy assessments. This guide facilitates a structured and effective collaboration between policymakers and technical experts, ensuring that the review process contributes positively to the overall assessment of policies. By promoting clarity, accuracy, and a comprehensive understanding of technical aspects, this guide plays a pivotal role in elevating the rigor and credibility of policy assessments.

ICAT Energy Pricing Guidance: Guidance for assessing the greenhouse gas impacts of Energy pricing policies

This methodology is structured into four parts, as illustrated in Figure (2). Its methodological guidance is geared towards evaluating the greenhouse gas (GHG) impacts of pricing policies within the Energy sector. The approach is delineated in a stepwise manner, focusing on estimating the effects of elevated fuel prices through the utilization of price elasticities of demand. While other methods for assessing the impacts of vehicle purchase incentives and road pricing policies are also provided, albeit in less detail, the overarching goal is to enhance impact assessment for the improvement of policy design and implementation.

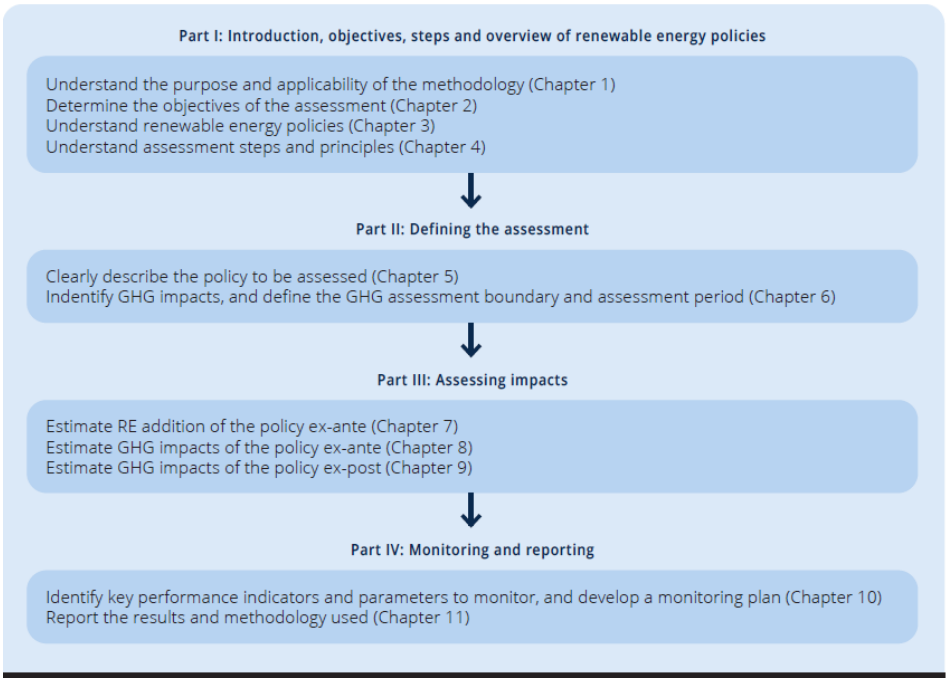


Figure 2: Overview of the methodology. Source: Energy Pricing Methodology ICAT Series of Assessment Guides

By offering a systematic approach, the methodology becomes a valuable resource for stakeholders involved in the formulation and execution of national energy policies, strategies, Nationally Determined Contributions (NDCs), or Nationally Appropriate Mitigation Actions (NAMAs). The intended users encompass a broad spectrum, including research institutions, businesses, and non-governmental organizations, fostering a collaborative and informed approach to the enhancement of national energy policies.

Overview of Renewable Energy Pricing Policies

Feed-in tariff policies

Policy Description:

Feed-in tariff policies aim to promote RE deployment by offering long-term purchase agreements with power producers at a specified price per kilowatt hour. In this methodology, feed-in tariff policies also include feed-in premiums, which provide power producers with a premium on top of the market price of their electricity production. Premiums can either be fixed at a constant level (independent of market prices) or sliding (with variable levels that depend on market prices). They provide market certainty for power producers by guaranteeing payments that are usually awarded as long-term contracts for 15–20 years.

Sudan Status:

In Sudan, energy consumption is dominated by the household and transport sectors. In the energy sector, specifically electricity, updates are underway for the Electricity Act to align with current needs. The revised act is anticipated to include provisions for renewable energy and energy efficiency, clarifying the regulator's role in setting tariffs. It also aims to encourage private sector involvement by permitting private investment in isolated grids. Additionally, it specifies the Sudanese Electricity Holding Company (SEHC) as the entity responsible for power purchase agreements (PPAs). In 2013, the Government of Sudan introduced the National Investment Act, providing incentives for key sectors in Sudan's development. More recently, efforts have been

made to finalize the Public-Private Partnership Act (PPP Act) to boost private participation in infrastructure development, especially in the electricity sector. The PPP Act is expected to establish a High Commission for public-private partnerships (PPPs) and a dedicated unit in the Ministry of Finance and Economic Planning (MoFEP.)

In 2010, the Government of Sudan established the Renewable Energy Department to introduce renewable-energy policies that are appropriate for the country's context and accelerate the dissemination of renewable-energy technologies with a focus on solar power. Sudan then committed to implementing the 2014–2030 Arab Strategy for Sustainable Energy produced by the League of Arab States, which proposes the following policies (among others)[1]:

- a feed-in tariff for small and medium renewable-energy systems;
- a net-metering system whereby consumers generate electricity via their rooftop solar PV systems and sell their sur-plus to the national grid; and
- setting standards for connecting renewable-energy plants to the national grid while adopting precise specifications for renewable-energy equipment and systems

Access to sustainable sources of clean, reliable and affordable energy has a profound impact on multiple aspects of human development. The Renewable Energy Master Plan (REMP), prepared under the UNDP-GEF 'Barrier Removal for PV Market Penetration in Semi-Urban Sudan' project, recognizes that Sudan is endowed with diverse energy resources, ranging from biomass to hydro, solar, wind and geothermal, and calls for the use of these renewable energy sources to ensure Sudan's energy security and to enhance access to electricity. In particular, the REMP recommends developing large-scale wind power over a near term time horizon, highlighting the potential of the Red Sea coast in particular, based on the experience of wind farm installations on the coast in neighbouring Egypt. In the RE sector, feed-in tariffs have realized successful results in increasing the RE technology use worldwide. Feed-in tariffs encourage investment in RE generation by ensuring to buy and pay for all electricity produced, particularly in early stage of the market development. 64% of global wind installations and 87% of global photovoltaic installed capacity have been driven by feed-in tariffs (GEF, 2012). While most of these installations are in developed countries, particularly Europe, the African continent has significant untapped RE potential (Development of a Feed-in-Tariff NAMA for Renewable Energy, 2015). Introduction of Feed-in-Tariff ensures financial viability of RE projects making those bankable and therefore ensures access to finance to the projects.

Although the Sudanese government has been planning, drafting laws and goal-setting for solar PV energy policy, no feed-in tariff or net-metering policy has yet been implemented.

Tax incentive policies

Policy Description:

Various types of tax incentive policies are available for the development and deployment of RE technologies. Many governments use tax policies to promote RE sources for electricity generation. Tax incentive types include: value added tax exemptions, income tax exemptions, import or export fiscal benefits, sales tax exemptions, accelerated depreciation, tax credits, exemptions from local taxes, RE-specific taxes, such as a geothermal vapor tax or geothermal surface tax.

Sudan Status:

According to the Sudan Investment Promotion Law of 2013, all renewable-energy equipment and

[1] Investigating energy policies to boost grid-connected rooftop solar PV in Sudan Tarig Z. Ahmed , Ayah Mohamed , Mawahib Eltayeb, Ahmed Osman, and Mohamed G. Hassan, 2023.

systems are exempt from customs duties, which apply to various pieces of solar PV equipment imported into the country. Furthermore, the government has been increasing main grid electricity prices and reducing its electricity subsidy from 95% to 69%[2]. This aims to save money for the government and encourage people to invest in renewable-energy technologies. Finalize and pass pending legislation on the Electricity Law, the Renewable energy law, the Private Public Private Partnership Act, the Feed in Tariff (FiT) policy, and the Independent Power Producers (IPP) policy are considered key factor to upscale the adoption of the RE

Auction policies (including tender policies)

Policy Description:

Auction policies for RE generation contracts create a competitive environment to procure renewable electricity through a defined selection process. In this methodology, "auction policies" refers to both auction and tender policies. Under these policies (as applicable in this methodology), governments issue a request for bids for the total investment cost of a project or for the cost per unit of electricity. An auction process will generally involve an open bidding process, whereas with tenders the bidding is done in confidence. They are usually designed with a total capacity of projects that will be funded. The government then selects multiple winning bids until the total capacity reaches the auction capacity goals.

Sudan Status:

Sudan currently does not impose an auction policy.

The Pricing Policy Barriers

The transition of Sudan's energy sector towards greater efficiency and reduced dependence on fossil fuels requires the effective implementation of a pricing policy. This policy should address institutional and behavioral challenges to eliminate key barriers to its successful adoption.

These barriers can be placed into Four major categories, these include Technical/Infrastructural Barriers, Economic Barriers, Financial Barriers, Institutional Barriers.

Table 1: The pricing policy barriers

Barrier classification	***Barrier***	***Description***	***Policy Affected***	***Impact***
Technical Barriers	Lack of skilled workforce	• Inadequate capacity of operation and maintenance including grid connection and storage. • Capacity related to design including metrological station for measuring solar radiation. • Lack of experience and expertise among the relevant stakeholders, including project	All policies	The adoption of the policy

[2] Thomson Reuters Foundation. Sudan Raises Electricity Prices as it Pushes Forward with... 2022. https://news.trust.org/item/20220124214611-xqo4u/?utm_source=pocket_mylist (5 February 2022, date last accessed).

		sponsors and power producers, investors and financiers, and regulators and authorities.		
	Infrastructure and energy balance	Lack of flexibility of the energy system (i.e., of the electricity grid to integrate or absorb RE)	All policies	The adoption of the policy
	Changing the system	Transitioning from one tax system to another may involve certain costs, both for the government and businesses. Implementing new technologies, retraining staff, and informing the public about changes all require financial resources.	Tax incentives	The reform of the policy
Economic and Financial Barriers	Access to finance	Sudan Banking system has challenged commercial lending sector. Private market (investor) as a source of fund is characterized by high expected rate of return. Public finance instruments are limited since Sudan experienced slowdown of GDP growth.	All policies	The adoption of the policy
	Expected ROI	Lack of long-term lending and creditworthiness for the RE project which characterized by high leverage with high debt portion which result in high equity IRR. lack of upfront grants instruments or other support instrument. Lack of risk mitigating mechanisms such as guarantees.	All policies	The adoption of the policy
	Cost of RE technology/RE project	Project cost overrun which may hinder the project completion.	All policies	Cost of RE technology/RE project
Institutional Barriers	Regulatory issues	Absences of clear sustainable policy for both Energy or RE.	All policies	The adoption/ineffective policies

		Lack clear structure and responsible body to issue permits. Issues related to influence of non-legal partners (corruptions)		
	lack of proper national strategies	Lack comprehensive, well-defined, and coordinated plans at the national level to tackle climate change through the mainstreaming climate change into the energy sector.	All policies	The adoption/ineffective policies
	Lack of associated institutional structures	The deficiency in the establishment of organizations, mechanisms, and frameworks with limited data collection mechanisms.		

Application of ICAT Guidance on the Sudanese Energy Sector

Commitments of the Sudanese NDC

Following the adoption of the Paris Agreement in 2015, countries committed to revisiting and renewing their climate commitments, known as nationally determined contributions (NDCs), every five years. For nations with commitments originally stretching until 2025, new commitments were to be made, while those with commitments extending through 2030 were expected to communicate or update them. In response to this call under Articles 3, 4.2, 4.6, and 4.11 of the Paris Agreement, particularly referencing decision 4/CMA.1, para.7 of the 24th Conference of the Parties, Sudan submitted its interim update of its first NDC in May 2021.

This submission outlines Sudan's national priorities to address the impacts of climate change on its economy. Importantly, Sudan's updated contributions to both climate change mitigation and adaptation align with the country's national development planning processes. These contributions are crafted in harmony with the overarching objectives and priorities, taking into careful consideration the unique national circumstances of Sudan.

Summary of Plans

Energy Component

The mitigation component of Sudan's updated contributions spans key sectors, encompassing energy, forestry, and land use, with a targeted timeframe from 2021 to 2030. In the *energy* sector, Sudan aims to undergo a transformative shift in its electricity generation, with a focus on low-emission power sources.

- The outlined contributions within the energy sector are diverse and comprehensive:
- The deployment of utility-scale solar and wind power plants, stand-alone systems, and mini-grids.

- Improvement in hydrogeneration.
- Enhancements in energy efficiency across the grid, residential appliances, and the transport sector.

Specifically, Sudan has set ambitious targets, such as achieving 2,140 MW from solar and wind power plants by 2030, resulting in an impressive emissions avoidance of 3,574,580 tCO2e. Additionally, stand-alone systems and mini-grids installations in various sectors are projected to reach 796 MW, leading to emissions avoidance of 1,086,360 tCO2e. Rewinding of two generator units, with a goal to increase hydrogeneration to 42 GWh/year by 2030, is anticipated to yield emissions avoidance of 26,221 tCO2e.

Further plans involve increasing energy efficiency and reducing grid losses in transmission and distribution, with a notable outcome of almost 6.5 MMtCO2e of avoided emissions. The estimated cost for these interventions is projected to be almost a billion dollars, with an expected increase in annual generation by 1,213 GWh by 2030.

Table 2: Sudan NDCs related to the energy sector

Mitigation Action	Description	Target	Timeline	Indicator
Increase the share of renewable energy in the energy mix to 40% by 2030	Implement policies and incentives to promote renewable energy deployment, such as feed-in tariffs and net metering	40% of electricity generation from renewable sources by 2030	2023-2030	Renewable energy generation capacity (MW)
Improve energy efficiency in the power sector by 20% by 2030	Upgrade power generation and transmission infrastructure, implement energy efficiency measures in power plants, and promote energy-efficient appliances	20% reduction in energy consumption in the power sector by 2030	2023-2030	Energy consumption per unit of electricity generated (kWh/MWh)
Reduce energy consumption in buildings by 30% by 2030	Implement building energy codes, promote energy-efficient construction practices, and provide incentives for retrofitting existing buildings	30% reduction in energy consumption in buildings by 2030	2023-2030	Energy consumption per unit of floor area (kWh/m2)
Increase the use of renewable energy in the transportation sector by 10% by 2030	Promote the use of electric vehicles and biofuels, and develop infrastructure for alternative transportation fuels	10% of transportation energy from renewable sources by 2030	2023-2030	Renewable energy consumption in the transportation sector (kWh)

These comprehensive and strategic interventions underscore Sudan's commitment to mitigating climate change and transitioning towards a sustainable and low-emission energy landscape. These planned interventions would result in almost 5.5 MMtCO2e of avoided emissions and almost three billion dollar as estimated cost.

Transportation Components

In the *transportation* sector, Sudan's plans are outlined as follows:

- Model Switching to Buses in Khartoum: Sudan aims to facilitate a shift in transportation models, particularly focusing on the adoption of buses in the city of Khartoum. This strategic move aligns with the broader goal of transitioning towards more sustainable and efficient public transportation systems.
- Fuel-Switching to Blended Fossil Fuels and Promotion of Fuel Efficiency: The plan includes initiatives for fuel-switching, emphasizing the use of blended fossil fuels. Additionally, there is a concerted effort to promote fuel efficiency across various modes of transportation. This dual approach not only contributes to emissions reduction but also aligns with global efforts to enhance the environmental sustainability of transportation.
- Scaling Up the Use of Rail Transport: Sudan envisions a significant scaling up of rail transport usage. This involves expanding and improving rail infrastructure, encouraging a modal shift towards rail transportation, and harnessing the efficiency and environmental benefits that rail transport offers.

These strategic interventions underscore Sudan's commitment to addressing climate change within the transportation sector. By embracing a multi-faceted approach that includes model switching, fuel efficiency promotion, and the expansion of rail transport, Sudan aims to foster a more sustainable and resilient transportation system aligned with its broader climate goals. These planned interventions would result in almost 6.5 MMtCO2e of avoided emissions and almost billion dollar as estimated cost.

Example of FiT pricing policy in the Sudanese context

According to the study conducted by the International Renewable energy Agency (IRENA) in 2014 (Sebastian Hermann, 2014), the total technical potential of solar PV in Sudan is 87,817 TWh/year, considering all suitable areas.

The total technical potential would be limited to the population, which currently consumes on average 308 kWh/household/month (The World Bank, 2020). With a projected population of 57.594 million people by 2031, and assuming 100% electricity access target, the electricity generation should approximately reach 69.55 TWh/year in 2031.

In the base year (2012), the total electricity generation was 8.58 TWh, and reached 18.13 TWh in the year 2020, with only 1.25% generated from solar in 2020.

Therefore, it is assumed that the practical technical potential would be **51.42 TWh/year** by 2031, which assumes only additions of solar. This figure translates to additions of **28.16 GW** of solar capacity by 2031, given the average yearly 1826 kWh/kWp output of solar PV in Sudan.

Business as usual scenario

The following chart shows an ex-ante for BAU scenario for the electricity production sector in Sudan, in which the energy sources are hydro and thermal production.

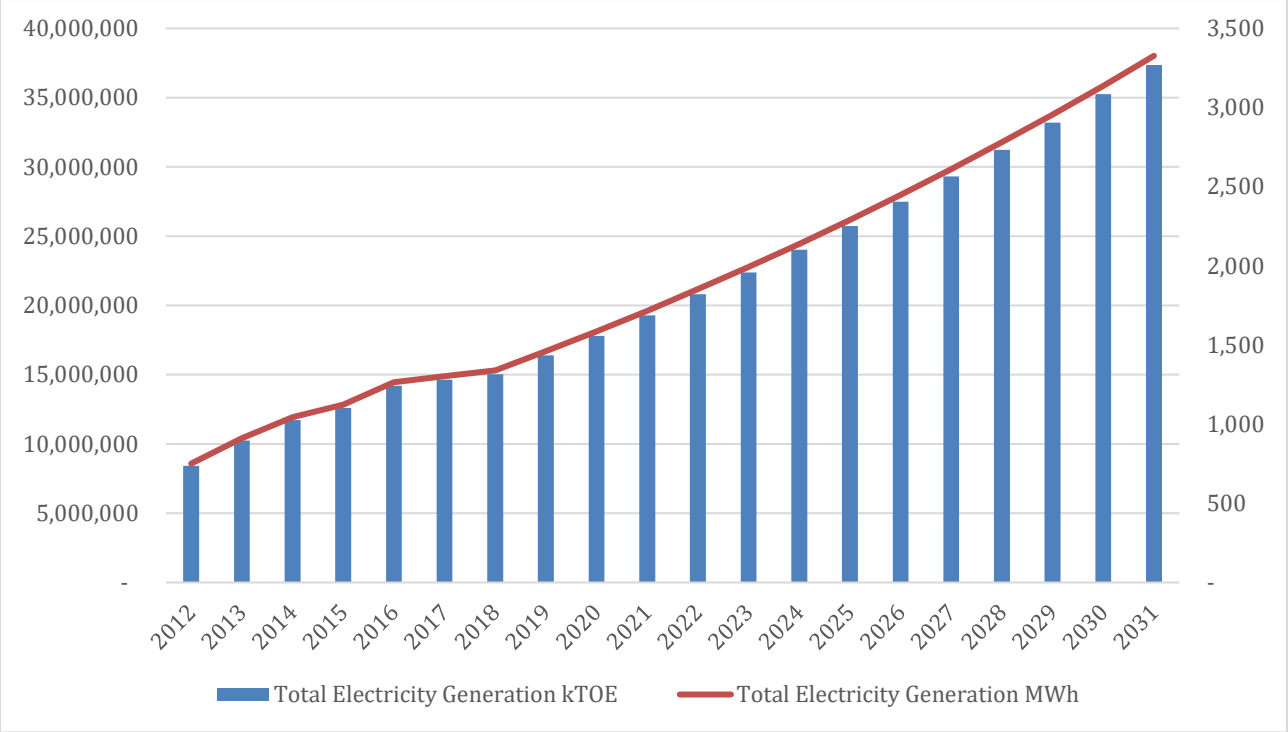


Figure 3: Projection of total Electricity Generation in Sudan (2012 to 2031) - BAUscenario

Although the on-grid electricity generation comes mainly from hydro power (Meroe dam, Rosirous dam and other hydro dams) the off-grid electricity production is mainly based on diesel generators.

The following table illustrates the business-as-usual scenario's total electricity generation from different renewable and conventional energy sources extended to 2050 with linear growth.

Table 3: Projection to electricity generation from different energy sources in Sudan

	Total Electricity Generation, kTOE	Thermal Electricity Generation, kTOE	Hydro, kTOE	Solar, kTOE	Wind, kTOE	Geothermal, kTOE	Waste to Energy, kTOE
2012	738	242	493	2	-	-	-
2013	896	178	715	3	-	-	-
2014	1,027	257	766	4	-	-	-
2015	1,103	374	725	4	-	-	-
2016	1,242	545	692	5	-	-	-
2017	1,280	525	748	7	-	-	-
2018	1,316	556	750	10	-	-	-
2019	1,435	670	751	14	-	-	-
2020	1,559	787	752	19	-	-	-
2021	1,687	909	754	24	-	-	-
2022	1,820	1,035	755	30	-	-	-
2023	1,959	1,110	757	36	28	25	3
2024	2,102	1,190	758	43	56	50	6
2025	2,251	1,275	759	49	84	75	9
2026	2,406	1,365	761	56	111	100	12
2027	2,566	1,461	762	64	139	125	15
2028	2,732	1,563	763	71	167	150	18
2029	2,905	1,670	765	79	195	176	21
2030	3,084	1,780	770	87	223	201	24
2031	3,270	1,920	770	96	249	211	25
2032	3,462	2,066	770	105	275	221	26

2033	3,662	2,219	770	115	301	231	27
2034	3,869	2,379	770	124	327	241	28
2035	4,084	2,546	770	135	353	251	29
2036	4,306	2,721	770	145	379	261	31
2037	4,537	2,904	770	156	405	271	32
2038	4,777	3,095	770	168	431	281	33
2039	5,025	3,294	770	180	457	291	34
2040	5,283	3,502	770	192	483	301	35
2041	5,550	3,719	770	205	509	311	36
2042	5,827	3,946	770	218	535	321	38
2043	6,114	4,182	770	232	561	331	39
2044	6,412	4,429	770	246	587	341	40
2045	6,722	4,686	770	261	613	351	41
2046	7,042	4,954	770	276	639	361	42
2047	7,375	5,234	770	292	665	371	43
2048	7,720	5,525	770	308	691	381	45
2049	8,078	5,829	770	325	717	391	46
2050	8,449	6,146	770	343	743	401	47

Indicators for tracking progress in the implementation of RE related NDCs:

Tracking progress in the renewable energy sector involves several indicators. For Sudan, these indicators can be specific to the country's energy profile and its Sustainable Development Goals (SDGs). Here are some suggested key indicators by the authors:

1. **Total Energy Supply (TES):** This includes the total energy supply each year and the percentage of that supply which comes from renewable sources.
2. **Access to Electricity:** This measures the percentage of the population that has access to electricity.
3. **Annual Increase in Access to Clean Fuels and Technologies:** This tracks the yearly growth in the availability of clean fuels and technologies for both urban and rural areas.
4. **International Financial Flows:** This new indicator, 7.A.1, tracks international financial flows to developing countries in support of clean and renewable energy.
5. **Progress on Energy Efficiency:** This indicator measures the rate of improvement in energy efficiency.
6. **Current Share of Renewable Energy in the Energy Mix:** This measures the proportion of total energy consumption that is met through renewable sources.
7. **Installed Renewable Energy Capacity:** This tracks the total capacity of all renewable energy technologies installed in a given year.
8. **Investment Trends into Renewable Energy Projects:** This monitors the amount of public and private investment in renewable energy projects over time.
9. **Co Benefits such as rural development and Job Creation in the Renewable Energy Sector:** This measures the number of direct and indirect benefits jobs created in the renewable energy sector.
10. **GHG Emission Reductions:** This tracks the reduction in greenhouse gas emissions as a result of renewable energy policies and projects.

These indicators provide a holistic view of the progress being made towards renewable energy goals. However, it's important to note that data availability and quality can vary, so these indicators should be interpreted with caution. The International Energy Agency (IEA) and the World Bank provide comprehensive reports that track these indicators, such as the "*Tracking SDG7: The Energy*

Progress Report". These reports can provide a detailed view of Sudan's progress in the renewable energy sector.

It is worth mentioning that these indicators are most effective when used together, as they provide a holistic view of the progress being made towards renewable energy goals. It's also important to note that data availability and quality can vary, so these indicators should be interpreted with caution by HCENR before submitting the upcoming BTR.

Estimating the impacts of different factors on the policy

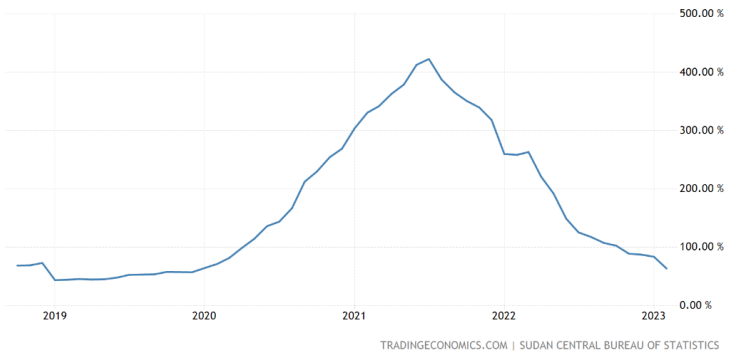
Policy Design Characteristics

The most likely policy design characteristics that may influence the technical potential are:

- **Pricing:** Attractive price, consistent with regional price.
- **Eligibility and administrative procedures:** Tariffs should be set at a level that is sufficient to attract investment and widen eligibility to enter the RE market in each renewable energy technology, taking into account the technology's cost and performance characteristics.

  Also, the simplification and streamlining of administrative procedures for developing and connecting renewable energy projects – could be lacking to attract investments, and the reason for that could be Sudan's only recent experience in that regard.
- **Long-term contract duration:** FIT contracts should have a long-term duration (e.g., 15-20 years) to provide investors with the certainty needed to make significant investments.

  This particular characteristic could be of significant influence, as the electricity utility in Sudan does not readily offer secure contracts packages, such as templates of PPA and interconnection contracts (Ministry of Water Resources, 2019).
- **Policy adjustments:** This characteristic may be of high significance, especially when it comes to adjustments for inflation. FIT tariffs should be indexed to inflation to ensure that they remain attractive to investors over time. This could be challenging for the government to constantly keep up with rising inflation rates to keep investments attractive, given the overall trend of inflation and uncertainty. The figure below shows inflation rates between 2018 and 2023. Due to the unusual circumstances as of April 2023, it is highly unlikely that the inflation rate shown for 2023, would reflect the true situation.



Based on the discussion above, it is estimated that the policy characteristics may affect the

technical potential by around 35%.

Financial Feasibility

The levelized cost of electricity (LCOE) for solar PV in Sudan is estimated at $0.0376/kWh. In contrast, the median rate (2nd 50 kWh purchase in a month) in the public electricity tariff structure, is around $1.2/kWh. The comparison shows that the technology cost does not restrict the diffusion of the policy.

However, many other financial factors may affect the policy, as briefly discussed below.

Upfront Costs

The upfront costs of solar PV systems are the primary barrier to adoption in Sudan. Solar PV systems can be expensive, especially for large-scale projects. These costs can be prohibitive for many potential investors.

Access to Financing

Access to financing is another major barrier to solar PV deployment in Sudan. Financial institutions are often reluctant to lend money to solar PV projects due to perceived risks, such as the volatility of electricity prices and the lack of a strong track record of solar PV projects in Sudan.

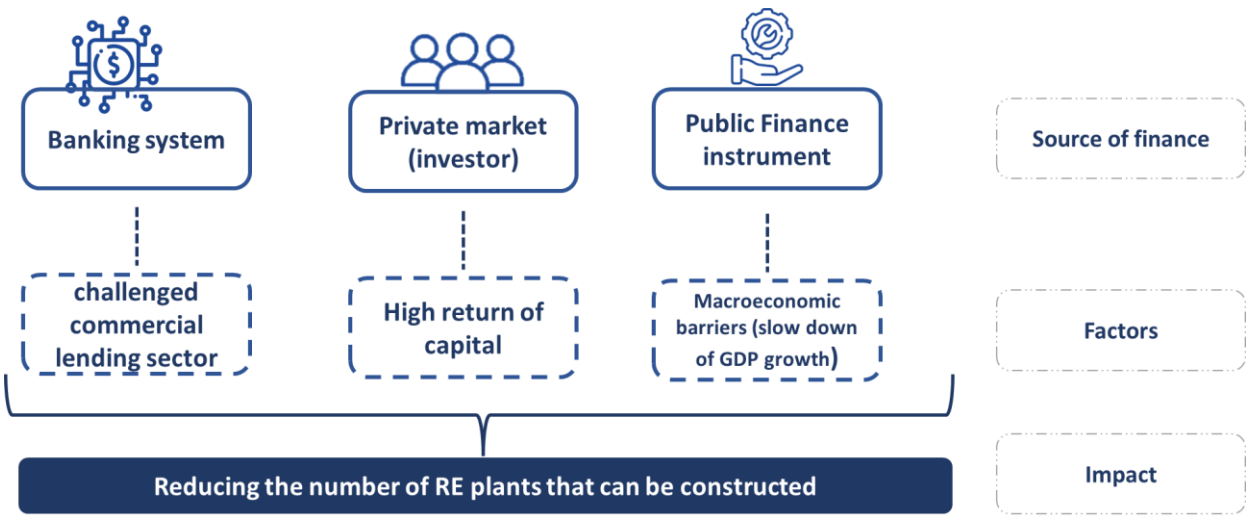


Figure 2: Access to finance

Cost of Capital

The cost of capital for solar PV projects is also high in Sudan. This is due to a number of factors, including high interest rates and a lack of competition among financial institutions. The high cost of capital can make it difficult for solar PV projects to generate a positive return on investment (ROI).

According to the discussion and the significance of these factors, it is estimated that the financial feasibility would impact the technical potential by around 35%.

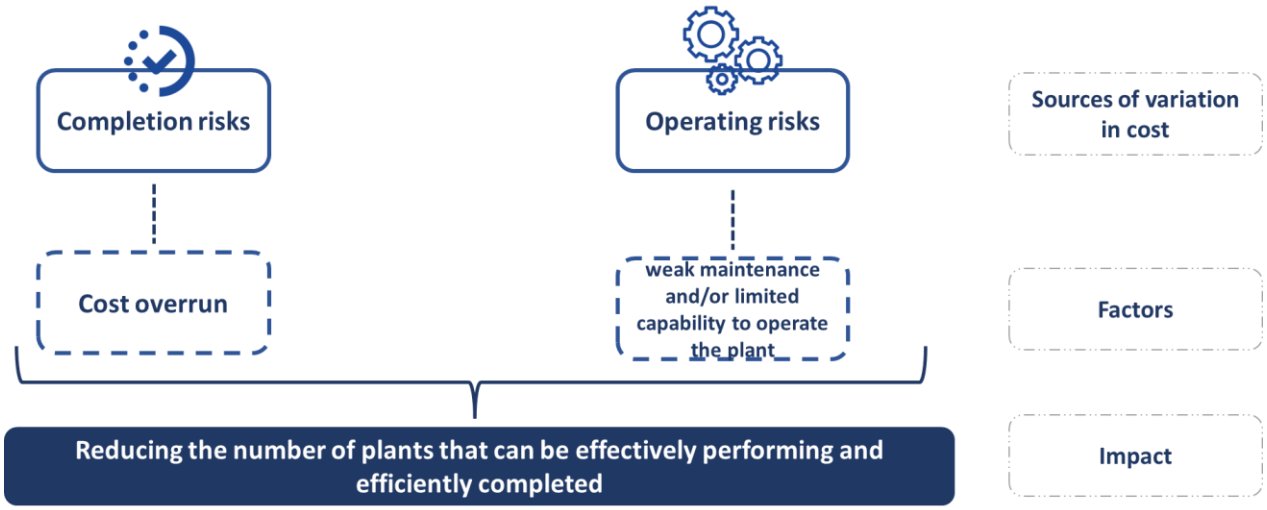


Figure 3: Cost of RE technology/RE project

Other barriers

Other barriers to diffusion of the policy would be limited human capacities and capacity building efforts, in addition to public awareness. These barriers would impact the diffusion of the policy by around 10%.

1- Capacities:
   - Relative presences of academic skills, engineer and researchers , based on theoretical knowledge.
   - Inadequate capacity of operation and maintenance including grid connection and storage.
   - Capacity related to design including metrological station for measuring solar radiation, dust etc
   - Capacity related to QC/QA.

2- Infrastructure:
   - Issues related to grid current status, design and operation.
   - Issues related to import and transport of required equipment. including customs issues and existence of adequate transport and storage.
   - Issues related Trade partners including import policy.
   - Issues related to standards and grid configuration requirements.

Estimating GHG impacts of the FiT policy in Sudan

Based on description of the policy scenario illustrated in section number 5, the estimated final potential of the FiT policy is shown in the following table after considering: (1) the policy design characteristics, (2) financial feasibility and (3) other barriers

Years	**Policy Scenario**	**Impacts on technical potential**				**Revised Potential (GWh)**
		100%	-35%	-35%	-15%	
	Solar Generation and technical potential 2031 (GWh)	Technical Potential in GWh	Policy design characteristics	Financial feasibility	Other barriers	

2021	4,880	4,880.08	1,708.03	1,708.03	732.01	732.01
2022	9,534	9,534.07	3,336.93	3,336.93	1,430.11	1,430.11
2023	14,188	14,188.06	4,965.82	4,965.82	2,128.21	2,128.21
2024	18,842	18,842.06	6,594.72	6,594.72	2,826.31	2,826.31
2025	23,496	23,496.05	8,223.62	8,223.62	3,524.41	3,524.41
2026	28,150	28,150.04	9,852.51	9,852.51	4,222.51	4,222.51
2027	32,804	32,804.03	11,481.41	11,481.41	4,920.60	4,920.60
2028	37,458	37,458.02	13,110.31	13,110.31	5,618.70	5,618.70
2029	42,112	42,112.02	14,739.21	14,739.21	6,316.80	6,316.80
2030	46,766	46,766.01	16,368.10	16,368.10	7,014.90	7,014.90
2031	51,420	51,420.00	17,997.00	17,997.00	7,713.00	7,713.00

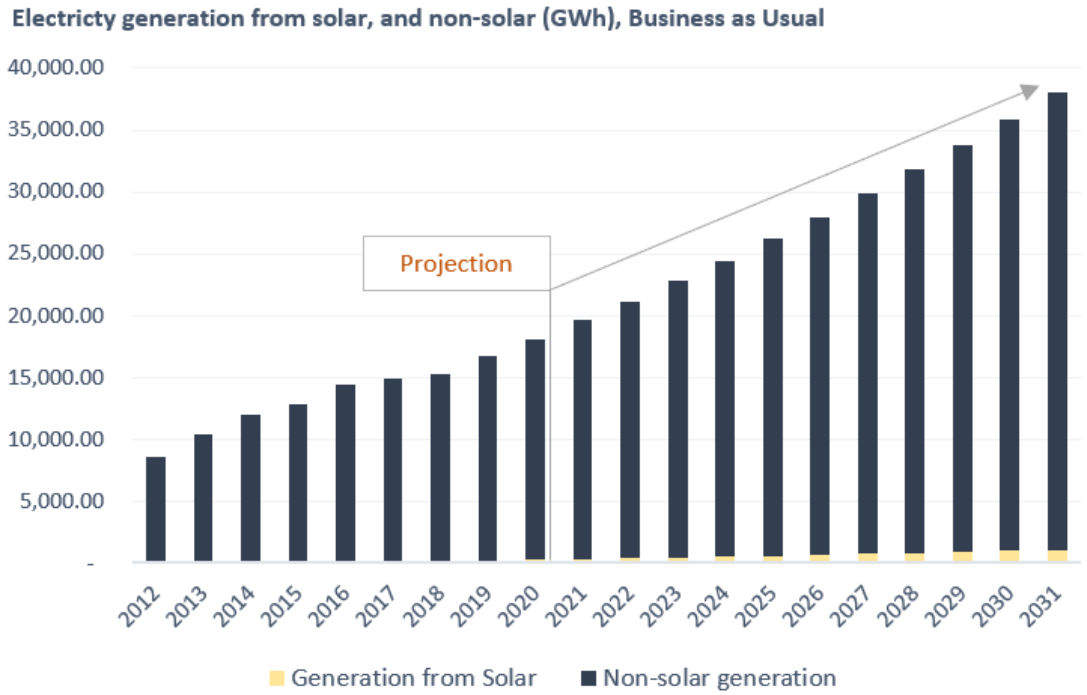


Figure 4: Projection of the BAU scenario for electricity generation

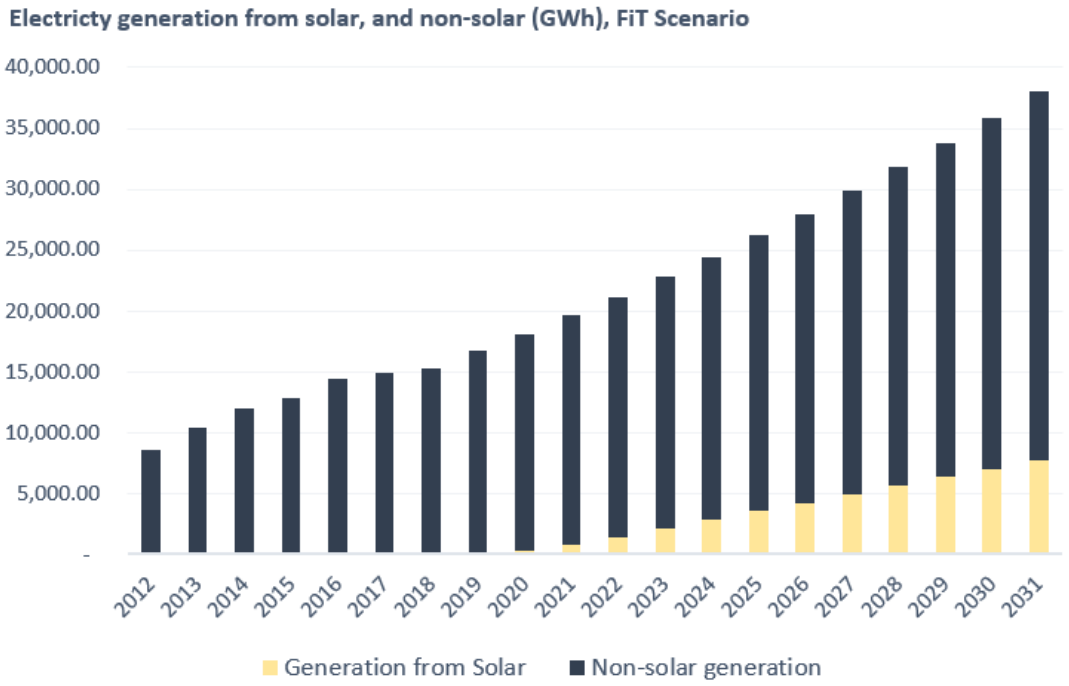


Figure 5: FiT policy scenario for electricity generation

Assuming the effect of the FiT policy on the national GHG emissions starting on 2025, the following figure shows the ex-ante GHG emissions baseline from electricity genertation in Sudan for both the BAU and FiT policy scenario

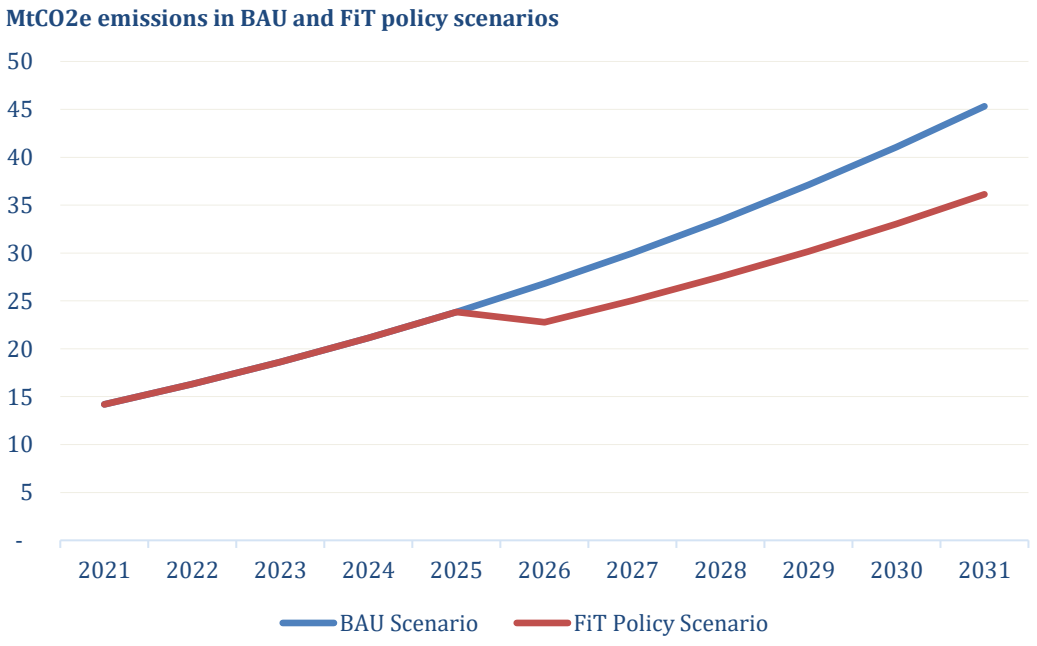


Figure 6: GHG emissions baseline estimation for BAU and FiT policy scenarios for electricity generation

The chart shows that the FiT scenario results in significantly lower GHG emissions than the BAU scenario. In 2030, GHG emissions under the FiT scenario are projected to be 15% lower than under the BAU scenario. This reduction in emissions is due to the increased deployment of renewable energy technologies under the FiT scenario. The reduction in emissions under the FiT scenario is

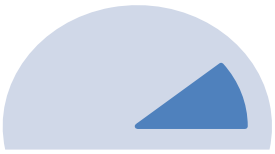
not linear, but rather accelerates over time. This is because the deployment of renewable energy technologies tends to snowball, as the falling cost of renewable energy makes it increasingly competitive with fossil fuels.

The FiT scenario is more likely to be resilient to shocks, such as changes in energy prices or technological breakthroughs. This is because the FiT scenario incentivizes the development of a diversified energy mix, which reduces Sudan's reliance on any single energy source.

Capacity Building and Technical Support Needs

The Sudan Renewable Energy Master Plan, revised in September 2019, and the Sudanese Nationally Determined Contributions (NDCs) both highlight the critical need for capacity building and technical support to effectively implement and monitor climate change mitigation and adaptation actions. The Initiative for Climate Action Transparency (ICAT) provides comprehensive guidance and tools to assist developing countries like Sudan in strengthening their transparency systems and tracking their progress towards achieving their NDC goals.

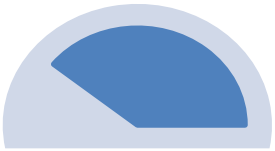
Tailoring ICAT Guidance: ICAT guidance should be adapted to address the unique characteristics of the Transport sector. This involves creating specific modules or chapters within the guidance that focus on transport emissions sources, data collection methodologies, and performance indicators.



Data Collection and Management: Capacity building programs should emphasize data collection, validation, and management. It should include training on monitoring vehicle fleets, fuel consumption, mode shifts, and the impact of transport infrastructure.

Emissions Factors and Calculations: Transport-specific emissions factors are vital for accurate emissions calculations. Technical support should include guidance on how to develop and use emissions factors specific to the transport modes and fuels used in a region.

Tools and Technologies: Training should cover the use of technological tools for data collection and analysis, including GPS tracking, telematics, remote sensing, and satellite imagery, to enhance data accuracy.



Reporting Protocols: Capacity building should guide policymakers and practitioners on developing standardized protocols for reporting emissions, ensuring consistency and comparability across regions.

Figure 7: Utilization of ICAT technical guidance for improving the Sudanese MRV system in the energy and transport sectors.

The Energy sector's contribution to climate mitigation is undeniable. By providing tailored technical support and capacity building, countries, regions, and cities can enhance their MRV processes within the energy sector. The goal is to empower policymakers, planners, and practitioners to align the sector's policies and actions with broader climate objectives, ultimately

achieving a more sustainable and low-carbon. It is a collective effort towards a more transparent, accountable, and climate-resilient Energy sector.

Table 1: Technical support and capacity building needs

Policy/Action	*Interventions*	*Technical support*
Creating an enabling Environment (policy, Legislative) for energy Sector	• Mainstreaming the climate change and the Sudan NDCs through designing national energy plan at the strategic level. • Developing guidelines to integrate energy plans in national and states development plans. • Establishing and strengthening enforcement mechanisms to the national energy plan and NDC implementation. • Integrate standalone and mini-grid systems into national energy plans and policies, recognizing their role in achieving broader energy access goals. • Develop policies that facilitate the grid interconnection of standalone and mini-grid systems, allowing for the exchange of excess energy with the national grid.	*Training modules and capacity-building programs:* Implement capacity-building programs to enhance the skills and knowledge of energy professionals and decision makers in climate change concepts and adaptation strategies. This ensures that the key stakeholders are equipped to integrate climate considerations into their planning and decision-making processes.
Existing Policy and Regulatory Analysis	• Systematic examination of existing policies, regulations, and legal frameworks related to the energy sector, with a specific focus on climate change considerations. • Develop and enforce supportive regulations that encourage the rewinding of hydrogeneration units, addressing any legal or permitting barriers. • Identify strengths, weaknesses, gaps, and opportunities within the	*Policy analysis frameworks*[3]*:* Conduct a thorough analysis of existing policies and regulations related to energy. *Policy integration*: through scenario planning, policy dialogue and cross sectoral coordination.

[3] an ex-ante assessment, an ex-post assessment, or a combined ex-ante and ex-post assessment.

	current policy landscape, facilitating the integration of climate considerations into national energy plans. • Establish and enforce energy efficiency standards and regulations for equipment, appliances in residentials, and industrial processes within the energy sector.	
Transformation of the electricity sector toward low emission power generation	• Developing and implementing strategic roadmap for community based RE projects.	• *Establishing policies* that facilitate community ownership of renewable energy infrastructure. • *Providing financial and technical assistance* for communities to develop and maintain their renewable energy projects.
	• Incentives for industry decarbonization.	*Supporting research and development* in industrial decarbonization
	• Promotion of Standalone and Mini-Grid Systems	Provide *technical assistance and capacity-building programs for local communities* and businesses to enhance their ability to develop, operate, and maintain standalone and mini-grid systems. *Support training programs for technicians* and engineers specializing in decentralized energy systems.
	Hydrogeneration Improvement through Rewinding	• Invest in *training programs* for local technicians and engineers in the specialized skills required for rewinding hydrogeneration units. • Collaborate with *educational institutions and industry experts* to develop training curricula tailored to hydroelectric systems.
	Promotion of the energy efficiency	• *Develop and implement capacity-building programs* to train energy sector professionals,

technicians, and operators in energy-efficient practices and technologies.
- Launch *public awareness campaigns* to educate stakeholders, including businesses and consumers, about the importance of energy efficiency.

Conclusion and recommendation:

This report demonstrated the potential of applying the ICAT Renewable Energy Methodology Guidelines to assess the greenhouse gas (GHG) impacts of energy pricing policies in Sudan. By analyzing the relevance of these guidelines to Sudan's NDCs for the energy sector, the report provides a valuable tool for policymakers aiming to achieve their climate goals.

The report not only offers an overview of various renewable energy pricing policies (feed-in tariffs, tax incentives, and auctions) but also identifies potential implementation barriers. This comprehensive approach allows for a more informed and realistic assessment of these policies' effectiveness.

Furthermore, the report highlights the need for capacity building and technical support to ensure successful implementation of the ICAT framework in Sudan. Finally, the example of a Feed-in Tariff pricing policy showcases the practical application of the methodology and the influence of various factors on achieving GHG reductions.To further refine and strengthen the assessment process and achieve more concrete results, the following recommendations are made:

1. Data Collection and Validation:

- **Activity data by source:** Gather and validate activity data (e.g., fuel consumption, electricity generation) for different energy sources to enable an accurate **ex-ante projection** of the FiT policy's impact on the **renewable energy share** in Sudan's total electricity generation.

- **Grid emission factor update:** Ensure the **grid emission factor**, which reflects the average CO2 emissions per unit of electricity generation, is updated with the latest available data. This will provide a more precise estimate of the overall GHG reduction potential.

- **Quantify technical potential impact:** Conduct a comprehensive study to quantify the **specific impacts** of the FiT policy on the **technical potential** of solar and other renewable energy applications for electricity generation. This will provide valuable insights

into the feasibility and effectiveness of the policy in promoting specific renewable energy sources.

2. Capacity Building and Technical Support:

Building on the identified needs in the report, further **capacity building and technical support** efforts are crucial to ensure the successful implementation of the ICAT RE methodology guidelines in Sudan. This could involve:

- Training programs for relevant stakeholders on the ICAT methodology and its application to FiT policy assessment.

- Providing technical assistance in data collection, analysis, and modeling techniques necessary for conducting GHG impact assessments.

3. Collaboration and Continued Analysis:

- Encourage **collaboration** between relevant government agencies, research institutions, and private sector stakeholders to share data, expertise, and resources for effective FiT policy assessment.

- Conduct **regular assessments** of the FiT policy using the ICAT framework, adapting and refining the methodology as needed to reflect evolving conditions and improve the accuracy of future assessments.

By implementing these recommendations, Sudan can ensure **reliable and robust assessments** of the FiT policy's GHG impacts, ultimately informing the development and implementation of effective policies that contribute to achieving the country's NDCs and a sustainable energy future.

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Appendix - A: Training Session on ICAT Toolbox for Energy Pricing Policy

[TYPE THE COMPANY NAME]

25-26 October 2023

Instructor:
Jyoti Prasad Painuly
Project Coordinator:
Alejandro Regatero Labadia

Alejandro Regatero Labadia

1. Introduction

The ICAT Sudan project hosted the capacity building training on MRV transparency systems based on the ICAT renewable energy and transport pricing assessment guides. This is as part of the country's efforts in developing the information necessary to track progress made in implementing and achieving Sudan's NDC,

under the Initiative for Climate Action Transparency (ICAT). This report is documenting the sessions on the ICAT Renewable Energy Assessment Guide.

2. Specific Objectives

This Capacity building program was an intended event for the ICAT project undertaken under the ICAT Secretariat and the UNEP-CCC partnership. The objectives of the program were to build the capacities of all participants representing project's stakeholders to meet the ICAT reporting requirements to track progress made in implementing and achieving Sudan's NDC under the Initiative for Climate Action Transparency (ICAT) through an MRV system.

3. Training Sessions Approach

The training sessions were preceded by provision of video recordings prepared by the Instructor and the IT team at the UNEP-CCC based on the Sudan NDCs and sector specific strategies. Then provided Power Point Presentations (in English), case studies and exercises facilitated by Dr. Abdelrahman Eltahir Ahmed Musa the ICAT National Consultant –Energy Sector. The discussion curried in Arabic to assure the participants' understanding of the objectives and outcomes of the training sessions.

4. Instructor and Facilitator

The training sessions were led by the Instructor Mr. Jyoti Painuly (UNEP-CCC) and facilitated by Mr. Alejandro Regatero (UNEP-CCC).

5. The Program

ICAT Renewable Energy Assessment Guide- Two Days On-Line Sessions Day 1 – 25 October 2023, 10:00 – 16:30, meeting link here		
10:00 – 10:15	Presentation of the project and round of introductions	Alejandro Regatero (UNEP-CCC)
10:15 – 12:00	ICAT Renewable Energy Assessment Guide	Jyoti Painuly (UNEP-CCC)
12:00 – 13:00	*Lunch break*	
13:00 – 14:00	Q&A - Group exercise and examples ICAT Renewable Energy Assessment Guide	Jyoti Painuly (UNEP-CCC)
14:00 – 16:30	Group work session – exercises on Renewable Energy Assessment Guide	All participants
Day 2 – 26 October 2023, 11:00 – 14:00		
11:00 – 12:00	Group work session – exercises on Renewable Energy Assessment Guide	All participants
12:00 – 13:00	*Lunch break*	
13:00 – 14:00	Group exercise / Solution presentation – ICAT Renewable energy Assessment Guide – Q&A	Jyoti Painuly (UNEP-CCC) / All participants

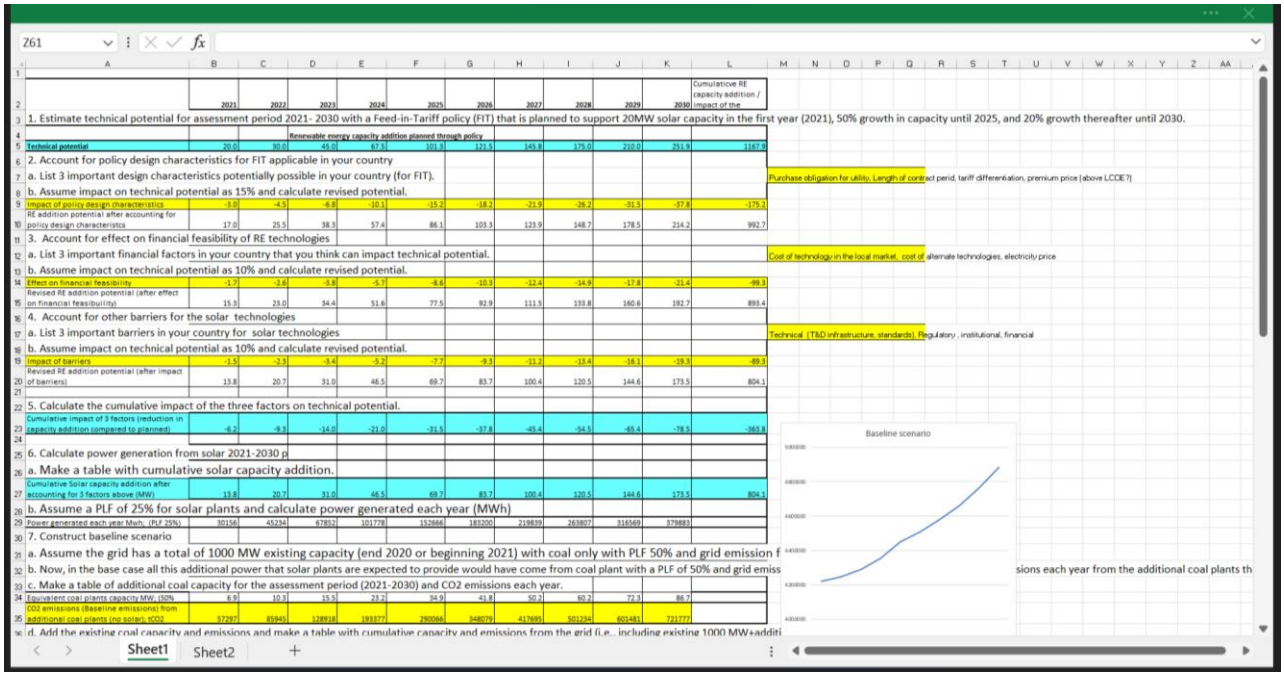
6. Exercise

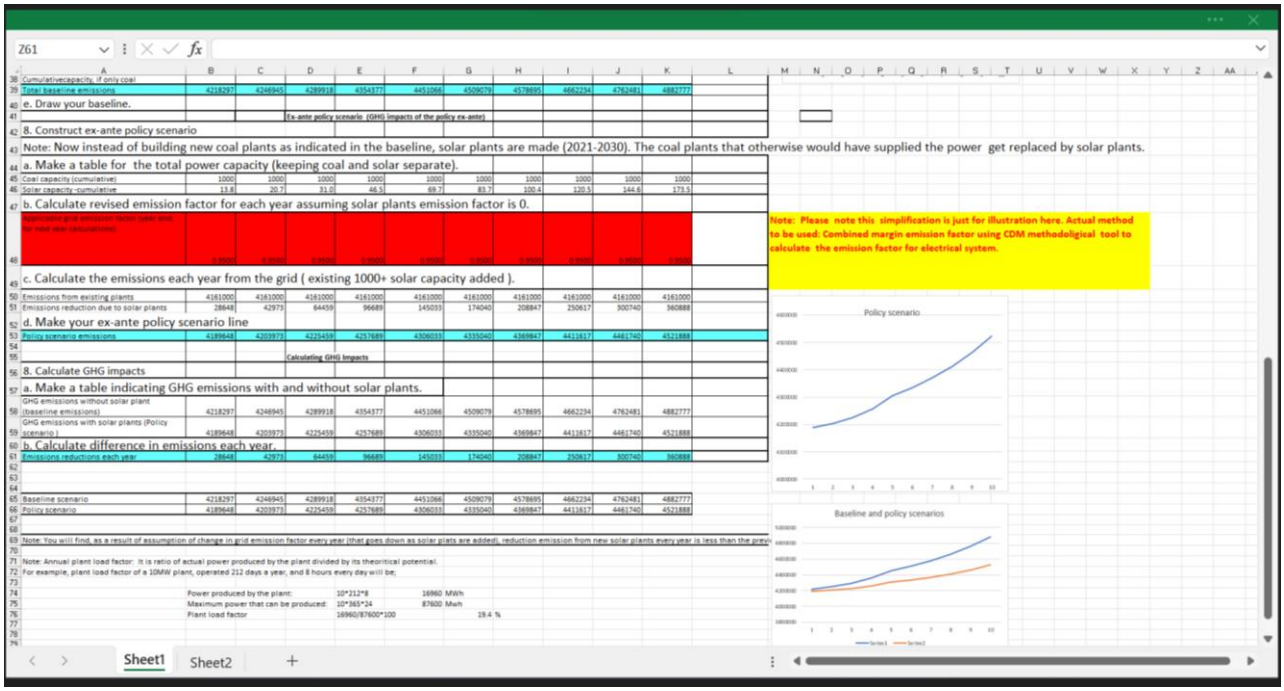
1. Estimate technical potential for assessment period 2021- 2030 with a Feed-in-Tariff policy (FIT) that is planned to support 20MW solar capacity in the first year (2021), 50% growth in capacity until 2025, and 20% growth thereafter until 2030.
2. Account for policy design characteristics for FIT applicable in your country.
   a. List 3 important design characteristics potentially possible in your country (for FIT).
   b. Assume impact on technical potential as 15% and calculate revised potential.
3. Account for effect on financial feasibility of RE technologies.
   a. List 3 important financial factors in your country that you think can impact technical potential.
   b. Assume impact on technical potential as 10% and calculate revised potential.
4. Account for other barriers for the solar technologies
   a. List 3 important barriers in your country for solar technologies
   b. Assume impact on technical potential as 10% and calculate revised potential.
5. Calculate the cumulative impact of the three factors on technical potential.
6. Calculate power generation from solar 2021-2030 period
   a. Make a table with cumulative solar capacity addition.
   b. Assume a PLF of 25% for solar plants and calculate power generated each year (MWh)
7. Construct baseline scenario
   a. Assume the grid has a total of 1000 MW existing capacity (end 2020 or beginning 2021) with coal only with PLF 50% and grid emission factor 0.95 t CO2/MWh.
   b. Now, in the base case all this additional power that solar plants are expected to provide would have come from coal plant with a PLF of 50% and grid emission factor 0.95 t CO2/MWh. Calculate total emissions each year from the additional coal plants that would have come up.
   c. Make a table of additional coal capacity for the assessment period (2021-2030) and CO2 emissions each year.
   d. Add the existing coal capacity and emissions and make a table with cumulative capacity and emissions from the grid (i.e., including existing 1000 MW + additional coal capacity).
   e. Draw your baseline.
8. Construct ex-ante policy scenario
   a. Make a table for the total power capacity (keeping coal and solar separate).

b. Calculate revised emission factor for each year assuming solar plants emission factor is 0.
c. Calculate the emissions each year from the grid (existing 1000+ solar capacity added).
d. Make your ex-ante policy scenario line.

9. Calculate GHG impacts
   a. Make a table indicating GHG emissions with and without solar plants.
   b. Calculate difference in emissions each year.

Sample of solutions:





7. Stakeholders

Table 1: Stakeholders Targeted by ICAT Project

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, MOil & Gas industry)
12	Unions, chambers of commerce and other associations
13	The Higher Council of Environment and Natural Resources (HCENR)

8. Attendance

The two days on-line capacity building program was attended by 23 participants representing the two sectors Energy and Transport and seven apologies due to the situation in the country. The consultants will make sure to ensure the dissemination of information and training materials to those who did not attend.