Initiative for Climate Action Transparency – ICAT

DELIVERABLE #3: IMPACTS OF THE RENEWABLE FEED-IN TARIFF REGULATION ON RE ADDITION AND GHG EMISSIONS REDUCTIONS IN MOZAMBIQUE AND RECOMMENDATIONS ON HOW TO IMPROVE DATA COLLECTION AND REPORTING FOR TRACKING IMPLEMENTATION OF THE RENEWABLE FEED-IN TARIFF FOR REPORTING UNDER THE ENHANCED TRANSPARENCY FRAMEWORK

Initiative for Climate Action Transparency - ICAT –

Impacts of the Renewable Feed-in Tariff Regulation on RE Addition and GHG Emissions Reductions in Mozambique and Recommendations on how to Improve Data Collection and Reporting for Tracking Implementation of the Renewable Feed-In Tariff for Reporting Under the Enhanced Transparency Framework

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Date of the deliverable (October 2019)

PUBLISHED BY

Ministry of Land, Environment and Rural Development (Mozambique)

PREPARED UNDER

Initiative for Climate Action Transparency (ICAT) project supported by the German Federal Ministry for the Environment, Nature Conservation, Building, and Nuclear Safety, the Children´s Investment

Fund Foundation (CIFF), the Italian Ministry for Environment, Land and Sea Protection, and ClimateWorks

The ICAT project is hosted by the United Nations Office for Project Services (UNOPS)

ACKNOWLEDGMENTS

We would like to acknowledge and express gratitude to the Ministry of Land, Environment and Rural Development (DINAB), Ministry of Mineral Resources and Energy (MIREME), and all interviewed energy sector stakeholders for their collaboration. Special gratitude to Mr. Federico Canu and Ana Cardoso from UNEP-DTU for insightful discussions and their continued support of this report.

ABSTRACT

Under the Paris Agreement, all Parties to the United Nations Framework Convention on Climate Change (UNFCCC) agreed on the ambitious goal to limit the increase in global average temperature to well below 2 °C, and pursue efforts to limit warming to 1.5 °C. The main framework to achieve the objective of the Paris Agreement is the countries' Nationally Determined Contributions (NDCs). In this context, the government of Mozambique approved the country's NDC, establishing domestic mitigation actions and adaptation measures, which include the improvement of access to renewable energy (RE) through the implementation of policies and programs as a specific mitigation contribution. The Renewable Energy Feed-in-Tariff (REFIT) regulation (approved by Decree nr. 58/2014), although still not operational, is a policy instrument expected to provide a substantial contribution to the emission reductions envisioned by this mitigation action.

The objective of this assessment is to apply the Initiative for Climate Action Transparency (ICAT) RE guidance to estimate the RE addition and the GHG emission reduction of the REFIT ex-ante, compared to what would have occurred in a baseline scenario, to determine the REFIT's potential contribution to meet the NDC's goals and RE targets. The GHG impact of the REFIT was estimated using the Long-range Energy Alternatives Planning System (LEAP) energy model. The results reveal that in the baseline scenario strting in 2020, the comulative emissions are expected to be 31,65 and 68,41 $MtCO_2eq$ in 2025 and 2030, respectively. Emission reductions in the NDC_REFIT (32 MW) scenario are found to be almost negligible for the period 2020-2025, and only 0.34 $MtCO_2eq$ by 2030, equivalent to a 0.6% reduction compared to the Business As Usual (BAU) scenario. However, achieving REFITs full implementation would lead to a reduction of 0.17 $MtCO_2eq$ by 2025 and 2.54 $MtCO_2eq$ by 2030, corresponding to a 0.5% and 4.3% reduction by 2025 and 2030 respectively.

This assessment has identified the main barriers that can hinder accurate estimations of GHG and consequently the implementation of monitoring, reporting, and verification (MRV) for the REFIT regulation. MRV of the REFIT implementation will be needed in order to properly assess the effectiveness of the regulation, and enable the required UNFCCC reporting through National Communications (NC), Biennial Update Report (BURs), and the coming Biennial Transparency Reports (BTRs). The identified barriers range from weak coordination between institutions, lack of consistent data, lack of robust mechanisms for data collection, processing and sharing, lack of skilled capacities, to lack of budgetary allocations for MRV activities. However, these barriers can be overcome by establishing a clear definition of roles and responsibilities between and within the institutions, enhance institutional capacities for MRV and local experts, and improve mechanisms for data collection, processing, and sharing.

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Abbreviations and acronyms

ICAT	Initiative for Climate Action Transparency
MIREME	Ministry of Mineral Resources and Energy *Ministério de Recursos Minerais e Energia*
NDC	Nationally Determined Contributions
INDC	Intended Nationally Determined Contributions
RE	Renewable Energy
GHG	Greenhouse Gases
MITADER	Ministry of Land, Environment and Rural Development *Ministerio da Terra, Ambiente e Desenvolvimento Rural*
MEF	Ministry of Economy and Finance *Ministerio da Economia e Financas*
FUNAE	Energy Fund *Fundo de Energia*
EDM	Electricity of Mozambique *Electricidade de Mocambique*
SEFA	Sustainable Energy Fund for Africa
ETF	Enhanced Transparency Framework
IRENA	International Renewable Energy Agency
REFIT	Renewable Energy Feed-in Tariff
ARENE	Energy Regulatory Authority Board *Autoridade Reguladora de Energia*
GET FiT	Global Energy Transfer Feed-in Tariffs Program
GHG	Greenhouse Gases
COP	Conference of Parties
UNFCCC	United Nations Framework Convention on Climate Change
MRV	Monitoring, Reporting, and Verification
BAU	Business-As- Usual
LEAP	Long range Energy Alternatives Planning System
O&M	Operation and Maintenance
CAPEX	Capital Expenditure
OPEX	operating expenses
ENAMMC	National Strategy for Adaptation and Mitigation of Climate Change *Estrategia Nacional de Adaptacao e Mitigacao das Mudancas Climaticas*
GWh	Gigawatt hour
MW	Megawatt
KWh	Kilowatt hour
PV	Photovoltaic
IPP	Independent Power Producers
PPA	Power Purchase Agreement
LCOE	Levelized Cost of Electricity
NPC	Net Present Cost
PV	Photovoltaic

CTRG	Central Térmica de Ressano Garcia
CTM	Central Térmica de Maputo
CO_2	Carbon dioxide
tCO_2eq	Tons of carbon dioxide equivalent
$MtCO_2eq$	Metric tons of carbon dioxide equivalent
CCGT	Combined Cycle Gas Turbine
NCs	National Comunications
BURs	Biennial Update Report
BAU	Business as Usual
BTRs	Biennial Transparency Reports
MCTESTP	Ministry of Science and Technology, Higher Education and Technical-Professional *Ministerio de Ciencia, Tecnologia, Ensino Superior e Tecnico-Profissional*
DNPO	National Directorate of Planning and Budget *Direcção Nacional de Planeamento e Orçamento*
DNE	National Directorate of Electricity *Direcção Nacional de Energia*
DPC	National Directorate of Planning and Cooperation *Direcção Nacional de Planificacao e Cooperação*
DINAB	National Directorate of Climate Change *Direcção Nacional de Mudanças Climáticas*
GIIMC	Inter-Institutional Group for Climate Change *Grupo Inter-Institucional de Mudanças Climáticas*
MPG	Modalities, Procedures, and Guidelines
INE	National Institute of Statistics *Instituto Nacional de Estatística*
GDP	Gross Domestic Product
QA/QC	Quality Assurance/Quality Control

1 INTRODUCTION

The twenty-first Conference of Parties (COP21) on Climate Change was marked by the adoption of the Paris Agreement, with the objective to limit the increase in global average temperature at well below 2 °C, relative to pre-industrial levels, and pursue efforts to limit warming to 1.5 °C. The adoption of the Paris Agreement also acknowledged the need to promote universal access to sustainable energy as a tool that will help to shift to energy transition to reduce Greenhouse Gases (GHG) emissions (UNFCCC, 2015)[1]. The main framework to achieve the objective of the Paris Agreement is the countries' Nationally Determined Contributions (NDCs), establishing domestic mitigation actions and adaptation measures to achieve the NDCs' targets.

To ensure that the global efforts to achieve the ultimate objectives of the Paris Agreement are on track, it is important to be able to monitor efforts leading to GHG emissions reductions. To this end, Article 13 of the Paris Agreement established an Enhanced Transparency Framework (ETF) to build mutual trust and confidence among Parties and to promote effective implementation of the Paris Agreement. The ETF is designed with built-in flexibility, which takes into account Parties' different capacities, and builds upon the collective experience of transparency under the Convention (UNFCCC).

The Initiative for Climate Action Transparency (ICAT) arises in this context, to respond to the critical need for support of developing countries for improved transparency and capacity building under the Paris Agreement. ICAT aims to strengthen the institutional capacity of developing countries to meet the enhanced transparency requirements and build robust measuring, reporting, and verification (MRV) systems for policies related to climate change, which can strategically be used to support and track the progress of NDC implementation. The country is implementing the ICAT initiative having prioritized, among others, the renewable energy (RE) sector, due to its contribution to the mitigation of climate change and prominent role in the NDC.

The Government of Mozambique has recently (December 2018) approved the second NDC[2] and its operational plan, currently being translated before submission to the UNFCCC. The second NDC identifies the energy sector as one of the priority sectors for mitigation of GHG emissions, due to its high share of national emissions and potential for emission reduction through the implementation of alternative energy policies. Although identified as a priority sector, a GHG impact assessment of the implementation of energy policies is needed to support decision making towards energy transition, while assessing their contribution to

[1] UNFCCC, 2015: Decision 1/CP.21 *Adoption of the Paris Agreement*

[2] Ministério D A Terra and Ambiente E Desenvolvimento Rural, 'Contribuição Nacionalmente Determinada (NDC) de Moçambique à Convenção Quadro Das Nações Unidas Sobre as Mudanças Climáticas (UNFCCC)', 2017.

emissions reductions. The GHG impact assessment of RE policies is crucial to identifying opportunities and gaps in effective GHG mitigation strategies[3]. Impact assessment supports evidence-based decision making by enabling policymakers and stakeholders to understand the relationship between policies and expected GHG impacts.

More specifically, Mozambique has identified the improvement of access to RE through the implementation of policies and programs as a specific mitigation contribution in its NDC. The Renewable Energy Feed-in-tariff (REFIT) regulation, although still not operational, is a RE policy instrument expected to provide a substantial contribution to the emission reductions envisioned by the improvement of access to RE. Thus, the main objective of this assessment is to apply the ICAT guidance on RE, to estimate GHG emission reduction of the REFIT ex-ante compared to what would have occurred in a baseline scenario, to determine the REFIT's potential contribution to meet the NDC's goals and RE targets. The study is particularly important for Mozambique since the country is currently in its energy transition, and hence, sound REFIT policies may help in attracting investments towards low carbon initiatives. Besides, the study may also be applied as an example for other initiatives in different sectors.

[3] ICAT'Renewable Energy Guidance', 2018.

2 METHODOLOGY FOR ESTIMATING GHG IMPACTS

This assessment applied the ICAT RE guidance to estimate the RE addition of the policy ex-ante. The guidance provides general principles, concepts, and a stepwise approach for estimating the effects of policy design characteristics, economic and financial factors, and other barriers of RE policies to achieve their maximum implementation potential. The guidance applies the emission trajectory method to estimate the GHG impact of RE policies (REFIT), which develops a trajectory for future emissions from the electricity grid based upon the expected future mix of generating technologies. The method involves making assumptions about the future electricity mix and can be done using limited data or more complex models that model the energy sector development in detail. The resulting emission trajectory can either be used as a stand-alone assessment to determine whether the trajectory is on track to meet a target or in combination with a baseline scenario to determine the emission reductions[4].

The RE ICAT guidance doesn't provide the tools necessary to model and do the actual calculations of emission reductions, why it needs to be used in conjunction with other tools and methods. Therefore, the GHG impact of the REFIT was estimated using the Long-range Energy Alternatives Planning System (LEAP) energy model. LEAP is an integrated modeling tool developed by the Stockholm Environment Institute, which can be used to track energy consumption, production, and resource extraction in all sectors of an economy.

For consistency with the recently developed NDC plan, the baseline scenario for this assessment is the same as that of the NDC approved by the government of Mozambique. The baseline uses the available historical data provided by Energy Statistics, by the Ministry of Energy, combined with other sources, as described in the section below about developing the baseline scenario.

[4] ICAT 'Renewable Energy Guidance', 2018.

3 DESCRIPTION OF MOZAMBIQUE's NATIONALLY DETERMINED CONTRIBUTIONS (NDC)

In October 2015, in preparation for the Paris Agreement, Mozambique submitted its Intended Nationally Determined Contributions (INDC's) for the period 2020 – 2030 to the United Nations Framework Conventional on Climate Change (UNFCCC). Increasing the access to RE sources was already identified as a component to reduce GHG emissions under the INDC mitigation contribution. The INDC outlined 12 mitigation policies, actions, and programs, including the RE Feed-in Tariff Regulation (REFIT), as a mechanism that proves to be efficient and effective in promoting RE.

The government has recently approved the second NDC and its operational plan (December 2018), but the new NDC has, however, not yet been submitted to the UNFCCC. Mozambique is vulnerable to climate change and its negative impacts. Therefore, the NDC presents an opportunity for the country to increase climate resilience, reduce the negative effects of climate change, promote the use of clean technologies, and build institutional and human capacity. Among others, the NDC specific objectives are to implement adaptation and GHG mitigation initiatives, contributing to the sustainable use of natural resources. The NDC contribution is although dependent on the access to international support to an estimated cost of approximately 11.000 million USD.

The mitigation contribution of the second NDC is now structured in the implementation of actions, policies, and programs divided by sector. The NDC describes how the country intends to contribute to the purpose of the Paris Agreement by reducing GHG emissions of about 31.9 $MtCO_2eq$ from 2020 to 2025, of which 30 $MtCO_2eq$ are reduced in the forest and land-use sector, and the conservation and sustainable use of biomass, including creating a sustainable value chain for charcoal. A reduction of 1.90 $MtCO_2eq$ is envisioned through other measures, including in the waste and energy sector. However, considering the projections of large socio-economic aggregates (GDP and population) by 2030, and also the fact that various mitigation measures are planned after 2025, the NDC also report emission trends by 2030. The NDC incorporates RE to accelerate the transition to a lower-carbon energy system by increasing the rapid deployment of clean and efficient energy technologies (Source: NDC Mozambique 2018).

Although the REFIT is no longer specifically mentioned in the second NDC, it is still a part of the operationalization of the NDC. The NDC operational plan contains adaptation and mitigation actions to be undertaken by different sectors, aligned with the National Strategy for Adaptation and Mitigation of Climate Change, sustainable development goals, and other sectoral development strategies and policies. They also include actions that the sectors intend to include in the next government's five-year plan. The following actions have been selected among the energy sector actions:

- Improving access to renewable energies (promotion of the use of renewable energy sources, including partial RE penetration through the application of REFIT);
- Expansion of the national grid (new connections);
- Increasing energy efficiency;

REFIT is in line with the RE policy and its strategy, and also with the objectives to be achieved under the NDC. It is included in the NDC as one of the activities that will contribute to its achievement by attracting the private sector for the development of the existing RE potential, increasing the integration of RE generations in the power systems, and reduce GHG emissions caused by fossil fuels. Although, the NDC mitigation contribution of 31.9 MtCO2eq from 2020 to 2025 includes only a partial penetration of RE caused by REFIT, compared to the REFIT policy's full implementation potential. While the NDC envisions the penetration of an additional 32 MW of RE through the REFIT during the implementation of the NDC up until 2030, the REFIT policy operates with its caps for implementation, set at a total of 250 MW of RE additions. The scenarios built in this analysis will illustrate how the different RE penetrations under the NDC scenario and REFIT policy implementation can contribute to GHG mitigation, and how the full implementation of the REFIT policy's potential could drive up ambition and achieve greater mitigation targets than the ones established under the NDC.

4 EXISTING POLICY, REGULATORY FRAMEWORK, AND EFFORTS TO PROMOTE RENEWABLE ENERGY IN MOZAMBIQUE

Mozambique has considerable energy resources, including hydropower, natural gas, coal, biomass, solar PV, and wind, with the capacity to satisfy most of its domestic energy needs and also provide additional revenue through exports. This section provides information about the efforts adopted to promote RE developments in the country. The government conducted a mapping exercise for RE, whose results are compiled in what we call the "RE Atlas of Mozambique"(www.atlasrenovaveis.co.mz), released in 2013, which provides detailed information for potential investors in RE. According to the RE Atlas, the total RE potential was estimated as being of 23.000 GW of which the government has identified priority projects of 5.645 MW for hydro, 600 MW for solar, 1.146 MW for Wind, 128 MW for biomass and 20 MW for geothermal power, taking into account the quality of the resource and proximity to the electricity grid. The atlas also highlights the need for adequate financing schemes for the effective implementation of these projects.

One of the main drivers for the development of RE is the fact that the government of Mozambique prioritizes the energy sector as one of the key sector to boost the socio-economic development of the country, fact that results in the specific policy and regulatory framework, to promote the integration of RE resources into the energy matrix as follows:

- The New and Renewable Energy Development Policy (Resolution no. 62/2009) that defines the policy of the country for RE Development;
- The Biofuel Policy and Strategy (Resolution no. 22/2009) that describes Mozambique's vision for biofuels, guaranteeing their presence in the energy sector; Followed by Resolution 58/2011, which established the blends of biofuels regulation for petrol to ethanol (90%:10%); and diesel to biodiesel (97%: 3%) ;
- The National Strategy for New and Renewable Energy Development, which is a guiding instrument of development planning and implementation of projects for the use and conversion of RE sources; and the Conservation and Sustainable Use of Biomass Energy Strategy, recognizing the contribution of GHG from deforestation;

The REFIT regulation for Mozambique (Decree nr. 58/2014) establishes tariffs for Solar, Wind, Biomass, and Hydro for projects less than or equal to 10MW. The REFIT arises in the context of the implementation of the New and Renewable Energy Development Policy and its Strategy, as an instrument that will mobilize/attract the participation of the private sector in developing RE projects. It is complemented by the Environmental Law (Decree nr. 20/1997), the Environmental Impact Assessments Process (Decree nr. 45/2004), and the National Climate Change Adaptation and Mitigation Strategy (ENAMMC) [5] for the period 2013-2025,

[5] 'Estratégia Nacional de Adaptação e Mitigação de Mudanças Climáticas', 2013.

that provides options for climate change adaptation and mitigation, and other sectoral policies and strategies. The ENAMMC also envisages actions to promote rural electrification using RE and increased energy efficiency.

The decentralized/rural RE sub-sector is experiencing quite significant advancements with the development of projects through the Energy Fund (FUNAE), responsible for off-grid electrification (construction). FUNAE was created to boost the rural electrification efforts in the country and has been implementing decentralized solar home systems, mini/micro solar PV and hydropower systems, and biomass (wood and charcoal) projects in rural areas over several years. The most common application of these systems includes lighting, refrigerators, solar lanterns, street lights, solar charging, radio, TV, and water pumping. According to the National Electrification Strategy (2018 - 2030)[6], FUNAE will transfer the built assets (off-grid mini-grids) to EDM for trading, operations, and maintenance, and EDM may outsource the operation of these assets to private operators or the communities involved.

Nevertheless, information about the total installed capacity is still limited. However, some micro/mini-grids projects have been successfully implemented. As of 2017, the country had 12 mini-grids implemented, with total capacity of approximately 3MW, which includes 6 (six) solar PV installations ranging from 0.01 to 0.55 MW, 5 (five) micro hydropower owned by FUNAE and 1 biomass cogeneration of 1.5 MW capacity developed and owned by a sugar factory (Maragra) for their own consumption. Furthermore, 38 solar power stations of 4kW each have been spread in many villages along the country, implemented by private entities through FUNAE (Source: FUNAE 2018).

[6] Blica D E Mo and Outubro De, 'Estratégia Nacional de Electrificação 2018 – 2030', 2018, 1–28.

5 DESCRIPTION OF THE REFIT REGULATION

Many countries worldwide have set targets in their policies to accelerate the integration of RE technologies in their rural electrification plans by adopting policies and regulatory framework for RE, taking into account their local conditions. These policy mechanisms are varied, which include quotas, obligations, and pricing instruments (feed-in tariff/premium payments, tendering, net metering, and renewable portfolio standard), supported by fiscal and financial incentives[7].

RE feed-in-tariffs and feed-in premiums are considered as promising RE policy instruments to attract private investments for the deployment of RE projects and reduction of CO_2. They have gained increasing attention and have been adopted by many countries as an instrument that oblige the energy utility to purchase energy produced by independent power producers (IPP)[8] at a specific preferential price per kWh, over a fixed period, providing investors with incentives to participate in the RE sub-sector by ensuring returns of their investments. These tariffs differ in their details and implementation in different countries.

The REFIT regulation in Mozambique is designed as a pricing mechanism to promote the use of the vast RE sources existing in the country. It has been approved by the Cabinet (Decree nr. 58/2014) and published in the *Boletim da Republica* on the 17th of October, 2014. However, there is no scheduled date for starting the implementation of this regulation. The REFIT is in itself contingent upon the adoption of accompanying regulations, such as the guidelines to connect RE electricity generation to the grid, the guidelines to the investors, design of PPA, as well as the legal framework for mini-grids that includes technical and environmental standards. This accompanying regulation is necessary to help to mobilize the private sector participation in the generation of power from RE technologies. These regulations are in the process of preparation by the Ministry of Mineral Resources and Energy (MIREME) with support from the African Development Bank through the Sustainable Energy Fund for Africa (Source: MIREME, 2018).

The REFIT regulation was designed with the primary objective of promoting and guaranteeing the diversification of the national energy matrix and the safe supply of electric energy, thus enabling a good environment to mobilize independent power producers (IPP's) and their investors into Mozambique's electricity sector. That will also help to increase generation capacity using hydro, solar, wind, and biomass resources and ensure energy security at the national level by gradually replacing fossil energy sources that rely on fuel imports.

[7] David Hales, *Renewables 2018 Global Status Report*, 2018.
[8] Peng Sun and Pu yan Nie, 'A Comparative Study of Feed-in Tariff and Renewable Portfolio Standard Policy in Renewable Energy Industry', *Renewable Energy*, 74 (2015), 255–62 <https://doi.org/10.1016/j.renene.2014.08.027>.

MIREME, as the policymaker, will be the entity responsible for the implementation of REFIT in close collaboration with other stakeholders from the energy sector. Guided by the new approach to electrification, the government recently (2018) released the National Electrification Strategy[9] assigning clear institutional roles and responsibilities for the main actors driving rural electrification, namely the Ministry of Mineral Resources and Energy (MIREME), Electricity of Mozambique (EDM), the Energy Fund (FUNAE), and the Energy Regulatory Authority Board (ARENE), as presented in Table 1.

Table 1: Institutional role of the main stakeholders for rural electrification in Mozambique

Institution	Actual Role
MIREME	Policymaker who should lead the planning process
EDM (Main utility company)	Utility company responsible for the generation, transmission, and distribution and also for the implementation of the electrification projects including extension lines to the customers
FUNAE	FUNAE is responsible for off-grid solutions including mini-grids for remote areas
ARENE	Responsible for adjusting the tariff to be cost-reflective and attractive for investments

Mozambique has developed a broad regulatory framework targeting RE sources similar to those targeted in the REFIT regulation. However, some of these instruments, such as the RE development policy and its strategy, and included initiatives may interact independently from the REFIT regulation. Beyond that, the country has developed broader incentives to encourage investments, generating employment and promoting exports such as Investment Law (Law nr. 3/93), Code of Fiscal Benefits Law (Law nr. 4/2009) and it's Regulation (Decree nr. 56/2009), and Public-Private Partnerships Law (Law nr. 15/2011).

A summary with the main elements of the REFIT regulation adopted for Mozambique is presented in Table 2. Understanding the aspects of the policy to be assessed will help to estimate the RE addition and the GHG impact throughout the REFIT ex-ante.

[9] ' Blica D E Mo and Outubro De, 'Estratégia Nacional de Electrificação 2018 – 2030', 2018, 1–28.
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Table 2: Summary of REFIT design elements (Mozambique)

#	Feed-in tariff design elements	Description
1	Type of policy	Feed-in tariff with cap
2	Level of policy	National
3	Sector target	Energy (RE)
4	Implementation entity	Ministry of Mineral Resources and Energy
5	Status of the policy	Not yet implemented
6	Data of implementation	N/A
7	Utility role	Negotiating and sign a PPA with the qualifying IPP
8	Eligibility (resources)	Solar, wind, hydro and biomass
9	Grid priority	Grid priority for RE projects within 10km from the grid
10	Tariff differentiation	The higher is the capacity. The lower is the tariff
11	Tariff adjustments	Every three years with the opinions of the Minister of Economy and Finance (MEF).
12	Contract and payment duration	Construction period plus 20 years of operation
13	Key indicators	REFIT regulation designed in an open manner
13	GHG targeted	Mainly - CO_2; Others - CH_4, N_2O
15	Key stakeholders	Energy sector actors (MIREME, ARENE, FUNAE, EDM), Ministry of Economy and Finance(MEF), MITADER, non-governmental organizations (NGO's), financial institutions, donors, research institutions, private entities.

Initial caps for the level of procurement have been imposed by MIREME under the REFIT regulation, 120 MW for mini-hydro, 60 MW for wind, 50 MW for biomass, and 20 MW for solar power plants. The caps may be periodically increased depending on the differential rate of additions into the system of each resource's base. Once the cap is reached, EDM would no longer be obligated to sign a PPA at the REFIT price for that particular technology.

The tariffs were at the time REFIT was initially designed estimated taking into account RE policy and strategic goals and were differentiated according to the size of the project, type of technology and application for each resource base (hydro, solar, wind and biomass), so that the tariffs would appropriately cover the investment costs and ensuring that they do not cause not excessive burden to EDM (the off-taker), who has to pass it through to consumers. The tariffs are currently set as follows:

Table 3: REFIT tariff structured by technology and capacity

#	Capacity	Tariff (Mt/kWh)			
		Solar	Wind	Small Hydro	Biomass
1	Up to 10 kW	13.0	8.0	4.8	N/A
2	Up to 0.5 MW	N/A	N/A	N/A	5.7
3	Up to 1 MW	10.7	5.6	3.4	5.4
4	Up to 5 MW	8.4	4.7	2.7	4.4
5	Up to 10 MW	7.9	4.1	2.3	4.1

According to Figure 1, the higher the capacity, the lower is the tariff. The graph also shows that solar technology had the highest tariff. However, due to the advancements of RE technology (especially for solar PV) and favorable regulatory and policy landscape, the costs of solar technologies worldwide declined drastically in the last years. Future projections indicate that costs will continue to fall, mainly by increasing the capacity factor due to the improvements in wind technology and solar PV modules efficiency, resulting in the reduction in costs of the modules and the area required for a given watt of power output[10]. Due to these expected developments, the tariffs proposed under the REFIT regulation should be revised to reflect the actual developments in technologies.

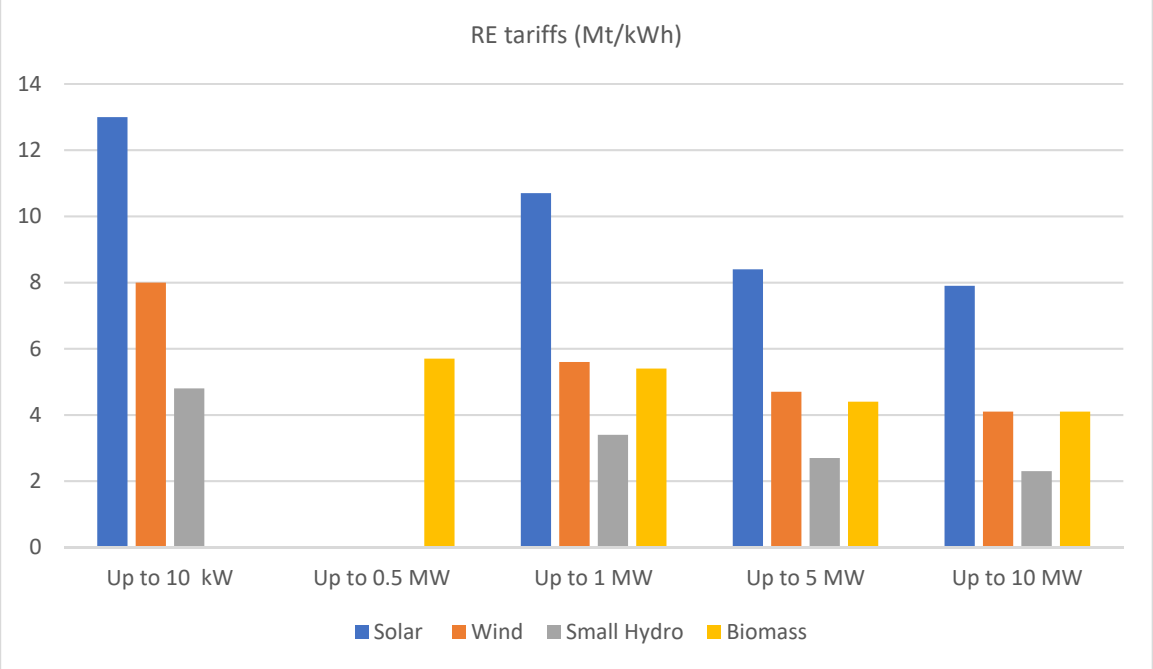


Figure 1: Renewable energy tariffs by technology. The current exchange rate is about 1USD: 61 MZN (December 2018)

[10] IRENA, *The Power to Change: Solar and Wind Cost Reduction Potential to 2025*, *Inernational Renewable Energy Agency*, 2016.

6 THE EX-ANTE BASELINE SCENARIO

6.1 Non-policy drivers included and excluded

The non-policy drivers for the scenario development include demographics (population) and the macroeconomic (GDP) data, provided by the National Institute of Statistics (INE). The Mozambican economy growth has gradually slowed in the last four years, from approximately 7.8 % in 2015 to about 3.3% in 2018. This economic recession contributes to the postponement of several development projects, including those on power generation, and there is considerably high uncertainty, especially on the commencement dates for a number of these projects. In more favorable economic circumstances, probably the investment in more of the proposed RE projects would have been secured shortly, and hence, these projects would have the *status* of planned projects in Table 5. Despite the fact the government is a partner in some of these projects, foreign investment is crucial for their effective implementation.

6.2 Indicators and data used

The main source of data about power generation for the baseline is the National Energy Statistics (2000 – 2011). These data are combined with the other recent available data from various sources, including the power generation Integrated Master Plan. The assumptions on the electricity generation development came from different sources, mainly from the annual reports by the national power utility company (EDM), the Renewable Energy Development Strategy, and the five-year government plan (2015 - 2019).

The baseline scenario was built based on data from the National Energy Statistics (2000 - 2011) [11], released by the Ministry of Energy in 2012, combined with the most recent available data from various sources including the recently approved Integrated Master Plan, Mozambique Power System Development[12] released by the national power utility (EDM) in 2018. Table 4 provides the breakdown of the capacity mix in which it can be seen that, historically, electricity generation is mostly dominated by hydropower. In addition to the existing capacity in 2012 (1.43 MW of natural gas, 2,278 MW of hydro, and 0.69 of diesel) extracted from the National Energy Statistics (2000 - 2011), it is considered that the large hydro and the fossil power plants are part of the baseline scenario, i.e., these are not considered in the mitigation scenario.

[11] 'Estatistica de Energia December 2012'.
[12] The Republic, 'Integrated Master Plan Mozambique Power System Development Draft Final Report', 2017.

Table 4: Historical installed capacity by type (MW) for the Baseline scenario

Capacity (MW)	2012	2014	2016	2018
Hydro	2,278	2,278	2,278	2,278
Natural Gas	1.43	247	282	344
Wind	-	-	-	-
Diesel	0.69	0.69	0.69	0.69
Bagasse	-	-	-	-
Municipal Solid Waste	-	-	-	-
Coal	-	-	-	-
Solar	-	31	36	40
Combustible Renewables	-	-	-	-
Total	2,280	2,557	2,597	2,662

The actions and measures that were used to construct the baseline scenario, beyond 2018, are presented in Table 5. The power projects shown in Table 5 were selected from a broader list of either proposed or considered development projects by proponents (mainly private entities) using a multi-criteria analysis. The selection process took place during the NDC plan development, and it involved participants from different relevant sectors. The multi-criteria analysis for the prioritization of power generation projects took into consideration five main pillars, namely, the relevance of the project, the actuality of the project, the financing issues, technology, and the technical capacity[13].

Table 5: Upcoming actions and projects included in the baseline scenario

Action ENAMMC	Measure ENAMMC / NDC	Description				
		Project name/ Location	Capacity (MW)	Year*	Status	Scenario
Improving access to renewable energies (4.6.2.1.1)	Promote the use of renewable energy sources (biogas, biomass, solar, wind, thermal, waves and geothermal energy (4.6.2.1.1.2.)	**HYDRO**				
		Mphanda Nkuwa	1500	2024	P	REF
		Cahora Bassa North	1245	2026	P	REF
		SOLAR PV				
		Mocuba-Zambezia	40	2018	I	REF
Increase energy efficiency (4.6.2.1.2)	Ensuring availability and access to low-carbon fossil fuels (4.6.2.1.2.1.); Use of "clean coal" technologies in coal-fired power stations (including the use of cogeneration, where applicable) (4.6.2.1.2.4.)	**Natural Gas (NG) & COAL**				
		Temane (NG)	400	2022	P	REF
		Temane II (NG)	100	2023	P	REF
		Central Térmica Maputo (NG)	110	2018	I	REF
		Nacala GT Emergency (NG)	40	2019	P	REF
		Moatize, Tete (Coal)	1200	2023	P	REF
		Jindal (Coal)	150	2023	P	REF
		Baobab (Coal)	300	2022	P	REF
		Nacala (Coal)	200	2022	P	REF

Source: Mozambique NDC Report, December 2018

*P: planned; I: in implementation; REF: a Baseline scenario * Most likely start year.*

[13] For more details, refer to the 2018 Mozambique NDC plan report.

As a result of the multi-criteria selection above described, the RE sources - wind and biomass – were not included in the baseline scenario (for 2020 - 2030), the capacity of solar PV (40 MW) from historical data is kept constant until 2030 in this scenario. There are indications that bagasse is used by some sugar cane companies in the southern and central region of Mozambique. However, these data were inconsistent and hence hard to be accounted for in the baseline scenario.

Table *6* provides the electricity demand and average electricity growth rates by sector for every 5-years, since 2010. The historical figures (2010/15) were calculated using the data from the national statistics and the recently available data published in reports by the national power utility.

Table 6: Electricity demand and average growth rates by sector, every 5-years

	2010	2015	2020	2025	2030
Demand (GWh)					
Residential	898	1,119	1,235	1,364	1,506
Services	45	57	62	62	63
Agriculture	0.3	1.1	1.6	2.0	2.7
Industry\Non Ferrous Metals	8,185	11,566	16,184	19,034	22,658
Industry\Non Specified	96	158	221	260	309
Non Specified	1,152	1,455	1,595	1,603	1,620
Total	10,377	14,355	19,298	22,324	26,159
Growth Rates (%)					
Residential		24.5	10.4	10.4	10.4
Services		25.9	9.6	0.5	1.1
Agriculture		273.3	40.9	29.2	30.0
Industry\Non Ferrous Metals		41.3	39.9	17.6	19.0
Industry\Non Specified		63.7	39.9	17.6	19.0
Non-Specified		26.3	9.6	0.5	1.1
Total		38.3	34.4	15.7	17.2

These data are modeled in LEAP, and the projections are estimated based on socio-economic and demographic drivers, as explained in the previous section and more detail in the 2018 Mozambique NDC report. LEAP supports a wide range of different modeling methodologies, and its accounting framework calculates future energy demand as the product of activity

levels (for instance, GDP, population, physical production levels) and energy intensity per unit of activity[14] (Heaps, C.G., 2012).

Table *6* shows that agriculture and industry sectors have registered the highest growth levels in the period 2010/15, whereas the residential sector shows an almost constant growth mainly driven by the national power utility electrification rate in the last decade of approximately 120 new household connections per year.

6.3 Challenges and gaps

The lack of a consistent energy statistic report (beyond 2011) is one constraining factor in the process. The 2000-2011 energy statistics by the Ministry of Energy was the last comprehensive report on energy at the national level. Although the national power utility company, regularly issues its annual reports, essential information, for instance, on micro/mini-grids, sugar cane (bagasse) based electricity generation is still hard to get. Some RE projects proposed by private companies or somehow mentioned in some reports or conference publications lack important information such as the cost, anticipated date of start, and other details, which makes it hard to include in the analysis. These detailed inputs on the features of the projects would be important for the multi-criteria analysis for the selection of the most likely projects to be implemented in the projection of the baseline scenario.

6.4 The resulting baseline scenario

The baseline scenario for this study is based on the same dataset as the one developed for Mozambique's NDC implementation plan, approved in December 2018, and was compiled using LEAP software (see section 2. Methodology for estimating GHG impacts) for the sectors of agriculture, forestry, energy, and transport. The baseline scenario of the NDC was initially analyzed in the context of the Intended Nationally Determined Contribution (INDC) submitted to the UNFCCC in 2015, and a feasibility study of low carbon development options (EBAC)[15].

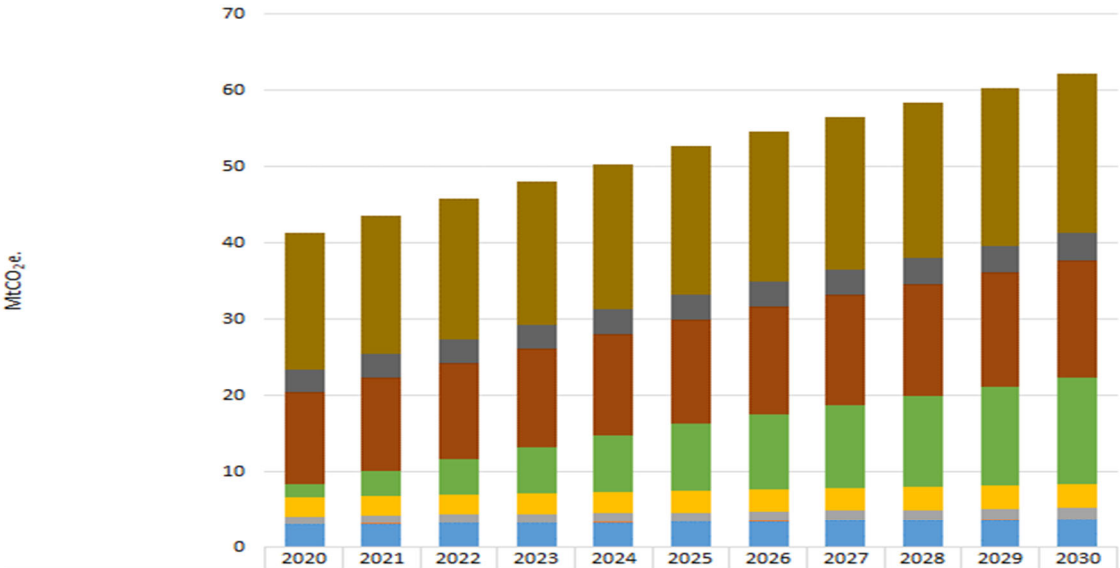
According to the recommendation from the ICAT RE guidance for assessing the GHG impacts of RE policies, in cases where NDC plans have already established emissions targets relative to a specific base year, or RE deployment, or sectoral emission levels, these baselines can be adopted for the purpose of estimating the GHG impact of the policy Ex-Ante. This section

[14] Gilberto Mahumane and Peter Mulder, 'Introducing MOZLEAP: An Integrated Long-Run Scenario Model of the Emerging Energy Sector of Mozambique', *Energy Economics*, 59 (2016), 275–89 <https://doi.org/10.1016/j.eneco.2016.08.010>.
Heaps, C.G., 2012. Long-range Energy Alternatives Planning (LEAP) system. [Software version 2012.0018] Stockholm Environment Institute. Somerville, MA,
USA. www.energycommunity.org

[15] Rita Sousa, 'Estudo Viabilidade de Opções de Desenvolvimento de Baixo Carbono', 2016.

explores specifically the baseline component of the power generation developed for Mozambique´s NDC.

Figure 2 provides an estimate of the GHG emissions by sector, including electricity generation for the baseline scenario at the national level. The GHG emissions from electricity generation in the baseline scenario are increasing rapidly over time, and they represent 3% (2015), 4% (2020), 17% (2025) and, 22% (2030) concerning the total national GHG emissions. The electricity generation sector is the third cause of GHG emissions after agriculture and forest use.



	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Agriculture - non energy	17.78	18.09	18.40	18.71	19.03	19.34	19.65	19.97	20.28	20.59	20.91
Waste	2.98	3.03	3.09	3.14	3.20	3.26	3.32	3.38	3.44	3.50	3.57
Forest and land use	12.01	12.35	12.69	13.03	13.37	13.71	14.05	14.39	14.73	15.07	15.41
Electricity generation	1.73	3.15	4.57	5.98	7.40	8.82	9.93	10.93	11.92	12.91	13.90
Transport - energy use	2.59	2.63	2.68	2.73	2.78	2.83	2.88	2.93	2.99	3.04	3.10
Industry - energy use	1.06	1.09	1.13	1.17	1.21	1.25	1.29	1.34	1.38	1.43	1.49
Agriculture - energy use	0.05	0.05	0.06	0.06	0.06	0.07	0.07	0.07	0.08	0.08	0.09
Residential - energy use	3.04	3.10	3.17	3.23	3.29	3.36	3.43	3.50	3.57	3.64	3.71

Figure 2: ***GHG emissions estimate by sector, including electricity generation for the baseline scenario. (Source: Mozambique NDC Report, December 2018)***

The upcoming energy projects for electricity generation illustrated in Figure 3 is considerably dominated by hydropower. However, the role of natural gas and especially coal, is becoming increasingly significant over time. Figure 3: Electricity generation capacity by type (MW) for the *Baseline scenario*

and Table 7 provide an overview of expected electricity generation capacity (MW) and electricity generation (GWh) by source for the baseline scenario and show that hydropower still plays a dominating role, despite an increase in natural gas and coal.

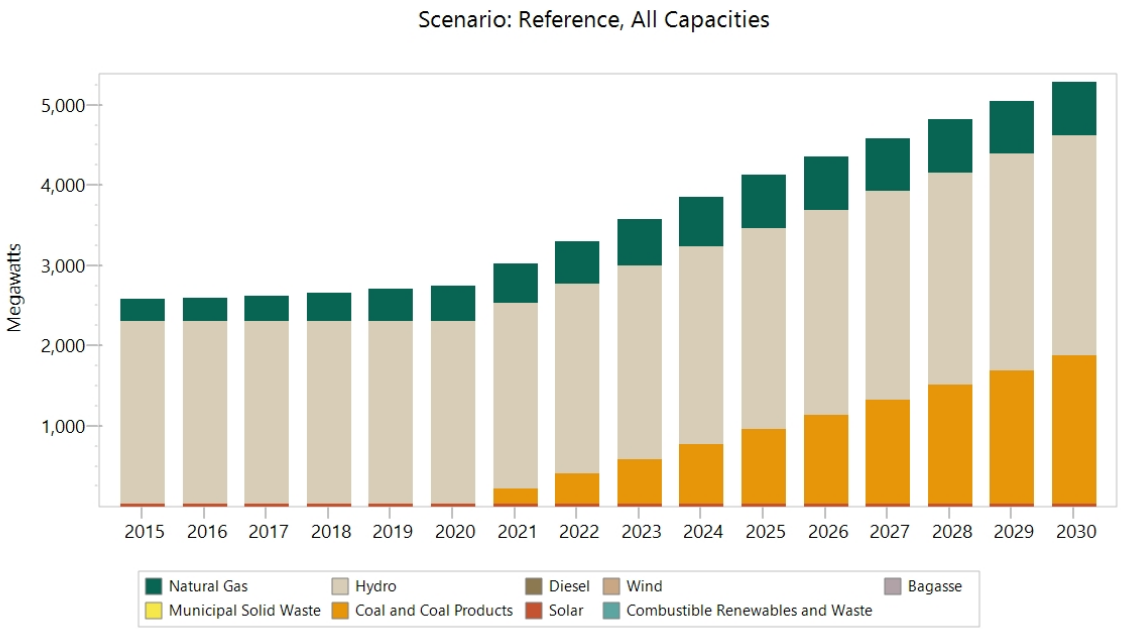


Figure 3: Electricity generation capacity by type (MW) for the Baseline scenario

Table 7 provides the electricity generation by source for the Baseline Scenario. It shows that hydropower dominates the electricity matrix of the country, despite an increase in natural gas and coal.

Table 7: Electricity generation by source (Thousand GWh) for the Baseline Scenario

Electricity generation by source	2016	2018	2020	2022	2024	2026	2028	2030
Hydro	15.96	15.96	15.96	16.62	17.27	17.71	17.67	17.8
Natural Gas	1.98	2.41	3.02	3.64	4.25	4.5	4.33	4.22
Diesel	0	0	0	0	0	0	0	0
Wind	-	-	-	-	-	-	-	-
Bagasse	-	-	-	-	-	-	-	-
Municipal Solid Waste	-	-	-	-	-	-	-	-
Coal	-	-	-	2.59	5.19	7.68	9.86	12
Solar	0.25	0.28	0.28	0.28	0.28	0.28	0.27	0.26
Biomass	-	-	-	-	-	-	-	-
Total	18.2	18.66	19.27	23.13	26.99	30.17	32.13	34.28

Two main sources of GHG emanating from electricity generation in Mozambique can be identified, and these are coal and natural gas. The recent discoveries and exploitation of these

fossil resources has led the country to opt-in the diversification of its electricity generation mix, and increase the use of fossil fuel sources. Interestingly, among various argumentations in support of these options are those related to extreme climate events such as droughts and floods that pose a risk to the hydro generation in Mozambique. Electricity exports to the neighboring countries are also one of the main drivers for fossil fuel-based generation[16].

Figure 4 shows that, currently, natural gas is the main source GHGs accounting for approximately all emissions from electricity generation. However, if no RE policy is put in place, i.e., under the baseline scenario, in the medium to the long-term, emissions from coal generation may substantially rise, accounting for approximately 70% and 82% by 2025 and 2030 respectively.

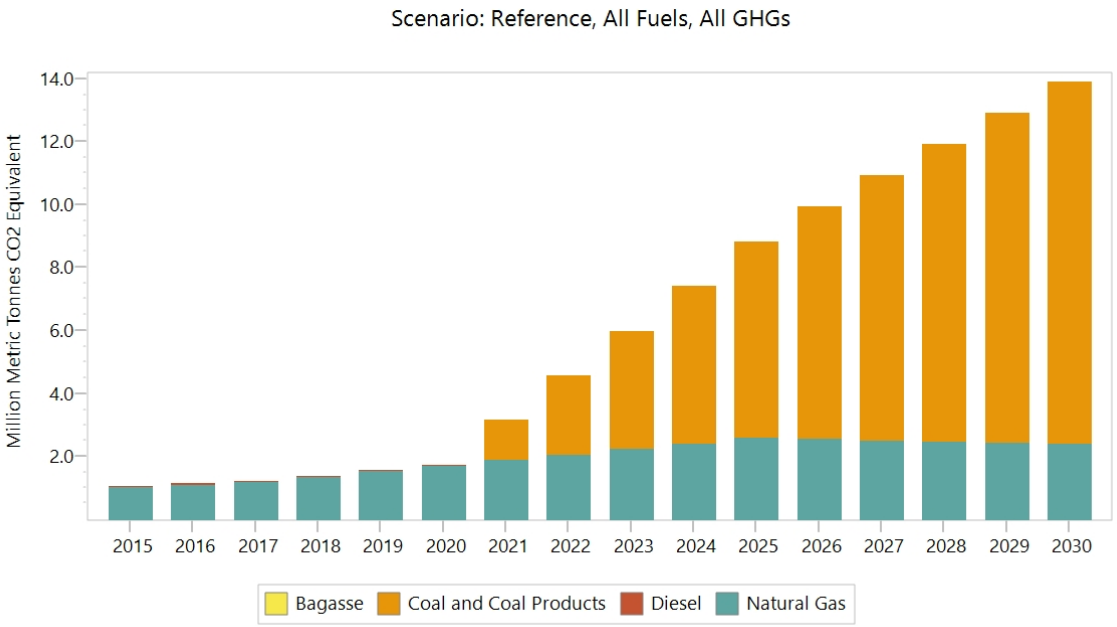


Figure 4: ***Greenhouse gas (GHG) emissions estimates by source (Million tCO2eq), Direct (At Point of Emissions) for the Baseline Scenario***

Figure 5 shows that carbon dioxide is the main type of GHG emissions from electricity generation for the baseline scenario.

[16] Mahumane and Mulder. 'Introducing MOZLEAP: An Integrated Long-Run Scenario Model of the Emerging Energy Sector of Mozambique', 2016

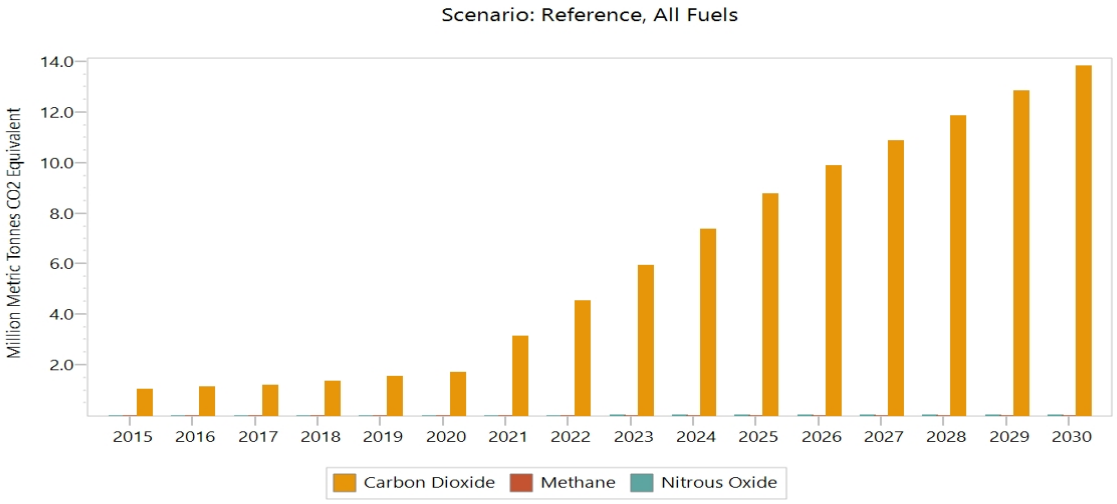


Figure 5: Greenhouse gas emissions estimates by Source from electricity generation for the Baseline Scenario

7 THE RENEWABLE ENERGY ADDITION OF THE POLICY EX-ANTE

According to the ICAT RE guidance[17], it is important to estimate the maximum implementation potential of the policy, that can be described as the maximum achievable RE addition (additional installations of RE capacity or electricity generation from RE sources) realized via the REFIT regulation and can be expressed in MW or MWh. After having identified the maximum implementation potential, the guidance provides the following steps on how to estimate the more realistic RE addition:

- Estimate the maximum implementation potential of the policy;
- Identify policy design characteristics and account for their effect on the maximum implementation potential of the policy;
- Identify factors that affect the financial feasibility of RE technologies and account for their impact on the implementation potential of the policy; and
- Identify other barriers not addressed by the policy, and to account for their impact on the implementation potential of the policy.

7.1 Maximum implementation potential

The ICAT RE guidance refers to the maximum implementation potential as the maximum achievable RE addition. That can be a policy cap inherent in the policy itself or a RE target that is separate from the policy, such as a target set at the national level. This section provides the potential additional capacity (electricity generation through RE technologies) in MW that the REFIT regulation will provide, taking into account the caps established under the regulation. This additional capacity has been used to assess the GHG reductions through an ex-ante assessment.

Commonly, countries are setting their feed-in tariffs with caps that can be set yearly or over the lifetime of the policy and regularly adjusted. For example, Uganda developed a FIT program for hydro, solar, geothermal, and bagasse for different capacities and specified capacity caps for each technology by year for different RE technologies[18]. Senegal developed tariff caps for different classes of projects based on technology and subsidy levels[19]. In Zambia, the Government launched a feed-in tariff program to allocate 200 MW of small and

[17] 'Renewable Energy Guidance'. 2018

[18] Makbul A.M. Ramli and Ssennoga Twaha, 'Analysis of Renewable Energy Feed-in Tariffs in Selected Regions of the Globe: Lessons for Saudi Arabia', *Renewable and Sustainable Energy Reviews*, 45 (2015), 649–61 <https://doi.org/10.1016/j.rser.2015.02.035>.

[19] IRENA;, OECD/IEA;, and REN21, *Renewable Energy Policies in a Time of Transition*, 2018 <http://www.iea.org/publications/freepublications/publication/IRENA_IEA_REN21_Policies_2018.pdf>.

medium scale hydro, solar PV, geothermal, biomass waste energy, and wind for projects with capacities up to 20 MW[20].

Mozambique has established the REFIT for solar, wind, hydro, and biomass up to 10 MW. Besides, the REFIT offers initial caps up to 250 MW (maximum capacity imposed under the REFIT regulation), as the maximum implementation potential, distributed according to the type of technology as follows: 120 MW for mini-hydro, 60 MW for wind, 50 MW for biomass and 20 MW for solar power plants. The caps have been set to control the resource mix for intermittency and cost mix reasons. These caps have been imposed by the government as the maximum generation capacity supported by the REFIT regulation and may be increased depending on the differential rate of additions into the system of each resource's base. Once the ceiling is reached, EDM would no longer be obligated to sign a power purchase agreement (PPA) at the REFIT price for that particular technology. Therefore, there are considered as specific targets for this assessment

7.2 Effect of REFIT design characteristics

The RE guidance [21] recommends the identification of the main elements of the policy design characteristics that could influence the maximum implementation potential. In this context, there are many elements of the REFIT regulation that could affect the maximum implementation potential, such as the scope of eligibility, tariff differentiation between technologies, payment structure, the longevity of financial support, complexity of regulatory, and legal procedures. Table 8 identified the main elements presented on the design characteristics of the REFIT regulation for Mozambique that are likely to influence the maximum implementation potential and describes how these elements could impact on the implementation of this regulation.

Table 8: Influence of the REFIT regulation on the maximum implementation potential

Design Characteristics	Description	Influence on maximum implementation potential
Eligibility	Resources; Size; Location.	REFIT is eligible for solar, wind, hydro, and biomass for generation facilities with capacities up to 10MW. This mix of technologies will allow the REFIT to meet the full implementation taking into account the distribution of projects along the country based on resource availability in specific locations.
Tariff differentiation	RE type; Project size; Resource quality; Technology application.	There is differentiation in tariff levels according to the technology and size of the plant. Since the investment vs. return ratio for smaller installations is expected to be less profitable than for large installations, the tariff differentiation, taking into consideration the different sizes of installations, has a higher potential to attract both

[20] Hales. *Renewables 2018 Global Status Report*, 2018
[21] 'Renewable Energy Guidance'. 2018

		large and small scale capacities, increasing the chance to achieve the full implementation potential.
Utility's role	Purchase obligation; Guaranteed grid connection	REFIT Program will be managed by the public utility (EDM), which is the central buyer of electricity in the Country. EDM has the obligation of negotiating and signing a PPA with the qualifying IPP, incentivizing that the policy achieves its maximum implementation potential.
Contract and payment duration	Payment duration; Contract period	The sale of electricity is contracted in a fixed-term, legally enforceable agreement. Once a PPA is signed under the provisions of the REFIT program, the contract will remain for the next 20 years. These terms are quite favorable, incentivizing that the policy achieves its maximum implementation potential.
Opt-out options	Contractual opt-out options for power producers to sell energy on the market	Under the REFIT program, all projects shall have the right to enter into a willing buyer – willing seller arrangements with off-takers other than EDM, at mutually agreed price levels, outside the program which may increase investment interest in the country and incentivizing that the policy achieves its maximum implementation potential.
Forecasting	Forecast obligation	It has a small effect on the likelihood that the policy achieves its maximum implementation potential, but may slightly increase project costs. However, it seems to be no forecast obligation on the design of the REFIT.
Grid access	Transmission; Interconnection	The cost of connection to the grid is to be covered by the project owners. Although, the REFIT program ensures grid priority for RE projects within 10km from the main grid, which is determinant for the financial viability of the project and to increase the security and certainty for the investors. This provides the security of the connection to the off-taker EDM to projects within 10 km to the grid facilitating the policy to achieve its maximum implementation potential.
Policy adjustments	Program adjustments	To ensure that the policy achieves its maximum implementation potential, but keep flexibility for the use of public funds, the REFIT tariffs are subject to revision every three years. Once a PPA is signed, the contract will remain for the next 20 years, with prices adjusted only according to the indexation provisions of that PPA agreed. This creates security for the investors while ensuring that the government will not over subsidize the development of RE, incentivizing that the policy achieves its maximum implementation potential.

7.3 Barriers that can hinder the maximum implementation potential of the REFIT

Despite its characteristic of being a powerful instrument to attract private investments for RE deployment, feed-in tariffs alone sometimes cannot guarantee investment in RE. They should be complemented by other incentives, subsidies, and also financial mechanisms such as loans and grants that can be used to incentivize RE investments.

Some barriers can hinder the RE deployment and consequently affect the implementation of REFIT policy that has been summarized in Table 9. These barriers include but are not limited

to the lack of financial support for RE deployment, lack of credit line facilities, weak coordination among stakeholders, and bureaucratic licensing procedures.

Table 9: Barriers that hinder the deployment of RE

#	Category	Barrier description	Examples
1	Institutional (Policy and Administrative and infrastructure)	Lack of strong agencies for rural electrification;	• A dedicated rural electrification agency is needed in the country. Also, the Energy Fund (FUNAE) as a funding entity responsible for off-grid solutions is in need of more staff and enhancement of staff's capacities;
		Lack of comprehensive planning and transparency for the power sector;	• Lack of transparency in existing regulation (e.g., specific targets); Lengthy, bureaucratic, and unclear licensing and concession procedures;
		Lack of specific incentives for RE technologies;	• No specific incentives targeted at RE are available other than the planned REFIT which is not operational;
		Poor institutional coordination;	• Poor communication among stakeholders;
		Scarce and inaccurate data;	• Current REFIT tariffs are outdated and should be reassessed; • Lack of data regarding the existing RE installed capacity in Country
		Lack of flexibility of the energy system.	• Insufficient, inadequate and old grid infrastructure; • The energy market is not prepared for the integration of intermittent RE sources.
2	Technical	Insufficient and Inadequate skilled personnel; capacity;	• A limited number of skilled workers; • Lack of training and education for the planning, operation, and maintenance of the technologies;
		Lack of sufficient technology providers;	• Insufficient number of technology providers (technologies eligible under REFIT regulation) in the country; • Lack of provision for operations and maintenance;
		Lack of awareness.	• Lack of awareness campaigns on technologies, benefits, and performance of RE technologies.
3	Financial	Insufficient funding available for RE initiatives;	• Limited access for funding mechanisms; • Lack of credit lines through local banks; • Lack of equity capacity of private sector stakeholders, as RE requires high capital cost of investment compared to conventional; • High grid connection costs; • Low expected return of investment on RE projects;
		Low income	• Inability of the rural population to pay for energy services;
		Lack of market.	• Lack of market competition among technology suppliers; • Insufficient market development to repair the broken equipment.
5	Social	Public Acceptance	• Lack of understanding and misleading information; • Resistance to change.

The barriers, presented in Table 9, have been provided by the experts from different institutions representing the main stakeholders of the power sector (MIREME, FUNAE, EDM,

ARENE, and others), during semi-structured qualitative interviews conducted to identify the main aspects that hinder the RE integration in Mozambique.

Administrative barriers, which includes the lack of dedicated agencies for rural electrification, the role of each institution or organization through a clear definition of roles and responsibilities, inadequate planning process, and bureaucratic licensing procedures which also includes complicated, slow or non-transparent permitting procedures are also behind the factors that can hinder the successful implementation of the REFIT.

RE additional capacities to be produced under the REFIT regulation are to be connected to the grid. However, non-conventional (other than large-scale hydro) RE generation is quite a new context in the country and may face challenges related to the lack of acceptability from the utility company and also poor or lack of grid infrastructure such as the availability and flexibility of the grid infrastructures to integrate or absorb power generation. These factors can jeopardize the development of the project or even postponed the delivery time.

Institutional coordination among the energy sector actors, private sector as well as the local communities and also technical knowledge related to sufficient knowledge about the resource availability and technical performance of RE technologies is fundamental to ensure a successful implementation of RE initiatives.

7.4 Financial feasibility aspects

The financial feasibility of RE technologies is usually presented in the literature using economic indicators such as levelized cost of electricity (LCOE), net present cost (NPC), investment cost, and operating cost. Levelized Cost of Energy (LCOE) is one of the powerful economic indicators that helps the policy and decision-makers with technology selection and decision support for electricity projects. It helps in assessing the economic viability and compares the cost competitiveness of different technologies easily, considering as inputs the capital expenditure, incentives, O&M costs, and fuel costs. The LCOE is calculated using Equation 1. [22] [23] [24]

[22] IRENA and Anisie Arina Gielen Dolf, Saygin Deger, Boshell Francisco, *Accelerating the Energy Transition through Innovation*, 2017 <http://www.irena.org/DocumentDownloads/Publications/IRENA_Energy_Transition_Innovation_2017.pdf>.
[23] Tuba Tezer, Ramazan Yaman, and Gülşen Yaman, 'Evaluation of Approaches Used for Optimization of Stand-Alone Hybrid Renewable Energy Systems', *Renewable and Sustainable Energy Reviews* (Pergamon, 2017), 840–53 <https://doi.org/10.1016/j.rser.2017.01.118>.
[24] Barun K. Das and others, 'A Techno-Economic Feasibility of a Stand-Alone Hybrid Power Generation for Remote Area Application in Bangladesh', *Energy*, 134 (2017), 775–88 <https://doi.org/10.1016/j.energy.2017.06.024>.

$$LCOE = \frac{Sum\ of\ costs\ over\ lifetime}{Sum\ of\ electrical\ energy\ production\ over\ lifetime} = \frac{\sum_{t=1}^{n} \frac{I_t + M_t + F_t}{(1+r)^t}}{\sum_{t=1}^{n} \frac{E^t}{(1+r)^t}}$$ Equation 1

Where I_t is capital expenditures (CAPEX) in year t, M_t represents the operation and maintenance expenditures in year t, F_t is the fuel expenditures in year t, E_t represents the electrical expenditures in year t, r is the discount rate, and n is the lifetime of the project.

According to the International Renewable Energy Agency (IRENE)[25], between 2010 and 2017, the global weighted average LCOE for solar registered considerable fall from 0.36 $/kWh to 0.10$/kWh. Despite the mature nature of biomass and geothermal technologies, they present lower potentials for cost reductions compared to solar and wind technologies. For the same period, the LCOE of biomass and geothermal varies as of 0.06$/kWh to 0.07$/kWh, and 0.05$/kWh to 0.07$/kWh, respectively, as shown in

.

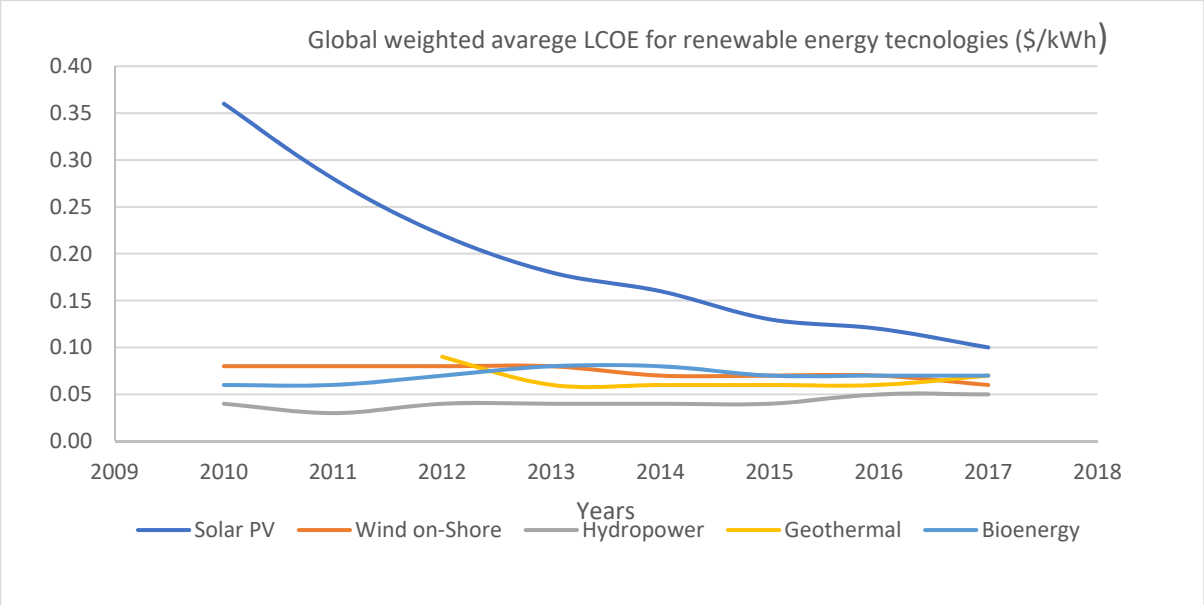


Figure 6: Global weighted average LCOE for renewable energy technologies. Source: IRENA Renewable Cost Database

The LCOE varies by region and country, technology, maturity of the market, taking into account the RE local resources, capital, replacement, operating and maintenance costs of each component of the systems throughout the lifetime, fuel price, lifetime of the components of the system, as well as the performance of the technology. Hence, the combination of these factors determines how financially feasible RE technologies are in a given country context.

However, in this context, the LCOE provides a comparison of the technologies on a cost basis and not a calculation of the level of feed-in tariffs. Under the REFIT regulation, the tariffs were

[25] IRENA, *Renewable {Power} {Generation} {Costs} in 2017*, 2018.

estimated using a pricing model, with the main task of calculating the RE tariff to be paid per kWh for a given capacity that can cover costs and provide an acceptable return of investments to the IPP's. The pricing model serves as a tool for policymakers to test various scenarios for the formulation of appropriate tariffs and incentives. The costs include capital expenditure (CAPEX) for the construction of the project and operating expenses (OPEX) for the operation and maintenance of the project.

Taking into account the LCOE estimated by IRENA (

), it is clear that solar PV registered a considerable fall in costs since the approval of the regulation (2014) up to now. Hence, the tariffs estimated under the REFIT regulation should be revised to reflect the current stage of development of RE technologies.

8 THE REFIT POLICY SCENARIO

8.1 Method

This section describes the policy scenario for the Mozambique REFIT regulation. As stated before, Mozambique has recently approved its NDC plan that will help to operationalize the country's contribution to pursuit the Paris Agreement commitments to limit the GHG emissions at the global level. To be aligned with the NDC mitigation scenario, the REFIT policy scenario analyzed in this study starts in 2020 and runs until 2030 being that one of the main objectives of this assessment is to estimate the GHG impacts of the REFIT policy ex-ante, to determine whether this regulation is on track to help meet goals such as NDCs or RE targets.

The mitigation scenario is dominantly characterized by RE energy projects in comparison to the baseline scenario, as seen in Table 10. Similarly to the baseline, the multi-criteria analysis was applied for the selection of power projects to build the NDC mitigation scenario. However, in this case, only RE projects are prioritized. The information on power projects comes from the Integrated Master Plan, Mozambique Power System Development[26] released by the national power utility (EDM) in 2018, from the Ministry of Energy and the energy fund (FUNAE) plans.

Table 10: Actions and projects included in the NDC mitigation scenario

Action ENAMMC	Measure ENAMMC / NDC	Description				
		Project name/ Location	Capacity (MW)	year*	Status	Scenario
Improving access to renewable energies (4.6.2.1.1)	Promote the use of renewable energy sources (biogas, biomass, solar, wind, thermal, waves and geothermal energy (4.6.2.1.1.2.)	**HYDRO**				
		Tsate - Sofala	50	2025	P	MIT
		Moamba Major - Maputo	15	2020	P	MIT
		Luaice - Niassa	0.5	2023	P	MIT
		Berua	1.52	2028-30	A	MIT
		Boroma	200	2028-30	p	MIT
		Lupata	600	2028-30	p	MIT
		WIND				
		Namaacha	120	2021	P	MIT
		Manhiça - Maputo	120	2025-30	p	MIT
		Quantum Power	120	2025-30	p	MIT
		SOLAR PV				
		Metoro - Cabo Delgado	40	2020	P	MIT
		Vilanculo - Inhambane	10	2023	P	MIT
		Dondo - Sofala	30	2021	P	MIT

[26] Republic.

		Nacala - Nampula	30	2022	P	MIT
		Boane - Maputo	30	2023	P	MIT
		Balama - Cabo Delgado	10	2023	P	MIT
		Cuamba - Niassa	30	2020	P	MIT
	Promote the electrification of rural communities using renewable energies (4.6.2.1.1.1)	**SOLAR PV**				
		Mini-grid systems	*no info*	2019-25	P	MIT
	Promote and disseminate techniques and technologies for the production and sustainable use of biomass energy (4.6.2.1.1.4.)	**BIOMASS**				
		Biomassa - Salamanga	30	2025-30	C	MIT
		Biomassa - Moamba	30	2025-30	C	MIT
		Açucareiras/sugar cane	10	2025-30	C	MIT

Source: Mozambique NDC Report, December 2018

P: planned; A: approved; C: conceptual; MIT: Mitigation scenario

* Most likely year of start.

The actions listed above describe the activities envisioned to be implemented through the NDC in the electricity generating sector. The collective implementation of these actions is in this analysis described as the NDC Mitigation (electricity generation) scenario. These actions include, as mentioned earlier, the introduction of 32 MW of RE through the partial implementation of REFIT. The 32 MW additions through REFIT is in this analysis presented as the NDC REFIT scenario, while the full implementation potential of REFIT by 250 MW is presented as the REFIT policy scenario.

8.2 Indicators and data used

In the context of the NDC, the electricity generation component for the mitigation scenario was built, taking into consideration the action “improved access to renewable energy” from the National Climate Change Adaptation and Mitigation Strategy (ENAMMC) by the Government of Mozambique[27], refer to the Table 8.

This action includes measures related to the promotion of the use of renewable sources of energy, rural electrification through RE as well as the sustainable use of biomass. Additional data for constructing the mitigation scenario was obtained from the Integrated Master Plan, Mozambique Power System Development by the national power utility, the National Power Utility Company Strategy 2018–2028[28], the New and Renewable Energy Development

[27] ‘Estratégia Nacional de Adaptação e Mitigação de Mudanças Climáticas’.

[28] Electricidade de Moçambique, ‘Lighting Mozambique ’s Transformation’, 2018.

Strategy 2011-2025[29]. Further input on the mitigation options for the NDC mitigation scenario was collected during the various working sessions, organized by the Ministry of Land and Environmental Affairs (MITADER) involving different sectors.

Table *11* summarizes the building of the REFIT policy (250 MW) scenario, based on the initial feed-in tariff ceilings, and the building of the NDC REFIT (32 MW) scenario, which is defined as the REFIT contribution to the energy sector mitigation in the NDC (mitigation) scenario. The fact that the NDC mitigation scenario, which includes electricity generation, aims at reducing emissions constituted the basis for constructing the NDC REFIT scenario which consists of those power projects with up to 10 MW of capacity, namely hydro (Luaice and Berue), solar (Vilanculo and Balama) and the sugar can project, all included in Table 10 Regarding the REFIT Policy scenario, its maximum capacity is distributed according to the type of technology as follows: 120 MW for mini-hydro, 60 MW for wind, 50 MW for biomass and 20 MW for solar power plants and it is described in detail in section 6.1 (Maximum implementation potential).

Table 11: Building of the REFIT policy scenario and the NDC REFIT scenario

Type	Scenario	Period*	Capacity (MW)	
			NDC_REFIT	*REFIT_Policy*
Hydro	*NDC_REFIT*	2023-2030	2.2	-
	REFIT_Policy	2020-2030	-	120
Wind	*NDC_REFIT*		-	-
	REFIT_Policy	2020-2030		60
Solar	*NDC_REFIT*	2023-2025	20	-
	REFIT_Policy	2023-2025	-	20
Biomass	*NDC_REFIT*			-
	REFIT_Policy	2025-2035	-	20
Bagasse	*NDC_REFIT*	2025-2030	10	-
	REFIT_Policy	2025-2030	-	30
Total	-	-	32.2	250

** Implementation period*

Figure 7 shows the power generation capacities for the REFIT policy, and it suggests that despite the increasing trend on the use of the non-renewable sources for electricity generation, particularly natural gas and coal, hydropower is expected to remain the main source. The share of hydropower, in terms of installed capacity, is currently estimated to be 84.2%, whereas the renewable sources (except hydro) are approximately 1.5% only, mainly driven by solar PV. Natural gas capacity is estimated at 14.3% of the total capacity. By 2030

[29] 'ESTRATÉGIAS DE DESENVOLVIMENTO DE ENERGIAS NOVAS E RENOVAVEIS'.

and following the REFIT scenario, the share of installed capacity is expected to be 49.3% for hydro and 12.1% for RE sources, namely, solar, wind bagasse, and biomass.

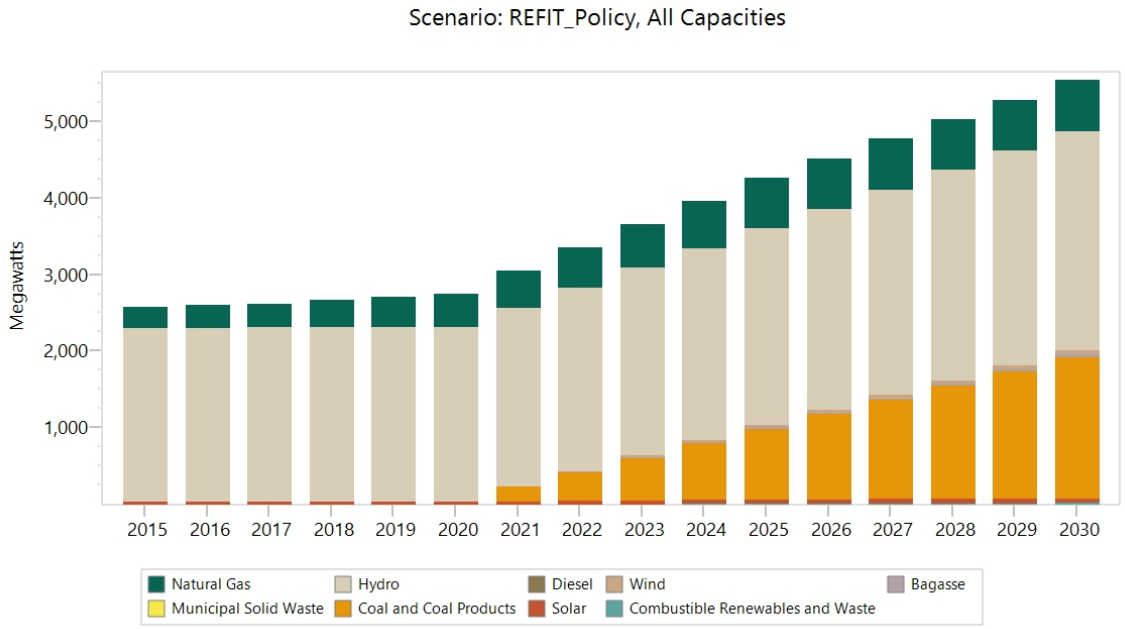


Figure 7: Electricity generation Capacity by Type (MW) for the REFIT Policy scenario

Table 12 provides the electricity generation by source for the REFIT Policy Scenario, and it shows that despite the dominance of hydropower over time, natural gas and coal, as well as other RE sources, will play an essential role in the national energy mix.

Table 12: Electricity generation by source for the REFIT Policy Scenario

Electricity generation by source	2016	2018	2020	2022	2024	2026	2028	2030
Hydro	15.96	15.96	15.96	16.79	17.61	17.58	17.58	17.76
Natural Gas	1.98	2.41	3.02	3.64	4.25	4.35	4.16	4.03
Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wind	-	-	-	0.08	0.17	0.24	0.31	0.37
Bagasse	-	-	-	0.03	0.05	0.08	0.10	0.12
Municipal Solid Waste	-	-	-	-	-	-	-	-
Coal	-	-	-	2.59	5.19	7.42	9.47	11.47
Solar	0.25	0.28	0.28	0.34	0.39	0.40	0.38	0.37
Biomass	-	-	-	0.04	0.07	0.10	0.13	0.16
Total	18.20	18.66	19.27	23.50	27.73	30.17	32.13	34.28

8.3 Challenges and gaps

As with the baseline scenario, the lack of consistent information, for the medium to the long-term perspective on the development of RE projects, constitutes a limiting factor. This study relies considerably on the Mozambique NDC plan (as also it is recommended in the ICAT Guidelines) recently developed. There was an effort by MITADER, as the coordinating entity, and the NDC team, to collect as much information as possible with a view of updating the baseline and the mitigation scenarios. The engagement of participants from different sectors in the sessions held during these processes presented an opportunity to gather important information to improve the results of this exercise. The REFIT policy scenario in this study is thus based on the NDC mitigation scenario and the limited information on the "Initial Feed-in tariff ceilings" by MIREME.

9. THE RESULTING POLICY SCENARIO AND COMPARISON WITH VARIANT SCENARIOS

This section presents a comparison of the following different scenarios:

- NDC_REFIT scenario illustrates expected emissions with the implementation of 32 MW of RE through REFIT as envisioned in the NDC.
- REFIT_Policy scenario illustrates emissions with the implementation of REFIT full potential of 250 MW of RE.
- NDC_Mitigation scenario illustrates expected emissions including all NDC activities related to electricity production
- REFIT_Ambition scenario illustrates emissions assuming an additional 218 MW of RE, compared to the NDC Mitigation scenario.

A comparison of emissions and emission reductions for the scenarios is available in Table 13. In this table, the accumulated emissions refer to the sum of total emissions within a period, emission reductions list the estimated emission reductions of different scenarios compared to the BAU scenario, and emission savings refer to the percentage of emissions reduced compared to the BAU scenario.

Figure 8: GHG emissions estimates for the electricity production Baseline, *the NDC REFIT, and the REFIT policy scenario*

illustrates the expected scenarios of the GHG emissions for the electricity production baseline, the REFIT contribution to the energy sector mitigation in the NDC scenario (32 MW), and the REFIT policy scenario, assuming maximum implementation (250 MW). A comparison between the baseline electricity production and the NDC_REFIT scenario shows that the REFIT contribution to electricity-related emissions will be minor, corresponding to 0,34 $MtCO_2eq$ accumulated emission reductions by 2030, corresponding to 0.6% reduction. A comparison of the baseline and the REFIT policy scenario shows that the difference between these scenarios is 0.17 and 2.54 $MtCO_2eq$ in 2025 and 2030, respectively, corresponding to a 0.5% reduction by 2020, and 4.3% reduction by 2030.

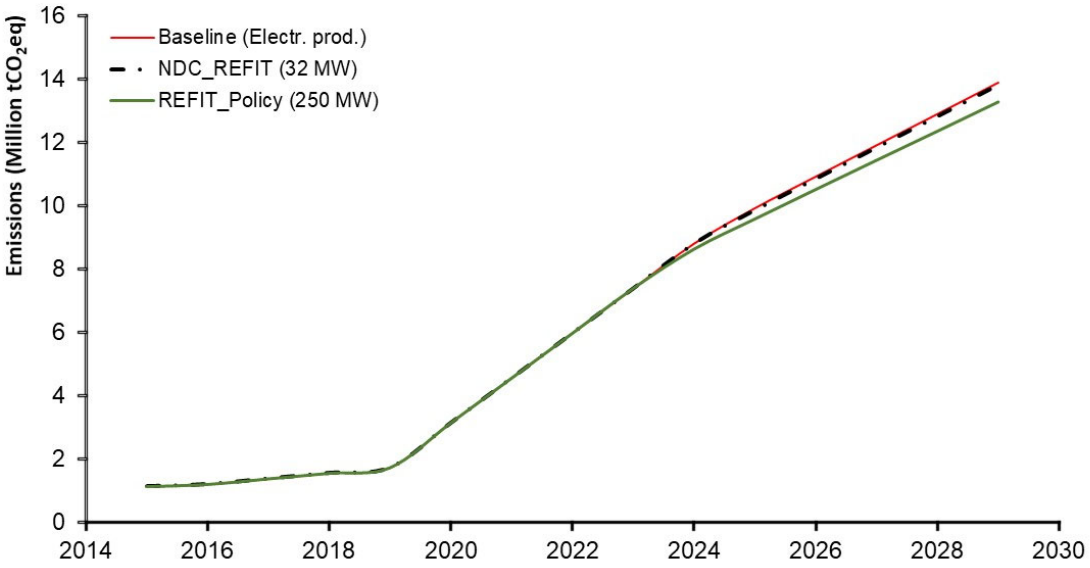


Figure 8: GHG emissions estimates for the electricity production Baseline, the NDC REFIT, and the REFIT policy scenario

Figure 9: Greenhouse gas emissions estimated for the electricity production Baseline *scenario, the NDC Mitigation scenario for electricity production, and the REFIT Ambition scenario*

compares the baseline scenario, with the NDC Mitigation scenario for electricity production including all electricity-related actions, and the REFIT Ambition scenario of the additional 218 MW of RE that could be installed if REFIT was to achieve its full implementation potential, i.e., the potential increased NDC ambition if full support for the implementation of REFIT, and the creation of the right enabling conditions were provided. The NDC Mitigation scenario is expected to lead to emissions reductions of 1.24 $MtCO_2eq$ by 2025, and 9.05 $MtCO_2eq$ by 2030, corresponding to a 3.9% and 15.2% reduction of emissions respectively. With the implementation of REFITs full potential, emission reductions could be reduced with 1.41 MtCO2eq by 2025, and 11.25 $MtCO_2eq$ by 2030, corresponding to a 4.5% and 18.9% reduction of emissions respectively. This indicates that REFIT has the potential to provide emission reductions additional to the NDC target equivalent to 0.17 $MtCO_2eq$ by 2025, and 2.2 $MtCO_2eq$ by 2030, meaning that NDC ambition for the electricity production sub-sector could be raised by 13.7% by 2025, and 24% by 2030.

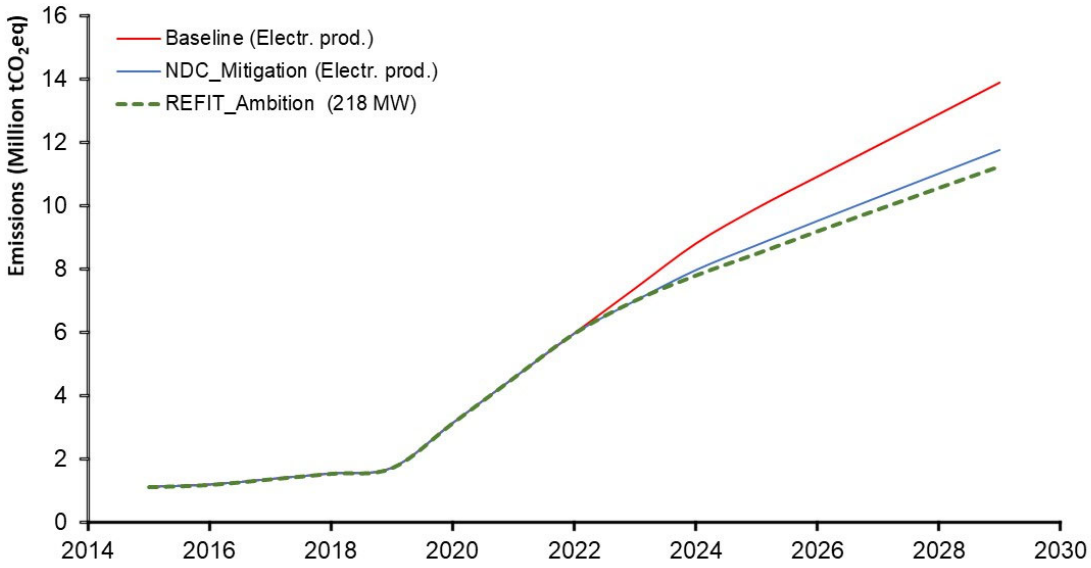


Figure 9: Greenhouse gas emissions estimated for the electricity production Baseline scenario, the NDC Mitigation scenario for electricity production, and the REFIT Ambition scenario

The full implementation of REFIT is, of course, dependent on the creation of the right enabling environments. Mozambique's NDC already indicates that the implementation of NDC targets is already dependent on international support, why additional international efforts to support climate action would be needed to support Mozambique in achieving the additional benefits of REFITs full implementation.

Table 13: Comparison of accumulated emissions and emissions savings for the different scenarios

Period	Scenario				
	Baseline*	NDC_REFIT	REFIT_Policy	REFIT_Ambition	NDC_Mitigation
	($MtCO_2eq$)	(32 MW)	(250 MW)	(218 MW)	
Accum. Emissions ($MtCO_2eq$)					
2020-2025	31.65	31.65	31.48	30.24	30.41
2025-2030	68.41	68.07	65.87	57.16	59.36
Emission Reductions (MtCO2eq)					
2020-2025		0.00	0.17	1.41	1.24
2025-2030		0.34	2.54	11.25	9.05
Emission Savings (%)					
2020-2025	-	0	0.5	4.5	3.9
2025-2030	-	0.6	4.3	18.9	15.2

Accum: Accumulated emissions

10 RECOMMENDATIONS ON HOW TO IMPROVE DATA COLLECTION AND REPORTING FOR TRACKING IMPLEMENTATION OF THE RENEWABLE FEED-IN TARIFF FOR REPORTING UNDER THE ENHANCED TRANSPARENCY FRAMEWORK

10.1 Information to be reported on mitigation policies and measures, actions, and plans

According to the modalities, procedures, and guidelines (MPG) for Article 13 of the Paris Agreement, countries will have to provide information to track progress and achievement of the NDC, and guidelines are provided for what information is relevant to report on mitigation policies and measures, actions, and plans. Information on the REFIT, being a part of the actions envisioned in the NDC, will also have to be reported in the Biennial Transparency Reports to be submitted by the end of 2024 at the latest. The information provided in Table 14 is what has to be reported in a tabular and narrative format.

As stated before, the REFIT regulation was designed for small hydro, solar, wind, and biomass up to 10 kW, differentiated by RE resource and capacity size.

Table 14: Information on actions, policies, and measures (tabular format in BTR)

BTR requirements[30]	**Information on REFIT to be reported**
Name	Renewable Energy Feed-in-Tariff
Description	Renewable Energy Feed-in-Tariff for small hydro, solar, wind and biomass up to 10 kW, differentiated by RE source and capacity size
Objectives	Provide 250MW of renewable energy into the national grid by 2030
Type of instrument (regulatory, economical instrument or other)	Regulatory
Status (planned, adopted or implemented)	Planned
Sector(s) affected	Energy
Gases affected	CO_2, CH_4, and N_2O
Start year of implementation	Not yet implemented
Implementing entity or entities	MIREME
Estimates of expected and achieved GHG emissions reductions (encouraged, if flexibility is needed)	Expected 340 ktCO2eq by 2030
Costs (may)	Will be monitored and provided during the implementation of REFIT.
Non-GHG mitigation benefits (may)	Socio-economic development related to improving living conditions (health, education, air quality), job creation, energy security, international support, and technology transfer are envisioned. They could be estimated ex-ante for reporting and national planning purposes and will have to be monitored and reported during the implementation of REFIT.
How the mitigation actions interact with each other (may report)	May be provided if analysis will be available on the interaction of the mitigation actions in the NDC.

[30] For relevant guidance on methodologies to provide the requested information see the ICAT Toolboxes at the end of this Chapter.

Besides, the MPG requires countries to provide information on methodologies and assumptions used to estimate the GHG emissions reductions or removals by each action, policy, and measure in a narrative format. As described earlier, the REFIT contribution to emission reductions under the NDC scenario was estimated using the RE Guidance provided by the Initiative for Climate Action Transparency (ICAT). The ICAT guidance was used in conjunction with the Long-range Energy Alternatives Planning System (LEAP) energy model. The baseline scenario is the same as that of the NDC approved by the government of Mozambique. The baseline uses the available historical data provided by Energy Statistics, by the Ministry of Energy, combined with other sources. The non-policy drivers for the scenario development include demographics (population) and the macroeconomic (GDP) data provided by the National Institute of Statistics (INE). The recent economic recession has contributed to the postponement of several development projects, including those on power generation, and there is considerable uncertainty in the baseline and emission scenarios, especially on the commencement dates for some projects included in the scenarios.

The electricity generation component for the mitigation scenario was built taking into consideration the action "improved access to renewable energy" from the National Climate Change Adaptation and Mitigation Strategy (ENAMMC), which includes measures related to the promotion of the use of renewable sources of energy, rural electrification through RE as well as the sustainable use of biomass. Additional data for constructing the mitigation scenario was obtained from the Integrated Master Plan, Mozambique Power System Development by the national power utility, the National Power Utility Company Strategy 2018–2028[31], the New and Renewable Energy Development Strategy 2011-2025[32]. Further input on the mitigation options for the NDC mitigation scenario was collected during the various working sessions, organized by the Ministry of Land and Environmental and Rural Development (MITADER) involving different sectors. The REFIT contribution to the NDC is assumed to be the provision of 32MW of renewable energy into the national grid by 2030, expected to provide 340 ktCO2eq of emission reductions.

Finally, according to the MPG, countries should provide information on those actions, policies, and measures that are no longer in place compared with the most recent BTR, and why they are no longer in place. If the REFIT's implementation is canceled or interrupted, Mozambique should, therefore, inform the UNFCCC through the Biennial Transparency Report. Countries should also report on how the actions, policies, and measures are modifying longer-term trends in GHG emissions and removals. This information is available through the presentation of scenarios that show how REFIT creates a slight deviation from the Business as Usual

[31] Electricidade de Moçambique, 'Lighting Mozambique 's Transformation', 2018.
[32] 'ESTRATÉGIAS DE DESENVOLVIMENTO DE ENERGIAS NOVAS E RENOVAVEIS'.

scenario, contributing to a permanent deviation than would otherwise have happened. Countries are also encouraged to provide an assessment of the economic and social impacts of response measures. An assessment of the economic and social impacts of the REFIT could be integrated into the national system for assessing policies.

Besides, the successful implementation of the REFIT regulation may bring co-benefits such as attracting investments, socio-economic development, improve the living conditions (health and education), job creation, emission reductions, energy security, international support, and promotion of job creation must also be reported to the UNFCCC.

The information that will be provided in the BTR will be regularly updated and compiled through the information needed to track the implementation of REFIT, as described in the following sections.

10.2 Information needed to track the implementation of REFIT

Tracking the implementation of REFIT will consist of tracking several aspects that are relevant to monitor its performance, not only limited to GHG emissions. According to the MPG, non-GHG impacts can also be reported to the UNFCCC. Tracking both GHG and non-GHG impacts are also relevant for national planning as they identify and document successful policies to achieve goals and objectives by tracking implementation and outputs systematically, and allow for measuring the effectiveness of a given policy's implementation. Transparency beyond GHG emissions is thus an important tool to demonstrate that REFIT has a measurable impact and is implemented effectively. In addition, tracking of the policy's impact will provide the necessary feedback to make potential modifications to REFIT, like recalculating the tariffs and assess the quality of the services provided.

Besides, monitoring, reporting, and verification (MRV) is needed to track the progress on the implementation of REFIT regulation towards the mitigation of greenhouse gas (GHG) emissions. However, no specific plan for Monitoring, Reporting, and Verification (MRV) procedures for REFIT is provided by the government, and the timing and frequency of MRV are not specified in the REFIT regulation. Although, there are existing monitoring initiatives for the electricity sector, and for climate at the national level that can be used to MRV the implementation of REFIT.

The key performance indicators are presented in Table 15. They include the entity responsible for measuring the indicator, and the entity who should gather the information and report it to MITADER for the compilation of the BTR and reporting to the UNFCCC.

Table 15: Key performance indicators to track the progress of REFIT

Parameter	Key Performance Indicator	Entity responsible for measuring	Data gathered and provided by	Monitoring frequency
GHG emission reduction	kW/h supplied to the grid by a source of REFIT supported energy provider	MITADER	MIREME (EDM and DPC)	Annual
	Grid Emission Factor	MITADER	MIREME (EDM)	Every three years
Utilization of national RE resources	Installed RE capacity (MW) by source	MITADER	MIREME (EDM and DPC)	Annual
Expenses for implementing REFIT	Level of tariff by source	MIREME (DNE, ARENE, EDM)	MIREME (DNE, ARENE, EDM), and MEF	Every three Years
	Sum of tariff's payments by source	MIREME (DNE, ARENE, EDM)	MIREME	Every 3 Years
Social benefits	Number of new business or investment opportunities	MIREME (DPC, DNE)	MIREME (DPC, DNE)	Annual
	Additional households with access to basic electricity services of electricity	MIREME (DPC, DNE)	MIREME (DPC, DNE)	Annual
	Number of new jobs created through REFIT supported activities	MIREME (DPC, DNE)	MIREME (DPC, DNE)	Annual

The Grid Emission factor should be regularly updated. The information on the built margin and operating margin, technology, and fossil fuels used are available through MIREME (EDM, DNE) and MITADER, but no institution is tasked with updating the Grid Emission Factor. As the information falls under the Climate Change arena, it should be a task for MITADER, based on data provided by MIREME. Plans to regularly update the Grid Emission Factor and make it publicly available should be established to properly track the emission reductions caused by the implementation of REFIT regulation.

EDM does track the generation of electricity and installed RE capacity (MW) by source, which is to be connected in the national grid under the REFIT regulation, and also provides annual reports to MIREME and MITADER. This information should be available online on EDM's, MIREME, and MITADER's website. However, MIREME through the National Directorate of Planning and Cooperation (DPC) and the National Directorate of Electricity (DNE) will bear the responsibility to report the co-benefits (social benefits), which includes the number of connected households, schools, health centers, public administrations infrastructures as well as jobs opportunities. The information is regularly provided in their semiannual, quarterly, and annual reports.

10.3 Information on financial, technology development and transfer and capacity-building support needed and received, including for Transparency related support

This section provides an understanding of the financial, capacity building, and technology transfer support needed or received. This type of MRV should be used to report to the UNFCCC and also to inform the bilateral and multi-lateral partners about the support needed and received. The modalities, procedures, and guidelines (MPG) for Article 13 of the Paris Agreement also include voluntary reporting for developing countries on support needed and received. Table 16 presents a list of the information requested by the MPG at the national level.

Table 16: Information to report in the BTR on support needed and received, in common tabular format

Information	FN	FR	TDTN	TDTR	CBN	CBR	ST
Title	X	X	X	X	X	X	X
Programme/project description	X	X	X	X	X	X	X
Channel		X					X
Recipient Entity		X		X		X	X
Implementing entity		X		X		X	
Type of technology			X	X			
Estimated or actual amount (domestic currency and USD)	X	X					X
Expected or actual time frame	X	X	X	X	X	X	X
Expected or utilized financial instrument (e.g. grant, concessional / non-concessional loan, equity, guarantee)	X	X					
Status (committed or received)		X					
Type of support (mitigation, adaptation or cross-cutting)	X	X	X	X	X	X	
Sector and subsector	X	X	X	X			
Whether the activity will contribute to technology development and transfer or capacity-building	X	X					
Status of activity (planned, ongoing or completed)		X		X		X	X
Whether the activity is anchored in a national strategy or an NDC	X						
Expected and achieved use, impact and estimated results	X	X	X	X	X	X	X

FN= Financial support needed; FR= financial support received; TDTN= technology development and transfer support needed; TDTR= Technology development and transfer support received; CBN= Capacity-building support needed; CBR= Capacity-building support received; ST= Support needed and received for the implementation of Article 13 of the PA and transparency activities.

The requested information is meant to be provided at an aggregate national level by support program. As such, it doesn't necessarily translate directly into a system for reporting this information for the REFIT policy as a stand-alone initiative, as the support needed and received can also be formulated in broader programs. An example is the ICAT initiative, whose activities in Mozambique cover a variety of topics.

Another example to highlight is the support received from the KfW development bank for preparing the Global Energy Transfer Feed-in Tariff (GET FiT) that aims to boost RE projects and assist the government of Mozambique in pursuing a climate-resilient low-carbon development path. The program is a package of support to unlock sustainable investment in

the RE project (viability gap funding, technical assistance facility, risk mitigation, and grid integration facility) and was primarily developed to support the feed-in tariff. (Source: MIREME 2018).

The current section provides some form of transparency related support already provided to the REFIT policy, but the activities cannot easily be disaggregated and isolated as solely REFIT related as, like the ICAT activities, tend to be much broader. Activities like the ICAT project are therefore expected to be reported by program/project, and not necessarily by NDC policy.

For the support needed for REFIT to be reported to the UNFCCC, the government of Mozambique should define a clear proposal, based on the information requested for dissemination to the international community. Table 17 presents a list of the REFIT information related to reporting on support needed and received and the entities responsible for providing the information, which will then have to be gathered and aggregated at the national level for reporting to the UNFCCC. However, reporting the support received is an ex-post event, and should occur after the implementation of mitigation policies and measures, actions, and plans, while reporting on support needed, is reporting ex-ante, and should occur before the support flow has even materialized.

Table 17: Information to report on REFIT support needed and received

MRV	Indicator	Entity responsible for measuring	Data gathered and provided by	Monitoring frequency
Financial support needed	Expected tariff costs to achieve the 250MW installed capacity in USD	MEF (DNPO)	MIREME (DNE, DPC)	Biannual
Financial support received	External funding mobilized for REFIT implementation by source and instrument in USD	MEF (DNPO)	MIREME (DNE, DPC)	Biannual
Technology development and transfer support received	REFIT related technology support received by technology	MCTESTP	MIREME (DNE, DPC)	Annual
Capacity-building support received	Number of staff and affiliation trained for the implementation of REFIT	MCTESTP	MIREME (DNE, DPC)	Annual

The Ministry of Economy and Finance (MEF), as the institution coordinating the international and national funding, will bear the responsibility of coordinating the external and internal financing mobilized for the implementation of the REFIT in close collaboration with MIREME. However, the expected tariff costs to achieve the full implementation of REFIT (250MW), partially reflected in the NDC scenario (32MW), can be extrapolated from the information

provided by MIREME. On the other hand, MEF should make the information available through their statistics and annual reports.

10.4 Summary of the main aspects for the institutional arrangement for coordination of monitoring, reporting, and verification (MRV) of the REFIT

The stakeholder participation has been an important step in this assessment, to ensure that the frequency of monitoring addresses the needs of decision-makers and other stakeholders, as well as to raise awareness of benefits of robust MRV, and increase the accountability and transparency of the monitoring and reporting process. For the purpose of this assessment, valuable insights for the establishment of MRV systems for REFIT have been provided by participants from different sectors, including MIREME (Ministry of Mineral Resources and Energy), MEF (Ministry of Economy and Finance), MITADER (Ministry of Land, Environment and Rural Development) during a number stakeholders consultation meeting.

The successful implementation and monitoring of REFIT require strong coordination among the stakeholders, as proposed in Figure 10. A strong coordination that can be achieved through a clear definition of roles and responsibilities among various actors, by identifying how the data and information on emissions, mitigation actions, and support is generated, and who has access and relevant mandate to manage the data, as well as a clear communication of the information and data needed to compile national reports such as National Communications (NC), Biennial Update Report (BURs), and the upcoming Biennial Transparency Reports (BTRs) to be submitted to the UNFCCC by end 2024 the latest.

The MIREME, through the DPC and DNE, will bear the responsibility for monitoring and reporting the energy produced by Electricity of Mozambique (EDM) and independent power producers (IPP's) under the REFIT regulation. The power meter will be placed on the connection point to the transmission/distribution grid, which is owned and maintained by EDM. Data from the meter is essential to provide information on the generation output of the facility. On the other hand, MIREME will report the statistical data, including the biannual energy balances on the installed/planned capacity to MITADER.

MITADER, through the National Directorate of Climate Change (DINAB), will bear the responsibility for the overall MRV system for mitigation by collecting data from different sectors, including MIREME. MITADER will have the responsibility to perform the estimations of GHG emissions reductions resulting from the implementation of REFIT, including the emissions resulting from electricity generated by fossil fuels (natural gas and coal) and report them in relation to GHG inventories, the goals set under the NDC and other UNFCCC reports like NC, BURs, and BTRs from 2024. On the other hand, MITADER has the responsibility of coordinating the Inter-Ministerial Working Groups for climate change, such as the existing Inter-Institutional Group for Climate Change (GIIMC), which comprises representatives from

various ministries including the academia, private entities, and civil society organizations. The GIIMC meets regularly for sharing data and information on climate change in different sectors of activity.

The Ministry of Economy and Finance (MEF), through the National Directorate of Planning and Budget (DNPO), will coordinate the planning activities, allocate and manage the budget for the implementation of REFIT regulation, as well as monitoring and reporting as presented in Figure 10. Whereas, the Ministry of Science and Technology, Higher Education, and Technical-Professional (MCTESTP) will be monitoring and reporting aspects related to technology development and transfer. However, the coordination among these entities is also necessary for avoiding duplication of effort by different actors.

One of the procedures established under the Convention is the improvement of the quality of data considering the Quality Assurance/Quality Control (QA/QC) results. MITADER, as the focal point of the UNFCCC, will be responsible for the implementation of the QA/QC activities by coordinating and verifying the information to ensure that quality data is collected and the reported information is complete, reliable and transparent.

Besides, under the REFIT regulation, a designated coordination body, an Independent Power Purchase (IPP) Committee, comprising representatives of MIREME, EDM, ARENE (formerly referred to as CNELEC), and other key stakeholders are to be formed for the evaluation of the applicants' expressions of interest and pre-feasibility findings of RE projects, which should also be considered to track the performance and outcomes of REFIT regulation over time.

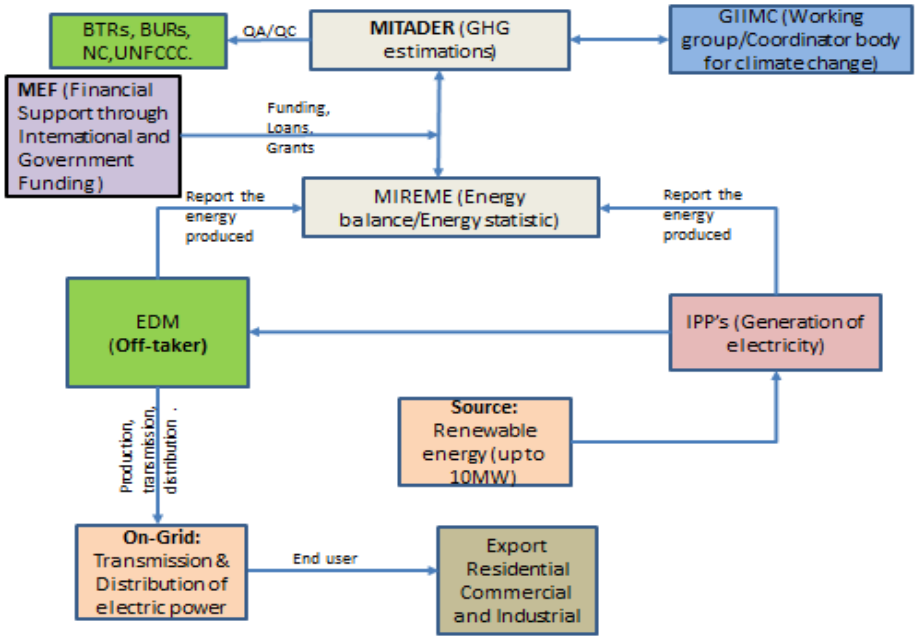


Figure 10: Proposed institutional framework for the coordination of MRV

10.5 Barriers and gaps for monitoring and reporting of the RE feed-in tariff and suggestions on procedures to overcome the barriers

The MRV of mitigation actions can be divided into three categories, MRV of GHG emissions reductions, MRV of non-GHG mitigation benefits, and MRV of support, which includes financial, technological, and capacity-building. This section aims at providing the main barriers that can hinder the implementation of MRV. The results are summarized in Table 14.

The weak coordination between institutions, and the insufficiently skilled technicians has been identified as the major challenges for the implementation of the MRV of emissions reductions of the REFIT regulation. In addition, the lack of mechanisms for data collection and the lack of recurrent updates of the grid emission factor may heavily affect the estimation of GHG emissions. Mozambique made significant steps through developing its Nationally Determined Contributions (NDC). Thus, establish a clear definition of roles and responsibilities, enhance institutional capacity building for MRV for local experts, and improve mechanisms for data collection, processing, and sharing can have a considerable impact on overcoming these barriers.

This section also addresses financial, technological, and capacity-building related barriers and gaps. One of the main constraints that the country is facing is the lack of skilled capacities for clear budgetary allocations, which can hinder the financial support for MRV and monitoring of funds spent. However, the enhancement of institutional capabilities for clear and transparent budgetary allocations can help to overcome these barriers.

Technology transfer is an important aspect to consider when tracking the implementation of MRV of the REFIT. However, like other developing countries, Mozambique is in its nascent stage of development when it comes to developing robust and comprehensive MRV systems.

Besides, the study also addresses some co-benefits (non-GHG emissions) such as job opportunities and the number of households with access to electricity that can be challenging to report due to lack of mechanisms for data collection, processing, and sharing.

Table 18: ***Barriers and gaps for monitoring and reporting of the REFIT***

Type of MRV	Indicators	Frequency of reporting	Data Provider	Roles and responsibilities	Barriers and gaps for MRV	Suggestions to overcome the barriers
GHG emission reduction	kW/h supplied to the grid by the source of REFIT Grid Emission Factor	Biannual Every 3 Years	MITADER MITADER	• Coordinate and establish standards, guidelines, and procedures for the elaboration of environmental management plans; • Collect data related to Climate Change activities in the country; • Estimate the GHG emissions; • Report reduced emissions.	• Weak coordination between institutions; • Insufficiently skilled technicians; • Insufficient data availability.	• Enhance institutional capacity building for MRV; • Clear definitions of roles and responsibilities; • MITADER through the GIIMC should improve the coordination among the institutions; • Improve mechanisms for data collection, processing, and sharing.
Utilization of national RE resources	Installed RE capacity (MW) by source	Biannual	MIREME	• Ensure the implementation of the REFIT regulation; • Account for the amount RE produced; • Provide data on the generation/Installed capacity (MW); • Provide data to calculate the grid emission factor.	• Lack/weak data collection mechanisms; • Weak sharing of information between institutions; • Insufficiently skilled technicians.	• Enhance institutional capacity building for MRV; • Improve mechanisms for data collection, processing, and sharing.

Expenses for implementing REFIT	Level of tariff by source Sum of tariff's payments by source	Every 3 Years	MIREME	• Ensure the implementation of the REFIT regulation according to the procedures established; • Ensure constant update on the tariff;	• Lack of financial and technical mechanisms for the revision of tariffs	• Improve capacities and establish technical and financial mechanisms for the revision of REFIT
Social benefits/Co-benefits	Number of new business and investment opportunities Additional households, health centers, schools, administrative office, and shops with access to basic electricity services of electricity Number of new jobs created through REFIT supported activities	Annual	MIREME	• Set attractive tariffs for private investment in coordination with MEF. • Provide data on the number of households, health centers, schools, administrative office, and shops; • Provide data on the number of new jobs;	• Insufficiently skilled capacities; • Low expected return of investment • Insufficient financial resource availability; • Insufficient data availability; • Weak planning process;	• Ensure cost-reflective tariffs; • Enhance institutional capacity building; • Improve mechanisms for data collection, processing, and sharing.
Financial support	External and internal funding mobilized for REFIT implementation by	Biannual	MEF	• Coordinate planning activities; • Allocate and manage funds for REFIT implementation;	• Insufficient financial resource availability for MRV;	• Ensure financial mechanisms; • Ensure a clear and transparent planning process;

	source and instrument in USD			• Mobilizing international/national financial resources for REFIT implementation; • Monitoring and evaluation of funded projects under REFIT.	• Insufficiently skilled capacities for budgetary allocations	• Enhance institutional capacity building
Technology development and transfer support	REFIT related technology support received by technology	Annual	MCTESTP	• Report on the technology needs and received for the implementation of REFIT	• Lack of consistent database on technology support received and needed; • Lack of skilled capacities;	• Enhance institutional coordination and capacity building.
Capacity-building support received	Number of staff and affiliation trained for the implementation and MRV of REFIT	Annual	MITADER/MIREME	Report on the international level of capacity-building resources needed and received for the implementation and MRV of REFIT	• Insufficiently skilled capacities on MRV;	• Mobilize financial and technical resources for institutional capacity building for MRV;

11 CONCLUSIONS AND RECOMMENDATIONS

This document provides the application of the Initiative for Climate Action Transparency Renewable Energy (ICAT RE) guidance for assessing the greenhouse gases (GHG) impacts RE policies. It is aiming at assessing the GHG reduction contribution of the implementation of the REFIT regulation in Mozambique. The assessment is particularly important for Mozambique since the country is currently on its energy transition and so, sound REFIT policies with clearly mapped impact potential may help in attracting investments towards low carbon growth while increasing the capacity generation through RE technologies. However, feed-in tariffs alone cannot guarantee investment in RE. In this sense, specific incentives that targeted specifically at RE are needed to complement the REFIT regulation.

Currently, hydropower dominates the electricity generation mix, and this pattern is likely to continue in the near future, given the relatively huge hydro potential available in the country. Although coal and natural gas have been identified as the main source of GHG from electricity generation in Mozambique, and their utilization is expected to grow over time under the baseline scenario.

The REFIT policy scenario considers the electricity generation component of the NDC mitigation scenario and the initial REFIT caps for the level of procurement imposed by the Ministry of Energy and Mineral Resources under the REFIT regulation. However, the tariffs and the caps on the maximum generation capacity established under the REFIT regulation should be revised to reflect the current stage of developments, taking into account declining costs in RE technologies.

The REFIT policy scenario assuming maximum implementation of 250 MW was presented, including two *variant* scenarios, namely, the NDC_REFIT of 32 MW and the REFIT ambition of 218 MW, which is a policy scenario additional to the NDC mitigation scenario. These scenarios were compared to the baseline for electricity production. In the baseline scenario, the emissions are estimated to be 31,65 and 68,41 $MtCO_2eq$ in 2025 and 2030, respectively. Emission reductions in the NDC_REFIT (32 MW) scenario are found to be almost negligible for the period 2020-2025, corresponding to practically no emission reductions by 2025, and only 0.34 $MtCO_2eq$ by 2030, equivalent to a 0.6% reduction compared to the BAU scenario. Achieving REFITs full implementation would lead to a reduction of 0.17 $MtCO_2eq$ by 2025 and 2.54 $MtCO_2eq$ by 2030, corresponding to a 0.5% and 4.3% reduction by 2025 and 2030 respectively, compared to the BAU scenario. The potential deviation from the BAU scenario might not seem highly significant, but it is still a considerable change compared to the NDC envisioned REFIT contribution.

It is important to note that the implementation of the REFIT policy scenario would lead to emission reductions additional to the NDC mitigation scenario, as the NDC REFIT scenario only accounts for 32 MW out of the total 250 MW potential. Therefore, the full implementation of the REFIT policy would result in an increased ambition of 218 MW compared to the current NDC. Comparing the NDC scenario including all activities in the electricity production sub-sector, the full implementation of REFIT has the potential to provide emission reductions additional to the NDC target equivalent to 0.17 MtCO2eq by 2025, and 2.2 MtCO2eq by 2030, meaning that NDC ambition for the electricity production sub-sector could be raised by 13.7% by 2025, and 24% by 2030. This is, of course, dependent on the creation of the right enabling environments, conditional on additional international efforts to support climate action allowing for the full implementation of REFIT.

Monitoring, reporting, and verification (MRV) is important to track the progress on the implementation of REFIT regulation towards the mitigation of GHG emissions, contribution to national policies and international reporting to the UNFCC, and also will provide the necessary feedback for policy adjustments, such as the updates on the tariffs. The proposed MRV system has been categorized into MRV of GHG emissions reductions, MRV of non-GHG impacts, and MRV of support. It provides a clear distinction of roles, responsibilities, and modalities to track specific indicators to establish impacts of REFIT, upon which reporting protocols can be established.

However, there are some barriers and gaps that can hinder the estimation of GHG and consequently the implementation of MRV such as weak coordination between institutions, lack of consistent data, lack of mechanisms for data collection, processing, and sharing, lack of skilled capacities, and lack of budgetary allocations for MRV. These barriers can be overcome by establishing a clear definition of roles and responsibilities of the institutions, enhance institutional capacity building for MRV for local experts, and improve mechanisms for data collection, processing, and sharing.

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