

Country Case Study  
**Renewables Readiness  
Assessment**

**MOZAMBIQUE**

Preliminary findings



## Foreword



Realising the full potential of my country's huge renewable energy resources is key to the development we require to expand our economy and lift our people out of poverty. Mozambique has worked tirelessly over the past decade to set up the framework in which these resources can be scaled up to the quantity we need. Our Ministry of Energy has been a separate entity since 2005 and incorporates a Directorate for New and Renewable Energy. We now have strategies and legal frameworks in place, and agencies—including the Energy Fund (*Fundo de Energia*, or FUNAE), and our national electricity utility (*Electricidade de Moçambique*, or EDM)—are making strong progress in increasing electrification. In addition, our petroleum company (PETROMOC) is engaged in biofuels production and future distribution.

Mozambique has been fortunate to receive very strong support for our renewables upscaling over many years, from within the country and from a number of strong donors and partners. Realising our plans will depend on the continuation of this support and the identification of increased resources for investment. We are actively looking at ways of maximising this investment, and have opportunities in the renewable energy sector at all sizes—from very large hydro to pico solar photovoltaic (PV)—and for all major resources: hydro, wind, solar and biomass.

Mozambique is a strong supporter of the International Renewable Energy Agency (IRENA) and its mission. We were proud to volunteer to host the second pilot study of the Renewables Readiness Assessment programme. The process and conversations with a range of government and other stakeholders, and with the external team led by IRENA, were very stimulating and have helped us to identify the key opportunities and barriers we can focus on over the short term. We are pleased that two of our examples of good practice are included in this report and are very keen to discuss and help to roll out these opportunities and the good practice examples from other countries, in the months and years ahead.

I commend this report to you and look forward to working with you in upscaling Mozambique's renewable energy.

Salvador Namburete, Minister of Energy, Republic of Mozambique, January 2012



## Preface



IRENA has a mandate to act as the focal point for international cooperation to promote the adoption of renewable energy. The IRENA-Africa High-level Consultative Forum, held in July 2011, recognised “Renewable Energy Readiness” as a crucial first step for better understanding the opportunities and constraints in African countries and regions, and for a collaborative process that will provide a rapid, objective assessment of the status of renewable energy opportunities, and identify pathways to address gaps.

Renewables Readiness Assessments (RRAs) will allow IRENA to identify and provide country-specific support and advice to participating countries. More broadly, RRAs will also generate the knowledge of good practice and the cooperation between countries that are essential to increasing deployment. The readiness assessment will help IRENA to provide assistance to countries in a targeted manner. Receiving one of the first RRAs—presented here by Mozambique—is an important milestone for IRENA.

In keeping with its strong and consistent support of IRENA and its mission, Mozambique kindly volunteered to host one of the first country pilot studies and test the RRA methodology. The process and details of RRAs will necessarily evolve with experience. We thank Minister Namburete and his team for their patience and generosity in hosting this first study. Their engagement and input have gone beyond what we could have expected and we are grateful for their important contribution.

IRENA hopes that this RRA will enable Mozambique to increase its deployment of renewables. We offer our continuing support, across all our functions and work programmes, to Mozambique in implementing the actions identified.

*Adnan Z. Amin, Director General, IRENA. Abu Dhabi, January 2012*

**Contents**

Foreword..... 3

Preface ..... 5

List of Acronyms..... 7

1. Introduction to RRAs and to the Report for Mozambique ..... 8

2. Increasing Readiness in Mozambique..... 9

    2.1 Overview of the energy situation ..... 9

    2.2 Actions Identified to Upscale Renewables Deployment in the Short- to Medium-term..... 12

    2.3 Good Practices in Mozambique ..... 17

3. Future Co-operation ..... 18

## List of Acronyms

CNELEC	<i>Concelho Nacional de Electricidade</i> (National Electricity Advisory Council of Mozambique)
ECOWAS	Economic Community of West African States
EDM	<i>Electricidade de Moçambique</i> (Electricity Utility)
EIA	Environmental Impact Assessment
FiT	Feed-in-Tariff
FUNAE	<i>Fundo de Energia</i> (Energy Fund)
HCB	<i>Hidroelectrica De Cahora Bassa</i> (Cahora Bassa hydroelectricity plant)
IPP	Independent Power Producer
PETROMOC	National Petroleum Company
PPA	Power Purchase Agreement
PV	Photovoltaic
RE	Renewable Energy
RRA	Renewables Readiness Assessment
SADC	South African Development Community

## 1. Introduction to RRAs and to the Report for Mozambique

This document is a precursor to a forthcoming detailed report on the Renewables Readiness Assessment (RRA) conducted by, and for, Mozambique in December 2011. RRAs—which will be rolled out across the world—are a pillar of the work programme<sup>1</sup> of IRENA, the International Renewable Energy Agency. An RRA is a **rapid assessment of how a country can increase readiness and overcome the main barriers to the deployment of renewable energy technologies**. It is a **national document**, owned by the government of the country.

**Renewables** encompass all possible applications: on-grid; off-grid applications (thermal, electricity services, motive power); and biofuels for transport.

**Readiness** is when actors are able to deploy renewables where they are the best option, accounting for all economic, social and environmental criteria.

**Assessment** is of the *current* state of *national* readiness, across the project lifecycle, from national energy strategy and policy to building, operation and maintenance, with capacity building cutting across.

The RRA process is designed to:

1. **Rapidly identify where action is needed** to improve readiness;
2. Identify **the partners and organisations who can help deliver** these actions; and
3. Allow more **focused discussions to be held with bilateral and multilateral partners**, allowing them to buy into the set of actions developed and avoiding the need for further reviews and assessment.

The RRA process in Mozambique benefitted from the expertise and engagement of many experienced professionals. The mission was conducted from December 11–17, 2011 and comprised the following elements:

1. A site visit to Pessene, a village located at 40 kilometres from Maputo where very small-scale (“pico”) photovoltaic (PV) systems had been used to electrify a school building and teachers’ accommodation, as well as a village dwelling.
2. A series of fact-finding interviews with stakeholders from the (renewable) energy sector.
3. Working sessions with employees from the Ministry of Energy and other stakeholders to fill in templates for different renewable energy (RE) resources and services.

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<sup>1</sup> The first phase of the RRA programme comprises methodology design and testing. The first pilot mission took place in Senegal (November 2011) and the second in Mozambique (December 2011). The first phase will develop materials by the IRENA Assembly in January 2012 and be complete by the end of February 2012. The second phase will see further pilot studies outside Africa, and roll out in Africa to certain countries in the Economic Community of West African States (ECOWAS) and Southern African Development Community (SADC) regions.



- The last day of the mission was a seminar with stakeholders, aimed at presenting findings from the week, eliciting further feedback on these findings, and developing the set of actions that form the last stage of an RRA.

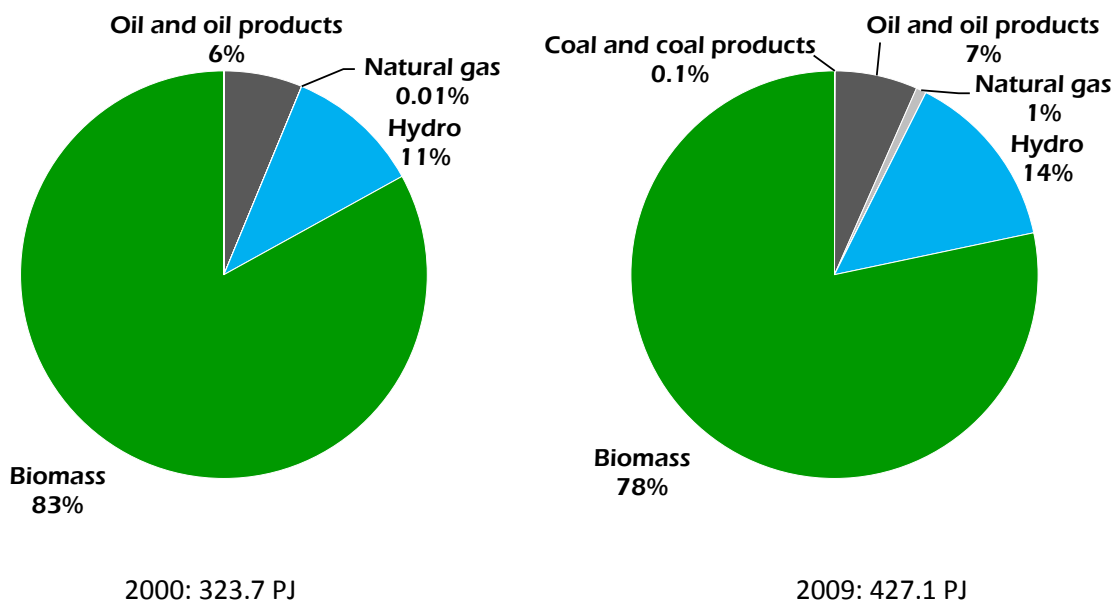
The key output of RRAs is the concrete actions identified. IRENA is committed to supporting these through the exchange of information between those facing similar issues and opportunities and through finding partners and linking them. A key resource from the RRA project is a database of good practices.

## 2. Increasing Readiness in Mozambique

### 2.1 Overview of the energy situation

The Total Primary Energy Supply (TPES) of Mozambique in 2009 is 408.9 Petajoules (PJ). Biomass meets 78% of the country’s energy needs, followed by hydro (14%) and oil products (7%). The use of coal and gas is marginal and accounts for about 1% of the TPES – Mozambique is a producer of natural gas but most of the production is exported. The country is also a net exporter of electricity. All the oil products used are imported and their cost accounts for 15% of country’s imports, making Mozambique vulnerable to increases in the price of oil products.

**Figure 1: Total Primary Energy Supply\* in 2000 and 2009**



\*excluding electricity trade

### Box 1: Energy national profile 2009

Total Primary Energy Supply: 408.9 PJ – of which renewables: 395.5 PJ (96.7%)

Energy self-sufficiency: 122.0%

Fuel imports: USD 581 million (15.4 % of total imports)

Electricity generation: 17.0 TWh – of which renewables: 17.0 TWh (99.9%)

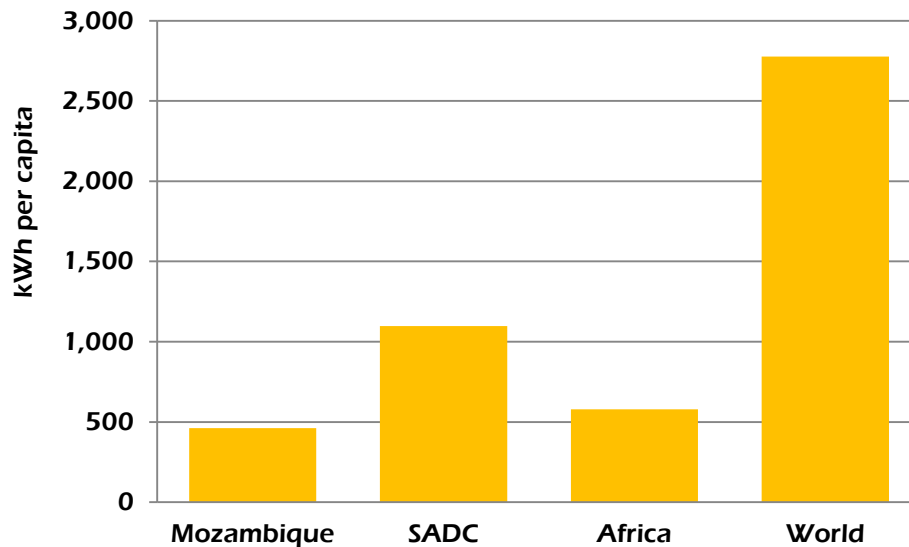
Electricity use per capita: 453 kWh

Electrical capacity (2008): 2,428 MW – of which renewables: 2,179 MW (89.7%)

Share of population using solid fuels: > 95%

Nearly all the electricity generation comes from hydro, with a small share of the output of the 2075 megawatt (MW) hydro-electric plant at Cahora Bassa (*Hidroelectrica De Cahora Bassa*, or HCB) providing 90% of electricity supplied to the grid. The electricity consumption per capita in 2008 is 461 kilowatt-hours (kWh), which is below the average of southern African countries (1,097 kWh), of Africa (579 kWh) and the world (2,777 kWh). Mozambique's level of access to electricity has increased significantly both on- and off-grid in recent years, but is still below 32%. Increasing electrification must cope with challenges that include the highly dispersed population, many of whom depend on subsistence farming on smallholdings, and the fact that the main electricity transmission line from Cahora Bassa goes south to South Africa, rather than feeding Mozambique.

**Figure 2: Electricity use per capita for 2008**



Note: SADC includes Angola, Botswana, DRC, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.

Mozambique's options to increase energy supply include opportunities at all scales, from the very large to the small. There are many opportunities for all sizes of hydroelectric power plants; most notably there is a planned extension of large hydro-associated transmission lines near Cahora Bassa.

Mozambique also has a significant solar resource. In terms of conventional energy, there are considerable reserves of coal and natural gas, and oil has recently also been discovered.

Politically and institutionally, Mozambique is making rapid progress on renewable energy. The Ministry of Energy became a separate entity in 2005, and includes a National Directorate for New and Renewable Energy. Legal and strategic preparations are also in place to support upscaling of renewable energy, including biofuels. A key challenge is to generate the resources necessary for up-front investment, whatever the renewable technology and project scale. An increased role for private sector investment is likely to be necessary for Mozambique to increase its rates of renewable energy use and electricity access.

The table below summarizes the status of renewables for five key issues of common concern for countries, and which feature in all RRA reports.

**Table: Status of Renewables by Issue of Common Concern**

Issue	Status in Mozambique
Rural electrification	The Energy Fund ( <i>Fundo de Energia</i> , or FUNAE) has the main responsibility for delivering the rural electrification strategy. It has successfully implemented a wide range of off-grid projects, using resources generated from fees on electricity sales, from the state budget and with donor support. FUNAE has a strong ambition to create opportunities for the private sector, which will be needed to increase the pace of electrification. In practice, customer tariffs are set at grid levels, reflecting FUNAE’s focus on providing social goods.
Integrating renewables into the electricity grid	The electricity grid is fed almost exclusively from the Cahora Bassa plant. Integrating electricity from other power plants, particularly if these are intermittent or of smaller capacities, will require building up experience and capacity. The state electricity utility, ( <i>Electricidade de Moçambique</i> , or EDM), owns and operates all plant on the system other than Cahora Bassa, but its main focus is on maintaining and developing the transmission and distribution grid.
FIT (feed-in tariff) and other preferential financial conditions for renewables	Project developers are free to approach the Ministry of Energy with proposals. Standard tariffs and conditions for renewables investments are not yet in place. Certain projects may be able to produce electricity at costs below the marginal cost of purchase from Cahora Bassa.
Off-grid power thermal and motive power	Significant potential exists but strengthening is needed across the supply chain, with new business models and a role for the private sector worthy of investigation.
Biofuels for transport	Mozambique has vast potential biomass resources and a developed strategy. Blending of both ethanol and biodiesel are planned from 2012. Meeting domestic needs—very important given Mozambique’s total reliance on imported oil products—before exporting is a key part of the strategy.

## 2.2 Actions Identified to Upscale Renewables Deployment in the Short- to Medium-term

The RRA process identified the actions below. They are not given in any order of priority, and the list of actions from a rapid assessment is unlikely to be exhaustive. The RRA identifies a range of actions which could increase the readiness of Mozambique to upscale its deployment of renewables. The actions are designed to be implementable in the short- to medium-term, largely by decisions taken by the government of Mozambique.

### Hydro: Key findings

<b>Action</b>	<b>Support the development of large and small scale hydroelectricity projects</b>
<b>Resource-Service pair(s)</b>	On-grid electricity, hydro resources
<b>Description</b>	<p>Hydro electricity is an important resource for Mozambique. There is a significant resource including the potential for large (greater than 25 MW) and small (5–25 MW). Large hydro opportunities are nationally significant projects developed on a case-by-case basis which are discussed directly with the group of multilateral and bilateral funding agencies. Further efforts should also be made to take advantage of the grid extension ongoing by EDM, so as to mobilise funds to support the development of small hydro projects along the grid, as these could offer significant reductions in grid losses (currently at ~29%) through distributed generation closer to consumption and could free up additional electricity for export and/or use within the country.</p> <p>The main barriers to the development of small hydro projects in Mozambique centre around the lack of a framework to support independent power producers. Reducing the uncertainty of the project revenue streams and increasing the availability of project finance would help to promote economically sustainable projects. The following measures should be employed to improve project bankability:</p> <ul style="list-style-type: none"> <li>- EDM could take a small equity stake in small hydro projects to reinforce the credibility of its long-term power purchase agreement (PPA);</li> <li>- The Ministry could work with the donor group to develop a partial risk-guarantee fund with financial institutions in Mozambique to promote lending to small hydro projects;</li> <li>- A system of feed-in tariffs could be developed to provide long-term power purchase agreements, access to the grid and attractive return on investment; and</li> <li>- Consultations could be held with stakeholders to design a simpler process for environmental impact assessment (EIA) for small run of the river hydro plants.</li> </ul>
<b>Actors</b>	The Ministry of Energy (National Directorate for New and Renewable Energy and National Directorate for Electrical Energy), donors and other potential investors (private companies, utilities and commercial banks), EDM, National Electricity Advisory Council of Mozambique ( <i>Concelho Nacional de Electricidade</i> , or CNELEC)
<b>Timing</b>	Take one project to contract signature within 12 months
<b>Keys for success</b>	<ul style="list-style-type: none"> <li>- Create mandate for EDM to issue long term PPAs and to agree standard terms for acquiring project equity;</li> <li>- Increase capacity within EDM for working in partnership with private sector actors to deliver successful projects; and</li> <li>- Work in partnership with other actors to address financing risks.</li> </ul>

<b>Action</b>	<b>Include potential sites for hydroelectricity projects in grid extension planning</b>
<b>Resource-Service pair(s)</b>	On-grid electricity, hydro resources
<b>Description</b>	<p>The grid extension carried out by EDM up to the district level provides an opportunity to link in and promote distributed on-grid generation through the development of small hydro projects. There are a number of sites for small hydro projects, which would require up to only 5–10 km of grid extension to allow those projects to inject power into the grid. These sites could be prioritised for development in EDM’s master plan for grid extension.</p> <p>The development of EDM’s master plan for new generation and grid extension should take into account this potential and the need to plan for grid connections for these sources. A study to assess the impact of promoting distributed hydro power generation with small hydro plants on distribution losses would provide further impetus to the sector.</p>
<b>Actors</b>	EDM, CNELEC, Project developers
<b>Timing</b>	12 months
<b>Keys for success</b>	<ul style="list-style-type: none"> <li>- Maintain registry of potential projects;</li> <li>- Place obligations on EDM to consider proximity to potential projects in master planning exercises; and</li> <li>- Complete EIA for small hydro plants to create a shelf of projects for IPPS.</li> </ul>

<b>Action</b>	<b>Evaluate the cost of energy generation from wind energy in Mozambique</b>
<b>Resource-Service pair(s)</b>	On-grid electricity, Wind energy
<b>Description</b>	<p>Wind power in Mozambique is in an early stage of development. A 300 kilowatt single turbine has been installed at Praia da Rocha, Inhambane. Mozambique is considered to have a good wind resource along the coastline and in highlands, with average wind speeds close to 6–7 metres per second in some areas. A study is underway to map the wind resource across the country in more depth and to produce a renewable energy resource atlas by 2013. To support this, a number of wind monitoring stations are being installed at selected locations.</p> <p>The cost of generation from wind turbines is likely to be higher than alternatives, including hydro. However, geographical and infrastructural benefits from distributed generation may increase the value of locally generated electricity. The resource mapping exercise should be used to further refine the estimates of generation costs and to inform the policies for the promotion of wind power.</p> <p>The outputs of the resource mapping exercise and any benefits from distributed generation should be reviewed to determine if the costs of generation from wind energy projects are acceptable. The outcome of this exercise should be to set priorities for developing further policy in support of wind energy.</p>
<b>Actors</b>	National Directorate for New and Renewable Energy, National Directorate for Electrical Energy, FUNAE, EDM, resource mapping companies
<b>Timing</b>	18 months
<b>Keys for success</b>	Objective review of the costs and benefits of electricity generated from wind energy

<b>Action</b>	<b>Develop a system of feed-in tariffs for electricity generated by RE technologies</b>
<b>Resource-Service pair(s)</b>	On-grid electricity, hydro and biomass resources
<b>Description</b>	<p>A number of tax incentives currently exist to support socially beneficial investments (Code of fiscal benefits, law 4/2009). To support this, a system of feed-in tariffs could be developed to promote small hydro and biomass co-generation for grid-connected electricity generation.</p> <p>The proposed feed-in tariffs will help give clarity to developers and incentivise independent power producers (IPPs). The design of the tariff should take into account the costs of generation, return on investment, impact on electricity prices and the costs of the support.</p> <p>The tariff could reflect the positive impact of reduced transmission losses.</p> <p>There is international experience on formulating feed-in tariffs from which Mozambique could benefit. Further dialogue with IRENA could explore the possibility of support for the development of feed-in tariffs.</p> <p>The prerequisite legal powers and for the introduction of feed-in tariffs should be evaluated to identify changes and legislation that would need to be drafted to enact such a scheme and map the legislative timetable for its introduction.</p>
<b>Actors</b>	The Ministry of Energy (National Directorate for New and Renewable Energy and National Directorate for Electrical Energy), Ministry of Finance and other potential investors (private companies, utilities and commercial banks), EDM, CNELEC, IRENA.
<b>Timing</b>	18 months
<b>Keys for success</b>	<ul style="list-style-type: none"> <li>- Publish a draft proposal for feed-in tariff scheme for key technologies;</li> <li>- Conduct legislative review on the introduction of feed in tariffs; and</li> <li>- Conduct review of international experience to the conditions in Mozambique.</li> </ul>

<b>Action</b>	<b>Promote development of sustainable biofuel projects</b>
<b>Resource-Service pair(s)</b>	Biofuels for transport, bio-energy resources
<b>Description</b>	<p>Biofuel production in Mozambique centres on investment by mainly foreign-owned companies in land and equipment for the cultivation and processing of liquid biofuels for transport. The main factors influencing the success of attracting investors in Mozambique for the production of biofuels are the availability and cost of suitable land, the perceived global and local biofuels price risk, and the stability and transparency of the regulatory environment.</p> <p>The current biofuels policy and criteria for sustainability balance the interests of export-led growth with those of local consumers so that biofuels can be developed in the national best interest of Mozambique. In the long-term, Mozambique needs to take a strategic decision on whether to become a major exporter of biofuels, taking account of the potential risks and benefits of such a strategy.</p> <p>In the short- and medium-term the following actions could be employed:</p> <ul style="list-style-type: none"> <li>- Obtain clear indications of local market size and process for allocating obligations for projects to supply the local market;</li> </ul>

	<ul style="list-style-type: none"> <li>- Balance sustainability criteria with land availability to identify available land for biofuels production; and</li> <li>- Develop legislative and regulatory timetable to provide biofuels specification standards, compatible with international standards.</li> </ul>
<b>Actors</b>	The Ministry of Energy (National Directorate for New and Renewable Energy and National Directorate for Fuels).
<b>Timing</b>	12 months
<b>Keys for success</b>	Availability of land, engagement with local communities and with investors

<b>Action</b>	<b>Clarify the requirements for biofuels producers to supply biofuels to the local market</b>
<b>Resource-Service pair(s)</b>	Biofuels for transport, bio-energy resources
<b>Description</b>	<p>Mozambique is currently entirely dependent on imports for transport fuel, which is an incentive to develop domestic sources of supply to reduce both costs and exposure to price volatility. It has implemented a fuel blending mandate which phases in bio-ethanol to 10% by 2012–2015, 15% from 2016–2020, and 20% from 2021. For diesel, the blending is 3%, 7.5% and 10% over these timeframes. There is currently no agreed pricing mechanism for how much will be paid for biofuels to satisfy this blending requirement.</p> <p>The biofuels strategy currently requires domestic markets to be satisfied first before companies can export. Further clarification is required regarding how the obligation to supply the local market will be allocated. There needs to be a dynamic mechanism for allocating the obligation to supply into the domestic market to create a level playing field between all suppliers (existing and new entrants). This mechanism needs to create a transparent price for suppliers into the national market to give greater price visibility for investment.</p>
<b>Actors</b>	The Ministry of Energy (National Directorate for New and Renewable Energy and National Directorate for Fuels), Ministry of Agriculture, Biofuel producers
<b>Timing</b>	Q2 2012
<b>Keys for success</b>	Clear published guidance for investors regarding the proportion of production required to meet the local demand, and clear pricing formulae

<b>Action</b>	<b>Scaling up deployment of rural electrification and decentralised energy</b>
<b>Resource-Service pair(s)</b>	Off-grid electricity, all resources
<b>Description</b>	<p>The Energy Fund (FUNAE) has the main responsibility for delivering the rural electrification strategy. While it was originally set up to finance projects, it has moved increasingly into project management. FUNAE is involved in identifying and tendering for projects and, in some cases, operation and maintenance.</p> <p>FUNAE is currently in the process of implementing a 5 MW solar module manufacturing facility.</p> <p>FUNAE has a successful record in implementing off-grid projects, and in the short term needs continued financial resources to continue this work. In the longer-term, its ability to deliver rural electrification on a much wider scale will ultimately be limited by human and financial resources, and a more strategic approach will be required. A review of the approach could consider the following:</p>

	<ul style="list-style-type: none"> <li>- Areas of FUNAE's scope that could be delivered by the private sector;</li> <li>- Scale up of alternative models for deployment by which service charges could provide a long-term income source to support FUNAE's future projects;</li> <li>- Assessment of progress against targets for electrification and decentralised energy, to highlight areas where additional action is needed; and</li> <li>- Review import duties charged on renewables and other technologies (notably diesel generating sets) to ensure that cleaner solutions are not being penalised; consider favouring renewables technologies compared to fossil fuel-based ones.</li> </ul>
<b>Actors</b>	The Ministry of Energy, National Directorate for New and Renewable Energy, FUNAE, representatives of civil society, community associations, Ministry of Finance
<b>Timing</b>	12 months
<b>Keys for success</b>	<ul style="list-style-type: none"> <li>- Strategic plan for FUNAE to meet policy objectives and promote private sector growth;</li> <li>- Engagement of local project developers and equipment manufacturers;</li> <li>- Outreach and engagement with local communities; and</li> <li>- Discussions and identification of resources from State budget.</li> </ul>

<b>Action</b>	<b>Encourage private sector involvement in rural electrification and decentralised energy</b>
<b>Resource-Service pair(s)</b>	Off-grid electricity, all resources
<b>Description</b>	<p>Mozambique is a large country with a widely dispersed, mostly rural population. Despite ambitious grid extension plans, large areas of the country will not be reached by the electricity grid in the short- to medium-term. The country has a great deal of potential for supplying electricity for off-grid applications, especially through solar PV, small hydro and biomass (including forest/agricultural waste).</p> <p>The Energy Fund (FUNAE) is involved in identifying and tendering for projects, and in some cases operation and maintenance. While FUNAE is currently the main player, there is a strong political ambition to create private sector opportunities for provision of these rural energy services based on business models, which could be scaled-up at lower cost to the State.</p> <p>There is an opportunity to encourage the private sector to supply equipment and finance. To promote private sector involvement in the rural electrification and decentralised energy sector the following points could be considered:</p> <ul style="list-style-type: none"> <li>- Introduce a role in which FUNAE engages with the private sector through creation of a private sector liaison officer</li> <li>- Establishment of a private sector forum to discuss possible revisions to policies and regulations;</li> <li>- Expansion of tender process to include management, design and maintenance activities previously undertaken by FUNAE;</li> <li>- Provide a clear policy and implementation guidelines by which private sector and community-led projects can apply for funds through FUNAE;</li> <li>- Proactively encourage allow a business-led approach to emerge by encouraging private equipment suppliers and distributors to enter the market in partnership with microfinance institutions where appropriate;</li> </ul>



	and - Consider the use of a concession-based system.
<b>Actors</b>	The Ministry of Energy (National Directorate for New and Renewable Energy), FUNAE, IRENA, installers and suppliers of systems.
<b>Timing</b>	12–18 months
<b>Keys for success</b>	Engagement of FUNAE and the private sector, willingness for collaboration between the two. Capacity building in the private sector

### 2.3 Good Practices in Mozambique

Among the areas where Mozambique is demonstrating good practice are the two examples below. These examples will form part of the best practice database being developed under the RRA project, which will become a knowledge-management tool designed to help all countries identify and track their renewables readiness.

#### **Good Practice Demonstration 1: FUNAE and Access to Electricity**

FUNAE aims to deliver the electrification of schools, clinics and villages using photovoltaic, wind and mini-hydro systems. To date, the electrification of 115 villages, 298 schools and 300 clinics has been successfully completed.

FUNAE has delivered projects using a wide range of scales of solar power, from just a few watts to tens of kilowatts. The successful deployment and demonstration of solar energy technologies have led to an upsurge in awareness and interest in the potential of solar energy for rural electrification. In particular, the deployment of pico-scale solar energy systems has led to requests for the kits to be sold on a commercial basis, leading to opportunities for income generation in the private sector.

To support the growing solar market in the country, FUNAE has been instrumental in the development of plans to construct a solar module manufacturing plant with a value of approximately USD 13 million to assemble solar modules for sale in Mozambique and in neighbouring countries. This will bring additional employment to Mozambique and could be the first step towards a domestic solar manufacturing sector.

FUNAE continues to deliver sample projects and provide a range of examples of solar installations. Plans for 2012 include the further electrification of 350 schools, 350 health clinics and 30 villages. In addition, three large solar projects, in the range of 400 to 500 kilowatts—a size never before installed in Mozambique—are planned in Niassa province.

Alongside the deployment of technology, FUNAE has developed the capacity for operation and maintenance, both through commercial arrangements and through training provided to community representatives. In 2008, FUNAE initiated a programme to train solar energy technicians in all provinces of the country.

#### **Good Practice Demonstration 2: Eduardo Mondlane University Renewable Energy Programmes**

In Mozambique, the deployment of renewable energy is motivated by both the global-level challenges of dwindling fossil fuel reserves and global climate change, and the country-specific problems related to

excessive consumption of biomass in its primary form and very low levels of electrification. These issues can be addressed through the adoption of renewable energy and increased energy efficiency, but this in turn requires that people be educated in these technologies. Mozambique has acted to support the development of sustainable energy through university education in the areas of science and engineering, complementing vocational training schemes.

Renewable energy studies have been included in the syllabi of a number of graduate-level courses, in both the Faculty of Science and the Faculty of Engineering at the Eduardo Mondlane University. This approach has helped to provide expertise to many of the energy-related government departments and agencies.

To further increase Mozambique's capacity to support the development of internal energy resources, a PhD programme in Energy Science and Technology has been established at Eduardo Mondlane University. This focuses on renewable energy and aims to create an institutional capacity for research and training in socioeconomic fields related to energy. In addition, a Master's programme in the field of Science and Technology is planned for the second semester of 2012. These programmes benefit from and reinforce a research capacity in renewable energy at the university that goes back to the early 1990s.

The commitment to education and research in the development and application of energy technology is an example of good practice and will help to provide the human capital to meet the energy challenges of the future.

### **3. Future Co-operation**

This RRA pilot study in Mozambique has served two purposes. First, it has identified a number of actions—many of which can be taken in the short term—to improve readiness for renewable deployment in Mozambique. Bilateral and multi-lateral institutions have a crucial role to play in supporting the implementation of these actions. Second, the pilot study has also provided valuable inputs to the development of the RRA methodology and process, and IRENA has expressed its gratitude for this input.

The report can serve as a basis for the development of international co-operation on country-level and regional-level programmes. At the country level, the report opens up the possibility of piloting a multilateral initiative to support the development of small hydro projects in Mozambique. At the regional level, IRENA could support the deployment of small hydropower projects in Mozambique and elsewhere through building a network of countries, resource persons and institutions engaged in project development. This will create a platform for sharing experience that is not often available and also enable countries to build their knowledge base.

In the next phase of the RRA project, the improved methodology and process will be rolled out to a number of other SADC countries through a regional workshop session. It is very much hoped that Mozambique will be able to continue its leading role in the RRA project, and allow other countries to benefit from its experience, by giving support to this roll out.





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