

Solar Thermal Roadmap for Mozambique

Authors

F. Arthur (EDM), G. Nhumaio (UEM), A.
Saide (FUNAE) and F. Cumbe (ENPCT)

Content

- Introduction
- The Solar Thermal Vision for Mozambique
- The Solar Thermal Technology Roadmap
- Roadmap Implementation
- Conclusions

Introduction

- The Solar Thermal Technology Roadmap for Mozambique development and discussion
 - 3 stakeholder workshops, which took place in May 2013 and March and September 2015 in Maputo.
 - Participants: Experts from the Ministry of Minerals Resources and Energy, Ministry for Education, FUNAE, UEM, Electricidade de Mozambique (EDM), ENPCT (STP).
 - The Roadmap document was prepared by Fabião Cumbe (ENPCT), Fátima Arthur (EDM), Antonio Saíde (FUNAE) and Geraldo Nhumaio UEM)

Introduction

- Socio-economic indicators
 - Land - 799.380 km²
 - Population – 24.7 million
 - Rural population – 70% of the total
 - Poverty – 60%
 - GNI per capita (\$) – 604.7
 - External debt – 6.276 \$ billion (2013)
 - Infant Mortality (per 1000) – 72.4
 - Life expectancy at birth (years) – 49.8
 - Economic growth – 7% (last 10 years average)
 - Illiteracy (% of population above 15 years) – 48

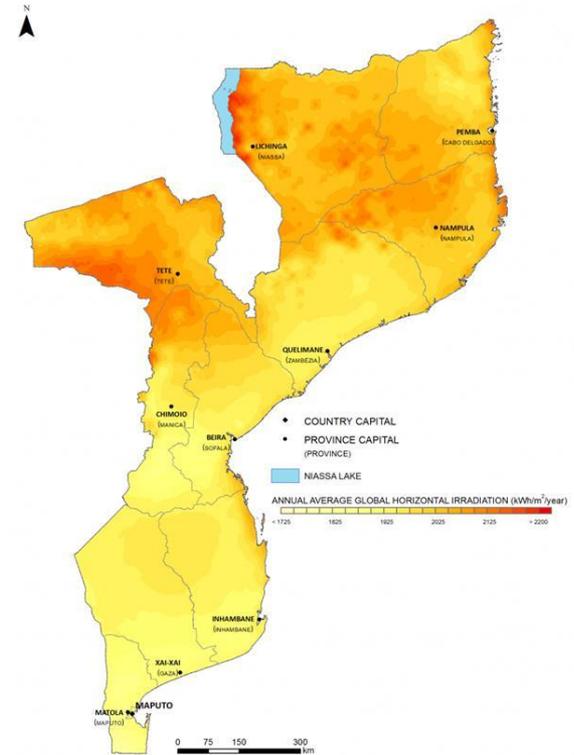


Introduction

- Mozambique's Energy Resources:
 - Hydropower – 12500 MW
 - Coal - 3 billion ton
 - Natural gas - 25 TCF (3 TCF proven reserves)
 - Renewable sources
 - Biomass – 61.8 million ha of forestry
 - Solar :
 - market potential of the solar photovoltaic 60MW.
 - The daily average solar irradiance is 5.7 kWh/m²
 - Annual global solar radiation - 1700 – 2200 kWh/ m²
 - Annual Average Temperature - 28° Celcius
 - Wind and other renewable

Introduction

- Climatic Conditions
 - Tropical country
 - Solar :
 - The daily average solar irradiance
5.7 kWh/m²
 - Annual global solar radiation
1700 – 2200 kWh/ m²
 - Annual Average Temperature
28° Celcius



Introduction

- Existing legislation, regulation and target for Mozambique
 - Energy Policy
 - Energy Sector strategy
 - Policy for development of new and alternative renewable energy
 - National Strategy for Renewable Energy

The Solar Thermal Vision for Mozambique

- to install 0.1 square meters (0,07 kWh) of solar collector area per inhabitant by 2030.
 - This relates to an overall installed collector area of 3.4 million square meters by 2030 for a population of 34 million persons countrywide.

The Solar Thermal Vision

- Population by 2014 - 24.7 million people
- The annual population growth 1.8% - 2,45%
- estimated population in 2030 - 30 and 34 million



The Solar Thermal Vision

- The estimated total solar thermal installations at the end of 2014 at about 500m² made of by the following applications:
 - Small-scale, low pressure solar water heating systems (2 – 4 m²)
 - Small-scale, high pressure solar water heating systems(2 – 4 m²)
 - Medium-scale pumped solar water heating systems for hospitals, hotels and commercial applications

The Solar Thermal Vision



Aumentei o tamanho manyendo locked aspect ratio

The Solar Thermal Technology Roadmap

- The roadmap based on the vision statement aims at 3.4 million m² of solar collectors by 2030 which is translated into about 0.1 m²/inhabitant.
- For the purposes of this roadmap, the solar thermal market in Mozambique is divided into subsections, based on the applications.

The Solar Thermal Technology Roadmap

Solar Thermal Applications

Residential Sector

Thermosyphon solar water heaters
Social housing
Medium and high income households...

50%

Tourism Sector

Pumped solar water heating systems for hotels, lodges...

25%

Public Sector

Pumped solar water heating systems for hospitals, student hostels...

15%

Industrial and Commercial Applications

Food, beverage industry, mining...

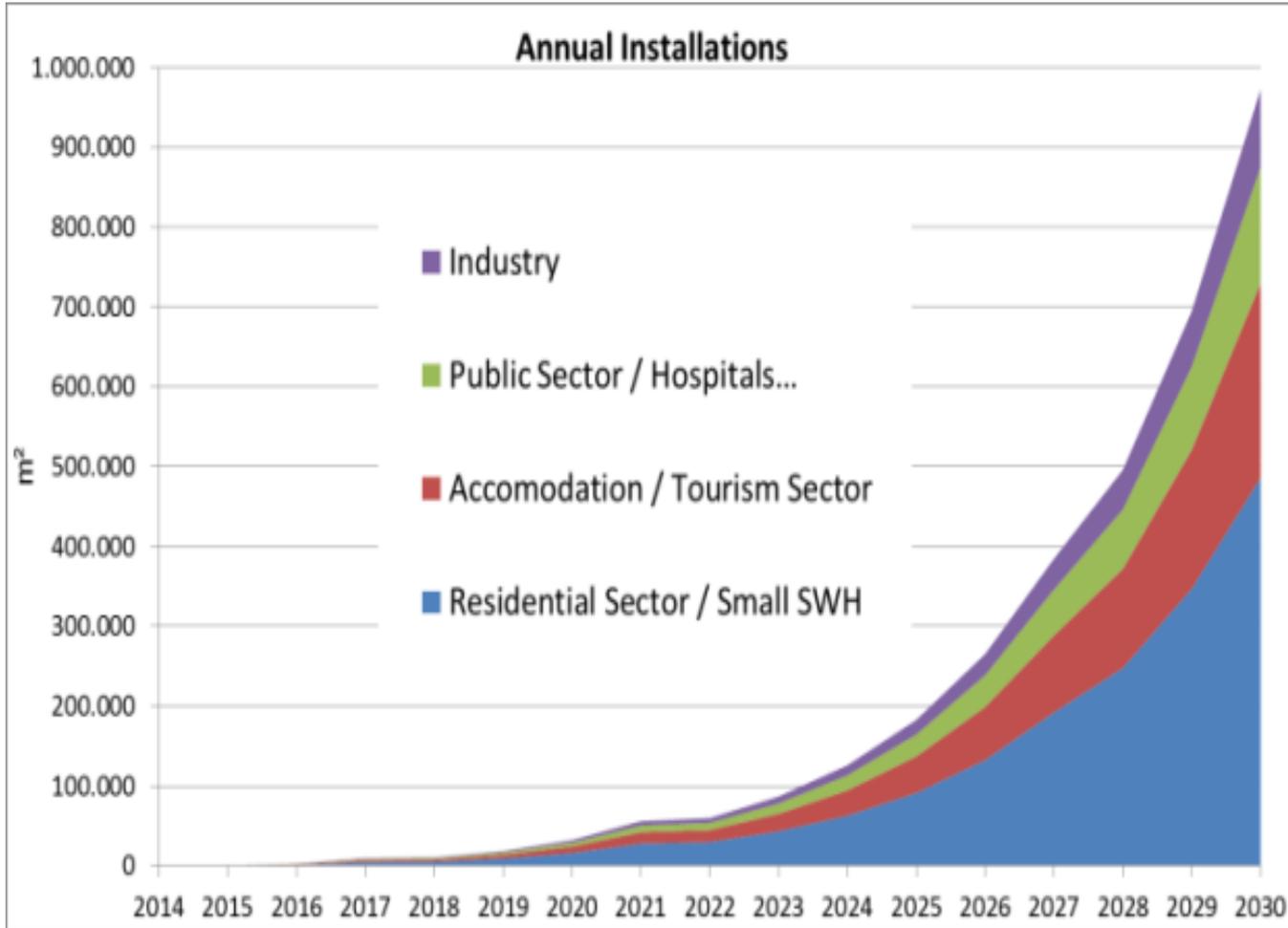
10%

The Solar Thermal Technology Roadmap

For the purposes of this roadmap, the solar thermal industry in Mozambique will focus on (though not limited) the following system types and sizes:

- Thermosyphon systems for single family houses (2 –4 m² per system)
- Thermosyphon for Lodges (2 – 4 m² per system)
- Pumped systems for hotels, hospitals etc. (20 – 100 m²)
- Industrial applications (50 - 500m² per system)

The Solar Thermal Technology Roadmap



The Solar Thermal Technology Roadmap

The Approach to the Roadmap

To achieve the envisaged target of 0.1 m² of solar water heater collector area per individual living in Mozambique by 2030 (translating to 3.4 Million m² of collector area for a population of 34 million persons countrywide or approximately 23.8 GW thermal equivalent) the targets set are estimated as per various sectors.

The Solar Thermal Technology Roadmap

Sector	Number of systems	Estimation of solar thermal collector area to satisfy requirement (100 %)
<p>Residential Sector Thermosyphon solar water heaters for social housing Medium and high income households...</p>	<p>1,000,000systems New houses but also electric geyser replacement</p>	<p>2,350,000m²</p>
<p>Tourism Sector Pumped solar water heating systems for hotels, lodges...</p>	<p>30,000 systems</p>	<p>600,000 m²</p>

The Solar Thermal Technology Roadmap

Sector	Number of systems	Estimation of solar thermal collector area to satisfy requirement (100 %)
Public Sector Pumped solar water heating systems for hospitals, student hostels and large service buildings	15,000 systems	450,000 m ²
Industrial and Commercial Applications Food, beverage industry, mining...	3,400 systems	340,000 m ²
TOTAL		3,400,000 m ²

The Solar Thermal Technology Roadmap

Thermo-syphon systems for residential sector (2 –4 m² per system)

The roadmap targets electricity consumers in the first stage, which are already using electricity for hot water use. The identification of the target population will be made with the following criteria:

- Urban population
- Electricity consumption \geq 250 kWh per month

The Solar Thermal Technology Roadmap

Pumped systems for tourism sector (10 – 30 m² per system)

The roadmap targets electricity consumers, which are already using electricity for hot water use. The identification of the target population will be made with the following criteria:

- Hotels, guest houses, Bed and Breakfast and similar institutions, contracted to EDM on the tariff category “Large Consumers of Low Voltage – GCBT)
- Electricity consumption $\geq 5,000$ kWh per month

The Solar Thermal Technology Roadmap

Pumped systems for the public sector (30 – 60m² per system)

The roadmap targets at first electricity consumers, which are already using electricity for hot water use. The identification of the target population will be made with the following criteria:

- Hospitals, schools, student residences and similar institutions with centralised hot water supply, contracted to EDM on the tariff category “Large Consumers of Low Voltage – GCBT or “Medium Voltage Consumers”)
- Electricity consumption \geq 8,000 kWh per month

The Solar Thermal Technology Roadmap

Pumped systems for Industrial and Commercial Applications (50 - 200m² per system)

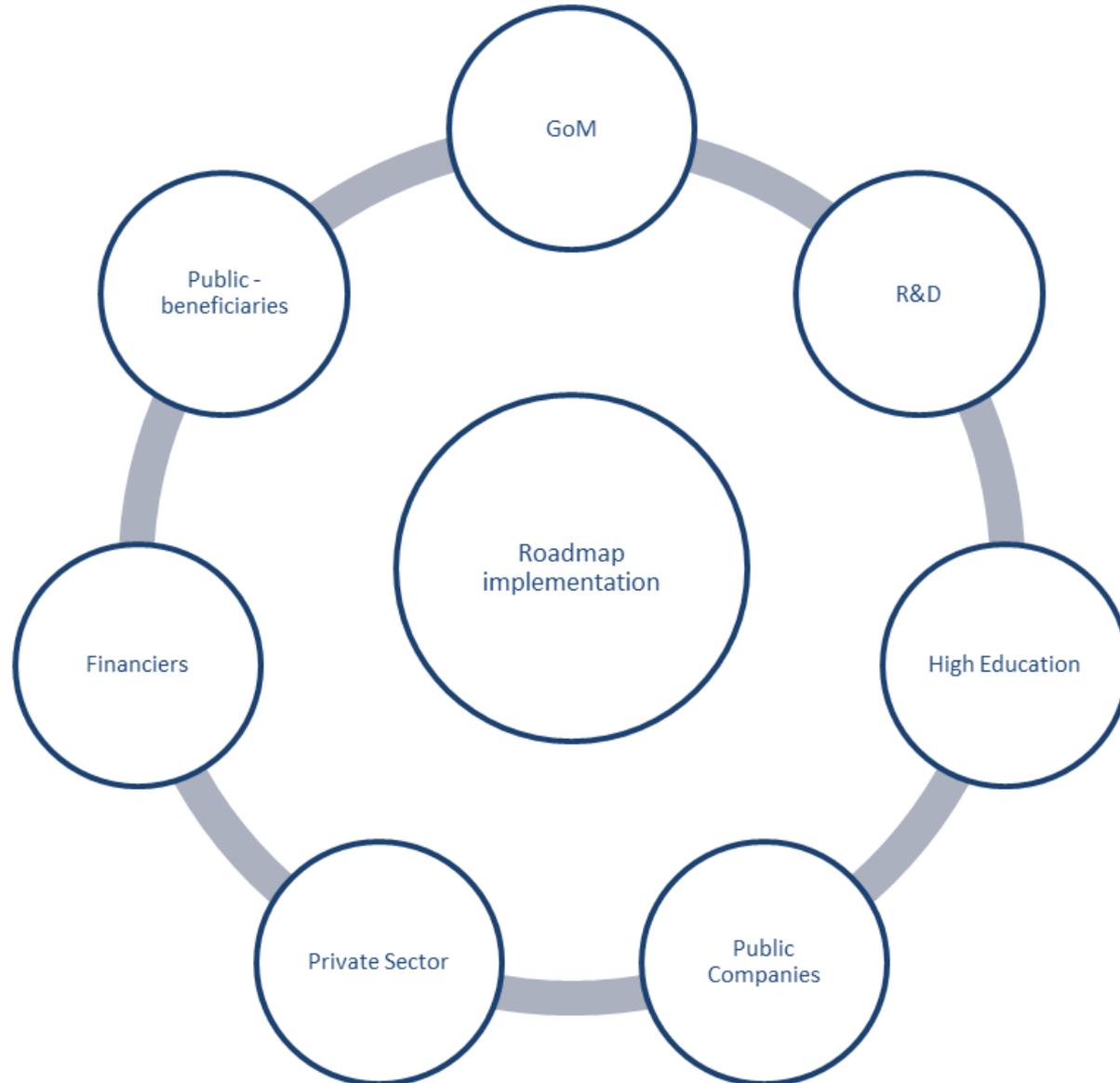
Mozambique has a vast agricultural potential and already possesses food processing industries, cloth and beverages, most of which rely on thermal energy for their production.

- tea districts of Gurué and Milange, using firewood in the tea drying processes,
- production of beer using marine diesel as a thermal source, and other examples.

Roadmap Implementation

The implementation of the Roadmap will engage various stakeholders in the country, in a coordinated effort under the leadership of the Government and guided by a vision of a Green Future and efficient energy consumption for the country.

Roadmap Implementation



Roadmap Implementation

The implementation of the road Map will engage, in the first stage, the following leading institutions:

- The science and technology park (STP), as an incubator for entrepreneurship and knowledge dissemination
- The public electricity company (EDM), as the contractual partner of potential beneficiaries of the SWH installations
- University Eduardo Mondlane (UEM), as the training resource for all the program participants
- The Energy Fund (FUNAE), representing public promoting and financing schemes for the SWH installations

Roadmap Implementation

Leading Institutions responsibilities:

- provide the initial thought processes
- deliveries of initial stages of the roadmap implementation
- obtain the government's validation of the roadmap;
- engage other relevant institutions into the program, as it gains speed,
- mobilize additional funds for a technology roll-out initiatives, and
- run the awareness and marketing campaigns for the program

Roadmap Implementation

Expected Outputs (deliveries) of the first 2 years of the implementation of the roadmap, are:

- Detailed recommendations on policy changes and regulatory developments
- At least 5 demonstration SWH systems, installed in medium sized tourism operators
- Data on hot water uses in tourism, correlated with other data to allow for crude modelling of hot water needs in the sector

Roadmap Implementation

- At least 2 Mozambican plumbing companies trained to design, install and maintain small to medium sized (pumped) SWH
- STP fully abled to certify on quality of SWH
- Draft roll-out programs for SWH in tourism, public and residential installations.

Roadmap Implementation

- **Potential constraints and risks**

Potential constraints and risks	Mitigation
Unclear leadership and responsibilities of the program. Mutual roles of the various partners are not clear and no accountability is placed	STP will sign the contract with AEE-Intec on the Soltrain program, and will manage the program on the Mozambican side. Then STP will sign a contract with EDM, FUNAE and UEM detailing their roles and responsibilities in the various stages of implementation of the roadmap and the Soltrain program.
EDM will be liable to something going wrong in the installed systems, because of its “leading” involvement in the project	The installed systems must have the highest quality. EDM will develop contracts with the beneficiaries, stating roles and mutual responsibilities
Insufficient consultant resources to help set up the monitoring and quality control procedures and tools	AEE-Intec will train the plumbing companies and will train STP and EDM staff on monitoring and quality control
Inadequate or unreliable Mozambican plumbing company – the learner	STP will put together 2 new plumbing companies and will partner them with south African companies for the duration of the Soltrain program, for knowledge transfer and quality assurance. AEE Intec will help identify the south African company(s) interested in the partnership
Bad fitting between the South African installer – the contractor, and the Mozambican company – learner	STP and EDM must carefully monitor the partnerships in order to help smooth any problem that may arise
After installation maintenance and/or technical support is deficient	The partnerships between plumbing companies must include the after-sale technical support. The cost of the system must include design, installation and technical assistance for the first 2 years

Roadmap Implementation

Potential constraints and risks

Potential beneficiaries will not have funds for financing their part and no public funds are available instead	The Mozambican team must seek public funding to cover the cost-share of potential beneficiaries
The program does not have enough credibility with potential beneficiaries	The quality of the system must be ensured, and a “help desk” or technical support resource must be available to the beneficiaries
The program is not sufficiently attractive to potential beneficiaries	This situation will change with the increase of electricity tariffs and the restrictions to power supplies that are expected for the next 2-3 years
Marketing of the experience is not well made, and the experience cannot be replicated	STP and the team must engage in a wide dissemination of the vision of the program, the experiences and the results, through facebook and internet platforms, TV and newspapers as well as radio stations, workshops and other media
There is no capability to satisfy unplanned demand for more systems	Soltrain 3 is only the kick-off of the roadmap implementation. The mobilization of cheap funding to fully or partly subsidize the installation of the first 5,000 sqm of SWH (about 120 tourism and public facilities) will give time for more sustainable funding mechanisms to be put in place, and for the local plumbing companies to solidify
The chronology of the program is too slow for the market demand	The program must start as soon as possible and run in a focused result-oriented manner. The project team must be made accountable to the funding/enabling bodies
Sector’s structure and policies do not adapt to include SWH in its technology portfolio	Ministries must be targeted in the dissemination campaigns, to speed up the approval of proposed policy changes. Public support to the program will also help.

Conclusions

- Mozambique has a great potential for renewable energy, including solar and wind, as well as hydro and geothermal in specific cases, which are still underexploited.
- Share of renewable energy in the primary energy supply is still very low and almost insignificant despite the effort done to overcome this situation
- To implement this SWH Roadmap, there is need to build up internal capabilities in design, installs and servicing SWH installations of various types, through the creation or resourcing of local plumbing companies, which will need to acquire quality certification before their services can be offered confidently to grand hotels and industry