



**Accessible, reliable and affordable solar irrigation for  
Europe and beyond**

## **Deliverable 5.3**

# **DOSSIER MOROCCAN SI MARKET**



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## Table of contents

Table of contents.....	1
List of figures .....	2
List of tables .....	3
Acronyms.....	4
1. Introduction .....	6
1.1. SolaQua in a nutshell.....	6
1.2. Purpose and scope .....	7
1.3. About this document.....	7
2. Main findings of the D5.2.....	8
2.1. Characteristics of SI national potential market.....	10
2.2. SI Market segments in Morocco .....	11
2.3. SWOT analysis of SI Market.....	12
2.4. Legal framework of solar energy in Morocco .....	13
2.5. Relevant actors of SI market .....	14
2.6. SI development roadmap in Morocco.....	15
2.7. Executive summary of the GEF-solar pumping project.....	16
Design, evaluate, and install PV pumping units comprising a set of configurations through:	16
Implementation of an enabling framework for sustainable and development of standards for solar pumping and fertigation practices :	16
Identification, design and proposal to the MEF for the implementation of financial support and incentive mechanisms:	17
Strengthened the beneficiaries’ capacities in the development, implementation and management of solar pumping and associated irrigation systems through:	17
2.8. Recommendations .....	17
3. Key Enabling Material and Tools (KEMT) .....	19
3.1. Solaqua brochures.....	19
3.2. Training Manuals and manuals .....	19
3.3. Manuals on best practices for solar irrigation .....	19
3.4. Financial instruments .....	19
3.5. Tools .....	20
4. Conclusion .....	20

## List of figures

*Figure 1: SI market segments in Morocco ..... 12*  
*Figure 1: Stakeholders of solar irrigation in Morocco ..... 14*



## **List of tables**

*Table 1: SWOT analysis of the PVP market in Morocco.....12*



### Acronyms

<b>ABH</b>	River Basin Agency
<b>ADA</b>	Agence de Développement Agricole
<b>ADEME</b>	Environment and Energy Management Agency
<b>AMEE</b>	Moroccan Agency for Energy Efficiency
<b>AMIAG</b>	Moroccan Association of Sprinkler and Drip Irrigation
<b>AMISOLE</b>	Moroccan Association of Solar and Wind Power Industries
<b>ANDZOA</b>	National Agency for the Development of Oasis and Argan Areas
<b>ANME</b>	National Agency for Energy Conservation
<b>CAM</b>	Crédit Agricole of Morocco Group
<b>DRPE</b>	Direction of Water Research and Planification
<b>EIB</b>	European Investment Bank
<b>EU</b>	European Union
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>FDA</b>	Agricultural Development Fund
<b>FENELEC</b>	National Federation of Electricity, Electronics and Renewable Energies
<b>GCAM</b>	Groupe Crédit Agricole
<b>GEF</b>	Global Environment Facility
<b>GIE</b>	Economic Interest Group
<b>GIZ</b>	German Cooperation of Sustainable Development
<b>KFW</b>	German Development Bank
<b>kWh</b>	Kilo Watts Hour
<b>MAPMDREF</b>	Ministry of Agriculture, Maritime Fisheries, Rural Development and Water and Forests
<b>Masen</b>	Moroccan Agency for Sustainable Energy
<b>MEE</b>	Ministry of Equipment and Water
<b>MI</b>	Ministère of Interior
<b>MIC</b>	Ministry of Industry and Commerce
<b>MTEDD</b>	Ministry of Energetic Transition and Sustainable Development, Morocco
<b>MWh</b>	Mega Watts hour
<b>NGO</b>	Non Gouvernemental Organisation
<b>ONCA</b>	Office National Agricultural Extension
<b>ONEE</b>	National Office for Electricity and Drinking Water
<b>ORMVA</b>	Regional Offices for Agricultural Development
<b>PMV</b>	Morocco Green Plan
<b>PNEEI</b>	National Program of Water Saving in Irrigation
<b>PV</b>	Photovoltaic
<b>PVP</b>	Photovoltaic Pumping
<b>PPA</b>	Power Purchase Agreement



## Dossier Moroccan SI Market

<b>PVGIS</b>	Photovoltaic Geographical Information System
<b>PVIS</b>	PV Irrigation System
<b>RE</b>	Renewable Energy
<b>REMIG</b>	Moroccan Network of Interprofessional of Irrigation
<b>SI</b>	Solar Irrigation
<b>SME</b>	Small and Medium Enterprise
<b>WB</b>	World bank



# 1. Introduction

## 1.1. SolaQua in a nutshell

SolaQua's overall objective is to increase the share of **renewable energy (RE)** consumption in Europe by facilitating the market uptake of **photovoltaic irrigation systems (PVIS)** in the farming sector. PVIS is based on a combination of **photovoltaic (PV)** technology, hydraulic engineering, and high-efficiency water management techniques to optimize irrigated farming.

The consortium of SolaQua, which represents more than 70% of European irrigators, is aware of the potential of PVIS to decisively improve the sustainability of farming and rural communities in Europe. Nevertheless, to fulfil this potential, it is necessary to overcome the existing barriers to the market uptake of SI. To do this, SolaQua will accelerate the clean energy transition in European agriculture by facilitating the development of a well-functioning market for SI. This will be done by producing and exploiting a set of **7 Key Enabling Materials and Tools (KEMT)** and by creating awareness, skills, action, engagement, and commitment (ASAEC) opportunities among more than 150,000 farmers, 70 local SMEs, and 40 Public Administrations in Europe and beyond.

The execution of SolaQua will result not only in a reduction of the cost of PVIS for farmers but also in the availability of effective standards for consumers and environmental protection, more efficient policies and supporting schemes, and new business opportunities for SMEs. Furthermore, to exploit the project's results and to trigger the PVIS market, SolaQua will facilitate a joint promotion of more than 100 MW of reliable and affordable PVIS led by the end-users themselves: the farmers.

To achieve the overall objective of increasing the share of RE in the European farming sector by facilitating PVIS market uptake, SolaQua has established the following 5 specific objectives:

- 1. Produce and disseminate a set of 7 KEMT**, designed to solve technical, economic, and legal issues which are acting as barriers for the market uptake of SI.
- 2. Produce awareness and skills of PVIS among the target groups in six countries** (France, Italy, Spain, Romania, Portugal, and Morocco). At least 150,000 potential end-users will be reached, 70 SMEs will be trained, and 38 Public Authorities will be able to produce more informed policies and supporting schemes.
- 3. Trigger the European PVIS market by facilitating a joint promotion of at least 100 MW of PVIS**, exploiting SolaQua's KEMT and led by the target audiences engaged in PVIS because of the project's dissemination and communication actions.
- 4. Increase the effectiveness of public supporting schemes for on-farm investments for the promotion of PVIS:** SolaQua will produce a new European Agrarian Fund for Rural Development (EAFDR) financial instrument that will be implemented in 3 European regions and will support more than 40 MW of new PVIS capacity.
- 5. Facilitate market uptake of reliable and affordable PVIS in markets outside the EU (Morocco)** that will result not only in increased cooperation but also in business opportunities for European SME's and investors.

### 1.2. Purpose and scope

The relevant information on the Moroccan SI potential market was produced on the deliverable D5.2. As a number of local ISINPA in Morocco are interested in introducing SI and they need a dossier on Moroccan SI Market. This dossier presents the most relevant findings of D5.2 "Market analysis of SI in Morocco and North Africa" in order to attract ISINPA interest. This document will be used to reach a large audience in advance of the networking activities in Morocco through a workshop which will be organized during the commercial mission. The objective will be to produce business opportunities and networking specifically addressing the introduction of SI in Morocco and beyond. The workshop will include at least 20 local stakeholders, including relevant actors, and at least 15 European SMEs will be invited to participate. The event will include an exposition of the results of the market analysis presented by IAV and activities to facilitate networking. The website of Solaqua project will have a section where this dossier can be found.

### 1.3. About this document

This report has been elaborated by IAV with the collaboration of UPM, CONAF and ABARCA and will be used to facilitate contacts between European and Moroccan stakeholders of SI during the commercial mission. The document is organized in two chapters.

The chapter one presents the main findings of D5.2 "Market analysis of SI in Morocco and North Africa" and will present a summary of the following aspects :

- Characteristics of SI national potential market;
- SI Market segments in Morocco;
- SWOT analysis of SI Market;
- Legal framework of solar energy;
- Relevant actors of SI market;
- Executive summary of the GEF-solar pumping project;
- Recommendations.

The chapter two presents the KEMTs developed in WP2 and adapted to the Moroccan market in WP5. Other tools will also be presented in this chapter. The chapter will contain a brief presentation of the following KEMTs :

- Brochures;
- Training Manual for SMEs;
- Training Manual for irrigators;
- Manual for irrigators;
- Guide of best practices for SI;
- Economic and environmental assessment;
- PPA contract;
- Self assessment tool : <https://www.sisifo.info/en/DataInput>;
- Solar geoportal of Morocco : <http://gepmapping.ma/>.

The document will end with a conclusion.

## 2. Main findings of the Market analysis of SI in Morocco and North Africa

This chapter presents a summary of the main findings of the D5.2 on the SI market analysis in Morocco. The details can be found in the document of the deliverable D5.2 (<https://.....>).

### 2.1. Solar irrigation potential in Morocco

Solar power in Morocco is enabled by the country having one of the highest rates of solar insolation among other countries— about 3,000 hours per year of sunshine but up to 3,600 hours in the desert.

The objectives of the Moroccan National Energy Strategy, launched in 2009, as described in Morocco's Nationally Determined Contribution (NDC) are (AMEE, 2018b):

- Achieve 52% of the installed electrical power from renewable sources, including 20% from solar energy, 20% from wind energy and 12% from hydraulic energy by 2030 (up from 34% in 2015);
- Achieve an energy saving of 15% by 2030, compared to the trend evolution;
- Reduce energy consumption in buildings, industry and transport by 12% by 2020 and by 15% in 2030;
- Install by 2030 an additional capacity of 3,900 MW in combined cycle technology running on imported natural gas;
- Supply the main industries with energy through pipelines of imported and regasified natural gas.

In year 2010, the total national energy consumption was 1,450 GWh, of which 900 GWh were for 4,400 Mm<sup>3</sup> of irrigation water (0.15 kWh/m<sup>3</sup>) and 550 GWh for 850 Mm<sup>3</sup> of drinking and industrial water (0.65 kWh/m<sup>3</sup>) (El-Badraoui & Berdai, 2011).

Energy requirements in the water sector are expected to increase in the coming years. El-Badraoui and Berdai (2011), forecast an energy consumption from the sector of 6,150 GWh by year 2030 (0.7-0.8 kWh/m<sup>3</sup>), which will be due to drip irrigation projects operation, the implementation of the desalination and water transfer projects, the use of conventional high energy-intensive resources for water supply, and the development of new sanitation activities and wastewater treatment plants.

A Solar Pumping program in Irrigation Water Saving Projects was launched in 2013 as part of a partnership between the Moroccan Agency for Energy Efficiency (AMEE), the Government of the Kingdom of Morocco represented by the Minister of Agriculture, the Minister of Energy, of Mines, Water and the Environment, and the Minister of Economy and Finance, and Groupe Crédit Agricole du Maroc (GCAM), a public bank for rural and agricultural development (MEME, 2015).

The program is part of the implementation of the commitments made by Morocco in terms of the promotion of renewable energies and the preservation of the environment. It combines the orientations of the National Energy Strategy, the National Water Sector Strategy and the National Program for Water Saving in Irrigation (MEME, 2015).

The main objectives of the program are to promote the use of solar pumping systems in water saving projects in irrigation, reduce the energy bill of farms and control agricultural water consumption (MEME, 2015).

Practically, the objectives of the program would be concretized by the development of institutional and technical tools for the installation of photovoltaic installations for agricultural irrigation. Financially, the program aims to establish mechanisms to facilitate the acquisition of solar systems, including tax reduction and customs exemption on imports (MEME, 2015).

These measures will promote the development of the national photovoltaic market by encouraging the use of photovoltaic pumping equipment in irrigation.

With an amount of 400 MDH, the program targets the investment subsidy of 50% of the value of the cost of the PVP system within the limit of 75,000 DH. The rest of the financing is in the form of credit granted by Crédit Agricole du Maroc (MEME, 2015).

### 2.2. SI Market volume in Morocco

Since 2008 Morocco is promoting water saving in irrigation through the use and the conversion of surface or sprinkler irrigation to drip irrigation in the framework of the Green Morocco Plan. According to the Ministry of Agriculture more than 600 000 ha are currently irrigated with drip irrigation. The most part of this area uses fuel or gas energy for water pumping. The new *Génération Green* Strategy aims to increase the area irrigated with drip irrigation to 900 000 ha by 2030. The average power installed per hectare in Morocco is around 2 kWp/ha. For an irrigated agricultural area of 1.6 million ha, the SI potential in Morocco is 1.8 GWp by 2030.

Irrigation systems in Morocco are classified in three types:

- Perimeters of private irrigation (more than 450 000 ha) developed through private initiatives. These perimeters use mainly the groundwater;
- Large scale irrigated perimeters (about 680 000 ha) set up by the state on a large area (more than 30 000 ha), located down stream of large dams;
- Small and medium scale irrigated perimeters (334 100 ha) where the irrigated perimeters area exceeds rarely 3000 ha. They are generally traditional and were equipped by the state or by the farmers communities. The large part of these perimeters uses water springs or water extracted directly from watercourses. Some of them are located downstream to the dams.

According to the Moroccan Ministry of Agriculture, the total number irrigated farms in Morocco is about 550 000 from which about 70% are of small size (irrigated area less than 2 ha). This category of farmers occupies only 15% of the irrigated surface (about 260 000 ha). The number of farms with an area that is greater than 10 ha is about 30 000 covering an irrigated area of about 760 000 ha (46 %). This offers for SMEs a market volume of 30 000 SI clients and a potential of 1.5 MWh for sola irrigation equipment.

Regarding the distribution around the country of the solar irrigation market volume, Marrakech-Safi region presents the higher SI market volume both in terms of the number and the area of irrigated farms. Beni Mella-Khenifra, Souss-Massa, Rabat-Sale-Kenitra and Fes-Meknes regions have a high potential of solar irrigation market. For the future, the eastern and southern regions (Oriental, Darâa-Tafilalet and Guelmim-Oued Noun) of Morocco constitute a high trend for Solar Irrigation development due to the development of private use deep aquifers.

### 2.3. Characteristics of SI national potential market

The characteristics of SI national potential market could be found on the deliverable D5.2 from page 25 to page 45. This document presents the result of survey with 26 companies to characterize the SI potential market in Morocco. The document focuses on the characteristics of SMEs, equipment, customers and products and services. SMEs have been characterized by their geographic localization, activities and their quality labelization. Si equipment have been characterized regarding the origin of photovoltaic panels, inverters, frequency converters, pumps and other equipment.

The region of Casablanca-Settat comprises about 42% of the surveyed SMEs of distributors/installers, followed by the region of Rabat-Salé-Kénitra and that of Souss-Massa with respective proportions of 23%. and 11%. Thus, the other regions have a relatively low concentration of photovoltaic equipment distribution/installation SMEs.

54% of the SMEs surveyed operate exclusively in the solar energy sector. In addition to solar equipment, 46% of SMEs carry out several activities, in particular pumping and irrigation equipment, electricity and lighting, air conditioning, heating, automation, etc.

The “Taqa Pro” PV quality label is intended for photovoltaic installers. This certification enhances the activity of companies and improves their competitiveness on the national photovoltaic market.

Regarding the solar panels marketed by the companies surveyed, 50% come from China and 31% from Germany. We note the importance of solar panel imports from China. Indeed, the Chinese solar panel market has many advantages since it is the most accessible market and, in addition, it offers a wide technical choice with different quality ranges and prices.

The assessment of imports of photovoltaic panels, conducted in 2018 by the Office de Change, showed that 90% of imports of these products come from China.

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Frequency converters are very numerous on the Moroccan market. Admittedly, the surveyed distributors/installers reveal that more than 36% of the products they offer are imported from the Netherlands, 20% from China, 12% from Switzerland, 8% from Germany and 4% from Japan.

In the case of farmers, there are two types: new farmers who start their irrigation projects and opt for solar pumping as their first choice, and others who wish to replace their pumping installations which originally operated with conventional energies, by solar pumping systems. In practice, the majority of customers are in the second category according to the distributors/installers surveyed.

The surveyed actors in the Moroccan market raised several constraints that hinder the development of solar pumping for agricultural irrigation in Morocco. They are summarized in the following:

- The subsidy of photovoltaic installations for agricultural irrigation remains the major obstacle to the development of the Moroccan solar pumping market;
- The absence of tax advantages on solar pumping equipment is a real obstacle when the value added tax (VAT) significantly amplifies the initial investment cost of the installations;
- Unqualified installers can be the cause of malfunctions in installations, which affects the performance of pumping systems, irrigation networks and possibly on water consumption;
- There are still sellers who market low-quality equipment or second-hand photovoltaic equipment whose performance is impaired.

SI has been also characterized at the local scale. A focus was made on oases area systems where general description of the system has been done in terms of components (solar generators, converters, pumps, ...), SI systems functioning and configuration, pumping practices and maintenance practices.

The results of SI systems performances have been also presented to their characterize. These

### 2.4. SI Market segments in Morocco

The SI market segment analysis in Morocco can be found in the deliverable D5.2 from page 46 to 51. In summary, according to AMEE, the SI value chain includes diversified main activities including production, transport, distribution, sale, installation and maintenance. Each of these levels of activity presents various products and/or services. Figure 1 below shows the different levels of main activities of the PVP value chain, as well as the actors involved at each level.

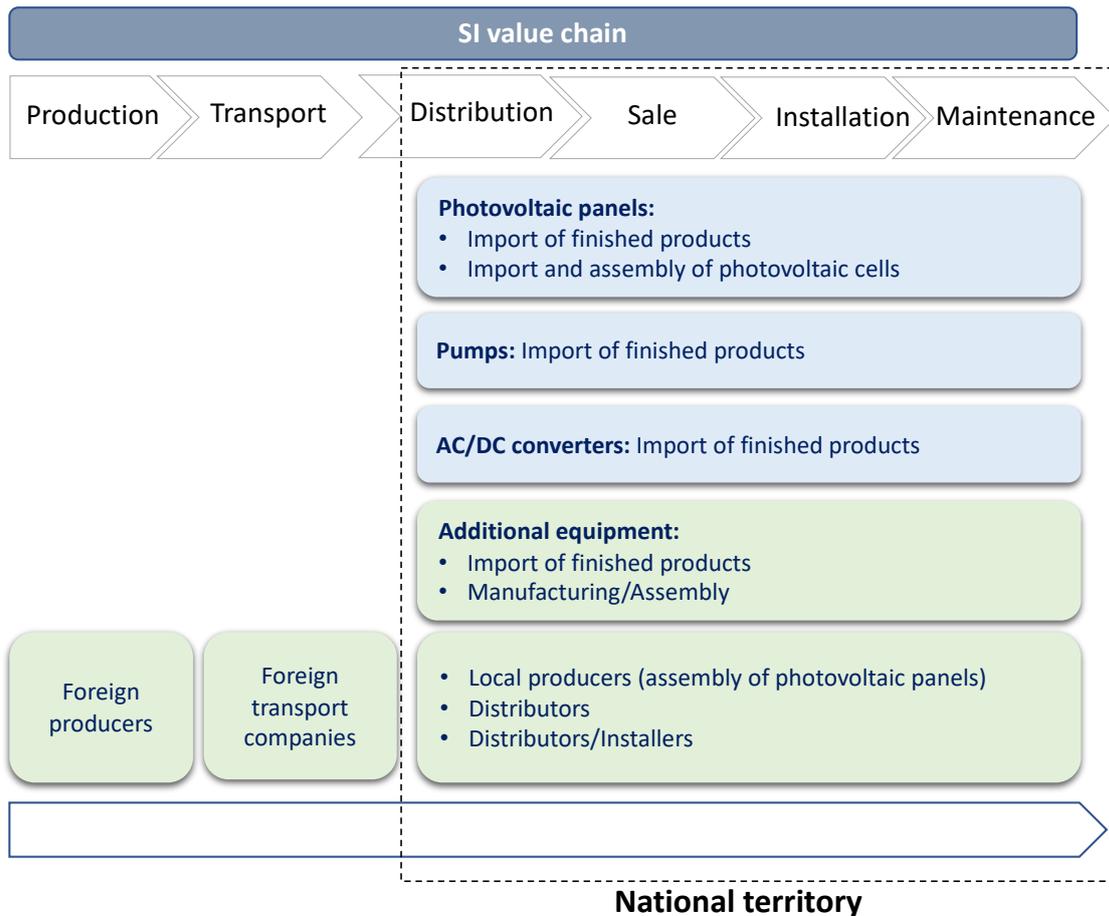


Figure 1: SI market segments in Morocco

## 2.5. SWOT analysis of SI Market

The SWOT analysis of SI Market in Morocco has led to the matrix of Table 1:

Table 1: SWOT analysis of the PVP market in Morocco

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> <li>• Take-off of the PVP market since 2015;</li> <li>• Drop in the price of PV panels worldwide;</li> <li>• Maturity of the downstream offer (distribution/installation);</li> <li>• Natural advantages: geographical location, sunshine;</li> <li>• Solar pumping is economically viable and competitive with other energy sources;</li> <li>• Lack of regulatory barriers or permissions to adopt PPV technology;</li> <li>• A great potential in PPV exceeding 10 billion Dirhams;</li> <li>• Solar pumping has already proven itself in many countries and also in equipped installations in Morocco;</li> </ul>	<ul style="list-style-type: none"> <li>• Few actors are present upstream of the sector;</li> <li>• Concentration of installers in limited areas;</li> <li>• Weak positioning of formal actors;</li> <li>• Low level of certifications compared to international standards;</li> <li>• Lack of SI subsidies;</li> <li>• High initial investment costs for smallholders;</li> <li>• Lack of innovative financial products.</li> <li>• Lack of traceability and quality control of PPV equipment sold on the market;</li> <li>• Lack of certification and classification of PPV equipment;</li> </ul>

<ul style="list-style-type: none"> <li>• The maturity of the PPV market at the offer level;</li> <li>• Low operating and maintenance cost;</li> <li>• Harmonious with nature;</li> <li>• Flexibility: The panels need not be right beside the well.</li> </ul>	<ul style="list-style-type: none"> <li>• Low yield: Solar pumping is not suitable where the requirement is very high;</li> <li>• Variable yield: The water yield of the solar pump changes according to the sunlight;</li> <li>• Theft of solar panels can be a problem in some areas;</li> </ul>
<b>OPPORTUNITIES</b>	<b>THREATS</b>
<ul style="list-style-type: none"> <li>• An energy transition strategy;</li> <li>• Commitment to environmental preservation and the fight against climate change;</li> <li>• The agricultural sector in development supported thanks to the Generation Green strategy: by 2030, more than 900,000 will be irrigated by systems using energy;</li> <li>• A national solar pumping program;</li> <li>• A favorable global solar market;</li> <li>• Important sector with strong development prospects which should create jobs;</li> <li>• Possibility of completing the value chain of the PV sector by attracting project leaders located upstream of the sector (production of cells and panels);</li> <li>• Existence of a promising export market (Africa);</li> <li>• Investment costs for PVP systems are falling;</li> <li>• Decompensation of butane gas;</li> <li>• Potential for job creation in the PVP sector (producers, suppliers, installers, after-sales services);</li> <li>• Injection authorization for low voltage;</li> <li>• Possibility of allocating energy savings for more productive investments: seeds, crop diversification, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Risk of over-abstraction of groundwater and overexploitation of aquifers due to low cost of pumping;</li> <li>• Saturation of the PV market;</li> <li>• Lack of skilled labor to meet future demand;</li> <li>• International competition at the industrial level;</li> <li>• Insufficient investment in R&amp;D activities;</li> <li>• Risk of creating an imbalance in the market between large farmers able to invest in PPV technology and small farmers unable without financial assistance.</li> </ul>

### 2.6. Legal framework of solar energy in Morocco

The analysis of the regulations in connection with the context of solar pumping for irrigation in Morocco allows us to identify two categories of laws. On the one hand, the laws governing the exploitation of water resources, in particular the laws relating to water and the environment, and on the other hand, the regulatory framework governing the development of renewable energies and energy efficiency, which is based primarily on laws developed as part of the National Energy Strategy in 2009:

- Law 13-09 on renewable energies aims to establish a legal framework offering prospects for the construction and operation of installations for the production of electrical energy

from renewable energy sources, including the production of electrical energy from solar panels.

- Law 58-15 which amends and supplements the Law 13-09 and aims to remedy the shortcomings of Law 13-09 and facilitate its application.
- Law 47-09 on energy efficiency which deals with the performance of energy appliances and equipment;
- Law 36-15 on water replacing Law 10-95. The main relevant part for SI of the law 36-15 is the fact that it regulates the exploitation of groundwater.
- Law 11-03 relating to the protection and enhancement of the environment. This law published in June 2003 sets the general framework for environmental protection in Morocco.

The main laws governing renewable energy and solar irrigation in Morocco will be presented in the dossier of the commercial mission.

### 2.7. Relevant actors of SI market

In Morocco, there are a number of public and private operators responsible for setting up plans and strategies to promote the use of solar energy in irrigation and to carry out studies to develop the use of solar energy and supporting farmers. The stakeholders of solar irrigation in Morocco are presented in the Figure 2 and described below (AMEE, 2018a):

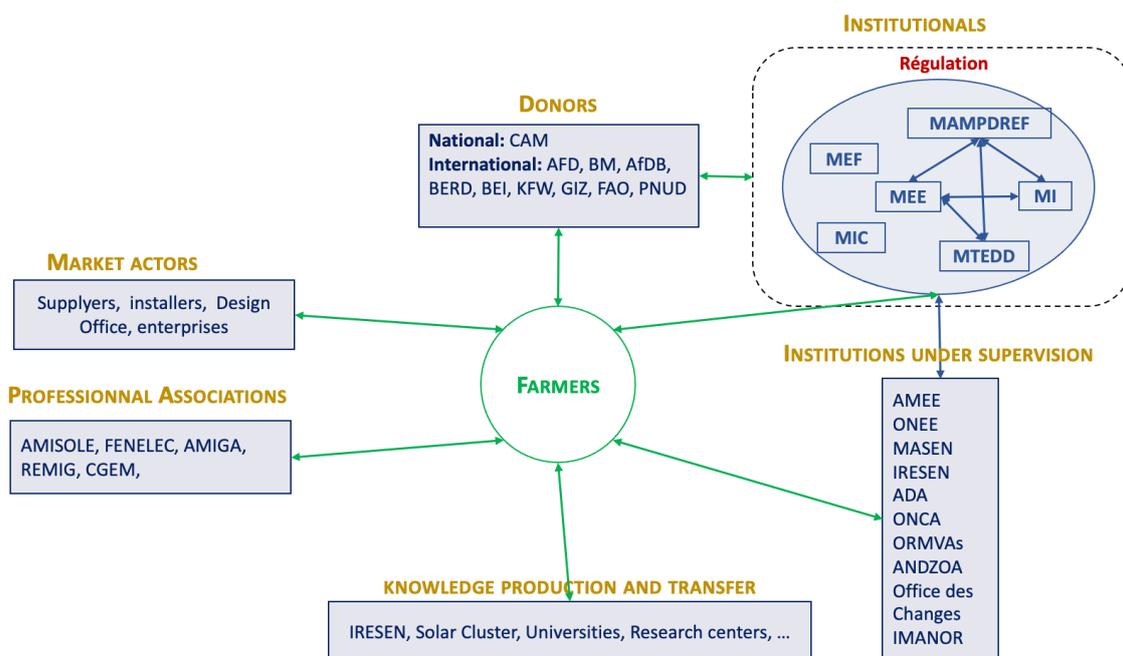


Figure 2: Stakeholders of solar irrigation in Morocco

The role of each of these institutions is presented in D5.2 document from page 61 to page 65. The most important actors for solar irrigation are:

- Ministry of Agriculture, Maritime Fisheries, Rural Development and Water and Forests is responsible for coordinating government actions in agricultural and rural

development. The Department of Agriculture within MAPMDREF is responsible for the development and execution of public agricultural policy, of which irrigation is a key element given the growing water shortage. Among its missions, this department supervises the use of irrigation water resources, conducts studies for the development of agriculture and provides training to farmers.

- Ministry of Energy Transition and Sustainable Development, among other missions, for developing and implementing government policy in the field of energy as well as the control of other institutions under its authority. the Renewable Energies and Energy Efficiency Department is responsible for developing and implementing the national strategy for the development of renewable energies and the strengthening of energy efficiency.
- Ministry of Equipment and Water is responsible for research and water planning as well as hydraulic infrastructures development.
- The Moroccan Agency for Energy Efficiency (AMEE) is responsible, under the METSD, for coordinating, executing and monitoring renewable energy programs (solar, wind, biomass, etc.) and energy efficiency (transport, building, industry, agriculture, public lighting), identify development areas and potential for renewable energies, develop standards and labels and provide assistance in research and development.
- Moroccan Agency for Sustainable Energy (Masen) is the group responsible for piloting renewable energies in Morocco, under the METSD.

### 2.8. SI development roadmap in Morocco

The roadmap for the development of PVP and IS is clearly defined at the level of 4 actions:

- National solar pumping subsidy program signed in April 2013, is the result of a partnership between the Ministries of Energy and Agriculture, the AMEE, and the CAM Group, the program aims to install a fleet of 3,000 photovoltaic pumping systems, for a cumulative installed power of 15 MW-Peak. The objective is to encourage small and medium-sized farmers to equip themselves with solar pumps for the needs of their farms.
- The national irrigation water saving program implemented as part of the Green Morocco Plan and the Generation Green strategy. It aims to increase the drip irrigation area from 600.000 ha to 900.000 ha by 2030.
- The GEF-Pompage Solaire project to support solar pumping: this project supports the national solar pumping program launched in 2013, in particular to improve several of its anomalies, and to create a framework conducive to its implementation, it is financed to the tune of 25 million dirhams by the Global Environment Fund (GEF).
- The implementation of alternative solutions for the financing of SI. 5 financing models are proposed by the AMEE (AMEE, 2019b):
  - Model 1: Bank loan with subsidy;
  - Model 2: “Supplier Credit” value chain credit;
  - Model 3: ESCO;
  - Model 4: Credit Cooperatives or GIE;
  - Model 5: Collective irrigation association.

### 2.9. Executive summary of the GEF-solar pumping project

The GEF-Solar Pumping project aims to promote the adoption of photovoltaic pumping systems for irrigation by creating an appropriate framework to the implementation of the national PV pumping program; building the capacities of the various actors concerned; support for the awareness of operators and farmers on the economic and environmental benefits of solar pumping; the implementation of financing mechanisms facilitating the acquisition of photovoltaic pumping systems; the standardization of solar installations for irrigation; and the implementation of a framework for monitoring the impacts of the project in terms of mitigating GHG emissions.

The National Focal Point of the project is the Moroccan Agency for Energy Efficiency (AMEE). The project is implemented in close collaboration with MTEDD, MAPMDREF, GCAM, MEF and other partners.

The objective of the project is the establishment of an adequate framework to the development of solar pumping and the creation of favourable conditions (technical, financial, organization and support) for its success.

The project is structured in 4 products targeted by the program according to the following axes:

Design, evaluation, and installation of PV pumping units comprising a set of configurations through:

- Support for solar pumping projects through configuration, installation and maintenance protocols;
- The realization of demonstration projects for the potential of water pumping by solar energy;
- The implementation of a final disposal and recycling scheme to reduce the effects of leakage and the reduction of GHG emissions associated with the project;
- The establishment of a monitoring system and indicators to reliably monitor energy and water consumption and GHG emission reductions.

Implementation of an enabling framework for sustainable and development of standards for solar pumping and fertigation practices:

- Design and implementation of a renewable energy service business model (RESCO) to support the implementation of the National Promotion Program for solar pumping of irrigation water;
- Design and implementation of a quality control system;
- The development of an extension and support tool for the conversion to localized irrigation, the optimization of fertigation to demonstrate to farmers the immediate financial benefits of switching to an optimal fertigation regime;
- Development of a NAMA concept in support of the program.

Identification, design and proposal to the MEF for the implementation of financial support and incentive mechanisms:

- Support of local private sector banks to design and offer financial products adapted to farmers to support the adoption of solar pumping;
- The proposal of relevant tax incentives and benefits that reinforce the interest in acquiring PV technology;
- Analysis and proposal of options for a better alignment of subsidies with sustainable fertigation practices.

Strengthened the beneficiaries' capacities in the development, implementation and management of solar pumping and associated irrigation systems through:

- Capacity building of stakeholders to develop local awareness and technical capacity in solar pumping technology, business planning, life cycle costs, quality assurance, maintenance, supply and marketing;
- Strengthening of national production capacities of equipment and components to be identified;
- Training of technicians in the design, installation, operation and maintenance of photovoltaic pumping systems;
- Training of finance professionals in the evaluation of bankable solar pumping projects;
- Capacity building of the partners concerned in the application of optimal fertigation practice.

The total budget of the project is 73,542,726 USD, financed by the GEF to the tune of 2,639,726 USD (Grant), the contribution of the Moroccan Government amounts to 70,803,000 USD, and that of the UNDP to 100,000 USD.

The project challenges for Morocco are:

- Promote the efforts of the agricultural sector in the mitigation of greenhouse gases;
- Generate synergies with national initiatives in terms of greenhouse gas reduction;
- Innovate clean development mechanisms;
- To position itself among the structuring projects at the international level.

The GEF-Pompage Solaire project supports the Sustainable Development Goals (SDGs) and more directly SDG 2 ("End hunger, ensure food security and promote sustainable agriculture"), SDG 7 ("Affordable energy, reliable, sustainable and modern for all"), SDG 13 ("Combating climate change and its impact") and SDG 15 ("The protection and sustainable use of the earth's ecosystems").

## 2.10. Recommendations

To enable the solar irrigation sector to develop in a sustainable manner, the following recommendations have been issued by the AMEE (AMEE, 2019a):

- The distribution of subsidies for solar pumping makes it possible to encourage the use of SI in areas where water is abundant and discourage it in others which suffer acutely from lack of water;

- Offering farmers the possibility of injecting into the grid will generate additional income for farmers by selling the surplus energy not used in irrigation, and at the same time it is a good solution to deal with the overuse of groundwater;
- Artificial recharge of aquifers raises groundwater levels by limiting surface runoff and encouraging infiltration of aquifers. This measure could be applied to save the most arid regions;
- Adopting a collective pumping system accompanied by a management, control and billing system ensures economies of scale and more efficient water use.

### 3. Key Enabling Material and Tools (KEMT)

The dossier of the commercial mission will also contain all the KEMT developed in the project which are relevant for Morocco. Here we present a summary of the main KEMTs that could be useful for the companies interested in the Moroccan SI market.

#### 3.1. Solaqua brochures

The Solaqua brochures will allow the Moroccan SI stakeholders to know more about Solaqua project. These brochures for irrigators and for SMEs have been adapted to the Moroccan market and are available in Arabic and in French.

#### 3.2. Training Manuals and manuals

Three manuals will be available:

- Training manual for technical managers of irrigation associations and companies (in French).
- Manual for irrigators using PV irrigation systems (in French and Arabic);
- Manual for SMEs installing PV irrigation systems (in French).

#### 3.3. Manuals on best practices for solar irrigation

These manuals aim to increase the awareness of SI practitioners on how to plan, design, install and manage the solar irrigation systems and also to carry out an environmental and economic assessment of SI projects. Three manuals are available for ISINPA:

- Best practices for photovoltaic irrigation systems;
- Economic assessment methodology for photovoltaic irrigation systems;
- Environmental assessment methodology for photovoltaic irrigation systems.

They can be found at <https://sol-aqua.eu/documents/>

#### 3.4. Financial instruments

The dossier of the commercial mission will contain the document on photovoltaic irrigation financial instruments for institutional investors. This document elaborated for the European context could be used as a template for developing such instruments for Morocco to boost the development of SI.

A model of Power Purchase Agreement (PPA) contract will be also presented in the dossier of the commercial mission. The PPA contract will allow SMEs and Moroccan irrigators to benefit from the financing mobilized by the Solaqua project through an association with European SMEs around solar irrigation projects.

The document about the financial instrument for PV irrigation system and the PPA contract can be found at <https://sol-aqua.eu/documents/>

### 3.5. Tools

Two tools will be presented in the dossier of the commercial mission:

- Self-Assessment Tool is a web service that allow farmers to obtain a preliminary planning of a photovoltaic irrigation system based in the main characteristics of their farms. The Self-Assessment Tool is available on the website of the project (<https://sol-aqua.eu/farmer/#sec4> ) and includes the most common configurations of irrigation systems: water pool and direct pumping systems. A training on the tool will be provided in the commercial mission.
- GEPMapping Tool (<http://gepmapping.ma/>) is presented in the form of high-resolution interactive solar maps (direct, diffuse, global radiation, etc.) to help decision-makers and researchers identify areas with high potential for each location in Morocco and Africa.

## 4. Conclusion

This document presents a summary of the Moroccan SI market and indicated the different items that will constitute the dossier of commercial mission to Morocco. The participants to the mission and other ISINPA will be able to find in the dossier all what they need to promote, develop and manage the SI systems. The following list of documents can be very useful for companies interested in the SI market and can be downloaded on the Solaqua project website ([www.sol-aqua.eu](http://www.sol-aqua.eu)):

1. Deliverable D5.2. on SI market analysis of Morocco and North Africa;
2. Law 13-09 on renewable energies:  
<http://supertaqa.ma/wp-content/uploads/2018/02/Loi-13-09.pdf>;
3. Law 58-15 on renewable energies:  
<https://autetouan.ma/web/uploads/dossier/5abcc46b5df93.pdf>;
4. Law 47-09 on energy efficiency:  
<https://www.amee.ma/sites/default/files/2019-07/Loi%2047-09.pdf>;
5. Law 36-15 on water replacing Law 10-95:  
[http://www.sgg.gov.ma/Portals/0/lois/Loi\\_36-15\\_Fr.pdf?ver=2018-11-28-153115-853](http://www.sgg.gov.ma/Portals/0/lois/Loi_36-15_Fr.pdf?ver=2018-11-28-153115-853);
6. Solaqua brochures (French, Arabic, English);
7. Training Manual for installers (French, English):  
[https://sol-aqua.eu/Files/ENG/TrainingManualForInstallers\\_Final.pdf](https://sol-aqua.eu/Files/ENG/TrainingManualForInstallers_Final.pdf);
8. Training Manual for irrigators (French, English):  
[https://sol-aqua.eu/Files/ENG/Training\\_Manual\\_For\\_Irrigators.pdf](https://sol-aqua.eu/Files/ENG/Training_Manual_For_Irrigators.pdf);
9. Manual for irrigators (Arabic, French, English):  
[https://sol-aqua.eu/Files/ENG/ManualForIrrigators\\_Final.pdf](https://sol-aqua.eu/Files/ENG/ManualForIrrigators_Final.pdf);
10. Best practices for photovoltaic irrigation systems:  
<https://sol-aqua.eu/Files/ENG/Best%20Practices%20for%20SI.pdf>;
11. Economic assessment methodology for photovoltaic irrigation systems:  
<https://sol-aqua.eu/Files/ENG/EconomicAssessmentMethodology.pdf>;
12. Environmental assessment methodology for photovoltaic irrigation systems

- <https://sol-aqua.eu/Files/ENG/EnvironmentalAssessmentMethodology.pdf>;
13. Legal analysis and best practices:  
[https://sol-aqua.eu/Files/ENG/LegalAnalysis\\_BestPractices.pdf](https://sol-aqua.eu/Files/ENG/LegalAnalysis_BestPractices.pdf);
  14. Photovoltaic irrigation financial instruments for institutional investors:  
<https://sol-aqua.eu/Files/ENG/FinancialInstrument.pdf>;
  15. PPA contact model  
[https://sol-aqua.eu/Files/ENG/PPA\\_contract.pdf](https://sol-aqua.eu/Files/ENG/PPA_contract.pdf).