



Growing Inclusive Markets

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CASE STUDY

North Africa • Morocco

TEMASOL: Providing Energy Access to Remote Rural Households in Morocco

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“To my knowledge, this is the first time ever, anywhere in the world; a solar electrification concession of this size has been allocated to a private operator by a national power-distribution company.”

Khalid Semmaoui, TEMASOL’s General Manager

Executive Summary

TEMASOL is an example of a company demonstrating how a public-private partnership combined with international cooperation and foreign direct investment in a developing country can lead to outstanding business results and at the same time be inclusive and environmentally friendly. It also shows how doing business in an inclusive way can change the lives of thousands of poor people who were previously completely isolated. Having access to electricity is synonymous with having access to a decent life, education, information, clean water, etc. Moreover, in a context of resource scarcity, having recourse to renewable sources of energy in developing countries can help them turn the vicious circle of underdevelopment into a virtuous one of development.

TEMASOL is a joint-venture between the French oil and electricity companies TOTAL and Electricite de France (EDF), through their joint affiliate TENESOL (Formerly TOTAL Energie). Its name stands for Total Edf MARoc SOLaire, which, by the same token, points to its parent companies, TOTAL and EDF; its geographic market, Morocco; and its main activity, solar energy.

TEMASOL was created in 2002 within the framework of a national program championed by Morocco’s National Electricity Office (ONE) aiming at electrifying rural regions of the country. This ambitious program known as the Global Rural Electrification Program¹ was initiated in 1994 with a view to increase the rural electrification rate from 12% in 1994 to 97% by 2007-2008.

Due to the high cost of connecting remote homes and hamlets to the national electricity grid, it was decided to opt for renewable sources of energy and in particular for photovoltaic (PV) electricity whenever the connection cost exceeds 27,000² MAD³ (about US\$3,500).

As of June 2007, 24,800 rural households totaling 170,000 individuals were given access to solar electricity with all the advantages that such an access entails including: better lighting, access to information through TV and radio sets, better access to education for children and in particular for girls, productivity improvement, strengthening of social ties thanks to exchanged family visits, improvement of communication through cell phones, etc. In addition, the program has created dozens of direct jobs within TEMASOL, as well as indirect

¹ Known as PERG in French: *Programme d’électrification rurale globale*

² This threshold was initially set at a lower level and was progressively increased to reach 27,000 MAD.

³ 1 MAD (Moroccan Dirham) = Approximately US\$0.12



ones through subcontracting some peripheral activities to local people. It also contributed to reducing gas emissions.

Introduction

The invention of electricity has undoubtedly revolutionized modern times and made possible access to appliances and devices that have considerably contributed to making the lives of human beings more comfortable and pleasant. Unfortunately, access to electricity is contingent upon the availability of appropriate infrastructures to convey power to customers. In many developing countries, such infrastructures are, more often than not, concentrated in urban areas. As a consequence, a large proportion of people living in rural areas have limited-to-no access to electricity because of the remoteness of these areas.

The lack of access to electricity also means lack of access to all of the appliances and devices that urban dwellers use daily and take for granted. For some people, it might be difficult to imagine how life would be without a fridge, a TV or radio set, a computer, a telephone, or at least lighting at home. We sometimes forget that without electricity, there would be no access to all of these things. Access to electricity is nowadays synonymous to decent living. Surprising as it may be, about 1.6 billion poor people around the world live without such access.⁴ Their active life is contingent upon daylight that stops at sunset.

In Morocco, until 1994, only about 12% of rural dwellers enjoyed access to electricity. Most rural households were living at the fringe of modern civilization. Being poor, they could not afford to buy generators to provide light and power. With no access to electricity, their conditions were worsening and they were sinking deeper into poverty, creating a vicious circle.

In the early 1990s, the Moroccan government decided to take concrete measures to help rural people overcome their tough conditions. Among these measures, it was decided to expand access to electricity in rural areas.

In this context, TEMASOL was awarded the largest concession because of the expertise of its parent companies in both solar energy and in rural electrification. Indeed, EDF and TOTAL have both developed a state-of-the-art know-how in these two domains. In addition, the French Fund for the World Environment (FFEM)⁵, TEMASOL's partner, has been conducting experiments and research and development (R&D) activities in the field of solar energy since its creation in the early 1990s.

⁴ OECD (Organisation for Economic Development) and IEA (International Energy Agency), *World Energy Outlook 2006*. Paris.

⁵ Fonds Français pour l'Environnement Mondial in French.



Market and Location Context

TEMASOL is located in Rabat, the capital of Morocco. Like many other developing countries, Morocco is confronted by many endemic problems and in particular, the high rate of poverty among its rural population counting for about 50% of its 31 million inhabitants. One of the most striking aspects of the rural poverty in Morocco is a very limited access to electricity with an electrification rate of only 12% in 1994. Such a low rate can be explained by the almost total reliance on the national grid to physically convey electricity to customer . As many rural households are geographically scattered, they could not cost-effectively be connected to the grid.

Lack of electricity usually entails many subsequent problems such as limited access to water. Indeed, in absence of electricity, rural populations cannot pump underground drinking water unless they have a diesel-operated electricity generator. They have to use manpowered turnstiles and pulleys to pull water from the wells as their ancestors used to do many centuries ago. Absence of, or limited access to electricity is also responsible for productivity reduction as people, and especially women, cannot work after sunset. Availability of TVs and radio sets is also very limited and negatively impacts access to information. The few households that can afford to buy a battery-powered TV set have to transport the heavy battery every few days to the closest electrified village to recharge it. This also contributes to productivity reduction because such an activity (transporting the battery to be recharged) keeps at least one person and one animal away from field work or other productive tasks sometimes for the whole day.

Limited access to electricity also impacts education. The absence of proper indoor lighting makes it difficult for students to do their homework and prepare their courses after sunset. Candles and gas lamps provide poor quality light and present a serious risk of fire.

These problems along with many others usually associated with poverty in developing countries, contribute to the harsh living conditions of a large portion of Moroccans. It is no wonder then that an increasing number of people trying to improve their access to electricity, migrate towards urban areas and gather in shantytowns in the suburbs of major cities such as Casablanca, Rabat, Fez, and Marrakesh.

Aware of this situation, the Moroccan government decided in early 1990s to tackle many of these problems through basic infrastructure development: construction of dams, building of highways, expansion of drinking water networks, etc. One of the most ambitious development programs is the rural electrification program initiated by ONE, the Moroccan National Electricity Office.

A comprehensive study carried out in the early 1990s convinced the managers of ONE that they could not expand the national grid to electrify the whole country on their own.



“In rural regions, the main obstacle to expand the power grid is a financial one. Because of the dispersed geographical distribution of the population, the cost of connecting scattered households and hamlets is very high and the local population cannot afford paying for this high cost...This prompted ONE to opt for decentralized systems in its electrification policy when the connection cost per residence exceeded 27,000 MAD [US\$3,500].”⁶

In Morocco, the majority of rural households do not live very far from areas serviced by the national grid but are not connected yet due to the limited coverage of this grid. Despite ONE's effort to expand its grid-based coverage, about 9% of the rural population living in areas distant from the national grid could not be cost-effectively connected. Given that Morocco is a very sunny country (almost all year round) with about 5 kWh per m² per day and 3,000 hours of sun per year, ONE's engineers and management realized that solar or PV energy could be a cost-effective alternative to the grid-electricity. *“We've got the sun ... we should use it!”* says Mr. Ahmed Acharaani, the regional technical director at the Moroccan electricity utility.⁷

With a view to electrifying rural areas through Photovoltaic kits (PVKs)⁸, ONE launched a call for bidding to service providers. The French electricity company EDF and the French oil company TOTAL decided to seize this opportunity through their joint subsidiary TENESOL. As a result, TEMASOL was born in 2002 as a joint-venture between the three partners: EDF (32.2%), TOTAL (32.2%), and TENESOL (35.6%).

TEMASOL won the first call of tender and a service contract was signed on May 21, 2002 with ONE to supply 16,000 rural homes with Photovoltaic (PV) electricity in four provinces: Khemisset, Khenifra, Khouribga, and Settat.

The success of TEMASOL in supplying the first 16,000 households encouraged ONE in 2004 to grant it new contracts, after an invitation to tender, to supply electricity to 58,500 scattered homes and hamlets⁹ in 29 provinces throughout Morocco. Without the wisdom of decision makers both at ONE and at the governmental authority in charge of energy, combined with the expertise of TEMASOL, access to electricity would have remained a dream for rural dwellers. More than mere access to brighter lighting, access to electricity has granted them the right to enjoy better welfare and improved productivity.

⁶ FFEM, *Decentralised rural electrification in Morocco – Combating the greenhouse effect and climate change*, 2005, p. 5.

⁷ Laurenson, J., *Morocco: World-Leading Solar Energy Nation.* (Deutsche Welle / DW – World. De, 2004). http://en.qantara.de/webcom/show_article.php?wc_c=478&wc_id=125, accessed on August 16, 2009.

⁸ PVK stands for Photovoltaic Kit. “A photovoltaic system [or kit] is a system which uses [solar cells](#) to convert light into electricity. A [photovoltaic](#) system consists of multiple components, including cells, mechanical and electrical connections and mountings and means of regulating and/or modifying the electrical output.” Source: http://en.wikipedia.org/wiki/Photovoltaic_system, [November 4, 2009].

⁹ Including the 16,000 homes connected in the first stage.



The head office of TEMASOL is located in Rabat, halfway between the first two geographic regions it had to service in its first mandate in 2002: Khemisset and Khenifra to the east and Khouribga and Settat to the south. In addition to its headquarters in Rabat, TEMASOL has 16 regional branches servicing 23 provinces. These local branches are managed by appointed agents hired locally to connect rural households and maintain the equipment. Between three and seven people work in each branch under the supervision of the central head office in Rabat.

In addition to giving rural population access to electricity, in July 2004 TEMASOL signed a contract with ONEP, the Moroccan drinking water office, to install and manage solar water pumping systems in rural areas where piped-water supply would be very expensive due to the cost of power generators and the fuel to operate it. Thus, four PV drinking-water-pumping systems were installed in isolated hamlets of the provinces of Khouribga and Khemisset.¹⁰ This solution contributed to increasing the rate of access to drinking water in Morocco. By the end of 2004, this rate jumped up to 60% versus 48% at the end of 2002. This service is thought to have reached about 90% of the population at the end of 2007.

Description of the Business Model

SOURCES OF TEMASOL FUNDING

The rural electrification program in Morocco was initially financed within the framework of the German-Moroccan financial cooperation through the KfW Development Bank. The program's technical assistance was financed by the French Fund for the World Environment (FFEM). Due to the high cost of PVKs, they are subsidized by the Moroccan Government through ONE that becomes the equipment owner. The subsidy totalling about 90% of the equipment cost is paid by ONE to TEMASOL according to a provision of the service contract. In addition, TEMASOL collects a connection fee of about 10% of the equipment cost in addition to a monthly fee from the customer for the maintenance of the system. The connection fee is collected before or at the installation of the equipment whereas the monthly fee is paid either at TEMASOL's local branch or to the company's employees at the weekly market of the region where the customer lives.

CUSTOMER SEGMENTATION AND PROPOSED SERVICE OPTIONS

The fee paid by customers depends on the type of service they choose as shown in Table 1, and is paid over a period of 10 years at a central point such as the weekly market, and TEMASOL's local branches.

¹⁰ Initially, 15 PV pumping systems were planned but only four have been installed so far



Table 1: Types of services offered by TEMASOL and their cost to the customer (Connection + Monthly fee)

Phases	PV power	Services	Connection	Monthly fee
1 (16,000 homes)	50 Wp	4 lamps + one 12 V socket	US\$82 (700 MAD)	US\$8 (65 MAD)
	75 Wp	6 lamps + one 12 V socket	US\$210 (1,800 MAD)	US\$11 (96 MAD)
	100 Wp	8 lamps + one 12 V socket	US\$365 (3100 MAD)	US\$15 (129 MAD)
2 & 3 (42,500 homes)	75 Wp	4 lamps + one 12 V socket	US\$105 (900 MAD)	US\$8 (65 MAD)
	200 Wp	4 lamps + one 12 V socket + 1 fridge	US\$470 (4,000 MAD)	US\$18 (150 MAD)

Although many customers were complaining about not being able to power a fridge with 50 Watt-peak (Wp)¹¹, the formula of 200 Wp [needed for a fridge] was not a success. Being poor, more than 90% of customers continued to choose 50 and 75 Wp. Nevertheless, TEMASOL kept offering the 200 Wp formula as well according to ONE's requirements.

Even though a connection fee between US\$82 and US\$470 (depending on the type of service chosen) might be affordable for an urban user, many low-income users find it difficult to save



TEMASOL's stand at the weekly market of Gnadiz (Photo credit: Brahim Allali)

enough money to pay for it. Some users had to sell one or two sheep¹² or some of their commodities to gather enough money to pay the connection fee. A 'satisfaction survey'¹³ conducted in 2006 by TEMASOL shows that 20.9% of surveyed customers find the connection fee very high.

Customers consider the monthly fee for the 50 Wp option as fair or even cheaper than alternative sources of energy they were using before like gas-lamps, batteries, and candles.¹⁴ Two customers at the company's

¹¹ Watt-peak (Wp) is a measure of power output, most often used in relation to [photovoltaic solar energy](#) devices.

¹² A similar example is narrated by Cyrille Desombre in "Something New Under the Sun" *Energie Special Issue*, Third Quarter, 2005, pp. 34-37.

¹³ TEMASOL, *Enquête de satisfaction – Résultats et analyse par agence*, October 2006.

¹⁴ The satisfaction survey conducted by TEMASOL in 2006 showed that 86.6% of customers were using gas lamps before the PVK was installed, about 67% were also using candles, and 17% were using car batteries.



stand in the Gnadiz weekly market (Province of Khouribga) said the alternative sources of energy they were using before the installation of PVK used to cost them every month about the same amount as the 50 Wp option (about US\$8). However, it seems that if the more powerful options were cheaper, most customers would have selected the 200 Wp formula to be able to have a fridge and/or a colour TV set. In this respect, the 2006 satisfaction survey shows that 60.8% of surveyed customers also consider the monthly fee too high.

TEMASOL'S ORGANIZATION

TEMASOL has 16 regional branches employing between three and seven agents (one supervisor and two to six technicians depending on the area serviced by the branch). It has a contractual obligation towards its customers to fix their technical problems within 48 hours. These branches are also in charge of collecting monthly fees from customers in weekly markets. Each branch has one to three cars used by technicians to repair PVKs, to collect fees from customers in weekly markets, and to visit their customers at least once a year as stated in the service contract.

TEMASOL'S ACTIVITY

TEMASOL's activity is twofold: (1) supply and installation of PVK, and (2) operation and maintenance. The PVKs are composed of several elements: photovoltaic modules (bought from TENESOL and produced in France and South Africa), batteries (produced locally by Moroccan companies), regulators (produced by TENESOL in France and by German-brand STECA in China), lights (produced by German-brand STECA in China), cables and electric accessories (produced in Morocco).

Installation

For the PVK installation, interested customers contact TEMASOL's local agent at the weekly market or at the local branch of the company to sign a service agreement with TEMASOL and a supply agreement on behalf of ONE, and pay the connection cost depending on the type of service they choose as seen in Table 1.



Solar panel (Source: TEMASOL)

The company's agents in regional branches collect orders from customers and send them to the headquarters in Rabat along with the contracts. The headquarters send the PVK to these local branches to install them according to ONE's standards and to collect corresponding connection fees. Within two weeks of receiving the order, TEMASOL's technicians install and test the PV kits including the solar panel(s), a charge controller, a battery, cables, and bulbs. A quick hands-on training is provided to the customer on the basics of how to use electricity, such as how to plug and unplug small electrical appliances. Once the installation work is completed, the customer starts receiving electricity according to the PV power installed. It is noteworthy that the installed pieces of equipment provided by TEMASOL



remain the property of ONE that pays for them.

Operation and Maintenance

With regard to the operation and maintenance part of TEMASOL's activity, local branches receive the list of customers to be visited and fees to be collected from Rabat. They also receive spare bulbs, plugs, batteries, and other materials as required by customers. In addition to its local agents, TEMASOL sometimes has recourse to local subcontractors for some peripheral activities mainly in peak periods.

“TEMASOL sells domestic energy services [electricity and lighting] based on PVK to the rural populations. The company also provides a full guarantee of service for 10 years (equipment maintenance and replacement of batteries and bulbs), as well as customer service at the weekly markets (called souk) in connection with payments and maintenance questions.”¹⁵

As a private company, TEMASOL aims primarily at achieving profitability although it took the company three years before it made its first profit.¹⁶ Although it is a for-profit-business, TEMASOL strives to carry out its activities in a pro-poor way since it specializes in supplying PV energy to remote rural and poor homes at affordable fees. Moreover, the type of energy it supplies is environmentally friendly and fully renewable. Therefore, one can easily conclude that the business is inclusive as it is profit-driven and, at the same time, contributes to improving the poor's lives by giving them access to energy, a key component of a comfortable and decent way of life.

For the society at large, TEMASOL's objective is to increase the proportion of people able to satisfy their basic needs as an indicator of human development. At the environment level, its main objective as a company is to encourage the use of renewable and cheap sources of energy, and to reduce carbon dioxide (CO₂) emissions as a means of fighting the greenhouse effect and global warming.

CONSTRAINTS AND SOLUTIONS

TEMASOL has been facing many constraints pertaining to finance, knowledge and skills, regulatory environment, and physical infrastructure as seen in Table 2.

Financial constraints

In terms of financial constraints, TEMASOL faces the problem of late payments as it deals primarily with low-income users. Some customers are even late up to three or four months. Monthly fees account for up to 52% of the company's total revenues during the installation stage. As this stage is now completed, these fees represent almost 100% of revenues. Then, any late payment may seriously affect the company's profitability. TEMASOL also has to pay

¹⁵ FFEM, *Decentralised rural electrification in Morocco*, p. 8.

¹⁶ At the end of its first year (2002), the company recorded a loss of about US\$23,500. It made its first profit in 2004 (about US\$518,300). For more details, see the section “Results created by the business”.



for PVKs and install them before applying for reimbursement from ONE. In addition, it invests in opening and equipping regional branches and in training local agents.

Knowledge and skills

Solar energy is a rather new activity in Morocco. Hence, some challenges are faced regarding knowledge and skills. Local expertise in this area was rare to absent when the company was first created. It was not easy to find qualified employees in the field. Moreover, it is usually difficult to do R&D in a small business due to the lack of resources. Another constraint pertaining to lack of knowledge stems from the perception of local people about solar energy. By and large, they prefer to be connected to the national grid instead of having access to electricity through PVK, which they believe to provide less power than grid-based electricity.

Regulatory environment

Regulatory issues remain a constraint for TEMASOL. For example, the company is having difficulty in convincing ONE to integrate provisions into the contract that would allow TEMASOL to adjust its prices according to its real costs and to receive compensation if the real number of customers is less than the potential expected by ONE. Such provisions should have been included in the initial contract that EDF, TOTAL and TENESOL signed with ONE.

Physical infrastructure

TEMASOL has a huge territory to service. This is certainly a challenge for a SME located in the capital of the country. Nevertheless, TEMASOL did not identify this as a major barrier.

Table 2: Constraints faced by TEMASOL

Type of constraints	Description of the constraint
Financial constraints	<ul style="list-style-type: none"> • Cash-flow difficulties due to late payments mainly because monthly fees accounted for about 52% of the company's total revenues during the installation stage, and for about 100% during the operation stage. • High upfront capital cost • Local agents' training costs • Increasing costs induced by rapid growth
Knowledge and skills	<ul style="list-style-type: none"> • Lack of local expertise in the field of solar energy. When it was created, the company could not easily find qualified employees • Difficulty of doing R&D in an SME • Somewhat negative perception of solar energy by rural people. This perception is sometimes strengthened by candidates to local elections who promise to bring 'wired electricity' to the region.
Regulatory environment	<ul style="list-style-type: none"> • Absence of price adjusting mechanisms in the service contract with ONE.
Physical infrastructure	<ul style="list-style-type: none"> • A huge territory to service for an SME located in the capital of the country



To cope with these constraints, TEMASOL has recourse to some appropriate solutions. With regard to finance, the company used to rely on its parent contributions to fund its inventory of PVKs as foreseen in its initial business plan.¹⁷ In addition, the government subsidies paid through ONE enables the company to quickly recover its investment in PVKs.¹⁸ The problem of late payments has been overcome by the ability of TEMASOL’s local agents to directly collect monthly fees from customers. This keeps the late payment rate at a very low level (less than 2% of total payments).

Since local expertise about solar energy was scarce, TEMASOL had to rely on its parent companies’ know-how and technical assistance in the beginning. Eventually, the company’s own technicians acquired enough expertise to handle technical problems by themselves. To improve the local people’s perception about solar energy, TEMASOL’s agents, at the local weekly markets have been doing a very good job demonstrating to potential customers that PVKs provide enough power to satisfy the limited needs of rural users. In addition, the cost of solar energy to the customers is independent of their monthly consumption as they pay a lump sum on the basis of the type of PVK chosen no matter the quantity of power they use.

At the regulatory level, it is noteworthy that the company itself was created as a result of a major policy change that made it possible to decentralize electricity provision in rural areas. Nevertheless, the company has not yet managed to find an appropriate solution to the pricing problem that opposes it to ONE.

With regard to the physical infrastructure constraints, the company’s local agents being on site make up for the remoteness of the head office and provide a proximity service as seen in Table 3.

Table 3: Solutions implemented by TEMASOL

Type of constraints	Description of the Solution
Financial constraints	<ul style="list-style-type: none"> • Very effective payment collection activity of local agents keeping the late payment rate very limited (less than 2% of total payments) • Upfront capital is covered through the contributions of parent companies • Government subsidies of up to 90% of PVK total cost make the business profitable
Knowledge and skills	<ul style="list-style-type: none"> • TEMASOL relies on technical assistance from its partners • TEMASOL’s stands in local weekly markets show to would-be customers that PVK provide enough energy for a rural household needs. In addition, the monthly fee is a lump sum and is not calculated on the basis of electricity consumption as for “wired electricity”.
Regulatory environment	<ul style="list-style-type: none"> • TEMASOL itself was created as a result of a change in the regulatory environment that made it possible to decentralize electricity provision. • No solution yet to solve the pricing problem with ONE
Physical infrastructure	<ul style="list-style-type: none"> • Solar energy offers the advantage of being provided independently from

¹⁷ The funding is completed and the company does not install PVK anymore.

¹⁸ During the first stage of the program when 16,000 households were connected to PVKs, government subsidies were limited to 90% of the total cost of kits. The remaining 10% were directly paid by customers.



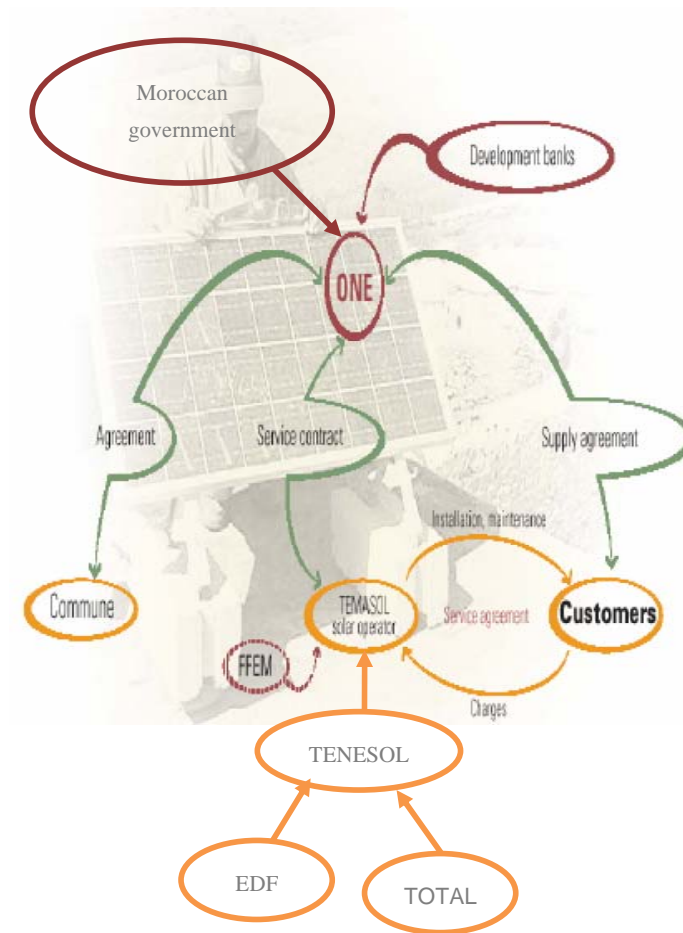
	<p>the national electricity grid.</p> <ul style="list-style-type: none">• The company tries to meet the demand through locally hired and trained agents
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TEMASOL's agents are hired and trained locally to do their job of installing and maintaining PVKs as well as collecting monthly fees from customers. Indeed, the company needs to have agents from the region to take care of visiting rural homes to install PVKs or to fix minor problems such as bulb replacement or major ones such as reinstalling solar panels after a storm. This way, current and prospective customers tend to be more cooperative and confident when they deal with a person who speaks their language, understands the specificities of their culture, and preferably, live the way they do. That is why TEMASOL's management gives preference to hiring local people and trains them according to the technical specifications agreed upon with ONE.

The Business and its Relationships

Chart 1 indicates all of the actors involved in the rural electrification program initiated by ONE and carried out in part by TEMASOL. In addition to TEMASOL and its customers, the most critical actors are ONE, and the communes. The role of foreign partners such as KfW and FFEM were critical at the inception of TEMASOL. FFEM funded technical assistance provision for solar energy to TEMASOL, while KfW Development Bank provided a grant to ONE to finance a large part of the program. However, as the business matured, these actors progressively lost their precedence to national actors and mainly to customers and communes. Indeed, the importance of partners' role is usually contingent upon the frequency of their intervention in the business. With regard to foreign partners, their role was predominant when the program started, either because the funding was very important and/or because their technical expertise regarding solar energy was needed. Once the program was able to sustain itself, the baton was passed to national actors because their importance in the process has increased.

Chart 1: Organisational structure for the delegation of service management



Source: Adapted from FGEF "Decentralised rural electrification in Morocco", 2005, page 9

NATIONAL ELECTRICITY OFFICE (ONE): THE PRINCIPAL ACTOR

The objective of ONE is to implement the Moroccan Government's agenda of electrifying the rural areas of the country. This could not be done cost-effectively through connection to the national electricity grid, so ONE opted for renewable and cheaper sources of energy, and in particular for solar energy. Besides the development objective, such a solution is very cost-effective for ONE despite the initial cost of equipment.

In this rural electrification program, ONE plays a critical role. Indeed, it is this public organization that accepted to decentralize the electrification through PVK and subcontracted some of its activities to TEMASOL. ONE also subsidizes the rural electrification on behalf of the Moroccan Government. In addition, it takes title to the equipment installed by TEMASOL.



COMMUNES: THE LOCAL PARTNERS

Local communes make it possible for TEMASOL to install and maintain solar energy equipment in their territory, and create conducive conditions for TEMASOL's agents to promote the solar solution. From the perspective of local development advocates, two key ingredients are critical to trigger local development, namely, roads to open up the remote region, and access to electricity. With roads and electricity, it would be easier to meet other local development criteria such as opening and operating public hospitals and schools, etc. In this respect, agreements were signed between ONE and local communes stating which *douars* (rural villages) are eligible to be equipped with subsidized PVKs, and which should wait to be connected to the national grid on the basis of the connection cost. As explained before, with expenses up to about US\$3,500, ONE prefers to connect rural households and hamlets to the electricity national grid. Beyond this threshold, it is deemed more cost-effective, easier, and quicker to install PVKs.

OTHER ACTORS

Other actors include the local authorities and, in particular, the *Caïd*. The *Caïd* is the government's local representative in a *douar* or a group of *douars*. The *Caïd* oversees on behalf of the government, the levelling-up of the local infrastructure as well as the provision of local population with water, electricity, etc. The *Caïd* or his local representative is officially informed by TEMASOL that PVKs will be provided in his district through TEMASOL's agents. His support and/or intervention can be required in case a problem occurs. Sometimes, local non-governmental organizations (NGOs) are also involved in connecting TEMASOL's agents with potential users.

“When we are in a region to equip its inhabitants with PVK, people are not necessarily happy. They have been waiting a long time to be connected to the national grid that provides much more power than PVK. They consider themselves as being second-class citizens when they are offered access to energy through PVK whereas others, sometimes a few kilometres away, are connected to the national grid.”

TEMASOL local agent in Oued-Zem

Some local candidates to the commune try to take benefit from this situation and promise to the population to connect them to the national grid if they are elected.

“This sometimes creates frustration and some prospective customers had refused to be connected to solar energy. When they found out they were fooled and made up their mind, it was too late. We had already attained our objective in the area and there were no PVK left.”

A TEMASOL local agent in Oued-Zem

PARTNERS' BENEFIT

The benefit for TEMASOL, EDF, TOTAL, and TENESOL, is primarily financial since they are for-profit companies and since the business is profitable. In addition, ONE gets another advantage from the program as it contributes significantly to bring it closer to its political



objective of providing access to energy to rural population throughout Morocco. Communes benefit at both the political and economic levels. Indeed, having access to electricity contributes somewhat to reducing population and gives impetus to the local economy through trade flows. With regard to FFEM, promoting renewable energies such as solar power is one of the mandates it was given at its creation in 1994.

TEMASOL started its relationship with ONE in a transactional way. Indeed, TEMASOL was created within the framework of a bidding transaction between its parent companies and ONE to seize the opportunity created by ONE's decision to decentralize the provision of solar energy in some rural areas of the country. Progressively, the relationship evolved into a collaborative one as the two entities had to partner to work out the details of providing a quality service to rural households. Nevertheless, the absence of a pricing adjustment mechanism in the contract that would allow TEMASOL to increase its prices when its own purchasing costs go up sometimes makes this relationship somewhat tenuous.

ONE is the main player behind initiating relationships with the local actors and coordinating with them. All local actors have a stake in having their regions connected to electricity; they have no interest in impeding TEMASOL's activity in their area, which reduces the coordination cost. However, it is noteworthy that such coordination is much easier once local people and their local representatives are convinced that they cannot be connected to the national grid at least in the short run, and that solar energy is much cheaper to them and to their constituents than grid-based electricity. In addition, villages located too far from the electricity grid were not planned to be connected anyhow. So, their only alternative was to choose the PVK solution.

Results Created by the Business

"It was wonderful the day we got electricity here (...) It was an amazing thing seeing lights in every room! Now we can watch television, we can listen to the cassette player ... the children can do their homework after dark (...) Before, I had to cook before it got dark (...) Now I can cook when I like and if I want to weave in the evening I can."

A rural customer¹⁹

ECONOMIC IMPACT

The main indicator chosen by ONE to assess the success of the rural electrification program is the percentage of people connected either to the national grid or to other sources of energy such as solar energy. This rate rocketed from 22% in 1996 to 93% in 2007²⁰ and to 95.4% in 2008²¹ thanks to the joint efforts of all of the actors involved in the program.

¹⁹ Laurenson, J., *Morocco: World-Leading Solar Energy Nation*

²⁰ ONE. Annual Report, 2007.

²¹ ONE website (Accessed on February 17, 2010)



As for the result of TEMASOL's activity, 106,200 customers were connected between 2002 and 2008 (see Table 4 for a breakdown per year). In 2009, TEMASOL's employees counted 84 people that include 13 employees in its headquarters in Rabat and 71 in its regional branches. The number of employees peaked to more than 130 during the installation stage of TEMASOL's activity. Most of the 71 locally-hired employees come from low-income communities. The company was even forced to have access to about 30 subcontractors during peak periods.

Table 4: Number of customers connected by TEMASOL to solar energy²²

2002	2003	2004	2005	2006	2007	2008
145	3,544	10,435	19,356	22,958	25,109	24,653

As emphasized by Mr. Semmaoui, the general manager of TEMASOL, the business aims first and foremost to make profit. Indeed, TEMASOL's financial data shows an increasing profit since 2004 as seen below in Table 5.²³

Table 5: TEMASOL's financial data (in US\$²⁴)

	2002	2003	2004	2005	2006	2007	2008
Operating profit	(23,377)	(18,030)	515,600	399,393	(87,847)	246,923	419,840
Cash flow	(38,770)	(79,386)	350,548	511,387	184,981	525,448	679,933

SOCIAL IMPACT

In addition to being profitable, the program has an important positive impact at the social level even if generating such an impact has not been specifically targeted as an objective. To assess this social impact, TEMASOL regularly carries out satisfaction surveys in addition to independent studies conducted from time to time by researchers and consultants. For instance, a study was carried out in 2003 on behalf of ONE and showed that rural electrification had important impacts on the living conditions of rural people, especially on girls' education. Indeed it was noticed that girls coming from 'connected families' were attending school for a longer period of time than they used to do and longer than girls from non-connected families.²⁵

²² Statistics provided by Khalid Semmaoui.

²³ In 2006 there was a loss due to an exceptional event.

²⁴ Data provided by Khalid Semmaoui

²⁵ ONE, *Étude d'impact socioéconomique de l'électrification rurale au Maroc*, Casablanca, 2003.



A German consulting company, Bliss & Gaesing, conducted another study in 2008 in the four provinces included in the first stage of the rural electrification program (2002-2004). More than 330 households were interviewed, including 142 homes not equipped with PVKs, to better assess the program's impact on connected families.²⁶ The research showed that access to electricity through PVKs has entailed positive impacts on the quality of life in connected homes. Access to proper lighting was indicated by most connected interviewees as being the most important improvement in their quality of life, even if this access is only for a few hours each day during winter, which is the case in some regions such as Khenifra.



A rural housewife watching a television program with her children (Source: TEMASOL)

activity such as hand-knotting carpets, weaving or spinning wool, making cheese, etc.

Moreover, lighting and access to television programs, both permitted by access to electricity, seem to have strengthened family ties as family members spend more time together than before. Visits between rural families after sunset were also indicated as an advantage permitted by solar energy.

Teachers interviewed within the framework of Bliss & Gaesing's study indicated that students coming from 'connected families' tend to improve their grades more than their colleagues from 'non-connected families'. Having an opportunity to see things they learn about in their textbooks and that do not exist in their rural region from watching TV helps them better understand their lessons. Lighting makes it possible for children to study at home for a longer period of time: 66.7 to 107 minutes per day for girls, and 53.8 to 91.4 minutes for boys (an extension of 60% on average for the two genders).

Educating girls leads to many benefits: they tend to be better mothers, are more eager to encourage their children to do advanced studies and help them with their homework. In a nutshell, they tend to become leverages for development themselves. However, in contrast

²⁶ ONE & Kreditanstalt für Wiederaufbau, *Électrification rurale photovoltaïque I – 1997 65 389 - Étude socioéconomique sur l'impact genre du projet*, 2008.



with ONE's study of 2003, Bliss and Gaesing's study found only a weak correlation between having access to electricity and going to school for a longer period of time.

In addition to the above-mentioned advantages, access to electricity also makes it possible for households to prevent the theft of their animals. Indeed, most of the customers say they have placed a light bulb outside their homes to be able to 'keep an eye' on their animals. Besides, visits between families become possible and safe.

Other positive social results of this program can be captured, such as: transfer of know-how to the local population through hands-on training in photovoltaic installation and maintenance; and access to electricity-operated small appliances.

ENVIRONMENTAL IMPACT

At the environmental level, the program has a definite impact on greenhouse gas emissions as it helps reduce reliance on the use of fossil fuels, candles, coal, oil lamps, and car batteries for lighting, heating, cooking, etc. A study by FFEM in 2005 explains the following data with regard to the reduction of carbon emissions permitted by this program based on 16,000 installations:

“Compared with traditional energy uses, this program allows for a saving of 32,000 tons of CO₂ over 10 years; compared with energy supplied by diesel-driven generators and low-voltage micro-networks, the saving corresponds to 10,000 tons of CO₂ over 10 years (...); compared with energy supplied by the national power grid, the saving corresponds to 8,400 tons of CO₂ over 10 years.”²⁷

Used batteries collected from customers by TEMASOL's agents are sent to a professional supplier that recycles them according to the highest environmental standards. The acid is neutralized, the plumb plates are recycled and a certificate is issued by the supplier testifying that the battery has been properly recycled.

OTHER IMPACTS

One of the most important indirect impacts that the business has had is the huge expansion of cellular phones in rural areas. Indeed, the only obstacle that used to impede such an expansion had been the lack of electricity to recharge cell phone batteries.

In addition, the Moroccan Government has identified the PV rural electrification program as being compliant with the Kyoto Protocol Clean Development Mechanism. Furthermore, *“in view of its effectiveness, this rural electrification program based on photovoltaic energy may encourage other countries to take the same approach.”²⁸*

²⁷ FFEM, *Decentralised rural electrification in Morocco*, p. 12.

²⁸ *Ibid*, p. 12.



Despite the success of the program, increasing the electricity power to enable customers to use electrical appliances such as fridges, ovens, parabolic receivers (free-to-air) without increasing the connection and monthly fees, would have been very beneficial.

Growth Strategy and Future Outlook

In 2008, TEMASOL attained its objective of installing PV kits as instructed by ONE. Since then, its activity has been focusing on maintenance and repairing of installed kits.

“There is still an important enough potential of connecting households in other regions of Morocco, but we cannot do it without amending the service contract with ONE.”

Khalid Semmaoui, TEMASOL’s General Manager

TEMASOL has acquired such an experience that it could consider exporting its know-how to neighbouring countries and even beyond. Delegations from Venezuela and Angola have visited TEMASOL’s facilities and relationships are being woven with similar companies in Cambodia, Mali and Senegal. These relationships may eventually evolve into outreach activity beyond the Moroccan borders.

As the installation stage of the business is finished, TEMASOL, in addition to focusing on the development and maintenance part of its activity, is developing a new path, namely, solar telecommunication. A few years ago, TEMASOL started exploring the possibility of expanding its activity to this emerging field. In contrast with the situation in industrialized countries, the land telephone network in Morocco was very limited. That is why when cellular telecommunications were introduced in Morocco in the mid-1990s, cell phones soon became very popular even in rural areas. However, the lack of access to electricity made it difficult for customers to recharge cell phone batteries and for telephone companies to provide power to regional satellite reception stations.

As the problem of recharging cell phone batteries has been largely solved in part through PVKs, TEMASOL is directing its efforts towards installing PVKs to provide energy to satellite reception stations and telecommunication relay stations in remote areas. Besides being cleaner than other solutions, PV energy is cost-effective for telephone companies and presents an important potential for development in the near future. Indeed, telephone companies are facing many problems such as providing fuel and maintaining generators, and theft of equipment and fuel. Having access to PV energy would permit making such stations autonomous, which is especially valuable in remote areas. It is noteworthy that beyond the economic, environmental, and social impacts of such an activity, it is deemed a profitable one and requires no subsidies from the Moroccan Government.

Also, the successful experience with Moroccan Water Provider ONEP in providing PVK to water pumping stations in remote regions encourages TEMASOL to further explore this avenue for its future development.



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