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REPLACEMENT OF DIESEL GENERATORS BY SMALL PV PLANTS

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ABSTRACT

Following United Nations estimations, more than 2 billion people living in developing countries are not connected to any electricity grid, and around 1.7 billion people has no access to any kind of electricity source[1]. This problem is concentrated in rural regions of developing countries. In many of these areas, population uses dry batteries as the only electricity source, and in others, population has turned to the installation of diesel generators. However, despite a rough number of 10 millions diesel generators have been worldwide installed, they have several disadvantages related with their performance, their ecological impact, and their limitations in satisfying users needs. The utilization of PV solar energy as a solution for rural electrification dates back to the 70's and it has shown its potential just in the diesel generators weakness: reliability, renewable energy, and user acceptation. This paper presents the results of a pilot experience of replacement of diesel generators by small PV plants in two remote rural villages in the south of Morocco.

This pilot experience is in line with a PV rural electrification programme that is being implemented since 1995 in the provinces of Ouarzazate and Zagora, in the south of Morocco. Although this programme focuses on PV water pumping (there exists already more than 40 PV pumping installations with almost a total of 150 kWp), our presence in the area evaluating this programme allowed us to disclose adequate circumstances for PV rural electrification. Firstly, in all the visited villages we could see diesel generators with small local grids that supplied electricity to the dwellings during 3 or 4 hours/day. These kinds of systems, of collective property, are managed by local associations that collect monthly the money corresponding to electricity consumption. The register of consumptions leads us to estimate the mean family consumption around 12 to 15 kWh/month with a cost of 50 to 60 Dh (5 to 6 euros). It is worth to note that, to this cost, it is necessary to add the punctual and important payments when the frequent breakdowns occur. This price is three times the cost of conventional electricity. Secondly, the service of these diesel generators is limited to 3 or 4 hours/day and its quality is very bad, in terms of stability of frequency and voltage, what makes impossible the use of the majority of appliances. Such a limitations have caused a spontaneous PV market and some families have installed SHS by their own.

These reasons lead us to implement two pilot PV plants, each one of 10 kVA, supplying 220 VAC through a local distribution mini-grid to the dwellings and to the community services (public illumination, water pumping, etc.). The PV plants have been designed to be compatible with a future arrival of national electricity grid. In order to learn from this experience, in one hand, we have installed electricity meters in each house that are monthly registered for tariff and following of the plant. The plant is also monitored. In the other hand, we have implemented some precautions to control the electricity consumption: limitation to 15 hours the supply of electricity, limitation of power in each house, control of allowed appliances, progressive tariffs according to consumption levels, etc. All these mechanisms have been previously accorded with local associations and they can be revised according the evolution of energy consumption.

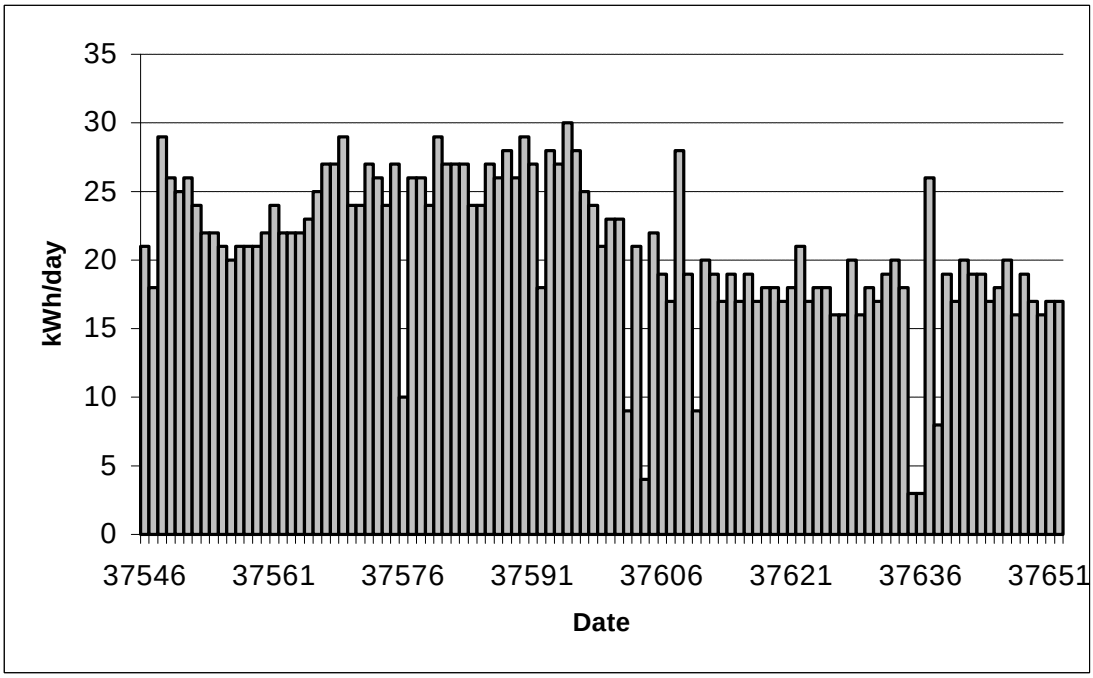
The good managerial skills of local associations and our close following of the pilot experience allow us to present, first, a proposal of standardisation of small PV plants substituting diesel generators; second, the lessons learned in the experience, especially, those related with the electricity consumption of population; and third, the managerial aspects that contributes to the sustainability on this kind of small PV plants.

[1] "World Energy Assessment: Energy and the challenge of sustainability". United Nations Development Programme (2000).

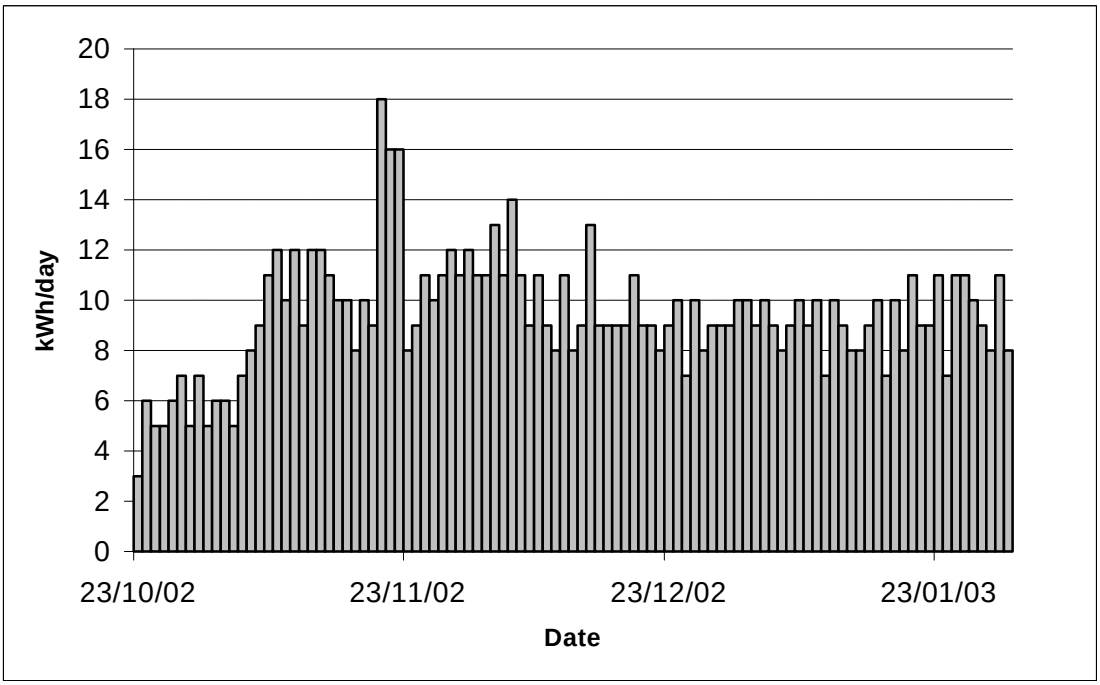
Explanatory page

EVOLUTION OF THE DAILY ENERGY CONSUMPTION

The graphics displayed below represents the evolution of energy consumption of each PV plant, since the beginning of the project until January 31, 2003. As can be seen, there is a period of high consumption, around November 2002, which coincides with the month of Ramadan. The last data show a trend towards the stabilisation of the energy consumption.



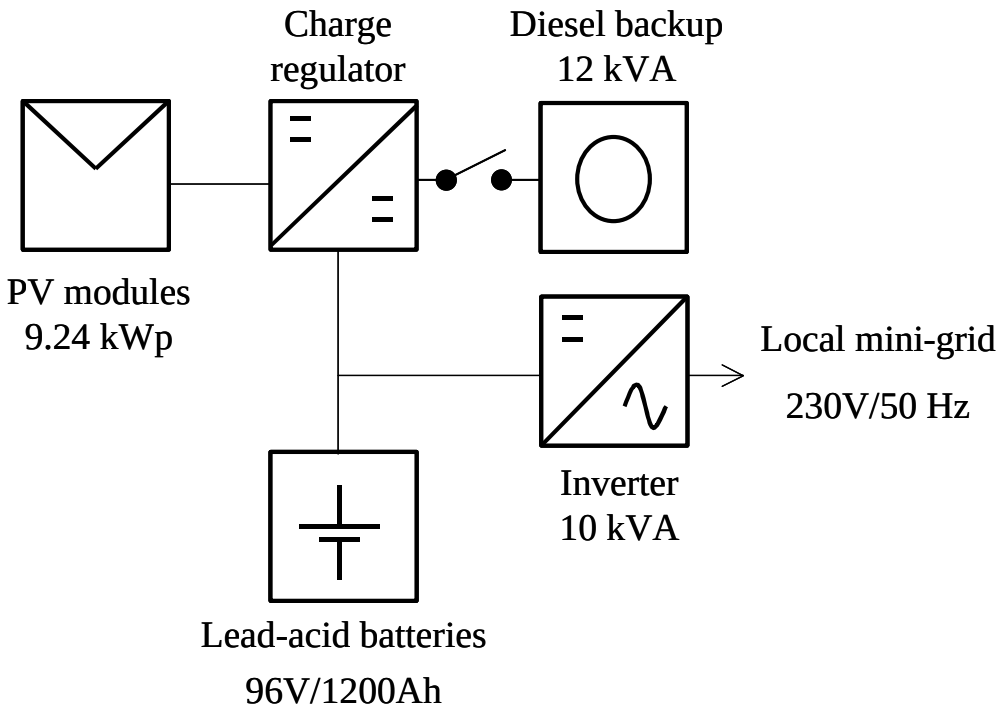
Iferd village



Idboukhtir village

PV PLANT TOPOLOGY

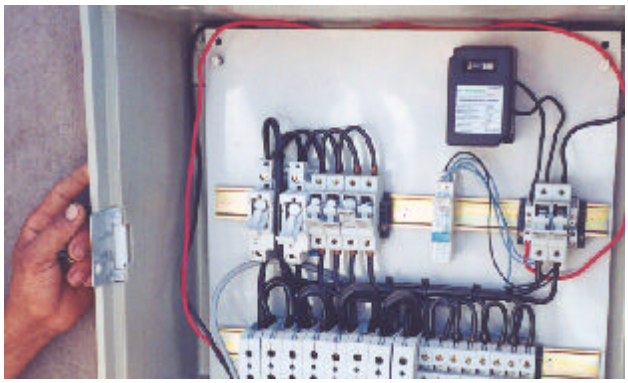
The topology of the PV plant is displayed below. The diesel generator of the previous system is reused to support the PV part.



PHOTOGRAPHIES

Idboukhtir village (32 electricity meters). The PV central offers electricity (15 hours/day) for individual dwellings, community services (public illumination, school, mosque, etc.) and water pumping.

Iferd village (80 electricity meters). The PV central offers electricity (15 hours/day) for individual dwellings and community services (public illumination, school, mosque, etc.). A previously installed PV system provides water pumping.



A custom-made AC electricity meter of high sensibility has been employed in order to measure low energy consumptions.