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Rural photovoltaic micro-grid with individual energy allowance scheme powers a 60 homes village in Santo Antão (Cabo Verde)

Overview of the pergola in Monte Trigo -Cape Verde-

While you were probably having a normal day's work, on Thursday, 9 February 2012, a small village in Africa experienced its first 24 hours of electricity.

The 60-family community of Monte Trigo, a village in the Cape Verde an island of Santo Antão, is only reachable by boat and is completely dependent on fishing and its trade with nearby villages. The need for ice to preserve fish is vital, and villagers have frequent five-hour boat trips to purchase it..

A reliable and clean source of energy, which would enable sustainable and affordable electricity, would not only respond to basic needs like lighting, communication and community services, but also productive uses like ice production.

Let there be light

It was to respond to this need that local entities, with the support of the ACP-EU Energy Facility programme, came together to finance and develop an off-grid solar energy project that consists of a rural Multi-user Solar micro-Grid (MSG) based on a photovoltaic generator mounted on a special wooden pergola that also provides shade to the village's schoolyard. The needs of the village are supplied with standard electricity of 230V, 50Hz AC delivered through an 800m aerial distribution line to 60 users including households, one school, a church, a kinder garden, a health centre, a satellite TV dish centre, three general stores and 22 street lights.

The PV micro power plant can produce an average of 74kWh per day. Part of this energy is consumed during the daytime and part is stored in batteries with a capacity of about 370 kWh for night time consumption. The old 20kVA genset can be used as a backup burning expensive diesel fuel, so it is essential that users understand the implications of their behaviour on the electricity service and cost.

The challenges and added-value of controlling energy demand

Generally speaking, concepts such as the sustainable and rational use of solar energy, and the implications of the different state of charge of the batteries, are not easily understood or introduced into the end-users' daily habits. To address this, **CIRCUTOR's** electricity **DISPENSER BII** integrates the concept of Energy Daily Allowance (EDA) in the Monte Trigo Project.

The EDA makes the demand-management more intelligent and flexible by caping the power and energy available to each user to an agreed maximum. This ensures the plant operates within its rated design and prevents black outs or unforeseen increases in operating costs because of higher back-up diesel fuel consumption. This limit is, nevertheless, flexible, depending on the plant's condition. On very sunny days users' are encouraged to make use of the surplus generation at no extra cost.

The implementation is done through this special type of meter called the electricity dispenser that permanently shows the user the available energy and includes a signal to encourage or refrain consumption, always according to the plant's condition.

The EDA concept is a vital design feature, as it is the element from which the PV generator and all the other major plant components are sized. Thus it is essential to establish in a detailed and accurate way each user's energy demand. The EDA also estimates future increase according to the community's specific social and economic environment, and enables components like batteries and inverters to operate within the specified range, hence increasing the plant's efficiency and their life time.

The Monte Trigo project's service was setup using a mixed private/public-utility concept, in which CMPN and APP are directly responsible for the service management and operation and maintenance (O&M) activities of the facility.

Tariff collection is based on fixed monthly rates related to the EDA and was established within the population's payment capacity. This not only sustains O&M but also partially pays back the capital costs.

The O&M activities are organised in order to involve local users and are structured around a concept of three levels of involvement:
(1) final users,
(2) fist-level O&M up-keeper/user and
(3) second-level O&M technicians.

The first level **i**ncludes the users themselves, as they are the first component of a successful and durable service. The objective is not only to support them in maintaining their home installation, but also make their electricity consumption behaviour and habits more efficient.

The second level includes a team of trained users, responsible for the basic daily operation, maintenance and, in case of specific alarm and issues, reporting.

Training session for end customers

Monte Trigo user, activating the electricity dispenser service

Finally, the operator's technical personnel are the focal point for problem-solving, ensuring substitution when end-of-life is reached, as well as for specific maintenance and overall activities.

The importance of strong partnerships

As with any successful rural electrification project, Monte Trigo involved many partners from different parts of the world working together. In isolated communities such as this one, the quality of the different components of the system gains new importance, so it is essential to involve the right (and experienced) companies for each job.

The design and implementation of the Monte Trigo project were managed by **TTA** on behalf of the developers. Founded in 1986, **TTA** is an international consulting and engineering firm working in the field of renewable energies, environmental projects and technology development in many developing countries.

Project Outcome

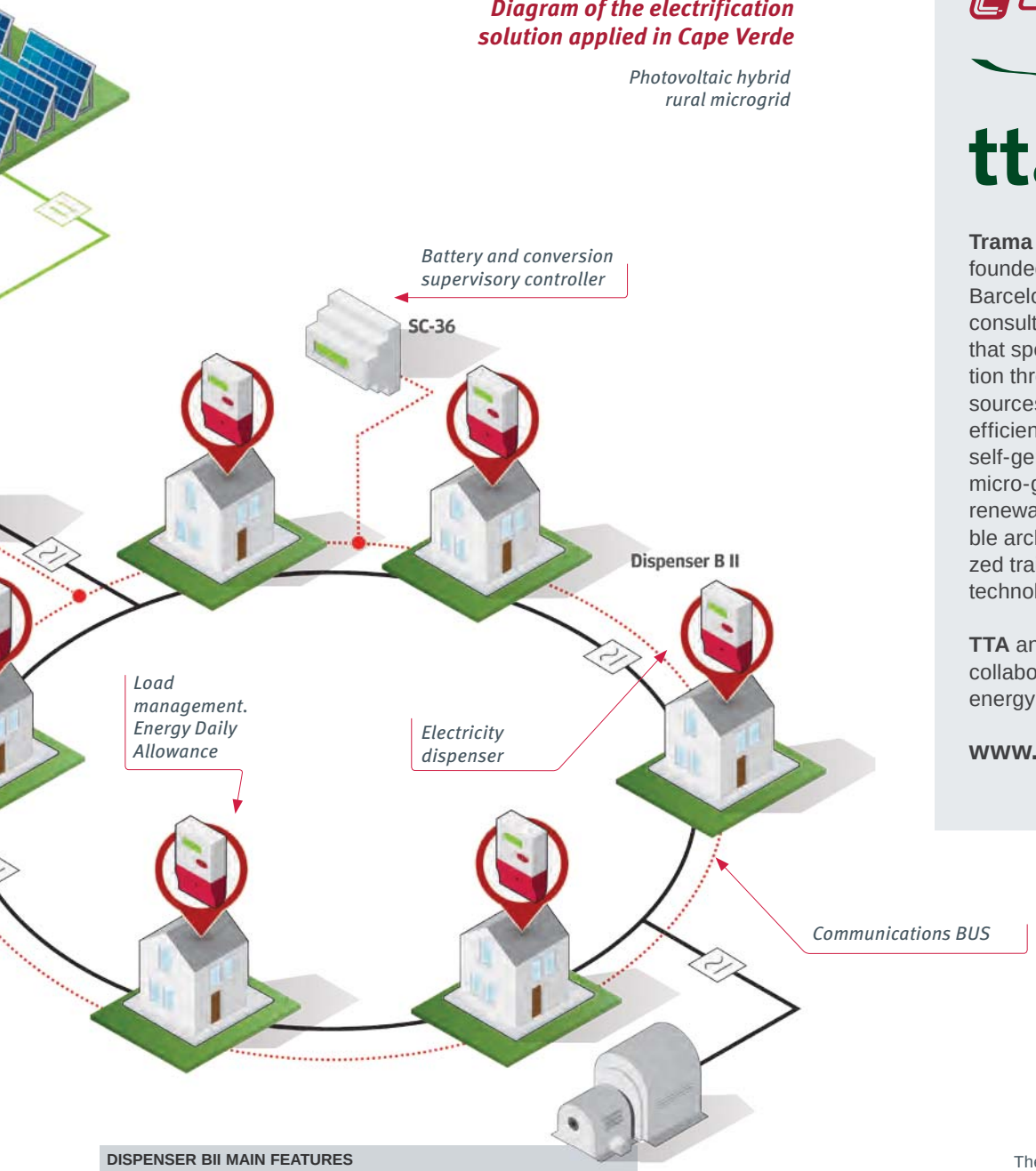
From the first days of operation, the local authorities showed their satisfaction with the new 24-hour electricity service, as demonstrated by the visit of the President of the Republic of Cape Verde (Dr. Jorge Carlos Fonseca) and of the European Union Ambassador in Cape Verde (Mr. Josep Coll) shortly after the project was commissioned.

But most of all, it is the enthusiasm of the Monte Trigo population which demonstrates the success of the project. The villagers' habits adapted very easily to their new quality of life and what it brought Major changes are already shaping the life of this community: one user already bought his first refrigerator (an A+ energy rating!) and local workers brought in a welding machine from the nearby village to fix a structure with a defect. It was the first time they were able to use something like this in the village.

It is expected that with the two ice machines capable of up to 500 kg/day production using peak of the day, solar surplus generation will improve the commercial activities on which the village sustains its economy. ◗

Diagram of the electrification solution applied in Cape Verde

Photovoltaic hybrid rural microgrid



DISPENSER BII MAIN FEATURES	
Power supply	
Nominal voltage	230 V or 120 V
Tolerance	80 % ... 115 % U_n
Consumption	<2 W; 10 V·A
Frequency	50 or 60 Hz
Voltage measurement	
Connection	Asymmetrical
Reference voltage	230 V
Frequency	50 or 60 Hz
Voltage consumption of the circuit	< 2 W
Current measurement	
Iref Nominal reference current	10 A
Maximum current Imax	40 A
Start-up current Ist	< 0.04 x I_{tr}
Minimum current Imin	< 0.5 x I_{tr}
Current consumption of the circuit	0.024 V·A at 10 A
Accuracy class	
Accuracy measured in active energy	**EN 50470** - Class B
Accuracy measured in reactive energy	**UNE-EN 62053-21** - Class 2
Memory	
Data	Non-volatile memory
Setup and events	Serial flash

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Trama TecnoAmbiental (TTA), founded in 1986 and based in Barcelona, Spain, is an international consulting and engineering company that specializes in distributed generation through renewable energy sources, energy management and efficiency, rural electrification and self-generation through distributed micro-generation, integration of renewables in buildings and sustainable architecture, as well as, specialized training and education and technological development.

TTA and **CIRCUTOR** are currently collaborating on various renewable energy projects.

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The **DISPENSER BII** electricity dispenser and the **CIRCUTOR SC-36** battery and conversion controller used in this Cape Verde project

DISPENSER B II

SC-36