Pere Soria
CIRCUTOR Energy

RECARGO project

Management of charging of commercial electric vehicles with renewable sources

RECARGO
Renewable Energies • Electric Car • Grid Optimization

This project aims to demonstrate the technical and economic viability of using solar photovoltaic energy to generate electricity, on a total self-consumption basis without producing surpluses, to charge electric vehicle fleets.

Commercial electric vehicle fleets are becoming more numerous and have certain unique features that make them ideal for the application of production technologies and management of the electricity used in their charging.

On the one hand, vehicle routes are known and regular, enabling the application of cost and efficiency comparisons of changes made and assessing whether they should be adopted or not.

In addition, kilometre cost optimisation and minimising incidents is a priority objective of management companies. It should be noted for these vehicles that the cost of electricity used in their charging is their main operating cost. In light of the above, the three participating companies in the project: **E.ON España, URBASER** and **CIRCUTOR** have decided to pool their knowledge on electric energy management, organisation of commercial vehicle fleets and efficient electricity production with renewable energies to show, through a real case study, the maturity of technologies and optimisation of energy management processes associated with these types of services.

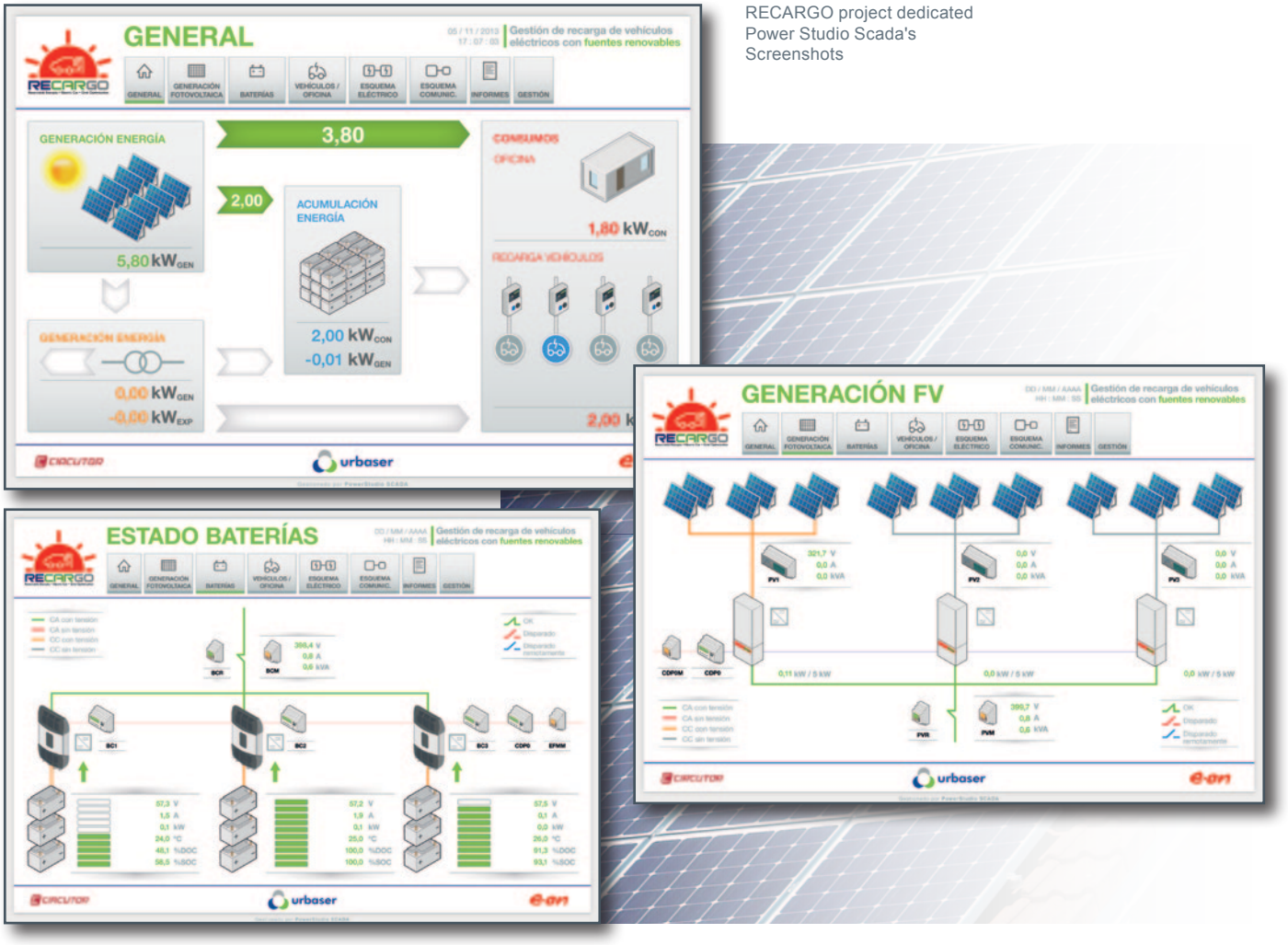
The project consists of a station that generates electricity through the direct conversion of solar radiation with photovoltaic modules and a group of three network star connected single-phase inverters in order to supply a 15 kW nominal power three-phase network.

The monocrystalline photovoltaic modules have been installed on the roof of one of the parking units on the site on which URBASER manages the Barcelona city street waste collection and cleaning service. Around fifty electric vehicles are parked on this site.

The transducers are located in a delimited area of the car park where the project vehicles will be charged: one light van, two vans and a management vehicle all 100% electric powered.

The energy injected by the photovoltaic system, during daylight hours, will be mainly used to charge the project vehicles. These vehicles are for night services, so there will be ideal compatibility between charging hours, solar energy and hours of use.

The total power required for charging the vehicles will be supplied by the solar photovoltaic installation on an instantaneous self-consumption basis supported by the electrical network to ensure that vehicle charging is guaranteed at all times and that the service of the vehicles is not exposed to any other risk than that of the vehicles charged fully by the network.



RECARGO project dedicated Power Studio Scada's Screenshots

The project does include a new feature, though: A self-consumption optimisation system based on the storage of surpluses that may occur at peak radiation or on days of maximum sunshine in a group of static capacitor banks so as to later release that energy to the vehicle charging system during hours when less solar radiation is available.

This combination of instant and time-delayed self-consumption will make it possible to exploit all available radiation without having to send energy to the network at any time. The system can therefore be defined as self-consumption with zero injection to the network.

A unit designed by CIRCUTOR will be responsible for controlling energy flows to avoid generating any energy surpluses in self-consumption projects. The power modulator or CDP0.

Its working is very simple. The unit measures the three-phase consumption of vehicle charging systems and calculates the percentage that the instantaneous power consumed by each phase represents in relation to nominal power installed. It then sends this percentage to the inverters as an individual power limitation setpoint and these adopt it requesting the maximum rated power from the photovoltaic modules. This balance is reached in less than 2 seconds. The unit then gives orders to the buffer battery charger so that it uses the remaining energy in the charging for optimum use of the incident solar radiation.

Whenever the power of the solar inverters does not reach the required power for charging the vehicles, the controller sends the setpoint to the transducers so that they discharge the batteries supplying the necessary energy to fulfil the task with minimum use of the conventional electrical network.

The network connection of the inverters is controlled via a RS422 communications channel while CDP0 communications with the measuring equipment are produced in a RS485 channel.

The control is carried out independently in each of the three phases, ensuring there is no network injection by any of them, even though the vehicle charging is performed in an unbalanced way.

In case the power modulation does not fulfil its task and it is detected that power is being injected into the network, the unit activates a relay output which triggers a power contactor to prevent this situation from continuing. Once the balance has been restored, the system is rearmed to continue its normal working.

Another new feature was also introduced for this project. Stationary batteries used as an energy lung to adapt production at all times to demand are reused and come from replacements regularly made in the vehicles. This is the so-called second life of the storage batteries.

This reuse of batteries allows the vehicle manager to obtain extra capacity from them and minimise the cost of taking them apart. It also represents a clear environmental improvement, giving a second opportunity to use something that is in fact considered waste.

All operating data, both generation and temporary storage and final use of energy, is recorded in a Power Studio Scada application which not only enables its real time and remote monitoring, using Internet access, but also acts as a gateway to the control and optimisation software prepared by the E.ON technical team.

The project therefore takes on a larger dimension, as it enables adaptation of the charging strategy based on the availability of solar radiation and the electricity tariffs with more advantageous time differentiation, by receiving external charging/discharging setpoints from the vehicles and redirecting the energy flows of the solar system to the storage battery or forcing the recovery of this energy.

To ensure that this project is replicable and its results can be shared by more companies and professionals related to the electric vehicle sector, the Spanish Cluster for Electric Vehicle Infrastructure (ADEVIE) is involved in it, leading communication actions. ◗

Project responsibles from E.ON, URBASER and CIRCUTOR at the kick off meeting

Indoor and outdoor views of the RECARGO project at URBASER's headquarter

Power Dynamic Control. CDP0 by CIRCUTOR