5th International Renewable Energy Storage Conference (IRES 2010)

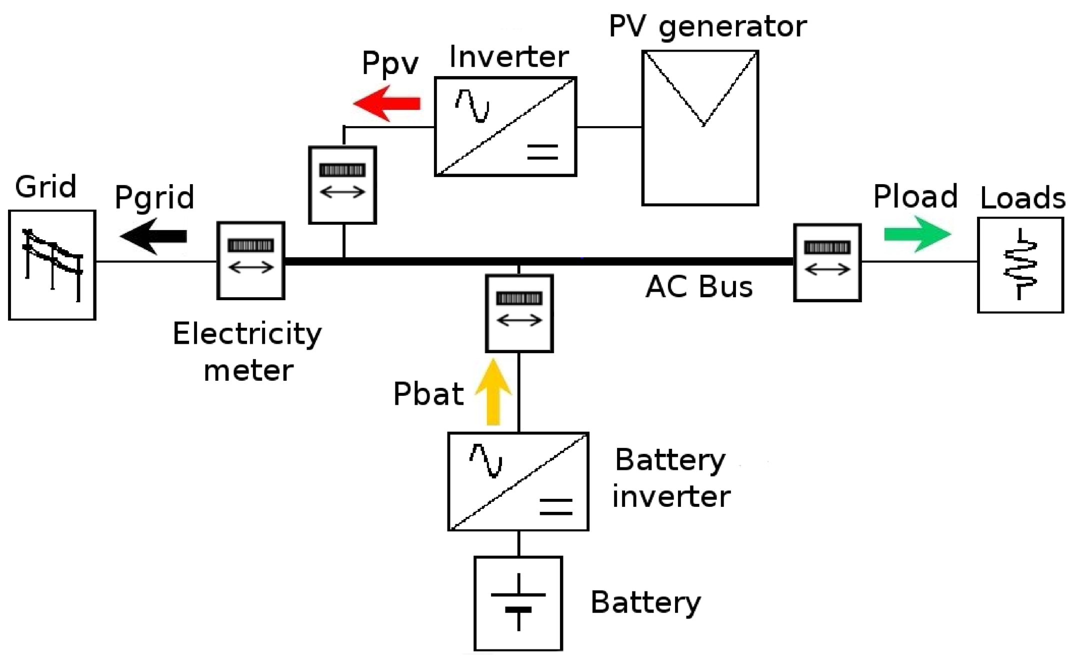
WCRE

EUROSOLAR The European Association for Renewable Energy

SELF-CONSUMPTION ENHANCEMENT WITH STORAGE SYSTEM AND DEMAND-SIDE MANAGEMENT: GEDELOS-PV SYSTEM

M. Castillo-Cagigal[1,2,*], E. Matallanas[1], D. Masa-Bote[2],
E. Caamaño-Martín[2], A. Guiérrez[1], F. Monasterio[1] and J. Jiménez-Leube[1]
* Corresponding author, e-mail: manuel.castillo@ies-def.upm.es
[1] E.T.S.I.T., Universidad Politécnica de Madrid - Av. Complutense 30, 28040 Madrid, Spain
[2] Instituto de Energía Solar, Universidad Politécnica de Madrid - Av. Complutense 30, 28040 Madrid, Spain

GeDELOS-PV system



The GeDELOS-PV system is an example of added value for PV electricity arising from the combination of modern hybrid PV technology with a lead-acid battery storage system and Demand Side Management (DSM) strategies in the residential sector. The main objective of this system is to satisfy the user demand by optimizing the use of PV electricity. In order to achieve this objective we have followed two strategies:

- The management of an small scale battery storage system in order to use PV electricity indirectly
- To schedule the local electricity demand in order to integrate the user demand and local PV generation patterns

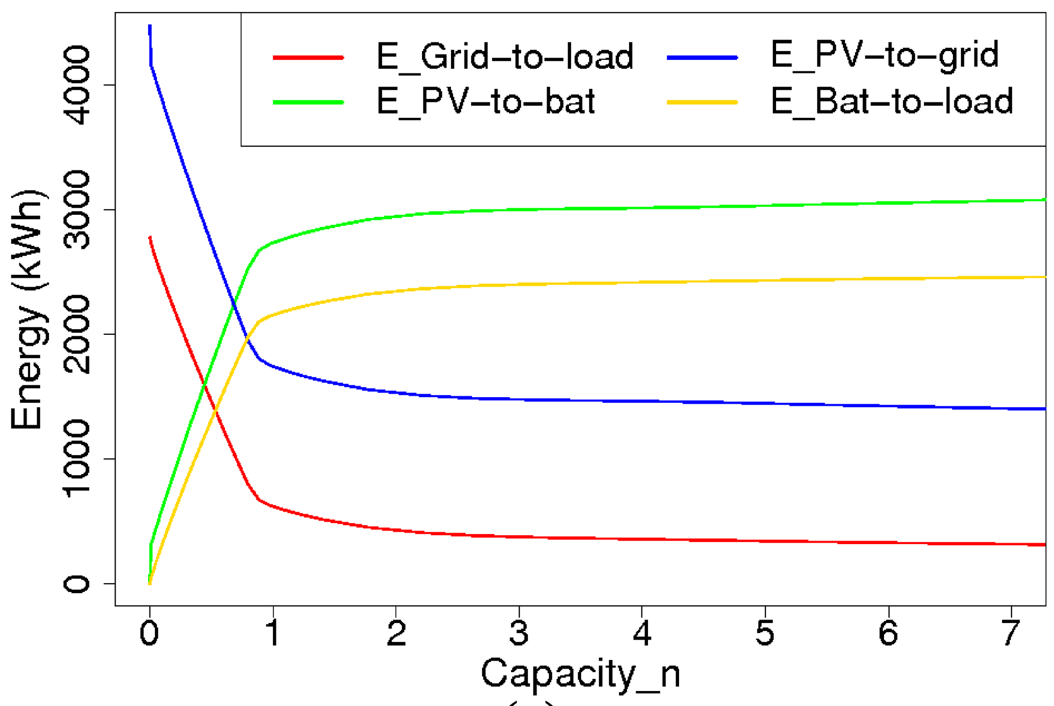
We have developped a software battery controller with the objective of maximizing the self-consumption. The principal characteristics of this controller are:

- To manage the battery inverter's current. This inverter has current limiters, with them we can modify the power flows.
- The battery controller does not allow the electricity exchange with the grid. The inverter and the grid are physically connected. By controlling the currents the controller only charges the battery with PV energy and only discharges the battery to supply the house demand.
- Preserve the battery against overcharge and overdishcharge.

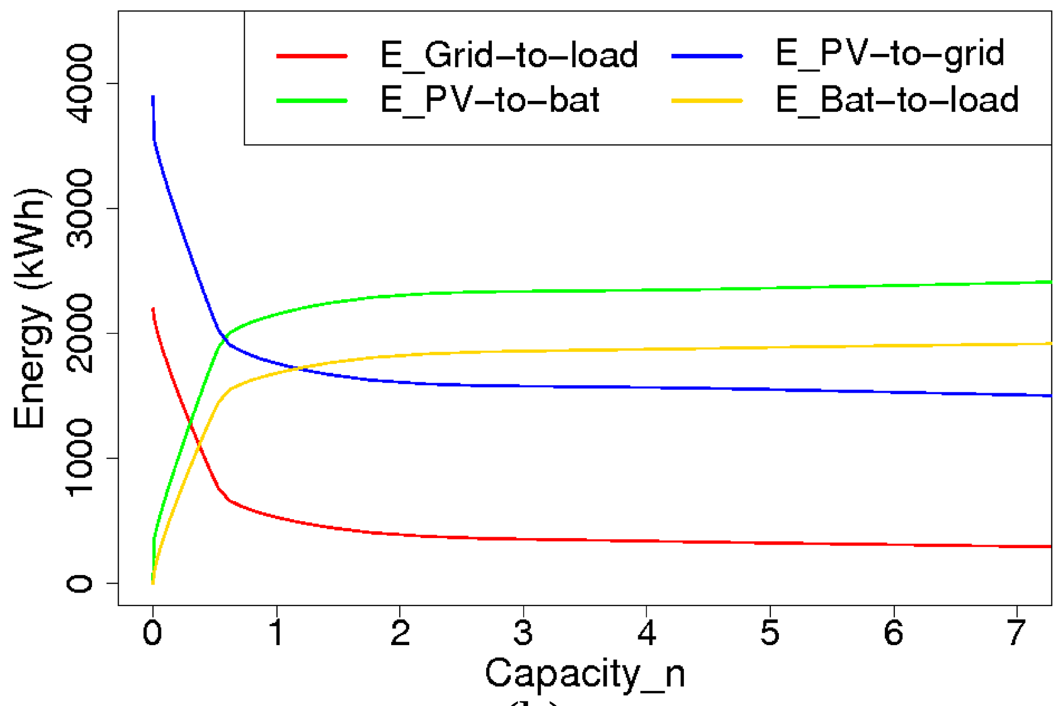
In order to evaluate the operation results we have defined a self-consumption factor (ξ), where $E_{PV\,to\,load}$ is the PV energy to the loads, $E_{Bat\,to\,load}$ the energy from the battery to the loads and E_{Load} the total energy consumed:

$$\xi = \frac{E_{PV\,to\,load} + E_{Bat\,to\,load}}{E_{Load}}$$

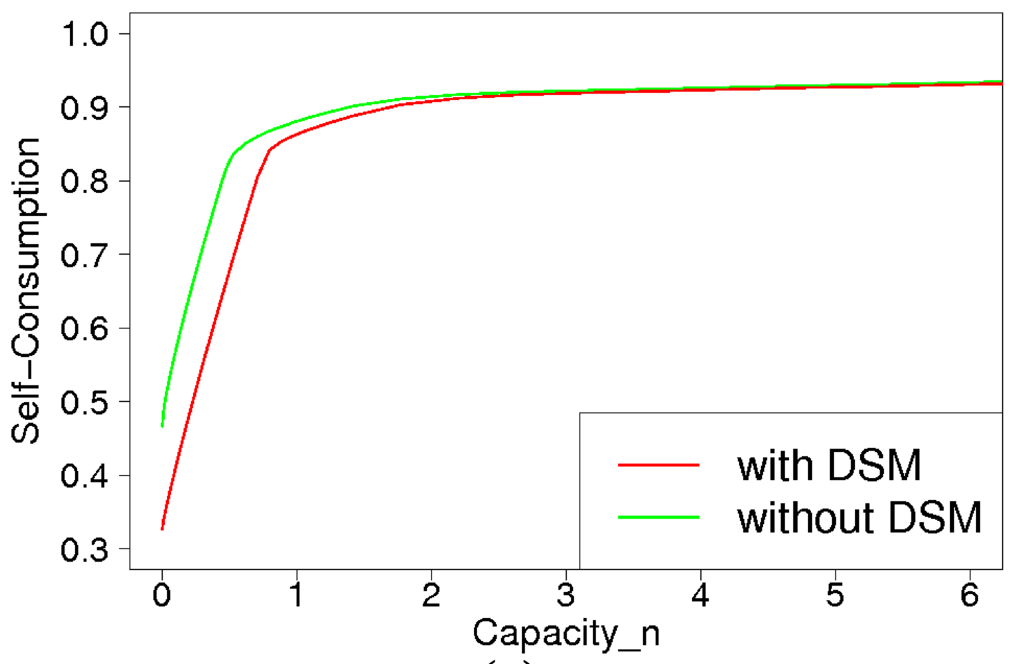
Simulated results (Yearly)



(a)



(b)

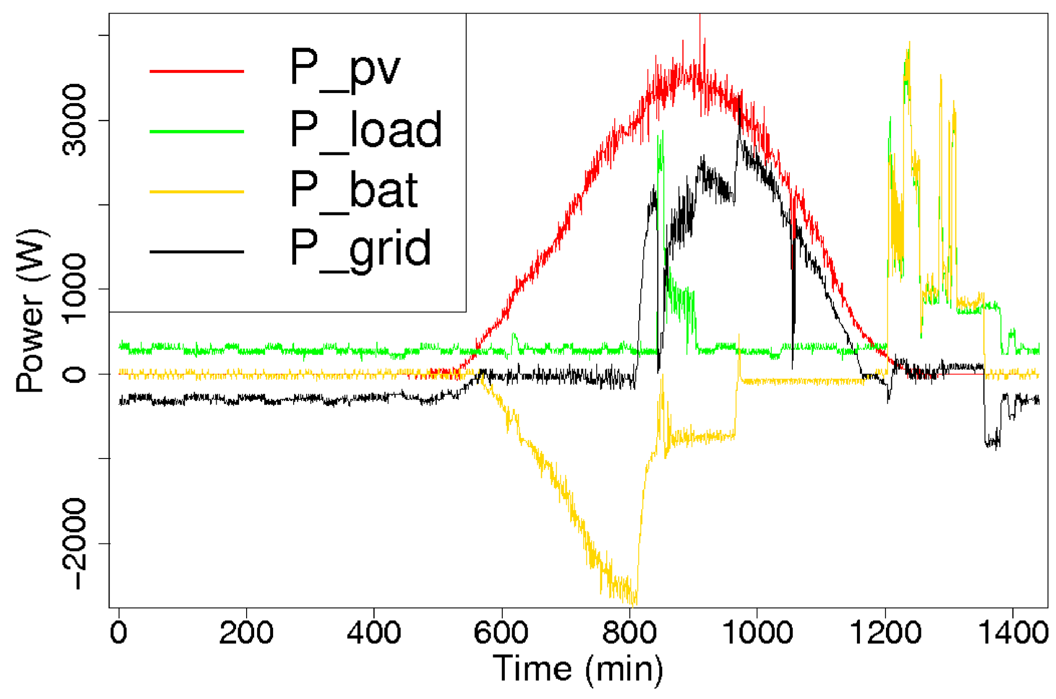


(c)

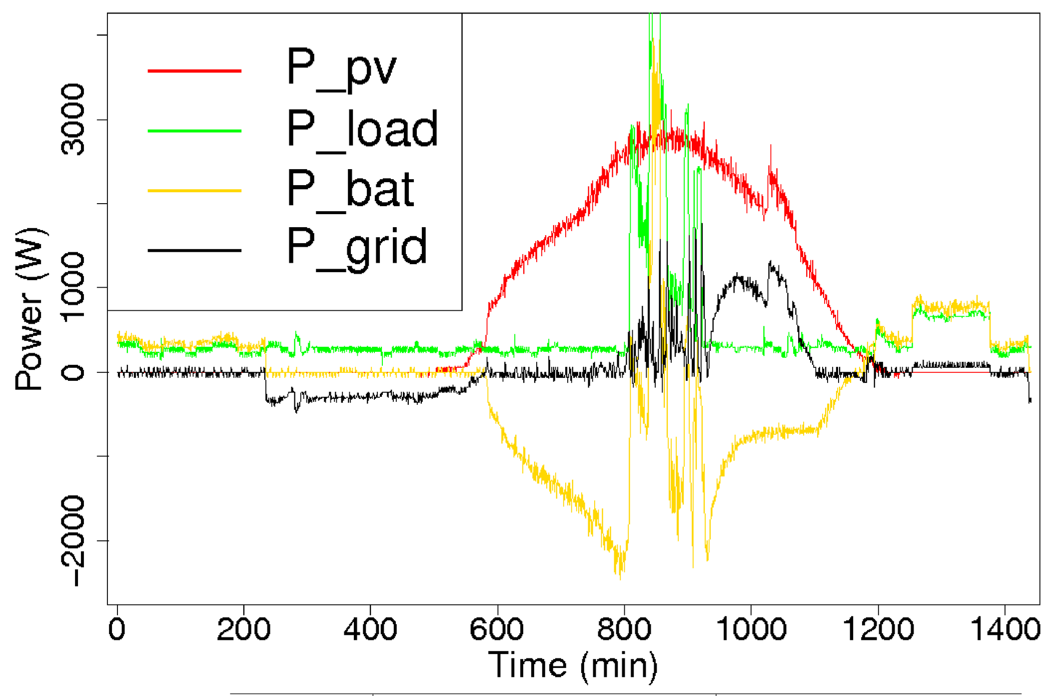
Cap_n^*	ξ without DSM	ξ with DSM
0	0.328	0.468
0.2	0.468	0.626
0.5	0.638	0.794
0.8	0.806	0.858
1	0.85	0.871
3	0.910	0.915
∞	1.0	1.0

* Capacity is normalized by the daily consumption in order to represent it in days of autonomy.

Experimental results



(a)



(b)

Cap_n	ξ Fig. a without DSM	ξ Fig b ξ with DSM
0.5	0.693	0.847

Conclusions

The self-consumption factor is not directly proportional to the capacity level and it is an important design criterion for an energy system. The DSM improves the energy behavior controlling only a part of the electricity demand, and its effects are similar to a small storage system.

The combination of both techniques can perform the energy behavior more efficiently and increase the use of PV electricity. These two strategies will play an important role in the smart grids. By combining multiple systems like this one, we can implement a more complex energy behavior and improve the use of the PV electricity.

This work was supported by the *GeDELOS-FV* project, funded by the Plan Nacional de I+D+i 2007-2010 (ENE2007-66135) of the Spanish Ministerio de Educación y Ciencia.