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ANALYSIS OF THE SELF-CONSUMPTION POSSIBILITIES IN SMALL GRID-CONNECTED PHOTOVOLTAIC SYSTEMS IN SPAIN

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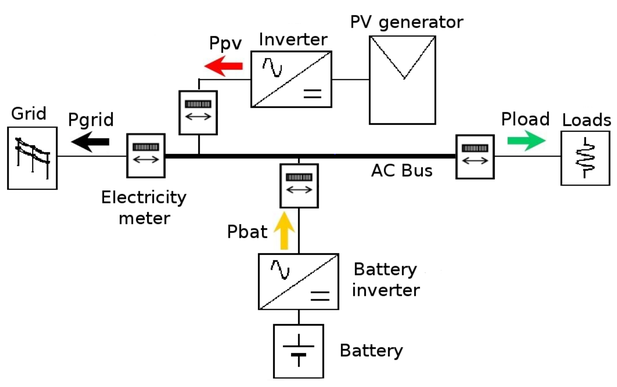
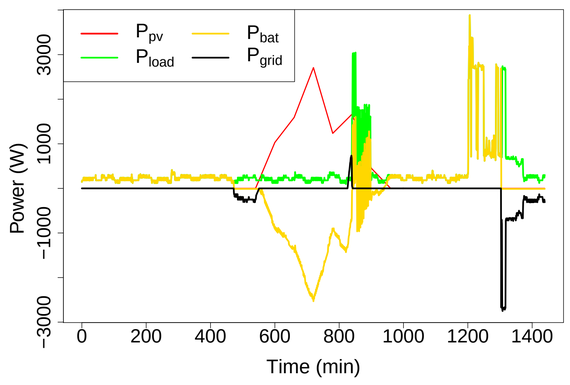
Analysis of Self-consumption



(a) Electrical system under study



(b) Power flows

Self-consumption is emerging as a new possible operating mode for PV energy. On distributed generation electrical networks, self-consumption is defined as the usage of the own generated electricity, while the electricity provided by the grid remains an optional generator or consumer.

The analysis, made in this paper, consists of studying the feasibility of the self-consumption and it is divided in two parts:

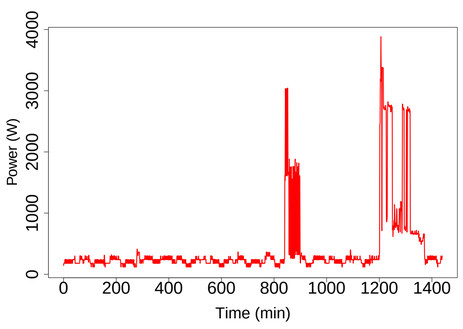
- An electrical analysis to study the amount of energy self-consumed by a small grid-connected PV system with an electrical storage system of a half-day of autonomy and three different load profiles.
  - Demand-Side Management (DSM) techniques have been also included to study their influence in the self-consumption.
  - In order to evaluate the electrical results we have defined two self-consumption factors (ξ_L and ξ_G), where $E_{PV\,to\,load}$ is the PV energy to the loads, $E_{Bat\,to\,load}$ the energy from the battery to the loads, E_{Load} the total energy consumed and E_G is the total energy generated:

$$\xi_L = \frac{E_{PV\,to\,load} + E_{Bat\,to\,load}}{E_{Load}} \qquad \xi_G = \frac{E_{PV\,to\,load} + E_{Bat\,to\,load}}{E_G}$$

- An economic analysis to study the profitability of the whole system in the current economic scenario.
  - Different configurations of the system and DSM techniques have been taken into account in this study.
  - Different tariffs for the electricity consumed by the user: single tariff, tariff with two periods of time discrimination and hourly discrimination tariff.
  - The tool used is the Net Present Value per cost of W_p.

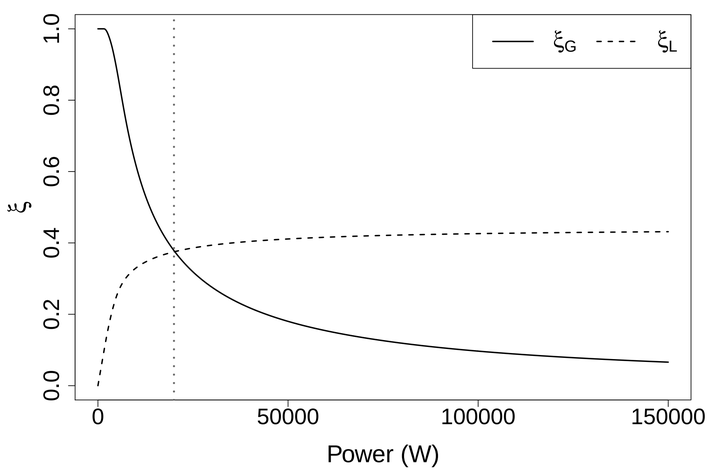
(a) Average business user

(b) Average domestic user

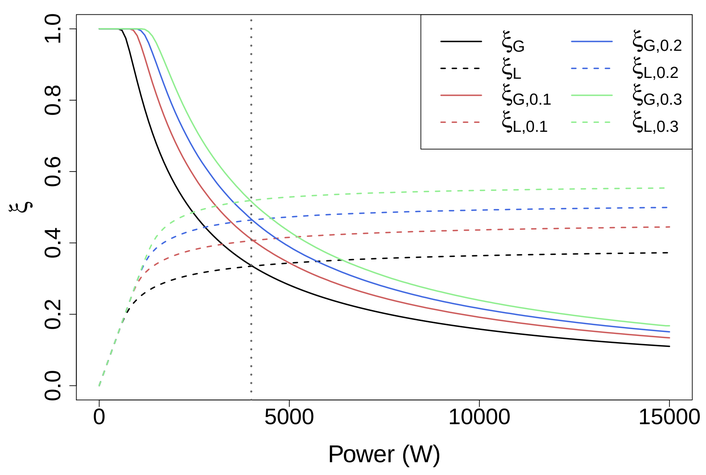


(c) Single domestic user

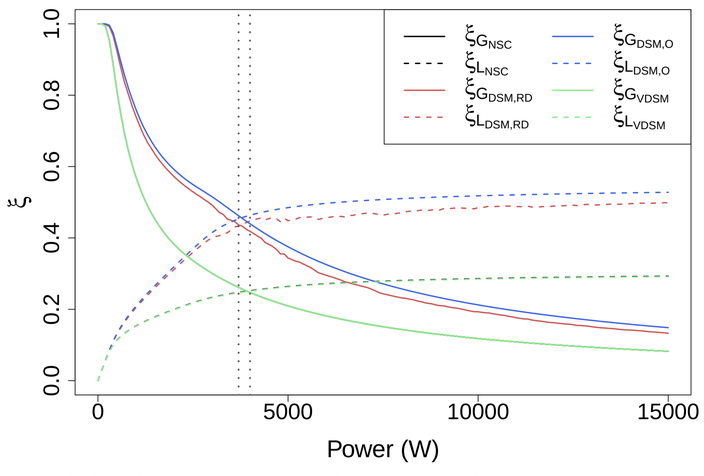
Electrical results



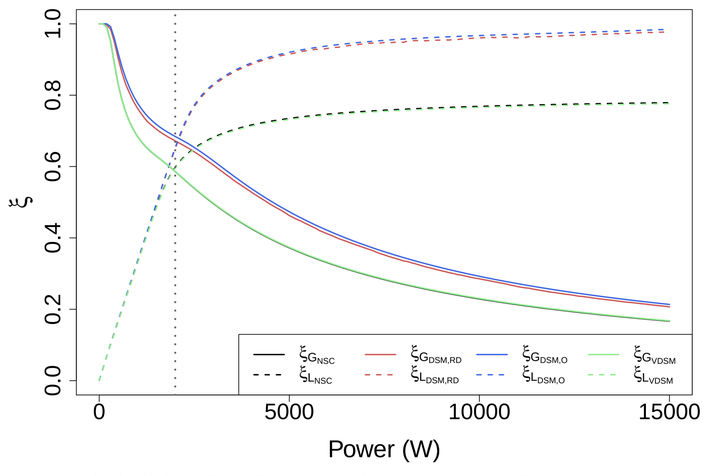
(a) Average business user without battery



(b) Average domestic user without battery

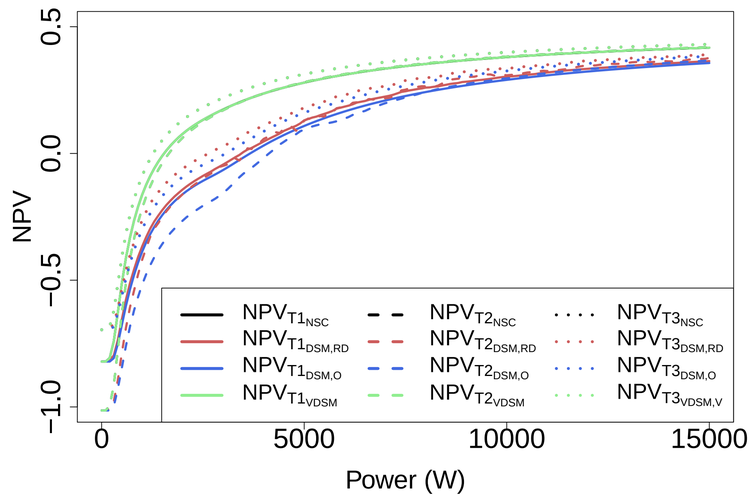


(c) Single domestic user without battery

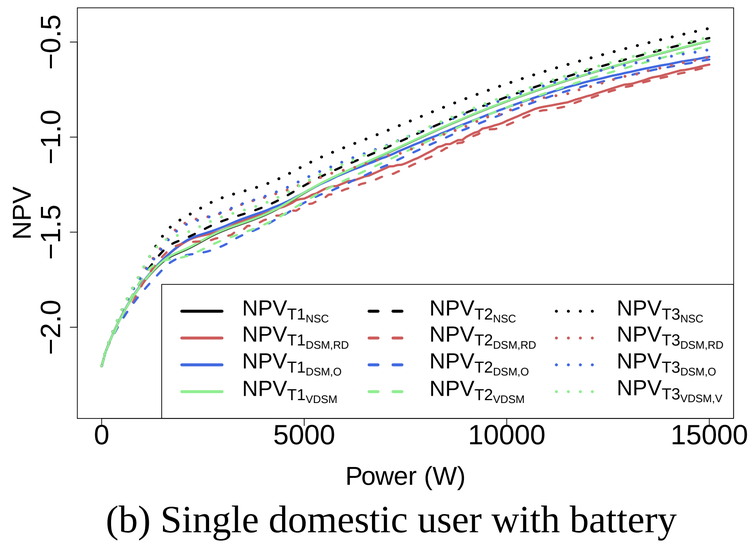


(d) Single domestic user with battery

Economic results



(a) Single domestic user without battery



(b) Single domestic user with battery

Conclusions

The self-consumption factors are not directly proportional to the size of the PV generator and it is an important design criterion for an energy system. The DSM techniques improve the rate of the self-consumed electricity and together with a storage system it reduces drastically the electricity consumed from the gird. In addition, with DSM and/or storage systems, not too large sizes of PV generators are necessary.

There is profitable size of PV systems when there is no battery. However, there is no profitability when the electrical system has a battery. This highlights the need to reduce system costs and the need to encourage economically self-consumption.