FLEXIBLE AND INTEGRATED
Photovoltaic Investment evaluation in a Smart Grid environment

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Overview

In Italy – and in the countries working for GHG emissions reduction - the last decade was characterized by a large development of distributed generation power plant. Private investment in the sector have been heavily boosted with monetary incentives, like guaranteed feed-in tariffs, especially for the photovoltaic sector. These incentives, on one hand, allowed for developing photovoltaic technology faster, guaranteeing payoffs for huge initial investments, but on the other hand they cause an increase in public costs, regarding both monetary disbursement to pay incentives and system costs connected to the management of a number of energy sources not efficiently integrated. To allow the development of photovoltaic energy production in a sustainable way, it's necessary to find how to design economic payoff for private investors and to ask them to collaborate for system balancing and management: this objective shall be reached implementing a Smart Grid.

Methods

In our work, we consider a private energy consumer that have the possibility to invest in a photovoltaic power plant, from which it's possible to directly consume electricity for private use, or to sell it to the market: in this way, the consumer becomes a potential *prosumer*, whose plant dimension (power) will be a result of the investment evaluation. To evaluate the investment decision, the consumer shall compare if the new condition allows for savings on energy expenditure: in order to do this, we perform a real option analysis of the private cost function, considering as possibilities for the *prosumer* 1) buy all the energy from the main grid and sell energy privately produced outside; 2) consume all the energy produced with the photovoltaic plant and buy outside only what exceeds the private production; 3) a mix of the two. Decision depends on prices: external energy price is fixed with a contract; selling price to the grid is uncertain and it depends on instantaneous technical grid necessities – Smart Grid tools allow for instantaneous information exchange on grid status and immediate agent reaction to the signals.

Results

The analysis shows that external energy price (national grid price) is not affecting decisions on plant dimension, but is relevant while deciding when to invest. Selling price, indeed, influences investment decisions on plant size: if the investor is given the possibility to sell energy to the grid, it could be convenient to choose a higher level of plant power. Since the selling price is the expression of grid technical needs (such as balancing), we can deduce that investments will take place preferably where 1) the possibility for the *prosumer* to participate to grid management through decisions on production and consumption is present – with Smart Grid tools and 2) where technical characteristics of the grid ask for more support from the local agents (higher energy selling prices).

Conclusions

The development of distributed power plant, in the future, shall be managed through a system that allow for a better integration of renewable energy plants, calling for private actions helping grid management.
The Smart Grid environment allows for an instantaneous interaction between the agent and the grid: depending on its needs, the grid can send signals (through prices) to the agents, and the agents have the possibility to respond to the signals having a monetary gain. In this way, the system can allow for better integration of the renewable – that collaborate in keeping the grid stable – and for a photovoltaic development without costly monetary incentives. What is relevant, indeed, is that this value is created by a Smart Grid, on which we shall invest.

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