Regulatory Framework Design and Market Response Interactions under Growing Solar and Wind Generation Deployment in the Portuguese Electrical Energy System

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Abstract

This dissertation investigates the Portuguese regulatory framework, and the response of energy markets under growing wind and solar generation. The developed models simulate:

- The impact of variations in wind energy production in the Iberian electricity market price, and also on network access tariff variations, for different ratepayer categories. The results obtained allow to evaluate energy policy decisions fostering renewable energy on energy markets, and as perceived by different ratepayer categories.
- The impact of substantial changes in energy production driven by PV self-supply, for three different regulatory design options, (**a**) the actual Portuguese tariff structure and parameters, (**b**) introducing a network usage charge when energy is supplied to the grid, and (**c**) evolution of the Portuguese tariff structure towards an higher proportion of revenues recovered through fixed tariff components. This last option does not dissuade PV deployment.

Methodology

Two models were built to:

1. Evaluate the impact of renewable generation on the Iberian market and on the electrical energy prices payed by Portuguese ratepayers
2. Evaluate the impact of PV self-consumption on the revenues associated with Network Access tariffs, for different regulatory decisions – including possible cross-subsidization between different ratepayer categories. This model internalizes expected PV module price reduction over time (Fig.1).

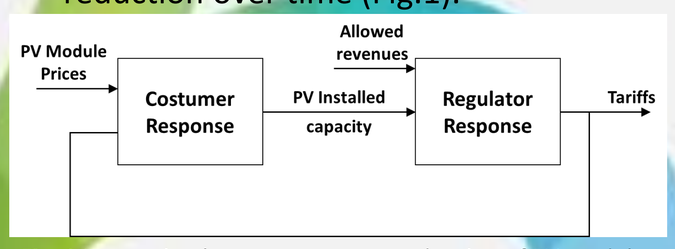

Fig. 1 Interaction between customer adoption of PV modules for self-supply and regulatory adjustment of network access charges.

Both models were based on the 2015-2017 Portuguese regulatory framework, with 2014 and 2015 data, with hourly resolution (market prices) and 15 min. resolution (consumption data).

Results

Wind energy production influences the electrical energy market prices, particularly in dry years (2015) (Fig.2).

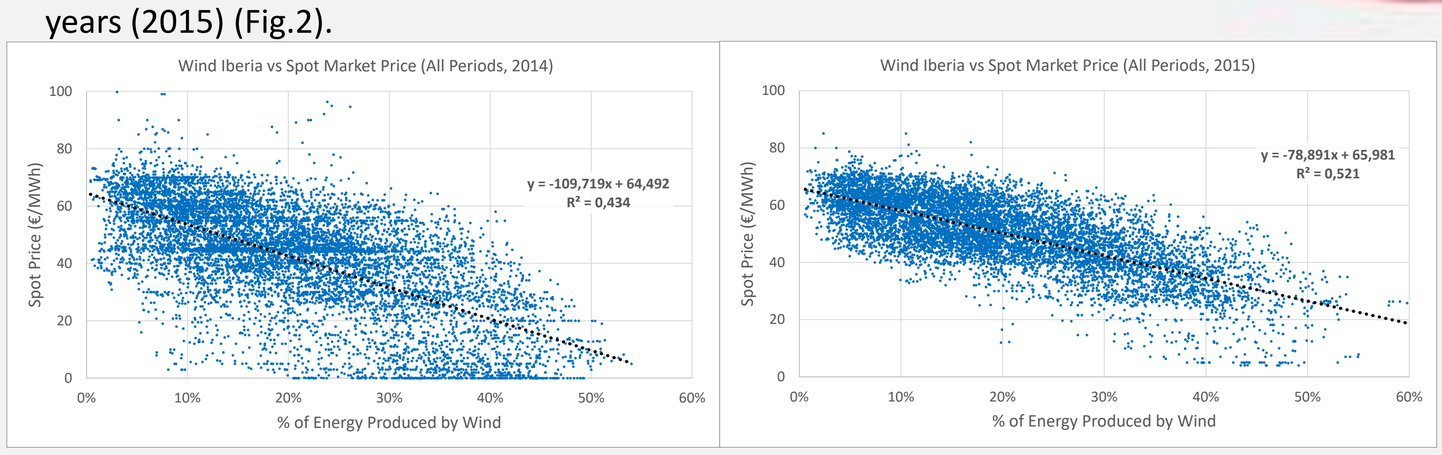

Fig. 2 Iberian wind energy production (as a percentage of total electrical energy production) compared with Iberian electrical energy spot prices

In Portugal, wind energy production has a FiT mechanisms, transferring most of the associated overcost to LV ratepayers. Therefore, the impact of wind energy production variations effects are different for different ratepayer categories (Fig.3).

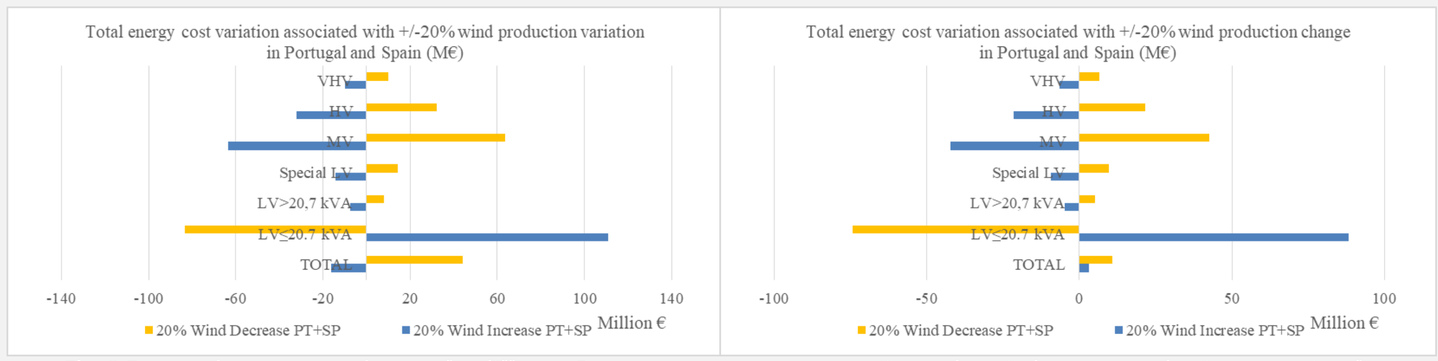

Fig. 3 Expected energy cost changes for different Portuguese ratepayer categories under wind energy production scenarios, for 2014 (left) and 2015 (right), considering ± 20 % wind production variations in Portugal (PT) and Spain (SP).

Self-consumption associated with LV ratepayers is expected to increase. The regulatory framework influences the rate of adoption of PV.

Total energy production for considered strategies are presented in Fig.4. Total annual costs payed by selected NV non-adopters is presented in Fig.5.

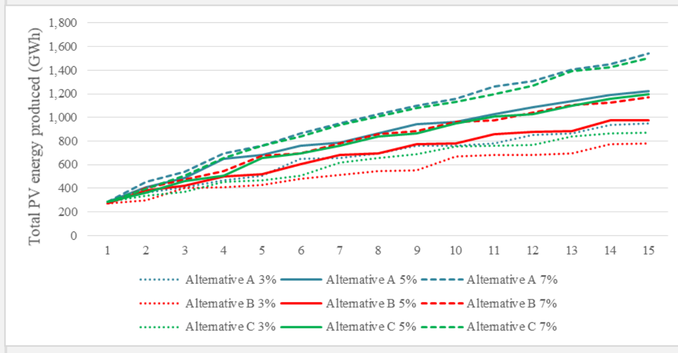

Fig. 4 Estimation of total energy produced by PV modules associated with NLV ratepayers

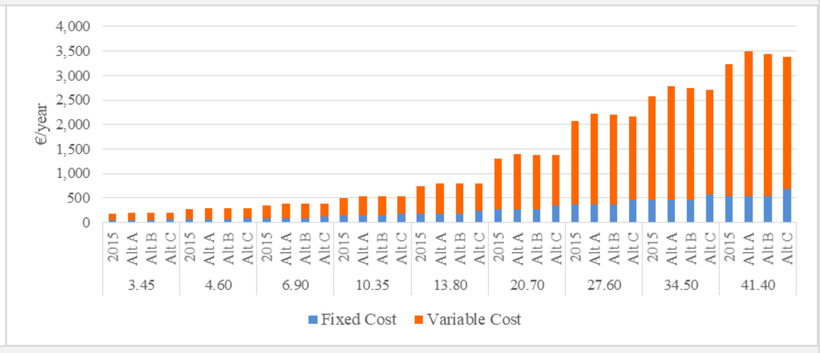

Fig. 5 Annual cost estimation of Network Access charges for selected NVL non-adopter ratepayer categories, after 15 years, considering a 5% annual reduction of PV module prices.

Conclusions and Policy Recommendations

- The electrical energy system plays a key role in the implementation of policy decisions responding to climate change. **Part of an electrical system is operated by regulated firms. The regulatory framework must be coherent with energy policy decisions**.
- Cross-border trading promoted by the Iberian Electricity Market results in spill-over effects, influencing electrical energy system costs in both countries. Therefore, **energy policy decisions should be harmonized across countries**.
- **The disaggregation of system costs** through different ratepayer's categories **is determined through national policy decisions**. Within the current framework, **a 20% increase in wind energy production in Iberia does not translate into increase costs for the Portuguese system,** even if in Portugal the effects of that growth are passed differently for the several ratepayer categories.
- **The transition to a regulatory framework with a higher preponderance of fixed charges (i) is not expected to discourage PV module installation growth, and (ii) leads to an increase in the regulated costs of ratepayers without PV that is expected to be smaller** than the one that would be associated under the current tariff framework.
- **The electrical energy system can accommodate a large growth of PV self-consumption production associated with LV**; no "death-spiral" effect was found by the model.

EDP Produção

edp renováveis

APREN ENERGIA PARA RENOVAR O FUTURO