

The Impact of Regulation on a Firm's Incentives to Invest in Emergent Smart Grid Technologies

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Executive Summary

What are the incentives of electrical network operators to invest in Smart Grids (SG)? What are the implications of regulation and uncertainties for the investment in these emergent innovations? SG can take a significant role in the needed modernization of electricity grids to overcome a number of challenges, such as the absorption of increasing quantities of intermittent local energy resources and the management of new electricity demands (e.g. electric vehicles). The new "smart" technologies may save operating costs and reduce the need for further conventional investments in the grid. However, the adoption of these technologies by network operators might be hampered by the uncertainties surrounding their actual performances, as well as by the regulation in place. Therefore, it is important to investigate suitable regulatory frameworks in order to encourage regulated firms to undertake these investments in the infrastructure.

This study assesses the effect of different regulatory designs in the investment in new technologies with a decision model. The model explicitly treats the uncertainty on the expected performances of immature technologies. The analysis looks particularly at the uncertainties surrounding the performances of SG in terms of avoided operating and (conventional) capital costs. It uses a foreseen discounted cash flow model to estimate the impact of regulation in the adoption of projects with different profiles of costs and revenues.

A number of simulations with the model reveals results consistent with the literature in terms of the expected effects in response to changes into the main regulatory parameters. The investment in "smart" technologies becomes more attractive with increases in the rate premium granted to the technology, as well as in the part of the expenditures that accrues to the regulatory asset base (RAB). Conversely, it becomes less attractive with increments in the share of cost savings that must pass to consumers.

The analysis further reveals a number of trade-offs and complementarities between regulatory instruments. For example, an increase in the premium rates reduces the exigencies of the firm in terms of the expenditure that must accrue to the RAB and/or its proportion in the operational gains. Likewise, the acceptance of a larger part of the investment expenditure in the RAB together with a higher proportion of cost savings for the firm, *ceteris paribus*, reduces

the need to increase the remuneration rates. These examples illustrate the flexibility of the regulatory process, which stems from the possibility of intervening in multiple parameters to align the regulation with the needs of the technology.

The study also examines the effect of different levels of uncertainty over technological parameters. Unsurprisingly, the analysis shows that higher levels of uncertainty prevent the implementation of SG. However, the effect of uncertainty can be amplified with technological complexity. A profitable project may not be undertaken if it requires the deployment of another innovation which falls outside the profitable region due to the uncertainties surrounding its implementation.

Based on these results, it is possible to conclude that technological risks might be hampering the implementation of SG technologies by contributing to reduce investment opportunities. Technological uncertainties can however be mitigated with experience and learning gained from deployment. Thus, public support may be needed for certain activities (e.g. R&D, pilot projects) that can reduce technical uncertainties and accelerate the commercialization of less mature concepts. Positive experiences from Italy and the United Kingdom have been reported that spurred investments in SG in the infrastructures.

In order to preserve a fair risk-allocation to customers, the regulator should balance the incentives against the externalities of the innovations for the system and the level of uncertainty blocking their implementation. For instance, full commitment accepting all the expenses and costs of a new investment will constraint regulatory reviews in the future and pass all the risks of a costly project to customers. This may be unacceptable for the regulators, since SG investments are not an end by themselves. Thus, a compromise must be found between credibility to investors and fairness to customers.

A new tool is, therefore, proposed that can be used by both regulators and firms to analyze how different regulatory schemes affect the attractiveness of the investment in emergent “smart” technologies.