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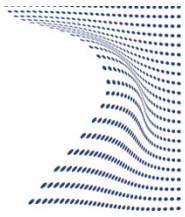

Abstract of Doctoral Dissertation
Doctoral Program in Management, Production and Design (31st Cycle)

Three Essays in Energy Economics: Regulatory Aspects, Institutions and Innovation

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Abstract

Energy economics can be defined as an interdisciplinary field of science which aims to identify and analyse different economic aspects of the energy sector. As the energy sector itself can be divided into several fields depending on the energy source, production technology, etc. its corresponding economic aspects can also take several shapes. In recent years due to the increasing concerns regarding climate change the main discussion among policy makers has focused on the shift from consumption of fossil fuels towards further exploitation of renewable energy resources. However, while this shift is inevitably creating new technical and economic challenges, former issues such as efficiency and quality of the energy networks remain as challenging as before. This thesis consists of three essays that focus on some of the existing and emerging economic challenges of the energy industry, especially that of the power sector. In particular, emerging regulatory issues due to an increasing exploitation of renewable resources, impact of local institutions on performance of utilities and adoption of innovative solutions to integrate energy systems are analysed and discussed.

In addition to the firm-level structural, environmental, and managerial differences, institutions impact quality of the business environment and ultimately how firms use their resources. However, whether the performance of regulated network utilities in a country is affected by the quality of regional institutions is yet to be investigated thoroughly. The first essay examines the impact of quality of local institutions, as efficiency determinants, on the performance of electricity distribution utilities in Italy. To this end, a stochastic frontier analysis approach was used to estimate cost functions and to examine the performance of 108 Italian electricity distribution utilities from 2011 to 2015. The dataset is constructed with the help of the Italian regulatory authority for energy and networks and includes

novel and unique regulatory accounting data. Our estimates indicate that utilities in regions with better institutions tend to be more efficient. Of the four governance indicators that we considered as institutional quality measures, control of corruption shows the highest impact on utilities' performance. The results can be of interest to the national regulators when they apply incentive regulation and efficiency benchmarking. They suggest that to improve the efficiency of the utilities, in addition to firm-level characteristics and activities, also institutional measures should be considered when designing incentive mechanisms.

In the second essay, impact of integrating an increasing number of distributed generation and prosumers in the electricity distribution network is analysed. The high penetration of dispersed generation calls for a regulatory revision on compensation systems and tariff structures. The aim of this essay is to design and to introduce a cost reflective tariff structure that would take into account the extra costs that are imposed on distribution operators by decentralized generation. A novel, multi-part tariff structure is introduced and examined under the net metering scheme. Four scenarios are designed which reflect shallow and deep connection cost charging policies. The results suggest that a multi-part tariff can alleviate the drawback of the net metering mechanism of creating too many prosumers and therefore is highly recommended when charging prosumers.

The third essay is focused on energy systems integration (ESI) as an emerging paradigm to maximize integration of renewable resources in a cost-efficient and sustainable manner. ESI provides a context through which energy networks, including electricity, gas and heat networks, can be seen with a holistic view and the existing synergies among these networks can be used to decrease the overall cost of the energy system and to increase flexibility and reliability of the energy networks. While technical aspects of ESI have been majorly investigated in the literature, yet its policy and economic aspects need to be discussed thoroughly. This essay provides an economic overview of innovative technologies which can be used for an efficient ESI and it discusses how different regulatory frameworks can stimulate adoption of these technologies. The main contribution of this essay is twofold. First, an evidence section is presented which provides an overview of innovative projects in the energy sector that are being promoted by national authorities around the European Union through various regulatory approaches. Second, policy and economic barriers to implement ESI are discussed and some policy recommendations to facilitate integration of energy systems are provided.