Security of Supply and Regulation of European Electricity Networks: Current Issues and Future Options

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(1) Overview

The liberalisation of the electricity sector has vividly exposed the vulnerability facing the European electricity networks. Most of the existing electricity networks in Europe are old and aged and in need of replacement and upgrade (European Commission, 2006). The transition towards a low-carbon economy also implies that the electricity networks need to undergo profound technical changes to accommodate the growing share of renewables and the on-going 'smart' technological innovations in delivering a secure (and reliable) supply of electricity. The advent of smart grids and mobile electricity consumers (electromobility) has signalled the demise of the long held assumption on the technological maturity of the electricity networks (Schiavo et al., 2011). The future networks need to move from a 'passive' to an 'active' operation and design with the opportunity for end-users to become the new actors of the market by actively responding to real-time price signals and no longer basing their consumption decisions in the realm of inelastic demand (Joskow, 2012).

However, under-investment in network infrastructures is just one of the many supply security challenges and risks faced by modern electricity networks. There exists several natural (such as natural calamities and severe weather conditions), accidental (such as explosions and nuclear accidents) and human conceived external threats and events (such as terrorist attacks, sabotage and vandalism and coordinated cyber-attacks) that can completely halt the functioning of the electricity systems (Hammond and Waldron, 2008). These natural, accidental and malicious threats can be termed as ‘high-impact, low-frequency’ (HILF) events (NERC, 2010). The HILF events are characterised as having low probability of occurrence but with the potential to cause significant and long-term catastrophic damage to the bulk power system and the economy of many countries. The risks from these exceptional events can transcend other types of supply (or reliability) risks facing the electric sector due their magnitude of impact (Jamasb and Nepal, 2012). The European electricity systems pose high risks of damage from HILF events due to the growing market integration and cross-border interconnectedness among member countries in the creation of a single electricity market. As such, the problems in one transmission node gets easily transmitted to other transmission nodes through the interconnector and thereby creating a 'ripple effect' of economic, social and environmental damages post-events (Douglas, 2005).

It is, therefore, necessary to assess the current issues and future options concerning the regulation of security of supply in the technologically evolving European electricity systems considering the risks facing the electricity networks from under-investment and HILF events. This paper essentially contributes to the discussions on the changing nature of network regulation from an input-based approach to a more output-based incentive regulation approach with regards to the security of supply risks and challenges facing the European electricity systems and the networks.

2) Methods

The paper is based on a qualitative analysis while the general approach of the paper is underscored from its structure. The conceptual aspects of security of supply from a European regulatory perspective are discussed along with the different network regulatory regimes for quality of supply and their subsequent effects on investment and innovation. Section five presents the output-based incentive regulation that is being implemented in regulating the electricity distribution companies from 2015 in the UK; one of the pioneers of modern day liberal electricity reforms. We

also discuss and attempt to accommodate the existing output-based incentive regulation approach as discussed in Italy and the UK to regulate the quality of supply in the European network companies with regards to the security of supply risks from exceptional events. Hence, the paper uses a cross-country case studies approach and compares the exisitng and evolving regulatory practice towards security of supply accounting for the threst from exceptional events in the European context.

(3) Results

The modern applications of incentive regulation concepts towards service quality is heading towards the application of elements of tradition cost-based regulation, yard stick regulation and high-powered price-based regulation together with a defined set of outputs. Incentive-based quality regulation in practice is clearly an evolutionary process as one set of mechanisms is tried, their performance assessed, additional data and reporting needs identified and refined mechanisms developed and applied (Joskow, 2011). However, the response of the liberalised and regulated EU electricity markets to security of supply considerations is a clear matter of preoccupation (Arriaga, 2007). The large-scale blackouts that occurred in the EU (most notably in Italy and Scandinavia) in 2003 and the large disturbance that spread over most of Europe on November 4, 2006 coupled with the under-investment in the networks have questioned the ability of the liberalised EU market and the regulatory mechanisms in place to deliver an acceptable level of security of supply. This is especially the case when considering the risks from the on-going technological transitions and exceptional events. Therefore, it is debatable if incentive regulation can actually deliver the required level of supply security considering the several accidental and malicious threats facing the electricity networks.

4) Conclusions

Our analysis suggest that the changing nature of network regulation from an input-oriented approach to an output-based incentive regulation can be theoretically suitable to address the security of supply risks arising under network under investments coupled with the risks from accidental and malicious threats. Moreover, the regulation of security of supply should be understood in its wider economic regulation and national policy context considering the investment and innovation challenges combined with the need to protect the network from accidental and malicious threats.

Some References

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