

INNOVATION INCENTIVES FOR ELECTRICITY NETWORKS TO ENABLE GRID EDGE TRANSFORMATION

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Overview

The electricity industry is amidst of transformation and this is reflected in rapid electrification of economy, decentralisation and digitalisation. There is ensuing need for more agility, control, automation, new regulatory models and innovative business models specifically at distribution network level where most of disruptive technologies are located. Up until now the efforts at low voltage grid level were largely focused on dealing with issues such as renewable intermittency, congestions, load shifting and bidirectional flow. In future, technological innovation at grid edge facilitates development of markets for distributed resources, service oriented business models and end-to-end integrated grid management. The role of the grid is evolving beyond just supplying electricity to consumer and becoming a platform that also maximizes the value of grid edge technologies such as distributed generation, storage, energy efficiency, demand response and electric vehicles.

A great deal of innovation (including technical, regulatory and business model) is required at grid level to integrate disruptive technologies, find new ways of operating to meet the customers' expectations and facilitate grid edge transformation. However, the grid utility is a natural monopoly while innovation activities are costly and risky undertakings. Therefore, a relevant query is how to incentivise innovation through economic regulation. Specifically, in this paper, we try to understand (i) how innovation costs need to be treated in the business plan of network companies (i.e., same as other regulated costs or differently?) (ii) how the risk of innovation activities need to be shared between firms and their customers and (iii) how effective are competitive innovation funds in rewarding the innovation projects with highest potential value?

Methods

The models adopted in this paper to investigate aforementioned questions are inspired by similar problems in different contexts that have been investigated in the literature of contract theory and game theory. We model two different cases: the case where a company is regulated through individual incentive contracts and the case of competitive scheme. In the individual incentive contract regulator incentivises regulated network utilities to undertake risky and costly innovation activities in return for a payoff. We distinguish between the normal efforts of the firm to gain costs efficiency and those activities that aim at creating value through innovation. The model investigates the implications of method of cost treatment on the choice of firm between static cost efficiency and innovation, given the presence of moral hazard, risk sharing and heterogeneity in the risk attitude of the firms. The competitive scheme is modelled as a rent seeking contest game in which companies compete for innovation funds by submitting proposal to the regulator.

Results

As innovation is riskier compared with business as usual activities of the firm, when innovation costs are subject to the same regulatory restrictions as other expenses, the attention of the firm will be diverted from innovation to conventional cost efficiency gain. Moreover, since regulator cannot observe the effort of firm but only performance which is a noisy function of effort, and given the risk attitude of regulated firms, the optimal model of innovation incentive requires the firm to bear some degree of risk for its activities. Competitive innovation schemes, however, can potentially lead to optimal effort among the competing firms, however, the risk attitude of firm plays a pivotal role as it directly impacts the winning probability of contestants.

Conclusions

Treating innovation costs like other costs in the business plan of grid company will come at cost of reduced innovation activities. There is a need for specific innovation incentives that take into account the risk profile of the undertakings. In order to incentivise the firm to exert the optimal effort, the compensation need to be linked (partially) to the performance of the firm because providing full insurance to the firm for its innovation costs destroy the incentive of firm (there is a fundamental trade-off between incentive and insurance). Finally, competitive schemes to allocate innovation funds are more likely to be effective when firms are not very heterogeneous in their degree of risk aversion.