

Research Networks in Electricity Markets: Analyzing the Role of Municipal Utilities

Malcolm Yadack, University of Hohenheim, (+49)711/459-24480, malcolm.yadack@uni-hohenheim.de
Markus Graebig, Technical University of Berlin, (+49)303/14-28163, markus.graebig@tu-berlin.de
Kristina Fährlich, University of Hohenheim, (+49)711/459-24480, kristina.faechnrich@uni-hohenheim.de
Andreas Pyka, University of Hohenheim, (+49)711/459-24480, a.pyka@uni-hohenheim.de

Overview

The electricity sector is experiencing a period of change. Worldwide, countries are implementing plans and policies for reducing emissions and dependence on fossil fuels. One result of this has been the renewed interest for renewable energy systems that has emerged in scientific work. Although this in itself has certainly further spurred technological innovation in recent decades, academic interest has not been confined to the engineering and physical science fields. The social, business, and broader economic aspects of implementing such ambitious plans have also gained significant attention in the literature. Prominent examples of the importance of the social side of energy transitions are the difficulty in creating social acceptance for large scale infrastructure projects (such as the high-voltage North-South corridor in Germany) or the “not in my backyard” (NMBY) phenomenon by which households often express support for country-wide renewable energy systems construction, but opposition to local infrastructure projects (e.g., Schubert et al., 2013). One prominent, related aspect of social considerations for energy transitions is the diversity of actors and interest groups involved in investment. This heterogeneity is especially prominent in the energy market where electricity utilities can vary in size from the largest of multi-national, publicly traded corporations to the tiniest local cooperatives. The roles played by these varied actors as investors have recently been the focus of interesting studies (eg, Bergek et al., 2013; trend:research, 2011), revealing a surprising importance of both smaller firms and heterogeneity in general. Firms’ potential for and contributions to innovation, however, are still only rudimentarily understood. We address this gap in the literature by studying the participation of electricity market actors in subsidized research and development projects. We identify actors in the electricity market by referring to official registries of retailers, network operators and power plant owners and apply our analysis to a federal database of governmentally funded R&D projects in Germany. We analyze not only the subsidies received, but also the network topology of the cooperating firms and institutions, revealing that major shifts are not only occurring in the activities and importance of the various considered subpopulations in terms of investment, but that the subpopulations’ positions and influence in the overall research network are heterogeneous and significantly related to factors such as municipal shareholder influence and firm size. Our objective is also to contribute to understanding the influences of an innovation network’s heuristic characteristics (e.g., dominance of one type of company) on network structure (e.g., density, connectedness, etc.). In doing so we refer to importance of network centrality to innovation and knowledge diffusion (Bell, 2005; Rowley, Behrens, & Krackhardt, 2000) and highlight thereby important trends in subsidized R&D, giving an indication of which firms are driving innovation and/or are increasing in relevance for research-based innovation in the sector as a whole.

Methods

This study contributes to the understanding of the roles played by the heterogeneous actors in electricity markets by studying in detail their participation in subsidized research projects. Firms belonging to the electricity sector are identified by utilizing official registries of registered electricity retailers, network operators and power plant owners, taking as an empirical example the case of the German electricity market and the data of the Federal Network Agency. Matching the firms identified as belonging to the electricity sector with those contained in a federal database of subsidized research projects for the period 1968-2013, we obtain fine-grained data on research activities carried out by firms in the electricity market. One strength of our method lies in the differentiation between actors carrying out defined market roles in the sector – specifically: retail, distribution, transmission and generation. We report time series for research grants awarded to each subgroup and the respective percentage of funds awarded to each population over the 45 year period considered. The sector’s performance in R&D projects and the relative performance of the various market roles are contrasted, allowing for classification of periods of influence of the respective subpopulations.

In a second stage, we focus on cooperative research projects only, taking a look at the structure of the network of connections made by electricity sector firms cooperating with each other and their partner non-electricity sector firms and institutions. Using the periods of influence identified in the previous step, we expose and elaborate on the

development of the network over time. Referring to the importance of network centrality to innovation and knowledge diffusion, we then report on centrality and other network statistics for the various groups.

Results

We find an emerging importance of smaller and municipal actors and a decreased influence of large incumbents in obtaining research funding and participating in research projects. The four largest electricity companies in Germany obtained 80% of all sectoral research grants in 1982 but only 28% by the end of 2013. Municipal utility companies increased their share from 0% in 1972, to 10% in 1982, to 25% in 2013, almost equaling the share held by the “big 4” companies by the end of the observation period. Power plant owners were historically very influential in obtaining research grants, having received 80% of all funds consistently from 1988 to 2002 but their share has since decreased by more than 30%. The fall in power plant owners’ share has been offset by the recent entry of retailers, distribution network operators and transmission network operators who in total increased their share of grants in the sector by 14% since 2004. In analyzing membership in a major trade organization (VKU), we also show that the organization is struggling to retain its influence as a participant in subsidized research, its members’ combined share having fallen from 100% of the sector’s funds in the 1970’s to 30% in 2013.

The structure of the network of firms is also observed to have undergone significant structural changes over time – relying on techniques of network analysis, we consider these changes and their dependence on the attributes of the firms involved in research, including municipal ownership share and number of employees, and find that non-municipal actors have joined in research more readily than companies under municipal influence, but that municipals have become unexpectedly central to the research network as a whole over the past decade.

Conclusions

We find that the influence held by firms in the electricity sector in applying for and participating in federally subsidized research projects has undergone large changes over the past 45 years – larger than can be accounted for by the R&D spending policy of the government alone. In particular, municipally owned utility companies have established a central role in the research network. Also the new influence gained by retailers and distribution firms could indicate a movement towards business models emphasizing prosumers and the inclusion of households in smart grid oriented solutions for the energy transition in Germany.

The trade organization’s loss in influence is an interesting result and indicates that the traditional formal networks in the industry may be becoming less influential to innovation in general, though this requires further investigation. We are currently in the process of verifying these results by carrying out a meta-analysis of news reports on innovative projects in the energy sector in Germany with colleagues at the Technical University of Berlin.

References

- Bell, G. G. (2005). Clusters, Networks, and Firm Innovativeness. *Strategic Management Journal*, 26(3), 287–295. doi:10.1002/smj.448
- Bergek, A., Mignon, I., & Sundberg, G. (2013). Who invests in renewable electricity production? Empirical evidence and suggestions for further research. *Energy Policy*, 56, 568–581. doi:10.1016/j.enpol.2013.01.038
- Rowley, T., Behrens, D., & Krackhardt, D. (2000). Redundant Governance Structures: An Analysis of Structural and Relational Embeddedness in the Steel and Semiconductor Industries. *Strategic Management Journal*, 21, 369–386.
- Schubert, D. K. J., Meyer, T., Selasinsky, A. Von, Schmidt, A., Thuß, S., & Erdmann, N. (2013). *Der Stromausfall in München - Einfluss auf Zahlungsbereitschaften für Versorgungssicherheit und auf die Akzeptanz Erneuerbarer Energien*. Retrieved from <http://nbn-resolving.de/urn:nbn:de:bsz:14-qucosa-117777>
- trend:research. (2011). *Marktakteure Erneuerbare-Energien-Anlagen In der Stromerzeugung*.