ENERGY NETWORK REGULATION WITH EMERGING COMPETITION FROM HYDROGEN GRIDS

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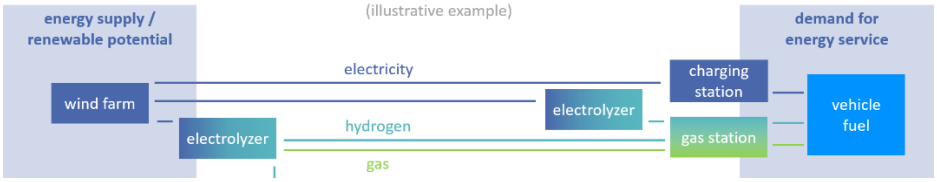
Overview

Technological innovation and ongoing decarbonization are introducing new energy conversion technologies into energy systems. Decentralization furthermore enables new supply paths. These new and alternative conversion options and supply paths foster substitutability between energy sectors and thus potentially raise competition between different network infrastructures. The demand for vehicle fuel for example can be supplied in a net-zero future by at least two alternative energy carriers: hydrogen and electricity. For hydrogen, the alternatives further include electrolysis either at the electricity source or at the hydrogen sink, i.e. near the wind farm or near the gas station. All supply paths originate in a renewable energy source such as a wind farm but require different transport and conversion infrastructure.



Thus the different energy networks can increasingly be considered as substitutes and some kind of competition might evolve.[1] In theory, competition between network infrastructures carries on during an initial phase and results in a dominant 'winning' standard in equlibrium (e.g. Cabral 2000, Economides 2008). The resulting dominant network depends only partially on service resp. product properties and largely also on strategy and system dynamics. In the case of regulated monopolies, it additionally depends on regulation. Consequently, network competition likely affects the requirement for and the optimal design of regulation regarding any remaining monopoly.

While the circumstances of competition are only just evolving among energy networks, along with technological progress and decarbonization effort, other network industries exhibit similar features. In fact, regulation in transportation and telecommunication has already adapted to some degree of competition within the network.

Methods

The paper applies literature on intermodal competition in transportation and on regulatory reform in telecommunication to energy networks with conversion technologies and alternative supply paths. It assesses the transferability of conclusions and lessons learned from these sectors to the future regulation in integrated energy systems.

In particular, it looks at competition among networks with different cost functions and varying substitutability levels and competitiveness, as discussed for example by Braeutigam (1979) and Einhorn (1987) for transportation. It further draws from the insights on the benefits from symmetrical regulation of a monopolistic bottleneck in telecommunication networks with different potential for entry deterrence (e.g. Schankermann 1996 and Knieps 1997).

Results

Critical factors for the analysis and for the transferability of conclusions are the level of substitutability and hence competition between the infrastructure as well as incumbents' options for entry deterrence.

[1] It seems important to stress, that this competition is only ever limited to certain parts of the market, as hydrogen is not expected to replace other energy sectors entirely. Also, while in some parts of the energy system, hydrogen and electricity compete for the same demand, they are complementary in other respects. Thus, this analysis only represents a starting point and covers a delimited part of the challenge, with a wide scope of further exploration.

Substitutability is already higher for some aspects of supply than for others, but will also likely evolve over time. For example substitutability between electricity and hydrogen transmission is high, whith respect to locating a new electrolyser near a wind farm or close to demand respectively. Furthermore, substitutability between electricity and hydrogen regarding space heating will likely increase as hydrogen readiness of end consumers' appliances increases. Targeting only the remaining monopolistic part of the grid by regulation is costly and prone to error. Importantly, it may furthermore unlevel the playing field for the development of competition over time. Regarding this latter aspect, it is vital to consider incumbents' options for deterrence and regulatory options to address them which can be applied symmetrically.

Conclusions

Firstly, the paper contributes a theoretical analysis of competition between energy networks and regulation of partially competitive networks. Many of the relevant aspects have been discussed in literature for other network infrastructures, such as telecommunication and transportation. An application to energy networks is missing as substitutability is increasing only recently in this sector.

Thus the paper provides guidance for the regulation of and particularly asymmetrical support for new hydrogen infrastructure. The analysis is topical for example regarding the European hydrogen strategy but can also be transferred to other energy sectors such as district heating.

Similarly, to the case of hydrogen discussed in the paper, gas, electricity and heat networks are alternatives for the supply of space heating. Thus in principle, the analysis in the paper applies to other types of energy infrastructures as well.

References

Braeutigam, R.R. (1979). Optimal Pricing with Intermodal Competition. American Economic Review 69(1), 38-49.

Cabral, M.L.B. (2000). Introduction to industrial organization. MIT Press, Cambridge & London.

Einhorn, M.A. (1987) Optimality and Sustainability: Regulation and Intermodal Competition in Telecommunications. RAND Journal of Economics 18 (4), 550-8563.

Economides, N. (2008). Public Policy in Network Industries, Chapter 13 in Buccirossi, P. (Ed.). Handbook of Antitrust Economics, MIT Press.

Knieps, G. (1997) Phasing out Sector-Specific Regulation in Competitive Telecommunications. Kyklos 50 (3), 325–39.

Schankerman, M. (1996) Symmetric Regulation for Competitive Telecommunications. Information Economics and Policy 8 (1), 3–23.