The Electricity Journal 31 (2018) 18–25

Contents lists available at ScienceDirect

The Electricity Journal

journal homepage: www.elsevier.com/locate/tej

The future of the electric grid and its regulation: Some considerations

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ARTICLE INFO

Keywords:
Utility platform
Utility business model
Two-sided markets
Utility of the future
Incentive regulation
Grid modernization
Customized services

ABSTRACT

A review of the modern economics of platforms suggests that the traditional single-market economics may not apply to the industry going forward. The authors suggest a framework for conceptualizing the changes in the industry and urge regulatory reform, both in its framework—such as moving toward incentive- or outcome-based regulation—and in its application, most notably in pricing reforms and new rules for pricing future services.

1. Introduction

Grid modernization is no longer a novel concept. In jurisdictions around the U.S. and the world modern grid technologies that provide for a greater level of sensing and information flow as well as automation, resource management, and analytics hold the promise for ever better control and, in turn, efficiency of the electric grid (US DOE, 2017). Indeed, these technologies and applications seem to hold the potential for transformation of the energy delivery system into a services-centered platform that fits with the modern evolution of other industries such as retailing, telecommunications, lodging, livery vehicles, logistics, and many others. Some observers see this transformation as a step back to the beginning, in which the electric grid and its associated energy and capacity are only a means to the end of providing consumers with tools to solve their everyday problems (Pramaggiore and Jensen, 2017). Undeniably this is an attractive idea that should be given serious weight in the coming transformation.

Yet technological transformation alone is only part, and perhaps the easiest part, of the total transformation of the grid. The economics, including the governance structures of providers and the degree of competition, must be understood and will play its role. Moreover, the regulatory construct and polices will also play a dominant role, at least in the short to intermediate term. Future regulation, perhaps more importantly its limitations, has the potential for delaying the transformation. As we have learned from other regulated industries that underwent massive technological change that fundamentally altered the business model, created new and innovative services that consumers highly valued, and led to increased choice and competition—such as telecommunications—regulation and changes in regulation do not and usually cannot keep pace with these myriad changes; they tend to lag. Nevertheless, regulators should critically assess the current regulations within the uncertain evolving business environment and attempt to adapt regulations as much as possible to and to minimize the lag. The evolving electricity business will require massive amounts of investment in physical assets, hardware, software, support systems, etc., and the regulatory regime will play a fundamental role in some key considerations such as: which entities make that investment, the timing of such investments, treatment of economic surpluses generated, and ensuring that competition is fair and fair treatment of utility customers. The goal is not outright deregulation of the traditional electricity utility distribution industry, as for the foreseeable future we do not see this as option; rather, the goal is to ensure that regulation is strong yet flexible to provide that all market participants (including the electricity utility) have the proper incentives to fully meet customers' evolving electricity needs and at the same time provide the same historic role of properly regulating the natural monopoly elements of the network.

In this paper, we review the economics of platforms and its implications for business model design and then provide some considerations on the business model based on possible futures for the electric grid as well as the alternative *regulatory platform* that needs to develop side by side to ensure that the business model reaches its full potential. The approach is to look forward and work backward, not in an all-too-foolish attempt at prediction, but rather more as a set of considerations for design of both the commercial and regulatory

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https://doi.org/10.1016/j.tej.2018.02.001

structures for the future.

2. The economics of platforms

The concept of the utility platform has gained significant and widespread attention in the utility trade press and is in its initial phase of implementation in a few states such as New York and California. The concept is nowhere defined and is evolving based on each jurisdiction's and utility's characteristics, history, policy goals and regulatory mechanisms. To gain insights into how the platform concept will emerge in the electricity sector, we discuss some basic concepts surrounding the economics of platforms.

Understanding the implications of platforms begins with an understanding of the platform as that term is used in this paper. The platform as an economic concept has less to do with physical infrastructure and more to do with the facilitation of exchange —an example is virtual net metering, which provides consumers who own rooftop solar PV and who generate excess energy to provide a credit to other consumers connected to the grid or the exchange among electricity customers who are interested in energy efficiency programs offered by the utility or third parties.

Platforms can be physical locations, virtual locations—such as a website—or some combination. A platform may exist on a digital network such as Amazon, the NASDAQ exchange or it may simply be a meeting place for buyers and sellers to congregate such as a shopping mall or the traditional town market. Whatever the characteristic of the platform, the role played by the platform is what economists call *intermediation*. Intermediation is effectively a facilitation of exchange or a matching function. This could be as simple as providing a location for buyers and sellers to meet or a more complicated organization utilizing complex pricing or the provision of supplementary services to help induce transactions to occur. Economists have used the term *two-sided market* to describe the market organization where the volume of transactions is influenced by the pricing structure.[1] For example, the traditional advertising-based media model is a form of two-sided market in which the buyer is induced to participate through a, likely, below-cost price. The model works because the seller is willing to pay an above-cost price for access to the platform with its access to buyers. The value to the participants is enhanced by the presence of other participants. Consumers of newspapers benefit from a more enhanced news organization as well as the information provided from more advertisements in the paper precisely because more consumers are buying the paper, thereby inducing more advertisers to advertise. Sellers benefit because their potential market increases with more consumers of the newspaper.

This is a distinct characteristic of a platform that can be called *network effects*.[2] The value of the platform increases with increased usage, providing a strong incentive for the platform provider to price in a manner than induces the largest number of transactions.[3] Moreover, network effects can also be two-sided (e.g., more customers drive the growth in suppliers and more sellers drive the growth in the number of buyers). Uber provides an obvious example of two-sided network effects: riders drive the growth of drivers and drivers drive the growth of riders.

There are several characteristics of the platform as an economic construct that are important. First, as noted above, the pricing structure of the platform matters.[4] A platform that treats all buyers and sellers the same is at a disadvantage since it is the *relative prices* paid by different users that determine the degree to which network effects can be harnessed and, in turn, the total surplus created by the platform. For example, charging the full cost of the videogame console to users lowers the quantity and reduces the benefits to the videogame developers. The console manufacturers are more likely to charge below-cost prices to the users and recover the profit margin from licensing fees paid by developers. Second, the users of the platform cannot effectively create the economies themselves due to high coordination and other transaction costs.[5] This is a function of the degree to which the network effects cannot be replicated through private exchange. While one could stand along the street, flag down drivers and negotiate for transportation services, the transactions cost of doing so is prohibitive.[6] In effect, the positive externalities created by the network are not readily incorporated into the private (or individual) demand curves of the participants, causing an inefficient level of the activity. Third, a platform cannot effectively harness the economies if users can resell or arbitrage around the platform. If a platform can be arbitraged by non-platform transactions (side payments) or the platform itself could be resold, effectively arbitraging the platform, then the benefits will diminish. For example, if Uber were required by regulatory authorities to resell its coordination platform to competitors such as Lyft, then Uber would have little incentive to operate the platform. Competition comes in the form of platform-on-platform competition and not the underlying components of the platform.

When these factors are incorporated into the economic models the resulting complexity produces a wide range of results. Despite this, Evans et al. (2011, p. 11) discuss three apparently robust results, all of which do not coincide with the results from single-sided markets commonly taught in economics classes and which provide the foundation for most public utility pricing:

1. Pricing to optimize the surplus depends on elasticity of demand for both sides of the market, the extent of the network effects discussed above and how costs change when output changes. These dependencies are complex.
2. Optimal prices may be below marginal cost and could even be negative.
3. The price-cost relationship is far more complex than the traditional relationships that are well-known from models of Cournot or Bertrand competition.

3. Business models implications

Parker et al. (2016) describe a platform business as a complex set of relational interactions of participants creating value in a multilateral fashion in contrast to the linear value chain of the traditional design-build-sell business model that has dominated industrial societies from the start.[7] Platforms work because of networked interactions throughout the supply chain that allow for the evolution of supply and

[1] Early reflections on the two-sided market can be found in Rochet and Tirole (2003). The term *multi-sided platform* is in more common use today to reflect the fact that two sides of the market is but one configuration of these types of governance structures.

[2] We use the term *network effects* to reflect network externalities but also to capture the strong complementarity between products and services that is, in general, not internalized. This approach stands in contrast to markets with product externalities that are generally assumed to be internalized (e.g., the razor blades are purchased by the same consumer that buys the razor).

[3] The term *usage* should not be interpreted to mean only physical transactions on the network. Usage also refers to the *option* to use the network, often referred to as *access*. Consider the communications network. While consumers clearly benefit from making a phone call or sending an email, they also benefit from the *option* to use the network to call 911 even if the user never actually calls 911.

[4] This discussion is largely based on Evans et al. (2011, pp. Ch. 1).

[5] To the extent that information is the key driver of the network economies there is a public good aspect to the platform that cannot be effectively solved through private transactions.

[6] Transactions costs are economic costs not direct costs. For example, one cost of attempting to replicate Uber by flagging down cars is the negotiation and enforcement costs of the contract. While the direct cost (e.g., gas, maintenance, depreciation, etc.) of operating a non-taxi is likely much the same as operating a taxi, it is the transactions costs of replicating the taxi model that, until the advent of digital technology, information processing and its associated analytics, prevented Uber from entering the market.

[7] The metaphor of the *pipeline* is used to connote the traditional linear value creation model and *platform* used to describe a multi-sided system of value creation.