Steering through Seas of Multi-Variate Change

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Introduction

If customer needs and expectations for electric service are changing, in addition to technological innovation, this situation requires utilities, regulators, and market participants to adapt. In the case of utilities, they need to update their strategies and practices to ensure that they satisfy customer needs as well as their public service obligations, and their fiduciary responsibilities.

But this is easier said than done! There's not one change impacting utilities, but many changes interacting simultaneously. Granted these changes are occurring at different rates in different states throughout the country. But for utilities dealing with high rates of change (and there are many) the challenge is to understand the combined effect of factors that include climate change, evolving distributed energy technologies, evolving customer preferences and options, new requirements for grid design and operation, new financial models for customers and third-party suppliers; and of course, the evolving perspectives and priorities of policy makers. This is a daunting task, for which new frameworks are needed.

Business Ecosystems

One such framework is based on examining the business ecosystem of the electric industry. This is a conceptual multi-variate framework that the Pacific Energy Institute is developing. The electricity industry – and in fact any segment of the economy – readily lends itself to being viewed as an "ecosystem", as evidenced by many terms which are used to describe business (including legislative and regulatory) relationships. In addition to discussions of "competition", "adaptation", and "survival", we label the users of products and services as "consumers".

Of course, in biological ecosystems, species don't compete with one another to be "consumed", as sellers do for their products and services, but the fact that the most successful and enduring businesses are the ones that most effectively compete with rivals is strongly analogous to species competing to survive. Also, products "evolve", as do entire industries, and this evolution, as in nature, occurs as the result of the need to adapt to changing environmental circumstances and/or as the result of beneficial "mutations" or innovations which create new, potentially disruptive, advantages for members of the ecosystem. A vibrant market, just like a vibrant ecosystem, is continuously accommodating changes among its various participants, with some of these changes more disruptive than others. The accommodation occurs as the various participants either react to changes, adjust to them, or undergo fundamental changes of their own, through innovation.

Electric Ecosystem

The electric industry ecosystem considers four categories of actors in the electricity system, and four respective intensity scales for how each type of actor may interact with other actors. (Figure 1). Each actor can be the source of changes that temporarily disrupt the whole system, causing other actors to change in ways that ultimately restore equilibrium to the system. Equilibrium is defined as a period of time in which the ecosystem interaction dynamic is relatively stable, evolving incrementally. The electric industry ecosystem framework facilitates an understanding of the net effect of the changes impacting the various actors, and to respond effectively.

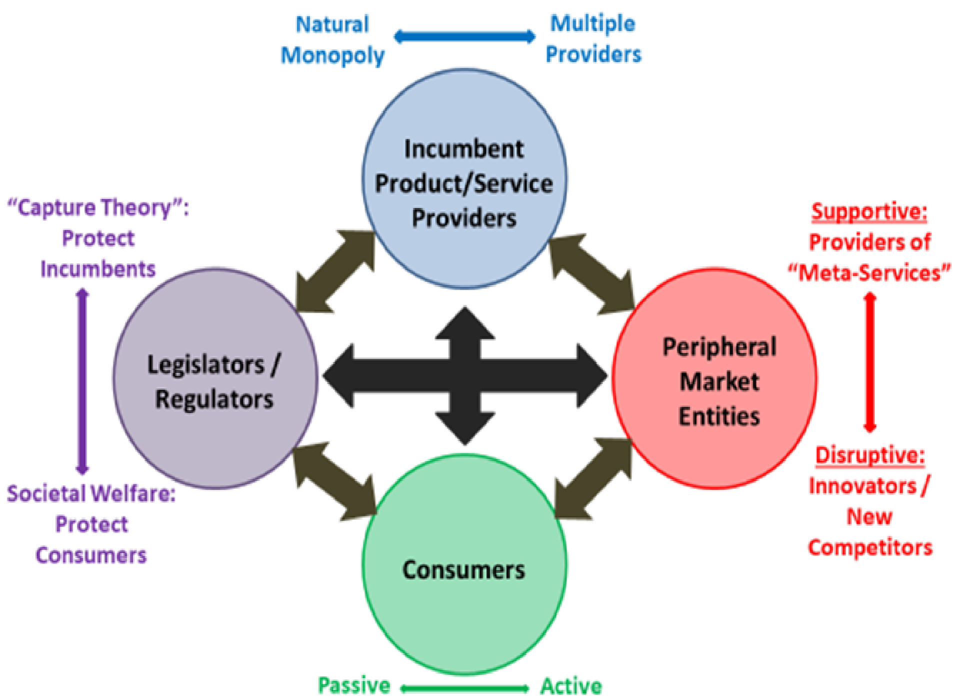

Figure 1: Electric Industry Ecosystem

Recognizing that every jurisdiction and/or service area is unique, the electricity ecosystem can be used to focus the changes impacting any given actor in that locale. In the examples below the arrow ("→ ") represents a direct action by external force or action by one actor impacting another actor:

- **Legislators/Regulators** → **Consumers**: Policy makers provide financial incentives to consumers (e.g., tax credits, net energy metering) to deploy distributed energy resources (DER).
- **Climate** → **Consumers**: Increasingly frequent and severe weather events cause consumers to seek increased reliability and resilience, which motivates them to

acquire DER; and in some cases, explore broader resiliency strategies such as microgrids.

- **Peripheral Market Entities → Consumers**: New market entrants develop and offer DER solutions to consumers. The cost of such solutions continues to drop, and providers make it easier for consumers with new financial models.
- **Consumers → Incumbent Product/Service Providers**: Customers deploy DER and become active participants in the market, procuring services at times; and at other times and locations, supplying services. These are the new "prosumers."
- **Consumers → Incumbent Product/Service Providers**: As consumers of all kinds (residential, business, community) deploy DER, they begin to use the grid in new ways; e.g.,
    - Prosumers – while still relying upon the electricity grid for partial or at least backup power supply, prosumers also use the grid to sell power and grid support services
    - Active Consumers – have sufficient flexibility – probably through ownership of some DER resources – to engage in price-responsive behavior
    - Traditional ("Passive") Consumers – use the grid for primary power supply, and don't want reliability or power quality to be adversely affected by other uses. Also, Traditional customers don't want cost to be shifted to them by other uses that do not benefit themselves.
- **Consumers → Incumbent Product/Service Providers**: To accommodate new uses, the incumbent utility modernizes the grid, providing new functionality and new services.

Analyzing such changes can lead, ultimately, to the identification of strategic trends/insights which are key to designing effective strategies for all actors.

As an example, the following are several cases in which a utility may need to consider responses to changes in the electric ecosystem.

Example 1

The growing demand for enhanced reliability and resilience is reflected in sales of backup generators, batteries, rooftop solar arrays, and initiatives by state policy makers to encourage the development of microgrids. A utility, for example, can respond in a couple of ways. It can facilitate an approach/methodology for quantifying resilience to support grid investments that is acceptable to regulators and stakeholders. This would allow the utility to increase the reliability and resilience of its delivery system through normal cost of service processes. A second potential way is to advocate for new regulatory policies and frameworks that allow the utility to offer premium reliability and resilience to customers who are willing to pay for it. The premium services route must address the use of infrastructure shared (and paid for) by customers who take standard service. Such customers need to be isolated from the incremental costs associated with premium services. The use of new grid capabilities (e.g., segmentation) can help separate the cost of standard service and one or more premium services.

Example 2

The rise of the prosumer offers new challenges for the utility (e.g., to shape their behaviors so they are socially efficient); but also, new opportunities (e.g., to sell profitable new custom services to such customers). A utility can engage customers with decision support tools that let customers evaluate the economics of DER retrofit options (efficiency, demand response, distributed generation) using the customers' metering and billing data. A utility also can provide on-bill financing for investments that make sense. To expand the range of new services the utility can offer, the utility can develop new business partners who have experience with new technologies (e.g., microgrids, district heating and cooling) which the utility may not have. Recognizing that prosumers are using the grid in new ways, the utility can develop new subscription rate options for different customer usages.

Table 1 below provides a summary illustration of the application of the ecosystem framework to assess changes underway and potential strategic responses for a utility.

Table 1: Application of Ecosystem Framework for Utility Example

Using the Electric Ecosystem to Guide Utility Business Strategy	
INSIGHT	**STRATEGIC RESPONSE**
There is a growing demand for reliability & resilience at levels greater than standard service.	Develop methods for measuring resilience acceptable to regulators. Facilitate regulatory policies/frameworks that allow premium services.
Customers who deploy DER are becoming prosumers.	Support customer choice: engage customers and show them how to make good DER investment decisions; provide on-bill financing options
Prosumers need custom services.	Expand the utility's value network by developing new business partners.
Customers are using the grid in new, differentiated ways.	Develop subscription rate options (e.g., traditional plan self-supply plan, export plan).
The utility's value proposition/business is shifting to being a supplier of advanced grid services.	Revise rates to reduce reliance on volumetric (kWh) charges to recover fixed costs; implement advanced grid planning tools and methods, educate regulators as needed.

These examples are recognized as very simple and in practice would involve a more detailed analysis of the interrelated actions and reactions among the various actors to determine the appropriate strategies and actions that result in a new “equilibrium”. The takeaway is that it is important to understand that changes affecting one actor will result in a change in their strategy and actions that will ripple across the ecosystem causing further changes among the other actors until a new equilibrium is reached. These business oscillations can be quite large in amplitude (i.e., significant disruptions) with very fast responses by some actors that create issues for those actors with much slower decision cycles, such as those involving regulatory processes.

Conclusion

Grid evolution, as the very name implies, is an organic process that will involve many entities interacting with one another in a dynamic web of interrelationships. These actors, and the relations between them, will be undergoing a recurring process of adaptation to innovation that could come from many quarters. Consequently, systems thinking will be a key to understanding and managing the fundamental changes to the electric system anticipated over the next 15-20 years. The confluence of climatic, technical, and human factors is such that conventional energy planning methods will fail to preserve and enhance the public interest. Both public policy and business strategy, to be effective, must view the electricity system holistically, and respect the underlying dynamism that will involve multiple actors with different goals and objectives that could change over time. This holistic approach to inform strategy and planning will help to ensure that the needs and interests of customers continue to be well served, even as these, too, change over time.