The Electricity Journal 29 (2016) 19–26

Contents lists available at ScienceDirect

The Electricity Journal

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

R&D and public utilities

Kenneth W. Costello

National Regulatory Research Institute, United States

ARTICLE INFO

Article history:
Available online 24 June 2016

Keywords:
R&D
Innovation
Utility business model
Regulatory incentives
Transformed electric industry
Risk-reward relationship

ABSTRACT

Compared to other industries, energy utilities spend an extremely low portion of their revenues on research and development. Since restructuring of the electric and natural gas industries, collaborative research by energy utilities has declined sharply. Yet, collaborative research has been an important part of R&D in the energy utilities industries, with documented benefits to consumers and society at large. Should the incentives be changed to encourage greater R&D spending?

Research and development (R&D)[1] is a precursor for the long-term development of new technologies and other innovations (e.g., a change in the utility business model) that can lead to greater societal welfare.[2] The demand for R&D is therefore a derived demand for improved products and processes that are commercially profitable or achieve some public benefit more effectively or at a lower cost.

Although innovation is difficult to measure, studies have shown that R&D spending is a critical input into innovation.[3] Another indicator of innovation that researchers often use is the number of patents granted annually.[4]

The main benefit of R&D is to advance the current state of technology. In the public utility sector, technological change has the additional value of fostering policy objectives. For some industry observers, the absence of breakthroughs in energy technology will preclude major strides toward attacking global warming in an affordable way.[5]

Technological change is probably the most important factor for improving the long-term performance of public utilities, which after all is the prime objective of regulation, along with assuring just and reasonable rates. It is driving today's dialogue on utility business models,[6] the regulatory paradigm and ratemaking, market developments and public policy. Technology typically has its genesis in R&D, at the basic level of creating new knowledge that ultimately leads to commercial viability of a new technology or other innovations.

There is widespread concern over the possibility of inadequate public-funded R&D in the future because of government budgetary pressures. Another worry is that R&D in the energy industries is

E-mail address: kcostello@nrri.org (K.W. Costello).

[1] This article uses the term "R&D" to include demonstration, which has the important function of showing whether a new technology or other innovation is feasible on a commercial scale. Some organizations and writings prefer the term "RD&D" to more explicitly convey demonstration as a research activity. The demonstration of new technologies may be the most important R&D function of utilities.

[2] Innovations can include hardware, software, management, and other practices, or just new knowledge that enables the production of new products or services, or more efficient production of existing products or services.

[3] Council of Economic Advisors, Economic Report of the President, transmitted to the Congress, February 2016, Chapter 5.

[4] The link between patent grants and aggregate productivity growth, which is a major contributor to economic growth, is tenuous, since the number of patents depends on several factors. See, for example, ibid., Chapter 5; and Zvi Griliches, "Productivity Puzzles and R&D: Another Nonexplanation," Journal of Economic Perspective, Vol. 2, No. 4 (Fall 1988): 9–21.

[5] As a peculiarity, innovations to combat global warming have the purpose of preventing our quality of life from deteriorating, rather than the normal "innovation" objective of improving it.

[6] By revamping their business model, utilities could embrace, accommodate (for third parties) or invest in new technologies to better serve their customers. It could also move the industry toward achieving broader public policy goals. One rationale for a changed business model is that technological and economic dynamics have affected utility sales and revenues to the degree that the status quo inevitably will (a) lead to an unsustainable financial outcome for utilities and (b) fail to allow utility customers to reap the full benefits of new technologies. See, for example, Edison Foundation Institute for Electric Innovation, Key Trends Driving Change in the Electric Power Industry, Lisa Wood and Robert Marritz, eds. (Washington, D.C.: The Edison Foundation, December 2015).

http://dx.doi.org/10.1016/j.tej.2016.06.001
1040-6190/

greatly underfunded, unable to address global warming and other challenges facing the U.S.[7]

This article discusses the effect of regulation on utility-funded R&D and on the opportunities for third parties to disseminate their new technologies to retail energy-utility customers. Public utility regulation plays a critical role in stimulating R&D by energy utilities.[8] Various features of public utility regulation affect how much and how utilities conduct R&D. For example, it affects the pace at which utilities innovate, the types of innovations they develop and adopt, and the management of R&D projects. The economics literature has devoted relatively little attention to regulated utilities' incentive to conduct R&D and innovate.

Compared to most other industries, energy utilities spend an extremely low portion of their revenues on R&D. Since restructuring of the electric and natural gas industries, collaborative research by energy utilities has declined sharply. Collaborative research has been an important part of R&D in the energy utilities industries, with documented benefits to consumers and society at large.

1. Improving utility performance as a regulatory goal

1.1. The futuristic electric industry

In the public utility sector, technological change has the special benefit of advancing public policy objectives, namely, safety, reliability, energy security, higher energy efficiency, affordable energy services, and a cleaner environment. With innovations, for example, electric utilities can improve their cyber security more effectively and at a lower cost.

Many experts are predicting a transformation of the electric industry from where the utility is an infrastructure and commodity provider to being a platform and service provider; that is, a change from a rigid, unidirectional, and centralized system to a more flexible, networked system.[9] The transformed industry will feature a dynamic, information-based interactive system. Utilities would assume the function of coordinating the flow of electricity on their systems so as to accommodate power flowing through multiple paths and maximize customer value. Technological advancements can help to achieve this outcome more economically.

In this new world, innovations in the form of new products and services offering customers greater convenience, control, value and participation will be in demand. The emphasis on consumer empowerment will entail new, value-added services, new pricing options, self-generation, choice of electricity sources, and real-time information. The question then turns to, how can innovation facilitate these developments?

A new business model could help electric utilities to embrace, accommodate or invest in new technologies to better serve their customers. An increasingly important function of regulated public utilities will be to act as a conduit in filtering the benefits of new technologies developed by third parties to retail customers. After all, most new technologies that benefit utility customers had their beginnings outside the utility space. The ability and willingness of utilities to play the role of new-technology adopter depend critically on regulators creating a favorable risk-reward environment.[10] If utilities feel that new technologies will not enhance their financial position, they will be less inclined to adopt them for the benefit of their customers.

1.2. R&D over subsidies

By definition, disruptive technologies, which normally begin with R&D, allow new or existing products and services to become more affordable to a broader population. They also overwhelm the established technologies. Disruptive technologies can therefore affect how businesses operate and their internal organization. They can be a major source of changing market structures, for example, as regulated firms move into unregulated markets, and vice versa. Frequently, new technologies require companies to abandon their old business practices and reinvent themselves for success and survival.

One reasonable view is that accelerating R&D instead of subsidies is a preferred approach to making clean energy resources economical and acceptable in the long run.[11] An important feat will be to hold participants in the energy market accountable for the adverse effect of greenhouse gas emissions. By requiring companies to internalize emissions and their damage to health and the environment, clean energy will become more competitive with fossil fuels, in the process stimulating more R&D spending on clean energy.[12]

1.3. Various causes of new technologies

For the electric industry, a confluence of new technologies is erupting on the scene. The most important ones include solar, wind, battery storage, electric vehicles, fuel cells, small modular nuclear reactors, digital control of the grid, smart technologies, demand-side innovations, and information and communications technologies. Some of these technologies will require a longer time before they become commercialized. Others that show technical promise today may never attain commercial success.

Different factors account for the emergence of new technologies. They include public policy, customer demands, favorable supply-side developments, rent-seeking, ideology, and synergy where one technology development spawns others. Public policy has become more aggressive in recent years, especially in meeting clean air and energy efficiency objectives. Many customers are demanding real-time information and access to the latest technologies. Reduced costs for renewable energy have been impressive. Some technologies have received special favors because of vigorous lobbying by their advocates. The emergence of some technologies has led to advancement in others; for example, the pairing of solar and storage, of batteries and electric vehicles, and of the modern grid and distributed generation (DG) and other new technologies. Because some of these motivators for new technologies may be antithetical to a better society, regulators and other policymakers must exercise vigilance in placing their bets on certain technologies even when they seem compatible

[7] See, for example, Laura Diaz Anadon et al., "Transforming U.S. Energy Innovation," November 2011; and Michael Greenstone, "The Importance of Research and Development (R&D) for U.S. Competitiveness and a Clean Energy Future," CEEPR WP 2011-010, June 2011.

[8] Although environmental and other types of regulation affect R&D by utilities, this section focuses on public utility regulation.

[9] See, for example, AEE Institute 2015; and Institute for Electric Innovation 2015. While this transformation may occur, the timing and extent of its presence will vary by state and utility. Some states (e.g., California, Hawaii, and New York) will be leaders while others will follow.

[10] As an adopter, the utility does not have to be the creator of a new technology; it can simply acquire and use the technology for the benefit of its customers.

[11] Economists generally consider subsidies as inefficient, often politically motivated, and enduring too long. Their preferred option is to have the government reallocate funds from subsidies to basic research. Energy subsidies are prevalent throughout the world, benefiting fossil fuels as well as renewable energy.

[12] Some countries and U.S. states are experimenting with different ways to price carbon. The objective is to create incentives for development of new energy solutions while also giving energy companies adequate certainty to invest in zero-carbon sources.