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DISSERTATION ABSTRACT

Environmental Regulatory Impact and Firm-Level Innovation: A Study of Electric Utilities' Responses to the Clean Air Act Amendments of 1990

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Is environmental regulation a cause of the declining innovativeness of American companies? Do environmental laws constrain firms' strategic choices and limit their innovative options? Many analysts argue that environmental regulation adds sizable compliance costs to firms, which forces cutbacks in R&D efforts and constrains the type of innovations firms pursue. Critics of regulation argue that the result is reduced innovation, which puts environmentally regulated firms at a competitive disadvantage.

But there is another view. Some analysts argue that environmental regulation may contribute to firm-level innovation and performance. For example, regulation may benefit one or a few firms in an industry by requiring the use of a technology that these firms—but not all firms—in the industry have already mastered. The firms with mandated technological expertise may hold an advantage over their competitors who are obligated to purchase and learn to use the new technology. This dissertation tries to explain these two competing views. It examines how one environmental law, the Clean Air Act Amendments of 1990 (CAAA90), affected the radicalness of innovation among a group of electric utility companies. Electric utilities are among the most heavily regulated sources of conventional air pollutants. Great environmental demands are being made on utility companies as a result of the CAAA90, and electric utilities have had to develop strategies to respond to these mandates. These responses vary in their degree of innovativeness, ranging from the relatively common practice of coal switching to investing in clean coal technologies for use with high-sulfur coal. As utilities look for ways to meet regulatory demands, considerable managerial choice is involved in these decisions.

This dissertation proposes a model suggesting that organizational variables moderate the effect of environmental regulation on the radicalness of innovation at the firm level. It hypothesizes that four moderating variables—the degree of centralization of decision making in the firm, the size of the firm, the firm's competitive strategy, and whether regulation is perceived as a threat or an opportunity—determine the effect of environmental regulatory impact on the radicalness of the firm's innovative response to the regulation.

The dissertation attempts to determine if Phase I of the CAAA90 had an effect on the radicalness of the compliance decisions, or innovations, adopted by the affected utilities. Innovation occurs when a firm adopts a device, system, policy, program, process, or product that is new to that firm. Radical innovations are very different from what the firm has done previously and require that new capacities be developed and that previous practices be abandoned. Less radical or routine innovations may be new to the organization, but they are very similar to something the organization has done before, and they draw upon existing competencies and knowledge within the firm. Some of the more radical innovations included industrial power cogeneration, switching to natural gas as a primary fuel, and purchasing power from off-systems. Less radical options for reducing SO₂ included switching from high- to low-sulfur coal, blending coal, transferring allowances within the utility's system, and installing wet flue-gas scrubbers.

Fifty-five electric utility companies were studied. This is the population of electric utility firms that were affected by Phase I of Title IV of the CAAA90. Data were collected by administering a telephone questionnaire to two managers in each utility company, and from archival sources.

Moderated regression analysis was used to examine if the degree of radicalness of the innovations in response to increasing environmental regulation depended on how centralized decision making was, the size of the company, its competitive strategy, and if management perceived the CAAA90 as a threat. The results of the analysis showed that the radicalness of the compliance decisions chosen by electric utility companies in response to Phase I of the CAAA90 did vary, depending on the levels of the four moderating variables. Electric utility companies that were highly impacted by Phase I made more radical compliance decisions if decision making was more decentralized in the company, if the company was large, if it used a differentiation or a "value" strategy to compete, and if management did not perceive the regulation as threatening.

The results suggest that environmental regulation affects utility companies differently, depending on certain characteristics that are specific to

each firm. Contrary to some conventional wisdom, environmental regulation does not necessarily deter radical innovation. In fact, depending on other characteristics of the utility company, environmental regulation can spur either more radical or less radical types of innovation.

Most important, environmentally regulated power companies may pursue cutting-edge, radical technological and administrative innovations in spite of, or perhaps because of, the demands of environmental regulation. A profile of the most radically innovative utility company emerges. It is a large utility company, and decision-making authority within it is delegated to lower levels of the company. It competes in the electricity business by differentiating services to enhance their value in the eyes of their customers, and the company's management tends to view the environmental laws they must comply with as opportunities instead of threats.

Similarly, a profile of electric utility companies least likely to choose radical compliance options can be sketched. Small utilities that compete by selling electricity as a commodity, where decision making is concentrated to upper levels, and where management thinks environmental rules threaten the company, are likely to choose less radical and lower risk innovations in response to environmental laws.

These profiles suggest that a new variety of electric utility company may be emerging. The new electric utility company may recognize that new competitive rules have come into play and that these rules have modified traditional ways of doing business. By testing new competitive strategies, by delegating decision-making authority to experts at the technical core, and by viewing external "jolts" such as regulation as opportunities, large utilities in particular may realize that their ability to solve problems in radically innovative ways is not compromised by environmental rules. In fact, the jolt of environmental laws may help utilities more effectively contend for leadership in electricity markets, as the industry invites new players and becomes more competitive.