



Change-actors in the U.S. electric energy system: The role of environmental groups in utility adoption and diffusion of wind power



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H I G H L I G H T S

- We study environmentalists' impact on utility-scale renewable technology diffusion.
- Incumbent-dominated systems hinder the diffusion of new technologies.
- Environmental groups' strategic actions increase legitimacy for new technologies.
- Environmental groups' legitimating actions affect incumbent's technology choice.
- Environmental groups create a favorable institutional context for new technologies.

A R T I C L E I N F O

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We study the contribution of environmental groups to new technology adoption and diffusion by dominant incumbents. Building on institutional and social movement theory, we develop a theoretical framework that sheds light on environmental groups as change-actors. We theorize that by approaching embedded key constituents with various strategic actions, environmental groups affect taken-for-granted beliefs, build legitimacy for renewable energy technologies, and convince skeptical constituents to support the new technology. We verify our theoretical framework with a case study of wind power development in Colorado. We find that environmentalists educate constituents on the benefits of the new technology, engage in activities leading to regulatory and legislative decisions for wind, while also providing direct assistance to the utility. As a result, utilities are both pressured and encouraged to adopt and diffuse wind power on a large-scale. This research directs attention to the role of environmental groups as change-actors and the legitimating effects of their actions. It highlights their part in creating a more favorable institutional environment for new technologies while directly influencing the incumbent's technology choice. This paper contributes to an understanding of bottom-up, actor-initiated changes in energy systems taking into account both the systemic technological infrastructure and the institutional context.

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"Environmental problems must be solved through changes in the institutional arrangements that govern industry and social action." (Hoffman, 1999, p. 367)."

1. Introduction

Increasing renewable electricity generation in the U.S. electric energy system has become an important priority in discussions

about how to address climate change issues and the environmental impact of electricity generation. The U.S. electricity system is largely dependent on conventional, fossil fuel burning generation technologies. Energy-related CO₂ emissions account for more than 80% of the U.S. greenhouse gas emissions, with electricity generation being the largest share, responsible for 40% of energy-related CO₂ emissions (EIA, 2011). Renewable energy technologies (RETs) for electricity production, such as wind and solar power, geothermal energy, forms of biomass, tidal power, and small hydropower, if deployed on a large-scale, are considered to have a great potential to meet future electricity demand (Neuhoff, 2005) while contributing, at the same time, to a significant reduction of CO₂ and greenhouse gas emissions. Apart from environmental benefits, a wide diffusion of RET can be a means to diversify domestic energy sources, diminish problems associated with dependence on foreign

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fossil-fuel supply, and contribute to a diverse electricity fuel mix, all of which are essential for ensuring a reliable electricity supply.

The U.S. electricity system is characterized by a systemic, incumbent-dominated technological infrastructure. Particularly major electric utility companies, i.e., investor-owned electric utilities (IOUs), would have the potential to widely diffuse RET and, consequently, to significantly reduce the environmental impact of electricity production and alter a state's electricity portfolio. However, despite the merits of a utility-scale diffusion of RET, most incumbent utilities seem to be reluctant to adopt new generation technologies. Electric utilities are found to defend established industry structures, inhibit regulatory changes towards the integration of RET, and to particularly lobby against their diffusion (Jacobsson and Bergesk, 2004; Jacobsson and Lauber, 2006; Stenzel and Frenzel, 2008). IOUs seem to strongly prefer fossil fuel-burning technologies over RET. In fact, renewables represent only 1.4% of the IOU's electricity portfolio in the United States (excluding hydropower) (APPA, 2012a).

Over the past decade, several U.S. states have begun to employ various renewable policies that both encourage and require utilities to generate and sell renewable electricity. Thus, not all that surprisingly, most of the academic research examining drivers for utilities adopting RET has largely focused on policy incentives. For instance, a significant amount of recent research is dedicated to analyzing the effectiveness of different green power policies (e.g., Bird et al., 2005; Delmas and Montes-Sancho, 2011; Menz and Vachon, 2006). While this work is useful for informing about the design of a supportive regulatory environment for renewables, most of these studies assume policy incentives to be the initial and often only stimulus for utility investment in RET, and credit RET diffusion solely to regulatory changes. However, these studies cannot explain what drives electric utilities to initially adopt new generation technologies when no supportive policies are in place. Furthermore, these studies often treat policies as given, exogenous variables and do not provide information on what triggers the implementation of renewable policies in the first place. Basically, there has been little research on the essential role of change-actors in the process of encouraging incumbent utilities to adopt and widely diffuse RET. Yet, such research may contribute to a better understanding of the social acceptance and sustainable growth of a utility-scale renewable energy sector.

Motivated by this gap in the literature, we explore how environmental groups can introduce RET as an alternative technological solution to well-established, conventional electricity generation technologies and encourage incumbent utilities to adopt and diffuse RET in markets where enforcing policy mechanisms are initially absent. Environmental groups are known to be strongly concerned about the environmental impact of electricity production. In this study, we investigate their ability and strategies to introduce alternative technological solutions and create a supportive institutional environment for new technologies to prosper.

Building on insights from institutional theory and research on social movements, we understand environmental groups as change-actors acting from the periphery of organizational fields (Leblebic et al., 1991; McAdam and Scott, 2005). We develop a theoretical framework of how they introduce new technologies as an alternative to highly institutionalized practice used by dominant incumbents and verify our theoretical insights with a case study on wind power diffusion in Colorado. Our framework focuses on environmental groups' diverse strategic actions aimed at persuading relevant field constituents to support the new technology as a legitimate alternative, and encouraging incumbent firms to adopt and diffuse the new technology. While recent research has begun to acknowledge the influential role of environmental groups in the energy sector (Lee and Sine, 2007; Sine

and Lee, 2009), past research mainly focused on the advocates' impact on entrepreneurial activity. We still know little about the influence of environmental groups on the technology choice of incumbent firms dominating a systemic technological infrastructure. Hence, in our study, we seek to fill this research gap by taking into account the incumbent-dominated technological infrastructure of the electric energy system, the role of other important field constituents, and the institutional barriers to new technology diffusion.

Our paper is structured as follows. In Section 2, we outline recent research on drivers for utility-scale renewable electricity generation, showing the need for an understanding of actor-initiated changes. We then describe the incumbent-dominated technological infrastructure of the U.S. electricity system and analyze the industry from an institutional perspective. In Section 4, we turn to our theoretical framework and elaborate on the ability and diverse strategic actions of environmental groups to encourage new technology adoption and diffusion. In Section 5, we present our case study of utility-scale wind power development in Colorado. We chose the case of Colorado since regulatory support for RET had not been achieved there and fossil-fuel burning technologies were perceived as the least-cost and most reliable, thus unchallenged practice for electricity generation. This case sheds light on the influential role of environmental groups and how their actions eventually led to the initial adoption of wind technology by the state's dominant electric utility, followed by a wide diffusion of wind power. Lastly, we discuss our findings.

2. Drivers for the adoption and diffusion of RET by incumbent utilities

Recent research examining drivers for utilities to adopt and diffuse technologies for renewable electricity generation has largely focused on the influence of public policy mechanisms. For instance, changes in the political agenda, such as electricity deregulation, have been shown to motivate utilities to invest in RET and offer green electricity. Under deregulation, incumbent utilities face competitive threats that are likely to foster the adoption of new technology (Delmas et al., 2007). Similarly, Markard and Truffer (2006) found that the liberalization of electricity markets has served as a driver for electric utilities to engage in innovation activities and that it has induced a shift towards new technology adoption in utility electricity generation.

In a similar vein, policy scholars have focused on the effectiveness of different renewable energy policies on the utility-scale diffusion of RET. For example, in a study on wind power development in California, Russo (2003) demonstrated that government support such as tax credits can initiate a market for RET. Bird et al. (2005) explored key factors that spur wind power development in 12 U.S. states and concluded that state policy instruments, particularly renewable portfolio standards (RPSs), are key drivers. While Menz and Vachon (2006) found that RPS and mandatory green power options have a positive effect on the diffusion of wind technology, Delmas and Montes-Sancho (2011) further differentiated between types of utilities and showed that RPSs in particular provide a stimulus for private utilities to invest in renewables.

A different line of research has shown that sudden events such as energy shortages, economic crises, or environmental disasters can give major impulses to change traditional incumbent practice (Meyer, 1982). Examples of such events are the oil crisis of the 1970s, the Deepwater Horizon oil spill in 2010, and nuclear accidents such as Chernobyl in 1986 and the Fukushima nuclear disaster in 2011. Such events can significantly alter the political and social perception of the benefits of environmentally friendly

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