



## What drives opposition to high-voltage transmission lines?

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### ABSTRACT

This paper critically reviews theoretical and empirical research from planning, social psychology, and political science relevant to the siting of high-voltage transmission lines (HVTLS). Siting of new HVTLS is important to reducing the emissions of greenhouse gases from the electricity sector as well as meeting demands for reliable power. We synthesize existing research by developing a meso-level framework that integrates and extends existing individual-level theories to better account for the nested impact of social interactions and institutional variables on siting outcomes. We apply our framework to a HVTLS case in California where community based opposition was effective due to the perceived high risk of the project and where trust in institutions was low. Statutory power for using existing right-of-ways, land use attributes, and political lobbying were also important in explaining the HVTLS siting outcome.

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### Introduction: siting high-voltage transmission lines

In order to meet growing demand for clean power, and to modernize and expand grid infrastructure, nations in Europe, Asia and the Americas are attempting to build high-voltage power lines. These projects are difficult and time-consuming to site due to the complex relationship between project characteristics, the landscape, individual sentiment, social interaction, the siting process and the political context. To better understand the factors that determine project outcomes, we integrate existing research from land-use planning, social psychology and political science into a comprehensive framework of the infrastructure siting process. We find that although individual-level factors are important, to better understand outcomes, researchers and practitioners must also take social interaction and the siting process into account.

Targets for clean energy, sometimes called Renewable Portfolio Standards (RPS), require utilities to provide a certain amount of renewable power, usually as a percentage of the total amount of electricity consumed in a state in a given year. In recent years, renewable energy targets have been established in Europe, Asia and North America. European Union (EU) nations have agreed to generate 20% of power from renewable sources by 2020 (European Union, 2009). Asia-Pacific nations including Australia, China, Japan, and Thailand have established RPS goals, as have some Indian states (Chaudhuri, 2010). Canada, Mexico and much of the United States

(US) have renewable energy goals of some kind. In the US, twenty-nine states have RPS goals including California (33% by 2020), New York (30% by 2015) and Colorado (30% by 2020) (Center for Climate and Energy Solutions, 2012). The definition of renewable power varies by nation and state, but usually includes sources such as wind, solar, hydropower and biomass (EPA, 2009).

Given these mandates to integrate utility-scale sources of renewable energy, combined with the need to modernize old equipment and meet growing demand for electricity, power grid operators in Europe, Asia and the US are calling for substantial investments in new infrastructure (Lydersen, 2012; Bojanczyk, 2012; Hirst, 2004). One significant challenge to meeting these goals is that high-voltage transmission lines (HVTLS) are expensive and time-consuming to build.<sup>1</sup> New projects can take a decade or more to build, and a lack of transmission capacity has become the largest barrier to the development of new renewable electricity sources in California, the Midwest and other areas of the US (California Public Utilities Commission, 2008; Haugen, 2012). A lack of transmission capacity is also a serious problem in Europe and in Asian nations such as China (Lydersen, 2012; Bojanczyk, 2012).

The goal of this essay is to review research and theory relevant to the siting of high-voltage transmission lines so that we may better understand the dynamics behind actual project outcomes. Industry experts have identified public opposition as the primary cause of electricity transmission line siting difficulty (Vajjhala and Fischbeck, 2007); public opposition leads to long delays, litigation

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<sup>1</sup> High-voltage transmission lines move electricity long distances from generation facilities to load centers at voltages of 230 kilovolts or greater. Retrieved from <http://www.eei.org/ourissues/ElectricityTransmission/Pages/default.aspx>.

and major costs to utilities and generators (Furby et al., 1988). Given this, much of the relevant research literature has focused on assessing and analyzing individual sentiment as measured through opinion surveys. This level of analysis and mode of description, although useful, misses important group level interactions and the political constraints of the siting process. Also critical to consider are social interactions that shape individual-level information about the project at hand, trust in the process and actors, and sense of efficacy. These factors are beginning to get more consideration, but their role remains underspecified. Another key level of analysis focuses on the siting process and the political context. By adding an institutional consideration to existing psycho-social work, we aim to provide an integrated framework for understanding the siting of high voltage transmission lines.

We proceed as follows. In Section "Material and methods" we discuss our materials, methods and sample selection criteria; in Section "Theory: citizen opposition, social interaction and institutional context" we discuss our theoretical approach; in Section "Individual level drivers of opposition to HVTLS" we review research on individual-level drivers; in Section "Social processes" we examine social processes; in Section "The siting process and political context" we focus on the siting process and political context; in Section "Results: outlining and applying a framework for siting HVTLS", we present a synthesis of existing research in a novel framework, and apply it to an individual case. In Section "Conclusion", we conclude.

## Material and methods

Devine-Wright (2005, p. 136) calls for a more interdisciplinary approach to analyzing siting that accounts for the physical aspects of the project and the project's environmental context, the psychology of the public, and the social interactions that shape individual perceptions. Our goal is to answer this call with an integrative literature review that critiques and extends the existing literature on siting (Torrao, 2005). Our framework links existing micro-models of attitudes and behavior across different levels of analysis into a meso-level framework (Coleman, 1990) that accounts for physical and psychosocial factors as well as the siting process and political context. Our meso-level framework is appropriate because individual attitudes and behaviors regarding transmission line siting are conditioned by social norms and regulatory processes. We demonstrate that linking micro-level theories with representation of community, stakeholder and process variables helps us better understand siting outcomes.

To integrate and extend the research on infrastructure siting, we searched for analytical and empirical studies published in peer-reviewed journals and industry publications. We began with research on perceptions of HVTLS and the infrastructure siting process (Furby et al., 1988; Priestley, 1992; Schively, 2007) and used digital search tools to find related articles. Given the limited research on HVTLS, we also reviewed articles dealing with the siting of other kinds of energy infrastructure, such as wind power. Where it may be useful to the reader to understand the generalizability of survey-based research, we include the location of the study area. We chose models that describe psychological, social and political processes with well-supported theory and empirical research. We then categorized these models and theories into three levels of analysis, depending on whether they focused on individual-level, psychosocial or institutional factors. Although some articles may look at multiple levels of analysis, most articles focus primarily on one, or at most two, levels. Our final step was to analyze the linkages between these levels of analysis to identify key interactions between variables that can help explain HVTLS siting outcomes. For our case analysis, we used digital search tools to find news articles

covering developments in the case, reviewed official documents, interviewed stakeholders, and made a visit to the project site.

## Theory: citizen opposition, social interaction and institutional context

In this section, we review theoretical and empirical research on the impact of individual-level, psycho-social and institutional factors on project outcomes. Typical research on siting has focused almost exclusively on how project features drive individual attitudes, although newer research has begun to consider the impacts of social interaction. Our review finds that while both these levels of analysis are important to understanding project outcomes, a comprehensive framework must also consider the institutional level as political institutions translate individual and group preferences into project decisions. After reviewing relevant research, we attempt, in Section "Results: outlining and applying a framework for siting HVTLS", to fuse these different levels of theory into a comprehensive theoretical framework.

### *Individual level drivers of opposition to HVTLS*

Understanding individual preferences is necessary to understand opposition, but, as we argue in subsequent sections, not sufficient to explaining siting outcomes. The dimensions we examine include the effects of power lines on property values, possible health risks, visual and noise impacts, land use attributes, psychological stigma and perceptions of these risks. In the last portion of this section, we look at the impact of political ideology on risk perception.

How individuals interpret the potential impacts from HVTLS is a product of both the physical facts of the project, as well as the individual sociodemographic characteristics of residents (Deming, 1996). Schively (2007) finds evidence that participants are acting as rational maximizers in resisting projects as they attempt to minimize financial risk to their home. Those living near a locally unwanted land-use project (LULU) perceive the costs as high, which in turns motivates opposition.<sup>2</sup> Benefits usually accrue to a dispersed group of beneficiaries, who often have little incentive to strongly support a particular project.

Objections often center on the physical aspect of towers and the various perceived negative externalities created by HVTLS, such as effects on property values, potential health risks, and esthetic impacts (Elliott and Wadley, 2002). However the symbolic impact of projects can be substantial and should not be overlooked (Devine-Wright, 2009). Furby et al. (1988) also find that how a project is interpreted can drive opposition: HVTLS may be viewed as a symbolic intrusion on personal property and can be associated with general feelings of loss of control (p. 33).

### *Effects of HVTLS on property values*

A wide range of empirical work has been conducted to judge the impact of power lines on property values, but results have been mixed. Jackson and Pitts (2010) review this literature and find that most studies report power lines have little to no effect on the sale price of homes. Studies that do show an effect find that transmission lines lower the value of houses right next to the line by 2–9% and that this effect diminishes with distance and time (Jackson and Pitts, 2010).

Research by Rosiers (2002) finds that HVTLS do have an impact, but that proximity to towers rather than the line as a whole is the

<sup>2</sup> We use the term LULU and avoid the use of the acronym NIMBY (Not in My Backyard). See research by Wolsink (2000), Schively (2007) and Devine-Wright (2009) criticizing the NIMBY concept as not descriptively accurate or theoretically useful.

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