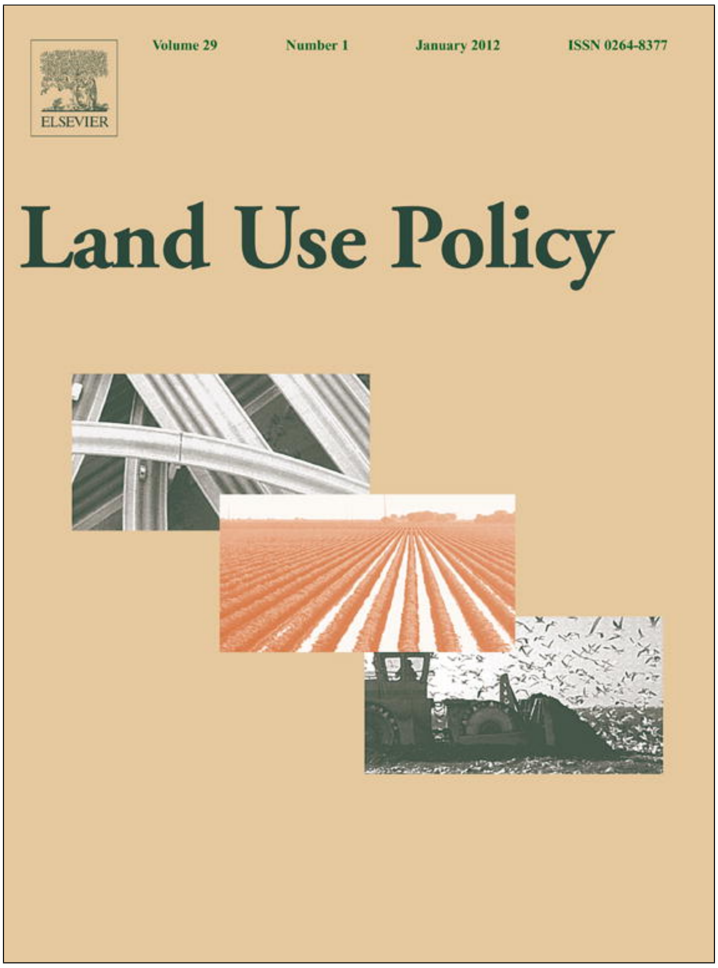
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What drives opposition to high-voltage transmission lines?

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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 HVTL 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 p for using existing right-of-ways, land use attributes, and political lobbying were also important in explaining the HVTL siting outcome.

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 (HTVL) are expensive and time-consuming to build.[1] 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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[1] 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.

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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 (Torraco, 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 HTVLs, 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 HTVL 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 understanding 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.[2] 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

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

key factor. Rosiers uses a microspatial (small scale) approach and finds, based on a sample of 507 home-sales in the Montreal area of Canada, that homes adjacent to a right-of-way[3] may actually increase in value due to improved views. However, houses that overlook HVTL *conductors* are usually reduced in value by 5–10%. Lower value houses that overlook HVTL *towers* are reduced in value by 10–15%, while higher value properties can suffer a 15–20% reduction (Rosiers, 2002, p. 297).

Resident perceptions of the impact of power lines on property values are also significant, if harder to assess. A review of the literature by Bolton and Sick (1999) finds that homeowners' fears regarding the impact of electric and magnetic fields (EMF) reduced the value of properties adjacent to HVTLs. Elliott and Wadley (2002), based on a series of focus groups conducted in Australia, determine that harm to property value is the second most important perceived impact behind health risks from EMFs.

Health risks of HVTLs

Although there is no definitive evidence that power lines threaten human health, research has given rise to concern. In 1999 the US National Institutes of Health concluded that evidence linking health problems to exposure to low-frequency EMF from power lines was "weak" and that "no consistent pattern of biological effects" from EMF exposure had been found. However, some epidemiological studies have found that proximity to power lines created a "small" increased risk of childhood leukemia (NIEHS, 1999, p. ii). In 2001, the International Agency for Research on Cancer determined that EMFs are a *possible* human carcinogen. Whatever the actual effects of EMF, public concern over exposure has been growing in recent decades.

Survey work by Priestley and Evans (1996) conducted in the San Francisco Bay Area shows that health and safety was residents' top concern from a project to upgrade a 115-kV power line to 230-kV. This survey ($n = 266$, response rate of 60%) used questionnaires to evaluate resident perceptions after the new line was constructed and taller towers were installed. A more recent project, based on a series of focus groups conducted in urban, suburban and rural areas of Australia, found that concern over EMFs is the primary driver of opposition to transmission lines (Elliott and Wadley, 2012, p. 195). Earlier work by Elliott and Wadley (2002) observes that due to this uncertainty about the effect of EMFs, power lines create a sense of "stigma" that in turn affects individual attitudes.

The risk of a power line falling due to earthquakes or other natural disasters is very low (ASCE, 1999, p. 40). However, in California and other states with seismic activity, the threat of a catastrophic failure is not impossible to rule out. EPRI (2001) observes that the catastrophic potential of a risk can increase its perceived risk level. However, Elliott and Wadley (2012) found that the risk of accidents was considered the least important factor in opposition to power lines.

Visual disruption and noise impacts of HVTLs

Because high voltage lines are usually placed on 100- to 200-foot-tall towers and extend over long distances, they can be viewed from many vantage different points and may have significant visual impacts (Elliott and Wadley, 2012). A review of the literature by Furby and coauthors finds that the visual impacts of HVTLs are a significant source of negative evaluations (Furby et al., 1988, p. 26). Visual disruption has also been identified as one of the prime sources of opposition to wind power (Wolsink, 2000).

Priestley (1992) observes that although many opinion surveys have focused on esthetics, the questions have varied over time, as have responses. Early studies carried out in rural areas of Canada in the 1970s found that only 13% of respondents were "bothered" by the lines. Research carried out by Rhodeside and Harwell in the Washington, DC-area in 1988, found that 39% of those surveyed believed a nearby transmission line harmed "neighborhood appearance" (Priestley, 1992, p. 65). In a survey by Priestley and Evans (1990), carried out in the San Francisco Bay Area, 87% of those surveyed believed the 230 kV line had a "negative effect" on the esthetics of the neighborhood (Priestley, 1992, p. 63). By comparing survey reports of esthetic impacts with a viewshed report created through field research, Priestley and Evans found that 40% of residents overestimated the actual visual impacts of the project, seven percent underestimated them and 53% had an accurate judgment. Visual and noise impacts from power lines were found to be the third-most important externality among urban residents, but the least important factor among rural residents (Elliott and Wadley, 2012, p. 196).

In the Priestley (1992) review, noise was determined to be an understudied impact. One study conducted in the Los Angeles-area in 1979 found that noise from power lines was mentioned unprompted by only 2% of the 403 respondents. In the urban setting, noise from substations and transmission lines did not cause significant disturbances. However residents living near 230 kV lines reported more disturbances than those living near substations, and residents living near 500 kV lines reported the most aural disturbance (Priestley, 1992, p. 72).

Land use attributes

Along with the perceived impacts of HVTLs, individual perceptions of the land use attributes of the project site are also a major driver of perceived acceptability of a project (Wolsink, 2007, p. 2696). Based on a survey of members of a Dutch environmental group, Wolsink (2010) finds that 94% of members of the organization believed that "island dunes" were unsuitable places to build a wind project; whereas only 2% believed that "industrial" and harbor areas would be unsuitable (Wolsink, 2010, p. 200). Survey research conducted by Soini et al. (2011) indicates that citizens living in areas with more transmission line cover were more likely to respond favorably to new lines (p. 303). Land use attributes are also related to community sense of place discussed below in Section "Disruption to sense of place".

Risk perception

When examining how HVTLs generate oppositional attitudes, the issue of risk perception is important to consider. In terms of public opposition, perceived risks are often more important than actual risks and the difference between perceived and actual risk can be large (Douglas and Wildavsky, 1983). Among the established characteristics of risk perception that may be a particular challenge in the siting of energy infrastructure: risks from unfamiliar technology are less acceptable than risks from familiar technology; risks from things that are undetectable (such as the potential risk from EMFs) are less acceptable than risks that are detectable; and risks that are involuntarily assumed (such as living near a transmission line) and not under personal control are less acceptable to most people than risks that are voluntary and controllable (Schively, 2007, p. 261).

High-voltage transmission lines have a moderately high level of perceived risk, according to a series of psychometric risk analysis studies reviewed by Slovic et al. (1985). The psychometric approach makes use of factor analysis to discern the underlying continuums that people use to relate various risks to each other. Based on factor analysis, researchers have found that the key dimensions for understanding risk are "Not a Dread Risk/Dread" and "Known/Unknown."

[3] A right-of-way (ROW) for a transmission line is usually an easement along public or private property that is kept free of development to allows a buffer zone around the construction of high-voltage transmission towers (also called pylons).

Using survey data, they determine that EMFs from large power lines are perceived as more *dread inducing* than an X-ray, but less than pesticides, and as less *known* than either.

Although psychometric evaluation is one approach to understanding risk perception, some researchers (see work by Sjoberg, 2000) believe that it does not explain a sufficient amount of variance in attitudes. New research on risk makes a strong case that risk evaluation is linked to a person's feeling about the technology (Slovic et al., 2004). Risk calculations, for most people most of the time, are made by the "experiential mind" and not by the analytical facilities assumed in many technical discussion of risk. Because risk perception is related to an emotional response, individuals may vary greatly in how they perceive risks (Slovic et al., 2004).

Since power lines may create broadly negative feelings due to their perceived externalities, the symbolic impacts of projects (Furby et al., 1988) and the general sense of "stigma" they create (Elliott and Wadley, 2002) we can anticipate that most members of the public will engage in emotional risk assessment and overvalue the threat presented by power lines. Although it is difficult to measure a person's risk propensity directly, political ideology and demographic factors correlate to a person's psychological response to risk.

Political ideology, demographics, and self efficacy

There is substantial support in the literature that political ideology, which is a comprehensive way of understanding the world, affects how an individual evaluates the risks and benefits of technology such as energy infrastructure. Ideology cuts across levels of analysis as it can be shaped by individual values and experiences, as well as by social processes as we discuss in the next section. One approach to understanding ideology and risk perception explains the association using cultural theory, which holds that people subscribe to one of three main worldviews: hierarchical, egalitarian or individualist (Wildavsky and Dake, 1990, p. 43). These world-views map closely, although not exactly, to political ideology. Wildavsky and Dake (1990) find that political liberals tend to favor egalitarian values while rejecting hierarchical and individualist approaches. They also find that liberals are, on the whole, far more technologically risk-averse than those who embrace hierarchy or individualism (Wildavsky and Dake, 1990, p. 50). In turn, people who subscribe to hierarchical and individualist worldviews are usually more acceptant of technological risk and more likely to identify as conservatives or libertarians respectively.

Looking at the question of ideology and environmental attitudes, Carlisle and Smith (2005) find strong support for Douglas and Wildavsky's approach. According to their study of California residents, those who subscribe to individualistic and egalitarian values are more likely to oppose offshore oil drilling and other kinds of energy projects (Carlisle and Smith, 2005, p. 535). Hunter and Leyden (1995) also finds support for the cultural values lens. Using opinion research, Hunter determines that respondents who hold a more hierarchical worldview are more likely to be in favor of the proposed waste incinerator while those who reject these values are more likely to oppose the project. A conservative political ideology was also found to be associated with a greater level of support for a nuclear waste facility in New Mexico, according to work by Jenkins-Smith et al. (2009). Along with ideology, demographic characteristics have been associated with attitudes toward projects. Jenkins-Smith and his coauthors (2009) find strong evidence that members of minority groups and women are much less likely to support technologically complex projects, such as the nuclear waste facility they study.

One of the key determinants of whether or not a citizen's attitudes are translated into action is their sense of political efficacy (Nishishba et al., 2005). Political efficacy is an individual's belief that their actions will have an impact on the political process (p. 271). Devine-Wright (2009) finds a similar dynamic at work in the context of siting wind projects: individual political efficacy is one of the most important factors driving "place protective behavior" by residents (p. 435). In other words, if a person believes they can impact the siting process, they are more likely to become involved; if they feel powerless, they are less likely to become involved. In turn, an individual's sense of political efficacy is socially linked to the broader economic and political context; those who live in affluent communities tend to believe they are more politically powerful.

In summary, we find that individual level perceptions of the project and the landscape drive sentiment, but that psychological processes have an important impact on how risks are perceived. HVTLs generate negative perceptions via their impact on property values, perceived health risks and esthetic impact. The landscape attributes of the project site influences individual-level perceptions of the project. In general, building projects in protected natural areas is seen as inappropriate, while siting projects within industrial settings is more tolerated. How an individual perceives these various risks is shaped by psychological biases, the symbolic impact of projects and by a person's political ideology. Social interaction also influences these relationships and it is to this level of analysis that we next turn.

Social processes

While research on siting has long focused on the determinants of individual attitudes, there is increasing attention to group-level processes and how social interaction affects preferences. Community perceptions influence both how a person views a landscape and what information a person has about a project (Devine-Wright, 2009). Community perceptions also shape how an individual perceives the possible risks from the project and the trust individuals have in projects sponsors, opponents, and the process itself (Soini et al., 2011; Gross, 2007). In this section we focus on how group-level interaction influences individual attitudes and behavior.

Disruption to sense of place

Devine-Wright (2009) makes the case that residents of a given community become attached to a place and its landscape characteristics, which in turn becomes part of the identity of residents. This creates a key link between individual perception and social interaction: a person's "sense of place" is determined in large part by the meaning a community attaches to a particular place. Devine-Wright's (2009) model is based on social representations theory, which holds that individual knowledge is socially constructed through interaction between individuals, and between individuals and social institutions.

Devine-Wright and Howes (2010) finds evidence, based on case studies of wind farm siting in the UK, that development of places that are deemed natural by the community will trigger oppositional attitudes and behavior in individuals. They observe that place attachment is a significant factor in determining whether residents took action (such as signing petitions) against a wind power project. Not only does social interaction determine individual attitudes toward a place, but it also shapes resident views of the project developer, who is often viewed as part of an "outgroup" and thus faces a higher burden in convincing a community that an infrastructure project will be beneficial.

Since these results are mostly based on case study analyses of wind projects in the UK, they may lack generalizability to other settings. Nonetheless, their model is well supported and appears robust: Given that similar people tend to live near each other and share attitudes and beliefs, an energy project that impinges on a shared community resource can disrupt community sense of place and unite people in opposition against the project.

The social amplification of risk

Work by Kasperson et al. (2003) argues that a social framework is critical to understanding individual perceptions and feelings regarding risk. Their framework begins with the assumption that "risk events" (such as accidents, incidents or new reports of hazards) are given meaning through person-to-person communication. At each "station" in the chain, a risk can be amplified (or attenuated) by the psychological biases that individuals employ to make sense of the world. Through this social amplification, a risk-event, much like a stone dropped into a pond, can create ripples that spread from those directly affected to other parts of a community (Kasperson et al., 2003, p. 16).

Drawing from classic communication theory and psychometric research, Slovic and co-authors finds that certain risks, such as power lines, have a high "signal value" that makes social amplification more likely (Kasperson et al., 2003, p. 17). Work by Trumbo (1996) categorizes people into either risk "amplifiers" or "attenuators" and finds that amplifiers focus on the perceived risk to individuals, while attenuators focus on the institutional response. In either case, a person's concerns are usually driven more by person-to-person communication as opposed to media information—although there is interaction between media framing and social communication (Kasperson et al., 2003, p. 18).

Social determinants of trust and sense of fairness

As Kasperson and his co-authors observe, the level of "social trust" in a society is an important moderator of the social amplification of risk. Distrust heightens perceptions of risk, intensifies the public reaction to "risk signals," contributes to the "perceived unacceptability or risk" and stimulates "political activism" regarding the risk (Kasperson et al., 2003, p. 32). A study by Groothuis and Miller (1997) used survey data and factor analysis to shed light on the role of trust on cost–benefit calculations surrounding a hazardous waste disposal facility in Pennsylvania. They found that people who distrust the "government, news media and business" viewed the facility as having a higher level of risk. In addition, distrustful individuals may not accept information on risk and may amplify risk signals in social interaction (Groothuis and Miller, 1997, p. 253).

Homophily, geography and opposition

The social component of siting opposition can be traced to a phenomenon that sociologists call homophily: individuals tend to bond more closely with those who are similar to themselves. As Rogers and Bhowmik (1970) discuss, homophily promotes the exchange of messages between individuals because communication between similar individuals is more frequent and carries greater credibility (Rogers and Bhowmik, 1970). This phenomenon also has a spatial component: individuals that share similar values and beliefs tend to group together geographically (McPherson et al., 2001, p. 419). And geography also determines, to some degree, the "thickness" of the relationship: those living closer to each other have more frequent contact and frequent contact tends to amplify homophilly (McPherson et al., 2001, p. 430).

Homophilly is behind the argument that Soini et al. (2011) make: groups of people that share similar backgrounds often live near each other and this shared background leads to "similar attitudes" on the landscape and its features (Soini et al., 2011, p. 296). How one views the landscape, Soini and her coauthors argue, can be tied in part to a person's attitude toward the environment and their economic concerns. For those who earn their living from agriculture, the landscape can be seen as a source of income; for others, the landscape may be associated with recreational activities.

The role of community based organizations

Collective organizations of one kind or another have a long history in natural resource management (Pretty and Ward, 2001). Although the definition of community-based organization (CBO) can vary widely, in the siting context, a CBO is usually an advocacy organization representing a specific community or segment of a community (Borden and Perkins, 2003). CBOs play a major role in how effectively a community is able to oppose a given project. Gross (2007) finds that community-based organizations (CBOs) may spring up in response to the perceived threat of infrastructure projects, especially if residents believe that the process is not fair or that their concerns have been ignored (p. 2732).

Boudet and Ortolano (2010) develop a useful approach for understanding how CBOs interact with individuals and the broader social context. After a project proposal generates a "shock" within a community, residents who are adversely affected assess the project risks and then evaluate the social resources (including existing organizations) available to contest the project (p. 8). In their case-based analysis of two attempts to site LNG terminals in California, Boudet and Ortolano find that existing organizations and associated "social capital" (such as trained activists) can play an important role in successfully opposing projects—however, networks of educated professionals can compensate for a lack of social capital by creating ad hoc groups to oppose projects (p. 14).

In summary, social interaction plays an important role in the development of individual attitudes. A community's sense of a place helps shape what an individual believes about a landscape and thus whether a project is appropriately placed. Social knowledge may be more important than personal knowledge in shaping an individual's attitudes toward the project, the process and the actors. Person-to-person communication may be especially important in individual risk perception. And since homophily leads to geographic proximity, and proximity increases interaction and improves credibility, a project may be viewed as an intrusion by an outside developer that violates shared community beliefs.

The siting process and political context

Now that we have reviewed research on the individual and social levels, we turn to examine the institutional level with a focus on the siting process and the broader political context. It is important to consider both of these areas because the political context determines the environment in which the siting process operates. Despite the pivotal role that institutions play, most of the siting literature has given little attention to this level of analysis. In this section, we will look briefly at how the national political context influences siting and then examine environmental impact assessment, and collaborative planning.

National political context

The political context has a powerful impact on how energy projects are sited. Since transmission lines usually cross many sub-national boundaries (and sometimes international ones as well) they often require substantial political negotiation within a country (Elliott and Wadley, 2012) and thus the openness of the national political system is important to consider. Boudet and Ortolano (2010) observe that project opponents will make use of a variety of strategies that include participating in the formal siting process, acting outside of the process, or some combination (p. 4). To better understand when opponents succeed or fail, the authors argue for a model that considers the threat created by the project, the level of "political opportunity" in the region, the resources (both material and organizational) available for opposition and the level of trust. Political opportunity refers to the "ripeness of the political environment for collective action" (p. 14). Based on social movement theory, Boudet and Ortolano indentify the key aspects as the level of openness of decision-making institutions, the stability of "elite alignments" and the presence or absence of elite oppositional allies. In this model, the political level serves as a constraint on collective action as well as containing elites who can help or hurt movements.

Toke et al. (2008) also argue that the institutional level is critical to understanding project outcomes. From examining previous literature on the siting of wind power in six European nations, the authors identify four key sets of factors that explain the differences in level of implementation: the planning rules that shape how a project can be sited, the financial incentives offered by governments, the activity of environmental NGOs, and how the energy assets are owned (Toke et al., 2008). Toke and coauthors observe that nations differ significantly in what level of government is responsible for siting infrastructure. And they determine that *where* the proposals are first evaluated in the political system is key: if outside proponents or national governments try to site projects without involving the local community, mistrust is often the result (Toke et al., 2008, p. 1136).

Although planning processes vary from nation to nation, environmental impact assessment has become a common framework underpinning the formal siting decisions made by politicians and agencies.

Environmental impact assessment processes

Environmental impact assessment (EIA) involves analyzing the likely environmental impacts of a project in a multidisciplinary fashion, presenting the information to the public and decision makers, and taking public and stakeholder comment into account in the final decision. After the US systematized EIA in the National Environmental Policy Act (NEPA) of 1969, some form of assessment has been required by all US states, and in a growing number of nations around the world (Wathern, 1988, p. 3). The European Union requires EIA for public and private infrastructure projects that are thought to have significant environmental impacts (European Commission, 2012). Most nations in Asia, including China, Korea, Japan, Indonesia and India require some form of EIA before major projects can proceed.

Although the exact structure of EIA processes varies, siting of an HVTL usually begins with a project sponsor proposing a project and the regulatory agency preparing a broad environmental assessment (EA). If the EA finds the possibility of significant impacts then a more detailed analysis, often called an Environmental Impact Statement (EIS) is required. This more detailed and substantial review involves pubic notification of the project proposal, public involvement in scoping, preparation of a draft EIS, public review and comment on the draft EIS, preparation of a final EIS that takes public comment into account, and then public communication of the findings before the record of decision is created (NEPA, 1969).

Depending on the nomenclature used by the EIA system, a full environmental impact statement can be avoided if a project is granted one of several exclusions or findings. Under NEPA (1969) a Categorical Exclusion (CE) is a category of programs or policies (usually related to maintenance) that an agency has determined have little or no impact and thus do not require EA or an EIS. Another way to avoid a full EIS is when the EA leads to a Finding of No Significant Impact (FONSI), or a Mitigated FONSI (where impacts are found but can be effectively mitigated). Project proponents have significant incentives to push for a FONSI to avoid the delay, scrutiny and cost associated with an EIS. Mitigated FONSIs are being used with increasing frequency over EIS processes (Hendry, 2004, p. 102).

Scholars and practitioners have found significant problems with environmental impact assessment. Doelle and John Sinclair (2006) argue that the process-based approach of EIA lacks standards and neglects outcomes. In many cases, even meeting the process-based milestones can be a challenge as members of the public may not have the time or resources needed to participate in technical siting decisions (Doelle and John Sinclair, 2006, p. 187). Jay et al. (2007) find that although creation of a full EIS can result in "modest fine tuning" of projects, EIAs usually fail to substantially change the scope and nature of development. However, the process does result in indirect benefits by raising "environmental awareness" among stakeholders, which contributes to the development of lower-impact projects in the future.

Public participation and trust in institutions

One of the problems with EIAs can be a lack of trust in the lead agency for the siting process. Research from several different disciplines indentifies trust as a key factor in support or opposition to a project. Most broadly, Wildavsky and Dake (1990) make the case that trust in institutions is the key feature that distinguishes those who hold hierarchical values from egalitarians (the latter of these groups perceiving more risk from energy projects). Jenkin-Smith's (2009) work on a nuclear waste facility in New Mexico also finds that trust in government (in this case state government) was associated with greater support for the project. At the level of project planning, Schively (2007) finds a consensus in the literature that lack of trust in government stimulates opposition, and that concerns about the fairness of the siting process set the stage for conflict.

Hunter and Leyden (1995) finds that the level of trust residents have in the proponents of a project, as well as in the *opponents* to a project, both impact outcomes. Those who do not trust the sponsors of the project will be more likely to oppose it, while those who find that opponents have blown the dispute out of proportion will be more likely to support the project. Devine-Wright and Howes (2010) also emphasize that a perceived lack of honesty among opposition groups reduces a person's desire to oppose a given project. Devine-Wright (2009) finds evidence that the institutional context influences individual level sentiment through sense of efficacy; if individuals believe they can be effective in their political goals, they are more likely to engage with the political process.

Gross (2007) also emphasizes the key role of trust and highlights perceptions of procedural fairness. Gross argues that one of the primary drivers behind opposition to the wind projects that she analyzes in Australia is that residents felt that they had no "voice" in the process. According to Gross, people in the area came together to create a community-based organization to protest the project because there was a lack of information and notification, and residents felt ignored and excluded (Gross, 2007, p. 2732).

There is substantial evidence in the planning and political science literature that ensuring robust public participation and making use of collaborative planning approaches can significantly reduce conflict. Beierle and Konisky (1999), in a study of planning in the Great Lakes region, find that an "open, fair" participatory process is associated with greater trust and better policy outcomes. A process that is well structured, clear and involves authentic communication between participants has been shown to reduce conflict. A collaborative approach to public participation is also likely to improve participant knowledge of the issues and their sense of procedural fairness. This calls to mind the benefits from "procedural justice" that Gross (2007) attributes to a collaborative approach to infrastructure planning. Schively (2007) also finds that institutions that reduce uncertainty and improve "social trust," can be used to address objections to LULU projects.

Results: outlining and applying a framework for siting HVTLs

A theoretical framework helps analysts identify critical variables and the relationships among the elements (Ostrom, 2007).

Responding to calls by Priestley (1992) and Devine-Wright (2005) to extend existing theory, we present an integrated, multi-level theoretical framework in the next section.

An integrated theoretical framework to explain infrastructure siting outcomes

Starting at *Box 1* we account for what type of landscape the project will be built in (e.g., a park, existing right-of-way, etc.) and also the technical details of the proposal (e.g., tower height) as depicted by *Box 3*. We connect these landscape and project attributes to individual attitudes via *Link A*, which shows information conveyed directly or indirectly by the news media (dotted line from *Box 2*). This draws on work by Furby et al. (1988), Priestley (1992) and Elliott and Wadley (2012) that project characteristics influence individual attitudes, and also on work by Wolsink (2000) and Devine-Wright (2009) that the land use attributes of the site are also important. In other words, both what kind of project and where it is to be built influences individual perceptions. Although a full discussion of the media is beyond the scope of this paper, we depict the media's role based on work by Devine-Wright (2009) that finds that indirect sources of information may be more important than direct experience and also on classic theory in communications, which finds that the media can distort and bias messages (Corman et al., 2007).

In *Box 4*, we depict an individual's evaluation processes. We base this on a simplified version of Devine-Wright's (2009) psychosocial model combined with work by Gross (2007). According to Devine-Wright's model, a person takes in multiple streams of information about a project and forms their judgment via a series of steps that involve social interaction, such as communication with neighbors, as shown by *Link B*. Drawing on Gross (2007), these social interactions can also influence a person's sense of fairness regarding the process, information about the project site, perceptions of project impacts, trust in actors, and personal political efficacy. Disruption to sense of place by a project is most likely to generate oppositional behavior when people feel politically powerful and distrustful. Personal efficacy is also influenced by the socio-political context. *Link C* depicts how individuals in a community may organize to create a community-based organization (CBO) and how the CBO (*Box 5*) will then attempt to shape individual attitudes and behavior (Gross, 2007).

Link D depicts participation in the siting process and/or participation in political or legal activities such as lobbying elected officials or filing a lawsuit (NEPA, 1969). As discussed by Jay et al. (2007) since the formal EIR process often results in only modest changes to the proposal, actors who are dissatisfied may go outside the siting process.

Box 6 represents the formal stakeholders: different levels of government, federal and state regulatory agencies, and NGOs (e.g., environmental and off-road groups) and *Box 7* depicts the project developer. As discussed by Schively (2007), a range of stakeholders are usually involved in major siting decisions and their views on the facility may vary considerably. As shown by *Link D*, a range of stakeholders may participate in both the siting process and in extra-process lobbying or legal actions.

In *Box 8*, the siting process is represented. The typical EIA process involves public notification of the project and public comment on the draft and final proposals via public events and/or written comments. Doelle and John Sinclair (2006) observe that meeting process goals for the EIA process can be challenging given the cognitive limits of actors.

Box 9 depicts extra-process political and legal activity, which is common in major projects and includes lobbying of decisions makers outside the siting process, and/or legal action. As shown by *Link E*, a project may receive formal approval, but face contemporaneous or subsequent political or legal challenge compelling reevaluation by regulatory agencies. The outcome as shown by *Box 10*, flows from the siting process as it interacts with political and legal institutions.

Applying the framework to the Tehachapi renewable transmission line

We now use the framework established in Fig. 1 to help explain the project outcome for the Tehachapi Renewable Transmission Project (TRTP) as a case example. Southern California Edison (SCE) is building TRTP to connect renewable generation facilities in Kern County with customers in Los Angeles and San Bernardino Counties. The 250-mile, $2.1 billion project includes both the construction of new 500-kV transmission lines and upgrades of existing transmission lines and substations (CPUC, 2009). After winning approval in 2009 for all segments and beginning construction, a protracted legal and political campaign has compelled the California Public Utilities Commission (CPUC) to revisit approval of Segment 8, a five-mile section that runs through the community of Chino Hills. After ordering a halt to construction in November of 2011, CPUC has required the SCE to reevaluate the feasibility of placing Segment 8 underground (Tasci, 2012a; CPUC, 2011). The TRTP provides us support for the use of our meso-level framework, as it highlights the critical importance of how strong individual and community level opposition are ultimately conditioned by higher order social and institutional factors.

Beginning with the Siting Process (*Box 8*), we observe that the CPUC required a full EIS as is standard for major HVTL projects. The public and many stakeholders commented on the TRTP scoping plan, draft EIS and final EIR (*Links D*). The City of Chino Hills developed an alternative route for the power line that ran through the neighboring Chino Hills State Park. The Park had existing power line ROWs through it, but according to the State Parks Foundation, routing TRTP through Chino Hills state park would have required amending the land use General Plan, which would have taken an additional 8–15 months (CSPF, 2009, p. F.B-63), which was apparently more of a delay than regulators were willing to risk.

Next, considering the land Use Attributes (*Box 1*) of the project, we observe that the existing right-of-way, which has been in place over 60 years and currently serves as buffer for a 220-kV line on 60-foot steel lattice towers, is visually perceived as park-like and has a trail that runs through a portion of it. The Project Attributes (*Box 3*) for this segment are an upgrade of the existing structures to accommodate a dual-circuit 500-kV transmission line on 198′ tubular steel poles. The width of the right of way through Chino Hills is only 150′, meaning that a fallen pole would extend from the centerline approximately 125′ past the right of way. Residents learned about the landscape context directly from viewing the area or visiting it, from media coverage (*Link A*), and/or from social interaction (*Link B*).

Looking at Individual Psycho Social Process (*Box 4*, *Step 1*) we observed that nearby residents became keenly aware of the project, especially as construction began and the new towers were placed in the existing ROW. In Evaluating Project Impacts (*Step 2*), residents next to the ROW evaluated the costs and risks as very high. One resident adjacent to the HVTL was told by a project engineer that they would have to install a ground to the metal fence surrounding their backyard, and that their swimming pool would no longer be usable due to electromagnetic fields coming from the line (Nelson, 2012). In Evaluating Whether to Act (*Step 3*) we observe that hundreds of residents believed that their input into the process would potentially be effective, and subsequently submitted comments to the EIR process.

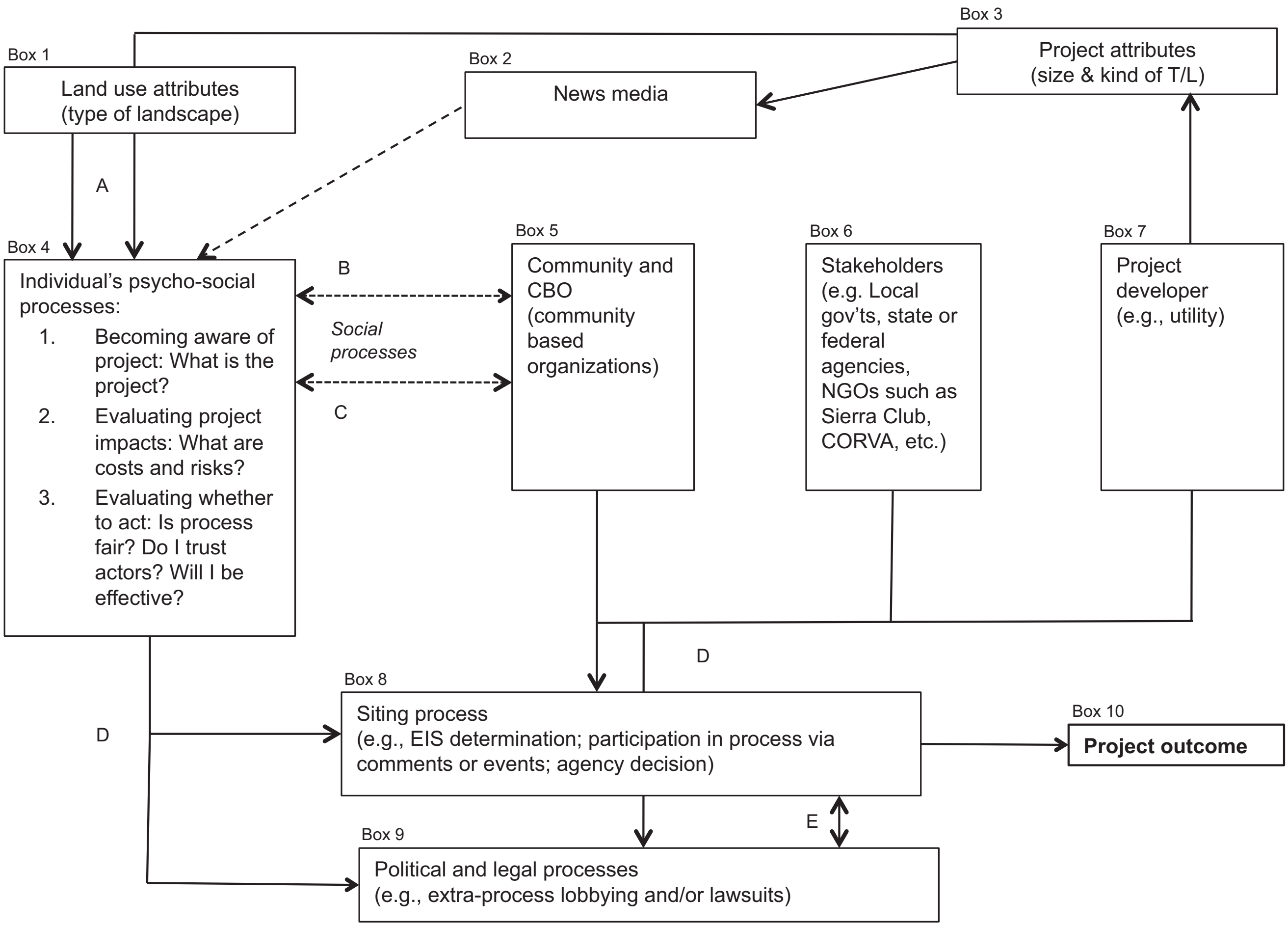

Fig. 1. Integrated theoretical framework to explain infrastructure siting outcomes.

Community based organizations (*Box 5*), such as Citizens for the Alternative Routing of Electricity and Hope for the Hills, were active during the campaign and articulated a message of concern over "health, safety and property values" that amplified individual perceptions of risk (Tasci, 2011). Using protests, social media and the Internet (Hope for the Hills, 2012), the group was able to help shape individual views of the process and participants, and lobby elected officials and regulators. Of the 237 comments on the TRTP public scoping plan, nearly 80% were from residents of Chino Hills (CPUC, 2009). Besides citizen comments, there was wide stakeholder involvement (*Box 6*) including 19 municipalities or public agencies, 10 private companies, and six environmental or community groups (CPUC, 2009).

The CPUC issued a decision in December of 2009 granting the certificate for the line in the utility's preferred route through Chino Hills. The City of Chino Hills immediately began to use the Legal Process (*Box 9*) to launch several challenges to the decision. The City has spent more than $4-million dollars over four years in attempts stop the project from going above-ground through Chino Hills (*Link E*). However, due to the Garamendi Principles, which encourage the use of existing right-of-ways, the City's legal challenges were not able to stop the project (Tasci, 2012a). Ultimately, the lobbying efforts of the community motivated political officials to force the CPUC to reconsider their decision and suspend construction (*Link E*).

Citizen's trust in the CPUC was low, given that the CPUC was also tasked with meeting the state RPS goals and this was perceived as conflicting with protecting the interests of area residents. The citizen group Hope for the Hills (2012) states, "the state entity that should be protecting families, voted against these viable alternatives and the concerns of thousands of families." The President of the CPUC and the CPUC's chief legal officer were both criticized by opposition groups for being too close to the industries that they were in charge of regulating (Worth, 2011).

In summary, segment 8 of TRTP was permitted by the CPUC in spite of sizable citizen opposition expressed through the siting process and through legal and political channels. A more socially desirable route through a neighboring park was dismissed because of the delays this route would have required. Opposition to the routing was intense, in part due to residents' lack of trust in the CPUC, which was perceived as more concerned with renewable energy than social protection.

Despite failing in the courts, political lobbying by the City, Hope for the Hills and residents created enough pressure to cause the CPUC, in November of 2011, to require SCE to stop work on the segment through Chino Hills. According to the most recent rulings, SCE has been required to submit engineering studies for alternative underground options (CPUC, 2011). After touring the disputed project site, CPUC President Michael R. Peevey stated that they were reacting to residents' concerns regarding the "extremely close proximity" of the project to homes. Commissioner Timothy Alan Simon concurred, saying that the "local impact issues" of the project warranted further review (CPUC, 2011a).

The CPUC order was issued after several years of direct lobbying and protest by Hope for the Hills and local residents (*Link D*). The CBO lobbied local elected officials to intervene on behalf of residents, and eventually had all the relevant elected officials at the local, state and federal levels communicating with the CPUC. At a hearing held by US congressional representatives in December of 2011, an estimated 450 to 500 residents attended, many wearing shirts showing affiliation with Hope for the Hills (Cruz, 2012; Tasci, 2012b).

Conclusion

While the outcome of the TRTP through Chino Hills is still uncertain at the time of this writing, three conclusions are clear: intense citizen and municipal opposition could not (at least initially) overcome California regulators' statutory requirement for using existing ROWs to site new HVTLs. The State Park land use plan constrained regulators' choices by effectively excluding the alternate route for the TRTP through the park. Community-based opposition was eventually able to delay construction of the TRTP, but only after a vigorous, multi-year political lobbying effort that engaged a range of elected officials, regulators, media and the project sponsor.

The theoretical implications from the analysis are equally clear. A multi-level and multi-disciplinary framework that integrates existing theory best explains project outcomes. We find evidence that the perceived externalities created by HVTLs, taken in the overall landscape context, drive individual opinion, but do not necessarily decide project outcomes. Risks of health and safety, and impacts on esthetics and property values, are all salient at the individual level—especially as facilities grow in scale. However, the perceived risk of energy infrastructure and a person's sense of efficacy are mediated by social processes and the broader political context.

Although individual opposition is a necessary ingredient, without social interaction and resources, and a conducive institutional setting, it will probably not be sufficient to stop a large-scale project. The community at large shapes an individual's "sense of place," their sense of the impact of the project, as well as their level of trust in the actors and in the siting process. When individual opposition is high, those living near each other may create CBOs, which are effective at improving an individual's sense of efficacy and intensifying the ability of residents to lobby elected officials and other stakeholders. Without this group interaction, individual opposition to projects may have limited impact on large-scale projects like HVTLs.

Another important area of interaction is between the institutional level and the social and individual levels. Different political systems provide different levels of openness regarding land use planning decisions. However, in a range of contexts, if individuals perceive that the siting process is fair, they are more likely to participate. If there is a sense of trust in the process, participants will be more likely to accept results that are counter to their perceived interests.

There are several things that researchers can do to improve understanding of opposition to HVTLs and other locally unwanted land uses. Although substantial empirical research has been carried out regarding perceptions of HVTLs, previous efforts have been limited by small sample sizes and the atheoretical application of methods. Contemporary opinion research on HVTLs in the public realm is limited. All of the research surveyed in Priestley (1992) is at least two decades old (and in many cases older) and perceptions of transmission lines may have changed significantly in the intervening years. Future studies should include larger sample sizes and compare the perceptions of residents of different areas.

Research in this vein should include questions that build off of past efforts summarized by Priestley (1992) and Soini et al. (2011), while also including questions designed to understand social interaction. Focus-group approaches, such as the approach used by Elliott and Wadley (2012) in Australia, also present opportunities to better understand individual and social drivers. Research at the institutional level is also needed to better balance the needs of local communities against broader regional or national energy policies.

The framework presented above is broadly applicable to the siting of high-voltage transmission lines and other kinds of infrastructure in non-authoritarian nations. Although social patterns and the institutional context varies across different societies, we believe the theories presented are generalizable across a wide range of nations. The physical, individual, social and institutional dynamics that influence siting are complex, but we hope the framework presented here will shed light on the interactions and provide a structure for further inquiry.

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