Briefing Document

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Understanding Costs Associated With Wind Energy Opposition and Stakeholder Engagement

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Introduction

The first deliverable for IEA Wind Task 28, Work Package 2 was an annotated bibliography that identified key pieces of literature that quantify the costs of opposition to wind energy projects. Although robust wind social acceptance literature exists, Task 28's efforts highlighted that there has been little research directly quantifying the cost of opposition, engagement, delays, and failures. To directly summarize the appropriate literature and provide context for potential future work, we conducted a literature review that ranged from directly relevant articles to works providing context and valuable information for our research objective in the future. This associated deliverable—a briefing document summarizing the outcomes of our literature search—is meant to guide future research on opposition to wind energy for IEA Wind Task 28 and beyond.

Literature Review Outcomes

The literature review indicated that although acceptance, equity, and techno-economic factors are well-researched and published, literature that specifically quantifies the cost of opposition, delays, and failures (either through modeled or empirical data) is sparse. However, some recent publications have started to address the costs of opposition more directly. This effort was able to identify just two resources that provide opposition cost quantification approaches.

The first and the most directly applicable journal article to our research objective was *Public Acceptance of Renewable Electricity Generation and Transmission Network Developments: Insights from Ireland* (Koecklin et al. 2021). This article outlines the costs to energy users at varying levels of opposition and explores the impacts of attitudes toward land-based wind development and transmission on consumer energy costs. The study uses a power systems generation and transmission expansion planning model with integrated public acceptance parameters to evaluate three renewable energy development scenarios. The research used the Ireland power system as the case study. The outcomes of this study indicate that using power system modeling to determine consumer costs will need to include public acceptance variables. For example, study participants were generally supportive of wind energy development but were less supportive of it near their homes, and even less supportive of transmission infrastructure like

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towers and transmission lines. The model produced three scenarios, all of which were in a high-renewable-penetration future. In these scenarios, energy costs increased by up to 33% when the highest opposition scenario costs were included in the analysis. These costs were primarily the value of lost load.[3] However, even discounting the value of lost load, costs for investment and operations increase by 5%–6% in high-opposition scenarios.

The second recent publication directly addressing the cost of opposition was *The Economic Costs of NIMBYism - Evidence From Renewable Energy Projects* (Jarvis 2021). This analysis, which was focused on the United Kingdom, estimates the economic costs of local opposition in the siting of renewable energy projects. The research draws on detailed planning data for all wind and solar projects in the United Kingdom, including information on projects that were not approved, and cost estimates are primarily derived based on hedonic models of local property value impacts. The author finds that planning officials place particular weight on local factors (particularly property value impacts) in their decision making, which has resulted in beneficial projects being rejected and therefore increasing the cost of deploying U.K. wind power by 10%–29%. Much of the increase in project cost can be attributed to the fragmented and localized nature of the planning process.

When considering the cost of community engagement, researchers at the National Renewable Energy Laboratory conducted a foundational study outlining the costs of public engagement in the United States. The study, *An initial evaluation of siting considerations on current and future wind deployment* (Tegen et al. 2016), explored the impact on development costs from three siting considerations: wildlife, radar, and public engagement. According to the empirical and anecdotal evidence, all siting considerations were linked to higher development costs and timelines. The study outlines ranges for cost across the three types of siting considerations for an average 100-megawatt wind project: public engagement ($1,319,000–$5,581,000), wildlife ($1,623,000–$6,697,000), and radar ($30,000–$710,000). This study also investigated the overall sector costs per completed wind farm. The interviews and data collected indicated that it would take 2 to 4 times the estimated cost of a wind farm when researchers included sunk costs across all failed projects. This study used interviews with industry stakeholders to calculate the cost ranges.

[3] The value of lost load is a quantitative measure of the costs associated with an interruption of power supply.

Associated Literature and Research

An important outcome of the literature review was identifying where current related but not directly applicable literature could help advance the cost of opposition research and methods. We classified the literature into three themes:

1. Classification of opposition criteria
2. Classification of effective stakeholder engagement
3. Quantification of barriers to wind energy development.

The IEA Wind Task 28 team included these adjacent resources to inform research design and potential research projects to continue to define the costs of opposition to wind energy. The classification of opposition criteria studies indicated what projects or scenarios may have higher instances of opposition. Conversely, the effective stakeholder engagement literature highlights what procedures/processes and the types of communities have not met projects with opposition. This literature will help us classify the criteria around opposition as well as provide potential methods to quantify the costs of those criteria. Finally, the literature quantifying the costs of barriers to wind development could influence future methods and thinking in calculating the cost of opposition to wind energy deployment. Associated references are included in the additional references section of this briefing paper.

Challenges

The current literature highlights several challenges to driving research on the cost of opposition to wind energy. The first major challenge is defining what costs and to whom are important to understand. For example, Koecklin et al. (2021) calculated the additional energy burden costs for consumers by using the value of the lost load. However, these costs could be approached from the developer, utility, or even more cosmopolitan societal costs like health outcomes.

Table 1. Opposition Costs Potential Approaches

Stakeholder	Cost Type
Energy users	Energy costs, tax
Communities	Lost tax revenue, jobs
Developers	Project cost, failed projects costs
Societal	Cost of carbon abated, health

The current literature also indicates several challenges in determining what factors contribute to opposition. An important challenge and current limitation is the interplay and co-dependence between social science research (e.g., surveys and interviews) and quantitative modeling research. The limited studies that do attempt to model direct costs of opposition, delays, and failures typically rely on a set of assumptions for those cost estimates; these baseline input data rely on prior survey-based research. For example, LaPatin et al. (2022) rely on the survey data and regression model results from Firestone et al. (2018) and Hoen et al. (2019), both of which were derived from the National Survey of Wind Project Neighbors in the U.S. led by Lawrence Berkeley National Laboratory. While that prior research provides key input parameters for LaPatin et al.'s model, the model also assumes a cost per day of delay (in the construction phase) of $7,500—a value that was not derived from prior literature or validated. Our literature review demonstrated a lack of the baseline input data necessary to quantitatively model and estimate direct costs of opposition, delays, and failures. That baseline data (for example estimates and ranges of the cost per day of delayed construction) could be gathered via surveys and/or interviews across a large sample of project developers; but such work has yet to be conducted.

Research Paths and Design

Our literature review revealed that a lack of baseline input data is preventing meaningful research advancement in estimating direct costs of wind project opposition, delays, and failures. Therefore, the clear priority from a research standpoint is to gather and make public such baseline data.

Examples of such baseline inputs that are necessary include, but are not limited to:

- Share (or annual number) of proposed projects that are abandoned due to public opposition
- Share of proposed projects that are delayed due to public opposition
- Typical duration (and range) of delays
- Typical cost (and range) associated with delays (per day)
- Typical cost (and range) associated with project failures
- Typical amount (and range) expended on development expense prior to permitting approval
- Typical share (and range) of development expense committed to community engagement activities
- Typical direct payments via land leases and other individual remuneration packages, typical amount (and range) of payments in lieu of taxes
- Typical (and range) amount of local tax expenditures
- Typical nonmonetary community benefit packages
- Timing (in the development process) of such negotiations and offerings.

Such data are not easily accessible. We envision that much of these data could be garnered through a large-sample survey of wind energy project developers, focused on the metrics described earlier. The resulting data could be anonymized and/or aggregated in such a manner that they could be made public for researchers and modelers conducting more advanced analysis. The survey format could also enable more qualitative (open-ended) questions to be answered by project developers about, for example, their perceived effectiveness of various compensation schemes, how costs of delays and failures get wrapped into successful project costs, and best practices for the timing, amount, and forms of community investments to bolster project support. Given that many wind project developers also develop large-scale solar, this developer survey could be applied to other technologies as well. Ideally, the developer survey would be international in scope, enabling comparison across geopolitical contexts and a larger overall sample size.

Once baseline data are collected, analyzed, and made public (likely in aggregated form), they can serve as inputs for a renewed focus on larger-scale modeling research. The models envisioned could build on prior work (such as Koecklin et al. [2021] and LaPatin et al. [2022]) but take advantage of more accurate and refined input data, and account for geographic factors, developer practices, and structural factors (e.g., local tax codes, planning process requirements) with more precision.

Conclusion

A better understanding is needed of the costs, risks, and associated factors of opposition and community engagement strategies related to wind energy. This brief outlines our initial exploration of these topics. Although the literature directly addressing these factors is relatively scarce, there are opportunities to advance this academic space. Further research is needed to define costs of wind project opposition, delays, and failures to various stakeholders (developers, utilities, communities, energy users) and to bridge the gap between the current literature, which identifies the variables that may affect opposition, and a framework that quantifies it.

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