Survey of Utility-Scale Wind and Solar Developers

Robi Nilson, Ben Hoen, Joe Rand, Lawrence Berkeley National Laboratory

In 2023, Berkeley Lab conducted the first of its kind survey of industry professionals with direct experience working in community engagement and permitting of land-based, utility-scale wind and solar energy facilities in the U.S. The survey solicited information about project timelines over the last five years, leading causes of project delays and cancelations, community opposition, experience with permitting authorities, community engagement, comparisons between wind and solar, and other related topics. A total of 123 individuals responded to the survey for a response rate of 19.2%. Respondents were employed at 62 unique companies, which together are responsible for approximately half of the wind and solar developed from 2016 to 2023. For additional information, graphs and analysis, see https://emp.lbl.gov/publications/survey-utility-scale-wind-and-solar.

Project timelines, delays, and cancelations

- Approximately one-third of wind and solar siting applications submitted in the last five years were canceled, while about half experience delays of 6 months or more. Both delays and cancelations are slightly more likely for solar than wind. Delays and cancelations most often occur during permitting but can also occur while establishing site control or under construction.
  - Project cancelations result in average sunk costs (expenses spent on the project that could not be recovered) of more than $2 million per project for solar, and $7.5 million for wind. The sunk cost per megawatt (MW) of electric generating capacity is similar. *
  - Project delays cost approximately $200k per MW for both wind and solar.*

- Most projects take 4-6 years from a project’s initial public announcement to commercial operations date. About 20% of projects take more than 6 years.

- Local ordinances or zoning, grid interconnection, and community opposition are the top three leading causes of project cancelations for both wind and solar (Fig. 1). These are also leading causes of significant delays – with the addition of supply chain as a leading cause of delay for solar.

*Respondents were less likely to answer cost-related questions. Asterisk indicates the information is based on limited sample of approximately one-half to one-third of respondents. The work described in this report was funded by the U.S. Department of Energy’s Wind Energy Technologies Office under Lawrence Berkeley National Laboratory Contract No. DE-AC02-05CH11231. If you have questions or need clarification of any points, please contact Robi Nilson at nmilson@lbl.gov. Interested in other LBNL Electricity Markets and Policy Group publications? Join our notification list here.
When asked about the cause of cancelations for their most recently canceled project, over half of developers indicated more than one primary cause. It can be difficult to disentangle exact causes of delays and cancelations and some causes are interrelated. For example, often, it may have been community opposition to prior project proposals or the expectation of proposals that led to the establishment of the local ordinance or zoning applicable to future projects.

Community opposition

- 4 out of 5 developers are at least moderately concerned that community opposition will get in the way of decarbonization goals. Wind developers were slightly more likely to be “very” concerned about opposition than solar developers, but it is a concern for both groups.

- Project delays due to community opposition on average last 11 months for solar, and 14 months for wind.

- For both wind and solar, opposition is becoming more prevalent and is more expensive to address than it was five years ago. Developers expect this trend to continue, becoming even more prevalent in the next five years.

- The vast majority of developers (about 95%) report that opposition is often caused by a vocal minority. About half report that opposition is more often driven by outsiders, and that opposition is more likely in mid to high income communities than low income communities.

- Developers may avoid communities where they expect opposition, but it can be difficult to predict. Less than one third of developers report that opposition is easy to predict before a project is made public. Most do agree that larger projects are more likely to encounter opposition.

- Developers report visual concerns to be the most likely root cause of community opposition for both wind and solar. Other leading concerns for wind are sound, community character, and property values, and for solar are loss of agricultural land, community character, and property values. Importantly, these reflect respondents’ perceptions of root causes (which may differ from justifications provided by opposition groups) and many causes may be interrelated.
Experience with permitting authorities

- Most developers expect state-based siting authorities to be more predictable and more likely to approve projects, but also more expensive for both large and small wind and solar projects.

- **Expectations regarding project timelines vary based on project size** - about 65% expect local siting authorities to have a more efficient timeline for smaller projects (< 20 MW), but almost half think state-sting authority will be more efficient for large projects (> 100 MW).

- Both wind and solar developers are much more likely to believe that local siting authorization will result in a project with more net benefits to the community compared to state authorization for both small and large projects (Fig. 2).

Figure 2: Developer perceptions of how siting authority affects net benefits to community.

<table>
<thead>
<tr>
<th></th>
<th>Solar respondents (n=74)</th>
<th>Wind respondents (n=35)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Project (&gt;100 MW)</td>
<td>43% Local/municipal</td>
<td>43% Local/municipal</td>
</tr>
<tr>
<td></td>
<td>34% No diff/Unsure</td>
<td>49% No diff/Unsure</td>
</tr>
<tr>
<td>Small Project (&lt;20 MW)</td>
<td>50% State</td>
<td>46% State</td>
</tr>
<tr>
<td></td>
<td>36% No diff/Unsure</td>
<td>51% No diff/Unsure</td>
</tr>
<tr>
<td></td>
<td>14% State</td>
<td>3% State</td>
</tr>
</tbody>
</table>

- Most expect local siting authorization may lead to more community opposition, regardless of technology or project size.

Community engagement

- In general, developers believe that community engagement addresses community concerns and decreases opposition. Most agree that increased engagement results in fewer project cancelations (75%) and local concerns are adequately addressed before project construction (66%).

- Most developers (77%) believe the most appropriate way to engage members of the public in decisions about project development is that the public should provide input, but not recommend or make decisions about projects.

- Typically, developers initiate community engagement after securing site control for a project.

- Many indicated that they expected earlier engagement would have been a good idea for the most recently canceled project they worked on. However, a few noted that early engagement allowed opposition to form which ultimately led to cancelation.

- **There are a wide range of community engagement activities utilized by companies**. In-person meetings with stakeholders, such as at local government meetings or a project open-house are used in most all projects. The least common engagement activities include conducting a poll of public opinion or use of a third-party facilitator.

- Developers rank in-person meetings with stakeholders to be the most effective engagement activities and conducting a poll of public opinion and using social media as the least effective.
• In general, wind developers report slightly higher usage of engagement activities than solar developers. While developers maintain a local office for about half of wind projects, this is less common for solar.

• Developers report they often make many project design changes in response to community feedback (Fig. 3). The three most common for solar are changes to vegetative screening, exclusion of certain properties, and increased setbacks. For wind, the top three are exclusion of certain properties, change to turbine layout, and additional neighbor compensation. For both technologies, inclusion of community subscription or ownership was the least likely to change.

Figure 3. Frequency of reported project changes in response to community feedback.

• On average, wind developers indicate slightly higher spending on community engagement. The cost per MW of community engagement expenditures for the most recent successful project was approximately $1,100 per MW for wind, and approximately $700 per MW for solar. Spending on community engagement was reported to be about five times lower than spending on site control for both wind and solar. Typical community engagement expenditures represent a small fraction of total capital expenditures for both wind and solar.

Comparing wind and solar development

• Most developers expect wind to be somewhat more difficult to site and experience more delays than solar in the future. Wind is also expected to experience more community opposition in the future. Of note, these expectations do not correspond to the reported rates of delays and cancelations for recent wind and solar projects presented above, which may have been affected by supply chain issues.

• Approximately 12% of respondents report their companies are now pursuing more solar because of concerns about community opposition to wind. However, many note that increasingly the development concerns with both technologies are similar. Large solar projects increasingly lead to more trade-offs with current agricultural uses. Wind projects can also require more landowners, which can result in greater spread of benefits and create stronger support base.
Acknowledgements

The authors would like to thank Juan Botero, KC Payne Hirsch, and Michele Boyd from the DOE Solar Energy Technologies Office, Patrick Gilman and Rin Ball from the DOE Wind Energy Technologies Office, and Raphael Tisch and Kendra Kostek from the DOE Office of the Deputy Assistant to the Secretary for Renewable Energy for their contributions to this report. The authors also thank the following experts for providing feedback at various stages during this research: Jeremy Firestone (University of Delaware), Sarah Mills (University of Michigan), Kim Wolske (University of Chicago), Davhi Wilson (Siting Clean), Hillary Clark (American Clean Power Association), and Ben Norris (Solar Energy Industries Association).

Disclaimer and Copyright Notice

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor The Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or The Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof, or The Regents of the University of California. Ernest Orlando Lawrence Berkeley National Laboratory is an equal opportunity employer.

This manuscript has been authored by an author at Lawrence Berkeley National Laboratory under Contract No. DE-AC02-05CH11231 with the U.S. Department of Energy. The U.S. Government retains, and the publisher, by accepting the article for publication, acknowledges, that the U.S. Government retains a non-exclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this manuscript, or allow others to do so, for U.S. Government purposes.

For more information, visit us at https://emp.lbl.gov/
For all of our downloadable publications, visit https://emp.lbl.gov/publications