Pathways to Accelerating Clean Energy: Assessing Non-Cost Barriers

Research Findings Report

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THIRD WAY

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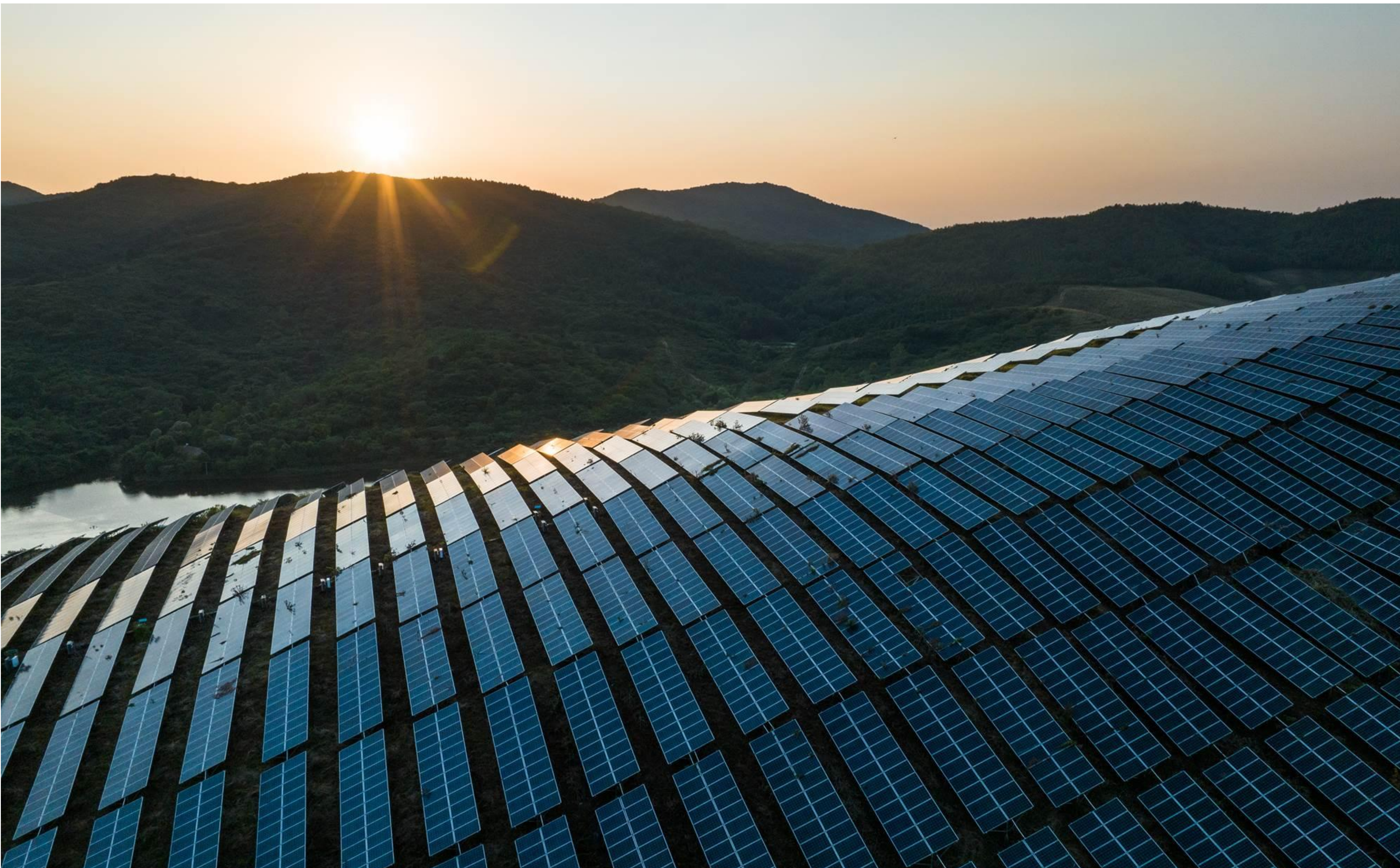

CONTENTS

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EXECUTIVE SUMMARY

Clean energy is cheaper and more readily available than at any other point in US history. Solar and wind are now cost-competitive with oil and gas and, in many cases, less expensive. Other clean technologies aren't far behind. But if costs are no longer the biggest barrier to clean energy deployment in America, what is? Non-financial barriers—from permitting complexity to stakeholder opposition—continue to slow the deployment of utility-scale solar and transmission projects. To better characterize the obstacles blocking further clean energy deployment, Third Way commissioned Environmental Resources Management, Inc. (ERM) to survey more than 200 experienced industry practitioners cumulatively involved in thousands of projects nationwide.

Our research confirms that delays, cancellations, and inefficiencies are widespread across utility-scale solar, and transmission and distribution projects. Though existing literature attributes most of these delays to stakeholder opposition, our research shows the reality is more complex:

- Only a minority of projects face concerted resistance capable of altering or halting development.
- Federal permitting reviews caused the longest delays for new projects, but state and local permitting also slowed deployment significantly.
- Interconnection delays are pervasive, and frequently exacerbated by broader process inefficiencies, rather than isolated technical issues.
- Market design factors—such as capacity markets or renewable portfolio standards—were not the primary drivers of delay.

Our findings point to a clear policy imperative: the United States needs targeted reforms, focused on streamlining permitting, enhancing agency capacity, improving interconnection transparency, and investing in workforce development. The stakes are higher than ever, as electricity demand surges nationwide, energy prices soar, and greenhouse gas emissions continue to climb.

By grounding policy actions in empirical evidence, this report offers actionable pathways to accelerate clean energy deployment and deliver on America's climate and energy goals.

1.0 BACKGROUND

Recent discourse has highlighted both the tangible and perceived obstacles impeding the deployment of large-scale energy infrastructure. These challenges have taken on new urgency as the need to strengthen energy security, reliability, and affordability grows. Even with record levels of public and private investment available to support the expansion and modernization of energy systems, persistent delays and systemic bottlenecks continue to threaten the timely pace of project deployment. These kinds of setbacks risk undermining America's path toward a more resilient, affordable, and accessible energy future.

To dig deeper into what‘s standing in the way of energy projects, Third Way commissioned ERM to inform the *Pathways to Accelerating Clean Energy* initiative, with the goal of shedding light on how barriers beyond financing are affecting the development and completion of critical energy projects. ERM designed the research to identify, and, where feasible, quantify current and anticipated obstacles that slow the build-out of energy infrastructure.

This study focuses on four key questions:

- What factors contribute to prolonged timelines and delays in energy infrastructure development?
- How significant are these delays, can they be quantified, and do they vary by technology, geographic region, or market structure?
- What non-cost barriers—such as regulatory complexity, community engagement, and market design—are most influential in extending project timelines, and how might these be measured?
- Where can targeted policy reforms and practical solutions accelerate progress?

By moving beyond broad categorizations, this analysis seeks to pinpoint specific, actionable reforms that can strengthen the reliability, affordability, and security of the clean energy system, ensuring that infrastructure projects are delivered efficiently and equitably.

2.0 METHODOLOGY

ERM adopted a multi-stage methodology for research designed to yield robust and actionable insights.

We began with a literature review, drawing on recent academic studies, most of which were published in the past three years, government reports, and industry analyses to identify prevailing challenges across utility-scale solar (hereafter referred to as solar), electric transmission and distribution (T&D), and green hydrogen projects. This foundational step informed ERM's subsequent design and administration of two survey instruments and interview protocols with practitioners, developers, and experts spanning project development, permitting, stakeholder engagement, and market operations. This iterative process ensured that our primary data collection addressed gaps in existing research; captured nuanced, real-world experiences; and gathered both quantitative and qualitative perspectives from a diverse respondent pool, representing experience in developing or supporting hundreds of projects nationwide.

A couple of notes on methodological context:

- While the comprehensive literature review helped inform the design and administration of the survey instruments and interview protocols, not every obstacle identified in the literature was quantifiable (lack of clear guidance in permitting regulations, for instance), and there were cases in which the survey results suggested an issue was not as severe as the literature implied (e.g., stakeholder opposition). In other words, survey response did not always corroborate the literature review, as the findings section of the report shows.
- While the initial literature review and first set of surveys and interviews included green hydrogen projects, in response to hydrogen market fluctuations' impact on project developments, we dropped the study of hydrogen technology from our second set of surveys to focus exclusively on solar and T&D projects.

By integrating literature review, survey data, and expert interviews in a logical sequence, our methodology provides a solid basis for understanding the multifaceted obstacles to the deployment of energy infrastructure.

Note: This report was prepared relying on information provided by or on behalf of Third Way and/or other persons. Third Way reviewed the Proposal and the Report for the accuracy and completeness of information provided by or on behalf of Third Way for inclusion in this report and based on its knowledge of the information.

2.1 LITERATURE REVIEW

We began with a literature review to understand the current state of data on the topic and to use this knowledge to guide our survey-based data collection and interviews.

The review focused on academic research, studies, papers, and government publications to determine key barriers and trends across three primary technologies: solar, electric T&D, and green hydrogen. We reviewed more than a dozen resources, most of which were published in the past three years.

Several key themes emerged across the research, indicating that regardless of technology type, most projects are likely to succumb to a similar set of non-cost barriers. While certain barriers are more acute for specific technologies or project types, and dependent upon project scope and location, the research indicated several universal barriers to clean energy deployment, listed below. As mentioned previously, the findings below are not necessarily corroborated by the additional research completed and summarized in this report, but rather are from the literature review only.

- ***Stakeholder engagement/opposition*** was consistently cited as one of the most critical determinants of a project's outcome. This criticality may be due in part to the complex nature of stakeholder engagement and the extensive range of community concerns or opposition that may emerge. This can range from stakeholder desire to be meaningfully included in the process, a lack of familiarity with or safety concerns about the technology, equity and property values, and quality of life. The literature showed that all of these factors have the potential to develop into a project-ending delay. Even when community and stakeholder engagement is done effectively, the literature indicated that the projects could still face setbacks, and that a project's fate may ultimately hinge on the extent of stakeholder opposition. Our survey findings demonstrate, however, that project delays due to stakeholder issues are not as universally prevalent as the literature suggests.
- ***Siting and permitting issues*** *were also cited as prevalent* barriers for most projects. For green hydrogen projects, the need to be close to renewable electricity sources and/or the need for maturity of hydrogen demand centers adds a layer of complication to siting decisions. For solar and T&D, local permitting complexities and community attitudes towards such projects can negatively impact siting and permitting.
- ***The growing interconnection queue*** is recognized in several research studies as a significant chokepoint in the overall system. Regional transmission organizations (RTOs) and independent system operators (ISOs) establish procedures to ensure that newly connected generation sources do not unduly burden the existing transmission system nor create market imbalances or undue market power. The studies to determine new projects' potential burden—and whether new generation in a specific place requires new transmission—are costly and time intensive. The literature also cited mounting interconnection queues as barriers to projects, spotlighting not just the need for more T&D, but areas to improve transparency and efficiency in the interconnection process.
- **A *lack of clear and consistent guidance and planning*** approaches hinders clean energy project development nationwide. A patchwork of state laws, regulatory structures, and

inconsistent and/or unclear local policies complicates project planning and needs assessments, particularly for cross-state projects. Perhaps unsurprisingly, the studies also suggest that a key indicator of a project's success and ability to navigate barriers is the developer's foresight and flexibility.

- Finally, the literature review highlighted ***fragmented regulatory policies and market inefficiencies*** as another critical non-cost barrier to clean energy infrastructure deployment. At the state level, misalignment between public utility commissions and federal approvals often leads to delays or cancellations, underscoring the need for supportive state policies and long-term regional planning. Recent federal rules like Federal Energy Regulatory Commission (FERC) Order No. 1920 aim to streamline long-term transmission planning and cost allocation, though the impact remains to be seen. Market design issues, such as curtailment of solar, supply chain vulnerabilities, and over-reliance on limited suppliers, further constrain project viability. For example, curtailment of solar leads to an excess in generation for projects that do not have sufficient storage capacity or ability to manage supply. This misalignment of market conditions can prevent a project's full attributes from being realized.

Though our literature review provided us with high-quality insight on barriers to energy project development, many existing studies fell short of quantifying the scale of these challenges and, more importantly, assessing how developer planning influences outcomes. To build on this foundation, we conducted a robust survey of practitioners with first-hand project experience across several disciplines, and supplemented these surveys with interviews. Our findings allowed us to validate and quantify the patterns in the existing literature and ground the results with live surveys.

2.2 SURVEYS AND INTERVIEWS

The first survey for the project was designed to gather the perspectives of experienced ERM partners and external experts who have worked across solar, T&D, and green hydrogen projects.

We began by drafting initial question sets informed by the literature review, internal subject-matter expertise, and prior experience with project development in the three technologies of interest. We then reviewed and refined these drafts, incorporating feedback to ensure alignment with project goals and contextual relevance to the research questions. After additional internal review and edits, Third Way approved the final versions of each survey prior to distribution.

We gathered the responses for the first set of surveys from December 2024 through mid-April 2025. We surveyed experts with extensive experience working at various stages of project development in all three technologies (solar, T&D, *and* green hydrogen projects), and also surveyed experts with deep expertise in one of the specific technologies—solar, T&D, *or* green hydrogen.

The first surveys represented feedback from 39 total respondents (including 17 ERM responses and 22 external industry responses). Those surveyed assist project developers and utilities through siting and routing, environmental data collection, permitting, community engagement, agency interactions, and post filing support. The collective accumulated experience of this set of respondents represents well over 1,000 projects—945 T&D, 683 solar, and 48 hydrogen projects.

Once we collected responses, we aggregated the data into the following themes:

- Community and stakeholder practices, along with the challenges encountered;
- Permitting and siting challenges;
- Difficulties in the interconnection process;
- Regulatory and market barriers;
- Additional factors contributing to project delays and their underlying root causes; and
- Suggestions for system reforms and mitigation measures.

Survey respondents were invited to engage in follow-up interviews, aimed to gather feedback and insights to deepen the discussion and inform any policy recommendations.

We then conducted a second, expanded round of interviews that shifted the focus away from hydrogen, given the rapidly changing market context for that technology.[1] Administered between July 22 and August 14, 2025, our second survey included 200 respondents with experience working in utility-scale solar and/or T&D (Figure 1); 82 had only solar project experience, 50 had only T&D project experience, and 68 had experience in both solar and T&D. We distributed survey responses from the 68 respondents with experience in both to either the solar or T&D group based on where they had more experience (Figure 1). As Figure 2 shows, these 200 respondents were highly experienced, with involvement in hundreds of projects. Across solar and T&D, more than 70 percent of respondents have been involved in 50 or more projects. We also sought individuals with backgrounds in renewable energy development; independent power producers; electric utilities; Engineering, Procurement, and Construction firms supporting project development; government representatives; or RTOs/ISOs. We aimed to include those with experience in one or more of the following areas: project planning; land acquisition; stakeholder engagement; project construction; permitting; RTO/ISO operations; financing; permit reviews from government agencies; and environmental assessments, including water, wetland, biological surveys, and cultural evaluations (Figures 3 and 4). We strived to ensure a geographical distribution of the respondents across solar and T&D areas and succeeded in getting a set of respondents with experience across the United States (Figure 5 and 6).

[1] Between late 2024 and mid-2025, the U.S. hydrogen sector experienced significant policy-driven uncertainty that disrupted project momentum. Guidance from the Treasury and IRS around Section 45V under the Inflation Reduction Act, and subsequent legislative changes impacting eligibility timelines for tax credits, created uncertainty, impacted developer planning horizons, and slowed investment decisions. These developments collectively diminished confidence in hydrogen's near-term viability, prompting our research to focus on solar and transmission projects for the second survey.

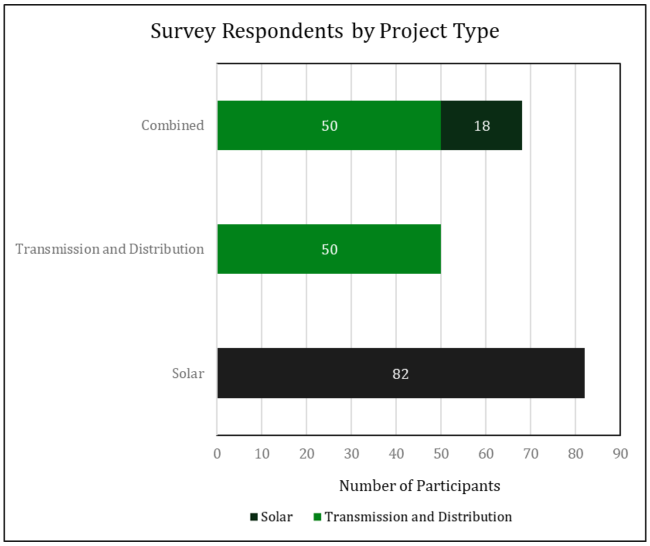

Figure 1: Based on the second survey, the number of respondents by technology.

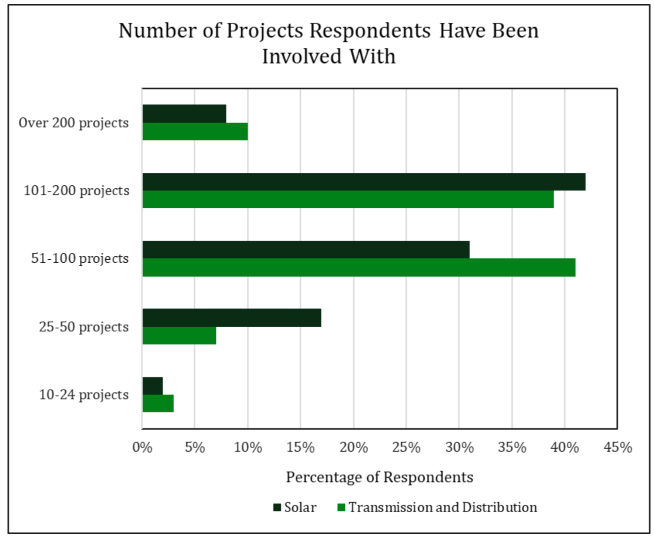

Figure 2: Based on the second survey, the number of projects respondents have experience in.

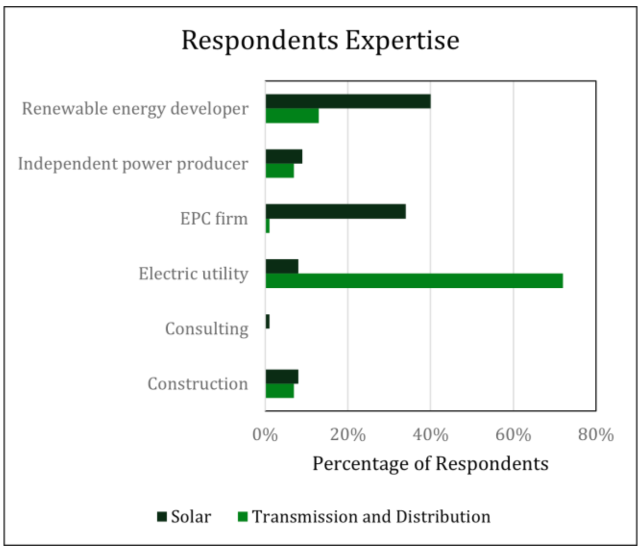

Figure 3: Based on the second survey, the range of expertise of the survey respondents.

Job Roles of Respondents

Project planning	74%
Land acquisition	25%
Stakeholder engagement	47%
Project construction	40%
Permit applications	57%
Submission to independent system operators/ regional transmission authorities	26%
Financing	43%
Permit reviews (govt agencies)	18%
Cultural heritage analysis	20%
Environmental assessments (water, wetland, biological surveys)	28%
Construction operations	22%

Figure 4: Based on the second survey, this table shows the range of job roles held by the survey respondents.

The second survey was designed, distributed, and conducted using Computer Assisted Telephone Interviewing (CATI) techniques. CATI involves creating an online survey that an interviewer administers by calling respondents, adhering to a scripted format, and recording their answers to ensure the collection of efficient, consistent, and high-quality data. This method was selected to guarantee uniform interpretation of the survey questions and to maintain data integrity while reaching a diverse array of respondents across various project disciplines nationwide.

As Figures 5 and 6 show, respondents had experience across a diverse set of states and localities nationwide. Respondents across T&D and solar have deep experience in states that are seeing a lot of project activity, such as Texas, California, Illinois, New York, and Colorado, and states which have some activity, but not as much, like Pennsylvania, Virginia, Idaho, and Washington. Our respondents, and their insights, are thus representative of locations with a range of project activity levels, enriching the findings with different permitting and community perspectives. Despite this location diversity, we did not find any differences in barriers between the locations. This is not to conclude that locational differences do not exist, but rather that, given that there are overlapping barriers that impact a project, location as the primary driver of a barrier could not be isolated in our research. Furthermore, many of the barriers are common across the locations, making isolating locational impact harder. Given the geographical distribution of respondents and their breadth of professional experience, we believe that the results are representative of the reality on-the-ground and therefore worth noting.

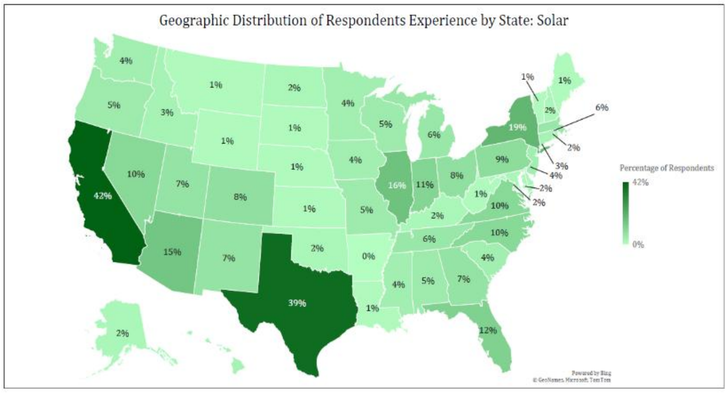

Figure 5: Geographical experience of respondents for solar, based on the second survey; aligns with where activity is.

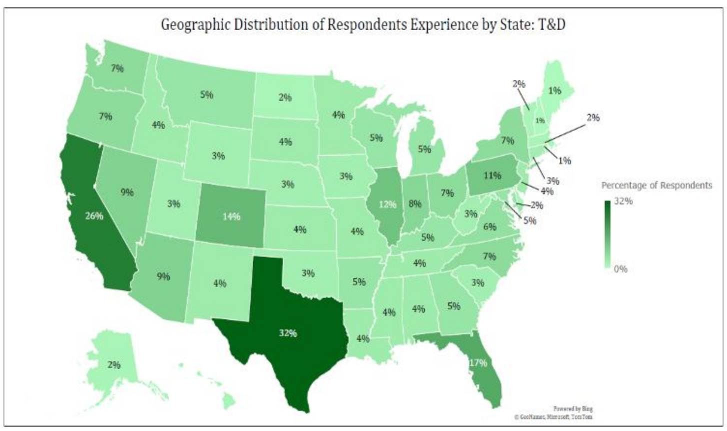

Figure 6: Geographical experience of respondents for T&D, based on the second survey; aligns with where activity is.

Between the two sets of surveys, we reached a total of 239 respondents with a broad and deep bench of experience across a variety of technologies, project functional areas, organizational perspectives, and states. We believe that this provides a very robust data set which makes our findings, detailed in Section 3 of this report, noteworthy. In some cases, our findings corroborate the barriers identified in the literature review, and in other cases they provide quantification that suggests that the barriers discussed in the literature may not be as significant as the literature presents. Overall, we believe that the quantification of the barriers helps provide foundation for this discussion.

3.0 FINDINGS

The interviews largely confirmed the presence of the barriers in practice that we identified in the literature review, reinforcing the validity of the literature. Stakeholder opposition, permitting complexity, and interconnection delays remain persistent challenges across solar and T&D. However, the degree of alignment between literature and survey data was not absolute. While the literature often emphasized the severity of certain barriers—particularly interconnection and regulatory hurdles—our quantification suggests a more nuanced and complex picture. For instance, although interconnection was cited by over half of the respondents in our survey as a critical-path delay, and interconnection queues are long, developers frequently described these issues as part of broader process inefficiencies rather than independent barriers. Respondents in our interviews described scenarios where stakeholder-driven design changes can cause cascading delays in interconnection if they necessitate new cable routes or relocation of panels leading to revisiting the interconnection studies, permitting, queue status, equipment procurement, and schedule coordination. Given that interconnection processes are already stretched and queued, such additional changes become material risks to timeline adherence. Similarly, regulatory and market design concerns, while prominent in academic and policy discourse, did not emerge as top-ranked drivers of delay in our survey responses. Barriers that aligned with literature review findings, such as stakeholder opposition, were not found to be as impactful to projects across-the-board as it might seem from the literature.

This divergence underscores an important insight: barriers identified in research are real, but the impact of each barrier on specific projects varies by project type, developer capacity, project timing, and recent history of projects in the local region.

It is also important to note the differences between permitting and regulatory barriers. Permitting barriers are obstacles that arise during the process of obtaining approvals for a specific energy project. These include delays in environmental reviews, lengthy agency coordination, or unclear application procedures, and can vary by location and project type. Regulatory barriers, on the other hand, are broader legal or policy constraints that affect entire categories of projects. These can include restrictive zoning laws, outdated codes, or limits on certain technologies, and they often require legislative or policy changes to resolve. For example, zoning laws can limit the scale or location of renewable energy projects by enforcing minimum lot sizes, setbacks, or height restrictions, while some jurisdictions impose moratoriums that temporarily halt the development of projects altogether, further delaying clean energy deployment. .

3.1 PROJECT DELAYS

3.1.1 WHAT “IS” A DELAY?

It is important to clarify what constitutes a “delay” in the context of stakeholder engagement, permitting, siting, interconnection, and other project development milestones. A general finding reiterated in the data and by respondents was that if project-development activities (stakeholder engagement, permitting, etc.) are not incorporated into the initial project schedule, or were incorporated but with an unrealistic (optimistic) timeline, integrating them later, or adding time that should have been planned for, may be perceived and reported as a delay.

Robust stakeholder engagement and planning time is a mark of sound project development and best practice. While early and meaningful engagement may appear to "extend the timeline" on paper, experts we interviewed emphasized that it often leads to smoother implementation and can ultimately reduce the overall duration of the project development timeline. This same principle applies to permitting, siting, and interconnection processes—project developers that do not adequately plan for the complexity or duration of these steps may face timeline extensions when unexpected challenges arise and cascading delays derail the project. In contrast, project developers that integrate flexible, proactive planning for these processes are better positioned to manage unforeseen regulatory, technical, or community-related barriers, reducing the likelihood of actual delays and enhancing long-term project efficiency.

As the data shows, however, even when reasonably adequate time appears to have been incorporated in a project's schedule, projects still suffer a significant amount of delay. This implies that systemic policy solutions are needed to address the root cause of delays, which appear to be the inefficiencies and onerousness of the permitting process, lack of clarity in requirements at local levels, the relatively low barrier for opposition to stall a project, weaknesses in market design exacerbated by high project volumes, and market conditions such as supply chain issues.

3.1.2 DELAY DURATION AND SEVERITY

Delays in projects are not short-lived. As Figures 7 and 8 from our second survey of respondents show, permitting delays can last anywhere from three months at the local permitting level, over a year at the state level, and up to two years or more at the federal level. The responses suggest that the pattern of delays is not materially different for T&D projects versus solar projects, and they can vary widely depending on the responsiveness of agencies, complexity of compliance requirements, and the extent of community opposition or interagency coordination needed.

As will be discussed further in the permitting and siting section of the findings, the survey results do not demonstrate any geographical pattern in delays, either. Taking advantage of the diversity of project locations in the survey database, we compared respondents' experience across states to gauge whether permitting peculiarities in specific states drive delays. The data showed that state location does not conclusively preordain whether a project will face delays due to the state's permitting process, but more research is needed into state specifics to draw definitive conclusions.

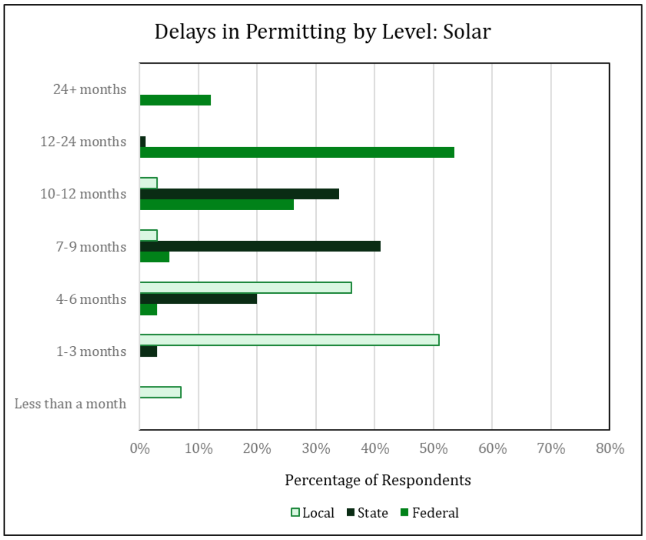

Figure 7: Delays by permitting level for solar projects – second survey results.

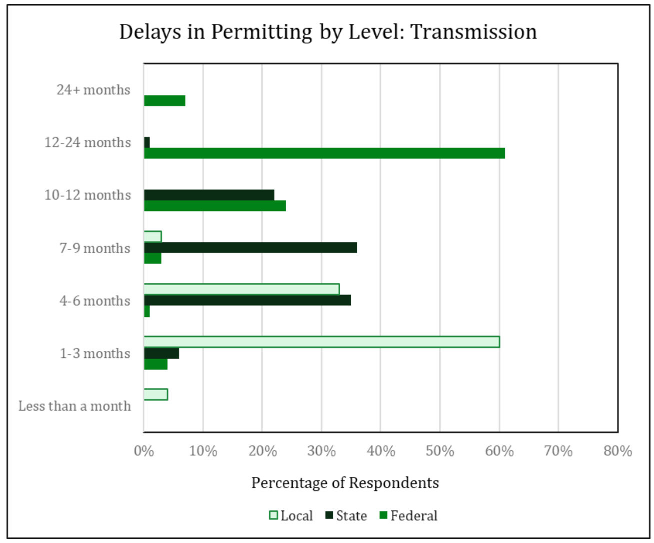

Figure 8: Delays by permitting Level for T&D projects – second survey results.

During our interviews, developers shared examples of delays extending up to three years or more, driven by agency staffing, field conditions, legal appeals, or the discovery of protected species. One developer explained how missing a narrow seasonal window for a required species survey due to delayed site access forced their team to wait an additional year to complete fieldwork required for a permit application. Another mentioned that design changes, particularly related to safety changes requested by local authorities, can also be critical since they may potentially result in the need for additional land, which would force the development team to re-initiate field studies, and potentially re-submit permit applications. In other words, the interdependent nature of project decisions and planning means that an ostensibly reasonable and benign request from a local permitting agency could end up leading to large delays as shown in Figures 7 and 8.

3.2 COMMUNITY AND STAKEHOLDER ENGAGEMENT AND OPPOSITION

One of the first round of surveys' more prominent findings was that opposition to energy projects tends to arise early, most commonly during the preconstruction phase (Figure 9). This trend was consistent across technologies, and highlights the importance of early, proactive stakeholder engagement during project planning. This opposition could either be because the developer did not plan for stakeholder engagement or did not provide enough time to conduct thorough stakeholder engagement.

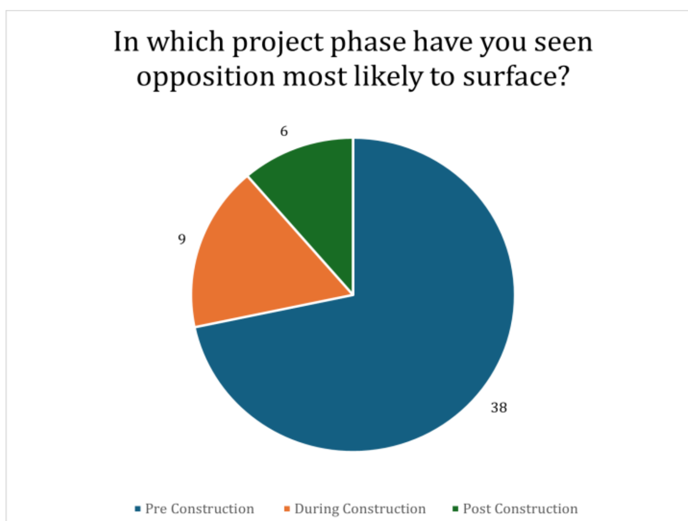

Figure 9: This figure indicates preconstruction is the project phase when opposition is most likely to surface.

To understand the drivers of this opposition better, during the second round of surveys we drilled down on three specific aspects of stakeholder engagement: the amount of time planned for the stakeholder engagement process, the primary reasons behind stakeholder opposition, and what types of stakeholder groups more frequently drive opposition towards these projects.

Data from the initial round of surveys indicated that stakeholder engagement processes are built into project timelines and project planning either most or all of the time. Though a few respondents said that some project plans did not include stakeholder engagement, which led to difficulties in advancing those projects, by and large, stakeholder engagement is included as a regular part of project planning; however, respondents said in open-ended responses that insufficient time or attention to earlier stakeholder identification is a recurring pain point. We therefore wanted to quantify the amount of time allocated for stakeholder engagement. As shown in Figure 10, 70 percent of T&D respondents, and almost 80 percent of solar respondents, plan for 4 months or more for stakeholder engagement, with almost 20 percent of T&D and solar respondents planning for up to 9 months. This data shows that solar or T&D developers are planning for a reasonable amount of time for stakeholder engagement to conduct the engagement as efficiently as possible to get electrons producing and out to the consumers.

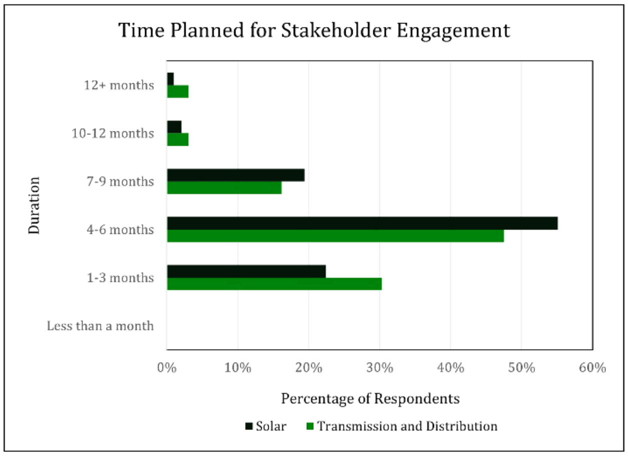

Figure 10: This figure indicates time planned for stakeholder engagement in solar and T&D projects.

Planning for a reasonable amount of time, however, is not a guarantee for fewer delays. As Figure 11 shows, even when developers allocate time for stakeholder engagement, opposition can still cause significant delays.

Almost 60 to 70 percent of respondents across solar and T&D projects have experienced delays of 4 to 9 months in the stakeholder engagement process, essentially doubling the amount of time for stakeholder engagement relative to the planned time. That said, data also shows that essentially 90+ percent of projects experience delays that are less than a year. The reasons for these delays are shown in Figure 12.

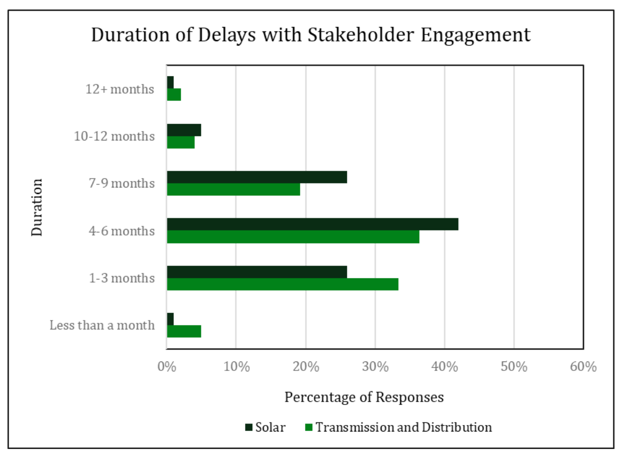

Figure 11: This figure shows the duration of delay in stakeholder engagement across solar and T&D projects.

There is no overarching reason that stands out as the leading driver of stakeholder opposition. Furthermore, across the 200 respondents, there emerged no driver of opposition more or less important to solar or T&D projects. The data implies that tailored engagement strategies are essential because stakeholder concerns stem from specific personal and local concerns, such as land use priorities and property values, health and safety concerns, and/or unfamiliarity with technology.

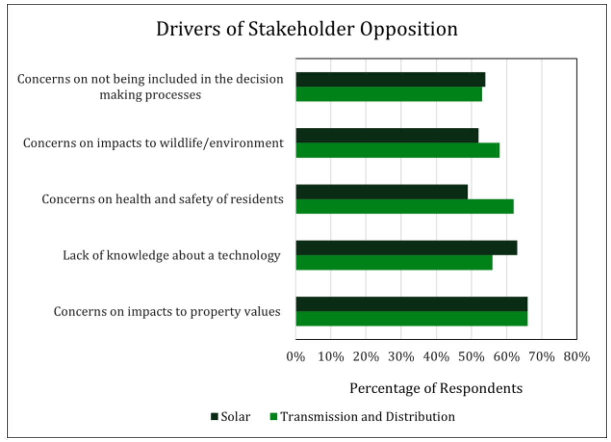

Figure 12: This figure shows the drivers of opposition across solar and T&D projects

Several interviewees identified the key reasons for the opposition to these projects from their experience. For instance, communities are feeling overwhelmed by the quick growth of data centers, transmission projects, and road expansions; this overwhelm spills over into other proposed projects, leading to push back from various groups, including Tribes, retirement communities, labor unions, and environmental justice advocates. A major concern of communities is that communication efforts are not effectively addressing the worries of these local communities *early on*. Important questions arise about visual effects and possible environmental impacts, such as noise, water quality, and effects on local plants and animals and their habitats. Furthermore, the rapid increase in the size and number of proposed solar projects, often in the same areas, has heightened opposition and made it harder to obtain the necessary permits in recent years.

In more rural areas, respondents highlighted strong anti-solar sentiments and political resistance as key obstacles to implementation, with a developer stating that "the farming community in many cases is opposed to solar developments." Developers also cited examples of state-specific approaches that can alleviate some of these issues. In one example, a developer said that "Florida has a very specific transmission review process for larger projects. The state allows all stakeholders opportunities to weigh in at prescribed milestones, and the state pre-empts local government approvals." The developer went on to suggest that "this approach in all states would make transmission siting and permitting more predictable in terms of schedule and approvals required." Though Florida's approach would not be possible everywhere, it serves as an illustration of the type of strategies states are using to help ease the review process. In the case of T&D projects, high levels of opposition may be attributed to the unique nature of their development footprint; transmission lines often span long distances and cross multiple communities, private properties, and jurisdictions. This wide geographic impact increases the number of potentially affected stakeholders, leading to increased opposition.

It is important to note, however, that when we compared stakeholder opposition on a state-by-state basis, using the diverse representation we had in our respondents, no single state stood out as having systematically more or less stakeholder opposition.

The third important element related to stakeholder engagement and opposition that we wanted to identify was which groups of stakeholders drive the opposition. Figure 13 shows the respondents' experience with different groups of stakeholders.

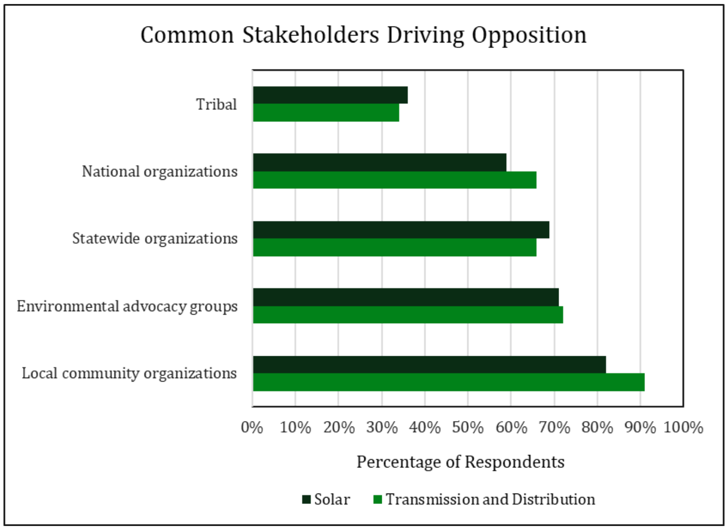

Figure 13: Based on respondents' experience, these are the most common groups of stakeholders driving opposition.

As Figure 13 shows, most project opposition is driven at the local level by local community organizations. As the drivers of opposition (Figure 12) center largely on property values and the health and safety of local residents, it is not surprising that such opposition is led by local communities. For a project developer, then, it clearly behooves them to invest time in identifying local community groups early; to engage with them early and often; and, as part of this engagement process, to address the more personal, local concerns that are top of mind for these groups. One developer defined the key to stakeholder engagement as "creat[ing] a collaborating team that includes solar project design engineers, land planners, and biologists who work together [with local groups] through the key steps in design and schedule milestones."

The data from our second set of surveys corroborates the need for project proponents to conduct proper and proactive stakeholder engagement by identifying and working with relevant local stakeholders and understanding their concerns. Such engagement is critical to smooth project execution and to building more projects to support rising load growth. With this said, and without diminishing the criticality and importance of stakeholder engagement, it is also important to contextualize how big of a barrier stakeholder engagement really is to clean energy project implementation.

Review of the literature on clean energy projects alone might give the impression that stakeholder opposition is one of the leading barriers to clean energy deployment. To quantify the severity of the opposition, in our second round of surveys we asked our 200 respondents to provide us with a sense of the percent of their projects that have faced concerted opposition by organized groups to materially change the scope of a project or to stop it altogether.

As Figure 14 shows, for 70-75 percent of the respondents across solar and T&D, only a third or less of their projects faced concerted opposition requiring project design change or cancellation. Though stakeholder opposition is clearly an issue, in most cases it is not to the degree and extent that it causes the developer to change project design or cancel the project altogether. However, it can still cause significant delays and increase project costs in many cases.

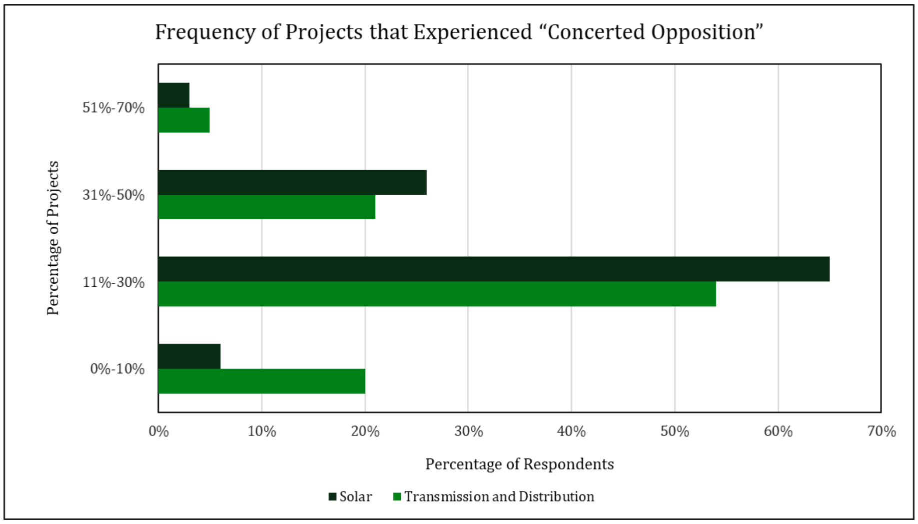

Figure 14: This figure shows the percentage of solar and T&D projects that face concerted stakeholder opposition, indicating that most respondents have experienced opposition in less than 30% of their total projects.

Overall, to garner stakeholder and community support, there remains a need for tailored outreach and education strategies that reflect local values, needs, and desires. Overlooking the potential for opposition or applying a one-size-fits-all approach can significantly undermine project timelines, approvals, and long-term viability. When developers fail to proactively address these concerns, they risk triggering formal opposition, permitting delays, or even legal challenges that can stall or cancel projects altogether.[2] These tailored strategies should be reflected in the planning time and processes.

3.3 PERMITTING AND SITING

Siting is the process of identifying and evaluating suitable locations for energy infrastructure projects, based on factors like land availability, resource potential, proximity to infrastructure, and environmental or community constraints, often using GIS and other spatial analysis tools.

In our surveys and interviews, local permitting issues as well as federal nexus issues such as Endangered Species and Clean Water Act triggers were most often cited as challenges during project siting (Figure 15). The second, larger survey provided more nuance to siting barriers, with over 70 percent of respondents for both solar and T&D identifying "number of permits required" for a given site or route as the biggest challenge (Figure 16). We know from working with developers that they often review multiple sites for constraints analysis

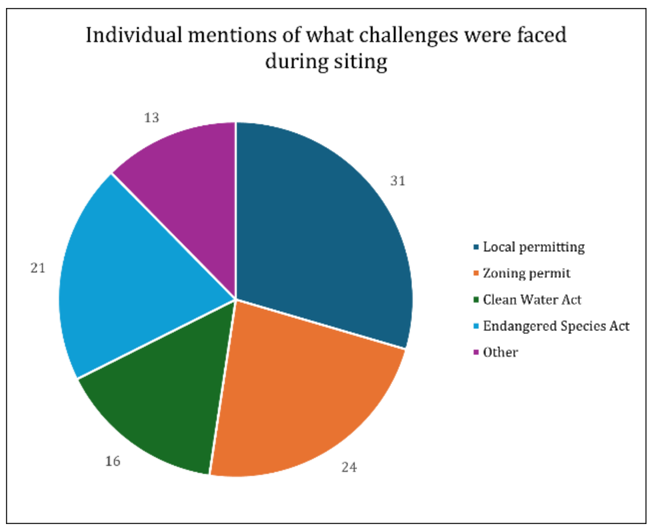

Figure 15: Data from survey respondents shows the variety of challenges faced during siting with local permitting as well as federal aspects identified as challenges.

[2] J.B. Ruhl and J. Salzman, "The Greens' Dilemma: Building Tomorrow's Climate Infrastructure Today," 73 Emory L. J. 1. 2023.

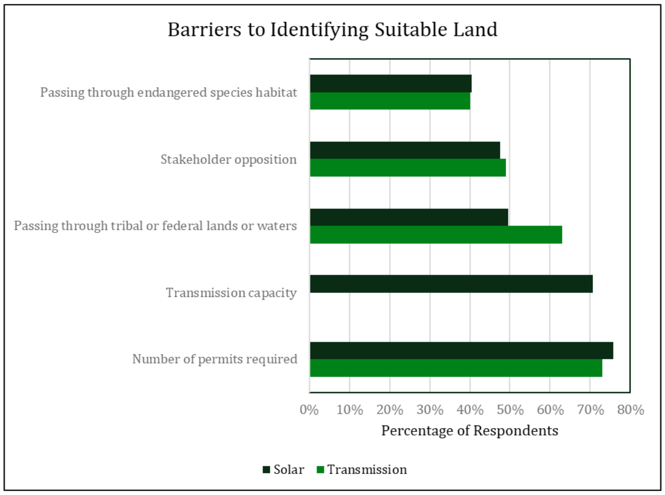

Figure 16: This figure shows that the number of permits required is the most common challenge faced during siting.

and permitting requirements, factoring in number of permits needed, stakeholder context, potential for impact to endangered species, etc. to narrow down which sites are likely to be most efficient to develop from a permitting, stakeholder, and regulatory perspective.

Another respondent expounded on local permitting barriers, stating, "local entities seem to experience staff constraints most acutely," and that, "there can be a steeper learning curve for the local Authority Having Jurisdiction when evaluating solar projects, compared to other types of construction projects they may see more frequently."

Permitting and approvals emerged as another major barrier. Challenges were consistently reported across all three jurisdictional levels: local, state, and federal, with federal permitting accounting for the longest delays and reported as the most onerous permitting level (Figure 17) by a significant margin.

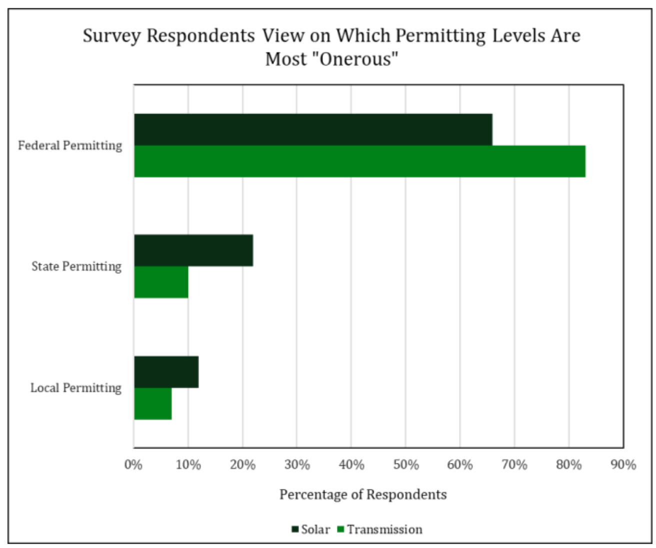

Figure 17: The overwhelming majority cite federal permitting processes as the most onerous

Federal permits, including required environmental reviews under the National Environmental Policy Act (NEPA), are widely regarded by developers as the most onerous aspect of renewable project permitting, despite research showing that less than 5 percent of projects actually trigger federal review.[3] This perception is driven by complexity, unpredictability, and potential for significant delays associated with federal processes; especially when compared to state or local permitting, even though local permitting can be more unpredictable. As one developer put it, "While only a small fraction of projects requires NEPA, those that do can face years-long timelines, extensive documentation, and multiple rounds of agency and public review, making federal permitting a critical-path risk that shapes project planning across the industry." We know from experience that the outsized impact federal review can have on project permitting leads many developers to design sites and projects specifically to avoid the federal nexus. As more projects compete for limited sites, and as development becomes increasingly likely on federal lands (e.g., those managed by the Bureau of Land Management) and/or areas with sensitive resources (e.g., areas with endangered species,

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[3] The Hamilton Project, "Eight facts about permitting and the clean energy transition," *The Hamilton Project*, May 2024. https://www.hamiltonproject.org/publication/economic-fact/eight-facts-permitting-clean-energy-transition/

Waters of the U.S., cultural sites), the likelihood of triggering federal review is rising. We believe this is what is reflected in the data.

To understand how this perception of permitting difficulty at the federal, state, or local level is reflected in project planning, we asked respondents to provide us with the planning timelines they included for various levels of permitting in project plans, if applicable.

Close to 70 percent of respondents plan for timelines of 12-24 months for federal permitting within T&D and solar project schedules, and over 60 percent of respondents experience federal permitting delays of at least 12 months in both project types (Figures 17 and 18).

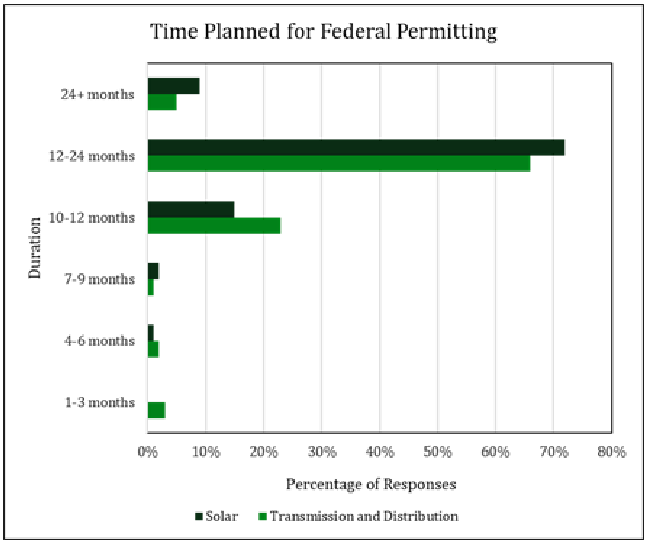

Figure 17: Time planned for federal permitting by respondents.

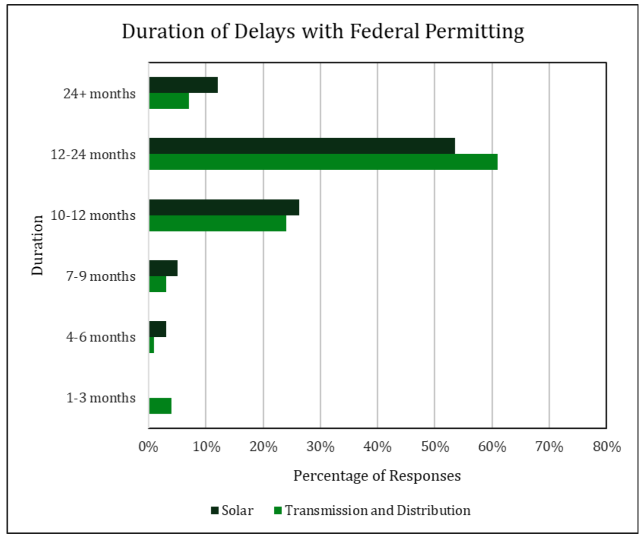

Figure 18: Amount of delays in projects with federal permitting nexus.

While state and local permitting generally experience shorter planning timelines as well as shorter delays than federal permitting, delays are still significant. For state permitting, the majority of respondents plan for timelines of at least 10 months and experience delays of at least 7 months; for local permitting, the majority plan for timelines of at least 4 months and experience delays of up to 6 months (Figures 19 through 22 below).

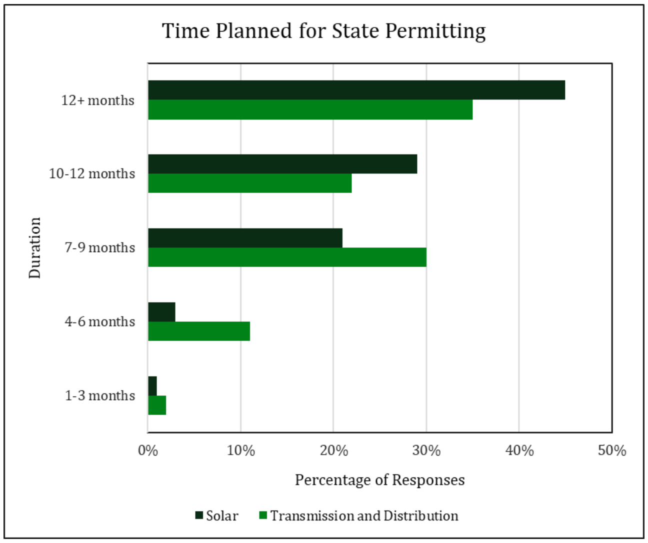

Figure 19: Time planned for state permitting by respondents.

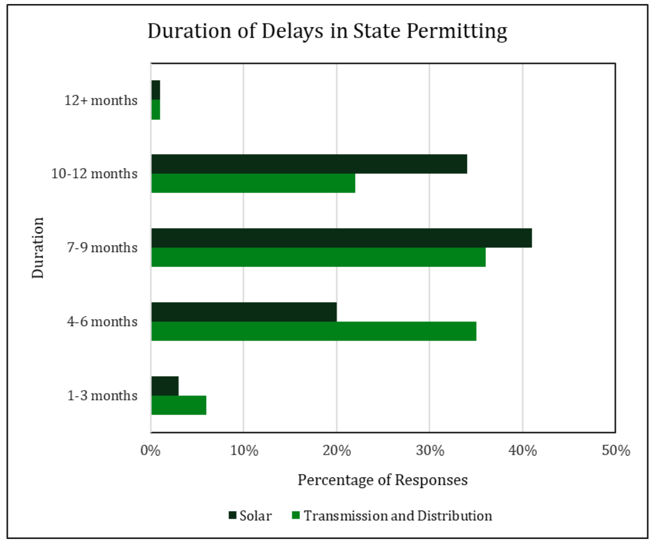

Figure 20: Delays experienced in state permitting by respondents

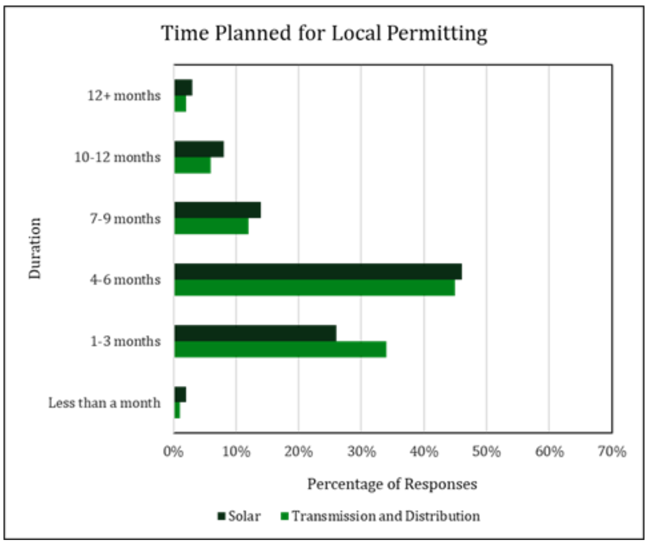

Figure 21: Time planned for local permitting by respondents

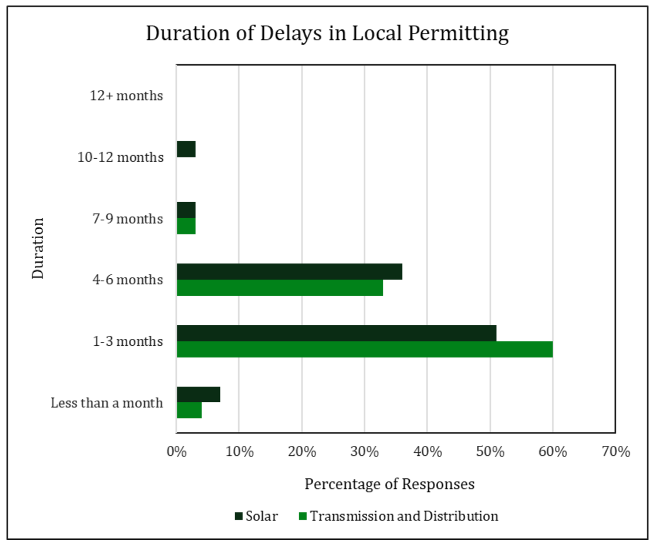

Figure 22: Delays in local permitting experienced by respondents

When analyzing permitting and delay timelines, it is important to determine how often permitting processes are overlapped versus following a sequential order. Ninety percent of survey respondents indicated that federal permitting timelines often overlap with state and local permitting or other non-permitting project tasks, meaning that within the common planning timeframe for 1-2 years for federal permitting, other project tasks and other state or local planning activities could be executed simultaneously (Figure 23). While state and local permitting were reported to overlap with other project tasks less frequently than federal, over half of the respondents reported state permitting overlapping with other tasks, and approximately 20 percent reported overlapping local permitting. While the local permitting timelines by themselves are smaller vis-à-vis state and federal timelines, the fact that local permitting timelines overlap the least with other permitting timelines suggests that local permitting could become its own critical path and can end up determining the overall timeline of the project.

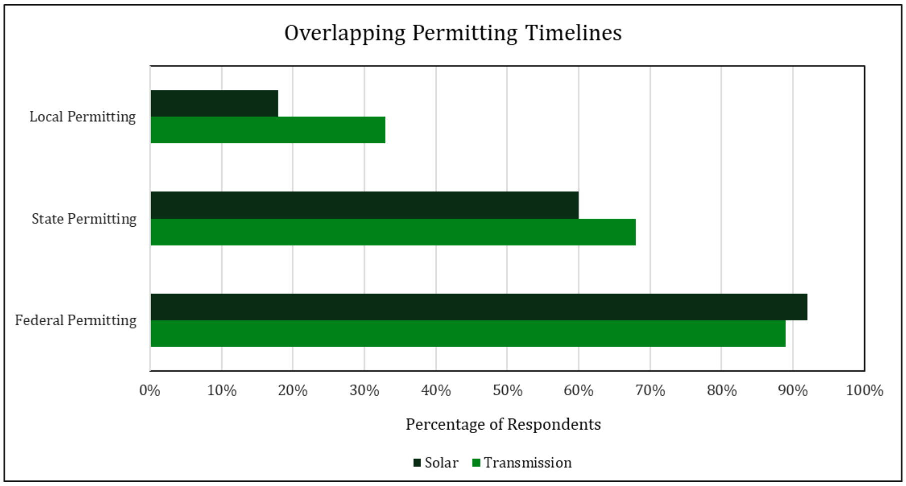

Figure 23: Survey data shows that respondents often plan for federal permitting overlapping with other permitting levels or other non-permitting project tasks, with local permitting the least commonly overlapped with other levels.

Further, as shown in Figure 24, our respondents overwhelmingly identified NEPA as the aspect of the permitting process in which they experience the longest delays. Over 80 percent of T&D experts reported this, and over 60 percent of solar experts. As has been discussed before, this perception is driven by complexity, unpredictability, and potential for significant delays associated with federal processes—especially when compared to state or local permitting. Compared to T&D, a smaller portion of solar projects are subject to full NEPA review.

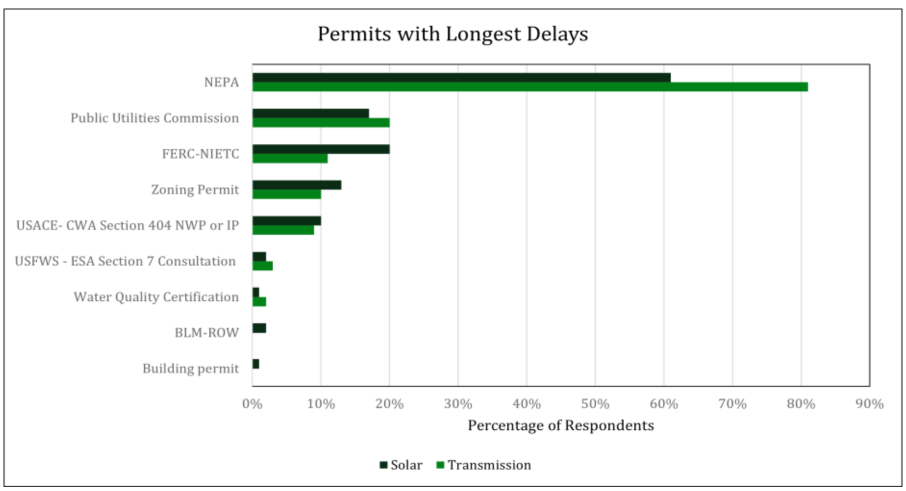

Figure 24: Respondents overwhelmingly picked NEPA process as the process that causes the longest delays in project

To understand what actions or policy initiatives could make an impact on permitting timelines, we asked respondents to provide us with what they believe to be the cause of delays related to permitting based on their experience.

The survey data shows that the most common cause of delays at all three levels of permitting is a bucket that can be termed as "Agency capacity for permitting review," a category that includes items such as number of applications being processed, degree of expertise required to complete a review, and insufficient agency staffing. "Lack of clarity or increased ambiguity in permitting requirements" and "Number of data points [environmental data, studies, supporting data, etc.] required for application" are also identified as key drivers of delays (Figures 25 and 26).

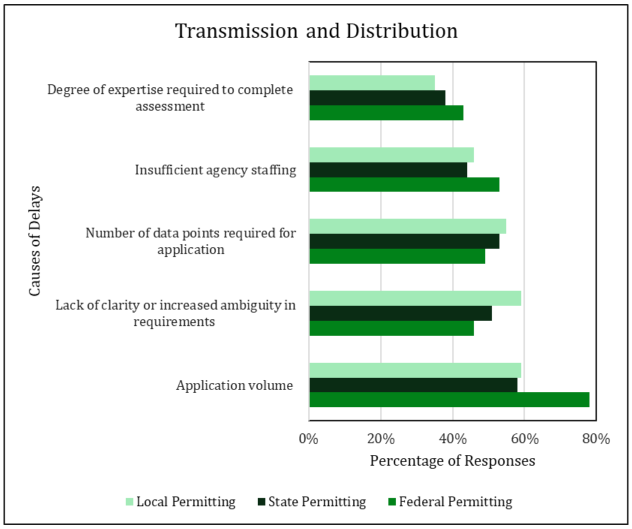

Figure 25: Causes of permitting delays in T&D

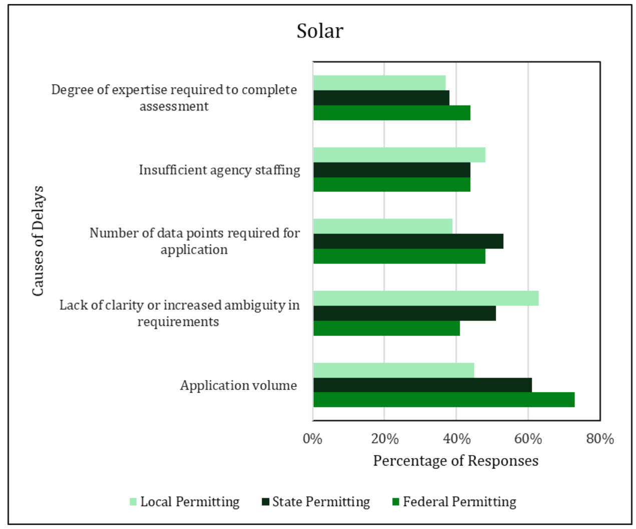

Figure 26: Causes of permitting delays in solar

As the number of proposed solar and T&D projects increase, and familiar jurisdictions with already high concentrations of project activities attract even more projects, the survey responses in Figures 25 and 26 foreshadow even longer delays and permitting timelines if "agency capacity" is not enhanced through reform that provides either more staffing, or more streamlined processes and reviews. Streamlined processes and reviews could enable staff, even at existing staffing levels, to do more and potentially do it faster. Reforms targeted at the local level could help "standardize" or help develop clearer requirements, thereby reducing the volatility in timeline at the local level.

Several developers described the difficulty of navigating inconsistent, complex, and unpredictable permitting systems. One added that local permitting timelines are "often unclear online and through the code," leaving developers to "figure it out themselves." Another developer stated that the permitting challenges and delays vary by the regulatory body by which the permits are approved, saying "some jurisdictions have a clearly defined process or statutory review timelines," and "a permitting delay is often tied to a significant event like litigation challenging [the] permitting decisions that may take years to unwind. In areas with unbounded review timelines a 'typical' permitting delay may be a year or two past the target schedule," a delay which the respondent called "optimistic" when navigating a permitting process without set review timelines. In other words, it is difficult to quantify the length of delay where there are no set timelines.

To address these systemic issues, respondents were asked to provide their top suggestions to remedy the current state of delays. Across all 200 respondents, the most cited suggestion was to create a centralized portal that integrates federal, state, and local requirements. Standardizing permitting processes across jurisdictions was also widely supported among survey respondents (Figure 27). The centralized portal suggestion points to transparency as a key enabler of efficient project timelines. In interview, one respondent made the point that, "if I have a project that is surrounded […] by other projects that have gone through permitting, it is still not easy to know what permits those other projects required without navigating a number of different portals and databases."

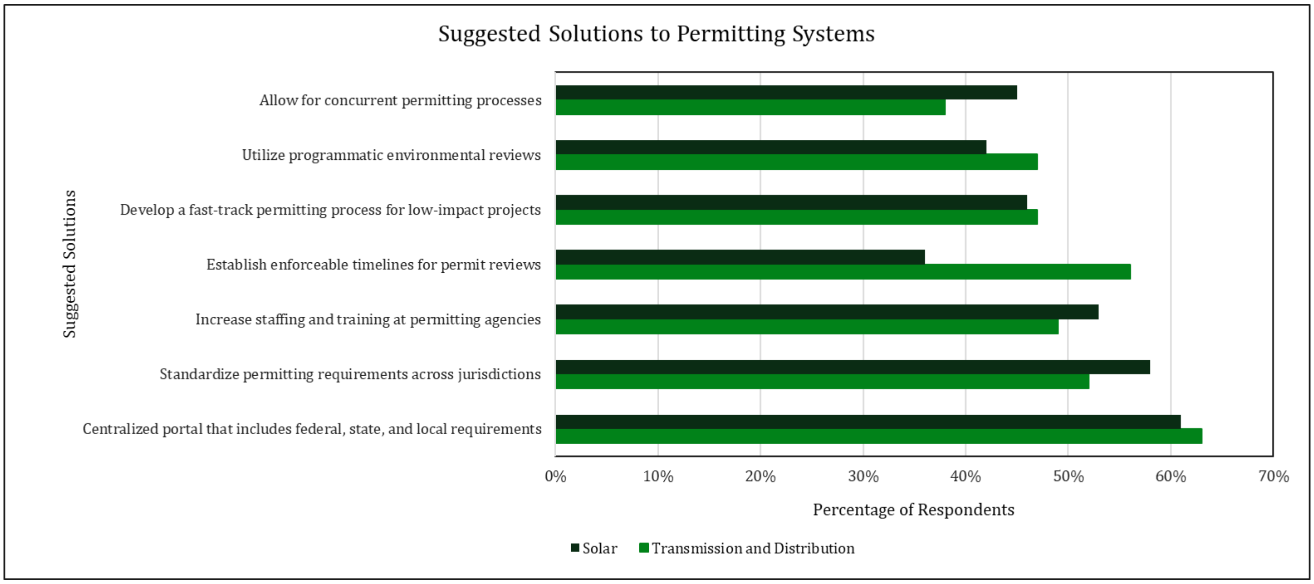

Figure 27: This figure shows the most common suggestions for improving the existing permitting systems.

3.4 INTERCONNECTION

Interconnection refers to the process by which projects are physically and operationally linked to electric grids, enabling the transfer for generated power to end users. Survey respondents most frequently cited interconnection as the critical path item that causes delays across both T&D and solar projects, with over 60 percent of T&D respondents and over 50 percent of solar respondents reporting interconnection as spurring the most delays (Figure 28). These delays often stem from a combination of technical, procedural, and regulatory factors, including queue congestion, unclear timelines, and coordination challenges with grids operators.

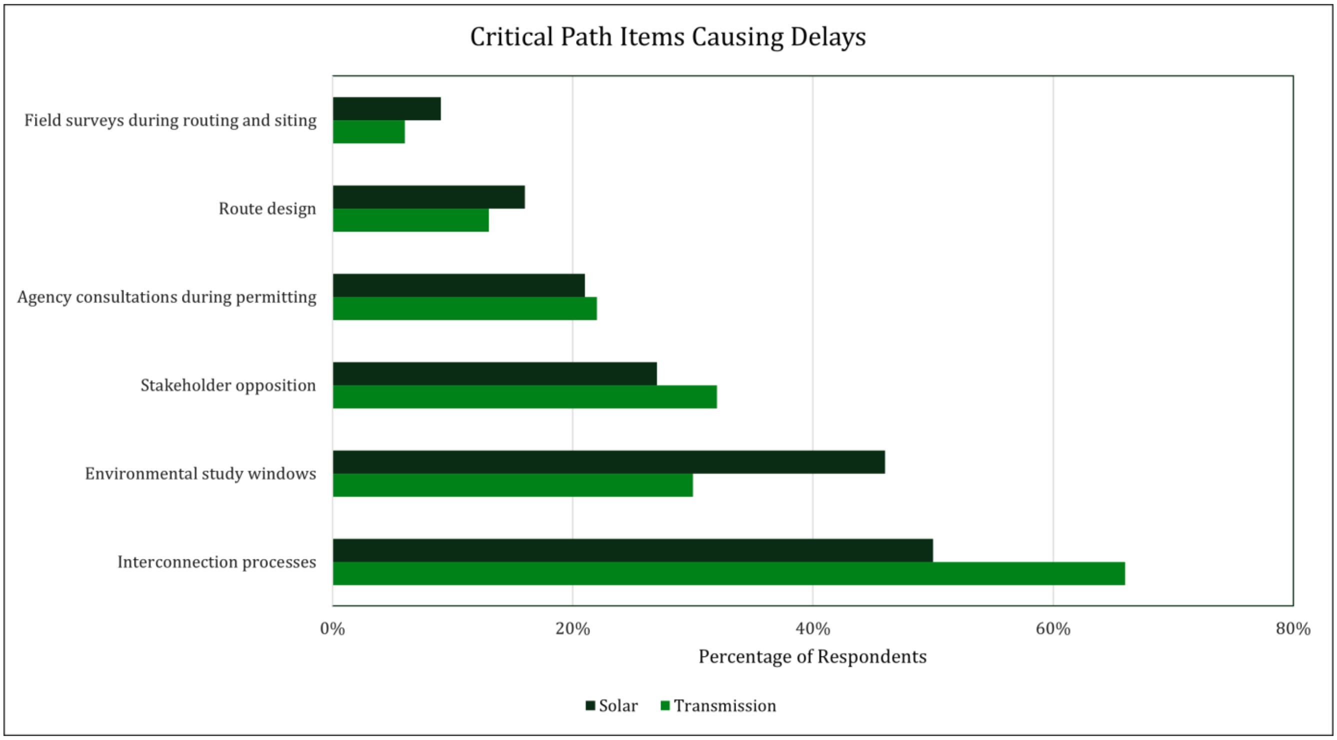

Figure 28: This figure shows that the critical path item that was most reported to cause delays was interconnection for both T&D and solar project experts.

Interconnection delays were reported to be more of a prevalent critical path item delay by T&D respondents, suggesting that the integration of new energy infrastructure into the existing power system is not only an issue for generation but, rather for new T&D infrastructure as well. When a developer requests interconnection, the relevant utility must study, plan, and often build new lines or substations to accommodate the new infrastructure. Even if a developer is ready to build its project, it cannot proceed until the interconnection studies, which are complex analyses of the impact of the new facility on the existing system, are complete, the scope of upgrades is finalized, and the allocation of the upgrade costs is settled. The owner of the T&D facilities to which the new facilities will interconnect must then ensure the necessary upgrades are complete before the new solar or T&D project can come online. Not only is the process complex, but there are backlogs of projects waiting in interconnection queues, meaning there are waits before the study process can even begin.

For solar projects, approximately 50 percent of respondents reported delays of six months or less, and only 10 percent experienced interconnection-related delays exceeding one year. T&D projects showed a larger range of delays, with respondents reporting delays relatively evenly distributed between 1 and 12 months.[4] However, the variability in delay duration underscores the unpredictability of the interconnection process. Survey responses also revealed that no single factor consistently explains the delays; rather, they appear to result from a combination of issues, such as grid upgrades, supply chain delays, deliverability requirements, clustering, and cost allocations. Respondents indicated that all of the issues contributed to interconnection delays and

[4] Unlike with the permitting and stakeholder questions, we were unable to quantify the planned time for interconnection. Therefore, the relative severity of the delay with respect to expectations is not known.

that the interconnection issue must be addressed holistically, and not by tackling the barrier on a piecemeal basis.

Given the state of interconnection and the impact it has on project timelines, we asked our respondents to provide the most common reasons they had to withdraw their projects from the interconnection queue. The findings from this question refer to a lack of adequate transmission capacity slowing the interconnection process. Fifty-seven percent of respondents indicated that they dropped out of the queue because the estimated interconnection costs are too high, and sixty-four percent because the estimated interconnection build time is too long. These responses highlight the high costs associated with significant transmission system upgrades being built through generator interconnection processes. Though more proactive transmission planning takes a long time to build, it would greatly improve the timeline and costs associated with interconnection for generator projects.

3.5 REGULATORY POLICIES AND MARKET DESIGNS

In recent years, policymakers and regulators have increasingly turned to multi-layered market mechanisms—such as capacity markets for resource adequacy, ancillary service payments for grid balancing, congestion revenue rights to hedge transmission bottlenecks, and renewable portfolio standards to stimulate clean generation—to address the imperatives of energy reliability, load growth, and economic efficiency in electricity markets. These instruments are designed in theory to send correct investment and usage signals to encourage project deployment. Market design, the structure of electricity markets, and the rules governing participation therefore can influence project timelines by shaping investment signals, operational flexibility, and risk allocation.

Market design plays a critical role in shaping project timelines, and while installed costs for solar fell, interconnection delays persist—highlighting systemic inefficiencies in market processes.[5] Elements such as capacity markets, ancillary service payments, congestion revenue rights, and renewable portfolio standards are intended to create efficient markets and incentivize resource adequacy. In theory, poorly designed markets can lead to uncertainty in revenue streams, discourage long-term planning, and complicate financing, all of which can delay project development.

To test whether these factors materially affect project timelines, and whether they are a significant "non-cost" barrier, our second survey asked respondents to assess whether specific market design features—such as deregulation, capacity markets, ancillary service payments, right of first refusal, congestion rights, energy imbalance markets, renewable portfolio standards, and participation in climate markets—cause delays "all the time," "some of the time," or "none of the time."

Across solar and T&D projects, respondents overwhelmingly indicated that these market design elements did not consistently drive delays. Across solar and T&D, 65 to 70 percent of the time, respondents chose "some of the time" category, while only about a third of respondents chose "all of the time," suggesting that while market structures certainly shape long-term economics, they

[5] Bolinger, M., Seel, J., Mulvaney Kemp, J., Warner, C., Katta, A., & Robson, D. 2023. *Utility-Scale Solar, 2023 Edition: Empirical Trends in Deployment, Technology, Cost, Performance, PPA Pricing, and Value in the United States*. Lawrence Berkeley National Laboratory. October.

are not perceived by developers as direct barriers to project delays. Instead, delays are more often attributed to operational and logistical challenges, regulatory uncertainty, and supply chain constraints rather than systemic market design drivers.

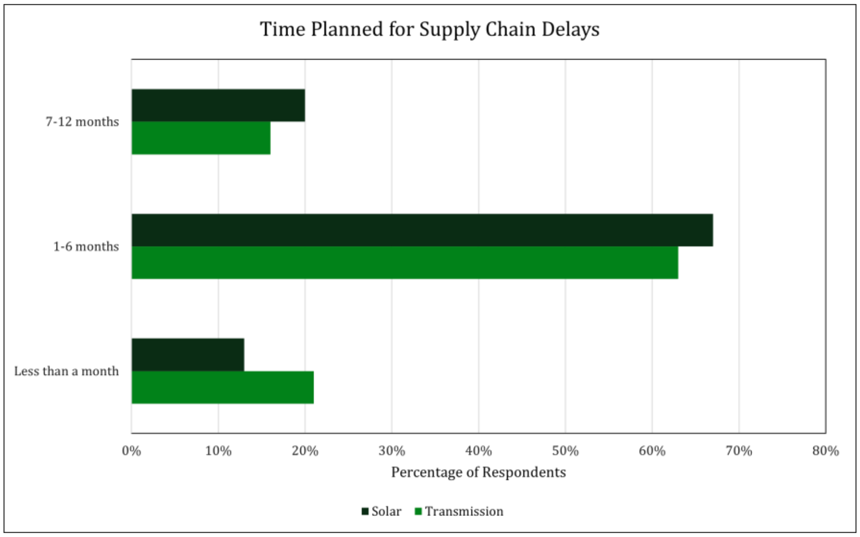

Figure 29: This figure, based on the second survey, shows time planned for supply chain delays in solar and T&D projects by respondents.

T&D projects face acute supply chain challenges, including limited manufacturing capacity for critical components such as transformers, switchgears, high-voltage DC converters, and other specialized equipment. Based on our second survey (Figure 29), a majority of respondents across solar and T&D routinely plan for supply chain delays of one to six months or more. Industry experts also indicated in interviews that labor shortages, particularly among electricians, compound these issues, with reluctance to work in remote "work camp" settings and insufficient worker accommodations cited as recurring problems. Respondents also noted that negotiations for power purchase agreements are taking longer or require re-negotiation due to ongoing supply chain disruptions, complicating efforts to secure bankable offtake agreements. The overlapping of multiple T&D and solar projects creates competition for the same equipment, further lengthening timelines. For solar projects that require new transmission or substation work, delays in T&D equipment extend the interconnection timeline such that even if the solar side is ready, grid integration becomes a bottleneck.

As part of our second survey, we asked respondents to provide us with their top suggestions for solutions to improve development timelines. The aggregated result from those responses is shown in Figure 30. As the figure shows, solar and T&D respondents most frequently suggested interconnection process reforms, streamlined interagency permitting, improved data transparency from grid operators/utilities, increased funding for permitting staff, and workforce (e.g., skilled electricians and construction workers) development programs as solutions to streamlining clean energy development.

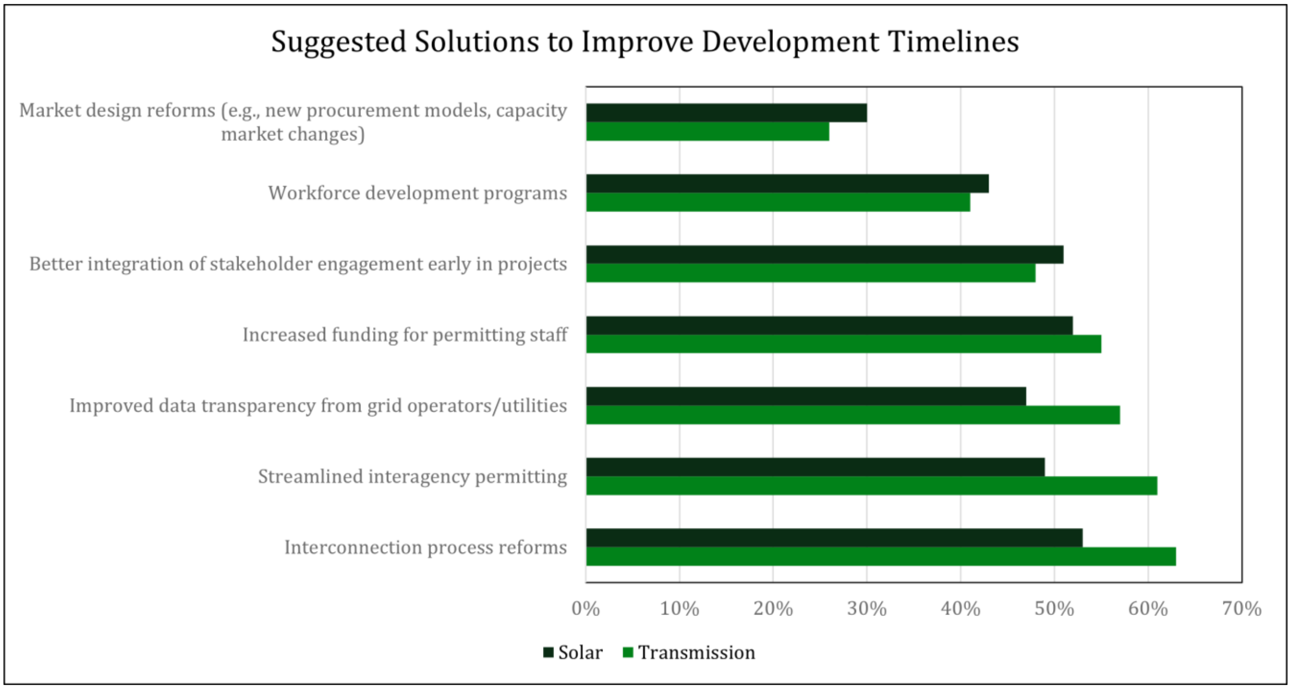

Figure 30: This figure, based on the second survey, shows the suggested solutions to improve development timelines.

This brings up an interesting question, however: if policy reforms targeting permitting and interconnection efficiencies are successful, and project permitting timelines reduce, will we simply move the chokepoint to the supply chain part of the project in absence of manufacturing capacity to meet timely demand for equipment? Or by offering greater assurance that projects are likely to reach commercial operation, could improvements in permitting, siting, and interconnection stimulate greater investment in meeting energy growth goals?

4.0 CONCLUSIONS

This study set out to move beyond qualitative accounts and anecdotal evidence of barriers to solar and T&D deployment to provide a more data-driven, practitioner-informed perspective on the non-cost barriers slowing energy infrastructure deployment in the United States. By combining a literature review, a survey of 200+ industry professionals, and interviews with developers and utility experts across the country, we have illuminated both the persistent and evolving challenges facing solar and T&D projects nationwide.

1. The Barriers Are Real—But Their Impact Is Nuanced and Contextual

The literature consistently identifies four non-cost barriers to energy infrastructure development: stakeholder engagement, permitting and siting, interconnection, and regulatory/market design. Our surveys and interviews confirmed these as critical friction points, but also revealed that their impact is far from uniform. For example, stakeholder opposition is a near-universal concern, yet its intensity varies drastically. As one developer noted, "80 percent of my projects are landfills and brownfields—those are seen as win-win by communities, while greenfields can be much more contentious."

2. Permitting and Local Processes Remain the Most Unpredictable Bottlenecks

Respondents cited permitting delays as the most volatile and least predictable barrier to project deployment. While local permitting introduces volatility and high variance, developers often see federal permitting as the more onerous process. Even if only a small percentage of renewable projects end up requiring the most stringent federal reviews, the process is so burdensome that many developers will work to avoid selecting land that could trigger a federal nexus. However, as additional projects are built, avoiding this federal nexus could get increasingly more difficult. In regards to local permitting, developers repeatedly described the "high variance" in local authority experience, resourcing, and even personal attitudes toward solar or T&D projects. In some cases, a single local official's unfamiliarity or skepticism can add months to a project's timeline for implementation. Several interviewees emphasized the importance of early, proactive engagement with local authorities and the value of pre-application meetings to "prime" permitting staff and reduce rounds of review. Yet even with best practices, the lack of standardized permitting processes across jurisdictions remains a major source of delay and uncertainty.

3. Interconnection Delays Are Systemic—But Solutions Are Emerging

Interconnection queues have grown exponentially, with developers reporting that what once took six months can now take years. The causes are multifaceted: surges in applications, limited utility staffing, and the complexity of required studies. Recent reforms like cluster studies and stricter project readiness requirements are beginning to show results in some regions, but developers caution that these changes may simply shift bottlenecks elsewhere, such as to supply chain constraints. As one developer put it, "The cluster process is working, but now the real issue is getting the transformers and high-voltage breakers—lead times can be three years." Interdependency also introduces cascading delays; for example, an interconnection-related delay of a year could mean that stakeholders in community planning boards may change, triggering another round of engagements.

4. Supply Chain and Workforce Shortages Compound Traditional Barriers

Supply chain disruptions and labor shortages are also central to project delays. Developers across the country cited year-long waits for critical equipment and difficulties finding skilled electricians and construction workers necessary to get projects built. These operational chokepoints often exacerbate permitting and interconnection delays, creating a compounding effect that can stall projects for years. The literature and interviews both highlight the need for targeted investment in domestic manufacturing and workforce development to address these vulnerabilities.

5. Stakeholder Engagement: Early, Consistent, and Localized

The importance of early and sustained stakeholder engagement cannot be overstated. Developers who invest in building relationships with local officials, landowners, and community groups report smoother permitting processes and fewer surprises. However, the interviews we conducted also revealed that "developer reputation" matters—communities burned by poor engagement on one project may oppose future projects, regardless of the developer. Best practices include regular communication, transparency about project benefits and risks, and tailoring engagement strategies to local priorities and concerns.

6. Regulatory Fragmentation and Policy Volatility Remain Major Risks

Fragmented authority between federal, state, and local agencies continues to create uncertainty, especially for transmission projects crossing multiple jurisdictions. Developers and utility experts alike called for greater harmonization of permitting standards, clearer timelines, and more predictable regulatory processes. Policy volatility, whether from shifting state siting laws or federal tax credit eligibility, was cited as a growing risk, particularly for hydrogen projects, which saw a marked decline in activity due to recent federal policy changes.

7. Market Design: Less a Direct Barrier, More a Background Risk

While market design issues such as pricing structures and regional planning rules are prominent in policy discourse, our surveys and interviews suggest that from a developer's standpoint they are rarely the proximate cause of project delays. Instead, these factors tend to shape the broader investment environment.

In summary, the path to accelerating clean energy deployment is not blocked by a single barrier, but by a web of interrelated challenges—some structural, others operational, all requiring coordinated action. The most effective reforms and policy actions will be those that streamline and standardize permitting, invest in workforce and supply chain resilience, and foster early, authentic stakeholder engagement. Above all, policymakers must recognize that "one-size-fits-all" solutions are unlikely to succeed; instead, reforms should be tailored to the realities on the ground, informed by the lived experience of developers and communities alike. By grounding policy in data and practitioner insight, the U.S. can move from incremental progress to transformative change in clean energy deployment.