Pathways to Accelerating Clean Energy (PACE)

A LITERATURE REVIEW

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SURVEYING THE LANDSCAPE

*"**Much has been written** about the real and perceived barriers to deployment for large infrastructure projects, and **concerns are intensifying** as clean energy projects are desperately needed to accelerate the transition to a decarbonized energy future. **Billions in federal funding** have become available in recent years to sustain this transition, helping **alleviate a share of the cost and financial burdens** that could otherwise impede project development."*

*"**Yet delays, roadblocks, and barriers still exist**, threatening the success of projects nationwide and jeopardizing meaningful progress toward a clean energy grid."*

SOURCES REVIEWED

SOLAR

- “Good Fences Make Good Neighbors: Stakeholder perspectives on the local benefits and burdens of large-scale solar energy development in the United States”
- “Utility-Scale Solar, 2023 Edition. Empirical Trends in Deployment, Technology, Cost, Performance, PPA Pricing, and Value in the United States”
- “Shedding light on large scale solar impacts: An analysis of property values and proximity to photovoltaics across six U.S states”
- “Survey of Utility-Scale Wind and Solar Developers”

HYDROGEN

- “Delivering Equitable and Meaningful Community Benefits Via Clean Hydrogen Hubs”
- “Harnessing Hydrogen: A Key Element of the U.S. Energy Future”

TRANSMISSION

- “Transmission Interconnection Roadmap, Transforming Bulk Transmission Interconnection by 2035, Interconnection Innovation e-Xchange (i2X)”
- “Barriers to Backbone Transmission Development in the West, A Primer”
- “A Quantitative Analysis of Variables Affecting Power Transmission Infrastructure Projects in the US”

GENERAL

- “How Big Things Get Done: The Surprising Factors That Determine the Fate of Every Project, from Home Renovations to Space Exploration and Everything in Between”
- “Sources of Opposition to renewable energy projects in the United States”
- “The Green’s Dilemma”

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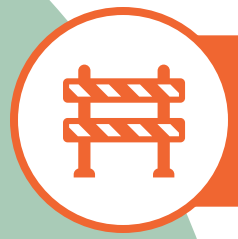
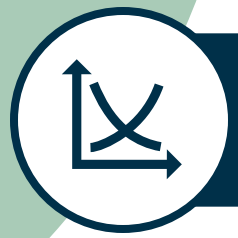
CATEGORIES OF NON-COST BARRIERS



Community/Stakeholder Engagement and Opposition

Permitting and Siting

Interconnection



Regulatory Policies and Market Designs

KEY INSIGHTS AND TRENDS

Community/stakeholder engagement and opposition emerged as *"perhaps the most crucial factor in determining the outcome of a project."* Five key trends were observed in the literature.

1.) EQUITY

Communities, especially marginalized groups, need their voices to carry weight in project decisions. They desire to have the resources (time, information) to consent to a project rather than only consult.

2.) AWARENESS AND EDUCATION

Communities frequently have a lack of knowledge about a technology (i.e., more community opposition to hydrogen compared to solar because newer tech) or a lack of understanding of project benefits.

3.) SAFTEY CONCERNS

Safety concerns commonly arise related to the development of green hydrogen projects (i.e., pipeline development, size, gas leaks). Even with a lack of evidence, health concerns lead to local opposition.

4.) ENVIRONMENTAL CONCERNS

Stakeholder concerns about the environment include impacts to wildlife, biodiversity, and the ecosystem. These sometimes create conflict between national environmental groups (that support a project) and regional chapters (that oppose a project).

5.) ECONOMIC CONCERNS

Community economic concerns primarily center around the impacts to property value (primarily in large-scale solar development), harm to tourism economies, and employment (quality of jobs).

KEY INSIGHTS AND TRENDS

Permitting and siting barriers exist as some of the most complex and consistent barriers facing clean energy deployment due to the coordination needed across industry and all levels of government.

1.) PERMITTING

The complexity of obtaining permits across the local, state, and federal government is a constant source of delay for energy projects. The exact point of delay in the permitting process is up to debate as well as who holds the responsibility for these delays (regulators or developers).

2.) SITING

Siting barriers include land-use restrictions that can delay the development of transport infrastructure, the need for hydrogen production sites to be located near renewable generation sources, regulatory requirements, and community opposition.

KEY INSIGHTS AND TRENDS

Barriers delaying **interconnection** are well-understood and well-documented challenges impeding clean energy deployment, with around 2,600 GW (2.6 TW) of capacity stuck in the interconnection queue at the end of 2023.

1.) INTERCONNECTION BARRIERS

Interconnection barriers include inadequate federal procedures for moving projects through the interconnection queue; a lack of developer access to data and lack of transparency for connecting projects to the grid, leading to planning delays; large disturbance events due to insufficient grid reliability that adds time to the interconnection process; infrastructure gaps; and projects remaining in limbo in interconnection queue.

KEY INSIGHTS AND TRENDS

Conflicting **regulatory policies** at the state and federal level, or a lack of guidance altogether, often leads to project delays. Inefficient **market design** or a lack of a robust market can also lead to challenges.

1.) STATE POLICIES

Fragmented authority between state and federal authorities can lead to project delays, especially as it relates to transmission development (i.e., a state PUC can delay a project even after FERC approval). State policies supporting transmission development are urgently needed.

2.) FEDERAL POLICIES

Federal policies act as both barriers and tools for clean energy deployment (i.e., FERC Order No. 1000 spurred transmission development but also led to barriers such as static planning and inconsistent consideration of new technology).

3.) MARKET DESIGN

Market design failures are due to inefficiencies or structural imbalances in the markets (i.e., curtailment of utility-scale solar are increasing as energy demand rises) that act as barriers to new project development. Supply chain delays and an overreliance on limited suppliers represent additional project barriers captured under market design.

GAPS IN EXISTING RESEARCH

1. There is a current lack of research in green hydrogen due to nascency of industry which will likely change as more projects are developed. The demand (or lack thereof) for green hydrogen could become an important non-cost barrier in the future.

2. Several important transmission developments, likely to have large impacts on technology deployment, are not included in research (i.e., FERC Order No. 1920 and No. 2023, DOE's Coordinated Interagency Authorizations and Permits (CITAP) Program). These initiatives could impact several research areas, including permitting/siting and interconnection.

3. The impacts of the Justice40 initiative are yet to be realized which could have significant impacts on community and stakeholder engagement.

4. A project's modularity (ability to scale up or down) wasn't discussed in depth across reviewed sources. Additional research in this area could be particularly helpful with green hydrogen and solar deployment.

5. Some research briefly touched on the impact of clean energy deployment in regulated vs. deregulated markets. Additional research determining the prevalence of non-cost barriers in regulated states where utilities are vertically integrated would be useful in analyzing the deployment of green hydrogen and solar projects.

IMPLICATIONS FOR THIRD WAY RESEARCH

"ERM plans to scan for barriers associated with all four categories in Phase II of the project. Specifically, the team will be examining which elements of ***community engagement/opposition*** *impacted projects, how, and at what stage. We will note how* ***permitting or siting requirements*** *affected the projects and capture the length of time required or estimated for* ***interconnection projects****, in months or years. Finally, we will also closely examine any* ***structural regulatory policies*** *or* ***market conditions*** *that impacted a project's completion."*