Community Voices and Renewable Futures: A Review of Public Opinion and Community Engagement in the Energy Transition

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Abstract

1. Introduction

There is a clear scientific consensus that to avoid catastrophic climate change, human societies must decarbonize. Today, in the United States, we are witnessing unprecedented levels of political will to finance this transition through Biden Administration initiatives. The enactments of the Infrastructure Investment and Jobs Act (IIJA), the CHIPS and Science Act (CHIPS), and the Inflation Reduction Act (IRA), the Bipartisan Infrastructure Law (BIL) provide hundreds of billions to be invested in a just transition away from fossil fuels (Pipa & Pietro, 2023). A significant amount of these financial resources is attributed to efforts to provide or enhance the capacity of communities, especially rural and marginalized ones, to identify opportunities and implement public policies to transition to a more sustainable economy (Eggers et al., 2023; Ricketts et al., 2023; Tomer, 2022). However, despite the clear scientific agreement and the current political will to decarbonize at the federal level, renewable energy developments are being blocked over and over at the local level. Hundreds of localities have implemented restrictions against renewable energy development, hundreds of projects have been contested across the country and nearly 20% of wind energy projects faced significant opposition (Palmstrom 2023; Stokes et al 2023).

2. Methods

This meta-analysis aims to provide a comprehensive understanding of public opinion patterns and community engagement processes related to renewable energy project development by synthesizing existing literature across four distinct themes: environmental science, economics, politics, and think tank reports. To ensure a systematic and rigorous approach, the research team employed a well-defined methodology in meta-analysis research, including identifying a set of primary research studies, transforming primary findings into initial units of data for meta-analysis, developing categories or themes, and communicating findings (Levitt, 2018). In this research, we compiled a comprehensive bibliography, created individual annotated bibliographies for each article, subsequently synthesized literature under specific subtopics within each overarching theme, and summarized findings from each of these themes. This systematic process enabled the extraction of valuable insights and the identification of trends and patterns across diverse scholarly perspectives.

The first step our research team took to conduct this meta-analysis involved the compilation of a comprehensive bibliography of articles related to renewable energy project development, especially in rural settings in the United States. This process included a thorough search across academic databases, journals, and reputable repositories, ensuring the inclusion of a diverse range of perspectives and research methodologies in four main topic domains: environmental science, economics, politics, and think tank reports. The compiled bibliography was organized into a Google Sheet, facilitating efficient data management and analysis. This comprehensive Google Sheet entails the article name, author name(s), topic, journal name, publication year, citation, a summary or abstract of the article, the summary of results and key findings, and additional notes (if applicable).

Next, individual annotated bibliographies were created to ensure a nuanced understanding of each article. These bibliographies provided detailed information on the author(s), publication date, research methodology, key findings, and theoretical framework of each study. This step not only facilitated a comprehensive overview of the literature but also enabled the identification of gaps, contradictions, and potential biases within individual studies. It also facilitated the identification of patterns across articles to identify the main themes or conversations in the literature on each topic.

With individual bibliographies in hand, the research team proceeded to synthesize the literature within each of the four overarching themes: environmental science, economics, politics, and think tank reports. Each theme was treated as a distinct analytical unit, allowing for in-depth exploration and analysis. Subtopics within each theme were identified, ensuring a structured approach to the synthesis process.

Environmental: The environmental theme focused on salient environmental impacts of various energy sources, community opposition motivated by environmental concerns, existing energy transition project successes and failures, and strategies to promote renewable energy technologies in different communities. The synthesis aimed to identify key environmental and cultural concerns for energy technologies, as well as best practices for a substantively and procedurally just renewable energy transition.

Politics: The political science literature was examined and synthesized for themes revolving around renewable energy development and community engagement. Common themes involved changing public opinion, the impact of framing on community support for renewable energy, the impact of political institutions, and sources of community acceptance and opposition. By examining political, governmental, and policy sources, the synthesis aimed to identify common understandings of how to successfully engage communities with renewable energy development.

Economics: The economic theme focused on synthesizing literature related to the financial aspects of renewable energy project development in rural settings. Subtopics included cost-benefit analysis, financial incentives, and the economic viability of different technologies. By examining diverse economic perspectives, the synthesis aimed to draw comprehensive conclusions regarding the economic sustainability of rural renewable energy projects.

Think Tank Reports: The synthesis of think tank reports involved extracting insights from policy-oriented perspectives, and identifying common policy recommendations and critiques. Think tank reports were treated as a unique category, providing a broader context for understanding the policy landscape surrounding rural renewable energy projects.

The final step in our methodology involved merging the synthesized literature from each theme, facilitating a cross-disciplinary analysis. By integrating perspectives from environmental science, economics, politics, and think tank reports, our meta-analysis sought to offer a holistic understanding of the complex dynamics influencing renewable energy project development in rural settings.

This comprehensive meta-analysis methodology, involving meticulous bibliography compilation, creation of individual bibliographies, synthesis within distinct themes, and integration across themes, ensures a thorough examination of the existing literature on renewable energy project development in rural settings. The resulting insights are expected to contribute significantly to the field, informing future research, policy decisions, and sustainable practices in the realm of rural renewable energy initiatives.

3. Public Opinion

General American Public Opinion on Renewable Energy

Public opinion data provides a baseline assessment of how Americans view renewable energy development. Understanding public opinion also makes it easier to identify why renewable energy opinions in fossil-fuel-dependent regions differ from the broader United States. By identifying the factors that influence individuals' opinions on renewable energy technology, researchers can predict community opinion and more effectively engage target communities in an energy transition. Factors that influence public opinion on renewable energy in the U.S. include partisanship, national & energy security concerns, risk aversion, age, sex, and education.

The United States as a whole displays overwhelmingly positive support for renewable energy. Public opinion polls reveal that 89% of Americans support expanding solar energy technology, while 85% support wind energy development. The United States also broadly rejects the expansion of fossil fuel energy production. Public opinion polls show that less than half of Americans, approximately 39%, support fracking, oil and gas, and coal mining industries (Pew Research Center, 2018). Another study supports these findings through a nationally representative survey. This study shows that 90% of Americans support solar energy technology, 88% support wind energy, and 75% support natural gas technology as cleaner energy. This study also finds that 69% of Americans oppose coal energy (Sharpton et al., 2020).

Despite high renewable energy and low fossil fuel support levels in the U.S., there is a general reluctance among the public to reduce or drastically change fossil fuel production. For example, a nationally representative survey conducted in 2023 found that 31% of respondents supported completely phasing out fossil fuel production, 32% of respondents felt that the U.S. would eventually have to phase out fossil fuels but they felt it was not in a place to do so anytime soon, and 35% of respondents felt that the U.S. should never phase out fossil fuels. While 90% of Democrats supported prioritizing renewable energy over fossil fuels, 51% of Democrats opposed phasing out fossil fuels completely (Kennedy et al., 2023).

Partisanism & Demographics

People vary in the extent to which they support transitioning to renewable energy despite an overall national consensus. ***Partisanship*** is one of the biggest determinants of a person's energy preferences. Specifically, Republicans are less likely to support regulating fossil fuels and increasing investment in renewable energy than Democrats. A growing divide along party lines over support for energy policy indicates that energy policy is becoming polarized. Increased polarization makes consensus surrounding a renewable energy transition difficult (Bergquist, Konisky, and Kotcher, 2020). Partisan politics in the United States contributes to massive variation in public perception of renewable energy resources. However, sweeping support for solar and wind technology expansion is observable across partisan divides. Eighty percent (80%) of American Republicans support the expansion of solar energy, compared to 96% of Democrats. Similarly, 71% of American Republicans support the expansion of wind energy, compared to 93% of Democrats (Pew Research Center, 2018). U.S. Democrats prioritize renewable energy development nearly 45 percentage points more than their Republican counterparts (90% of Democrats versus 46% of Republicans), meaning that when asked about their opinion on renewable energy industries, Democrats are significantly more favorable to the industry's expansion than Republicans.

In addition to politics, education, age, and sex widely influence public opinion on renewable energy in the United States. Higher education levels deepen this political divide. Increasing a liberal or moderate's education level increases their support of renewable energy technology while increasing a conservative individual's education level decreases renewable energy support. In addition to political affiliation and education, variation in public opinion on renewable energy is affected by age. Younger Americans are more likely to prioritize renewable energy than older individuals. A vast 90% of millennials support renewable energy technologies, while only 75% of Americans aged 65 and older support renewable energy. Finally, women are more likely to support renewable energy than men. In the United States, women are 10 percentage points more likely to support renewable energy technology than their male counterparts, on average (Hamilton et al., 2019).

Individuals' risk aversion affects public support for renewable energy as well. Risk-averse people were more likely to oppose the construction of any power plant, regardless of the energy source (Ansolabehere and Konisky, 2009). People perceive the greatest environmental harm from coal and nuclear plants and perceive the least harm from wind farms. Perceived environmental harm was the most significant indicator of negative attitudes towards energy development (Ansolabehere and Konisky, 2009). People's risk preferences are important to consider because it may influence existing attitudes towards renewable energy potentially formed by partisanship and demographics.

Energy Security

Energy security is important to consider when explaining the formation of and shifts in public opinion on renewable energy. This section describes public opinion regarding energy security and renewable energy in a chronological timeline over the past 10 years. A 2013 poll finds that a majority of Americans were concerned with U.S. energy production and supported increased emphasis on renewable energy sources (solar, wind, and natural gas). Seventy-six percent (76%) of Americans supported increased solar production and 71% supported increased wind production A minority of Americans wanted to increase the production of traditional energy sources (Jacobe, 2013). A 2018 Gallup poll revealed continued decreasing support for coal. There was a 9-percentage point decrease in Americans who supported increasing coal production from 31% in 2013 to 22% in 2018 (Jones and Saad, 2019). A 2021 survey showed that Americans are increasingly troubled by the state of U.S. energy. The survey captures concerns after two energy crises in the U.S. (the breakdown of the Texas electric grid in early 2021 and blackouts in California during a heatwave). Concern for the availability and affordability of energy increased by 19 percentage points between 2020 and 2021. Republicans' concern grew by 39 percentage points between 2020 and 2021. Despite increased concerns, fewer Americans supported increasing solar (73%) and wind production (66%) than in 2013 (76% supported solar and 71% supported wind) indicating a potential consequence of the increased politicization of energy (Jones, 2021). A 2023 poll revealed that substantially fewer Americans view the energy situation as "very serious" when compared to 2021 polling data. 44% of Americans viewed the energy situation as very serious in 2022. This number dropped by 10 percentage points in 2023. There was a 15 percentage point decrease in Republicans who viewed the energy crisis as very serious, going from 64% in 2021 to 49% in 2023. There was a 9 percentage point decline in Democrats who viewed the energy crisis as very serious, going from 34% in 2021 to 21% in 2023 (Jones, 2023).When people express concern about the state of energy in the U.S. they tend to be more open to increasing renewable energy development (Bolsen and Lomax Cook, 2008). There was also a stark difference in the prioritization of environmental protection versus energy production along party lines. Seventy-nine percent (79%) of Democrats supported prioritizing environmental protection over energy production whereas 80% of Republicans supported prioritizing energy production from traditional sources over environmental production (Jones, 2023). *Between 2018 and 2023, support for increasing renewable energy production decreased by 14 percentage points from 73% to 59%. Support for increasing the production of traditional sources of energy including oil and gas increased from 21% in 2018 to 35% in 2023 (Gallup, 2023).*

There is evidence that the political and economic state influences Americans feelings towards renewable energy. National security and energy security are increasingly intertwined. Concerns with national security often correspond with concerns about energy security. When people are concerned with national and energy security, they tend to favor increasing production of renewable sources. For example, when global oil prices are stable American support for increasing U.S. energy production, including renewable energy, declines. When global oil prices increase or the global oil market is volatile, Americans' support for renewable energy development increases. Public attitudes towards renewable energy development are highly conditioned by the state of the economy and international stability indicating that people frame energy within an economic context (Bolsen and Lomax Cook, 2008).

In sum, the general public opinion on renewable energy in the United States is primarily positive. The expansion of wind and solar energy resources receives significant support from the vast majority and exists across partisan lines. Less than half of Americans support the expansion of coal, fracking, and oil industries, but many Americans are hesitant to fully phase these resources out. Public support for renewables varies due to political affiliation, education level, age, and sex. Increased concerns for energy security can increase public support for renewables. Synthesizing available literature provides an understanding of the public consensus on renewable energy in the United States. Using this data, researchers know that renewable energy receives broad support at the national level and which factors contribute to this consensus. They can also identify how target communities' opinions may differ, allowing them to more effectively engage the community in a renewable energy transition. Broader public opinion in the United States can be compared to fossil-fuel-dependent regions, such as Appalachia, to understand how they differ and why renewable energy implementation proves difficult in these communities.

American Fossil Fuel-Dependent Regions' Public Opinion on Renewable Energy

Efforts to decarbonize energy production industries have been streamlined and successful in many countries. However, energy transitions prove difficult for communities dependent on fossil fuels. *Economic and cultural ties* to mining, coal, or other fossil fuel industries often decrease these communities' support and trust in renewable energy. Regions predominated by fossil-fuel industries often exhibit strong place-based attachments, and their historical and economic reliance on mining industries shapes their community identity. As a result, these communities display high support for fossil fuels and low support for renewable energy technology.

Fossil-fuel-dependent communities in the U.S. often view mining or extractive energy industries as their only prospect for economic development, leading them to negatively view efforts to regulate fossil fuels or transition to renewable energy sources (Poudyal et al., 2019). Although many individuals in these communities dislike coal due to its environmental and health effects, they are loyal to the industry because of their historical dependence on extractive mining for economic prosperity. Many fossil-fuel-dependent communities believe the mining industry is their only reliable source of jobs. These communities support and promote extractive industries because they believe it is their only chance for upward mobility and job opportunities. As a result, they think that the fate of their economy is "linked" to their non-renewable energy industries (Feng, 2020).

Support is low for renewable energy in fossil-fuel-dependent communities because the more individuals believe in the economic benefits of fossil fuel industries, the less they support a renewable energy transition. A public survey conducted in 2019 in a fossil-fuel-reliant Alberta, Canada (researchers compare this region to West Virginia and Texas in the U.S.) shows that perceived economic benefits of fossil fuels, rather than realized economic benefits, undermine public confidence in renewable energy sources. However, the less respondents think that fossil fuels will remain a dominant economic player, the more they support decarbonization (Scimpf et al., 2022). Regardless of the true economic impact of extractive industries, communities may be less inclined to consider alternatives if they believe that the dominant fossil fuel industry benefits their economies.

Many fossil-fuel-dependent regions view fossil fuel industries as long-term facilitators of their economic mobility. The fossil fuel industry has dominated many of these regions' economies for a long time, leading them to shape proud heritages and cultures around mining. Proud heritages built around fossil fuels lead them to view environmental activists and regulation as threats (Lewin, 2019). An energy transition requires deeper change than shifting the form of energy production for these communities. It requires systemic and cultural change (Lewin, 2019). The added element of cultural and economic reliance on extractive industries makes their energy transitions harder to achieve than those in other communities throughout the United States.

Some communities in Appalachia feel that environmental organizations prioritize curtailing climate change and sustainability over their local heritage and well-being. As many activists focus on limiting pollution and switching to renewable energy, the pressure for reform lands on communities with non-renewable industries. Some Appalachian community members feel that because they are the target of many reform efforts, they "bear the brunt" of solving climate change. They also note that activists often push aside community interests in heritage and economic growth in favor of sustainable solutions, which leads to community resistance against decarbonization and anti-environmentalism sentiments (Lewin, 2019).

Interestingly, fossil fuels receive increased support from people who live near fossil fuel industries. This phenomenon, called "*proximity* benefits," occurs because of deep-rooted cultural and economic community relationships with fossil fuels. Researchers can predict a community's support for fossil fuels based on their proximity to extractive industries. The closer a community is to an economically dominant fossil fuel industry, the more likely they are to support fossil fuels. Unlike fossil fuels, living near renewable energy sources does not have a consistently reliable impact on individuals' attitudes toward renewable energy. Renewable energy has only recently arisen as an economic sector and does not bear the same economic and cultural influence as fossil fuels in their localities (Mayer, Olson-Hazboun, Howe, 2021). Communities closer to dominant fossil fuel industries may display high support for fossil fuels and be less supportive of a renewable energy transition, but proximity effects for renewable energy are more variable. Proximity to a proposed wind energy site can affect public opinion. People who live close to a proposed wind energy site are more likely to oppose its development. Furthermore, people who anticipate seeing the installed windmills daily are more likely to oppose wind projects, regardless of whether they live near the wind farm (Olson-Hazboun et al. 2016). The role of proximity and support for wind farms is further demonstrated by an observed "distance decay" where communities that are the furthest from a wind farm have the greatest support (Swofford and Slattery, 2010).

Research in fossil fuel-reliant Utah shows that negative views of renewable energy often arise from three main concerns: the economic potential of renewable energy industries, the threat they pose to local identity, and a sense of unfair reward and punishment for renewable energy and fossil fuels. As aforementioned, many individuals in similar communities have confidence in the economic benefits of extractive industries. Some individuals are doubtful that renewable energy offers economic potential and worry that the shutdown of non-renewable energy industries and the promotion of renewable energy would be zero-sum. In addition to this, their heritage, pride, and culture are often rooted in mining and non-renewable energy production. Replacing fossil fuels with renewable energy technology as the dominant economic industry means potential damage to their local identities and communities. Finally, some protest renewable energy because they disapprove of federal tax incentives, grants, and reduced regulation for renewable energy markets. Communities with fossil fuel economies are regulated, while the renewable energy industry receives economic and regulatory support. Individuals from fossil fuel communities view it as an unfair governmental market manipulation and punishment to their industries (Olson-Hazboun, 2018). This us-versus-them mentality leads to decreased support for renewable energy technologies.

The kind of fossil fuel industry a community relies on can be a helpful proxy for support for renewable energy. Counties with dominant natural gas and coal industries correlate with lower support levels for renewable energy technology. Counties that predominantly produce oil, on the other hand, do not correlate with renewable energy support. (Olson-Hazboun, 2018). Researchers can use this data to form a preliminary hypothesis of a community's public opinion on renewable energy by identifying their predominant means of non-renewable energy production.

Support for energy transition projects is easier achieved for the broader United States than for communities economically dependent on fossil fuels. Fossil fuel-dependent communities have a historical, cultural, and economic relationship with their extractive industries that have shaped their heritages and identities. This dependence on nonrenewable industry pushes communities to view fossil fuels as their only source of economic mobility and job security. Thus, threats to fossil fuels, such as decarbonization, receive pushback from these communities. Sustainable solutions mean potentially devastating economic and cultural losses, leading to public disapproval of renewable energy, environmental activism, and governmental intervention to promote cleaner energy. An activist can successfully implement a community-accepted renewable energy transition in these regions if they understand that a transition means complete cultural and economic change. Engaging with the target community to understand their needs and concerns can allow environmental activists to help fossil fuel-reliant regions transition to alternative energy.

4. Community Engagement Efforts

Sources of Community Acceptance

While people generally accept renewable energy, there is a gap between general individually-surveyed support and mobilized community support for the energy transition. Renewable energy implementation is accepted overwhelmingly throughout the United States, but community acceptance is critical for the successful development of renewable energy. Effective development occurs in locations where community participation and support of the project are high. Engaging a community through collaboration among renewable energy developers, local officials in charge of decision-making, and community members fosters acceptance. For example, communities with higher levels of acceptance were often stakeholders in renewable energy facilities (Krug and Rosaria Di Nucci, 2020). The stages of renewable energy development provide channels for community engagement. The use of "citizen advisory boards" during problem and direction-setting phases was useful for establishing policies that incorporated a variety of stakeholder perspectives (Pitt and Congreve, 2017). Local governments that implement collaborative efforts pass more renewable energy policies than localities where the government engages in little collaboration (Curley et al., 2021; Brown and Hess, 2016). Collaboration with stakeholders representing a variety of interests can increase the number of renewable energy policies adopted by the locality (Pitt and Bassett, 2014). Renewable energy implementation is accepted overwhelmingly throughout the United States. Understanding the sources of acceptance for renewable energy can help push successful energy transition projects.

Engagement with individual community members is an important part of increasing acceptance. Community-based organizations and mobilization by grassroots organizations are another avenue for garnering local acceptance. Community-based organizations build support by educating community members about renewable energy, legitimating the project, advocating for community engagement and support, etc. (Grimley et al., 2022). Social acceptance has been divided into three dimensions: social acceptance, community acceptance, and market acceptance. Social acceptance is broad and represents general, public support for renewable energy technology. Community acceptance is localized and directly related to whether community members accept a specific project. Market acceptance is tied to whether financial institutions and community members, those buying the energy, will support the project. These dimensions have different implications for overall community acceptance (Wüstenhagen et al., 2007).

Individual and community values inform the acceptance of renewables. Place-based attachment can significantly influence whether people support a wind development project. People with psychological attachments to an area are more likely to be cautious of development. Perceptions of economic costs and benefits were found to also impact community acceptance in addition to values (Bidwell, 2013). For example, a community in a rural area reliant on one industry cited economic benefits as the strongest reason for supporting wind energy development because of the economic diversification. Despite economic benefits, some stakeholders opposed wind development because they felt it would impede on traditional rural lifestyles (Mulvaney et al., 2013). In some cases, increased tax revenue can build support when used to improve community services and infrastructure. Increased tax revenue has also been used to reduce taxes for community members. Economic benefits provided directly from new energy sources can be used to gain acceptance from community members (Shoeib et al., 2021).

Traditional understandings of community acceptance of renewable energy argue that public support grows over time as people become increasingly comfortable with renewable energy in their community. However, most of the research on public support has only been conducted on support throughout the development process and ends once the energy source is constructed. One study found that public support for wind energy is not necessarily linear. This is evident in community support to extend the life of wind farms or re-power them. The community benefits received throughout the operation of a wind farm can promote community support if stakeholders feel that benefits are distributed equitably and trust the developers and decision-makers. Building community support is a continuous process that extends throughout the operation of the facility (Windemer, 2023). Residents who felt the process was fair perceived greater economic benefits and residents who felt the process was not fair had significantly more negative perceptions of the project (Mills et al., 2019). For example, people who shifted their attitudes to be negative towards a project tended to think that wind turbines harmed aesthetics and felt the development process lacked procedural fairness and transparency. People who initially opposed the project but switched to support generally cited tangible economic benefits as the reason for their change in opinion. Attitudes toward wind energy can be achieved by promoting trust, transparency in information, and reducing the gaps between expectations and reality (Bingaman et al., 2023). There are a number of ways to foster community acceptance of renewable energy, however, sources of opposition can inhibit renewable energy development.

Sources of Community Opposition

Understanding community acceptance of renewable energy lies in better understanding sources of community opposition. Through this, researchers can address community concerns and promote support for renewable energy projects. While most Americans support renewable energy when asked, many oppose projects proposed in their communities. People cite various reasons for opposition including environmental concerns, social concerns, cultural concerns, and a lack of technical knowledge on the issue. Despite the many rationales for opposition, there have also been instances where opposition was grounded in false estimates of the impacts of a project.

Opposition groups to renewable energy have been successful at preventing renewable energy development in some cases. Sometimes, opposition comes from skepticism of how renewable energy will impact the environment or economy and whether promised benefits will come to fruition. Therefore, understanding the reasons for opposition is essential for crafting policies that address people's concerns and considering opposition groups in decision-making processes.

One study of 53 cases where renewable energy was either significantly delayed or completely blocked examined common sources of opposition. The authors found seven common reasons for opposition including concern for environmental impact, challenges to financing and revenue generation, lack of public participation, failure to respect indigenous rights to consult, threats to health and safety, disputes between government agencies, and concern over property devaluation. In 79% of cases, protest was sourced from more than one concern. The two most common sources of opposition were concern for property devaluation and environmental degradation which were present in over 50% of the cases studied (Susskind et al., 2022). People may frame renewable energy development within the context of general land development (Jacquet, 2012). Therefore, concerns for environmental degradation may be related to concerns associated with any form of land development.

One common source of opposition to wind energy is the visual impact caused by wind turbines. Visual pollution and its impacts on people's views are commonly cited reasons for opposition and negative feelings towards wind. Much of the opposition along visual grounds is rooted in inaccurate perceptions of how the turbines will impact viewsheds. For example, groups opposing the Cape Wind project in Massachusetts distributed simulated images of how wind turbines would impact the viewshed. The images were inaccurate depictions of the visual impacts that led to the project's failure (Phadke, 2010). Therefore, perceptions of how wind turbines impact visual aesthetics, whether accurate or not, can significantly impact support.

Opposition to wind development can also be rooted in health concerns. Some people think low-frequency vibrations from wind turbines have harmful health impacts. Thinking wind turbines pose health risks is a significant indicator of opposition. However, concern over health impacts decreases as respondents get further from turbines. Additionally, communities that already live with wind turbines are less likely to have concerns about health impacts or visual impacts than communities where no wind turbines are present (Baxter et al., 2013).

A lack of community engagement and poor communication regarding community benefits with stakeholders can produce substantial opposition. For example, when community benefits were vague, residents considered them to be a bribe leading people to oppose the project. Not only is collaboration with community members important but ensuring that the information they receive is clear may be just as important (Aitken, 2010). Inequitable distribution of economic benefits can breed opposition making distributional justice key to acceptance (Walker et al., 2010, Landeta-Manzano et al., 2018).

Cultural impacts can be another concern among community members. Specifically, land can often have a cultural significance which development may threaten. Communities that have a positive valuation of the land are more likely to oppose renewable development demonstrating the cultural barriers to renewable energy development (Van der Horst, 2007, Bidwell, 2013). Policies that place restrictions on the type of land that can be developed can reduce opposition (Fast and Mabee, 2015).

Concerns over Infringement on Ways of Life

There is a gap between majority support for renewables and support for renewables in one's community. This discrepancy has been attributed to a social and an individual gap. The social gap relates to high public support for renewable energy but poor renewable energy development. The individual gap describes individuals who support renewables in an abstract sense but oppose their development in their community. One explanation for the social gap is a democratic deficit where a well-resourced minority opposing renewables successfully mobilizes and stops development. Another explanation is that people are misinformed, contributing to opposition when wind energy is proposed in their community. A NIMBY ("Not In My Backyard") explanation argues that people support renewables hypothetically but oppose it when it directly impacts them (Bell et al., 2005). However, the NIMBY explanation may be less applicable, and the former explanations may be the most robust. Specifically, a majority of people support renewable energy. However, well-resourced minority groups successfully stop development despite a majority supporting it (Bell et al., 2013). Some Americans oppose renewable energy due to concern about its economic impact on local jobs and land value. Support for renewable energy technology dwindles when Americans believe its implementation will damage their local economies (Sharpton et al., 2020). Concerns regarding the local economic impacts of renewable energy play a significant factor in shaping public opinion.

Proximity to a proposed site for renewable energy can increase opposition. People who live close to a proposed site are more likely to oppose its development. Furthermore, people who see the windmills daily are more likely to oppose them, regardless of whether they live near the wind farm (Olson-Hazboun et al., 2016). The role of proximity and support for wind farms is further demonstrated by an observed "distance decay" where communities that are the furthest from a wind farm have the greatest support (Swofford and Slattery, 2010).

Lack of Technical Knowledge

In several instances, people's justifications for opposing renewable energy development in their communities were based on inaccurate assumptions of how the energy would impact their communities. For example, opponents of the Cape Wind project distributed simulated images of how the offshore wind project would impact the community's viewshed. These images generated considerable opposition. In reality, the pictures were inaccurate depictions of how the wind farms would look from the shore (Phadke, 2010). Additionally, opponents of the Cape Wind project cited concerns related to harmful impacts on marine and ecological systems as well as impacts on boating and fishing activities. The Environmental Impact Statement from the project indicated that most of the perceived costs were inaccurate and not representative of potential risks (Firestone and Kempton, 2007). Nevertheless, the images contributed to opposition which successfully stopped the project.

People who support wind energy tend to underestimate the share of their community who also support wind energy, perceiving that they are in the minority. Opponents of renewable energy tend to perceive a false consensus where they overestimate the number of people in their community who also oppose wind farm development (Sokoloski et al., 2018). Democrats tend to perceive a large gap in support for renewables between Republicans and Democrats. On the other hand, Republicans tend to base their perceptions of public support on their feelings toward wind energy. Republicans who support wind energy tend to believe that Republicans and Democrats have similar levels of support for wind energy. People incorrectly estimate other people's opinions, which have important implications for how wind energy developers perceive a community responding to a proposed wind project. Specifically, if developers base perceptions of how the public will respond on incorrect judgments it could stifle wind energy development (Sokoloski et al., 2018).

Another source of opposition to renewable energy technology in the U.S. is the public doesn't have a reliable method to learn about renewable energy. Some Americans worry that renewables are costly to implement and maintain. Others worry that renewable energy can be highly unreliable (this is known as "intermittency." for example, no solar energy production at night or on heavily overcast days, wind energy production when the air is still, etc.) (Miniard & Attari, 2021, Sovacool, 2009). These concerns lead to lower support levels for renewable energy technology. Due to government subsidies and the availability of renewable energy sources, renewable energy technology can prove to be cheaper than their nonrenewable alternatives, and due to storage technology and mixed-renewable energy implementation strategies, just as reliable. These strategies can address salient public concerns, but worries often go unaddressed due to a lack of community procedural inclusion and accessible, quality information about renewable energy technology. While there is generally high baseline support for renewable energy projects in the United States, renewable energy projects in the U.S. are protested, delayed, or canceled due to this lack of access to information that addresses public concern (Bidwell, 2016).

Community Acceptance and Opposition to Specific Types of Renewable Energy

Communities may vary in their support for specific renewable energy technologies. Salient environmental research shows that individual renewable energy technologies have respective sources of support and opposition. The following section details public opinion for each renewable energy industry. Understanding how the U.S. regards specific renewable energy technologies can help researchers advocate for proposed energy sources when engaging with local communities. Overall, there is more data for oppositional sources than for public support.

Solar Energy

According to nationally representative public opinion data, 89% of Americans support expanding solar energy technology (Pew Research Center, 2018). Support for solar energy comes from its positive impact on climate change, benefits to the economy, improvements to public health, and promises of employment (Sharpton et al., 2020). Americans are also more likely to support solar energy when it is perceived as a symbol of national renewable energy commitment and when they trust their local solar companies (Carlisle et al., 2015). Utilizing these sources of acceptance when framing solar energy implementation projects may generate public support. There are also several sources of opposition to solar energy. Concerns about the reliability of solar technology generate public opposition (Bidwell, 2016). Individuals know solar panels generate electricity when the sun is shining but may doubt their effectiveness on overcast days and at night due to misinformation. While implementing storage technology and diversifying renewable energy sources mitigate this issue, an information gap influences this public perception. In addition, many activists worry about potential chemical environmental contamination from discarded solar panels and hazardous construction materials of photovoltaic solar panels (Sovacool, 2009). Concerns about solar field land devaluation, government incentives that lower the cost of land leases, and solar fields spoiling aesthetic natural scenery all lead to public opposition (Carlisle et al., 2015).

Wind Energy

Wind energy expansion receives support from 85% of the population (Pew Research Center 2018). The dominant drivers of support for wind energy include improvements to public health, its positive impact on climate change, benefits to the economy, and promises of employment (Sharpton et al., 2020). However, it receives opposition because of its landscape and ecosystem alteration, significant land use, spoiling aesthetics of shores and mountains, avian mortality, and stereotypes of blade noise and signal interference from older models of wind turbines (Sharpton et al., 2020, Sovacool, 2009).

In the Cape Wind project in Massachusetts people with higher levels of education, young people, and people who owned their own homes were more likely to support the project. Whether a person would see the turbines daily was a predictor of negative attitudes toward the project. Proximity and interactions with wind projects (i.e. seeing the turbines) can increase negative attitudes, as has been found in other studies (Olson-Hazboun et al., 2016, Swofford and Slattery, 2010, Van der Horst, 2007). Concern over impacts on aesthetics, boating and fishing, and general environmental harm were commonly cited as reasons for opposing wind energy development. However, an environmental impact statement indicated that the costs cited by the opposition were inaccurate and not representative of potential risks (Firestone and Kempton, 2007).

Hydroelectric Energy

Hydroelectric technology is not as desired as solar or wind energy but is positively regarded in the United States (Miniard & Attari, 2021). 81% of Americans hope to maintain existing hydroelectric infrastructure, and 75% support expansion of hydroelectric energy generation (National Hydropower Association, n.d.). While the public views it as a clean and reliable energy source, it has several sources of opposition. Those who oppose hydroelectric production worry about the aquatic ecosystems destruction, greenhouse gas emissions from standing water, sedimentation, and potential effects on water quality (Sovacool, 2009).

Biomass Energy

Biomass has an overall positive assessment in the United States but receives less support than all other renewable energy sources. It receives lower support primarily because of insufficient public knowledge about biomass energy production (Sharpton et al., 2020). Other sources of opposition include atmospheric pollutants, generated odors, traffic congestion from smoke, and improper biomass material harvesting resulting in ecosystem degradation (Sovacool, 2009).

Geothermal Energy

Geothermal energy production isn't supported as widely as solar or wind energy (Miniard & Attari, 2021). There is not much data regarding American support for geothermal energy, but the United States generates more geothermal energy than any other country (U.S. Department of Energy, n.d.). While geothermal energy is reliable and abundant, it receives concerns regarding its mild emission of air pollutants, hazardous waste byproducts, and heavy water and land use requirements (Sovacool, 2009).

Solar, wind, hydroelectric, and biomass energy resources are supported widely in the United States. Data regarding levels of support for geothermal energy in the U.S. are limited, indicating a potential gap in existing literature to be filled through future research. Regardless, the literature shows prominent sources of concern for geothermal energy that can be addressed to promote community support. Identifying sources of support and opposition for various renewable energy technologies in the U.S. can help researchers predict potential community concerns and leverage support for renewable energy through lenses that are more broadly supported. Commonly supported aspects of renewable energy technologies can also be used to frame an energy transition in a way that garners optimal community support.

5. Framing Renewable Energy Development at the Community Level

Understanding what aspects of renewable energy create opposition may help address community concerns and reduce the number of failed projects. Similarly, advocating for renewable energy sources through their commonly identified benefits may help plan renewable energy projects that communities support. How an activist or policy maker frames renewable energy technology to a community is pivotal, especially a fossil fuel-dependent community that may have lower levels of pre-existing support for renewable energy. The words used and incentives highlighted can be enough to persuade a community that favors fossil fuels to consider alternative energy sources. However, some framing methods are less effective than others, while some prove counterproductive. Understanding how to frame renewable energy when engaging with a community can help increase support for renewable energy projects and policies.

Renewable energy frames used by politicians, the media, and community groups have important implications for public opinion. Common framing, or arguments, regarding renewable energy include: aesthetics, economics, environmental health and safety, and politics. Framing can be used either positively or negatively to encourage or discourage renewable energy support at different community levels as documented by this section.

In Massachusetts, aesthetic frames generally reflect negative associations with wind farms whereas Montana and Minnesota's aesthetic frames are generally positive. There is large variation in how states frame renewable energy, demonstrating that the deployment of wind energy differs as a result of the framing context (Fishlein et al., 2014).

One study examines the public opinion of renewable energy in the Western United States to determine which framing strategies are the most effective. The proposed frames include energy security, diversification of energy sources, economic growth, conservation, environmental pollution, religious stewardship, and climate change. States that do not depend primarily on fossil fuels respond best to frames referencing the diversification of energy sources to promote energy access, reliability, and security. Fossil fuel-dependent Wyoming, the top coal producer in the United States, responds best to frames of economic development and reducing air pollution (Olson-Hazboun, 2019). Using these frames could bolster support in other fossil fuel-producing communities in the United States.

Addressing the Negative Externalities of Fossil Fuel Industries

Traditional energy sources such as coal produce negative externalities. Negative externalities occur when people who are not a part of the market transaction are harmed through pollution, negative health outcomes, etc. When bringing renewable energy development to communities, economic arguments can be used to show the positive impacts of renewable energy. For example, renewable energy addresses the negative externalities of fossil fuels and imposes several positive externalities on those not consuming renewable energy. Framing renewable energy as a solution to harmful externalities from fossil fuels can garner community support.

Renewable energy production addresses several of the negative externalities produced by fossil fuels. Specifically, many fossil fuel energy sources harm people who are not a part of the market transaction. Traditional sources of energy, such as coal, are incredibly cheap, as they do not include the total cost to health and the environment in their price. Accounting for these aspects in the price is known as the true cost of fossil fuel. There is an externality produced by low-priced sources of energy that impose costs on people around the world. In monetary terms, externalities associated with fossil fuel-based energy production have been estimated at around $24.662 trillion (Sovacool et al., 2021). It is estimated that air pollution largely from fossil fuels accounts for 4.9 million premature deaths annually demonstrating the expansive nature of negative externalities (Sovacool et al., 2021). Fossil fuel combustion alone accounts for 3.61 million premature deaths annually (Lelieveld et al., 2019).

One prominent externality associated with traditional fossil fuel industries is the negative health outcomes that are not included in the pricing of fossil fuel-based energy. For example, it is estimated that the health impacts associated with fossil fuel sources cost between $361.7 to $886.5 billion in the United States. This is equivalent to between 2.5% and 6% of the United States GDP (Machol & Rizk, 2013).

Renewable sources of energy produce significantly fewer negative externalities per unit of energy generated than carbon-intensive sources of energy (Sovacool & Monyei, 2021). Therefore, renewable energy production can mitigate some of the market inefficiencies produced by traditional sources of energy. One key component of efficiently transitioning to renewable energy sources is to remove market distortions that reduce the price of fossil and make them relatively cheaper than renewable energy. Specifically, subsidies provided to fossil fuel technologies have led to pricing that does not internalize the true costs of fossil fuels on communities, health, and the environment. To promote an economically viable clean energy transition, market distortions associated with fossil fuel pricing must be remedied (Owen, 2004). Renewable energy avoids emitting significant amounts of greenhouse gas emissions that are produced by traditional energy sources. For example, one estimate claims that using wind energy reduces the burning of approximately three tons of coal and the release of over 10,000 pounds of carbon dioxide per resident (Moore et al., 2010).

Explaining the Positive Externalities of Renewables

In addition to addressing negative externalities caused by fossil fuels, renewable energy creates many positive externalities for people who are not part of a market transaction. Positive externalities occur when people who are not a part of the market transaction are benefited through health harm reduction, pollution reduction, etc. For example, there is evidence that renewable energy saved over 38 million lives through the reduction of carbon emissions and air pollution that negatively impact health outcomes (Sovacool & Monyei, 2021). There is also evidence that renewable energy use can improve health outcomes by both decreasing mortality rates associated with fossil fuels and increasing life expectancies. A predominant mechanism through which renewables improve health outcomes is reducing chronic diseases that are instigated by fossil fuel emissions and pollution (Majeed et al., 2021).

Investment in renewable energy development has been associated with improving environmental quality. Specifically, a 1% increase in investment in renewable energy was found to be associated with a 0.01-0.02% decrease in per capita carbon dioxide emissions, where average per capita carbon emissions are equal to 9.8 tons (Hailemariam et al., 2022).

Positive externalities associated with renewable energy have been described as "co-benefits" which describe the reduction in air pollution, corresponding improved health outcomes, economic benefits, and more (Xie et al., 2023). One "co-benefit" of renewable energy production is the avoided emissions. A study found that US energy consumers should be willing to pay between $0.24-$0.45 per kilowatt of renewable energy produced for avoided emissions and improved health outcomes (Machol & Rizk, 2013).

Renewable energy development is associated with improved health outcomes in surrounding communities, decreasing healthcare-related costs. There is a high level of variability in the health benefits that communities receive from renewable energy development due largely in part to the source of energy that was replaced. For example, a study found that areas in the Eastern United States received higher health benefits from renewable energy than areas in the Western United States. Specifically, communities where coal was replaced by renewable energy tended to have some of the highest health benefits indicating a positive externality of renewable energy (Buonocore et al., 2019). Areas with the greatest reliance on coal often receive larger health benefits from renewable energy when compared to communities less reliant on coal (Gallagher & Holloway, 2020). The policy costs associated with implementing renewable energy may be outweighed by the benefits of improved health outcomes alone (Dimanchev et al., 2019).

Explaining the Economic Impact of Renewable Energy Development

Another way to persuade and engage communities in renewable energy development initiatives is to demonstrate the economic impact of renewable energy development which includes direct and indirect impacts to local communities. Economic impacts can be separated into two main categories: specific employment and labor-related effects and economic growth.

Renewable energy development has direct impact to the labor market by boosting green jobs. Green jobs are created in occupations that are 21% higher paying on average. The definition of green jobs, or wind and solar jobs, encompasses the kinds of jobs that require skills related to these energy sources and the job postings by the firms specializing in these domains. Since 2019, the US produced 52500 solar and 13500 wind job openings. Most of the solar jobs are in the sales occupation and the utilities industry while the wind jobs are in the maintenance occupation and manufacturing industry. These jobs are more prevalent in the U.S. counties with a high share of fossil-fuel-related jobs.

The Weatherford Wind Farm in Oklahoma, located on 5000 acres of land and developed by NextEra Energy, and purchased by American Electric Power, created 5000 full-time employees and had an overall impact of 2 billion USD. In the Weatherford Wind Farm's case, surveys and interviews were conducted to study the economic impact of wind energy. This project of 147 MW of wind farms created 188 new jobs and 27 million USD in local spending. The combined direct and indirect effects are around 25 million dollars. Property taxes were an important element accounting for 600,000 USD. This tax supports the local infrastructure too (Greene & Geisken, 2013).

The Great Plains account for 63% of the wind generating capacity in the US as a renewable source of energy and help in the economic development of rural populations. A study analyzed the Langdon Wind Energy Center which has 106 turbines, located in northeastern North Dakota. The project used the economic input-output framework like the Impact Analysis for Planning (IMPLAN) and Jobs and Economic Development Impact (JEDI) models and used four modules: economic module, demographic module, public services module, and fiscal impact module. The Langdon area, through private entities, has benefited by $9.4 million. The project created 1656 jobs throughout the state. The study estimated that most of the jobs were taken by the locals. The net fiscal benefit of the project is expected to be 271000 USD which accounts for a 13% increase in the district's local revenue. The primary ways a community benefits are the payroll and the local expenditures. The project had beneficial effects on employment and local expenditures. The Purchase of wind farm items also had a positive effect on the state economy (Leistritz & Coon, 2009)**.**

Texas is a leading state in wind energy production. A report examined the economic development of 1000 MW (as a baseline) wind power generation in Texas using the JEDI model developed by MRG and associates, using input-output models. 1000 MW represents a $2 billion investment. Even if all the manufacturing is not done on-site, there are great prospects for employment for the locals. 75 to 80% of the workers were reported to be Texas the 1000 MW project, during its construction phase, created 2100 FTE jobs and 240 permanent jobs. It also generated 260 million USD in economic activity during the construction phase and generates 35 million USD annually. It annually generates 7 million USD as property taxes and the landowners leasing their lands get 5 million USD according to 2009 estimates. 70% of the total cost is related to wind turbines and component manufacturing. residents (Reategui & Hendrickson, 2011).

Twenty five states in the US have introduced renewable portfolio standards and the amount of wind energy production has been expanding according to a 2010 study. Illinois will become one of the leading wind energy capacity holders. Wind power capacity in Illinois grew from 50 to 1000 MW from 2003 to 2009—the Illinois Power Agency Act of 2007 aims to raise the RPS by 25% by 2025. However, the following dynamics have led to a shortage of wind turbine components. It comes as an opportunity for Illinois to fill the gap in production. It can lead to high-paying jobs and increased economic production (Carlson et al., 2010).

A report using a job creation model for the US between 2009 and 2030 concludes that renewable energy technologies produce more jobs per unit of electricity than non-renewable sources of energy. It considered the jobs lost by non-renewable jobs as well. Increasing carbon capture and storage to 10% and nuclear power to 25 percent can create an additional 500,000 new full-time jobs (Wei et al., 2010).

A 2009 study examined the impact of solar thermal energy power capacity in Spain using the input and output model. It examined the goods and services and the demands from the two solar thermal plants under study and compliance with the Spanish renewable energy plan. It is estimated that they will create 108, 992 full-time jobs, 4.5% of the Spanish unemployment rate (Caldés et al., 2009). Overall, renewable sources of energy produce more employment opportunities, even if we consider job losses in the non-renewable sectors. It is also associated with higher support from consumers unless the factor of cost is considered.

The job creation in renewable energy extends beyond direct employment in the wind and solar industries. Manufacturing and services sectors experience a boost due to the demand for components and ongoing maintenance. The manufacturing sector sees increased job opportunities as the production of wind turbines, solar panels, and associated equipment expands. This includes jobs in factories producing blades for wind turbines, assembling solar panels, and manufacturing inverters and energy storage systems. The growth of renewable energy projects also generates jobs in various service sectors. This includes technicians and engineers involved in the maintenance and operation of wind and solar facilities. Additionally, the installation and integration of renewable energy systems require skilled labor, leading to job creation in construction and electrical services. Advancements in renewable energy technologies drive research and development activities. This creates jobs for scientists, engineers, and technicians working on improving the efficiency and reliability of renewable energy systems. The planning and execution of renewable energy projects involve consulting firms and project management services. This sector experiences job growth as more companies and organizations seek expertise in navigating the complexities of renewable energy development.

First, renewable energy development contributes to local and regional economies by providing a tool for economic diversification (Haggerty and Gentile, 2022; Morris and Bowen, 2020). Renewable energy development rates have been surging in communities historically dependent on fossil fuels for their local economies (Clausen and Rudolph, 2020). The Economist penned the term Dutch Disease in 1977 to refer to the phenomenon wherein an economy becomes dependent on a rare commodity (*The Economist*, 1977). Because of this dependence, all other goods in the economy become more expensive relative to other markets, driving firms selling these goods out of business. The economy then becomes further dependent on the one rare commodity. Therefore, when this economy runs out of the existing rare good, a strategy to maintain economic stability is seeking another one to rely on. Some economists attribute this phenomenon to the economies dependent on fossil fuels as well. A strategy to escape this Dutch Disease trap is to diversify the local economy, and renewable energy provides an opportunity for such diversification (Ianchovichina and Onder, 2017). By diversifying their economies, communities historically and currently reliant on fossil fuels can enhance their long-term economic resilience.

Second, renewable energy generates revenue resources for rural communities. Even if renewable energy does not immediately replace fossil fuels as the key commodity for rural economies, it provides a new revenue resource either through policy-based tools like taxation or through community ownership models that can contribute to local revenue streams. According to Haggerty and Gentile (2022), fossil-fuel-dependent communities like Big Horn County, Montana control very few revenue resources, most of them coming from royalty payments for lending out public lands and taxes for coal extraction activities. In the case that coal runs out in this community, the local government will run out of almost all revenue resources. Recently, authors at Resources for the Future published a working paper investigating fossil fuels and renewable energy revenue in 79 US counties across 10 states. The article shows that while “revenues from fossil fuels far outweigh renewables in aggregate terms, [...] wind and solar in some states generate more local public revenue than fossil fuels per unit of primary energy production” (Raimi et al. 2024).

Economic framing for community engagement in Appalachia

Coal is a key component of Appalachian economies. While the economic output produced from coal in Appalachia is high and can oppose renewable energy development, there are considerable external costs imposed on Appalachian communities from coal production. Once premature mortality (both immediate injury from mining and long-term exposure to related pollutants) in an Appalachian community is included in the costs of coal production, coal production imposes a negative net social cost (Collins et al., 2012). Internalizing the mortality costs associated with coal production in Appalachia demonstrates a net benefit while coal provides a net cost, introducing the potential for renewable energy to address a market failure in Appalachian coal communities (Collins et al., 2012).

The predominance of the coal industry in central Appalachia has contributed substantially to the high poverty rates in the region. Specifically, the "resource curse" has led to the dominance of coal production in the area at the expense of other economic development. Therefore, coal production in Appalachia has produced a market failure where other forms of economic growth are disincentivized, and the costs on Appalachian communities are not included in the costs of coal production (Douglas & Walker, 2017). As fossil fuel communities are shown to show concern for health and economic growth, utilizing the economic benefits to frame renewable energy can appeal to affected communities. Renewable energy benefits communities by addressing harmful health costs of fossil fuels that create market failure and incentivizing alternative methods for economic growth.

Communities dependent on fossil fuels express concerns about environmental health, public health, and economic growth associated with nonrenewables. Promises of economic prosperity and job protection fuel many supporters of fossil fuels (Miniard & Attari, 2021). Thus, these communities would be more inclined to support renewable energy projects that promise to clean up air pollution, grow their economies, and create lasting jobs. Advocating for renewable energy policies using energy security framing strategies that would work in the broader United States is not beneficial in communities with cultural ties to extractive energy industries. It helps to utilize frames that best align with the target community's interests.

Environmental Framing: Climate Change vs. Environmental Health and Safety

Promoting renewable energy through climate change has low support (Miniard & Attari, 2021, Olson-Hazboun, 2019). Many renewable energy projects and community energy transitions aim to reduce carbon emissions and combat anthropogenic climate change. However, climate change is a hotly contested, partisan topic in the United States. Republicans believe in climate change significantly less than Democrats and are far less likely to support climate change framing (Hamilton et al., 2019, Feldman & Hart, 2018). Thus, framing renewable energy as a solution to climate change would be ineffective for a large portion of the U.S. population. However, Republicans are far more likely to support air pollution or energy security frames (Feldman & Hart, 2018). Many Americans, including those in fossil fuel-dependent communities, also support the reduction of air pollution and environmental health. Renewable energy technologies can help communities meet these goals, so framing them through their benefits to environmental health instead of benefits to climate change would result in more persuasive advocacy. Framing these benefits to communities without using politically polarizing language may boost support for renewable energy projects and policies.

People do not solely relate renewable energy with environmental protection or climate change. For example, people may support wind energy because it helps the environment, but others may support wind energy because it provides economic benefits. Renewable energy is not as politically charged as climate change, therefore framing renewable energy as related to climate change may not help gain broad support (Olson-Hazboun et al., 2016).

Framing renewable energy as environmentally friendly may influence public opinion. However, drawing upon the environmental and economic benefits is a better approach. This method is helpful when promoting solar energy policies. Researcher Jessica Crowe explains that promoting solar energy policies through economic benefits significantly increases the number of individuals who want to live in a house with solar panels, and framing renewable energy policies with economic and environmental incentives increases support for solar energy more than either individual method (Crowe, 2021). Utilizing more than one thoughtful framing method can generate more public support for a renewable energy project or policy than any one frame alone.

People may also frame renewable energy development within the context of general land development and disruption. For example, when people were faced with the simultaneous development of natural gas and wind energy, landowners had more negative attitudes towards natural gas while people tended to have neutral or positive attitudes towards wind. The disruption of land associated with fracking contributes to negative public opinion. However, some favored natural gas if they had previous experience with leasing their land and were not concerned about environmental impacts. Contrastingly, those who largely opposed land development were likely to oppose both wind and natural gas development. Therefore, residents framed natural gas and wind energy within the context of land development (Jacquet, 2012).

Partisan Framing

Democrats and Republicans have expressed different rationales for supporting renewable energy. Republicans who supported renewable energy based their support on the financial self-sufficiency provided (i.e. hybrid cars require less gas which provides financial stability). Republicans pushed back when asked whether they supported renewables because of environmental protection indicating that framing renewable energy within an environmental protection frame may not help gain Republican support. In contrast, the Democrats' justification for supporting renewables was based on a "communion" frame where they linked environmental protection with renewable energy (Horne and Kennedy, 2019). Republican rationales are often related to the economic benefits provided from renewables while Democrats rationales are often related to perceptions of how renewable energy will help combat climate change (Gustafson, et al., 2020). Framing energy development in terms of economic benefits is useful for gaining support among ideologically moderate people and conservatives (Wiener and Koontz, 2010). Gaining support for renewable energy policy among Republicans will look different from gaining support among Democrats.

The extent to which people support decreasing fossil fuels and increasing renewable energy is highly conditioned by an individual's political ideology. For example, liberals tend to support greater reductions in fossil fuels and larger increases in renewable energy production. Liberals are more likely to accept the scientific consensus regarding climate change. Contrastingly, conservatives are less likely to support substantial reductions in fossil fuels or significant growth in the renewable energy sector. Conservatives are also less likely to accept the scientific consensus regarding climate change or that it is anthropogenic. Ideologically moderate people tended to have beliefs informed by both conservative and liberal perspectives. For example, moderates were more likely to believe climate change was occurring but not anthropogenic. Partisanship informs people's renewable energy preferences which is important when framing changes to energy production (Hawes and Nowlin, 2022).

People respond differently to renewable energy based on how it is framed. Therefore, framing renewable energy before development requires careful consideration of the community members who will be affected by the project. For example, Republicans are more likely to respond well to framing renewable energy development in terms of economic benefits while Democrats are more likely to respond well when development is framed in terms of environmental benefits. The way a project is framed can have significant impacts on community acceptance and is therefore an important part of the development process.

Explaining and Utilizing Political Implications

A clean energy transition has several political implications. Stakeholders use political mechanisms to build either support or opposition to development. As climate change has become an increasingly politicized issue, renewable energy has been associated with the politically charged narrative of climate change. However, there is evidence that people do not necessarily associate renewable energy with climate change (Olson-Hazboun et al., 2016). Nonetheless, politicians and opponents of renewable energy may politicize climate change and related policies to build opposition. Another political mechanism stakeholders utilize to foster support or opposition is political structures and institutions. Specifically, political systems where there are spaces for opponents to stall development often have fewer policies facilitating development (Bayulgen and Ladewig, 2017). Successful community engaged development requires several considerations for the variety of stakeholders impacted by development.

Politicization of Renewable Energy and Climate Change

Increasing politicization of renewable energy has substantial impacts on public support. For example, when political parties politicize and polarize wind energy people tend to have more intense reactions towards development in their communities. Politicization also increases local, intra-community conflicts as support and opposition become defined along party lines (Walker et al., 2018).

The increased politicization of renewable energy and energy efficiency (REEE) projects has prompted legislators to employ several strategies to promote the adoption of REEE policies. A prominent source of opposition to renewable energy policies is public utilities and industries. Legislators mobilized "countervailing political interests" to push back against public utilities and carbon-intensive industries. Framing these interests as pro-business has helped gain support for REEE, which has historically been labeled as anti-business. Legislators have collaborated with Public Service Commissions to develop REEE policies that would normally be blocked by utility companies. When stakeholders with a variety of interests collaborate on a bill it is more likely to be passed because the stakeholders that would normally block the legislation are included in the development process (Brown and Hess, 2016).

Leveraging Political Structures and Institutions

Policies and political structures can be leveraged to build trust between developers and community members by dictating how the public participates in renewable energy development. Political processes and policies can facilitate community engagement. Policies that give final approval to one central authority negatively impact community acceptance by removing local planners and politicians who are normally an avenue for the public to be involved (Fast and Mabee, 2015).

Impediments built into political systems can restrict and stall energy transitions. Political systems where well-resourced stakeholders can intervene, and stall development have fewer renewable energy policies. Correspondingly, these systems have more difficulty increasing the share of renewable energy sources in their energy portfolio (Bayulgen and Ladewig, 2017). Political structures influence the impact that exogenous energy market shocks have on policy adoption. Governments can implement “positive reinforcement mechanisms" that strengthen renewable energy policy. “Green" governments institute positive reinforcement mechanisms such as a straightforward path where an exogenous shock empowers renewable energy coalitions. Contrastingly, “brown” governments institute political structures that prevent renewable energy transitions. Political institutions and preferences of the government have significant implications for renewable energy policy adoption (Aklin and Urpelainen, 2013).

Mobilization of oppositional groups, how opposition groups frame risks associated with renewable energy, and political opportunities for opposition can also contribute to opposition. A common mechanism for the opposition is political structures that restrict the public’s ability to participate in decision-making which breeds oppositional sentiments among community members (Giordono et al., 2018).

A common strategy employed by opposition groups is to place pressure on local officials who have the authority to reject development proposals. The success of these opposition groups is related to the resources available. For example, well-resourced groups are more successful and often bring in planning officials to advance opposition (Ogilvie and Rootes, 2015). Oppositional stakeholders often form coalitions to oppose renewable energy development in their community. For example, in Hampton Roads, Virginia, an oppositional coalition made up of different stakeholders formed against the construction of a power plant. There are many industries in Hampton Roads. A main concern with the new power plant was how it would impact the economic growth of existing industries. Another source of opposition is how the facility disproportionately impacts communities of color. The industrial stakeholders and those concerned with equity form a coalition. However, the coalition was likely successful because of the well-resourced industries that overpower the voices of communities of color demonstrating that public mobilization is not always just (Zaup and Casey, 2016).

The punctuated equilibrium theory (PET) stipulates that policy undergoes long periods of slow, incremental change followed by short periods of significant change catalyzed by a focusing event. In some instances, a focusing event, like the energy crises of the 1970s, led to increased energy policy adoption. However, there were also instances where a focusing event did not lead to significant policy adoption. Inconsistent degrees of policy adoption resulting from focusing events have been attributed to varying levels of cultural salience. Specifically, focusing on events that produced the greatest policy changes had the largest cultural implications. Therefore, cultural impacts play an important role in energy policy adoption indicating that energy policy is intertwined with cultural systems (Fowler et al., 2017).

Policy Considerations

Policy considerations regarding renewable energy development involve a variety of sectors that impact community acceptance differently. Policy considerations include financial, community, site/location, environment, safety, and infrastructure. Financial considerations involve both investment and tax implications. Community considerations include socio-cultural concerns regarding the impacts of a project. Siting considerations include potential resources of the area (i.e. wind potential) and local permitting and zoning regulations. Environmental implications include the impacts of the renewable energy facility on surrounding environmental and ecological systems. Safety considerations include the feasibility and safety of actually constructing the site on the proposed location, the feasibility of maintaining the facility, and any potential harm caused to surrounding areas (i.e. people's homes, etc.). Finally, infrastructure considerations include whether the community or proposed location has sufficient roads or the ability to store energy (Tanaka et al., 2012). There are a myriad of sectors, people, and organizations impacted by renewable energy and the policies that either support or inhibit its development.

The electoral backlash against elected officials can measure public support for renewable energy policies. Constituents may "punish" incumbent politicians and parties when wind farms are developed in their community. Incumbent parties lost between 5 and 10 percent of the vote share in elections following the construction of wind farms. This effect persisted within three kilometers of the wind farm (where the turbines were within people's view-shed) and throughout the wind farm's operation (Stokes, 2016).

6. Recommended Best Practices in Community Engagement

There are several suggested practices for fostering acceptance of a renewable energy project through community engagement. Project planners, researchers, and activists can use these best practices to help communities transition from fossil fuels to renewable energy. These recommended strategies include educating communities on renewable energy, bridging differences between activists and community members, creating a followable decommission checklist and re-development framework, ensuring procedural justice, planning for quality job creation as well as job loss, acknowledging the cultural impact of fossil fuels, understanding various community concerns, addressing the energy sector gender gap, protecting workers' retirement funds, helping workers find and transition to new jobs, funding local infrastructure, subsidizing lost revenue for the local government, revitalizing local environments, communicating plans with affected actors, and retraining workers.

One persistent issue that project planners must contend with is the lack of commonly known, quality information on alternative energy- a source of many concerns and protests against renewables. Promoting quality information in target communities is recommended to help increase baseline support and follow-through for renewable energy projects (Bidwell, 2016). Environmental knowledge is often limited in communities because researchers do not have the time to share their findings directly. Collaborating with communities in research projects and knowledge production can help educate the target audience and better involve them in decision-making. Some Appalachian communities have proven to be receptive to environmental education briefs. Thus, sending out educational renewable energy information to target communities directly may be a promising way to engage communities (Burke et al., 2015). Another way to educate fossil fuel regions and effectively engage the community in an energy transition could be by local government creation of educational or research institutions. Researcher Sandeep Pai and peers explain that having a reliable local research institution can positively shift the public sentiment away from fossil fuels and toward clean energy (Pai et al., 2022).

Fossil fuel-dependent communities in the United States often feel that environmental activists prioritize climate solutions over their well-being and interests. Renewable energy transitions are especially difficult for these communities because they have historical and economic ties to fossil fuels. Transitioning to renewable energy means potential cultural losses for these communities that are not an issue in other regions in the United States. Many activists ignore these aspects of decarbonization, creating a rift between activists and community members. Building bridges with these communities to deconstruct perceived differences can increase the success of renewable energy projects. One good way to build bridges with communities is by targeting middle-ground individuals who are on the fence about renewable energy. When talking to these communities, highlighting win-win scenarios for the members and activists and acknowledging power relations is pivotal. Gathering support from more community members shifts public opinion closer to renewable energy support. By bridging differences, activists can show fossil fuel-dependent communities that they want to fight for their interests and improve trust (Feng, 2020). Building bridges, gaining trust, highlighting win-win scenarios, and targeting the middle ground are all beneficial strategies for community engagement. Another important bridge-building method is acknowledging that coal and other fossil fuels are integral to community identity and culture to ensure they are granted justice through recognition (Pai et al., 2022).

Environmental literature suggests having a followable and replicable plan for an energy transition. This way, a transition process can be easily replicated and adjusted across various fossil fuel communities. Bethel Tarakengne and peers suggest achieving this by creating what they coin a "decommissioning checklist" and a "re-development decision-making framework" (Tarakegne et al., 2022). A decommissioning checklist is a replicable list of criteria to meet when shutting down a fossil fuel plant. These criteria should include procedural, distributional, and recognitional justice principles to ensure that affected stakeholders and the local community receive equitable and fair outcomes from plant decommissioning. A re-development decision-making framework is a four-step framework that allows planners to easily plan the best strategy for the re-development of communities during decarbonization and clean energy implementation. This process includes identifying stakeholder needs, creating a list of mandatory criteria that marries stakeholder interests, proposing potential re-development pathways, and performing a cost-benefit analysis of those pathways to select the most equitable and beneficial outcome (Tarakegne et al., 2022).

Authors Sandeep Pai and peers recommend seventeen integral strategies to ensure a just transition to renewable energy. They explain that a renewable energy transition can cause a lot of disruption in fossil fuel regions, potentially altering their economies, jobs, infrastructure, tax revenues, livelihoods, identities, cultures, retirement plans, and more. Thus, they recommend understanding how decarbonization will impact the target community uniquely and accounting for the long-term effects of a transition before enacting plans. In addition, integrating principles of justice into the planning process and proposed public policies can help ensure that the communities receive just and beneficial long-term outcomes (Pai et al., 2022).

Pai and fellow researchers recommend including all affected actors in the energy transition planning process, including union workers. The fossil fuel industry has a relatively high unionization rate, and if not included, members may seek to protect their jobs and oppose transition plans. Including them provides workers with procedural justice that may shift their support to clean energy (Pai et al., 2022). As for all other affected actors, Susskind shows that community exclusion from the decision-making process is a salient source of public opposition to renewable energy in fossil fuel regions (Susskind et al., 2022). These communities may be more likely to support decarbonization if they are involved in the planning process. After planning and implementation, actively communicating transition plans and projected timelines is just as important as actively involving communities in the planning process (Pai et al., 2022). Community-based development helps to alleviate uncertainty associated with renewable energy which is a common source of opposition and resistance. Projects that incorporate community members have greater community support (Bauwens and Devine-Wright, 2018).

Decarbonization of the energy sector means vast job losses for fossil fuel communities. However, with the implementation of renewable energy technologies comes the potential for upward mobility and the creation of new jobs. Pai recommends planning proactively for job loss and creation when proposing an energy transition. With job loss comes potential losses to worker's pensions, benefits, and incomes. There are several recommended strategies to ensure communities are benefitting from a transition without facing these significant losses. First, planners can work with local governments to ensure that fossil fuel companies distribute workers' pensions and retirement savings despite their closure. Second, planners can help create new job guarantee programs and income compensation programs to help fossil fuel workers transition to new positions. To help with the mental and logistical challenges of a job transition, Pai recommends creating a job transition service that helps with job training, guidance, and employee support. Environmental literature also suggests that planners provide access to job retraining programs within the clean energy industry so that displaced workers can feasibly access newly created jobs. Finally, planners can help ensure that jobs created by renewable energy companies are attractive, well-paying, accessible, and quality positions to incentivize and compensate displaced laborers. Another recommended strategy to ensure a just energy transition is to address the systemic gender gap present in the energy industry by promoting diversity in newly created renewable energy jobs (Pai et al., 2022).

Subsidizing local government revenue can compensate for any economic losses resulting from a transition from fossil fuels. The fossil fuel industry is often the dominant economic actor for fossil fuel communities. Therefore, a lot of funding for community infrastructures comes from taxes and direct investment from fossil fuel companies. Loss of these dominant economic actors could mean losses to infrastructural development and even tax revenue that allows the local government to operate. Thus, Pai and peers recommend that planners should try to compensate local governments for lost revenue from fossil fuel companies, invest in creating and maintaining local infrastructure, and restore local environments impacted by fossil fuels to take pressure off of the local government, create new jobs in restoration, and better the quality of life of the community members (Pai et al., 2022).

A culturally minded framework describes the importance of considering how a community may value the land proposed for renewable energy development. Residents with a strong sense of place attached to the land are more likely to oppose a project. Therefore, understanding the cultural importance of land where a wind farm is proposed is important for addressing potential opposition. People often perceive wind energy benefits in a global context but experience the costs in their community. Therefore, communities with a strong sense of place who perceive a lack of benefits will be more likely to oppose because they see costs without tangible benefits. Another cultural implication is the sense of loyalty towards developers. Communities tend to support local developers because there is a sense of trust. Therefore, local developers may garner more support from the community than outside developers (Haggett, 2011).

Lack of trust in developers is a common source of opposition and skepticism towards renewable energy development. A developer framework creates a guideline for how developers can interact with communities to encourage community engagement. Developers who ensure procedural and distributive justice and promote trust between themselves and community members can increase community acceptance. Protecting procedural justice involves taking into consideration the concerns of the community, in particular social impacts. Economic and technical concerns are often prioritized at the expense of social concerns which can leave community members feeling excluded. Distributive justice revolves around disbursing economic benefits equitably. When economic benefits are distributed inequitably, community members are more likely to have negative feelings toward a project. Finally, trust in the information that community members receive from developers is critical to acceptance. To build trust, developers should ensure that information is as complete as possible. For example, when developers are vague about the details of community benefits, there is significant opposition built on the lack of information. (Aitken, 2010). Additionally, communities tend to respond poorly to information from developers that sugar-coats benefits or mulled over impacts as it is viewed as disingenuous (Landeta-Manzano et al., 2018).

An organization-based framework provides insight into how community organizations can support community engagement in renewable energy transitions. Civil society organizations can encourage clean energy transitions in communities where governments lack the capacity to lead renewable energy initiatives. Organizations focus on social change by promoting democratic institutions and equity. Civil society organizations can facilitate energy transitions by educating communities, defining what it means for a just energy transition, and fostering political will of community members (Hess, 2021). Keeping in mind culturally minded, developer, and organization-based frameworks can provide helpful guidance for developers, civil society organizations, and local planning officials to engage with the community to foster public participation and support.

7. Conclusion

Based on the comprehensive meta-analysis presented, a nuanced approach to renewable energy development in the United States emerges as crucial. While broad national support exists, significant challenges arise at the local level, particularly in communities historically dependent on fossil fuels. The research reveals that public opinion on renewable energy is influenced by a complex interplay of factors including partisanship, age, education, and local economic context. Understanding these influences is essential for tailoring effective engagement strategies.

The framing of renewable energy projects proves critical to their acceptance. Economic benefits, environmental health, and energy security tend to resonate more strongly than climate change messaging, especially in fossil fuel-dependent regions. This underscores the importance of adapting communication strategies to local contexts and concerns.

Community engagement emerges as a cornerstone of successful renewable energy development. Involving local stakeholders in decision-making processes, ensuring procedural and distributive justice, and building trust between developers and community members are vital components of this engagement. The research highlights that projects with strong community participation and support are more likely to succeed.

Addressing the economic and cultural impacts of energy transitions is crucial, particularly in fossil fuel-dependent communities. This includes thoughtful planning for job transitions, protecting workers' benefits, and acknowledging the cultural significance of existing industries. Such considerations are essential for a just transition that doesn't leave communities behind.

Education and information dissemination play a key role in building support for renewable energy. Providing quality, accessible information can help address misconceptions and build baseline support. This is particularly important given the knowledge gaps that often exist around renewable energy technologies and their impacts.

Policy considerations for renewable energy development must be holistic, addressing financial, community, environmental, and infrastructure aspects. The research suggests that developing replicable frameworks for decommissioning fossil fuel plants and redeveloping communities can provide a valuable roadmap for just transitions.

In conclusion, successful renewable energy development requires a nuanced, community-specific approach that addresses economic, cultural, and procedural concerns while leveraging local support and mitigating opposition. By implementing these evidence-based strategies, policymakers and developers can work towards a more just and effective transition to renewable energy across diverse American communities. This approach not only promotes the adoption of clean energy but also ensures that the transition is equitable and beneficial for all stakeholders involved.

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