Study explores how wind turbine visibility affects property values across the US

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Renewable energy sources are essential for transitioning towards a decarbonized energy system and making the electricity grid more environmentally sustainable. Clean energy alternatives like wind power

can effectively replace fossil fuels, contributing to reduced air pollution and slowing down climate change.

Wind power has emerged as the fastest-growing non-hydro renewable energy source worldwide. However, the implementation of wind energy infrastructure, including windmills, faces significant challenges. One major obstacle is the opposition from local communities.

Wind turbines, the primary components of wind power generation, can be noisy, obstruct sunlight, produce flickering lights, and disrupt scenic views. These concerns can lead to conflicts between renewable energy development and environmental preservation, potentially exacerbating existing social inequalities.

A study published in the journal *Proceedings of the National Academy of Sciences* (*PNAS*) by an international team of scientists, including researchers from CMCC, the Potsdam Institute for Climate Impact Research (PIK), and University of California at Berkeley, offers a comprehensive perspective on this issue, crucial for evaluating the trade-offs between the benefits and costs of renewable energy sources, and for gaining a thorough understanding of their impacts.

This study represents a unique evaluation of the externality costs of wind power generation, specifically focusing on the impact of visibility on property values across the United States.

"This situation is a classic 'Not In My Backyard' problem, which leads to extensive policy debates on renewable energy growth," says Wei Guo, researcher at CMCC and EIEE, the European Institute on Economics and the Environment, and first author of the study. "In the big picture, the economic solution is about finding a balance between the global environmental benefits of renewable energy and the local impacts on communities nearby."

The research focuses on the impact of wind power generation on local communities, which is usually overlooked. Specifically, the study addresses how wind turbines, when integrated into the landscape, influence the perceived value of homes by residents.

The main aim is to contribute to the benefit and cost analysis of renewable energy development, facilitating more informed decision-making for both policymakers and the public regarding new projects.

In pursuit of this objective, the researchers have meticulously compiled a database on wind turbine visibility, incorporating details on the location and height of each utility-scale turbine that has contributed power to the U.S. grid. The database is complemented by a high-resolution elevation map, which accounts for the underlying topography of the landscape.

Grounded in hedonic valuation theory, the researchers conducted statistical estimations to discern the impact of wind turbine visibility on home values. These estimations draw on data sourced from a comprehensive dataset covering the majority of home sales in the U.S.A. since 1997.

The study reveals that, on average, the visibility of wind turbines has a negative and economically significant impact on home values within proximity of less than 8 km. However, this effect becomes indistinguishable from zero at larger distances. Moreover, the impact is notably smaller for recently installed turbines and diminishes significantly over time following their installation.

The findings shed light on the nuanced dynamics between renewable energy infrastructure and local property values, providing valuable insights for sustainable and community-friendly energy development.

The results of the study show that seeing a windmill closer than 2 kilometers away can lower a house's value by up to 8%. "To picture this, imagine holding a golf ball at arm's length—that is roughly how big a wind turbine looks from that distance," says Guo.

"However, as one moves further from the windmill, its impact on house values drops off quickly. From 8 kilometers away, a wind turbine looks about as big as an aspirin tablet at arm's length, and at this distance, it doesn't really affect what people think their homes are worth."

The total loss in values across all US houses with a view of windmills adds up to a drop of US $24.5 billion. Although this is a significant loss, it amounts to a relatively small fraction when comparing it to the total value of all homes in the US—over $45 trillion in 2022.

"We conclude that although houses close to wind turbines can lose some value due to the disrupted view, the impacts are just a small part in the grand theme of all houses, and we expect it to become even less an issue in the future," says Guo.

"This project stands at the cutting edge of understanding how renewable energy affects local communities. It is like putting on a new pair of glasses to look at how wind power impacts people's lives and homes."

This research pioneered a comprehensive nationwide evaluation of the external costs of wind power generation, but it also marks a significant advancement in quantitative precision by considering not only proximity but also actual visibility of wind turbines from homes.

The creation of an extensive database utilizing advanced techniques from geography and cartography sciences is another innovative element of this research. By applying these methods to every utility-scale turbine and high-resolution elevation maps, the study integrates interdisciplinary

areas, representing a substantial step forward in environmental economics and policy research.

"Personally, living in northern California for the past five years, I have seen firsthand how local people can be hesitant or opposed to new wind turbines projects. This sparked my interest in this field of research," said Guo. "For me, this project is more than just an academic study. It's about addressing a real-world issue that I've observed, and using my expertise to shed light on a topic that affects many people's lives."

More information: CMCC Foundation et al, The visual effect of wind turbines on property values is small and diminishing in space and time, *Proceedings of the National Academy of Sciences* (2024). DOI: 10.1073/pnas.2309372121. doi.org/10.1073/pnas.2309372121

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