Preferences for the spatial distribution of wind turbines in Germany

Extended Abstract

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Overview

The transition towards a decarbonized power sector relies heavily on the expansion of renewable energies, especially wind power onshore. At the local level, wind power can be associated with both benefits and burdens. Benefits may include tax revenues or job opportunities in hosting municipalities, while burdens can range from negative effects on local wildlife to visual disamenities for residents (Edimar Ramalho et al. 2025; Zerrahn 2017; Mattmann, Logar, and Brouwer 2016; Munday, Bristow, and Cowell 2011; Costa and Veiga 2021). These positive and negative local effects often spatially diverge, i.e., they are not felt by the same entities. When it comes to the spatial allocation of wind power, this raises the question of spatial distributive justice. In the economic and energy systems literature, several studies include justice concepts, such as equality and equity, as criteria for the spatial distribution of wind power (Vågerö, Inderberg, and Zeyringer 2024; Lehmann et al. 2024; Lohr et al. 2024; Sasse and Trutnevyte 2020; Sasse and Trutnevyte 2019; Drechsler et al. 2017). Taking a normative perspective, these analyses show that considering justice concepts for the deployment of wind energy may have a moderate effect on the economic costs of power production, yet it can strongly affect the spatial distribution of wind turbines. In our analysis, we study which spatial allocations for wind power are preferred and which concepts of spatial distributive justice are actually applied by the public. Based on a survey experiment with respondents in Germany, we determine preferences and willingness-to-pay (WTP) for the spatial allocation of wind power and how they are affected by attitudes towards different concepts of distributive justice and experience with wind power.

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Methods

We conducted a survey and discrete choice experiment (DCE) with about 7,000 German participants. In the DCE, respondents were asked to choose between two alternative options for the spatial distribution of wind power across German federal states. The alternatives were based on the criteria of equal area shares, wind yield, per-capita GDP and power consumption in each federal state, each reflecting a distinct concept of spatial distributive justice: equality (equal area share), ability (wind yield or per-capita GDP) and benefit (power consumption) concepts. Importantly, these underlying justice concepts were not explicitly communicated to the respondents. Additionally, the DCE alternatives included factors such as whether regions with wind power deployment benefit from financial compensation schemes, the expansion of wind power in the respondent's own region and a change in the annual electricity bill. Using a mixed logit model, we estimate preferences and WTP for the different spatial distribution criteria, the implementation of compensation schemes and local wind power expansion. We also examine how these preferences and WTP vary with respondents' characteristics, with a particular focus on attitudes towards concepts of spatial distributive justice.

Results

Our findings indicate that respondents show a significant preference for the distribution of wind power based on power consumption over one based on per-capita income, with a mean WTP of -351 €/year/household. If the expansion of wind power is combined with a financial compensation scheme in expanding regions, respondents prefer the distribution based on wind conditions over one based on power consumption. However, the strong expansion of wind power in their own region is associated with a mean WTP of -236 €/year/household. Furthermore, respondents are sensitive to increases in the annual electricity bill. Regarding the drivers of respondent's preferences for the distribution of wind power, our results suggest that respondents do not apply their general preferences for concepts of distributive justice. The same applies to respondent's experience with wind power in their residential surroundings. However, we find that respondents who live in municipalities with potential areas for wind power, in federal states with better wind conditions or in rural areas show, on average, a stronger negative preference and WTP for the distribution of wind power based on wind yield. Also, attitudes towards wind power seem to matter. Respondents who support the expansion of onshore wind power display a positive WTP for the strong expansion in their own region, while respondents who are opposed to wind power show a significantly more pronounced aversion against the strong expansion in their region. Finally, we find significant heterogeneity in preferences and willingness-to-pay among respondents regarding all of the factors above.

Conclusion

At a local level, the benefits and burdens associated with onshore wind turbines are often spatially divergent, which underscores the importance of considering spatial distributive justice in the allocation of wind power. We address this topic by analyzing public preferences and WTP for the spatial distribution

of wind turbines in Germany. In a survey-based DCE, we explore which preferences exist and how they are shaped by attitudes towards concepts of spatial distributive justice and experience with wind power. Our results suggest that the distribution based on power consumption is preferred over one based on per-capita income. The distribution based on wind conditions is favored over one based on power consumption if it is combined with a financial compensation for regions that expand wind power. We show that these preferences are not determined by general preferences for concepts of distributive justice or by experiences with wind power in the residential surroundings. However, attitudes towards and the general experience with wind power do affect preferences and willingness to pay for the distribution of wind power.
These findings have notable implications for policymakers, as they shed light on public preferences for the spatial distribution of wind turbines and accompanying measures, such as compensation schemes. Currently, to secure sufficient areas for wind power expansion, all German federal states are mandated to provide the same area share for wind power. Our results suggest that this approach may not align with public preferences.

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