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Not in my Postcode?
Wind Turbines and U.S. Presidential Approval

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Abstract

The expansion of wind power has the potential to make a major contribution to the mitigation of climate change. While wind power generates positive externalities at the global level by reducing carbon dioxide, it also generates negative externalities at the local level, such as noise pollution from sound emissions. This paper analyses whether sound emissions from wind turbines have an effect on the popularity of the incumbent government. It thereby exploits the exogenous temporal and spatial variation in wind speed as a measure of sound emissions from wind turbines and combines it with high-frequency zip-code-level survey data for the United States. The results demonstrate that sound emissions from wind turbines lead to a decrease in the popularity of the (pro-renewables) President Barack Obama. This effect is temporal, diminishes with distance from wind turbines, and is driven exclusively by individuals identifying as Democrats. Furthermore, individuals who are older, have lower levels of education, or live in rural areas and small towns exhibit a more negative reaction. In order to maintain public support for the energy transition, it is essential that policymakers take these local impacts into account.

Keywords: Presidential approval, Voting behavior, Renewable energy, Wind turbines, Public support, Retrospective voting, Externalities, Geospatial data

1 Introduction

Renewable energy has a large potential to mitigate climate change (Edenhofer *et al.* 2011). This has resulted in a growing demand for renewable energy sources. The Intergovernmental Panel on Climate Change (IPCC) projects that renewable energy will account for 70-85% of global electricity generation by 2050 (IPCC 2022). In particular, wind energy plays a key role in the transition to renewable energies. In the United States, wind energy accounted for 47% of the total utility-scale electricity generation by renewable sources in 2023 (U.S. Energy Information Administration 2024).

In general, the transition from fossil fuels to renewable energy sources creates positive externalities on a global scale as renewable energy sources emit little greenhouse gas emissions. However, the construction and operation of wind turbines induces several negative externalities at the local level. For example, studies find negative impacts on landscape aesthetics (e.g. Devine-Wright 2005; Jobert, Laborgne, and Mimler 2007; Wolsink 2007), and on wildlife (e.g. Pearce-Higgins *et al.* 2012; Schuster, Bulling, and Köppel 2015). Furthermore, studies indicate that individuals are disturbed by the sound emissions of wind turbines (e.g. Bakker *et al.* 2012; Radun *et al.* 2022).

Yet, the majority of the population in the U.S. supports the transition to renewable energy sources and specifically investments in wind power (Borick 2014). However, specific wind power farms often face resistance from local individuals who are directly affected by negative externalities. This discrepancy is often described as the ”not in my backyard” (NIMBY) phenomenon.

Among the negative externalities, the sound level of wind turbines is identified as the primary determinant of public acceptance of wind turbines (Langer *et al.* 2018; Hoen *et al.* 2019). Accordingly, this paper focuses on the sound level emissions and employs the exogenous temporal and spatial variation of wind speed as a measure for the emitted sound level by wind turbines. There are various sources of sound generated by wind turbines, which can be classified into mechanical noise and the dominant aerodynamic noise generated by the movement of the blades (Wagner, Bareiß, and Guidati 1996). So far, data on sound emissions from wind turbines are not available covering a large spatial area. However, the sound level typically increases with wind speed at the hub height of the wind turbine (Wagner, Bareiß, and Guidati 1996; Katinas, Marčiukaitis, and Tamašauskienė 2016; van Kamp and van den Berg 2021). Therefore, wind speed can be used as an appropriate measure for the sound level of wind turbines.

In democratic societies, elections represent the most important mechanism through which individuals can articulate their discontent (Cheibub, Gandhi, and Vreeland 2010). Consequently, individuals may seek to hold the government accountable for the negative externalities they receive. As politicians are bound by the preferences of the electorate, this may result in a reduced incentive for politicians to promote the expansion of renewable energy.

This paper assesses empirically whether the negative externalities and in particular the sound emissions of wind turbines have an effect on the popularity of President Barack Obama, whose policies support the expansion of renewable energy. The exogenous temporal and spatial variation of wind speed serves as an exogenous treatment to identify a causal link between the sound level and the popularity of the president. The findings of this study demonstrate that, in the short term, there is a decline in popularity ratings followed by the exposure to the sound emissions of newly installed wind turbines. However, this effect is only short-lived and a habituation effect is observed, with the results becoming insignificant for individuals interviewed after the first year of wind turbine installation. Additionally, the effect diminishes in magnitude with increasing distance from the wind turbines. In contrast, the effect increases with the number of installed turbines, capacity, and the diameter of the wind turbines. The results are heterogeneous among socioeconomic characteristics, indicating larger effects for older or less educated individuals. Furthermore, the effect is largely driven by individuals living in small towns and rural areas. Notably, the findings also indicate a higher effect for individuals self-identifying as Democrats.

So far, the existing literature analyzing the effects of wind turbines on voting outcomes does not focus on the sound emissions and relies exclusively on election data, which is a significant limitation given that elections are infrequent and voting behavior is typically unobservable at the individual level . Another limitation is that voting data are typically not observed at small spatial scales. However, the effects of wind turbines typically vary with the spatial extent, and in particular sound level emissions are concentrated at small scales. Consequently, the matching of electoral behavior with wind turbine data may potentially yield biased results. To overcome this problem, this study employs high-frequency (daily) geo-referenced survey data on U.S. presidential approval ratings at the ZIP code level. Due to the limitations of available data the analysis is restricted to the presidency of Barack Obama (2009 to 2017).

The presidency of Barack Obama serves as a suitable sample given that environmental policy constituted a central component of President Obama's domestic policy agenda (Konisky and Woods 2016). In the beginning of his presidency, President Obama set the goal of doubling renewable energy generation capacity by 2012 (The White House - President Barack Obama 2024). To reach this goal, he implemented several policies to support the expansion of renewable energy projects e.g. the extension of the production tax credits (PTC), the investment tax credits (ITC) and the American Recovery and Reinvestment Act of 2009, a stimulus package which granted additional tax credits and loan guarantees for renewable energy projects. All these measures enabled wind power developers to reduce the price at which their electricity can be sold and thus, making renewable energy projects less costly. Hitaj (2013) reveals that the national policies and in particular the PTC played an important role in promoting wind power. As a result, wind energy capacity increased significantly during Barack Obama's presidency, from 20.7 GW by 2009 to 87.5 GW in 2017, the largest growth during a presidency at that time (Hoen *et al.* 2024). This can result in individuals ascribing accountability for wind turbine expansion and, in particular, negative externalities to

President Obama.

Given the vast scale of the expansion of wind turbines to achieve climate targets, the number of individuals directly affected by the negative externalities will continue to grow. Not considering the negative externalities may result in a broad opposition towards wind energy and thus, an increase in the likelihood that a government with a policy opposing the energy transition is elected. Consequently, this threatens the success of the renewable energy transition. This is particularly relevant given that, as this study shows, the negative effect on presidential approval ratings is driven predominantly by individuals who identify as Democrats. Consequently, this may lead to a reduced likelihood of these individuals actually casting their vote for a (prorenewables) Democratic president. Hence, understanding who supports and who opposes renewable energy projects under which circumstances is vital for policymakers. To counteract this problem policymakers could introduce distance rules, and allocate wind turbines evenly across space. The study also highlights the key role of education.

The remainder of this paper is structured as follows: Section 2 presents an overview of the related literature. Section 3 outlines the empirical strategy, followed by Section 4 which provides a summary of the datasets used in this study. Section 5 presents the empirical results, and finally, Section 6 concludes.

2 Literature

This paper draws on several strands of literature. First, it addresses the area of well-being and its effect on voting behavior. In general, several studies show that subjective well-being is a significant predictor of electoral outcomes. The analysis by Ward (2020) uses European data and finds that higher levels of subjective well-being are associated with higher vote shares of the governing parties. He could also show that measures of subjective well-being explain more of the variation in government vote shares than standard macroeconomic indicators. Using a UK dataset, these findings are confirmed by Liberini, Redoano, and Proto (2017). They are also consistent with a later study by Ward *et al.* (2021) focusing on the 2016 U.S. presidential election. The study finds that Trump's victory over the ruling Democrats is strongly predicted by low levels of subjective well-being, even after controlling for demographic, ideological and socio-economic variables. Another study focuses on the effect of subjective well-being on voting for populist parties and finds a negative relationship between levels of subjective well-being and populist vote shares (Nowakowski 2021). Using an U.S. sample the study by Hassell and Settle (2017) finds that life stress negatively affects individuals' likelihood to vote, but this phenomenon is only observable among those with no history of voting participation.

Second, this paper addresses the area of wind turbines and its effect on individuals. The effects of wind turbines vary in particular with the spatial level, the unit of observation and the empirical strategy used. Some studies focus on the economic effects and find positive effects on employment (e.g. Brunner and Schwegman 2022; Brown *et al.* 2012; Scheifele and Popp 2024). However, a recent study by Gilbert, Gagarin, and Hoen (2023) finds only very local employment effects and concludes that the aggregation to arbitrary spatial units such as counties can lead to biased economic impact results. A recent study by Fabra *et al.* (2024) confirms this by finding no effect on employment.

At the individual level, Krekel and Zerrahn (2017) and von Möllendorff and Welsch (2017) find a negative effect on well-being. Another study conducted by van der Horst (2007) analyses the effect of wind turbines on public attitudes towards wind projects and finds that in particular proximity has a strong influence on public attitudes. However, the overall effect on the local level remains unclear as does the extent to which this may influence voting behavior. The literature focusing on the effect on voting behavior is rather small with ambiguous results. The study by Otteni and Weisskircher (2022) examines how attitudes towards wind turbine projects are associated with the pro-renewable Green Party and the populist anti-renewable right AfD in Germany. The findings suggest that positive attitudes are correlated with higher support for the Green Party, while negative attitudes are associated with higher support for the AfD. Furthermore, they identify positive effects on regional election outcomes for both parties from 2013 to 2019, concluding in an increase in voter polarization. Conversely, Germeshausen, Heim, and Wagner (2023) find a reduction in the Green Party's vote share in the 2009 and 2013 German federal elections. However, they also show that this effect is very local and rapidly diminishes as the radius around wind turbines increases. Stegmaier and Krause (2023) find similar effects, but focus on the visual effect of initial exposure to wind turbines. While they find no significant effect on the Green Party vote share for most election periods from 1998 to 2009 in Germany, they identify a negative effect for later elections from 2013 to 2021. Using data from the 2003 to 2012 U.S. congressional elections, Urpelainen and Zhang (2022) report large electoral gains for (pro-renewables) Democratic candidates. Since they find no effect on public opinion on environmental issues, they suggest that localized gains rather than a pro-environmental shift explain the results. However, because congressional districts are quite large, the study cannot distinguish between local and broad effects. In contrast, Bayulgen *et al.* (2021) use census data at the much smaller electoral precinct level and estimate the effect on the electoral outcome of the incumbent state legislator in Minnesota between 2006 and 2018. They also find a positive effect on the incumbent party's vote share and conclude that the negative effects are offset by economic benefits. In contrast, Stokes (2016) uses Canadian data for the 2003 to 2011 federal elections and finds a negative effect on the incumbent party's vote share that persists 3 km from wind turbines. Similarly, Larsen, Nordang, and Martin (2021) report a negative effect on the incumbent's vote share in Denmark. However, it turns out that the effect size is small or not-existent for federal elections and becomes large for local elections. Umit and Schaffer (2022) use survey data from Switzerland and find a positive impact on public acceptance, but no effect on the election outcome.

There are several reasons for the differences in results. First, the unit of observation varies widely, ranging from very small-scaled data at the precinct level up to data covering very large areas such as congressional districts. However, this is crucial as effects depend on the spatial coverage. Second, the majority of studies uses electoral data, while only a few use survey data. Election data have the advantage of observing the actual voting behavior of individuals. However, it comes with the disadvantage that elections are only conducted very rarely. Moreover, voting behavior at the individual level is typically not observable at a small scale level. Third, some studies rely on a two-way fixed effects model, while others rely on an instrumental variable approach to overcome the potential endogeneity of wind turbine location by using wind speed as an instrument. The study by Germeshausen, Heim, and Wagner (2023) additionally addresses the potential temporal endogeneity and concludes that the positive result identified by using a two-way fixed effects may be severely biased.

This study tries to address these challenges by using highly frequent (daily) survey data geo-referenced at the small scale ZIP code level and by exploiting the exogenous temporal and spatial variation in wind speed, a measure for wind turbine sound. Moreover, the existing literature has so far focused on the effect of subjective well-being on voting behavior, neglecting the more specific effect of the negative externalities of wind turbines. Besides, it exclusively focused on the general effect of wind turbines, or the visual effects on electoral behavior. To the best of my knowledge, this study is the first to focus on sound emissions and its effect on presidential popularity.

3 Empirical Strategy

The aim of this study is to identify the impact of sound emissions from wind turbines on the popularity of the president. First, I use of a binary variable to test whether the presence of a wind turbine has a systematic effect on presidential popularity. Accordingly, the following equation is estimated by means of the ordinary least squares (OLS) method:

$$PA_{i,j,s,d} = \eta \text{ Post}_{j,y} + \theta X_{i,d} + \alpha_j + \gamma_{s,y} + \epsilon_{i,j,s,d} \tag{1}$$

The binary variable $PA_{i,j,s,d}$ takes the value of one if individual i living in ZIP code j within state s interviewed on day d approves of how the president is doing his job. As this variable is binary a linear probability model is used to account for unobserved heterogeneity at the year-by-state and zip-code level. The variable $Post_{j,y}$ is set to one if a wind turbine is installed in ZIP code j at least in the previous year of y[1]. The individual-level control variables $X_{i,d}$ encompass a range of factors, including information on gender, age, race, education, employment status, income levels and the individuals' political views. α_j and $\gamma_{s,y}$ are ZIP code and state-by-year fixed-effects. Finally, $\epsilon_{i,j,s,d}$ is the error-term.

However, it is important to note that a binary variable may not capture only the sound emissions from wind turbines. It is possible that additional factors and their impact on the president's popularity, such as changes in employment due to the wind turbine construction, are also captured by the variable $Post_{j,y}$. To take this into account, I use wind speed as a measure of the sound level emitted by wind turbines, as wind turbine sound emissions typically increase with wind speed. This allows to exploit the spatial and temporal exogenous variation to identify a causal effect of wind turbine sound emissions on presidential popularity by interacting the variable $Post_{j,y}$ with wind speed. Therefore, the following estimation equation is used in the second step:

$$\begin{aligned} PA_{i,j,s,d} = {} & \beta \left(\text{Post}_{j,y} \times \text{Wind Speed}_{j,d-1}\right) + \eta \text{ Post}_{j,y} + \nu \text{ Wind Speed}_{j,d-1} + \theta X_{i,d} + \\ & \alpha_j + \gamma_{s,y} + \epsilon_{i,j,s,d} \end{aligned} \tag{2}$$

Wind Speed$_{j,d-1}$ is the average wind speed in 100 meters height in ZIP code j on day $d-1$. The coefficient of primary interest is ν of the interaction term, namely, $Post_{j,y}$ * *Wind Speed*$_{j,d-1}$. The interaction term indicates the wind speed of day $d-1$ in ZIP code j of individual i interviewed after the installation of a wind turbine. This measures the impact of a wind turbine's sound emissions on an individual's i probability of approving the president's job.

In order to ensure the identification of a causal relationship, a number of measures are employed. Given that the dependent variable relates to the presidency of Barack Obama, it is imperative to ensure that the independent variable captures the impact of installed wind turbines during Obama's presidency. This should allow for a clear distinction of the extent to which individuals may ascribe accountability for these outcomes to President Obama. In order to achieve this, the analysis is limited to ZIP codes in which a wind turbine has been installed during the presidency of Barack Obama, specifically between 2009 and 2017. Consequently, all ZIP codes in which a wind turbine was installed prior to the specified period are excluded.[2] As the planning and construction phase of wind turbines takes some time, the sample is further restricted to wind turbines installed one year after President Obama's inauguration.

As there is no information on the exact time of the interview, the wind speed of the preceding day of the interview is employed. This also helps to ensure that the interview date is random and unrelated to the magnitude of the wind speed in order to establish causality. Additionally, there is no obvious reason why the interview dates should systematically depend on the average wind speed of the preceding day. In addition, some measures are implemented to ensure that the control group is comparable to the treatment group. As only information on the ZIP code in which the individual resides is provided, and not the exact location of the individuals within the ZIP code, it is only possible to differentiate between treated and untreated individuals based on the ZIP code

1. Information on the installation of wind turbines is only available on an annual basis.
2. To analyze whether individuals may also attribute the effect of wind turbines installed before Obama's presidency, this restriction is eased. The results of this analysis are presented in Section 5.5.

level. To ensure a clear separation of treated ZIP codes and untreated ZIP codes, all ZIP codes within or intersecting a 2 km buffer of each wind turbine and outside of the ZIP code with wind turbines are excluded. Furthermore, to ensure comparability of the control and the treatment group, individuals interviewed in the same state and year are compared with each other by adding state-year fixed effects in the empirical estimation equation. Additionally, ZIP-code fixed effects are employed to control for unobserved heterogeneity across ZIP codes. Observations from states in which no turbine has ever been installed are also excluded from the dataset. These measures allow for a clear identification of the impact of wind turbine sound on presidential popularity.

4 Data

To estimate the effect of wind turbine sound on presidential popularity I combine three different datasets: wind turbine data, wind speed data and presidential approval ratings.

4.1 Wind Turbine Data

To distinguish ZIP codes with installed wind turbines from ZIP codes without installed wind turbines, I use the United States Wind Turbine Dataset (Hoen *et al.* 2024). This data provides information on all installed wind turbines in the U.S. since 1982, including the exact location (longitude/latitude), the year in which each turbine became operational, the nameplate capacity of each turbine in kilowatts, and the rotor diameter in meters. Figure 1 shows all wind turbines up to 2008 the year preceding President Obama's inauguration. A total of 17,367 turbines with a capacity of 20.7 GW are listed for the years up to 2008.

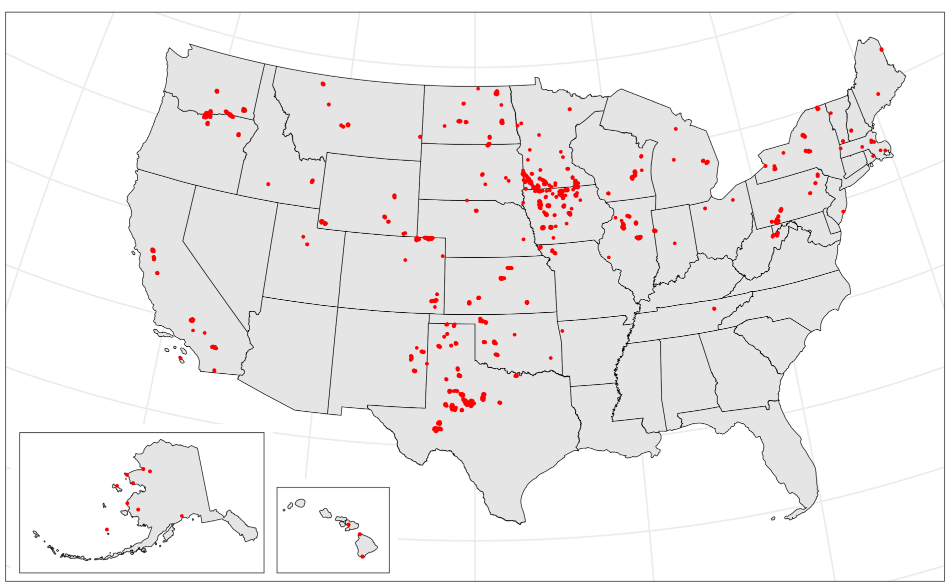


Figure 1. Installed Wind Turbines before 2009 (17,367 turbines; 20,709 MW)

So far, the majority of wind turbines were installed during the presidency of Barack Obama. As Figure 2 illustrates, roughly twice as many wind turbines (34,422) became operational between 2009 and 2017. In addition, higher capacity wind turbines were installed, as capacity more than tripled (66.8 GW).

This data is employed to identify all ZIP codes where wind turbines have been installed, together with the years in which the wind turbines were installed in each ZIP code.

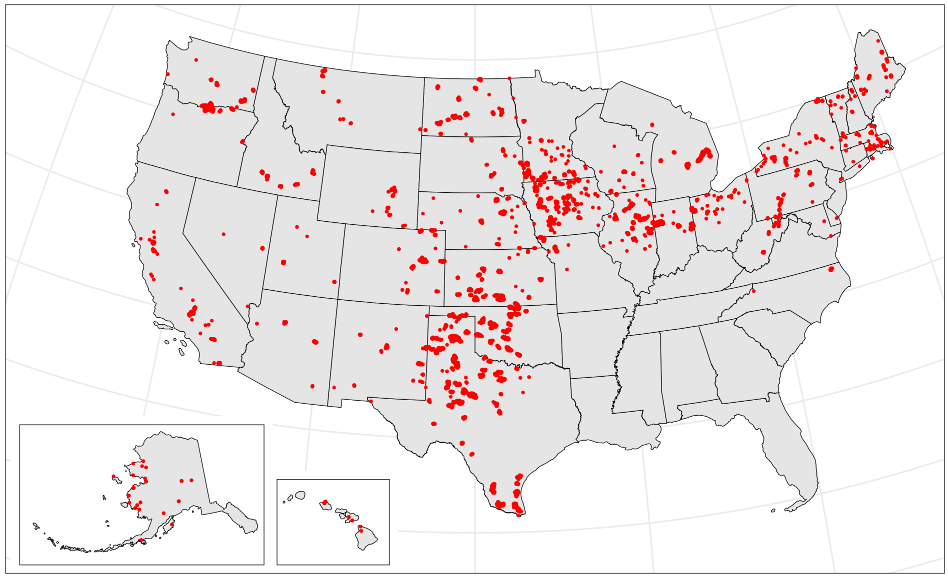


Figure 2. Installed Wind Turbines between 2009-2017 (34,442 turbines; 66,822 MW)

4.2 Wind Speed Data

In order to analyze the impact of wind turbine sound as measured by wind speed, wind speed information at hub height level is required with high spatial and temporal accuracy across the whole United States. Since precise observational data are not available, I rely on a mixture of observed and modeled data and use the average hub height of wind turbines which is 100 meters for the U.S. (Center for Sustainable Systems 2024).

This data is provided by the ERA5 hourly data on single levels from 1940 to present (Hersbach *et al.* 2023). It is produced by the European Centre for Medium-Range Weather Forecasts (ECMWF) within the Copernicus Climate Change Service (C3S) by combining model data with observations from around the world into a consistent dataset. As new information becomes available, these data are combined in an optimal way to produce more accurate data. ERA5 provides a range of hourly atmospheric estimates at a resolution of 0.25° x 0.25°. I use the 100m u-component and the 100m v-component of the wind, which estimate the wind speed at 100 meters above the surface for every hour of the year. The u-component specifies the eastward wind component, which measures the horizontal speed of air moving towards the east, while the v-component gives the northward wind component which is the horizontal speed of air moving towards the north (Copernicus Climate Change Service, Climate Data Store 2024). In the first step, I use this data to calculate the wind speed for each hour h of day d from 2009 to 2017 by applying

$$\text{wind speed}_{hd} = \sqrt{(u\text{-component}_{hd}^2 + v\text{-component}_{hd}^2)}$$

In this way, it is possible to construct first grids of scalar average wind speed at 100 meters height for each hour h of the day d. However, as the survey data is only available on a daily basis, I finally construct the daily average wind speed for each ZIP code in the sample.

4.3 Presidential Approval Rating

Analyzing the effect of sound emissions on the presidential popularity requires data at a very small scale and high frequency. Therefore, I use data from the Gallup Daily Tracking Survey, in which

1,000 individuals aged 18 years and over are interviewed in the United States every day (Gallup 2010). The survey is a repeated cross-sectional survey divided into two tracks, with half of the respondents interviewed in the Well-being track and half interviewed in the Politics and Economy track. Both tracks include demographic information of the respondents and the location at the ZIP code level. The survey is conducted by mobile phone and landline and includes information on the exact day of the survey. This allows to combine the survey data with other information based on time and space. Data is available for this project from 2008 to 2019. Since Barack Obama was president for most of this period, I use a subsample that covers his entire presidency from 20 January 2009 to 19 January 2017, the day of Donald Trump's inauguration. The variable of interest on the presidential approval rating is based on the question (*P128*):

> **"Do you approve or disapprove of the way [the current president] is handling his job as president?**"

Individuals can then respond with 'approve', 'disapprove', 'don't know' or 'refuse'. The responses are used to construct a binary variable (presidential approval), which equals one if the individual approves the question and zero in the case of disapproval. For the other options, the value is set to NA. In total, the dataset contains responses from 31,066 ZIP codes out of a total of 33,144 ZIP codes. On average, half of the respondents in the sample express presidential approval. The District of Colombia has the highest average presidential approval rating, while Wyoming has the lowest. President Obama received his highest presidential approval ratings at the beginning of his presidency (78%) and his lowest in November 2013 (41%). As Figure 3 shows, there exists substantial variation across space and time (see Figure 5 in the Appendix).

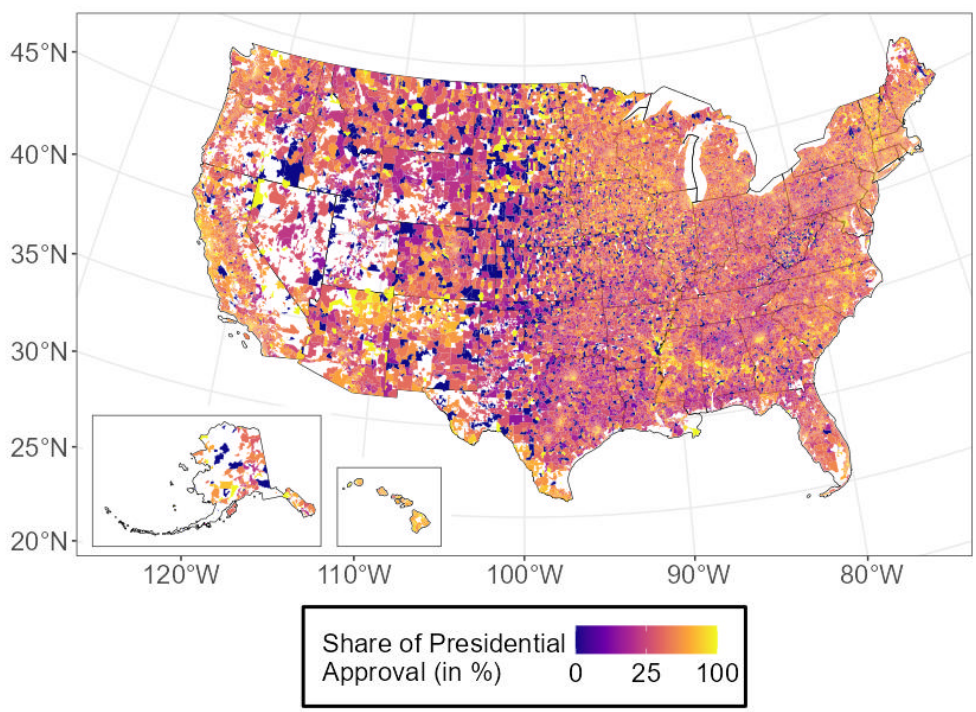


Figure 3. Average Share of Presidential Approval per ZIP code over 20 January 2010 to 19 January 2017

Table 1 shows the descriptive statistics of the final sample. The sample is well balanced with 49% of respondents being female. Respondents are on average 53 years old. Several control variables for race, the highest completed education level, employment status (employed, unemployed, not in the work force) and income classes (ranging from less than $720 annually classified as one up to $120,000 or more annually classified as ten) are included. In general, the question of presidential approval depends highly on the respondents' political affiliation. For example, Democratic respondents are more likely to approve this question for President Barack Obama than Republican respondents. For this reason, the political affiliation (Republican, Democrat, Independent, Other Party) is also included in the sample. The majority of respondents identify themselves as either Democrats (34%), Republicans (31%) or Independents (34%).

Table 1. Summary Statistics

	Mean	St. Dev.	Min	Max
Explanatory variables:				
Female	0.49	0.50	0	1
Age	53.31	17.67	18	99
White	0.80	0.40	0	1
Black	0.07	0.26	0	1
Asian	0.02	0.15	0	1
Hispanic	0.08	0.27	0	1
Other race	0.02	0.14	0	1
Below High School	0.04	0.21	0	1
High School	0.20	0.40	0	1
Tech School	0.06	0.23	0	1
Some College	0.25	0.43	0	1
College Grad	0.24	0.43	0	1
Post Grad	0.21	0.40	0	1
Unemployed	0.04	0.19	0	1
Not in Work Force	0.35	0.48	0	1
Income	6.85	2.29	1	10
Republican	0.31	0.46	0	1
Democrat	0.34	0.47	0	1
Independent	0.34	0.47	0	1
Other Party	0.01	0.10	0	1
Post	0.02	0.12	0	1
Wind speed	5.08	2.32	0.43	21.56
Dependent variables:				
Presidential Approval	0.48	0.50	0	1
Observations	708,351			

5 Individual-level Effects

5.1 Main Results

Table 2 reports the main results when estimating equation 1 in the first column and estimating 2 in the second column[3]. Column 1 shows the local effect of a wind turbine installation on presidential approval ratings. The coefficient of $post$ turns out to be significant and negative, indicating that individuals living in ZIP codes with a wind turbine installation have a lower probability in approving the president's job.

Column 2 presents the results when the variable on wind speed and the interaction between

3. Table 9 in the Appendix shows the results for all coefficients including all control variables.

wind speed and *post* are additionally included. It turns out that the coefficient of *post* becomes insignificant. However, the highly significant and negative coefficient of the interaction term between the variables *wind speed* and *post* indicates that the negative effect is driven by wind speed, which is used to measure the sound level of wind turbines. Furthermore, the negative effect is amplified with increasing wind speed levels. Specifically, an increase of 1 m/s in average wind speed the day before in a ZIP code with a wind turbine installation results in a 0.41 percentage point decrease in the likelihood of approving the president's job. The magnitude of this impact is remarkable in size. For example, the median wind speed in the ZIP codes with wind turbines of 5.8 m/s yields an effect of -2.4 percentage points. The effect is even more pronounced for the third quartile (7.6 m/s) of wind speed, resulting in an effect size of -3.2 percentage points.

Table 2. Effect of Wind Turbines on Presidential Approval

	(1)	(2)
Post	-0.0145*	0.0104
	(0.0076)	(0.0121)
Wind speed		0.0005*
		(0.0002)
Wind speed × Post		-0.0041***
		(0.0016)
ZIP code FE	Yes	Yes
State-Year FE	Yes	Yes
Controls	Yes	Yes
Observations	708,351	708,351
Within R^2	0.37005	0.37006
Dependent variable mean	0.48469	0.48469

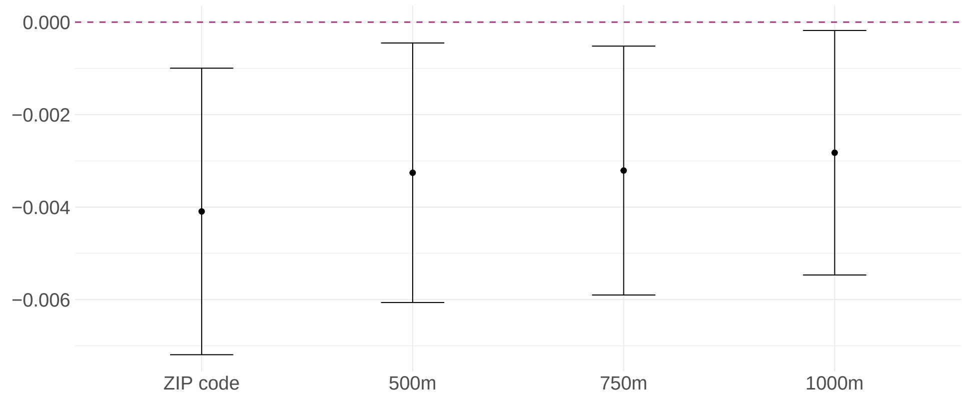
Notes: The dependent variable is binary and indicates presidential approval during Obama's presidency from 20 January 2010 to 19 January 2017. All regressions control for a broad set of socioeconomic control variables. Standard errors are in parentheses and clustered at the ZIP code level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Many studies suggest that the impact of wind turbines diminishes with increasing distance from the wind turbine (see e.g. Stokes 2016; Germeshausen, Heim, and Wagner 2023). This may be particularly true for wind turbine sound emissions, which tend to decrease with distance from the turbine. Accordingly, to evaluate this, the area of the treatment group is expanded stepwise based on different buffer sizes around a wind turbine.

Figure 4 shows the results of the interaction term between *wind speed* and *post* when first using only the ZIP code in which the wind turbine is located as the treatment group (as in the baseline) and then extending the treatment group based on a buffer around the wind turbines from 500m to 1000m. It turns out that all coefficients are negative and significant. However, the size of the coefficients become smaller with increasing distance from the wind turbines. This is an expected outcome given that sound levels typically decline with distance.

5.2 Who are the drivers of the results?

The individual's political view has a strong impact on the likelihood of whether an individual approves the presidents' job or not. For example, Democrats are generally more likely than Repub-



Notes: This figure plots the point estimates and the corresponding 95 % confidence intervals of the interaction term between wind speed and post on presidential approval. Each group represents ZIP codes that fall within a given radius around the installed wind turbines. For full results see Appendix Table 10.

Figure 4. Effect of the Wind Turbine Sound on Presidential Approval under different Distances

licans to approve of the way President Obama is handling his job. Moreover, individuals typically tend to exhibit higher interest in the political activities of the president when they are aligned with the same political party. For example, individuals identifying themselves as Republican or Independent may be less interested in the policies of Barack Obama, a Democratic President and thus, they may not attribute the installation of wind turbines to him. On the contrary, the opposite may be true for individuals identifying as Democrats as they may have a higher interest in his political actions and thus, are more likely to attribute the negative externalities of wind turbines to Barack Obama.

However, it is plausible that an individual's political view may influence the effect, with Democrats typically supporting renewable energy and Republicans opposing it (Urpelainen and Zhang 2022). Thus, Democrats may have a higher probability in accepting negative externalities and thus avoid holding the president accountable than those who identify as Republicans. On the contrary, due to the high degree of polarization within the U.S., Republicans are unlikely to approve how a Democratic president is handling his job (Iyengar *et al.* 2019). Consequently, there is minimal to no scope of a decrease in the probability of the president's job being approved. To investigate this further, the dataset is split again based on different samples of each political group. The results presented in Table 3 support the first hypothesis, as there is a significant negative effect observed for Democrats, while the coefficients for all other groups turn out to be insignificant. This result is remarkable given that Democrats may also be more likely to approve President Obama's job performance, irrespective of his political actions and provides compelling evidence of the negative impact of wind turbine sound emissions on the popularity of the president.

Furthermore, it is also possible that different socio-economic sub-groups react differently. Consequently, the observed effect may be driven by specific groups, as they may have a different probability of accepting wind turbines and consequently, respond in different ways in their assessment of attributing negative externalities of wind turbines to the president. To gain further insight into the effect heterogeneity, different subsamples are used in the subsequent analysis to estimate equation 2.

The first two models presented in Table 4 report the findings when splitting the sample according to the age of the individuals. The first model is based on respondents aged 20 or below. It turns out that there is no significant effect when the sample is limited to individuals aged 20 or below.

Table 3. Effect of Wind Turbine Sound on Presidential Approval based on Political Views

	Republican	Democrat	Independent	Other Party
Wind speed × Post	-0.0033	-0.0045*	-0.0024	0.0202
	(0.0021)	(0.0026)	(0.0036)	(0.0312)
ZIP code FE	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	216,514	241,157	243,222	7,458
Within R^2	0.05666	0.03017	0.05282	0.09846
Dependent variable mean	0.09849	0.87048	0.45104	0.31925

Notes: The dependent variable is binary and indicates presidential approval during Obama's presidency from 20 January 2010 to 19 January 2017. All regressions control for a broad set of socioeconomic control variables. Standard errors are in parentheses and clustered at the ZIP code level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

This result is not unexpected, given that younger individuals are more likely to accept wind turbines than their older counterparts (Willis *et al.* 2011). This may be attributed to their greater openness to adopt new technology, and more generally, their more environmental friendly behavior (Salamon 2023). Therefore, they may not make President Obama responsible for the negative externalities of wind turbines. Conversely, older individuals are less likely to adopt new technologies. Additionally, retired individuals tend to spend more time at their homes. Therefore, they may also be more disturbed by the sound emissions and may then attribute this to President Obama. To test this hypothesis, the sample is split based on the average U.S. retirement age between 2009 and 2017 (Gallup Inc. 2022)[4]. Accordingly, the second model the second model contains responses of individuals aged 64 and above. And indeed, the results reveal a significant negative effect for individuals aged 64 and above, which is also more pronounced in comparison to the baseline results presented in Table 2.

Gender may also be a key factor in whether individuals blame President Obama for sound emissions of wind turbines. Research indicates that women tend to exhibit more knowledge about climate change, environmental concerns and pro-environmental behavior than men (McCright 2010; Arnocky and Stroink 2010; Tranter 2011; Hunter, Hatch, and Johnson 2004). There is evidence that higher levels of female parliamentary participation are associated with higher levels of renewable energy consumption (Salamon 2023). Thus, females may view renewable energy as a necessity and may react differently compared to men and indeed, results in column three and four of Table 4 show that male individuals show a slightly more negative effect than females.

The education level may also play a role when evaluating the effect. As demonstrated by Sardianou and Genoudi (2013), individuals with higher levels of education are more willing to adopt renewable energy sources. The results presented in columns five and six of Table 4 indicate that when the sample is restricted to individuals with a high level of education[5], the results turn out to be not significant. However, there is a significant negative effect for those with a low level of

4. The mean retirement age during the period 2009 to 2017 was 63.1 years. For the purposes of this study, the data are rounded up to the nearest whole number.

5. Respondents with at least a highest completed school level or highest received degree of at least two year associate degree from a college, university, or community college level of bachelor or above.

education[6].

The negative effect is also more pronounced among individuals living in small towns and rural areas than for those living in urban areas. The prevalence of surrounding noise in urban areas may contribute to a reduction in the perceptibility of the sound emissions from wind turbines. Hence, individuals living in small towns and rural areas are more affected by wind turbine sound emissions and thus more aware of it. This results in a stronger negative effect on the probability of approving President Obama's job as presented in column eight of Table 4 compared to the results of individuals living in urban areas presented in column seven.

Table 4. Effect Heterogeneity of Wind Turbine Sound on Presidential Approval

Sample	Age		Gender		Highest Education		Geographical Region	
	Younger than or equal to 20	Older than or equal to 64	Male	Female	Some college or lower	College or higher	Urban	Small towns and rural areas
Wind speed × Post	-0.0170	-0.0054*	-0.0049**	-0.0040*	-0.0052*	-0.0022	-0.0032*	-0.0078**
	(0.0127)	(0.0030)	(0.0021)	(0.0024)	(0.0031)	(0.0026)	(0.0017)	(0.0038)
ZIP code FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	20,362	222,203	364,733	343,618	213,374	316,636	638,275	70,056
Within R^2	0.20848	0.43110	0.35119	0.38521	0.28739	0.42730	0.37364	0.33775
Dependent variable mean	0.63795	0.44444	0.44507	0.52675	0.44911	0.53105	0.49672	0.37503

Notes: The dependent variable is binary and indicates presidential approval during Obama's presidency from 20 January 2010 to 19 January 2017. All regressions control for a broad set of socioeconomic control variables. The estimation results are based on specified sub-samples, as indicated in the column header. The term "some college" is used to describe individuals with a highest education level of having not received a college, university or community college degree or below. "College" is used to describe individuals who have completed at least two years of an associate degree at a college, university, or community college, or who have obtained a bachelor's degree or above. Urban includes all ZIP codes which are defined as a metropolitan or micropolitan area. Standard errors are in parentheses and clustered at the ZIP code level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5.3 Does wind park size matter?

In the baseline model, individuals are considered as treated whenever the first wind turbine is installed in the ZIP code in which they live. However, the number of turbines and the installed capacity varies across ZIP codes and time. Especially in areas with high wind speed levels multiple wind turbines may be installed during the sample period. As a result, individuals living in those ZIP codes with multiple wind turbines may respond differently, as more wind turbines with higher capacities tend to produce more sound. Additionally, the diameter of the rotor blades has increased over time, which in turn leads to an increase in the sound emissions. This may lead to an increased effect on presidential approval. In order to investigate this question, the binary variable $Post_{j,y}$ of equation 2 is replaced with different continuous treatment variables on the ZIP code level: the cumulative installed wind capacity in megawatt per km², the cumulative number of turbines per km², and the cumulative turbine diameter in meters per km². The results presented in Table 5 reveal that the coefficients for all three continuous treatment variables are significant and negative. Thus, the negative effect on presidential approval increases as more wind turbines, more capacity, or wind turbines with a larger diameter are installed.

5.4 Does habituation play a role?

It is possible that the effect diminishes over time as individuals may become habituated to the sound emissions generated by wind turbines. An additional hypothesis is that individuals may initially associate the sound of wind turbines with the president, but that this association may dissipate over time.

6. Respondents with highest completed school level or highest received degree of college, university or community college, but no degree or below.

Table 5. Intensive Margin Effect of Wind Turbine Sound on Presidential Approval

	Capacity per km^2	Turbines per km^2	Turbine diameter per km^2
Cumulative capacity per km^2	0.0708		
	(0.0922)		
Wind speed × Cumulative capacity per km^2	-0.0227**		
	(0.0109)		
Cumulative turbines per km^2		0.1125	
		(0.1667)	
Wind speed × Cumulative turbines per km^2		-0.0351*	
		(0.0203)	
Cumulative diameter per km^2			0.0011
			(0.0018)
Wind speed × Cumulative diameter per km^2			-0.0004*
			(0.0002)
ZIP code FE	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Observations	708,351	708,351	708,351
Within R^2	0.37006	0.37005	0.37005
Dependent variable mean	0.48469	0.48469	0.48469

Notes: The dependent variable is binary and indicates presidential approval during Obama's presidency from 20 January 2010 to 19 January 2017. All regressions control for a broad set of socioeconomic control variables. Standard errors are in parentheses and clustered at the ZIP code level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In order to investigate this hypothesis, it is helpful to ensure that individuals are only affected by a wind turbine in one year during the sample period. Therefore, the treatment group of the dataset is limited to ZIP codes with only one wind turbine installation. Consequently, there are no ZIP codes where multiple wind turbines are installed during the sample period. Secondly, only observations are included for which a wind turbine is installed in the year preceding the year of the interview[7]. In the next step, these observations are excluded from the sample and only those individuals are included who are interviewed at least one year after the installation year.

The results presented in Table 6 confirm the existence of a habituation effect, as only the coefficient for model (1) is significant and negative. Conversely, the coefficient in model (2) is not statistically significant, indicating that wind turbine sound does not affect respondents interviewed at least one year after the installation of a wind turbine. This suggests that individuals may become habituated to the presence of wind turbine sound emissions over time, and may not hold the president responsible after some time, possibly due to repeated exposure or because they no longer associate the wind turbine installation with the president.

7. As there is no information of the exact date of the wind turbine installation, it is possible that the sample may include responses from at least one day following the wind turbine installation and up to a maximum of one year and 364 days after the installation.

Table 6. Habituation Effect of Wind Turbine Sound on Presidential Approval

	One year after installation	More than one year after installation
Wind speed × Post	-0.0070*	-0.0029
	(0.0037)	(0.0020)
ZIP code FE	Yes	Yes
State-Year FE	Yes	Yes
Controls	Yes	Yes
Observations	698,205	703,286
Within R^2	0.37049	0.37037
Dependent variable mean	0.48538	0.48509

Notes: The dependent variable is binary and indicates presidential approval during Obama's presidency from 20 January 2010 to 19 January 2017. The sample in model (1) contains solely observations of the first year following the installation year of wind turbines, and exclusively ZIP codes with one construction year within the sample period. The sample in model (2) contains only observations from subsequent years. All regressions control for a broad set of socioeconomic control variables. Standard errors are in parentheses and clustered at the ZIP code level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5.5 Robustness

In the absence of sufficient wind speed, wind turbines do not rotate, as the wind speed is insufficient to propel the wind turbine. The threshold is typically reached at a wind speed of 2.5 m/s. The first column of Table 7 reports the results when the sample is limited to observations with average wind speed levels below 2.5 m/s. As anticipated, the observed effect is not statistically significant. In general, there is a notable increase in rotational speed with increasing wind speed levels up to 12 m/s. To further analyze the effects within the wind speed range of 2.5 m/s and 12 m/s, the results for the sample comprising average wind speeds above 2.5 m/s and below 7.25 m/s are presented in the second column of Table 7, while column three shows the results for average wind speed levels above 7.25 m/s but equal or below 12 m/s.

Table 7. Effect of Wind Turbine Sound on Presidential Approval at Different Wind Speed Levels

Average wind speed	Below 2.5m/s	≥ 2.5m/s and < 7.25m/s	≥ 7.25m/s and ≤ 12m/s	Above 12m/s
	(1)	(2)	(3)	(4)
Wind speed × Post	-0.0432	-0.0112***	-0.0131**	-0.0412
	(0.0567)	(0.0039)	(0.0065)	(0.0295)
ZIP code FE	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	86,103	499,322	117,898	5,028
Within R^2	0.38089	0.37036	0.36984	0.37037
Dependent variable mean	0.49241	0.48494	0.47724	0.50199

Notes: The dependent variable is binary and indicates presidential approval during Obama's presidency from 20 January 2010 to 19 January 2017. All regressions control for a broad set of socioeconomic control variables. Standard errors are in parentheses and clustered at the ZIP code level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The coefficients of the interaction term turn out to be significant and negative in both regressions, with the negative coefficient being slightly higher for the higher wind speed levels. Compared to the baseline results, they are also higher in magnitude. Using the median wind speed of 5.8 m/s, this results in a 6.5 percentage point lower probability of approving the presidents' job. Using the third quartile (7.6 m/s) the effect size even increases to 10 percentage points. At wind speed levels exceeding 12 m/s, wind power is excessive, and therefore, wind turbines are regulated down until wind turbines are switched off at wind speed levels of 25 m/s or above in order to prevent damage. When considering only high average wind speed levels above 12 m/s, results turn out to be insignificant as shown in column four of Table 7.

Table 8. Robustness of the Effect of Wind Turbine Sound on Presidential Approval

	Only one installation year	All installations	Installations before 2009	Min. 3 observations per ZIP code and year	Control for days to election
Post	0.0157	0.0017	17.7824	0.0075	0.0105
	(0.0134)	(0.0107)	(52.4222)	(0.0124)	(0.0121)
Wind speed	0.0005*	0.0005*	0.0005**	0.0005*	0.0000
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Wind speed × Post	-0.0044**	-0.0027**	-0.0002	-0.0034**	-0.0041**
	(0.0017)	(0.0013)	(0.0021)	(0.0016)	(0.0016)
Days to Election					0.0000***
					(0.0000)
Zip Code FE	Yes	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Observations	705,219	715,232	695,738	682,855	708,351
Within R^2	0.37024	0.36995	0.37084	0.37126	0.37056
Dependent variable mean	0.48508	0.48396	0.48508	0.48814	0.48469

Notes: The dependent variable is binary and indicates presidential approval during Obama's presidency from 20 January 2010 to 19 January 2017. All regressions control for a broad set of socioeconomic control variables. Standard errors are in parentheses and clustered at the ZIP code level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The results are robust to various additional specifications. In the baseline estimation, the variable *post* is set to one if an individual is surveyed after the first wind turbine installation in a ZIP code. Thus, all ZIP codes are included, regardless of whether there was a single wind turbine installation or multiple installations over the years. As illustrated in Table 6, the results indicate the existence of a habituation effect. Thus, individuals evaluate the initial year following a wind installation in a distinct manner. To ensure the equitable treatment of all ZIP codes, irrespective of heterogeneous treatment effects, those with multiple installation points in time are excluded from the dataset. The first column of Table 8 shows the results of this specification, which are comparable to those of the baseline specification presented in Table 2.

In the baseline specification, only wind turbines are considered which are installed during the tenure of President Barack Obama. However, to test whether individuals also attribute the sound of already existing wind turbines to the incumbent president, in this case to Barack Obama, all installed wind turbines are taken into consideration in the second stability test considers all installed wind turbines regardless of the year of installation, while the sample in column three considers only wind turbines installed before Obama's inauguration. The coefficient on the interaction term is still significant and negative when considering all wind turbine installations. However, it becomes insignificant when considering only wind turbine installations before President Obama's inauguration (see columns two and three of Table 8)

In order to increase the accuracy of the estimated fixed effects, the results presented in the fourth column of Table 8 are based on a sample which is limited to ZIP codes with a minimum of three observations per year.

The timing of the survey is also a significant factor in determining whether individuals approve the presidents' job, as the timing typically influences the outcome when a presidential election approaches or shortly after the election (Berlemann and Enkelmann 2014). This could also impact the environmental policies of the president, and consequently, the number of new installed wind turbines. To account for this, an additional control variable measuring the days between the next presidential election and the date of the interview is included in the next stability test (see column five of Table 8).

The coefficient of the interaction term remains also consistent and stable in these specifications.

6 Summary & Conclusions

The transition to renewable energies is an important step towards preventing climate change. This requires a continuous expansion of wind turbine infrastructure and hence, an enhanced local exposure of the population. There is substantial evidence that in general the majority of individuals support the transition to renewable energies, and particularly wind power. Nevertheless, in some cases local exposure to wind turbines leads to resistance against specific wind turbines ("not in my backyard" (NIMBY) effect), driven by negative externalities such as sound emissions.

The primary objective of this study is to determine whether this results in different voting behavior, an issue that has been largely neglected in the literature. The main contribution is based on using exogenous wind speed data to measure the sound level exposure of individuals. Additionally, by employing spatial geo-referenced daily survey data at the small scale ZIP code level, the study addresses the primary limitation of using voting data, namely the lag between the exposure and the day of voting.

The findings indicate that the likelihood of approving the presidents' job decreases significantly with an increasing sound level for individuals residing ZIP codes with wind turbines. This effect persists even after controlling for individual-level effects and including ZIP code and state-by-year fixed effects. Additionally, the study identifies a wide range of heterogeneity. The effect diminishes with distance from the wind turbines, depends on the number of installed wind turbines in a ZIP code, and is more pronounced in small towns and rural areas. Furthermore, evidence indicates the existence of a habituation effect, whereby the impact is most evident during the initial year after the installation of wind turbines and subsequently diminishes. The impact is heterogeneous across individuals, with a slightly more negative effect observed for male respondents and becomes more negative with higher age and lower levels of education.

The results have important policy implications. In order to maintain public support for renewable energy, it is important to consider local impacts when determining the location of wind turbines. Therefore, it is essential to extend the scope of distance regulations as with higher distance from wind turbines the sound emissions also diminish. In addition, as the number of wind turbines also has an effect, wind turbines may be distributed evenly across the area. The study also highlights the important role of education in this context. Furthermore, it demonstrates that different socio-economic sub-groups are affected in different ways. It may, therefore, be helpful for policymakers to consider how to compensate these groups. While several studies have examined the impact of negative externalities such as visual effects on elections (Stegmaier and Krause 2023), the extent to which each negative externality contributes to the overall effect remains unclear. Several studies have shown that there are also positive local effects, such as increased tax revenues, which are associated with smaller negative effects on citizen support for wind turbines (Germeshausen, Heim, and Wagner 2023). The extent to which other direct compensatory measures can also help to mitigate negative externalities, and thus change the overall effect on government popularity remains unclear and should be addressed in future studies.

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Appendix

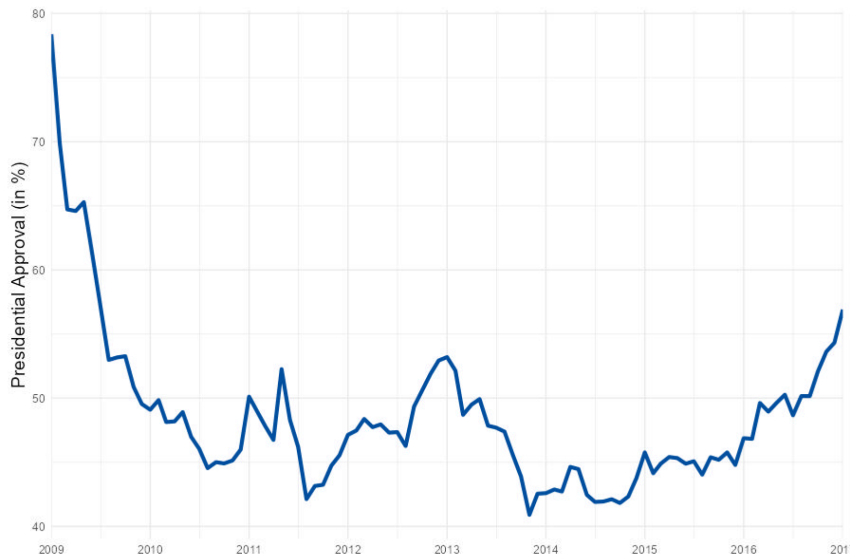

Figure 5. Average Share of Presidential Approval over 2009 to 2017

Table 9. Effect of Wind Turbines on Presidential Approval

	(1)		(2)	
Age	-0.0068***	(0.0002)	-0.0068***	(0.0002)
Age square	0.0001***	(0.000)	0.0001***	(0.000)
Female	0.0268***	(0.0009)	0.0268***	(0.0009)
Unemployed	-0.0179***	(0.0026)	-0.0179***	(0.0026)
Not in Work Force	0.0088***	(0.0012)	0.0088***	(0.0012)
Below High School	Reference Category		Reference Category	
High School	-0.0041	(0.0028)	-0.0041	(0.0028)
Tech School	-0.0084***	(0.0033)	-0.0084***	(0.0033)
Some College	0.0063***	(0.0028)	0.0063***	(0.0028)
Bachelor	0.0389***	(0.0029)	0.0389***	(0.0029)
Post Grad	0.0845***	(0.0029)	0.0845***	(0.0029)
Income Class 1	Reference Category		Reference Category	
Income Class 2	0.0194***	(0.0065)	0.0194***	(0.0065)
Income Class 3	0.0122**	(0.0050)	0.0122**	(0.0050)
Income Class 4	-0.0001	(0.0045)	-0.0001	(0.0045)
Income Class 5	-0.0064	(0.0045)	-0.0065	(0.0045)
Income Class 6	-0.0068	(0.0046)	-0.0069	(0.0046)
Income Class 7	-0.0059	(0.0045)	-0.0059	(0.0045)
Income Class 8	-0.0065	(0.0045)	-0.0065	(0.0045)
Income Class 9	-0.0075	(0.0046)	-0.0075	(0.0046)
Income Class 10	-0.0116***	(0.0045)	-0.0116***	(0.0045)
White	Reference Category		Reference Category	
Black	0.2182***	(0.0023)	0.2182***	(0.0023)
Asian	0.1209***	(0.0035)	0.1209***	(0.0035)
Hispanic	0.1036***	(0.0023)	0.1036***	(0.0023)
Other Race	0.0339***	(0.0038)	0.0339***	(0.0038)
Republican	Reference Category		Reference Category	
Democrat	0.6919***	(0.0015)	0.6919***	(0.0015)
Independent	0.3132***	(0.0014)	0.3132***	(0.0014)
Other Party	0.1867***	(0.0053)	0.1867***	(0.0053)
Post	-0.0145*	(0.0076)	0.0104	(0.0121)
Wind speed			0.0005*	(0.0002)
Wind speed × Post			-0.0041***	(0.0016)
Zip code FE	yes		yes	
State-Year FE	yes		yes	
Observations	708,351		708,351	
Within R^2	0.37005		0.37006	
Dependent variable mean	0.48469		0.48469	

Notes: The dependent variable is binary and indicates presidential approval during Obama's presidency from 20 January 2010 to 19 January 2017. All regressions control for a broad set of socioeconomic control variables. Standard errors are in parentheses and clustered at the ZIP code level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 10. Effect of Wind Turbine Sound on Presidential Approval under Different Distances

Treatment	ZIP code (1)	500m (2)	750m (3)	1000m (4)
Wind speed × Post	-0.0041***	-0.0033**	-0.0032**	-0.0028**
	(0.0016)	(0.0014)	(0.0014)	(0.0013)
ZIP code FE	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	708,351	711,579	713,257	714,450
Within R^2	0.37006	0.36983	0.36984	0.36974
Dependent variable mean	0.48469	0.48469	0.48480	0.48489

Notes: The dependent variable is binary and indicates presidential approval during Obama's presidency from 20 January 2010 to 19 January 2017. All regressions control for a broad set of socioeconomic control variables. Standard errors are in parentheses and clustered at the ZIP code level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.