IFN Working Paper No. 1464, 2023

Wind Power Approval, Decentralization, and NIMBYism: Evidence from the Swedish Greens

Erik Lundin

Research Institute of Industrial Economics
P.O. Box 55665
SE-102 15 Stockholm, Sweden
info@ifn.se
www.ifn.se

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Erik Lundin †

May 29, 2023

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Abstract

Green parties are commonly seen as strong proponents of wind power. This paper presents an alternative view, examining data from the highly decentralized institutional setup in Sweden where approval of wind power applications is delegated to local governments. I demonstrate that the approval rate of land based wind power drops by 11 percentage points (from 49 % to 38 %) in municipalities where the Greens are in the ruling coalition, conditional on the share of Green seats in the local council. The association is identified using a two-way fixed-effects logit model with panel data on electoral outcomes from six election terms (2000-2020) in 290 municipalities, combined with detailed data on every application for wind power in Sweden. No statistically significant effect is found for any other of the main parties. A likely mechanism is that even if the Greens have relatively stronger preferences for climate policy than other parties, they are also relatively more concerned about local environmental disamenities caused by wind power. Since decision making is decentralized, local environmental concerns dominate preferences for climate policy, which should be especially pertinent in small municipalities. In line with this argument, I also show that the effect is inversely correlated with municipality population size.

Keywords: Wind power; decentralization; negative externalities; electricity market; energy transition; climate policy; elections; NIMBYism; Green Party

JEL: D62, D72, H73, P18, Q48

*I thank Henrik Horn, Henrik Westander, Thomas Tangerås, and seminar participants at the Research Institute of Industrial Economics for helpful comments and discussions. This research was conducted within the framework of the IFN research program "Sustainable Energy Transition". The author gratefully acknowledges financial support from the Swedish Energy Agency.

†Research Institute of Industrial Economics (IFN). Email: erik.lundin@ifn.se. Website: www.eriklundin.org.

1 Introduction

Fighting climate change is a cornerstone of Green politics, with "Green" here meaning the ideological framework laid down by the Global Greens (2017) and adopted by more than 100 member parties worldwide. The preference for climate policy is often manifested through a strong support for wind power among national Green party representatives. However, wind power is also associated with environmental disamenities in the form of visual and acoustic disturbances for local residents and worsened conditions for wildlife, especially in pristine areas (Zerrahn, 2017). Since protection of the local environment is also a prominent feature of Green ideology, local decision making among the Greens reflects a delicate balance between climate policy versus concerns for the local environment, putting *Not In My Back Yard* (NIMBY)-ism to the test. In addition, the widespread practice of participatory democracy among the Greens (Global Greens, 2017) likely amplifies the influence of public opposition on political decision making, strengthening the negative impact of NIMBYism on wind power expansion. In Europe, voter support for Green parties is steadily increasing, and the parliamentary group incorporating the Greens now holds 10 percent of the seats in the European Parliament (European Parliament, 2019), underlying the importance of understanding how Green politics shape the energy transition.

The Swedish process for wind power application approval creates conditions where concerns for the local environment are likely to dominate preferences for climate policy. Decision making is highly decentralized and delegated to local municipal governments with a median of 16 thousand residents. Applications for wind power may be rejected without motivation; there are few economic benefits for municipalities accepting wind power such as corporate taxes or other institutionalized compensations; and local job creation from wind power is likely very limited (Aldieri et al., 2020). Compared to more densely populated countries, wind power in Sweden is often located in pristine areas with high environmental values. Given this institutional setup, I conjecture that local decision makers representing the Greens are less likely to approve wind power relative to other parties due to their concern for the local environment, despite the fact that national Green party representatives advocate stronger pro-wind power policies than representatives from other parties. In terms of political economics, the most closely related framework is likely Oates' *Decentralization Theorem* (Oates, 1972), from which it follows that decentralization will lead to underprovision of goods with positive interjurisdictional externalities (in this case wind power approval). In terms of wind power, these positive externalities are not only climate related, but also includes lower electricity prices, although electricity price formation is not the focus of the present study.

Swedish municipalities are governed by a system of proportional representation, where the share of seats in the municipal council roughly corresponds to the vote shares. There are eight major parties, and after each election a ruling coalition is formed, usually comprising a majority of the seats. I demonstrate that municipalities where the Greens are members of the local ruling coalition (henceforth referred to as *Green* municipalities) are less likely to approve applications for land based wind power than other municipalities (offshore wind power is yet in its infancy). In my main specification, the association is estimated using a two-way fixed effects logit model with panel data on electoral outcomes from six election terms (2000-2020) in 290 municipalities, combined with data on all applications for wind power during the same period, as well as application-specific characteristics such as the number of turbines, average wind speed on the site, and the number of nearby residents.

The association is statistically and economically significant. Conditional on the share of seats in the municipal council for the Greens, the estimated probability of approval is 0.38 for Green municipalities, compared to 0.49 for others, implying a marginal effect of -0.11. There is no association between approval and the seat share itself, except to the extent that a higher seat share increases the probability that the Greens enter the ruling coalition. There is no statistically significant association for any other of the main parties. However, the party expressing the most negative attitude towards wind power, the nationalist *Sweden Democrats*, was only recently included in a number of municipal ruling coalitions, and therefore had to be excluded from the analysis.

To demonstrate that the estimated association is due to decentralization, I show that it is driven by smaller municipalities with less than 50 thousand residents (comprising 85 percent of all municipalities in the sample). For very large municipalities, the effect is in fact instead positive, although less precisely estimated. I interpret this as evidence that there is a population threshold above which the climate-policy effect dominates the NIMBY-effect, and policy making then becomes more similar to national politics.

Since the support for wind power among national Green politicians is often highlighted in media, investors may believe that Green municipalities are relatively prone to approve wind power. Therefore, Green municipalities may receive applications for less suitable locations than other municipalities. However, since there is no statistically significant association between observable application characteristics and political representation by the Greens, I conjecture that such selection effects are not driving the results.

The estimated association should not be strictly interpreted as the *causal* effect of party representation, since the bargaining game determining the set of parties entering the ruling coalition is endogenous to the political environment in general, including the anticipation of future decisions on wind power applications. Although it is not clear in which direction this could bias my estimates, it is important to recall that the outcome of the barganing game is not random. In the extreme, one could imagine a situation where Green representatives would prefer to approve an application, but agrees to reject it in return for inclusion in the ruling coalition.

Another potential endogeneity issue is that Green voters may influence decision makers directly by lobbying for certain policy decisions. Such lobbying may influence both Green politicians as well as other parties. For example, if the Greens are gaining voter support, other parties may also become more "green" in order to attract more voters in future elections. However, since there is no statistically significant association between the seat (or vote) share in the council and wind power approval, it is unlikely that such endogeneity issues are driving my results.

Even if the estimated association cannot be interpreted as the causal effect of party representation due to the potential endogeneity of the bargaining game, the main economic interest does not hinge on the exact identification of a causal effect of Green representation, but instead lies in highlighting how *decentralization* causes local environmental concerns to prevent wind power expansion in Green municipalities. For a more sophisticated approach to identify the causal effect of party representation in proportional election systems, see Folke (2014).

In terms of my research question, the most closely related study is Lauf et al. (2020) who examine the association between Green party representation as well as a large set of other socio-demographic variables and installed wind power capacity on the municipality level in both Sweden and Germany. The study does not find any relationship between installed wind power capacity and Green representation in either country, but data are cross-sectional and the study only examines installed capacity, not applications. In a related study from the US, Dorrell and Lee (2020) find that Democrat governors have a slightly positive effect on wind power expansion as a result of favorable subsidy schemes and other regulatory interventions.

A related strand of European literature study the effect of wind power expansion on election results, i.e., the reverse relationship from what is studied here. In a German study, Otteni and Weisskircher (2022) employ a two-way fixed effects OLS estimator concluding that the construction of wind turbines in a municipality boosts the electoral support for *both* the Green Party and the populist anti-wind power party Alternative für Deutschland. In another German study, Germeshausen et al. (2023) instead find that the construction of wind turbines lead to *lower* support for the Green Party if the turbines are placed close to the municipality center. The effect is identified using a two-way fixed effects IV-estimator, and the corresponding OLS results are insignificant. In a survey experiment in Switzerland, Umit and Schaffer (2022) show that exposure to wind turbines does not have an effect on neither electoral turnout nor vote choice.

Anshelm and Simon (2016) give a qualitative discussion on environmentally based resistance towards wind power in Sweden, concluding that such resistance has grown stronger through the years and will likely hinder future wind power development, although they do not provide any quantitative analysis or discussion on the importance of party politics. Wretling et al. (2022) argue that the introduction of a financial compensation for municipalities accepting wind power will likely be crucial for a continued Swedish wind power expansion. Devlin (2005) discusses various sources of resistance towards wind power in Sweden, e.g., that the benefits in terms of lower electricity prices disproportionately favor urban areas far away from the sites. Other Swedish studies of the determinants of wind power expansion include e.g. Ek et al. (2013), finding that expected profitability has likely been a more important determinant of the geographic distribution of wind power installed in recent years, while the period up until 2006 was characterized by local individual wind energy "enthusiasts". In line with this result, Lundin (2022) studies the effect of geographically differentiated electricity prices on regional differences in wind power expansion, finding that prices affect the locational choices of large commercial firms, but not small, often locally owned, firms.

Previous studies on the effect of Green representation in Swedish municipalities demonstrate that the Greens issue more environmental fines (Sjöberg, 2016) and pursue more environmental policies in general (Folke, 2014) compared to other parties. The results in the present paper are in line with these studies, albeit with the added complexity that that local environmental concerns prove to dominate climate concerns.

Studies on effect of wind power on property values has been steadily increasing during the last decade. In Europe, the vast majority of these studies have found economically and statistically significant negative effects at least up to a distance of around 2 km from the site; see Parsons and Heintzelman (2022) for a literature review. Westlund and Wilhelmsson (2021) is the only published Swedish study on this topic, suggesting that the effect in Sweden is comparatively large by international standards, at about -20 percent at a distance of 1-2 km from the site, and approximately linearly declining down to -3 percent at 6-8 km. Naturally, the effect also depends on other factors such as the number and height of the turbines. A likely reason for the comparatively large effect is that wind power in Sweden is more often located in pristine areas used for recreation, compared to more densely populated countries where most other studies have been conducted. For a general literature review on the negative local environmental externalities of wind power I refer to Zerrahn (2017), and a Swedish synthesis of current research is provided by the Environmental Protection Agency (2021).

2 Institutional background

Wind power expansion in Sweden

Before 2003, large scale wind power plants were virtually non-existent in Sweden. A green electricity certificates system was then introduced in 2003, spurring investors' interest in wind power. Green certificates were awarded for each MWh produced, and demand was created by a regulation demanding consumers to purchase certificates amounting to a certain share of their consumption. Although the certificate system was important for creating initial investments, certificate prices have been declining steadily in tandem with lowered production costs. The system is currently being phased out, and from 2022 new plants are no longer awarded certificates.

Although investors started submitting applications soon after the introduction of the certificates, due to the long lead times it was not until 2010 that the share of wind power reached 2 percent of total output. Since then wind power has expanded steadily, and in 2021 the share was 16 percent. During the same period, technological progress caused the mean turbine capacity to approximately double. Figure 1 depicts all applications comprising three or more turbines submitted between 2000-2020, where green dots indicate that the application has been accepted and is currently either built or in the planning phase. Red dots indicate that the application has been rejected. Smaller projects with only one or two turbines are excluded, since these projects are mainly non-commercial and sited on the owners' property. Applications that are currently in process for decision are also excluded. Although there are somewhat more applications located in the southern part of the country, the median capacity of a project in the south is only 15 MW compared to 45 MW in the less densely populated north. This implies that the total generation capacity is higher in the north, both in terms of accepted and rejected applications. In terms of output shares, the Swedish market was in 2021 comprised by: hydro (43 percent); nuclear (31); wind power (16); other thermal (10); and solar (1) (Swedish Energy Agency, 2021).

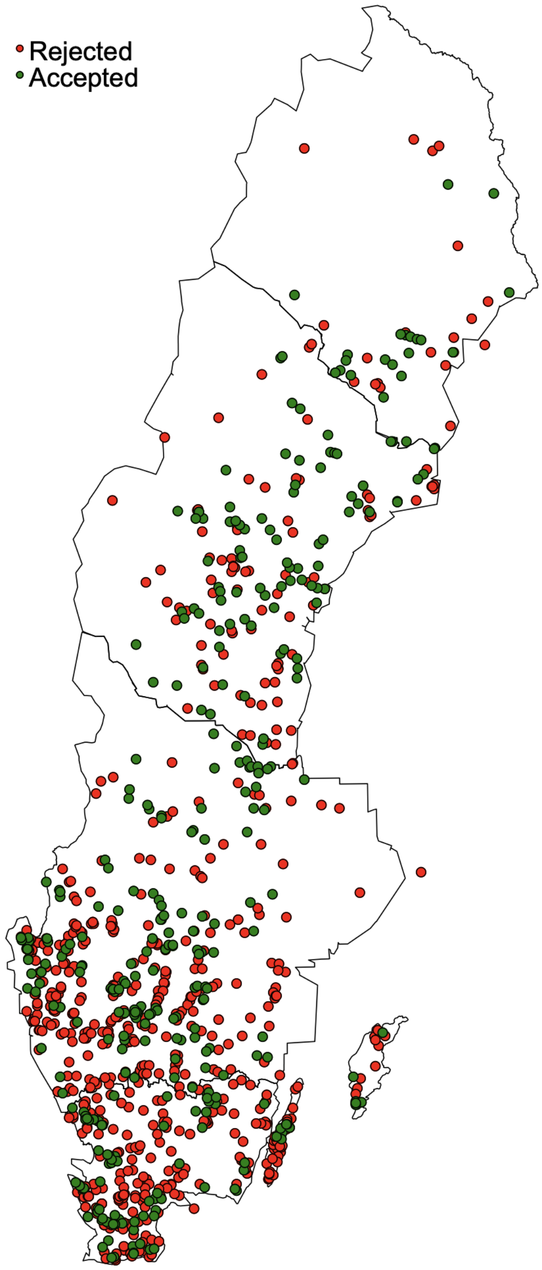
Until 2011, Sweden constituted one single price zone. In 2011, a market splitting reform was implemented, creating four price zones, leading to somewhat higher prices in the southern regions. Lundin (2022) finds that the price reform led to an increase in wind power investments in the southern regions, and that this effect was driven by large, commercial investors. Spot prices remained fairly stable during the sample period but increased significantly during 2022, i.e., after the sample period.

Application process

Below I describe the application process for a representative project in chronological order.

1. Pre-investigation and public hearing. Before an application is submitted, the investor investigates the proposed site and contacts land owners to ensure access to the land. The process is usually comparatively thorough, spanning 1-4 years (Vattenfall, 2023). The investor then organizes at least one public hearing concerning the proposed project, which is obliged by law (chapter 6, the Swedish Environmental Code). The hearing is intended for nearby residents, politicians, and other stakeholders. If the investor already in this phase perceives that the project will not be accepted by the municipality it often abstains from submitting a formal

Figure 1: Accepted and rejected wind power applications



Note: Accepted and rejected wind power applications 2000-2020. Green indicates accepted, and red rejected. Only projects with three or more turbines are included. N=775.

application. A survey report commissioned by the Energy Agency notes that the municipality may already in this phase communicate that they will exercise their veto against the project if a formal application would be submitted, which is also quoted as the main reason why investors decide to abandon the project after a public hearing (Swedish Energy Agency, 2021). Since my data includes information on the approximate time also of hearings that were not followed by formal applications, I exploit these data in the analysis.

2. Application submission and original decision. A formal application is then submitted to the county administration, evaluating the environmental impact of the project regarding birds, wildlife, impact on nearby residents, potential conflicts with military interests, and other potential issues. The evaluation is conducted by non-political officials (*Miljöprövningsdelegationen*) and there are 21 county administrations across the country. The evaluation is independent, but the investor also needs to submit its own report on the presumed environmental impact of the project. These reports are comparatively extensive, and usually comprises several hundred pages.

Before the county awards a permit, the relevant municipality also has to announce to the county administration whether it approves the project or if it decides to exercise its veto. Approval decisions are usually taken directly by the municipal board, in which the ruling coalition is in majority (Energy Agency, 2015), although the ruling coalition may also choose to delegate the decision to some other administrative committee such as the municipal council or the plan and building committee. The reason for exercising the veto is in principle always due to some negative impact on nearby residents or recreational areas that the county evaluation has not considered as significant enough to reject the project. If the project spans several municipalities, each municipality has veto right over turbines within its own border.

The county administration then notifies the investor about the final decision, which may include separate decisions for each turbine. Usually all turbines get the same decision, but due to e.g. differences in environmental impacts or in the exercise of the veto across municipalities, there may be differences within each project.

The Energy Agency (2022) notes that the municipal veto is the primary reason why projects get rejected. It may appear surprising that failure of the county's environmental evaluation is not more important, but since investors are well informed about the environmental assessment criteria beforehand, they likely abstain from submitting applications when the probability of failure is high. Conversely, the position of the municipality is not always clear at the outset of the application process, and often the evaluation period spans over several election periods.

Technically, the so-called municipal veto right was not introduced until 2009, when approval decisions for about 20 percent of all applications in the sample had already been made. However, the municipalities still had to approve applications already before the formal introduction of the veto, although the bureaucratic process was more circumstantial. Since results only differ trivially when excluding decisions pre-2009 (see column (4) in Table 2), I do not discuss this reform further.

3. Appeal and final decision. Original decisions may be appealed to the Land and Environmental Court (*Mark- och miljödomstolen*) by both the investor and other stakeholders. There are six such courts across the country. More than 40 % of all decisions are appealed. Although less common, it is also possible to further appeal the decision to the national Land and Environmental Court of Appeal (*Mark- och miljööverdomstolen*). Even if the municipality previously has announced that it will approve the project, it may withdraw its approval also during the appeal process. Recently, a government report proposed that the opportunity to exercise the veto should be limited to the first phase of the application process, strengthening legal predictability (Swedish Government, 2021). However, the municipalities were strongly opposed to this proposal and no legal changes were made.

Local political institutions and the Swedish Greens

The municipalities form the lowest administrative level. There are 290 municipalities, with a median population of 16 thousand residents. Elections are held every fourth year, in tandem with the national and county elections. The municipal council is the equivalent of the national parliament, and the number of seats in the council is determined by the vote shares. After election results are realized, negotiations take place, and a ruling coalition is formed so that it usually acquires a majority of the seats in the municipal council. The ruling coalition has the right to decide on several topics without consulting the council, such as wind power approval. The middle level of public administration is the counties. Although counties are also governed by party representatives, they have no influence over the decision making process for wind power (except for decisions about environmental compliance that are made by non-political officials).

Although the median support for the Greens in the local elections is only 4 percent, they are in 30 percent of all ruling coalitions during the sample period. In $\frac{2}{3}$ of all municipalities there has been at least one change in the composition of the ruling coalition where the Greens enter or leave, which is necessary for econometric identification within the fixed-effects model. In 40 (30) percent of the observations where the Greens are in the ruling coalition, the remaining ruling parties are classified as left (right). This is different from national politics, where the Greens have been in the left wing coalition since it first entered the Swedish Pariament in 1988. The Greens were members of the national ruling coalition during three of the six terms during the sample period. The remaining parties differ somewhat in their support for wind power, with a somewhat higher support from the left wing parties, at least in national politics. However, in my main specification I control for political representation of each party, finding that there is no statistically significant association between wind power approval and representation for any of the other parties. Therefore, I do not discuss the specific political agendas of the remaining parties.

Except for concerns for the local environment, a contributing reason why Green municipalities may be especially susceptible to local opposition is the widespread practice of participatory democracy in the form of e.g. public hearings. This is especially relevant in political systems with a high degree of decentralization, since smaller political entities provide better opportunities for direct interactions between decision makers and voters. The advocacy of participatory democracy is expressed by the international umbrella organization of Green Parties, the Global Greens, according to the following:

"We strive for a democracy in which all citizens ... are able to directly participate in the environmental, economic, social and political decisions which affect their lives; so that power and responsibility are concentrated in local and regional communities, and devolved only where essential to higher tiers of governance." (Global Greens, 2017)

Participatory democracy is also advocated in the party platform of the Swedish Greens, stating that:

"We are convinced that ... participatory democracy improve society ... A participatory democracy requires easily available information, a vibrant political debate and opportunities for citizens to attend meetings and submit their own proposals to political assemblies." (Swedish Greens, 2023)

2.1 Data

The main data set containing the applications and the associated approval decisions has been compiled from the publicly available database "*Vindbrukskollen*", administered by the Energy Agency. These data contain information about the application date of each project; the owner; data on original and final approval decisions (i.e., approval or rejection); if and when the project was constructed; and a large set of project characteristics. Projects that only reached the "public hearing" phase are also included in the data, and are recorded as rejections, since these projects did not lead to any formal applications. In the robustness section I relax this coding choice, which has no effect on the qualitative results (see Table A3). Some projects involve only one or two turbines and are excluded from the main analysis since these are usually smaller, non-commercial projects located close to the residential building of the owner's property. In the robustness section I relax this assumption, revealing that the magnitude of the effect is only trivially affected, but that estimates become somewhat less precise (see Figure A1).

In addition, the application data include coordinates of each turbine. If an application spans two municipalities, I code it as separate applications, based on turbine locations. Different turbines within the same application-municipality pair may also receive different decisions, although usually all turbines receive the same decision. Therefore I code the decision for each application-municipality pair using a binary variable (approval/rejection) based on the mode. Some applications are withdrawn already before a decision has been announced. The main reason for these withdrawals is that the municipality has informed the investor that the veto will be exercised. Hence, such applications are also coded as rejections.

Descriptive statistics for all applications are displayed in Table 1. The left (right) column contains applications when the final decision is made during an election term when the Greens were (not) in the ruling coalition. As a complement, Figure 2 maps the location of each application across groups. At least from visual inspection, there does not appear to be any notable difference in the geographic distribution across groups.

Decision making characteristics. The first group of variables in Table 1 relate to the decision making process. The main variable of interest is the final decision, which is the main dependent variable. In Green municipalities, 37 % of all applications were approved, compared to 44 % in other municipalities.

Application characteristics. The next set of variables describe application characteristics, including the number of turbines in the project; mean turbine tip height (usually all turbines are identical); the year when the application was submitted; time between application submission and final decision (in years); time between final decision and construction (in years); and the number of previously approved or built turbines in the municipality at the time of the final decision.

Ground characteristics. When an application is rejected, I do not know if it was caused by the municipal veto or that it failed the county's environmental evaluation. However, as noted above, the majority of the rejections are due to the municipal veto. To evaluate if there are any differences in observable characteristics based on the geography of the surrounding area across groups, I employ GIS-matching to combine application data with various ground characteristics from the Land use Authority. Notably, none of these variables exhibit any statistically significant difference across groups, mitigating concerns that rejections due to the counties' evaluations differ across groups. Specifically, these variables are: the number of buildings within 2 km of the site; the number of residents within 2 km of the site (these variables are naturally highly correlated); and indicators if the site is located on land categorized as Forest, Arable, Military interest; and if the project is located on an area categorized as suitable for wind power by the Energy Agency ("designated area"). The last variable, wind speed, measures the average wind speed on the site 100 meters above ground, and is also provided by the Energy Agency.

Representation of other parties. The next group of variables indicate which of the other parties that were in the ruling coalition at the time of the approval decision. Even if the Greens do not exclusively form coalitions with the left wing, it is more common than coalitions with the right wing. The main left wing party is the Social Democrats (S), which is in the ruling coalition in 62 (45) % of all observations when the Greens are (not) in the ruling coalition. A similar relationship holds for the Left Party (V). The remaining parties can roughly be categorized as right wing. The main right wing party is the Moderate Party (M) which is in the ruling coalition in 41 (55) % of all observations when the Greens are (not) in the ruling coalition. The other right wing parties are the Centre Party (C), the Liberals (FP), and the Christian Democrats (KD).

Economic indicators. Although there are few local economic benefits of wind power, there may still be some upsides in terms of local employment opportunities; leasing rents for landowners; road rehabilitation; and voluntary local compensation schemes (*bygdemedel*). Economic downturns may therefore increase the willingness to accept wind power. In my main specification, time fixed effects account for national economic trends, but municipality-specific variation is taken into account by controlling for Gross Regional Product (GRP) and unemployment data from Statistics Sweden.

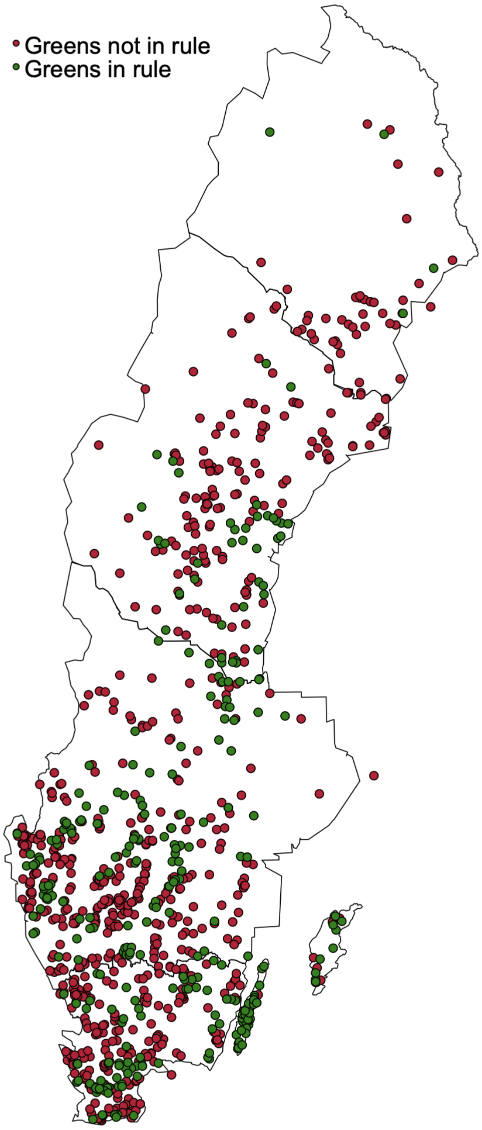
Table 1: Summary statistics of main variables

	GP in rule		***GP not in rule***		***Diff***
	Mean	Sd	Mean	Sd	
Decision making characteristics					
Approved (final decision)	0.37	0.48	0.44	0.50	0.07*
Approved (original decision)	0.49	0.50	0.55	0.50	0.06
Built	0.25	0.44	0.30	0.46	0.05
Approved or built	0.36	0.48	0.43	0.50	0.07*
Appealed	0.38	0.49	0.34	0.48	-0.03
Application characteristics					
Nr of turbines	13.50	38.98	14.53	20.91	1.03
Height	160.38	32.17	157.03	34.13	-3.35
Application year	2010.13	3.37	2009.68	3.32	-0.44
Time to decision	2.30	1.61	2.32	1.65	0.03
Time to construction	2.96	2.05	3.24	6.87	0.28
Previously approved or built	3.28	4.20	3.71	4.53	0.43
Ground characteristics					
Nr of buildings	7.17	7.05	7.37	7.55	0.20
Population	64.80	239.55	53.91	234.46	-10.89
Forest	0.80	0.40	0.84	0.36	0.04
Arable land	0.32	0.47	0.33	0.47	0.02
Military interest	0.25	0.43	0.24	0.43	-0.00
Nature reserve	0.05	0.21	0.03	0.16	-0.02
On designated area	0.16	0.36	0.16	0.36	-0.00
Wind speed	6.77	0.55	6.73	0.57	-0.04
Representation of other parties					
S in rule	0.60	0.49	0.42	0.49	-0.18***
V in rule	0.51	0.50	0.18	0.38	-0.34***
C in rule	0.46	0.50	0.66	0.47	0.20***
FP in rule	0.46	0.50	0.59	0.49	0.13***
KD in rule	0.41	0.49	0.54	0.50	0.14***
M in rule	0.42	0.49	0.58	0.49	0.16***
Economic indicators					
Unemployment	6.41	1.96	6.06	1.91	-0.35**
GRP per capita	294.45	83.49	286.27	79.96	-8.18
Observations	358		793		1151

* $p < .10$, ** $p < 0.05$, *** $p < 0.01$

Note: Summary statistics of the main variables. Each application is a separate observation. The left (right) column contains applications where the Greens were (not) in the ruling coalition at the time of the final decision. Only projects involving three or more turbines are included. Time to decision and time to construction are in years. Wind speed is in m/s. A *t-test* is used to test for differences in means across groups.

Figure 2: Locations of applications and Green municipalities



Note: Geographic locations for applications when the Greens are in the ruling coalition (green), and when they are absent (red).

3 Econometric model

My main identification challenge is that Green representation is not random with respect to geographic conditions determining the suitability for wind power. It is a stylized fact that the Greens gain higher vote shares in urban than rural municipalities, with urban municipalities being less suited for wind power. This could imply that applications for wind power in Green municipalities could be associated with more severe potential impacts on nearby residents, leading to a spurious relationship between low approval rates and Green representation. However, such selection issues are likely less severe when studying application approvals compared to the volume of constructed projects, since investors are unlikely to submit applications in very unsuitable locations due to a high risk of rejection. In line with this reasoning, Table 1 also suggests that applications in Green municipalities are not different than other applications with regard to application characteristics or observable characteristics of the surrounding geography. Nevertheless, it is important to employ an identification strategy that controls for potential selection issues based on municipality-specific confounders. I therefore employ a logit model with municipality- and time fixed effects, according to the following specification:

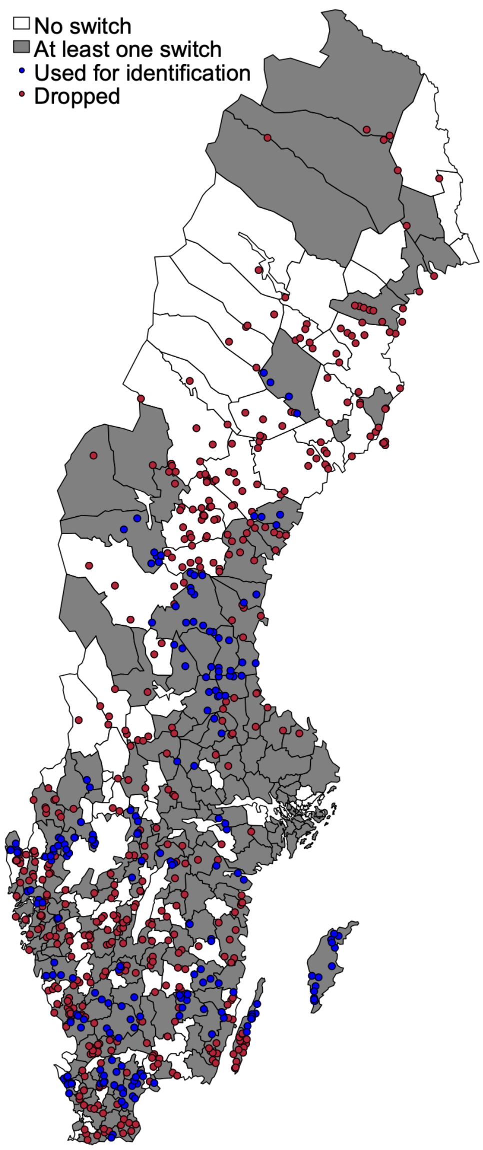
$$Y_{lit} = \alpha_i + \lambda_t + \beta_1 Green_{it}^{rule} + \beta_2 Green_{it}^{seats} + \boldsymbol{\phi}\mathbf{X}_{it}^{muni} + \boldsymbol{\delta}\mathbf{X}_{lt}^{appl} + \varepsilon_{lit} \tag{1}$$

Where:

- Y_{lit} is the outcome of interest for application l in municipality i during election period t. This indicator variable is coded according to approval/rejection according the criteria for the final approval decision described above. The time subscript refers to the election term in which the final decision was announced. In the main specification, also projects that only reached public hearing are included, and are recorded as rejections. Sensitivity with respect to the inclusion of these projects, as well as projects that have been approved but are not yet constructed, is discussed in the robustness section.

- α_i and λ_t are municipality- and election term fixed effects. By inclusion of the municipality fixed effects, applications are only used for identification if the Greens enter or exit the ruling coalition at least once during the sample period, *and* that there is at least one application decision in that municipality during each period. Figure 3 depicts how the spatial distribution of the applications vary depending on this classification. At least from visual inspection, it does not appear the spatial distribution of applications used for identification (blue) is different from the spatial distribution of other applications (red).

Figure 3: Map indicating applications used for identification



Note: Applications are only used for identification if the Greens enter or exit the ruling coalition during the sample period, *and* that there is at least one application decision in the municipality during each respective period. Such applications are represented by blue dots, and remaining applications are red. Municipalities where the Greens enter or exit the ruling coalition at least once during the sample period are in gray.

- $Green_{it}^{rule}$ is the main explanatory variable of interest, which is an indicator variable equal to unity if the Greens are in the ruling coalition in municipality i during election term t, with its associated coefficient β_1. Correspondingly, $Green_{it}^{seats}$ represents the seat share of the Greens in the municipal council in the same election, with its associated coefficient β_2.

- $\mathbf{X}_{it}^{muni}$ is a set of time-varying municipality-specific control variables with its associated coefficient vector $\boldsymbol{\phi}$. Included here are variables indicating which of the other parties that are in the ruling coalition (i.e., the equivalent of $Green_{it}^{rule}$). Other variables include unemployment and GRP.

- $\mathbf{X}_{lt}^{appl}$ is a vector of applications-specific variables with its associated coefficient vector $\boldsymbol{\delta}$. This set of variables includes both the number of turbines in the project, as well as ground characteristics around the site.

- Last, ε_{lit} is the error term which I assume is clustered within municipalities.

The estimator is not robust to treatment-effect heterogeneity under time-varying adoption, but an estimation of the corresponding main OLS model using the two-stage estimator proposed by Gardner (2022) reveals that the estimated association is only trivially affected both in terms of magnitude and precision when employing this estimator as compared to a conventional two-way fixed effects OLS estimator (please contact the author for full results).

Effect heterogeneity and population size

As decentralization strengthens the effect of NIMBYism associated with local environmental disamenities, the effects of NIMBYism should be more pronounced for municipalities with small populations. The primary reason is that a comparatively large share of the population would be affected by a given project. Both individually, through visible exposure from recreational areas and residential properties, but also indirectly through the exposure of family and friends.

Although beyond the scope of this paper, small municipalities are likely to experience lower approval rates *ceteris paribus*, regardless of political representation in the ruling coalition. I do not directly test this hypothesis, since municipality size (both in terms of population and area) is as good as static, making it impossible to identify the effect using a fixed effects model. However, since the central hypothesis of this study is that the effects of decentralization are especially pronounced in Green municipalities, I estimate the fixed effects model separately for ten subsets of municipalities depending on population size, hypothesizing that the negative association between the Greens and wind power approval should be more pronounced in smaller municipalities.

4 Results

4.1 Main specification

Table 2 displays results from the main specification. Odd ratios are displayed instead of coefficients, meaning that a value below unity is associated with a negative correlation between a marginal increase in the independent variable and the probability of approval. For the main variable of interest, “GP in rule”, predicted probabilities are displayed in the bottom of the table computed at the sample mean of the remaining variables. The marginal effect is also displayed, i.e. the change in the probability of approval when the Greens enter the ruling coalition.

In columns (1) and (2), no fixed effects are included, and the GP-coefficient is below unity and comparatively precisely estimated, at least in (2) when other controls are included. Except for FP (the Liberal Party) there is no precisely estimated association between representation in the ruling coalition and the probability of approval for any of the other parties. The FP-coefficient also becomes statistically insignificant in (3)-(8) when including the fixed effects.

In columns (3) and (4), both time- and municipality fixed effects are included, somewhat reducing the number of observations used to identify the effect. The marginal effect is now greater, and the precision of the GP-coefficient remains high. In (4), only decisions taken after 2009 are included, i.e. when the veto right was technically introduced, although municipalities already before enjoyed a *de facto* veto right. Removing pre-2009-decisions only has a minor effect on the estimated marginal effect, which increases from -12 to -15 percent.

In column (5), which is my preferred specification, I also control for seat share of the Greens in the municipal council, implying a marginal effect of -12. The coefficient on the seat share is both statistically and economically insignificant, also when removing the “GP in rule”-variable in (6). These results indicate that the seat share has no influence on decision making except to the extent that it increases the probability that the Greens enter the ruling coalition. One could also imagine a case where the seat share matters, but only conditional on that the Greens are already in the coalition, due to a stronger bargaining position in relation to other parties. I test this in (7), by including the interaction between the seat share and “GP in rule”, but also this representation of the seat share is statistically and economically insignificant.

In the last column (10) I introduce separate fixed effects depending on the seat share of the Green party, rounded to the nearest percent, instead of controlling for the seat share directly. This allows for a more a flexible relationship between the seat share and the probability of approval. Since the highest seat share in the sample is 14 percent, this means adding 14 additional fixed effects (these are not specified in Eq. 1). Although somewhat less precisely estimated than in my preferred specification (5), Green municipalities are still associated with a 10 percent lower probability of approval than other municipalities.

Few of the remaining variables exhibit any statistically significant relationship with the probability of approval throughout the various specifications, with the exception of the number of previously approved or built turbines within the municipality. This coefficient is below unity, suggesting that additional turbines are substitutes rather than complements to existing turbines. This could be both due to scarcity of land, as well as negative experiences related to disamenities caused by previous turbines. Some of the variables representing ground characteristics indicate statistically significant relationships with the probability of approval in (2), i.e., when the model is estimated without fixed effects. For example, the number of residents within 3 km of the site has a negative impact on the probability of approval, which is expected. However, none of these variables remain statistically significant throughout all specifications.

Table 2: Logit estimation with final approval decision as the dependent variable.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Green Party representation								
GP in rule	0.73*	0.68**	0.52**	0.46**	0.54**		0.58	0.58*
	(0.12)	(0.12)	(0.15)	(0.15)	(0.16)		(0.29)	(0.17)
GP seat share					0.96	0.93		
					(0.080)	(0.077)		
GP in rule x seat share							0.96	
							(0.18)	
Other parties representation								
M in rule		1.08	0.98	0.93	1.01	1.02	0.98	0.94
		(0.28)	(0.36)	(0.44)	(0.38)	(0.39)	(0.36)	(0.38)
S in rule		0.86	1.08	1.74	1.06	1.05	1.06	1.30
		(0.27)	(0.66)	(1.35)	(0.65)	(0.66)	(0.65)	(0.86)
V in rule		1.46	1.28	0.89	1.27	1.12	1.28	1.09
		(0.34)	(0.55)	(0.45)	(0.54)	(0.49)	(0.55)	(0.53)
KD in rule		0.82	1.04	1.09	1.03	0.95	1.02	1.32
		(0.21)	(0.51)	(0.81)	(0.51)	(0.52)	(0.51)	(0.80)
C in rule		1.04	0.91	1.21	0.90	1.03	0.91	0.89
		(0.24)	(0.48)	(0.76)	(0.47)	(0.53)	(0.48)	(0.44)
FP in rule		0.60**	0.72	0.71	0.72	0.70	0.71	0.68
		(0.12)	(0.27)	(0.29)	(0.27)	(0.28)	(0.27)	(0.26)
Ground characteristics								
Previously approved or built		1.01	0.75***	0.84*	0.75***	0.77***	0.75***	0.77***
		(0.019)	(0.054)	(0.079)	(0.054)	(0.056)	(0.053)	(0.054)
Population within 3 km		0.85***	0.96	0.89	0.96	0.97	0.96	0.96
		(0.041)	(0.084)	(0.095)	(0.084)	(0.083)	(0.085)	(0.086)
Forest		0.64**	1.01	0.95	1.00	1.07	1.01	1.10
		(0.13)	(0.38)	(0.57)	(0.38)	(0.39)	(0.38)	(0.40)
Open ground		1.48**	1.68*	1.52	1.68*	1.74**	1.68*	1.73**
		(0.27)	(0.46)	(0.46)	(0.46)	(0.47)	(0.46)	(0.48)
Nature reserve		0.28***	0.37*	0.58	0.37*	0.36*	0.37*	0.32*
		(0.13)	(0.21)	(0.32)	(0.21)	(0.20)	(0.21)	(0.20)
Wind speed		0.67*	0.73	0.92	0.74	0.77	0.73	0.66
		(0.14)	(0.27)	(0.39)	(0.27)	(0.29)	(0.27)	(0.25)
On designated area		1.01	1.18	1.07	1.17	1.14	1.18	1.14
		(0.20)	(0.40)	(0.45)	(0.39)	(0.37)	(0.40)	(0.40)
Application characteristics								
Local owner		1.07	0.94	0.80	0.94	0.97	0.94	0.95
		(0.30)	(0.33)	(0.37)	(0.33)	(0.34)	(0.33)	(0.34)
Turbines		1.11	1.19	1.28*	1.18	1.19	1.19	1.21
		(0.097)	(0.15)	(0.17)	(0.15)	(0.15)	(0.15)	(0.15)
Economic indicators								
Unemployment		0.93*	0.90	0.97	0.90	0.88	0.90	0.87
		(0.035)	(0.085)	(0.16)	(0.085)	(0.086)	(0.085)	(0.084)
GRP per capita		1.00	1.01	1.01*	1.01	1.01	1.01	1.01
		(0.00088)	(0.0054)	(0.0068)	(0.0054)	(0.0054)	(0.0054)	(0.0056)
GP in rule pred.	0.37	0.36	0.37	0.33	0.38	.	0.39	0.39
GP not in rule pred.	0.44	0.44	0.50	0.48	0.49	.	0.49	0.49
Marginal effect	-0.074	-0.086	-0.12	-0.15	-0.12	.	-0.10	-0.10
Time FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Muni FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
GP share of seats FE	No	No	No	No	No	No	No	Yes
N	1146	1146	905	694	905	905	905	904

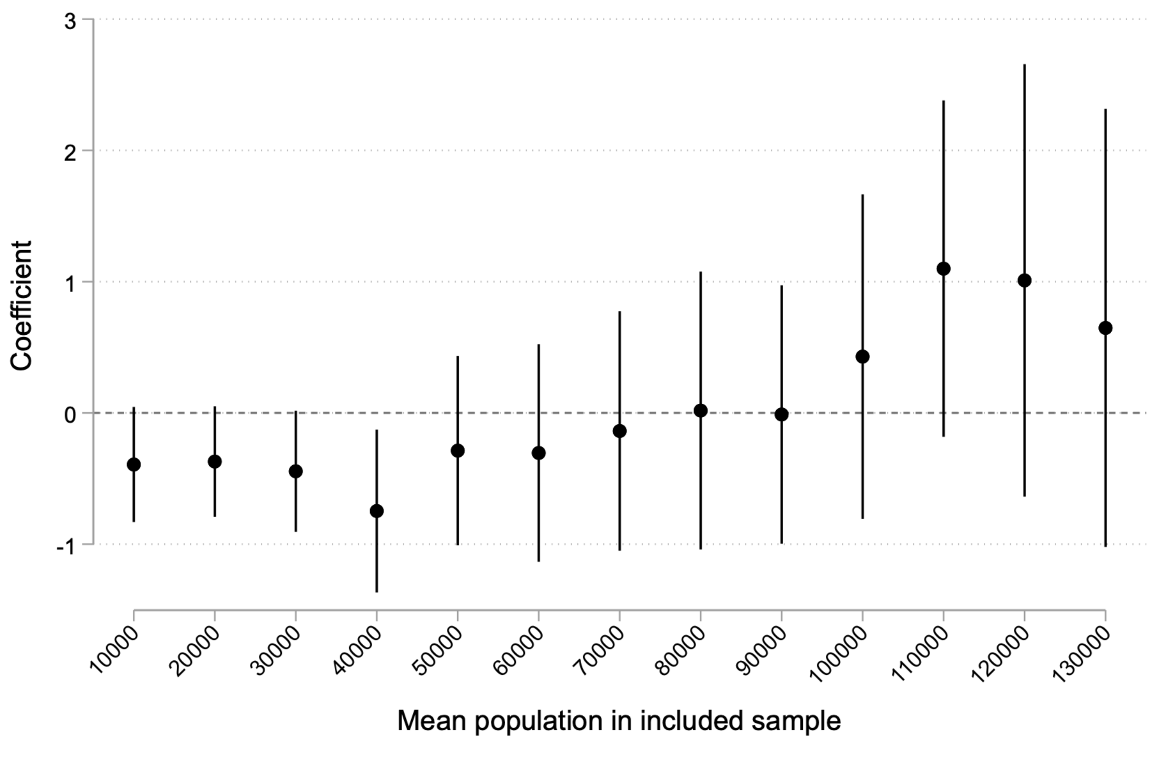
* $p < .10$, ** $p < 0.05$, *** $p < 0.01$

Note: Results from the main logit specification according to Eq. (1). Only applications with more than two turbines are included. Standard errors (in parentheses) are clustered by municipality. Predicted probabilities and marginal effects are computed based on the mean value of all variables except for "GP in rule". Odds ratios are displayed instead of coefficients.

4.2 Heterogeneity with respect to population

To examine heterogeneity with respect to population size I estimate the preferred specification (5) in Table 1 separately for 13 population intervals. Each regression is carried out using a window of municipalities with populations of ±20 thousand, using steps of 10 thousand. The "GP in rule" coefficients are depicted graphically in Figure 4, including 95 percent confidence intervals. By visual inspection, it is evident that the effect is only statistically significant for populations below 50 thousand residents. For ranges between 50-90 thousand the effect is statistically and economically insignificant, and for even larger populations, the effect is positive but imprecisely estimated. Since 85 percent of all municipalities have populations below 50 thousand, it is not possible to estimate heterogeneity with respect to population size with any greater level of precision.

Figure 4: Heterogeneity with respect to population



Note: Estimated coefficients for "GP in rule" from estimating specification (5) in Table 2 for various population intervals. Each regression is carried out using a window of municipalities with populations of ±20 thousand, using steps of 10 thousand. Vertical lines depict 95 percent confidence intervals. Coefficients have not been transformed to odds ratios.

4.3 Robustness

Using construction as the dependent variable

Although the main interest is wind power approval, potential welfare implications are mainly relevant to the extent that the approved projects are also constructed. To test this, I estimate the same specifications as in Table 2 using an indicator variable of actual construction as the dependent variable, while still mapping political representation to the year of the final decision. An alternative would be to use the year of construction, but since there is no reason to believe that the ruling coalition would influence investment decisions after the final approval decision has been made, I do not estimate such a model.

According to Table 1, the mean time between final decision and construction ("Time to construction") is approximately three years, with a standard deviation of two years, implying that the vast majority of accepted applications are constructed after five years. Since the sample period ends in 2020, I therefore exclude applications receiving their final decision in 2016 or after. If these applications would be included, many of them would be coded as zeros although they are or will eventually be constructed.

Results are displayed in Table A1, revealing that estimates are both qualitatively and quantitatively in line with the main estimates, although the precision is generally lower. The results for the Greens are still more precisely estimated than for any other party, although only statistically significant at the 10 percent level. In the preferred specification (5) the marginal effect is -13 percent, which is only trivially different from the main results.

The choice of cutoff for the minimum number of turbines

Since there is no evident *a priori* cutoff for the number of turbines, I estimate the preferred specification (5) from Table 2 while varying the cutoff for the minimum number of turbines required for the application to be included in the estimation. Coefficients for "GP in rule" are depicted graphically in Figure A1. All coefficients are negative and are of comparable magnitude, although the highest precision is achieved when excluding applications with less than three turbines.

Estimating the effect of party representation separately for each party

Although my main specification includes controls for political representation in the ruling coalition of the remaining main political parties, I do not include controls for the seat share of every other party, since this would imply overcontrolling. To further examine the association between political representation and wind power approval for the other parties, I estimate the model iteratively for each of the remaining parties while removing controls of political representation for all other parties. Results are displayed in Table A2. For each party I estimate both a pooled and a fixed effects model. The pooled model is identical to specification (1) in Table 2 and is displayed in the odd columns. The fixed effects model is identical to specification (5) except for the removal of party representation variables for the remaining parties, and is displayed in the even columns. In the pooled model, all coefficients for political representation are both statistically and economically significant for every party. However, in the fixed effects model, the most precisely estimated coefficient is for the Green party, which is the only coefficient that is statistically significant at the ten percent level.

Removing applications that only reached a public hearing

In the main estimation I code projects that only reached a public hearing as rejected applications. To examine if these project drive the results, I estimate the main specification while removing these observations. Results are depicted in Table A3, revealing that the marginal effect is both greater and more precisely estimated when these projects are removed. Especially, the main specification (5) indicates a marginal effect of -19 percent, and is statistically significant at the 1 percent level.

5 Concluding discussion

I demonstrate that demonstrate that the probability of approval for a proposed wind power project drops by on average 11 percentage points (from 49 % to 38 %) in municipalities where the Greens are represented in the ruling coalition. No statistically significant effect is found for any other of the main parties. A likely mechanism is that even if the Greens have relatively stronger preferences for climate policy than other parties, they are also relatively more concerned about local environmental disamenities caused by wind power.

Since decision making is decentralized, local environmental concerns dominate preferences for climate policy, which is especially pertinent in small municipalities. I show that the effect is driven by smaller municipalities with less than 50 thousand residents (comprising 85 percent of all municipalities in the sample). For very large municipalities, the effect is in fact instead positive, although less precisely estimated. I interpret this as evidence that there is a population threshold above which the climate-policy effect dominates the NIMBY-effect, and policy making then becomes more similar to national politics.

Except for concerns for the local environment, a contributing reason why Green municipalities may be especially susceptible to local opposition is the widespread practice of participatory democracy in the form of e.g. public hearings. Future work could attempt to disentangle the relative importance of these two mechanisms.

My results indicate that economic incentives for municipalities and/or nearby residents could be a useful policy intervention for achieving higher approval rates. One such intervention could be some type of mandated revenue sharing policy or other compensation scheme. A recent government report proposes such a revenue sharing scheme, including compensations for both municipalities and nearby resident (Swedish Government, 2023). Properly designed, such a policy has the potential to increase welfare given that it internalizes the local negative externalities associated with wind power with a reasonable level of precision.

References

Aldieri, Luigi, Jonas Grafström, Kristoffer Sundström, and Concetto Paolo Vinci, "Wind Power and Job Creation," *Sustainability*, 2020, *12* (1).

Anshelm, Jonas and Haikola Simon, "Power production and environmental opinions – Environmentally motivated resistance to wind power in Sweden," *Renewable and Sustainable Energy Reviews*, 2016, *57*, 1545–1555.

Devlin, Elizabeth, "Factors Affecting Public Acceptance of Wind Turbines in Sweden," *Wind Engineering*, 2005, *29* (6), 503–511.

Dorrell, John and Keunjae Lee, "The Politics of Wind: A state level analysis of political party impact on wind energy development in the United States," *Energy Research Social Science*, 2020, *69*, 101602.

Ek, Kristina, Lars Persson, Maria Johansson, and Åsa Waldo, "Location of Swedish wind power—Random or not? A quantitative analysis of differences in installed wind power capacity across Swedish municipalities," *Energy Policy*, 2013, *58*, 135–141.

Energy Agency, "Vägledning om kommunal tillstyrkan vid tillståndsprövning av vindkraftverk," Report ER 2015:05, The Swedish Energy Agency 2015.

_ , "Analys av statistik över tillståndsgivna och icke tillståndsgivna vindkraftverk 2014 - 2021," Report ER 2022:16, The Swedish Energy Agency 2022.

Environmental Protection Agency, "Vindkraftens påverkan på människors intressen," Report Report nr. 7013, The Swedish Environmental Protection Agency 2021.

European Parliament, "2019 European election results," website April 2019. https://www.europarl.europa.eu/election-results-2019/en.

Folke, Olle, "SHADES OF BROWN AND GREEN: PARTY EFFECTS IN PROPORTIONAL ELECTION SYSTEMS," *Journal of the European Economic Association*, 2014, *12* (5), 1361–1395.

Gardner, John, "Two-stage differences in differences, https://arxiv.org/abs/2207.05943," 2022.

Germeshausen, Robert, Sven Heim, and Ulrich J. Wagner, "Support for renewable energy: The case of wind power," Technical Report 2023.

Global Greens, "Charter of the Global Greens," website April 2017. https://globalgreens.org/wp-content/uploads/2020/04/Global-Greens-Charter-2017.pdf.

Lauf, Thomas, Kristina Ek, Erik Gawel, Paul Lehmann, and Patrik Söderholm, "The regional heterogeneity of wind power deployment: an empirical investigation of land-use policies in Germany and Sweden," *Journal of Environmental Planning and Management*, 2020, *63* (4), 751–778.

Lundin, Erik, "Geographic price granularity and investments in wind power: Evidence from a Swedish electricity market splitting reform," *Energy Economics*, 2022, *113*, 106208.

Oates, W.E., *Fiscal Federalism* Harbrace series in business and economics, Harcourt Brace Jovanovich, 1972.

Otteni, Cyrill and Manès Weisskircher, "Global warming and polarization. Wind turbines and the electoral success of the greens and the populist radical right," *European Journal of Political Research*, 2022, *61* (4), 1102–1122.

Parsons, George and Martin D. Heintzelman, "The Effect of Wind Power Projects on Property Values: A Decade (2011–2021) of Hedonic Price Analysis," *International Review of Environmental and Resource Economics*, 2022, *16* (1), 93–170.

Sjöberg, Eric, "An empirical study of federal law versus local environmental enforcement," *Journal of Environmental Economics and Management*, 2016, *76*, 14–31.

Swedish Energy Agency, "Fortsatt hög elproduktion och elexport under 2021," Official statistics Official statistics, The Swedish Energy Agency 2021.

Swedish Government, "En rättssäker vindkraftsprövning," Technical Report SOU 2021:53, The Swedish Government 2021.

_ , "Värdet av vinden - Kompensation, incitament och planering för en hållbar fortsatt utbyggnad av vindkraften," Technical Report SOU 2023:18, Swedish Government 2023.

Swedish Greens, "Party programme of the Green Party of Sweden," website April 2023. https://www.mp.se/sites/default/files/mp_partiprogram_english.pdf.

Umit, Resul and Lena Maria Schaffer, "Wind Turbines, Public Acceptance, and Electoral Outcomes," *Swiss Political Science Review*, 2022, *28* (4), 712–727.

Vattenfall, "Hur fungerar tillståndsprocessen för en vindkraftpark på land?," , website 2023. https://group.vattenfall.com/se/var-verksamhet/vindprojekt/faq-vindkraft/hur-fungerar-tillstandsprocessen-for-en-vindkraftpark-pa-land.

Westlund, Hans and Mats Wilhelmsson, "The Socio-Economic Cost of Wind Turbines: A Swedish Case Study," *Sustainability*, 2021, *13* (12).

Wretling, Vincent, Berit Balfors, and Ulla Mörtberg, "Balancing wind power deployment and sustainability objectives in Swedish planning and permitting," *Energy, Sustainability and Society*, 2022, *12* (1), 48.

Zerrahn, Alexander, "Wind Power and Externalities," *Ecological Economics*, 2017, *141*, 245–260.

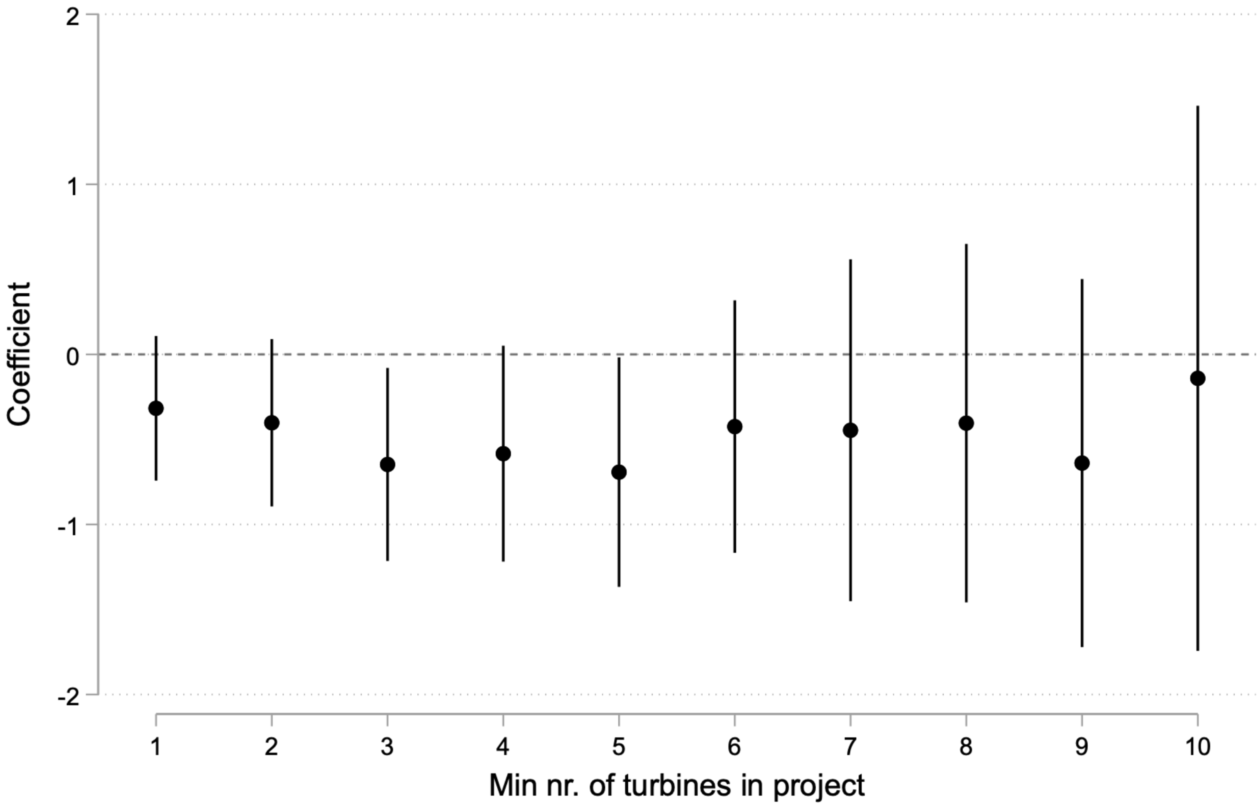
Appendix A: Additional tables and figures

Table A1: Logit estimation using construction as the dependent variable

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Green Party representation								
GP in rule	0.74	0.63**	0.51*	0.40*	0.46*		0.46	0.59
	(0.14)	(0.14)	(0.21)	(0.21)	(0.20)		(0.32)	(0.27)
GP seat share					1.16	1.12		
					(0.15)	(0.15)		
GP in rule x seat share							1.04	
							(0.25)	
Other parties representation								
M in rule		0.88	0.78	0.97	0.67	0.70	0.79	0.62
		(0.33)	(0.41)	(0.91)	(0.36)	(0.38)	(0.41)	(0.42)
S in rule		1.13	0.70	2.15	0.79	0.79	0.72	1.12
		(0.45)	(0.78)	(3.95)	(0.88)	(0.95)	(0.80)	(1.75)
V in rule		1.75**	1.81	1.67	1.85	1.47	1.82	1.55
		(0.45)	(0.88)	(1.21)	(0.90)	(0.74)	(0.89)	(0.89)
KD in rule		1.00	1.77	4.19	2.05	1.68	1.82	3.70
		(0.29)	(1.47)	(6.67)	(1.72)	(1.57)	(1.53)	(4.55)
C in rule		1.33	0.48	0.75	0.50	0.57	0.48	0.43
		(0.35)	(0.36)	(0.74)	(0.36)	(0.43)	(0.36)	(0.32)
FP in rule		0.75	0.94	0.75	0.95	0.95	0.94	0.75
		(0.19)	(0.63)	(0.66)	(0.63)	(0.64)	(0.64)	(0.54)
Ground characteristics								
Previously approved or built		1.01	0.76***	0.86	0.76***	0.78***	0.76***	0.77***
		(0.018)	(0.067)	(0.092)	(0.067)	(0.072)	(0.067)	(0.070)
Population within 3 km		0.92	1.20*	1.14	1.20*	1.20*	1.20*	1.22*
		(0.050)	(0.13)	(0.16)	(0.13)	(0.13)	(0.13)	(0.14)
Forest		0.59**	1.33	1.22	1.33	1.38	1.33	1.41
		(0.12)	(0.55)	(0.90)	(0.55)	(0.57)	(0.55)	(0.56)
Open ground		1.36	1.66	1.34	1.70	1.73	1.66	1.83
		(0.29)	(0.57)	(0.57)	(0.59)	(0.61)	(0.57)	(0.68)
Nature reserve		0.27**	0.36*	0.53	0.39	0.39	0.36*	0.33
		(0.14)	(0.22)	(0.35)	(0.25)	(0.24)	(0.22)	(0.24)
Wind speed		0.83	1.41	2.68*	1.41	1.50	1.42	1.17
		(0.19)	(0.57)	(1.46)	(0.58)	(0.62)	(0.58)	(0.49)
On designated area		1.03	1.07	0.84	1.08	1.03	1.07	1.01
		(0.25)	(0.41)	(0.42)	(0.42)	(0.39)	(0.41)	(0.41)
Application characteristics								
Local owner		1.08	0.87	0.78	0.90	0.90	0.87	0.89
		(0.34)	(0.33)	(0.51)	(0.35)	(0.35)	(0.34)	(0.34)
Turbines		1.08	1.40**	1.57**	1.39*	1.39**	1.40**	1.44**
		(0.12)	(0.24)	(0.30)	(0.23)	(0.23)	(0.24)	(0.25)
Economic indicators								
Unemployment		0.91**	0.78**	0.89	0.77**	0.75**	0.78**	0.75**
		(0.041)	(0.091)	(0.25)	(0.089)	(0.088)	(0.091)	(0.086)
GRP per capita		1.00	0.98**	0.98*	0.98**	0.98**	0.98**	0.98**
		(0.0010)	(0.0080)	(0.010)	(0.0082)	(0.0082)	(0.0080)	(0.0086)
GP in rule pred.	0.28	0.26	0.32	0.25	0.31	.	0.31	0.34
GP not in rule pred.	0.34	0.35	0.43	0.40	0.44	.	0.44	0.43
Marginal effect	-0.065	-0.093	-0.11	-0.15	-0.13	.	-0.13	-0.087
Time FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Muni FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
GP share of seats FE	No	No	No	No	No	No	No	Yes
N	967	967	691	480	691	691	691	683

* $p < .10$, ** $p < 0.05$, *** $p < 0.01$ .Note: Results from estimating Eq. (1) using construction as the dependent variable. Only applications with more than two turbines are included. Applications receiving the final decision in 2016 or after are excluded. Standard errors (in parentheses) are clustered by municipality. Predicted probabilities and marginal effects are computed based on the mean value of all variables except for "GP in rule". Odds ratios are displayed instead of coefficients.

Figure A1: Varying the cutoff for the minimum number of turbines.



Note: Estimated coefficients for “GP in rule” when estimating specification (5) in Table 2 by varying the cutoff for the minimum number of turbines included in the estimation. Vertical lines depict 95 percent confidence intervals. Coefficients have not been transformed to odds ratios.

Table A2: Iterative removal of party representation variables

	GP		M		S		V		C		FP		KD	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
GP in rule	0.73*	0.63*												
GP seat share		0.95												
M in rule			0.59***	0.78										
M seat share				0.95										
S in rule					1.71***	1.52								
S seat share						0.99								
V in rule							1.72***	1.36						
V seat share								1.04						
C in rule									0.61***	0.80				
C seat share										0.95				
FP in rule											0.51***	0.64		
FP seat share												1.00		
KD in rule													0.57***	0.69
KD seat share														1.03
Ground characteristics														
Previously approved or built		0.77***		0.77***		0.78***		0.77***		0.78***		0.77***		0.78***
Population within 3 km		0.95		0.96		0.96		0.97		0.97		0.96		0.96
Forest		1.04		1.08		1.09		1.10		1.09		1.08		1.10
Open ground		1.67*		1.73**		1.75**		1.73**		1.73**		1.75**		1.76**
Nature reserve		0.37*		0.36*		0.35*		0.35*		0.37*		0.36*		0.36*
Wind speed		0.74		0.76		0.76		0.78		0.78		0.78		0.75
On designated area		1.17		1.19		1.16		1.14		1.15		1.16		1.16
Application characteristics														
Local owner		0.97		0.97		0.97		0.97		0.96		0.99		0.97
Turbines		1.18		1.19		1.20		1.20		1.19		1.20		1.20
Economic indicators														
Unemployment		0.90		0.87		0.87		0.88		0.86		0.87		0.87
GRP per capita		1.01		1.01		1.01		1.01		1.01		1.01		1.01
In board pred.	0.37	0.40	0.36	0.43	0.49	0.50	0.51	0.50	0.37	0.44	0.34	0.42	0.35	0.42
Not in board pred.	0.44	0.48	0.49	0.48	0.36	0.42	0.38	0.44	0.49	0.48	0.51	0.50	0.49	0.49
Marginal effect	-0.074	-0.088	-0.13	-0.047	0.13	0.081	0.13	0.060	-0.12	-0.042	-0.16	-0.088	-0.14	-0.072
Time FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Muni FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Seat share FE	No	No	No	No	No	No	No	No	No	No	No	No	No	No
N	1146	905	1146	905	1146	905	1146	905	1146	905	1146	905	1146	905

* p < .10, ** p < 0.05, *** p < 0.01

Note: Results from estimating specifications (1) and (5) in Table 2 for each party, by iteratively removing variables of political representation for other parties. Standard errors (in parentheses) are clustered by municipality. Odds ratios are displayed instead of coefficients.

Table A3: Removing projects that only reached a public hearing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Green Party representation								
GP in rule	0.64**	0.56***	0.34***	0.33***	0.35***		0.22**	0.38***
	(0.12)	(0.12)	(0.12)	(0.13)	(0.13)		(0.15)	(0.14)
GP seat share					0.93	0.88		
					(0.10)	(0.093)		
GP in rule x seat share							1.21	
							(0.29)	
Other parties representation								
M in rule		1.07	0.46	0.50	0.47	0.49	0.47	0.45
		(0.35)	(0.26)	(0.31)	(0.27)	(0.27)	(0.26)	(0.26)
S in rule		0.67	0.99	1.72	0.97	1.03	1.04	1.04
		(0.27)	(0.85)	(1.59)	(0.84)	(0.88)	(0.89)	(0.95)
V in rule		1.67*	1.29	0.85	1.27	1.00	1.30	0.99
		(0.46)	(0.64)	(0.50)	(0.63)	(0.52)	(0.64)	(0.56)
KD in rule		0.99	2.65	2.27	2.70	2.50	2.88	2.99
		(0.30)	(1.87)	(1.85)	(1.95)	(2.02)	(2.08)	(2.55)
C in rule		0.84	0.87	1.23	0.85	1.03	0.86	0.71
		(0.22)	(0.63)	(1.03)	(0.61)	(0.70)	(0.62)	(0.50)
FP in rule		0.48***	0.46**	0.45*	0.46**	0.45**	0.46**	0.42**
		(0.11)	(0.17)	(0.21)	(0.17)	(0.18)	(0.17)	(0.16)
Ground characteristics								
Previously approved or built		0.99	0.79***	0.91	0.78***	0.81**	0.78***	0.79**
		(0.018)	(0.071)	(0.095)	(0.071)	(0.075)	(0.074)	(0.075)
Population within 3 km		0.89**	0.94	0.87	0.93	0.93	0.93	0.91
		(0.047)	(0.096)	(0.11)	(0.095)	(0.095)	(0.098)	(0.097)
Forest		0.70	1.52	1.06	1.53	1.73	1.51	1.54
		(0.16)	(0.71)	(0.86)	(0.71)	(0.75)	(0.70)	(0.75)
Open ground		1.29	1.43	1.32	1.42	1.58	1.44	1.37
		(0.26)	(0.40)	(0.42)	(0.40)	(0.45)	(0.40)	(0.40)
Nature reserve		0.59	1.15	1.02	1.11	1.05	1.23	1.08
		(0.29)	(0.87)	(0.76)	(0.85)	(0.80)	(0.96)	(0.89)
Wind speed		0.72	0.92	0.89	0.93	0.99	0.95	0.85
		(0.19)	(0.36)	(0.38)	(0.36)	(0.38)	(0.37)	(0.35)
On designated area		0.92	0.90	1.04	0.90	0.82	0.88	0.89
		(0.21)	(0.39)	(0.51)	(0.39)	(0.35)	(0.39)	(0.38)
Application characteristics								
Local owner		1.12	0.70	0.79	0.70	0.75	0.72	0.65
		(0.36)	(0.39)	(0.49)	(0.39)	(0.41)	(0.39)	(0.38)
Turbines		1.22**	1.40**	1.39**	1.38**	1.38**	1.41**	1.37**
		(0.12)	(0.19)	(0.21)	(0.19)	(0.19)	(0.20)	(0.19)
Economic indicators								
Unemployment		0.88***	0.80*	0.93	0.80*	0.78*	0.79*	0.77**
		(0.040)	(0.095)	(0.17)	(0.096)	(0.099)	(0.096)	(0.091)
GRP per capita		1.00	1.00	1.00	1.00	1.00	1.00	1.00
		(0.0011)	(0.0062)	(0.0072)	(0.0063)	(0.0062)	(0.0061)	(0.0062)
GP in rule pred.	0.46	0.45	0.42	0.38	0.42	.	0.37	0.44
GP not in rule pred.	0.58	0.58	0.62	0.59	0.61	.	0.64	0.61
Marginal effect	-0.11	-0.13	-0.20	-0.21	-0.19	.	-0.27	-0.17
Time FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Muni FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
GP share of seats FE	No	No	No	No	No	No	No	Yes
N	885	885	664	532	664	664	664	662

* $p < .10$, ** $p < 0.05$, *** $p < 0.01$ .Note: Note: Results from the main logit specification according to Eq. (1). Only applications with more than two turbines are included. Projects that only reached a public hearing are excluded. The dependent variable is the final approval decision. Standard errors (in parentheses) are clustered by municipality. Predicted probabilities and marginal effects are computed based on the mean value of all variables except for "GP in rule". Odds ratios are displayed instead of coefficients.