Energy Policy 192 (2024) 114185

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

# The relevance of proximity and work-related experience for the individual support for the expansion of power plants: An empirical analysis of wind, coal, and nuclear energy

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ARTICLE INFO

*Keywords:*
Proximity to power plants
Work-related experience
Coal power
Nuclear power
Wind power
Energy transition

ABSTRACT

This paper empirically examines whether proximity to power plants and work-related experience in the wind, coal, and nuclear energy sectors are correlated with the individual support for the expansion of corresponding regional power plants. The data for this analysis stem from a large-scale computer-based survey among more than 3700 citizens in Germany. The econometric analysis with binary and ordered probit models reveals significantly positive correlations between work-related experience in a specific energy sector and the support for the regional expansion of the corresponding power plants, whereby work-related experience in the coal and nuclear energy sectors is of particular relevance. In addition, our estimation results show a significantly positive correlation between proximity to wind turbines and the support for the regional expansion of wind turbines, but no clear relationship for proximity regarding coal and nuclear power plants. We discuss several energy policy implications. For example, it is extremely important to accompany energy transition measures with structural change measures to take into account the economic dependencies of the working force.

## 1. Introduction

To mitigate climate change, Germany has decided to phase out the use of coal by 2038. Furthermore, the German federal government will examine in 2026, 2029, and 2032 whether the dates for the phase-out of coal power plants planned from 2030 can be brought forward by three years in each case. For North Rhine-Westphalia, i.e. the largest federal state in Germany, it has even been decided to phase out coal by 2030. In addition, the accident at the Fukushima Daiichi nuclear power plant in Japan in March 2011 has intensified the already long-running debate in Germany about the risks of nuclear energy (e.g. Renn and Marshall, 2016). In particular, this accident very quickly led to the decision of the German federal government at that time to phase out nuclear energy by the end of 2022 (although it should be noted that the phase-out originally planned for 2022 was postponed slightly to spring 2023 and the debate about the continued use of nuclear energy is still ongoing).

However, various obstacles stand in the way of these important steps towards an environmentally friendly and sustainable energy system, such as the slowdown in the expansion of wind power in recent years. For example, less than 1000 MW of new wind power capacity were installed in 2019, while the average annual expansion between 2015 and 2017 was more than 4000 MW (e.g. Umweltbundesamt, 2021). The expansion slowed down due to the lengthy approval procedures as well as lawsuits of local municipalities that do not want wind power plants in their neighborhoods (e.g. Fachagentur Windenergie and Land, 2019). At the same time, the coal and nuclear energy sectors are economically relevant for coal- and nuclear-intensive regions so that these regions are often reluctant to phase out these energies. These examples illustrate that the success of energy policy measures depend on the support and opinion of local municipalities and their citizens.

Against this background, this paper empirically examines the individual support for the regional expansion of various power plants by specifically considering the relevance of work-related experience in a specific energy sector and personal experiences with power plants due to their residential proximity, which can lead to negative externalities, for example, through negative visual effects on the landscape. It can be assumed that these two experiences are closely linked. For example, Groh and von Möllendorff (2020) reveal that the perceived importance of changes in the landscape and the level of unemployment are strongly correlated with each other as well as with the individual support for the energy transition. Therefore, it is very important to consider both experiences in a joint econometric analysis of the support for the expansion

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https://doi.org/10.1016/j.enpol.2024.114185
Received 5 September 2023; Received in revised form 1 May 2024; Accepted 16 May 2024
Available online 14 June 2024

**Table 1**
Absolute and relative frequencies of the support for the expansion of wind, coal, and nuclear power plants in the region.

| | Strongly oppose | Rather oppose | Undecided | Rather support | Strongly support |
|---|---|---|---|---|---|
| Wind power plants | 375 (10.12%) | 422 (11.39%) | 758 (20.46%) | 1330 (35.91%) | 819 (22.11%) |
| Coal power plants | 1774 (47.89%) | 975 (26.32%) | 629 (16.98%) | 236 (6.37%) | 90 (2.43%) |
| Nuclear power plants | 2844 (76.78%) | 367 (9.91%) | 308 (8.32%) | 116 (3.13%) | 69 (1.86%) |

of power plants to avoid omitted variable bias. In addition, there are relatively few studies so far (exceptions are e.g. Sherren et al., 2019, or Schumacher et al., 2019) that compare the role of experiences across different power plants, i.e. most studies focus only on a specific energy source (e.g. Greenberg, 2009a; Swofford and Slattery, 2010; Jacquet, 2012; Rand and Hoen, 2017) or a specific power plant to analyze the effects of experience (e.g. Baxter et al., 2013; Thomson and Kempton, 2018).

Based on data from a broadly representative survey among citizens in Germany, this paper therefore aims to analyze both the relationship between the residential proximity to power plants and the support for their regional expansion as well as the relationship between work-related experience in the wind, coal, and nuclear energy sectors and the support for the regional expansion of the corresponding power plants. While our empirical analysis focuses on the individual experiences with wind, coal, and nuclear power plants, we also consider a large number of other variables that previous empirical studies find to potentially influence the support for the expansion of power plants, such as economic preferences (e.g. Ziegler, 2021), environmental values (e.g. Rand and Hoen, 2017), and socio-economic characteristics (e.g. Hüppe and Weber, 1999). The econometric analysis with binary and ordered probit models shows significantly positive correlations between work-related experience in an energy sector and the support for the expansion of the corresponding power plants. In addition, our estimation results also reveal a significantly positive correlation between proximity to wind turbines and the support for their expansion, but no clear correlation regarding coal and nuclear power plants.

The remainder of the paper is organized as follows: Section 2 provides the background and a literature review. Section 3 presents the data and variables used in our econometric analysis. The estimation results are discussed in section 4 and section 5 concludes.

## 2. Background and literature review

### 2.1. Proximity to power plants

While the expansion of renewable energies is generally strongly supported in Germany (e.g. Ziegler, 2019), several empirical studies show that individuals are willing to pay considerable amounts of money to increase the distance to wind turbines (e.g. Meyerhoff et al., 2010; Drechsler et al., 2011; Betakova et al., 2015; Brennan and van Rensburg, 2016; Zaunbrecher et al., 2017). The tendency of people to support the expansion of wind power plants, while opposing it in their immediate neighborhood is an example of the so-called "Not-in-my-backyard" (NIMBY) phenomenon (e.g. Devine-Wright, 2005; Warren et al., 2005). The reasons for this phenomenon are manifold and include, for example, negative externalities[1] of nearby wind turbines, such as negative visual effects on the landscape or noise pollution (e.g. Rand and Hoen, 2017). Accordingly, many studies examine the support for local wind power plants and the expansion of wind turbines (e.g. Warren et al., 2005; Jobert et al., 2007; van der Horst, 2007; Zoellner et al., 2008; Jones and Eiser, 2010; Vuichard et al., 2022). Swofford and Slattery (2010) find that people who live closest to a wind farm have the least positive attitudes towards it. Similar results are reported in Jacquet (2012) and Thayer and Freeman (1987).

In contrast, Mayer et al. (2021) cannot confirm that proximity influences the support for the expansion of renewable energies. Furthermore, there is empirical evidence that local opposition is highest during the planning and construction phase of wind power plants,[2] but decreases after a few years of operation (e.g. Wolsink, 1989; Gipe, 1995; Warren et al., 2005). In addition, several empirical studies suggest an inversion of the NIMBY phenomenon. For example, Baxter et al. (2013) find more positive attitudes among people living near wind turbines. This is also found in the large-scale analysis of Schumacher et al. (2019) in Germany (see also e.g. Dudleston, 2000; Braunholtz, 2003; Warren et al., 2005; Hoen et al., 2019). However, Schumacher et al. (2019) find no significant effect of living near wind farms on the strength of their support in France and Switzerland (see also Slattery et al., 2012; Groth and Vogt, 2014). Similarly, Sherren et al. (2019) compare people in Canada who are exposed to various energy infrastructures, i.e. regularly see, hear, or smell them, with those people who are not. They find no significant effect of exposure to a wind power plant on the support for

[1] According to economics, externalities are indirect costs or benefits for an uninvolved party or the society as a whole that are caused by the activities of another party. These unpriced (non-internalized) costs or benefits are thus not included in the cost-benefit-analysis of the party (e.g. individual or firm) causing the externality.

[2] Especially in Germany, local resistance during the planning phase can be encouraged by lengthy and complex regulations. These include restrictive siting rules such as the 10H rule in Bavaria from 2014, which sets the minimum distance between the wind turbine and the nearest residential building at ten times the total height of the wind turbine (e.g. Karakislak and Schneider, 2023), inefficient electricity auctioning (e.g. Lundberg, 2019; Del Río and Kiefer, 2023), as well as lengthy approval procedures (e.g. Karakislak and Schneider, 2023). According to previous studies showing that procedural fairness and participation are important determinants of local acceptance (e.g. Jobert et al., 2007; Zoellner et al., 2008; Zaunbrecher et al., 2017; Landeta-Manzano et al., 2018), these conditions could influence local support. However, since our paper focuses on the experiences with wind, coal, and nuclear power plants, we do not examine the experiences of local communities during the planning and construction phase in detail, but leave this for future studies.

the expansion of renewable energies.

Coal and nuclear power plants also cause negative externalities that are even more far-reaching, such as the risk of nuclear accidents in the case of nuclear power plants or air pollution from coal power plants. In contrast to wind turbines, however, little is known about the relationship between proximity to coal and nuclear power plants and the support for the regional expansion of these plants. Thomson and Kempton (2018) show that people in a coal region have more negative attitudes towards their local coal power plant than people in a wind power region towards their local wind power plant. However, they find no significant effect of distance to the power plant on the willingness to pay to remove or maintain the plant. Sherren et al. (2019) provide evidence of a positive effect of exposure to coal power on the support for its expansion. Greenberg (2009b) finds that individuals who live in a community where nuclear power plants operate or who are familiar with their local nuclear power plant are more likely to support the construction of new nuclear power plants. Similarly, van der Pligt et al. (1986) reveal positive effects of living in proximity to a nuclear power plant on the support for nuclear power plants. However, Frantál and Malý (2017) and Parkhill et al. (2010) find no significant effect of proximity on the level of support.

### 2.2. Work-related experience in the energy sector

Despite the negative externalities described above, all power plants also provide a common positive externality, namely economic benefits such as regional value-added and employment opportunities. Against this background, Frantál et al. (2017) show that economic benefits play an important role in supporting the expansion of power plants. Perceived economic impacts are examined by asking about the perceived development of the local economy and labor market (e.g. Baxter et al., 2013; Bidwell, 2013; Guo et al., 2015; Larson and Krannich, 2016; Frantál et al., 2017) or the perceived impacts on the local municipality in general (e.g. Slattery et al., 2012; Jacquet and Stedman, 2013). Many studies examine the effects of proximity to wind power plants on actual housing and property values (for an overview see e.g. Brinkley and Leach, 2019). However, few studies directly consider the effect of working in the relevant energy sector. Jacquet (2012) and Sherren et al. (2019) find that work-related experience in the wind energy sector has no significant influence on the level of support. The results for coal and nuclear power paint a different picture. For example, Sherren et al. (2019) find a significantly positive effect of working in the coal or nuclear energy sector on the support for the expansion of coal or nuclear power, respectively. This result is confirmed by Frantál (2016) for coal power and by Frantál and Malý (2017) and Greenberg (2009b) for nuclear power.

## 3. Data and variables

### 3.1. Survey implementation and sample

Our empirical analysis is based on a large-scale computer-based survey among 3705 citizens in Germany that was carried out in cooperation with the market research institute Psyma + Consultic GmbH in June and July 2016.[3] Due to the focus of the survey on energy-specific questions, only adults who are responsible for choosing electricity tariffs and providers alone or together with a partner were included. After this filtering, the sample was stratified in terms of age, gender, place of residence, and religious affiliation so that it is largely representative for the German adult population according to these criteria.[4] Due to missing information on the postcode and the place of residence, one respondent had to be excluded from the analysis so that our estimation sample consists of 3704 respondents. The median time to complete the questionnaire[5] was about 28 min.

### 3.2. Dependent variables

The dependent variables in our econometric analysis refer to the support for the expansion of wind, coal, and nuclear power plants in proximity to the place of residence of the respondents.[6] To this end, we asked the respondents whether they support the expansion of wind, coal, and nuclear power plants within a two km radius and within a radius of between two and 50 km of their place of residence.[7] The five symmetrically scaled ordered response categories were “strongly oppose”, “rather oppose”, “undecided”, “rather support”, and “strongly support”. Since wind power plants mainly cause negative externalities in a small radius around their location, as, for example, visual effects on the landscape or noise pollution become rare beyond a radius of five to seven km (e.g. Bishop, 2002), we focus on the support for the expansion of wind power plants within two km of the place of residence. In contrast, the negative externalities of coal and nuclear power plants

[3] Shortly before the data were collected, the 2015 Paris Agreement had just been adopted at the UNFCCC (United Nations Framework Convention on Climate Change) Conference of the Parties (COP21), at which 195 countries and the European Union agreed to limit global warming to “well below” 2 °C compared to pre-industrial times and to make efforts to limit warming to 1.5 °C. In Germany, the expansion of renewable energies and in particular wind power plants continued, although some restrictive distance regulations such as the aforementioned 10H rule in Bavaria from 2014 prevented an even faster expansion. Furthermore, the decision to finally phase out nuclear energy had already been made some years ago after the Fukushima accident in 2011, even if this phase-out had not yet been completed. The decision to phase out coal had not yet been made at the time of data collection, although it was already publicly discussed.

[4] However, this sampling strategy can lead to deviations for other criteria, for example, due to an overrepresentation of highly educated respondents.

[5] The first part of the questionnaire consisted of screening questions to identify the previously described target group. The second part referred to personal values and attitudes, especially economic preferences. The next three parts referred to energy-specific details including questions on the support for the expansion of power plants in the region of the respondents as well as a stated choice experiment for different electricity tariffs, which is, however, not considered in this paper. The final part of the survey comprised further socio-economic variables.

[6] The translated survey questions used to construct all dependent and explanatory variables in the econometric analysis can be found in the online appendix.

[7] Accordingly, we only consider the hypothetical (stated) support for the expansion of power plants. However, since there are no citizen referendums in Germany about the expansion of power plants, it is unfortunately not possible to analyze the actual support for corresponding projects. In the absence of actual (revealed preferences) data, it is therefore common to consider hypothetical or stated preferences data from surveys. In this context, it is important to note that we do not focus on the levels of support for the expansion of power plants in this paper, but on the effects of individual characteristics on this support. While the levels of support in our survey may differ from actual levels of support due to hypothetical bias, there is no evidence that using hypothetical or actual data leads to differences in the effects of proximity to power plants and work-related experience on the support for the expansion of power plants.

affect larger regions, for example, the evacuation area in the case of a nuclear accident covers more than one postcode district (e.g. Frantál and Malý, 2017). In addition, previous studies regularly choose larger areas when examining externalities of nuclear power plants (e.g. 15 km in Hüppe and Weber, 1999, or 50 miles in Greenberg, 2009a) and coal power plants (e.g. 27,5 km in Goldfarb et al., 2016). Therefore, for coal and nuclear power plants, the support for the expansion within a larger radius is considered for the second and third dependent variables. As explained below, we use the 50 km radius since this is a legal definition of regional energy in Germany.

According to Table 1, about 58% of the 3704 respondents support the expansion of wind power plants within a two km radius (i.e. they indicated "rather support" or "strongly support"), whereas a minority of just about 22% oppose it. With respect to coal and nuclear power plants, the table shows that their expansion is strongly opposed. Only about 9% of the respondents support the expansion of coal power plants and only about 5% support the expansion of nuclear power plants within a 50 km radius, while about 74% oppose the regional expansion of coal power plants and even about 87 % oppose the regional expansion of nuclear power plants (i.e. they indicated "rather oppose" or "strongly oppose"). These results are in line with previous empirical studies, which show higher levels of support for the expansion of wind power plants compared to the expansion of non-renewable energy sources such as coal or nuclear power (e.g. Ansolabehere and Konisky, 2009; Sherren et al., 2019). The strong opposition to nuclear power is also in line with the decision of the German government to phase out nuclear power by the end of 2022 (at the time of the survey) after the Fukushima accident in 2011. Similarly, the opposition to coal power plants is in line with the public debate about their phase-out and especially with the decision of the German government in 2020 to phase out coal power by 2038.

### 3.3. Main explanatory variables

The focus of our econometric analysis is on the relationship between the experience with wind, coal, and nuclear power plants, and the support for their regional expansion. Experience is considered by two indicators in our analysis. First, experience through residential proximity to wind, coal, or nuclear power plants, and second, work-related experience in the corresponding energy sector.

#### 3.3.1. Residential proximity

Our variables for residential proximity are measured by the number of power plants in proximity to the place of residence of the respondents. Following the approach of Von Möllendorff und Welsch (2017), the number of wind, coal, and nuclear power plants in proximity to the place of residence were determined by matching the number of power plants at the postcode level with the survey data.[8] As explained in the previous section, we consider wind power plants in the immediate neighborhood, represented by the postcode districts (small radius), and coal and nuclear power plants within a radius of 50 km of the postcode or municipality boundary (large radius). The data about the number of power plants were merged through the market master data by the German Federal Network Agency (see Bundesnetzagentur, 2019) and the regional identification register of the German Federal Environmental Agency (see Umweltbundesamt, 2018). The market master data contain the data of all power plants located in Germany, including the postcode of their location, and were used to merge the data on the number of wind turbines in the small radius.[9] According to a legal standard, the regional identification register defines a 50 km radius around the postcode area of an electricity consumer as the area in which an electricity suppliers may label renewable electricity as regionally produced. This definition of the register was used to add up the power plants in the postcodes belonging to the large radius to merge the number of coal and nuclear power plants in the 50 km region with the survey data.[10]

**Table 2**
Descriptive statistics for residential proximity.

| | Mean | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|
| Number wind power plants in region | 2.886 | 11.539 | 0 | 282 |
| Wind power plant in region | 0.267 | 0.442 | 0 | 1 |
| Number coal power plants in region | 9.896 | 12.997 | 0 | 51 |
| Coal power plant in region | 0.457 | 0.498 | 0 | 1 |
| Number nuclear power plants in region | 0.271 | 0.494 | 0 | 2 |
| Nuclear power plants in region | 0.247 | 0.432 | 0 | 1 |

The variable 'number wind power plants in region' is the number of wind power plants that are located in the same postcode district as the place of residence of the respondent, while the variables 'number coal power plants in region' and 'number nuclear power plants in region' are the numbers of coal or nuclear power plants that are located within a 50 km radius of the boundary of the postcode or municipality of the respondent. In addition, we also consider dummy variables for the presence of a particular power plant type in other model specifications. Therefore, the dummy variable 'wind power plant in region' takes the value of one if there is at least one wind power plant in the postcode district of the respondent. The dummy variables 'coal power plant in region' and 'nuclear power plant in region' take the value of one if there are more than five coal power plants or at least one nuclear power plant in the region of the respondent, respectively.[11] Table 2 reports that 26.7% of the respondents have at least one wind power plant in their postcode district. The average number of wind power plants in the postcode district is about 2.89, while the average number of coal power plants in the region of the respondents is almost ten. Nuclear power plants are scarcer with about 24.7% of the respondents having a nuclear power plant in their region and

[8] Through this matching approach, our variables for residential proximity to power plants only take into account physical distance and are thus measured externally and objectively. In contrast, some previous studies also consider perceived or psychological proximity, such as feelings of familiarity or whether the respondents are exposed to the infrastructure by hearing or seeing it (e.g. Parkhill et al., 2010; Sherren et al., 2019).

[9] Since we are interested in the effects of experiencing power plants, only power plants in operation are included in the empirical analysis. Therefore, power plants built after July 1, 2016, are excluded since they were not in operation at the time of the survey. Furthermore, offshore wind power plants are excluded from the dataset since the levels of support and the externalities differ between onshore and offshore wind power plants (e.g. Jones and Eiser, 2010). In 25 cases, the postcode district of a wind, coal, or nuclear power plant is corrected by the name of the municipality since the reported postcode in the market master data is a post office box number instead of an area-related postcode.

[10] The regional identification register uses two definitions of areas, i.e. the region is defined either by the boundary of the postcode district or by the boundary of the municipality that consists of more than one postcode district. Of the 3704 respondents, 1794 respondents are assigned to a region via their postcode district and 1987 via the municipality in which they live. Accordingly, in 77 cases the regional identification register identifies two regions, one via the boundary of the postcode area and another via the boundary of the municipality. In these cases of conflict, the postcode district is used. However, there are no qualitative differences if the municipal district is used instead.

[11] The dummy variables are constructed around the medians in the sample, i.e. five and zero for coal and nuclear power plants, respectively.

**Table 3**
Descriptive statistics for work-related experience.

| | Mean | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|
| Work experience wind energy sector | 0.086 | 0.280 | 0 | 1 |
| Work experience coal energy sector | 0.050 | 0.219 | 0 | 1 |
| Work experience nuclear energy sector | 0.052 | 0.222 | 0 | 1 |

an average number of about 0.27 power plants.

### 3.3.2. Work-related experience

To capture work-related experience in the wind, coal, and nuclear energy sectors, we asked the respondents whether they themselves or their social environment were currently or in the past directly or indirectly (e.g. in supplier companies) professionally involved in the wind, coal, and nuclear energy generation systems in their work.[12] The respondents had to answer the question separately for wind, coal, and nuclear power with the response categories “yes, I myself”, “yes, someone in my social environment”, or “no, neither I myself, nor anyone in my social environment”. The dummy variables ‘work experience wind energy sector’, ‘work experience coal energy sector’, and ‘work experience nuclear energy sector’ take the value of one if the respondent selected the first or second response option. According to Table 3, the work-related experience is similar between the three energy sectors. While about 5% and 5.2% of the respondents have work-related experience with the coal or nuclear energy sectors, 8.6% have work-related experience with the wind energy sector.

## 3.4. Control variables

To mitigate omitted variable bias, we include a large set of control variables in our econometric analysis, i.e. environmental awareness, political identification, economic preferences, and common socio-economic variables.

### 3.4.1. Environmental awareness

Environmental awareness is shown to influence the individual support for the general energy transition as well as for single energy policy measures such as the phase-out of nuclear energy, the expansion of renewable energies (e.g. Ziegler, 2019), and the phase-out of coal mining and combustion (e.g. Engler et al., 2021). They are thus expected to also influence the support for the regional expansion of power plants. We measure environmental awareness with a short version of the New Ecological Paradigm (NEP) scale (e.g. Dunlap et al., 2000; Whitmarsh, 2011). In line with Ziegler (2021), we consider the agreement with six statements[13] on a symmetric scale with five ordered response categories, ranging from “totally disagree” to “totally agree”, which are assigned with values from one to five, with higher values indicating higher environmental awareness. The variable ‘NEP’ is the sum of the values for the six ordinal variables and can thus vary between six and 30.

### 3.4.2. Political identification

Political identification also plays an important role in shaping opinions on environmental policy measures (e.g. Dietz et al., 1998; Devine-Wright, 2008; Ziegler, 2017; Hyland and Bertsch, 2018; Ziegler, 2019). However, due to possible interrelationships between different policy orientations, especially in Germany (e.g. Groh and Ziegler, 2022), we do not restrict our analysis to simple one-dimensional indicators such as for ecological policy orientation or left/right-wing policy identification. Instead, we examine three dimensions of policy identification in addition to ecological policy orientation (e.g. Ziegler, 2017, 2019). The dummy variables ‘ecological policy identification’, ‘social policy identification’, ‘liberal policy identification’, and ‘conservative policy identification’ take the value of one if the respondent rather or totally agrees with this orientation and thus indicated one of the two strongest identifications on a symmetric scale with five ordered response categories, respectively.

### 3.4.3. Economic preferences

Economic preferences, i.e. time and risk preferences as well as social preferences such as altruism, trust, and positive and negative reciprocity, are frequently examined in behavioral economics (e.g. Falk et al., 2018, 2023) and are shown to play an important role not only for individual behavior such as stock purchases (e.g. Dohmen et al., 2012), but also for pro-environmental behavior (e.g. Ziegler, 2020; Fischbacher et al., 2021). With respect to time preferences, our variable ‘patience’ measures the patience of the respondents based on an incentivized scheme. In a multiple-choice task with 12 choices, the respondents had to decide to receive 80 Euro one month after the survey or a higher amount between 80 Euro and 108 Euro seven months after the survey, provided that they were among the winners of a lottery (for details of the experiment, see Ziegler, 2021). Our specific variable is based on Dohmen et al. (2010), Bruderer Enzler et al. (2014), or Fischbacher et al. (2021) and represents the ratio between the fixed amount one month after the survey and the amount at which the respondent chose the higher payment seven months after the survey for the first time. Therefore, the variable ranges between 0.74 and one.

Due to the finding that proximity need not be the dominant variable affecting the support for the expansion of power plants, but may also have an indirect effect by influencing perceived risk (e.g. Venables et al., 2012; Frantál and Malý, 2017), it is important to control for risk preferences as well.[14] Our variable for risk preferences is based on a self-reported general willingness to take risk (e.g. Dohmen et al., 2011; Vieider et al., 2015; Falk et al., 2018, 2023). The respondents were thus asked how willing they generally are to take risks on a symmetric scale with the five ordered response categories “not at all willing to take risks”, “rather not willing to take risks”, “undecided”, “rather willing to take risks”, and “very willing to take risks”. The dummy variable ‘risk-taking preference’ takes the value of one if the respondent indicated one of the latter two categories.

In addition, we consider four components of social preferences. Our variable for altruism is also based on an incentivized scheme, i.e. on a dictator game in which the respondents had to divide 100 Euro with another randomly selected respondent in the case that the respondent was randomly selected as winner of a lottery (for details see Ziegler, 2021). The variable ‘altruism’ is the amount allocated to another respondent divided by 100. Therefore, the variable ranges between zero and one. Our variable for trust is measured with three items that are

[12] Our study thus tries to take actual individual work-related experiences or experiences in the social environment into account. While our concept of work-related experience refers to economic dependency, it can also be related to other aspects such as knowledge or identity. We acknowledge that more research is needed to better understand how work-related experience influences the support for the expansion of power plants.

[13] The six statements according to Whitmarsh (2011) were: “Humans have the right to modify the natural environment to suit their needs”, “humans are severely abusing the planet”, “plants and animals have the same right to exist as humans”, “nature is strong enough to cope with the impacts of modern industrial nations”, “humans were meant to rule over the rest of nature”, and “the balance of nature is very delicate and easily upset”.

[14] This is also suggested in studies examining the effect of residential proximity to nuclear power plants or waste facilities on risk perceptions (e.g. Maderthaner et al., 1978; Baxter and Lee, 2004; Lima, 2004; Freudenburg and Davidson, 2007; Greenberg, 2009a; Venables et al., 2012; Cale and Kromer, 2015). For example, Parkhill et al. (2010) show that people become familiar with risks and therefore perceive less risks from the plants as a result of daily exposure.

**Table 4**
Descriptive statistics for the control variables.

| | Mean | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|
| NEP | 24.183 | 3.774 | 6 | 30 |
| Ecological policy identification | 0.489 | 0.500 | 0 | 1 |
| Social policy identification | 0.637 | 0.481 | 0 | 1 |
| Liberal policy identification | 0.339 | 0.473 | 0 | 1 |
| Conservative policy identification | 0.224 | 0.417 | 0 | 1 |
| Patience | 0.865 | 0.097 | 0.741 | 1 |
| Risk-taking preference | 0.285 | 0.451 | 0 | 1 |
| Altruism | 0.341 | 0.205 | 0 | 1 |
| Trust | 9.812 | 1.420 | 3 | 15 |
| Positive reciprocity | 12.721 | 1.666 | 3 | 15 |
| Negative reciprocity | 7.494 | 2.671 | 3 | 15 |
| Age | 48.727 | 15.092 | 18 | 87 |
| Female | 0.505 | 0.500 | 0 | 1 |
| High education | 0.494 | 0.500 | 0 | 1 |
| High income | 0.461 | 0.499 | 0 | 1 |

regularly used in the German Socio-Economic Panel (SOEP) as well as in several behavioral economics studies (e.g. Dohmen et al., 2012). The respondents again had to indicate their agreement with statements on a symmetric scale with five ordered response categories, ranging from "totally disagree" to "totally agree". We assign increasing integers from one to five, with higher values indicating higher levels of trust, respectively. The variable 'trust' is the sum of the values for the three ordinal variables so that it ranges between three and 15.

Similar to the trust variable, our variables for positive and negative reciprocity are measured with three items from the SOEP, which are frequently used in previous studies (e.g. Dohmen et al., 2008, 2009; Caliendo et al., 2012). The respondents were asked to indicate how strongly they agree with three statements on positive reciprocity and three statements on negative reciprocity on a symmetric scale with five ordered response categories, ranging from "totally disagree" to "totally agree", each with values from one to five. The variables 'positive reciprocity' and 'negative reciprocity' are the sums of the values for the three ordinal variables in both cases. Therefore, the variables range between three and 15, respectively.

#### *3.4.4. Socio-economic variables*

Finally, we consider common socio-economics as control variables. 'Age' is the age of the respondent in years. The dummy variable 'female' takes the value of one if the respondent is female. The dummy variables 'high education' and 'high income' take the value of one if the education level of the respondent is higher than or equal to a vocational baccalaureate diploma and if the net household income of the respondent is equal to or above the sample mean, i.e. 2500 Euro per month, respectively. Some descriptive statistics for all control variables are reported in Table 4.

## 4. Econometric analysis

Our econometric analysis is mainly based on binary probit models, where the two highest categories of our dependent variables for the support for the expansion of wind, coal, and nuclear power plants are combined into one category for support.[15] Thus, the dependent variables take the value of one if a respondent rather or strongly supports the expansion of wind (coal, nuclear) power plants within a two km (50 km, 50 km) radius around the place of residence, respectively. Table 5 reports the average marginal and discrete probability effects as well as robust z-statistics based on maximum likelihood estimations of the binary probit models. The first column for each power plant type reports the results in a model that accounts for residential proximity by a dummy variable, while the second column for each power plant type reports the results of a model that accounts for residential proximity by the number of the corresponding power plants in the region.

### *4.1. Estimation results for residential proximity*

The estimation results for the dummy variable for wind power plants in the region in the first column of Table 5 show that the presence of at least one wind turbine in residential proximity is highly significantly positively correlated with the probability of supporting the expansion of wind power plants in the region. The estimated correlation with the number of wind power plants according to the second column of the table is only weakly significant, suggesting that the question whether someone has experience or not (extensive margin) is more relevant than the number of power plants, i.e. the intensity of the experience (intensive margin). These results are in line with inverse NIMBY, i.e. with studies finding that people who are familiar with wind power plants have a higher level of support for them (e.g. Warren et al., 2005; Baxter et al., 2013; Hoen et al., 2019). This suggests that experiencing wind turbines is associated with a decrease in prejudice against wind energy and points to potentially biased preferences in the public. Another possible explanation is Tiebout-sorting (Tiebout, 1956), which suggests increasing positive attitudes over time, i.e. people who strongly dislike local wind power plants will eventually move further away from the plant and vice versa (e.g. Rand and Hoen, 2017; Thomson and Kempton, 2018).

With respect to coal and nuclear power plants, the results in the last four columns of Table 5 show that the presence of at least five coal power plants in the region is highly significantly positively correlated with the probability of supporting the expansion of coal power plants in the region. This result is in line with Sherren et al. (2019) who find a positive effect of noticing coal power plants in the region. In contrast, the correlation with the presence of at least one nuclear power plant in the region is weakly significantly negative. However, the correlations for coal and nuclear power plants are not significant when proximity is considered by the number of power plants. Thus, as in the case of wind turbines, the extensive margin (i.e. whether one or more power plants are present or not) seems to be more important than the intensive margin (i.e. the intensity of the exposure to power plants). The results for nuclear power plants are in contrast to previous studies that find a positive effect of residential proximity to a nuclear power plant on the level of support (e.g. van der Pligt et al., 1986; Greenberg, 2009b). However, previous results on nuclear power plants are inconsistent since other studies find no significant effect of nuclear power plants in the region (e.g. Parkhill et al., 2010; Frantál and Malý, 2017).

### *4.2. Estimation results for work-related experience*

The estimation results for work-related experience are qualitatively very similar for the different power plant types. In all six binary probit models, work-related experience in an energy sector is significantly positively correlated with the probability of supporting the expansion of the corresponding power plants in the region. These results are in line with previous studies showing that economic aspects such as perceived economic impact as well as economic impact on the municipality or on property values are highly relevant for the level of support (e.g. Baxter et al., 2013; Bidwell, 2013; Guo et al., 2015; Frantál et al., 2017; Brinkley and Leach, 2019). Furthermore, Table 5 reveals that work-related experience is more important than residential proximity to power plants. On average, work-related experience in the wind energy sector leads to an increase by more than six percentage points in the

[15] The econometric analysis was conducted with the statistical software program Stata 16.

**Table 5**
Average marginal or discrete probability effects (robust z-statistics) based on maximum likelihood estimations of binary probit models.

| Explanatory variable | Support expansion wind power plants in region | | Support expansion coal power plants in region | | Support expansion nuclear power plants in region | |
|---|---|---|---|---|---|---|
| Wind power plant in region | 0.050***(2.85) | – | – | – | – | – |
| Number wind power plants in region | – | 0.001*(1.76) | – | – | – | – |
| Work experience wind energy sector | 0.061**(2.14) | 0.062**(2.17) | – | – | – | – |
| Coal power plant in region | – | – | 0.024***(2.61) | – | – | – |
| Number coal power plants in region | – | – | – | 0.000(1.06) | – | – |
| Work experience coal energy sector | – | – | 0.111***(3.97) | 0.116***(4.07) | – | – |
| Nuclear power plantin region | – | – | – | – | −0.012*(-1.72) | – |
| Number nuclear power plants in region | – | – | – | – | – | −0.010(-1.45) |
| Work experience nuclear energy sector | – | – | – | – | 0.104***(4.20) | 0.105***(4.21) |
| NEP | 0.005**(2.20) | 0.005**(2.19) | −0.005***(-4.13) | −0.005***(-4.22) | −0.004***(-4.22) | −0.004***(-4.23) |
| Ecological policy identification | 0.107***(5.71) | 0.106***(5.66) | −0.031***(-2.98) | −0.032***(-3.02) | −0.025***(-3.36) | −0.025***(-3.34) |
| Social policy identification | 0.057***(2.99) | 0.056***(2.95) | −0.005(-0.51) | −0.005(-0.49) | −0.011(-1.39) | −0.011(-1.41) |
| Liberal policy identification | 0.006(0.32) | 0.006(0.32) | 0.011(1.07) | 0.011(1.12) | 0.009(1.13) | 0.009(1.13) |
| Conservative policy identification | −0.060***(-3.04) | −0.063***(-3.16) | 0.034***(2.86) | 0.034***(2.83) | 0.048***(4.76) | 0.048***(4.76) |
| Patience | 0.126(1.54) | 0.127(1.54) | −0.061(-1.28) | −0.062(-1.30) | 0.007(0.20) | 0.007(0.19) |
| Risk-taking preference | 0.039**(2.16) | 0.038**(2.15) | 0.026**(2.45) | 0.026**(2.43) | 0.017**(2.15) | 0.017**(2.14) |
| Altruism | 0.102***(2.60) | 0.101**(2.56) | 0.005(0.23) | 0.005(0.24) | 0.019(1.11) | 0.019(1.10) |
| Trust | −0.006(-1.04) | −0.006(-1.01) | 0.012***(3.28) | 0.011***(3.30) | 0.010***(3.81) | 0.010***(3.80) |
| Positive reciprocity | 0.005(1.04) | 0.005(1.05) | 0.009***(3.08) | 0.009***(3.10) | 0.003(1.48) | 0.003(1.49) |
| Negative reciprocity | −0.007**(-2.38) | −0.007**(-2.39) | 0.001(0.77) | 0.001(0.71) | 0.000(0.20) | 0.000(0.19) |
| Age | −0.004***(-6.99) | −0.004***(-6.85) | 0.000(1.52) | 0.000(1.60) | 0.001**(2.29) | 0.001**(2.29) |
| Female | −0.027(-1.63) | −0.028*(-1.68) | −0.021**(-2.19) | −0.021**(-2.21) | −0.015**(-2.17) | −0.016**(-2.18) |
| High education | −0.041**(-2.48) | −0.043**(-2.56) | −0.009(-1.00) | −0.009(-0.92) | 0.017**(2.43) | 0.018**(2.45) |
| High income | 0.009(0.55) | 0.010(0.63) | −0.005(-0.59) | −0.005(-0.57) | 0.009(1.30) | 0.009(1.26) |

Note: * (**, ***) means that the estimated effect is different from zero at the 10% (5%, 1%) significance level, respectively.

estimated probability of supporting the expansion of wind power plants in the region. This corresponds to an increase in the estimated probability by more than 10%.[16]

The estimation results are even more pronounced for coal and nuclear power plants. A corresponding work-related experience leads to an increase in the estimated probability of supporting the expansion of coal and nuclear power plants by more than ten percentage points and thus to an increase in the estimated probability by about 135% for coal power plants and even about 236% for nuclear power plants. One possible explanation for these high values is that the coal and nuclear sectors are an important driver of the local economy and provide a high number of jobs (e.g. Frantál et al., 2017). The results could also indicate that people employed in these two energy sectors are tied to the specific sector due to their specialized job training.

### 4.3. Estimation results for control variables

With respect to our control variables, Table 5 shows that age and higher education are significantly negatively correlated with the support for the expansion of wind power plants, but significantly positively correlated with the support for the expansion of nuclear power plants. Females are significantly less likely to support the expansion of all three power plant types. In particular, Table 5 reveals significant correlations between the support for the expansion of power plants and environmental awareness and political identification. As expected from previous studies as discussed above, environmental awareness and ecological policy identification are highly significantly positively correlated with the probability of supporting the expansion of wind power plants and significantly negatively correlated with the support for the expansion of coal and nuclear power plants. Although always significant, the direction of the estimated correlations is reversed for conservative policy identification. Social policy identification is significantly positively correlated with the support for the expansion of wind power plants in the region.

In addition, several economic preferences are significantly correlated with the support for the expansion of power plants. Risk-taking preference is significantly positively correlated with the probability of supporting the expansion of all three power plant types in the region. For nuclear power plants, this result is not surprising since previous studies show that perceived risk influences the support for nuclear power plants (e.g. Whitfield et al., 2009). Furthermore, altruism is significantly positively correlated with the support for the expansion of wind power plants in the region. Interestingly, trust is only significantly positively correlated with the support for the expansion of coal and nuclear power plants and positive reciprocity is significantly positively correlated with the support for the expansion of nuclear power plants in the region.

### 4.4. Robustness checks

To check the robustness of our estimation results, we have estimated additional model specifications. Table 6 reports the average marginal and discrete probability effects as well as robust z-statistics based on maximum likelihood estimations of the binary probit models that additionally control for the federal states in which the respondents live. While the results for the estimated effects on the support for the expansion of wind turbines are relatively stable (with the exception of patience that has a weakly significantly positive effect in this model specification), the estimated effects of residential proximity to coal and nuclear power plants on the support for their regional expansion are no longer significant when controlling for the federal states. One potential explanation for this result is that sectors that create local jobs, such as in the coal and the mining sectors, influence local identities that might be captured by the state dummy variables (e.g. Bell und York, 2010; Venables et al., 2012; Olson-Hazboun et al., 2018; Olson-Hazboun, 2018).

Finally, Table 7 reports the maximum likelihood estimates and the corresponding robust z-statistics in ordered probit models that take into account the ordinal structure of the dependent variables and thus all five symmetrically scaled ordered response categories in the underlying survey questions. The estimation results in the models with dummy variables for residential proximity to power plants and especially for work-related experience are extremely robust, while the models with

[16] The estimated average probability of supporting wind power plants when working in the wind energy sector is 0.636, while it is 0.575 when not working in the wind energy sector. Therefore, the percentage change can be estimated with 0.636/0.575–1. The percentage changes for coal (0.193/0.082–1) and nuclear power plants (0.148/0.044–1) are estimated accordingly.

**Table 6**
Average marginal or discrete probability effects (robust z-statistics) based on maximum likelihood estimations of binary probit models (controlling for regional differences).

| Explanatory variable | Support expansion wind power plant in region | | Support expansion coal power plant in region | | Support expansion nuclear power plant in region | |
|---|---|---|---|---|---|---|
| Wind power plantin region | 0.047**(2.47) | – | – | – | – | – |
| Number wind power plants in region | – | 0.001*(1.92) | – | – | – | – |
| Work experiencewind energy sector | 0.064**(2.26) | 0.064**(2.24) | – | – | – | – |
| Coal power plantin region | – | – | 0.021(1.64) | – | – | – |
| Number wind power plants in region | – | – | – | 0.000(0.06) | – | – |
| Work experiencecoal energy sector | – | – | 0.103***(3.84) | 0.105***(3.91) | – | – |
| Nuclear power plantin region | – | – | – | – | −0.012(-1.43) | – |
| Number nuclear power plants in region | – | – | – | – | – | −0.011(-1.25) |
| Work experiencenuclear energy sector | – | – | – | – | 0.106***(4.25) | 0.106***(4.26) |
| NEP | 0.005**(2.08) | 0.005**(2.06) | −0.005***(-4.10) | −0.005***(-4.13) | −0.004***(-4.47) | −0.004***(-4.48) |
| Ecological policyidentification | 0.107***(5.71) | 0.107***(5.70) | −0.031***(-3.03) | −0.031***(-3.00) | −0.026***(-3.51) | −0.026***(-3.49) |
| Social policyidentification | 0.059***(3.12) | 0.0582***(3.08) | −0.006(-0.55) | −0.006(-0.56) | −0.011(-1.47) | −0.011(-1.50) |
| Liberal policyidentification | −0.002(-0.10) | −0.002(-0.10) | 0.011(1.08) | 0.011(1.10) | 0.010(1.35) | 0.010(1.35) |
| Conservative policy identification | −0.064***(-3.21) | −0.066***(-3.31) | 0.035***(2.86) | 0.034***(2.86) | 0.047***(4.77) | 0.047***(4.77) |
| Patience | 0.144*(1.75) | 0.145*(1.77) | −0.051(-1.08) | −0.05(-1.08) | 0.009(0.27) | 0.009(0.26) |
| Risk-taking preference | 0.040**(2.25) | 0.040**(2.24) | 0.029***(2.67) | 0.029***(2.67) | 0.018**(2.25) | 0.018**(2.25) |
| Trust | −0.006(-0.98) | −0.006(-0.99) | 0.012***(3.37) | 0.012***(3.40) | 0.010***(3.91) | 0.010***(3.90) |
| Altruism | 0.099**(2.53) | 0.099**(2.51) | 0.004(0.19) | 0.004(0.17) | 0.019(1.17) | 0.019(1.17) |
| Positive reciprocity | 0.006(1.17) | 0.006(1.18) | 0.009***(3.07) | 0.009***(3.07) | 0.003(1.41) | 0.003(1.42) |
| Negative reciprocity | −0.007**(-2.38) | −0.007**(-2.36) | 0.001(0.81) | 0.001(0.80) | 0.000(0.05) | 0.000(0.04) |
| Age | −0.004***(-6.55) | −0.004***(-6.42) | 0.000(1.16) | 0.000(1.20) | 0.000**(2.37) | 0.000**(2.36) |
| Female | −0.024(-1.49) | −0.025(-1.53) | −0.022**(-2.32) | −0.022**(-2.33) | −0.015**(-2.16) | −0.015**(-2.17) |
| High education | −0.039**(-2.33) | −0.040**(-2.41) | −0.010(-1.06) | −0.009(-1.00) | 0.018**(2.48) | 0.018**(2.48) |
| High income | 0.002(0.14) | 0.004(0.23) | −0.003(-0.28) | −0.003(-0.27) | 0.010(1.47) | 0.010(1.44) |
| Federal state dummy variables | Yes | Yes | Yes | Yes | Yes | Yes |

Note: * (**, ***) means that the estimated effect is different from zero at the 10% (5%, 1%) significance level, respectively.

**Table 7**
Maximum likelihood estimates (robust z-statistics) in ordered probit models.

| Explanatory variable | Support expansion wind power plant in region | | Support expansion coal power plant in region | | Support expansion nuclear power plant in region | |
|---|---|---|---|---|---|---|
| Wind power plantin region | 0.111***(2.76) | – | – | – | – | – |
| Number wind power plants in region | | 0.001(0.47) | – | – | – | – |
| Work experiencewind energy sector | 0.213***(3.10) | 0.219***(3.19) | – | – | – | – |
| Coal power plantin region | – | – | 0.097***(2.61) | – | – | – |
| Number wind power plants in region | – | – | – | 0.002*(1.72) | – | – |
| Work experiencecoal energy sector | – | – | 0.617***(8.27) | 0.626***(8.37) | – | – |
| Nuclear power plantin region | – | – | – | – | −0.103*(-1.96) | – |
| Number nuclear power plants in region | – | – | – | – | – | −0.084*(-1.84) |
| Work experiencenuclear energy sector | – | – | – | – | 0.670***(7.64) | 0.673***(7.65) |
| NEP | 0.015***(2.77) | 0.015***(2.77) | −0.048***(-8.18) | −0.048***(-8.22) | −0.053***(-7.87) | −0.053***(-7.88) |
| Ecological policyidentification | 0.276***(6.73) | 0.273***(6.66) | −0.295***(-6.87) | −0.296***(-6.88) | −0.338***(-6.44) | −0.337***(-6.42) |
| Social policyidentification | 0.117***(2.84) | 0.116***(2.80) | −0.066(-1.54) | −0.066(-1.53) | −0.179***(-3.55) | −0.180***(-3.57) |
| Liberal policyidentification | 0.010(0.24) | 0.008(0.20) | 0.039(0.94) | 0.039(0.93) | 0.036(0.72) | 0.037(0.73) |
| Conservative policy identification | −0.186***(-4.22) | −0.191***(-4.32) | 0.117**(2.51) | 0.118**(2.52) | 0.330***(6.12) | 0.330***(6.13) |
| Patience | 0.333*(1.82) | 0.334*(1.83) | −0.158(-0.81) | −0.157(-0.81) | −0.043(-0.18) | −0.044(-0.19) |
| Risk-taking preference | 0.076*(1.89) | 0.075*(1.86) | 0.061(1.43) | 0.059(1.39) | 0.080(1.57) | 0.080(1.57) |
| Trust | −0.019(-1.39) | −0.018(-1.34) | 0.037**(2.54) | 0.038**(2.57) | 0.073***(4.22) | 0.073***(4.21) |
| Altruism | 0.195**(2.18) | 0.191**(2.13) | 0.092(0.99) | 0.094(1.01) | 0.228**(2.02) | 0.227**(2.02) |
| Positive reciprocity | 0.036***(3.05) | 0.037***(3.09) | 0.004(0.37) | 0.005(0.41) | −0.012(-0.87) | −0.012(-0.87) |
| Negative reciprocity | −0.015*(-1.88) | −0.015*(-1.90) | 0.015*(1.84) | 0.015*(1.83) | 0.009(0.98) | 0.009(0.98) |
| Age | −0.010***(-8.09) | −0.010***(-7.90) | 0.002(1.62) | 0.002*(1.65) | 0.005***(3.13) | 0.005***(3.13) |
| Female | −0.095**(-2.56) | −0.096***(-2.60) | 0.103***(2.64) | 0.102***(2.60) | −0.128***(-2.70) | −0.128***(-2.70) |
| High education | −0.111***(-3.00) | −0.114***(-3.08) | −0.073*(-1.89) | −0.071*(-1.83) | 0.006(0.13) | 0.007(0.14) |
| High income | 0.047(1.30) | 0.050(1.37) | −0.078**(-2.04) | −0.076**(-1.99) | 0.046(0.97) | 0.044(0.94) |

Note: * (**, ***) means that the estimated parameter is different from zero at the 10% (5%, 1%) significance level, respectively.

continuous variables for residential proximity to power plants lead to slightly different results. While the estimated parameter for the number of wind power plants is not significantly different from zero, the corresponding estimated parameter for coal power plants is weakly significantly positive and for nuclear power plants weakly significantly negative. However, the estimated average marginal and discrete probability effects are economically not very significant.[17] As expected, the significance of the effects of some control variables changes slightly due to the change in the dependent variable. Nevertheless, the estimation results are qualitatively similar to the results in the binary probit models.

## 5. Conclusions and policy implications

This paper empirically examines the relationship between proximity to power plants or work-related experience in certain energy sectors and the individual support for the expansion of corresponding regional power plants. Our estimation results suggest that it is not residential proximity but economic dependence that is the dominant factor for the support for the expansion of power plants in the region. Overall, we find no clear relationship between residential proximity to coal or nuclear power plants and the support for their regional expansion. In the case of wind power plants, people who live in proximity to these power plants have a significantly higher level of support for their regional expansion than people who live in regions without wind turbines. In contrast, work-related experience is significantly positively correlated with the support for the regional expansion of all three power plant types. Especially in the case of coal and nuclear power plants, people with work-related experience are significantly more likely to support their expansion.

Our results are in line with inverse NIMBY (e.g. Warren et al., 2005; Baxter et al., 2013; Hoen et al., 2019), i.e. people who are familiar with wind power plants are more likely to support their regional expansion. This could indicate that experiencing wind turbines in close proximity is associated with a decrease in prejudice against wind energy or a familiarization effect. To accelerate the expansion of wind turbines, it could therefore make sense in the short run to focus on areas where wind turbines are already installed. However, to increase the number of wind turbines, it will be necessary in the long run to build new wind power plants in areas where there are no wind farms yet. Since experience with wind power plants seems to increase the support for their expansion, it might be a good idea to start with a small wind farm or a few wind turbines in a region before building large wind farms to reduce the risk of an opposition.

Our result that work-related experience is of great importance for the support for the expansion of all power plant types, and especially more important than proximity to power plants, underlines the importance of the economic impact of regional power plants and the corresponding energy sectors. Therefore, it is extremely important for the transition of the energy system from coal and nuclear to renewable power plants to accompany the phase-out of coal and nuclear energy by structural change measures, especially in coal- and nuclear-intensive regions. Those measures should also take into account individual economic welfare, i.e. include job training to overcome the lock-in effect of highly specialized employees.

## CRediT authorship contribution statement

**Elke D. Kanberger:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Theresa Luigs:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Andreas Ziegler:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Funding acquisition, Data curation, Conceptualization.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

[17] The estimated average marginal and discrete probability effects are not reported due to brevity, but available upon request.

## Data availability

Data will be made available on request.

## Acknowledgements

This paper has been carried out within the research project 'The energy transition process between the priorities of regionalization and centralization' (Energio), supported by the German Federal Ministry of Education and Research (BMBF) [grant number 01UN1220B] under the funding priority 'Environmentally and Socially Compatible Transformation of the Energy System'.

## Online appendix. Survey questions

The appendix to this article can be found online at https://doi.org/10.1016/j.enpol.2024.114185.

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